Proposed Development of

Crudine Ridge Wind Farm

Central New South Wales

Environmental Assessment

Volume 1

December 2012

Prepared for Crudine Ridge Wind Farm Pty Ltd by Wind Prospect CWP Pty Ltd

CERTIFICATION

Submission of Environmental Assessment prepared under Part 3A of the *Environmental and Planning Assessment Act 1979*.

Application Reference	11_0033		
Document Description	Proposed development of Crudine Ridge Wind Farm - Environmental Assessment		
Declaration	I certify that I have prepared the contents of this Environmental Assessment with the Director-General's Requirements dated 17th March, 2011 and amendments dated 16th August 2011, 23rd March 2012 and that to the best of my knowledge, the information contained in the Environmental Assessment is not false or misleading.		
	Name	**Signed**	**Date**
Reviewing Manager	Edward Mounsey		28 November 2012

Person managing this document	**Person(s) writing this document**
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CHANGES TO GOVERNMENT DEPARTMENT NAMES

During the preparation of this Environmental Assessment, there have been changes to several Government Department names. Reference made to the former should be considered to mean the latter, and vice versa.

- The Land and Property Management Authority was abolished, with its business transferred to Land and Property Information, Department of Premier and Cabinet.
- The Department of Primary Industries was established as a Division of the Government Service.
- The NSW Roads and Traffic Authority was renamed Roads and Maritime Services.
- Responsibilities of The Department of Water and Energy were transferred to the NSW Office of Water (NOW).

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CHAPTER 1

Executive Summary

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1. PREFACE

The Environmental Assessment (EA) has been prepared to provide a project description, discuss all potential effects of the Crudine Ridge Wind Farm on the existing environment and community, and discuss the measures proposed to manage and mitigate any potential adverse effects. The proposed development is for the purpose of generating electricity from wind energy.

The EA has been prepared in four volumes:

Volume 1: Main text (this volume)

Volume 2: Figures

Volume 3: Appendices

Volume 4: Landscape and Visual Impact Assessment Report

During the Public Exhibition phase of the assessment process the Crudine Ridge Wind Farm EA will be available for inspection at the Mid-Western Regional and Bathurst Regional Council offices and online through the New South Wales Department of Planning and Infrastructure website, following the links to the Major Project Assessments page.

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2. INTRODUCTION

The Proponent is proposing to install, operate and maintain up to 106 wind turbines and ancillary structures on an area of the Central Tablelands, 45 km south of Mudgee and 45 km north of Bathurst, New South Wales (NSW) (**Figure 2.1**); the proposed Crudine Ridge Wind Farm (the Project). The wind turbines will be erected for the purpose of generating electricity from wind energy.

The Project was publicly announced in March 2011, at the commencement of detailed feasibility studies and early stages of planning. The results of public consultations and feasibility assessments are presented in this EA, as part of the Development Application (DA) for the Project.

The Project will also be assessed by the Federal Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) with respect to matters of National Environmental Significance under the *Environment Protection & Biodiversity Conservation (EPBC) Act 1999*.

This EA is broad in scope, covering many topic areas. This chapter, being the Executive Summary, provides a summary of the outcomes established by the EA as a result of the assessments and consultation that took place.

The Proponent

The Project is being developed by Crudine Ridge Wind Farm Pty Ltd (the Proponent), a wholly owned subsidiary of the Wind Prospect Group and Continental Wind Partners (CWP). Wind Prospect CWP (WPCWP) is a joint venture partnership between the Wind Prospect Group and Continental Wind Partners to develop wind farm projects in New South Wales.

The Wind Prospect Group undertakes all aspects of wind energy development, including design, construction, operation and commercial services, with offices in the UK, Ireland, Canada, Australia and China. With over 18 years of successful development within the industry, the Wind Prospect Group has been involved in over 3,500 MW of approved wind farms, including onshore and offshore projects, in terms of development, construction, operations and commercial services, and has a further 4000 MW in the early phase of development. The company's civil, electrical and mechanical engineers have been involved in the commissioning of over 100 wind farms around the world. Within Australia, the Wind Prospect Group offices are located in Adelaide, Newcastle, Brisbane and Melbourne. Wind Prospect Pty Ltd (WPPL) is the most successful developer in Australia, having achieved planning approval for 14 wind farms totalling over 1,750 MW, of which 837 MW is operating or under construction.

Continental Wind Partners (CWP) was established in 2007 to finance the development of wind farms in Romania and Poland. CWP has since grown to be a leader in renewable energy development, expanding into the rest of Europe, Australia and New Zealand; with projects totalling over 4,500 MW. Their primary focus remains in wind energy, however they also have interests in solar, hydro, biomass and other renewable energies. Their successful and rapid expansion is based on a proven model of co-operation with local developers. Here CWP's international expertise in the finance / banking industry and technical aspects of development are combined with the developer's own technical expertise and local knowledge. It is this collaborative partnership that ensures accelerated, professional wind development in a mutually successful manner.

3. PROJECT DESCRIPTION

The proposed Project development consists of the installation of up to 106 wind turbines, on-site electrical cable network, a main collector substation, secondary collector substation, switching station, site compound, access tracks, crane hardstand areas, up to 6 permanent wind monitoring masts, and appropriate site signs. The Project is to have an installed capacity of approximately 135 MW. Operation of the wind farm is to be carried out by a combination of remote computer control, local operations and maintenance staff.

Final turbine selection will occur through a competitive tender process pending Development Approval. The turbines used for the Project will be three-bladed, semi-variable speed, pitch regulated machines with the rotor and nacelle mounted on a reducing cylindrical steel tower. Each turbine will rise up to 160 m from the ground to the tip of the blades, with typical tower heights of between 80 and 101.5 m, and blades between 40 and 63 m in length. Wind turbines under consideration for this Project vary in terms of generation capacity upwards of 1.5 MW. Typically turbines of this magnitude begin to generate energy at wind speeds in the order of 4 metres per second (m/s) (14.4 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph).

Up to six permanent wind monitoring masts, up to 100 m in height, will be installed on-site. The purpose of the masts is to provide necessary information for the performance monitoring of the wind turbines. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design.

The electricity produced by each wind turbine generator would be transformed from low voltage up to 33 kilovolts (kV) by a transformer generally located within or adjacent to each turbine. Underground electrical cables will be installed at a depth of approximately 0.8 to 1 m below the ground surface to conduct the electricity from the wind turbines to the collector substation. The underground electrical cables will follow site access tracks where practical.

The main collector and secondary collector substations, and the switching station sites are expected to require approximately 3.5 hectares (ha) of land and will include standard grid connection infrastructure and buildings. The chosen locations minimise the visual impact of the wind farm by siting the infrastructure away from frequently used public roads, and with vegetation screening, post construction, if warranted. This also allows for the Project's internal electrical infrastructure and grid connection to have a reduced visual impact.

To harness the energy produced, the Project will connect into a 132 kV TransGrid transmission line 15 km east of the Crudine ridgeline. When it is not generating, the Project will draw a minor amount of electricity from the local transmission network.

Project management will be carried out by the Proponent, unless commercial or other arrangements change. All Project and construction management will comply with the appropriate company's Quality Assurance System and Environmental Management System, or equivalent, ensuring that relevant procedures, statutory requirements and operational standards are met.

4. PROJECT JUSTIFICATION

There has been growing global recognition of the need to mitigate the environmental effects associated with fossil fuel energy generation. Such thoughts have manifested into international, national and state wide commitments supporting the development of clean and sustainable energy projects.

In 2007, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were is 1990. This was a watershed decision and an important step in determining Australia's position on climate change in the international arena.

On 20 August 2009, the Federal Parliament passed the Renewable Energy Target legislation, which aims for 20 %, or 45,000 GWh, of Australia's electricity to be generated from renewable sources by 2020. Since then, in January, 2011 the RET was separated into the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). This change is anticipated to support a higher REC price for large scale projects, like wind farms, and provide greater certainty for the renewable energy sector. Wind energy generation is a low cost, mature and viable renewable energy source and can be readily implemented to meet a substantial percentage of these targets.

The Project will play an important role in addressing the increasing local and global need for renewable projects in tackling the issues of Global Warming and Climate Change; contributing up to 0.93 % of the new renewable generation needed to meet the legislated Australian target. Moreover, the Project site and size has been carefully selected using a number of factors and will displace a conservative estimate of 7,450,380 tonnes of carbon dioxide equivalents over the life of the Project.

5. PLANNING CONTEXT

The development of the Project requires:

- Project approval under Part 3A of the New South Wales (NSW) *Environmental Planning and Assessment (EP&A) Act, 1979*; and
- Consideration of the requirements of the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act, 1999.

The NSW Department of Planning and Infrastructure (DoPI) issued the Project with Director-General's Requirements (DGRs) on 17th March 2011. The DGRs include key issues for the Proponent to address in the EA with a focus on impacts, management and mitigation strategies. These DGRs were subsequently extended on the 18th August to stipulate more detail and transparency in the consultation process. Finally, the Project was classified as a 'Controlled Action' under the *EPBC Act* on the 5th March 2012*,* which saw the Project issued with further supplementary DGRs. The supplementary DGRs apply to the accredited assessment process.

In addition, relevant Federal, State and Local Government legislation, policy and guidelines are considered and addressed throughout the EA.

6. STAKEHOLDER CONSULTATION

Public consultation for the Project commenced in March 2011 during the early stages of planning and feasibility assessment. Consultation at this time aimed to inform the general public, neighbouring residents, statutory regulators and other stakeholders of the Project in order to identify issues that required addressing during project planning and design.

Consultation for the Project was conducted by way of letters of notification to stakeholders, face-to-face contact with neighbouring residents, two public exhibitions and consultation meetings with various stakeholders. The Project website (www.crudineridgewindfarm.com.au) presents an ongoing, active consultation medium for people to track the development of the Project and provide comment.

A number of consultees have responded, providing input or advice to the Project. The public exhibitions, held in July 2011 and February 2012, were attended by over 100 local and regional residents. Nominations have been sought and received for a Community Consultation Committee for the Project. The committee will proceed to be established over the coming months, in line with existing Committees and *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines), released on the 23rd December 2011 for public consultation.

7. ASSESSMENT OF KEY ISSUES

The Proponent, along with a number of specialist consultants and stakeholders, has used various methods during the feasibility and planning stages of the Project. Together, the Proponent, specialists and stakeholders have determined the baseline environmental conditions at the Project site, identified potential impacts and developed management strategies to mitigate those impacts where possible. These assessments and consultations have been consolidated into this EA, to develop an optimal wind farm design that balances environmental, social, economic and cultural needs.

This EA is structured to address the requested key issues and non-requested additional issues by the DGRs under the *EP&A Act* that have the potential to create environmental or human impacts. These are summarised in the following sections of the Executive Summary with extensive detail found within the main chapters of this **Volume 1** and associated **Volumes 2**, **3 and 4**.

8. LANDSCAPE AND VISUAL ASSESSMENT

The Proponent commissioned Moir Landscape Architecture Pty Ltd to prepare a Landscape and Visual Impact Assessment (LVIA) for the Project. The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the Project would be located, and an assessment of the potential landscape and visual impacts that may result from the construction and operation of the Project, taking into account appropriate mitigation measures.

In terms of overall landscape sensitivity, the LVIA determined that of 32 viewpoints surrounding the Project, ten will have a low visual impact, eleven will have a moderate visual impact and nine will have a high visual impact.

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

There are a number of potential visual effects associated with the wind farm, including glinting, which experience suggests is relatively rare and shadow flicker effects which are unlikely to be experienced at any residences. The Project will have some degree of visual influence, however it is unlikely that wind farm projects will ever conform, or be acceptable to all points of view.

Overall, the cumulative visual effect of the Project would not result in any significant 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any existing or proposed projects. The Project is well suited to the scale of the landscape and is unlikely to give rise to an unacceptable cumulative visual influence.

9. NOISE ASSESSMENT

Hearing is a fundamental human sense and is used constantly for communication and awareness of the environment. Noise is generally described as being 'unwanted' or 'unfavourable' sound and, to some extent, is an individual or subjective response as what may be a sound to one person, may be regarded as noise by another.

The unique acoustic emissions from wind turbines can be a potential problem for residents located closely to a wind farm. Noise assessments have been carried out by Sonus Pty Ltd, to predict the likely noise levels for comparison with the South Australian Environmental Protection Authority (SA EPA) *Noise Guidelines for Wind Farms* (February 2003) (SA EPA Guidelines). This document was developed to assess and manage environmental noise impacts from wind farms in South Australia and has been adopted by the DoPI. The SA EPA have since prepared revised noise guidelines (*Wind Farms Environmental Noise Guidelines* 2009), however these are yet to be implemented in NSW and are not considered here.

Proposed within the Draft Guidelines are specific NSW Wind Farm Noise Guidelines which are also subject to public consultation. The Crudine Ridge Wind Farm Environmental Noise Assessment report was commissioned in June 2011 to address the DGRs that were issued in March 2011. Correspondingly the Project has been assessed against the DGRs; however the DoPI required inclusion of assessment based on separate daytime and night-time periods, which was subsequently undertaken.

Wind turbine noise has been predicted and assessed against relevant criteria prescribed by the SA EPA Guideline and World Health Organisation (WHO) goals where appropriate.

The operation of the wind farm has been considered against the stringent SA EPA Guidelines based on Acciona AW77 turbines installed for Layout A and Siemens SWT2.3-101 turbines for Layout B, with a hub height of 80 m for both layouts. These turbines were chosen based on the likely "worst case" (highest sound power level) turbine selection available to the Proponent at the time of the assessment. The process included consideration of a number of potential turbines for each layout and subsequent selection of turbines that would result in the highest noise level scenario for that layout. Based on predictions, the noise from the turbines is predicted to adhere to the SA EPA Guidelines at all dwellings for both layouts.

Based on the above, for any turbine model with sound power levels and hub height that are equal to or less than that assessed for the Acciona AW77 and Siemens SWT2.3-101 turbines, the respective proposed planning layouts can achieve the stringent requirements of the SA EPA Guidelines.

Once the final turbine model has been selected, the noise assessment will be re-run to determine final noise modelling for the Project. Any exceedances will be resolved through landowner agreements, reducing turbine operational noise, micrositing turbine positions or by the removal of turbines, whichever is deemed the most acceptable and appropriate course of action.

Construction noise impact, blasting impact and vibration levels have been assessed and the 'worst case' scenarios modelled and found to be generally acceptable. Construction traffic noise impact has also been assessed and the 'worst case' maximum construction traffic generation considered. It is predicted that at a distance of 10 m 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. Due to the typically large setback of dwellings from the road network, the resulting noise levels would be considered acceptable under the ECRTN.

10. ECOLOGICAL ASSESSMENT

Eco Logical Australia Pty Ltd (ELA) was commissioned to undertake an ecological assessment of the area proposed to be affected by the Project. The assessment methodology comprised a literature review, site reconnaissance, vegetation mapping and detailed flora and fauna surveys.

Targeted surveys for threatened species were undertaken across the study area between October 2008 and September 2011. Vegetation mapping, flora quadrats and an assessment using the Biobanking methodology were also undertaken.

The study area was found to support sixteen threatened fauna species and one Endangered Ecological Community (EEC). Potential habitat exists for seven threatened flora species, however only one was found on-site, as well as one Rare or Threatened Australian Plant (RoTAP). Threatened species and endangered ecological communities recorded on-site included:

- CW209 White Box – Blakely's Red Gum – Yellow Box (Box Gum Woodland equivalent);
- *Swainsona recta* (Small Purple-pea);
- *Discaria pubescens* (Hairy Anchor Plant);
- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Diamond Firetail (*Stagonopleura guttata*);
- Hooded Robin (*Melanodryas cucullata cucullata*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Pyrrholaemus saggitatus*);
- Sugar Glider (*Petaurus breviceps*);
- Common Ringtail Possum (*Pseudocheirus peregrines*);

- Common Brushtail Possum (*Trichosurus vulpecular*);
- Koala (*Phascolarctos cinereus*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Pied Bat (*Chalinolobus picatus*);
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*);
- Greater (Eastern) Long-eared Bat (*Nyctophilus corbeni* (*N. timoriensis*)); and
- Eastern Cave Bat (*Vespadelus troughtoni*);

Ten migratory species were identified from the EPBC Act Protected Matter Search Tool however no species were recorded during the surveys.

A Referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in November 2011 addressing the likely impacts of the Project on matters of National Significance, and in particular on the Box-Gum Woodland (BGW) within the Project Site which is listed as Critically Endangered under the EPBC Act. The Project was designated a Controlled Action under the *EPBC Act* on the 29th February 2012 and, subsequently, SEWPaC provided the Proponent with supplementary Director-General's Requirements (DGRs) in March 2012, which apply to the accredited assessment process.

The Proponent has made a number of amendments to the proposed layout to minimise and avoid impacts on the ecological values of the site. Given the extensive areas of EEC vegetation types across the site area, and the requirement for turbines to be placed on ridge tops, the opportunities to avoid all impacts are limited. Whilst it is also not possible to completely avoid placing turbines in areas supporting woodland, as this would impact upon the Project feasibility, a number of amendments have been made to minimise impacts in these areas. The linear layout of turbines along ridgelines, required for the wind farm to function at maximum capacity and to be economically feasible, in some cases, limits the areas to which turbines can be moved to avoid impacts, however, also ensures no consolidated areas of clearing occur.

The avoidance measures that will or have been implemented to minimise impacts on the ecological integrity of the site whilst maintaining the engineering and economic feasibility of the wind farm are summarised below:

- Access roads have been designed around tracks and roads that currently exist within the study area, where practicable, to avoid additional vegetation clearance for access;
- Turbines have been placed in cleared, treeless or low tree density areas, where practicable, to minimise the need for additional or excessive tree clearance and hollow loss;
- Where turbines have been placed in woodland areas, they have been situated in areas where ground layer disturbance has previously taken place (e.g. sown areas);
- Construction compounds, collector substations, switching stations and rock crushing facilities have been located outside ecologically sensitive areas where practicable;
- The Project has been designed such that native tree removal has been minimised wherever practicable and will be further minimised during the detailed design phase. Where practicable, wind turbines will be placed at least 30 m from hollow-bearing trees;

- Access tracks and powerline routes have been re-aligned so as to minimise the impact on the EEC, with disturbance occurring only for the installation of the external transmission line, where only the canopy will be removed, ensuring the understorey remains;
- Where necessary, transmission line poles will be realigned within the powerline easement to ensure there are no impacts on *Swainsona recta*, avoiding loss of all recorded individuals of this species; and
- Electrical reticulation has been placed underground and within the road footprint where practicable to allow for temporary rather than permanent disturbance. Electrical reticulation will pass overhead across gullies and waterways to reduce impacts.

In order to protect the ecological values of the site a number of management and mitigation measures have been proposed. Given their extent, and to avoid duplication, these are generally outlined in **Chapter 20** Statement of Commitments together with the Project stage during which each would be implemented. A number of species-specific mitigation measures are included and it is envisaged that some of these would be implemented at both the proposed impact site and offset site with full details provided in the Construction Environmental Management Plan and Operation Environmental Management Plan post approval.

There are seven properties considered as potential environmental offset options, with three properties in particular having been verified as having equivalent vegetation types to and being in equivalent or better condition than the impact sites. One or a combination of these properties, and others that have been identified, will provide a suitable offset area and meet the “like for like or better” offsetting principles with a minimum 2:1 offset ratio.

11. CULTURAL HERITAGE ASSESSMENT

New South Wales Archaeology Pty Ltd was commissioned in June 2011 to undertake an archaeological and cultural heritage assessment, comprising of a literature review and field surveys, to collect data.

The assessment identified that the Project region was traditionally occupied by the Wiradjuri peoples who functioned primarily in small groups that would coalesce to form collective bands during feasting in times of plentiful food and for ceremony. The predominant land use in the Project area is predicted to have been restricted to a limited range of activities including hunting and gathering forays conducted away from base camps and movement through the country, with the actual presence of Aboriginal groups limited due to the lack of reliable water sources found on-site. The early 1800’s saw changes in the traditional land use of Aboriginal people with the introduction of European settlement.

European settlement of the area began in the 1810s, after an expedition across the Great Dividing Range in search of grazing land. Bathurst, Pyramul and Mudgee were all progressively settled from the 1820s through until the 1850s when the gold fields opened at Sofala and Hill End. Then, as now, sheep grazing was the dominant land use in the Pyramul and Crudine areas, with Pyramul playing a significant role in the Australian sheep industry.

In accordance with the *Interim Guidelines for Aboriginal Community Consultation* (IGACC) – *Requirements for Applicants* (NSW Department of Environment and Conservation (DEC) 2004b), the required field surveys were conducted with the assistance of a number of people from Orange, Mudgee and Bathurst LALCs and Murong Gialinga Aboriginal Torres Strait Islander Corporation.

The assessment report determined that the archaeological resource across the Project site is of low significance, given the nature and density of the artefact locales recorded in the area, and the low scientific significance rating they have been accorded. However, the construction of the Project will result in substantial physical impacts to any Aboriginal objects which may be located within direct impact areas irrespective of their archaeological significance. That is, any Aboriginal object situated within an area of direct impact will be comprehensively disturbed and / or destroyed during construction.

A total of 44 Aboriginal object locales with stone artefacts were recorded on-site, all of which were considered to be of low archaeological significance. Eight European items were recorded during the survey, all located outside areas of proposed impacts. All items are associated with animal husbandry and most are sheep sheds and yards, some still in use. The Project has a low likelihood of causing any impacts to items of Non-Aboriginal heritage; therefore, based on potential impacts to Aboriginal items, an appropriate form of impact mitigation will be implemented, such as minimising impacts to ground surfaces where feasible.

Ground disturbance will occur predominantly during the construction phase of the Project with the potential to cause direct impacts to any Aboriginal objects or Non-Aboriginal items which may be present on-site. Aboriginal objects (stone artefacts) can be expected to extend in a relatively continuous, albeit very low to low density distribution across the broader landscape encompassed by the Project. Overall the proposed impacts are predicted to be discrete in nature due to the relatively small footprint of construction activities and, therefore, impacts to the archaeological resource across the landscape can be considered only partial in nature.

12. TRAFFIC AND TRANSPORT ASSESSMENT

Samsa Consulting was commissioned to undertake a Traffic and Transport Assessment for the proposed Project. The study was conducted in accordance with the NSW Roads and Traffic Authority (RTA) *Guide to Traffic Generating Developments* and the DGRs, and provided a technical appraisal of the traffic and safety implications arising from the Project.

The assessment identified two construction period scenarios. A moderate (average) scenario, which is likely to occur for the great majority of the 18 month construction period, and a conservative (high) scenario, which assumes that peak construction periods will occur simultaneously.

It was estimated that, as a result of the Project, under a conservative (high) scenario an additional 193 vehicles per day (calculated as two way trips) would be expected along both the northern and southern access routes. In reality, it is more likely that the moderate (average) scenario would occur, contributing only a third of that conservative traffic volume. This contribution could have a significant impact on the existing road users, especially on the minor and unsealed roads, for approximately 18 months until construction of the Project has finished. The more significant impacts are expected only during the construction and decommissioning periods, with minor impacts during the operational phase.

A range of management and mitigation strategies have been proposed during the construction, operation and decommissioning phases of the Project to minimise traffic impacts, reduce community disruption and the risk of traffic incidents. In turn this will facilitate minimum disruption to existing traffic conditions.

13. AVIATION ASSESSMENT

Existing aviation activity in the locality of the Project site was identified during planning and design through consultation with the Department of Defence (DoD), Civil Aviation Safety Authority (CASA), Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), NSW Rural Fire Service and the local community.

There are two registered aerodromes within the vicinity of the Project Study area; Bathurst, 45 km to the south and Mudgee, 50 km to the north. There is also an unlicensed airfield and an unlicensed aerodrome in the area, Dabee Station (34 km east) and Rylstone Aerodrome (35 km east). According to the aviation hazard assessment carried out by HART Aviation, the Project does not impact the OLS and PANS OPS of these airfields.

CASA administers regulations for the intrusion of obstacles into aerodrome OLS and PANS OPS and obstacles 110 m above ground level outside of aerodromes. On 1 March 2011 CASA indicated that a review would be undertaken of safety issues associated with obstacles remote from an aerodrome, which will now be undertaken by Department of Infrastructure and Transport (DIT). As there is no current standard in place, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent.

HART Aviation recommends the Proponent consider the provision of obstacle marking and lighting as a duty of care obligation. On receipt of Development Approval for the Project, the Proponent will consult with CASA and DIT on the issue of obstacle lighting. The Proponent will be seeking a solution, which, if appropriate to do so, will consider the provision of obstacle marking and lighting. If CASA insist on full compliance with the requirements of the now withdrawn CASA Circulatory AC 139-18(0), the Proponent will commit to shielding provisions allowed under existing CASA guidelines.

Agricultural aerial spraying activity occurs for pest management and pasture top-dressing. Pest management spraying is unlikely to be affected by the Project. Top-dressing activity will require care by pilots applying the material to properties along the ridgelines.

Some private landing strips are present and of those known, the majority are not impacted by the Project's wind turbine locations. Those strips which are known to be impacted by the wind turbines have been discussed with the relevant associated landowners.

14. COMMUNICATION ASSESSMENT

Electromagnetic signals (or radio waves) are transmitted throughout the country as part of telecommunication systems by a wide range of operators. Such systems are used for radar, radio broadcast, television, mobile phones and mobile and fixed radio transmitters. Electromagnetic signals generally work best if a clear path exists between the transmitting and receiving locations, known as line of sight (LOS).

There is the potential for interference from any large structure, including wind turbines, which occur within or close to the signal path. Signals can be interfered with or reflected by the rotating blades of a wind turbine, which could degrade the performance of the signal (Bacon 2002). Electromagnetic emissions from generators and other machinery also have the potential to affect signals; however with modern turbine generators and strict International Electrotechnical Commission (IEC) regulations for manufacturers, there are now negligible emissions from wind turbines (Auswind 2006).

There are a number of point-to-point links and omni-directional services which occur across and near to the Project. Assessment of these links has predicted that no impacts will occur on communications as a result of the Project. If the Project does cause any interference to any links, the Proponent will conduct an investigation with the afflicted parties and implement a suitable solution to the problem.

15. ELECTROMAGNETIC FIELD ASSESSMENT

Electric and magnetic fields (EMFs) are associated with a wide range of sources and occur both naturally and as a result of human activity. Naturally occurring EMFs are those associated with lightning or the Earth's magnetic field. Human induced EMFs occur wherever electricity is present, meaning we are constantly exposed to EMFs in our home and work environments.

Wind farms create EMFs from operational electrical equipment, such as transmission lines, substations and the electrical components found within the wind turbines. This equipment has the potential to produce Extremely Low Frequency (ELF) EMFs, which means the current will alternate direction between 30 and 300 times per second, or at 30 to 300 Hertz (Hz).

The measurements of electromagnetic fields can vary within a wind farm, depending on the placement of equipment such as turbines, substations and internal electrical cables. The *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* (NHMRC 1989) places guidelines on exposure to both electric and magnetic fields for the public and construction industry.

The typical strategy for reducing electromagnetic fields is distance from the source. Other strategies also include burying cables and placing cables together to cancel the emitted fields. As most of the wind turbine electrical equipment is encased within the turbine, in housing at the base of the tower or located 80 to 100 m above ground level, the distance and shielding from electromagnetic fields decreases the impact from emitting sources.

Electromagnetic fields can be recorded highest at substations; however, appropriate fencing and remote placement of the substation within the landscape can greatly reduce any exposure to electromagnetic fields.

16. FIRE AND BUSHFIRE ASSESSMENT

Fire and bushfire impacts of the Project on human life and property have been assessed in accordance with the DGRs and the *Rural Fires Act 1997*.

By basing the risk management process on the AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009), the National Inquiry on Bushfire Mitigation and

Management (Council of Australian Governments (COAG) 2004) and NSW Bushfire Coordinating Committee (BFCC) Guidelines (2008), an analysis and evaluation of bushfire risk and acceptable risk treatments have been undertaken.

The Project occurs in an area of low bushfire risk due to the vegetation and agricultural practices in the area. By reviewing the possible ignition sources from the wind farm and analysing bushfire risk assessments on life and property, it is possible to create mitigation and management strategies to minimise the Project's impact on fire and bushfire risk. Through implementing these strategies in a Bushfire Emergency and Evacuation Plan it is possible to increase the awareness of the procedures of bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire. The consideration of these mitigation and management strategies will allow the Project to decrease its impact on fire and bushfire hazards.

17. WATER ASSESSMENT

The Project falls under the Macquarie and Cudgegong Regulated Rivers Water Source Water Sharing Plan, the Draft NSW Murray Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan and the Draft Macquarie Unregulated and Alluvium Water Sources Water Sharing Plan. The area is also managed with regards to the Central West Catchment Management Authority Catchment Action Plan. Therefore, there are a number of water management targets in place including water sharing, water quality, management of water supply and wastewater, water conservation and efficiency, and river and wetland protection and rehabilitation.

Water required for the Project, as also discussed in **Chapter 3** Project Description, will be sourced from on-site water sources, such as bores and dams, where practicable or brought in from offsite suppliers as a last resort. There will be minimal impacts to surrounding groundwater and surface waters due to limited activities within these areas and effective mitigation actions and management. Potential impacts are likely to occur mostly from construction activities. However, with an EMP in place all potential impacts can be managed, resulting in minimising the extent of remediation efforts being required on-site.

18. GENERAL ENVIRONMENTAL ASSESSMENT

The General Environmental Assessment chapter addresses aspects of the Project beyond the key issues identified in the DGRs. In summary the following aspects are assessed in terms of the existing situation, potential impacts and, where necessary, the management and mitigation measures put in place:

- Climate;
- Air quality;
- Soils and landforms;
- Water / Riparian Zones;
- Waste;
- Crown roads and Triangulation stations;
- Responses to Consultation; and

- Aspects relating to construction, operation and decommissioning.

19. SOCIO-ECONOMIC ASSESSMENT

The Socio-Economic Assessment chapter addresses aspects of the Project beyond the key issues identified in the DGRs. In summary the following aspects are assessed in terms of the existing situation, potential impacts and, where necessary, the management and mitigation measures put in place:

- Land value;
- Mineral exploration;
- Tourism;
- Community wellbeing and Community fund;
- The local economy; and
- Health.

20. STATEMENT OF COMMITMENTS

The Statement of Commitments (SoC) is a summary of all management and mitigation measures collated from chapters of this EA. The SoCs have been developed to inform Development Consent Conditions of Approval which are to be managed through Environmental Management Plans (EMP) as the project is constructed and operated.

The Construction Environmental Management Plan (CEMP) outlines the environmental management practices and procedures that are to be followed during construction. The CEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Compounds and ancillary facilities management;
- Noise and vibration;
- Traffic and access;
- Soil and water quality and spoil management;
- Air quality and dust management;
- Aboriginal and non-Aboriginal heritage management;
- Soil contamination, hazardous material and waste management;
- Ecological impact management; and
- Hazard and risk management.

The Operational Environmental Management Plan (OEMP) outlines the environmental management practices and procedures that are to be followed during operation. The OEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Noise management;
- Landscaping;
- Bird and bat management;
- Telecommunication interference; and
- Decommissioning.

21. CONCLUSION

This EA has assessed the potential environmental impacts that may result from the proposed Project, a proposal incorporating up to 106 wind turbines and capable of generating approximately 135 MW of new renewable energy.

The Project has been assessed in accordance with the *Environmental Planning and Assessment Act 1979* and taken into consideration the *Environment Protection and Biodiversity Conservation Act 1999*, along with other Federal, State and Local Government legislation, policy and guidelines.

The Project has incorporated the findings identified through the design phase, including consultation with the local community and associated stakeholders. The potential impacts of the Project have been assessed and appropriate avoidance, mitigation and management measures proposed. **Chapter 20** Statement of Commitments provides a summary of measures to inform the Development Consent Conditions of Approval which the Proponent will implement during the pre-construction, construction, operation / maintenance and decommissioning phases.

Benefits of the proposal have been identified at a global, regional and local scale, including:

- Production of approximately 413,910 MWh per annum, sufficient for the average consumption of 56,700 homes (based on conservative calculations). A figure equal to up to 0.93 % of the 45,000 GWh Renewable Energy Target;
- Displacement of greenhouse gas emissions by approximately 372,519 tonnes of CO_2-e per annum, the equivalent of taking 93,130 cars off the roads (based on conservative calculations);
- Provision of local jobs, a Community Fund to benefit the local area in the vicinity of the Project and the injection of up to $151 million into the Australian economy; and
- Improved security of electricity supply through diversification.

The Proponent is committed to ensuring the measures proposed in developing the Project are best practice, and that they maintain the high standard set in all regions within which the Wind Prospect Group operate.

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CHAPTER 2

Introduction

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2. INTRODUCTION

2.1 The Proposal

The Proponent is proposing to install, operate and maintain up to 106 wind turbines and ancillary structures on an area of the Central Tablelands, 45 km south of Mudgee and 45 km north of Bathurst (**Figure 2.1**); the proposed Crudine Ridge Wind Farm.

Figure 2.1 General location of Crudine Ridge Wind Farm
(An A3 size version of this Figure is displayed in Volume 2)

The proposed Crudine Ridge Wind Farm (the Project) lies within the Mid-Western Regional and Bathurst Regional Council boundaries, in central New South Wales (NSW). The turbines will be erected for the purpose of generating electricity from wind energy.

The Project was publicly announced in March 2011, at the commencement of detailed feasibility studies. The results of public consultation and feasibility assessments are presented in this Environmental Assessment (EA), as part of the Development Application (DA) for the Project.

The purpose of the EA is to support the DA associated with the construction and operation of the Project, including:

- Construction and operation of up to 106 turbines;
- Construction of access tracks, hardstand areas and other associated on-site infrastructure; and
- On-site electrical connections and infrastructure, including a 15 km external transmission line and switching station.

The EA may also be used in support of subsequent applications for approval under Section 78A of the *Environmental Planning and Assessment Act 1979 (NSW)* associated with the lease of land for the turbine sites and associated infrastructure.

The Project was also assessed by the Federal Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) with respect to matters of National Environmental Significance under the *Environment Protection & Biodiversity Conservation (EPBC) Act 1999*.

To enable the development of the Project, certain land is to be leased from relevant landowners. More specifically, the overall corridor of land upon which the Project infrastructure, for either Layout Option A (see **Figure 3.1**) or Layout Option B (see **Figure 3.2**), is to be constructed will be leased from 17 landowners (the Project site). The relevant property details of the land to be leased for the Project site are set out in **Appendix 1**. Notably, the leased area is identical to the Project site.

It is acknowledged that the lease of land for a period of greater than five years is deemed to be the 'subdivision' of land pursuant to Section 4B(1)(b) of the *Environmental Planning and Assessment Act 1979* (although it is not an actual subdivision of the land which creates a new allotment and deposited plan) and requires approval under that legislation.

To avoid any doubt, this deemed 'subdivision' forms part of the Project the subject of this Project application. The lease corridor, for which Project approval is sought, is generally depicted in **Appendix 2**.

2.2 The Proponent

The Project is being developed by Crudine Ridge Wind Farm Pty Ltd (the Proponent), a wholly owned subsidiary of the Wind Prospect Group and Continental Wind Partners (CWP). Wind Prospect CWP (WPCWP) is a joint venture partnership between the Wind Prospect Group (WPG) and Continental Wind Partners to develop wind farm projects in New South Wales.

WPG undertakes all aspects of wind energy development, including design, construction, operation and commercial services, with offices in the UK, Ireland, Canada, Australia and China. With over 18 years of successful development within the industry, WPG has been involved in over 3,500 MW of approved wind farms, including onshore and offshore projects, in terms of development, construction, operations and commercial services, and has a further 4000 MW in the early phase of development. The company's civil, electrical and mechanical engineers have been involved in the commissioning of over 100 wind farms around the world. Within Australia, WPG offices are located in Adelaide, Newcastle, Brisbane and Melbourne. Wind Prospect Pty Ltd (WPPL) is the most successful developer in Australia, having achieved planning approval for 14 wind farms totalling over 1,750 MW, of which 837 MW is operating or under construction.

WPG have no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against them and operate under the following environmental policies:

- Environmental Policy;
- Carbon Neutral Policy; and
- Project-specific Environmental Management Plans.

CWP were established in 2007 to finance the development of wind farms in Romania and Poland. They have since grown to be a leader in renewable energy development, expanding into the rest of Europe, Australia and New Zealand; with projects totalling over 4,500 MW. Their primary focus remains in wind energy, however they also have interests in solar, hydro, biomass and other renewable energies.

Their successful and rapid expansion is based on a proven model of co-operation with local developers. Here CWP's international expertise in the finance / banking industry and technical aspects of development are combined with the developers own technical expertise and local knowledge. It is this collaborative partnership that ensures accelerated, professional wind development in a mutually successful manner.

2.3 Form and Content of the Environmental Assessment

This EA has been prepared to provide a Project description, discuss all potential effects of the Project on the existing environment and community, and describe the measures proposed to mitigate any potential adverse effects.

The EA has been prepared in four volumes, and comprises:

- Volume 1 – A4 Main Text (this volume)
- Volume 2 – A3 Figures
- Volume 3 – A4 Appendices
- Volume 4 – A3 Landscape and Visual Impact Assessment Report

NOTE: The subject matter of this report involves the use of technical words, units and terms with which the reader may be unfamiliar. A glossary and list of unit conversion factors has been included in **Chapter 21** and reference to this may be of assistance.

An outline of the contents of **Volume 1** (this chapter) is provided below:

Chapters 1-6 provide an executive summary and description of the Project. They also outline Project justification, planning context and a summary of the public consultation process.

Chapters 7-19 contain the bulk of the EA for the Project. They describe:

- The existing physical, ecological and social environment of the region;
- Impact assessment information; and
- Impact mitigation measures.

Chapter 20 Statement of Commitments, provides an outline of Environmental Management Plan actions relating to the Project which are to inform Development Consent Conditions of Approval.

Chapter 21-23 concludes the EA, has a glossary, abbreviations and unit conversion factors, and provides references made throughout the document.

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CHAPTER 3

Project Description

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3. PROJECT DESCRIPTION

This chapter presents a detailed description of the works associated with the construction and operation phases of the proposed Crudine Ridge Wind Farm development, which is otherwise referred to as 'the Project' throughout this Environmental Assessment (EA).

3.1 Key Terms

For the purposes of this EA the following terminology has been used when referring to the Project.

Locality: Area encompassing all land within a 10 km radius around the Project site.

Project site: Land within the cadastre boundaries of all properties subject to this proposal, comprising an area of 5,971.6 hectares (ha).

Study area: 200 metre (m) wide corridor in which the turbine footprint, roads and electrical cables will be contained, comprising an area of 1,663.8 ha.

Development footprint: All proposed locations of the turbines, roads, reticulation, collector substations, facilities building, network switching station and compound, comprising an approximate area of 106 ha, of which approximately 72 ha is considered permanent.

Clusters: The Project comprises two 'Clusters' of wind turbines. The Pyramul Cluster generally incorporates the north of the Project, with the Sallys Flat Cluster incorporating the south of the Project (refer to **Figure 3.1** to **3.6** and **Table 3.2**). It is possible one Cluster may be constructed and commissioned prior to the other, or each Cluster may be partially constructed in stages.

3.2 Location and Site Design

The Crudine Ridge Wind Farm is situated 45 km south of Mudgee and 45 km north of Bathurst, New South Wales (NSW). The ridgeline is of moderate-to-high elevation (890 to 1,000 m above sea level, Australian Height Datum (AHD)). The nearest locality is Pyramul, which is located approximately 5 km to the north west along Aarons Pass and Pyramul roads.

When first announced in March 2011 the Project consisted of up to 110 turbines and ancillary structures spread over 17 different properties, with the capability to produce enough energy to supply over 80,000 average Australian households. Since being announced, the Project has been revised to take into account findings from key assessments and consultation with interested stakeholders. This has resulted in a slight reduction in the extent of the wind farm and a re-design of the turbine layouts to arrive at the two configurations presented as part of this EA.

The Project now comprises a wind farm with two potential turbine layouts; one consisting of up to 106 wind turbines (Layout Option A) and the other up to 77 wind turbines (Layout Option B), together with ancillary structures spread over 17 different properties (the Project site). Details of the land tenure for the Project are contained within **Appendix 1**. Coordinates of each layout are detailed in **Appendix 3**. One or a combination of these layouts will be used in the construction of the Project, to be determined following final turbine selection post-consent. The worst-case impacts of both layouts are considered within this EA.

To enable the development of the Project, certain land is to be leased from relevant landowners. More specifically, the overall corridor of land upon which the Project infrastructure, for either Layout Option A (see **Figure 3.1**) or Layout Option B (see **Figure 3.2**), is to be constructed will be leased from 17 landowners (the Project site). The relevant property details of the land to be leased for the Project site are set out in **Appendix 1**. Notably, the leased area is identical to the Project site.

It is acknowledged that the lease of land for a period of greater than five years is deemed to be the 'subdivision' of land pursuant to Section 4B(1)(b) of the *Environmental Planning and Assessment Act 1979* (although it is not an actual subdivision of the land which creates a new allotment and deposited plan) and requires approval under that legislation.

To avoid any doubt, this deemed 'subdivision' forms part of the Project the subject of this Project application. The lease corridor, for which Project approval is sought, is generally depicted in **Appendix 2**.

The Project will have an installed capacity of up to 135 MW, which is dependent on the final turbine model and layout selected, and will consist of the following components:

- The installation of up to 106 wind turbines (Layout Option A) or up to 77 wind turbines (Layout Option B) in the Pyramul area between Mudgee and Bathurst, NSW (**Figure 3.1** and **3.2**) with a maximum blade tip height of 160 m (refer to **Section 3.8** Potential Layout Design Variations);
- A main collector substation (MCS) comprising cable marshalling, switchgear, high voltage transformers and associated protection and communications assets;
- A secondary collector substation (SCS) to be located within the Sallys Flat Cluster comprising cable marshalling, switchgear and medium voltage transformers;
- Site compound and lay down area (part temporary, part permanent), including site operations facilities and services buildings;
- Underground electrical interconnection lines (up to 132 kilovolt (kV)) and control cables within each of the Clusters, connecting to the MCS and SCS;
- Internal overhead electrical interconnection lines (up to 132 kV double circuit) and control cables between the main and secondary collector substations;
- Access roads from the public roads to the turbine locations and substations;
- Crane hardstand areas for the erection, assembly, commissioning, maintenance, recommissioning and decommissioning of the wind turbines;
- Up to six permanent wind monitoring masts;
- Appropriate wind farm signage both during the construction and operational phases of the proposed development; and
- Mobile concrete batching plant(s) and rock crushing facilities.
- A switching station (SS) to be located at the point of connection adjacent to the existing TransGrid owned 132 kV line, east of the Project;
- External overhead electrical interconnection lines (up to 132 kV double circuit) and associated communications cables between the MCS and SS; and
- Deemed 'subdivision' of land by way of lease of the Project site for a period of greater than five years.

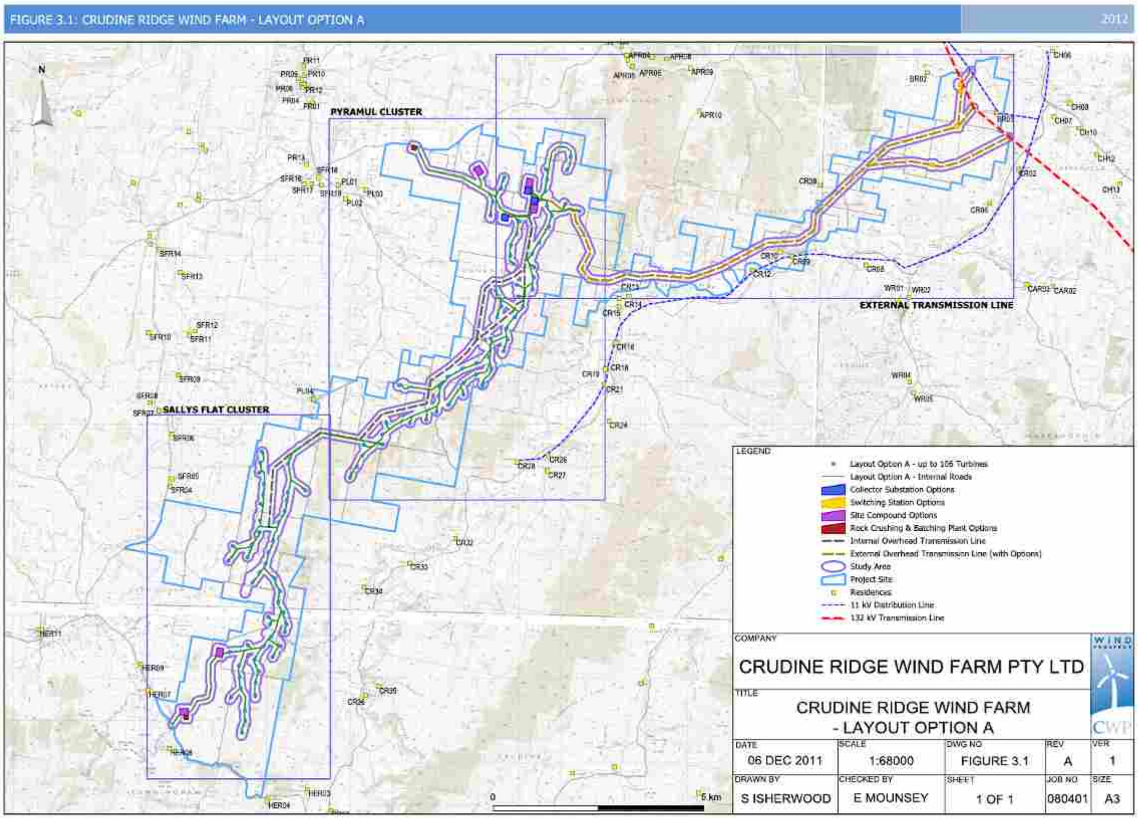

Figure 3.1 Crudine Ridge Wind Farm - Layout Option A

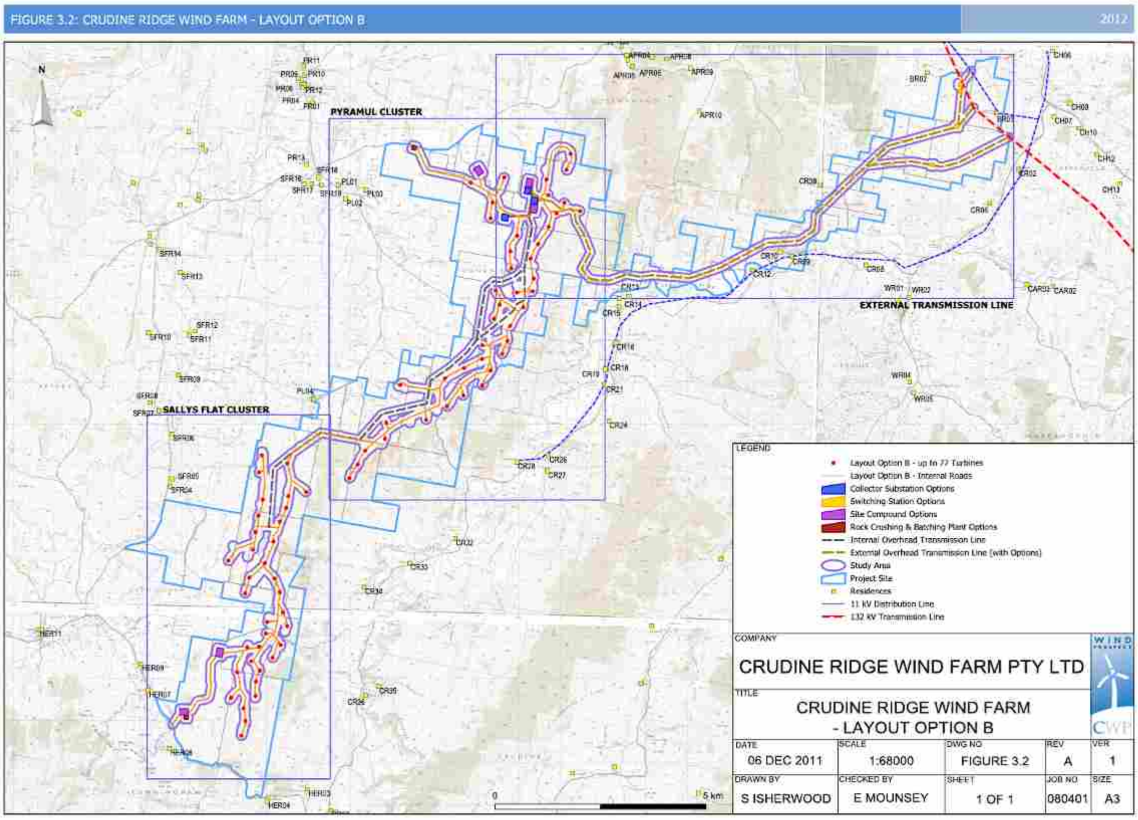

Figure 3.2 Crudine Ridge Wind Farm - Layout Option B

(A3 size versions of these Figures are displayed in Volume 2)

Typical dimensions of the components that comprise the Project are presented in **Table 3.1** below.

Table 3.1 Project components and approximate dimensions (based on greatest impact)

Project Component	Approximate Dimensions
Permanent	
Turbine footings (max footprint)	20 x 20 m
Turbine assembly / crane hardstand areas	30 x 50 m
Main collector substation (MCS)	150 x 150 m
Secondary collector substation (SCS)	25 x 25 m
Site compound *(the extent of permanent section retained within temporary compound)*	75 x 75 m
Site access: new roads	6 m x 50 km
Underground cabling on-site	1 m x 100 km
Internal overhead electrical interconnection / easement [1]	2 m x 15 km / 45 m x 15 km
Switching station (SS)	75 x 100 m
External overhead electrical interconnection / easement [1]	2 m x 15 km / 45 m x 15 km
Wind monitoring masts	5 x 5 m
Temporary (during construction)	
Earthworks alongside permanent infrastructure (roads / hardstands) [2]	10 m x 50 km (est.)
Concrete batch plant	50 x 100 m
Rock crushing facility	50 x 100 m
Site compound and office	150 x 200 m

[1] *The estimated easement width is up to 45 m for the internal overhead powerlines, though the actual impact area has been estimated to be 5 % of this total area given the low level of impacts associated with installing the power / transmission lines and the sparse vegetation cover along the selected routes.*

[2] *Construction of the internal road network will require earth works that are beyond the limits of the permanent road impact within the Study area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for both Layout Options based on available contour and geotechnical data, to include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works. An assessment of these impacts is included in* ***Chapter 10*** *Ecology.*

Details of each of the component parts of the development are described in the following sections and in the accompanying figures. An outline of the construction and operational phases of the development are also provided, along with a timeframe detailing the proposed stages of activity pending Development Consent.

The Layout Options have been designed with respect to a number of technical, environmental and social factors and more detailed site assessments. Each layout ensures optimum, undisturbed use of the measured and predicted wind resource, after accommodating constraints, for the range of turbines currently being considered for the Project.

Given the scale of the Project it is likely that 'Clusters' of turbines will be constructed and commissioned in stages, which is discussed in more detail later in the chapter. Consequently, and for the benefit of stakeholder understanding, we have divided the Project into two main Clusters (**Table 3.2**, **Figures 3.3** to **3.6**).

Table 3.2 Wind Turbine Clusters

Turbine Cluster	Maximum Number of Turbines (Layout Option A)	Maximum Number of Turbines (Layout Option B)	General location
Pyramul	58	42	Northern Cluster
Sallys Flat	48	35	Southern Cluster

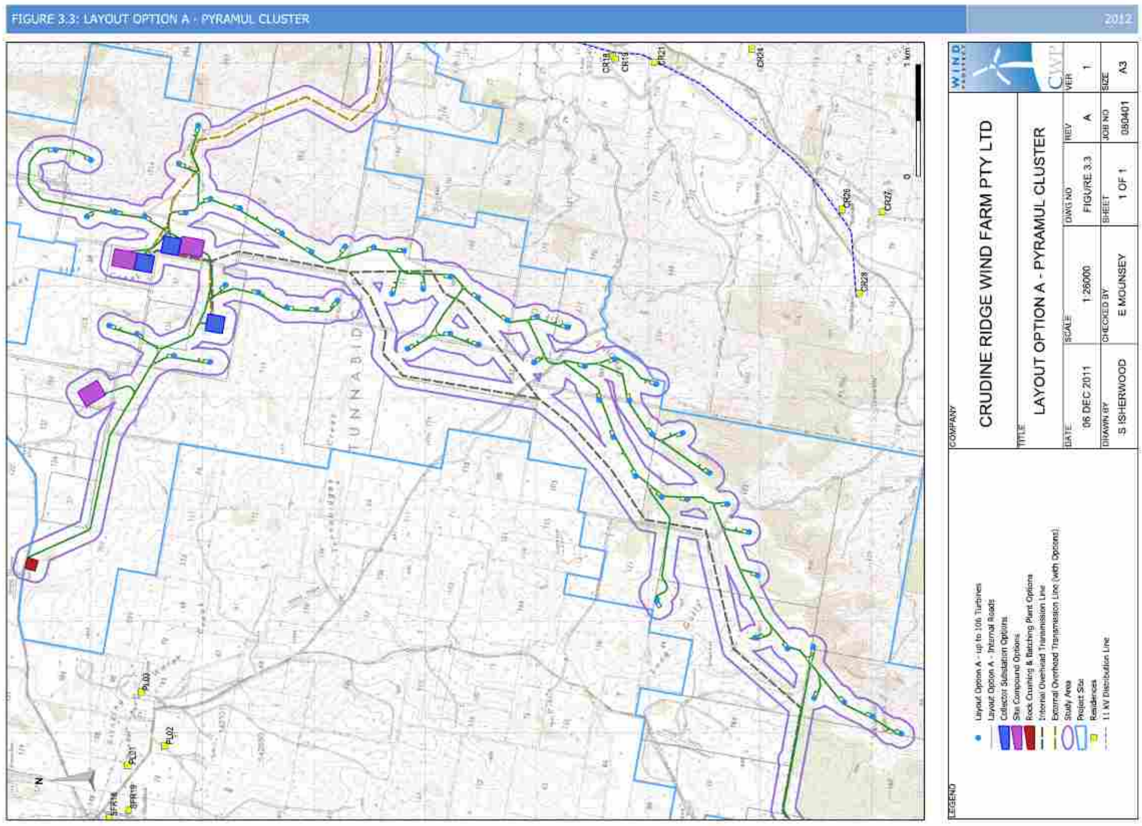

Figure 3.3 Layout Option A – Pyramul Cluster
(*An A3 size version of this Figure is displayed in Volume 2*)

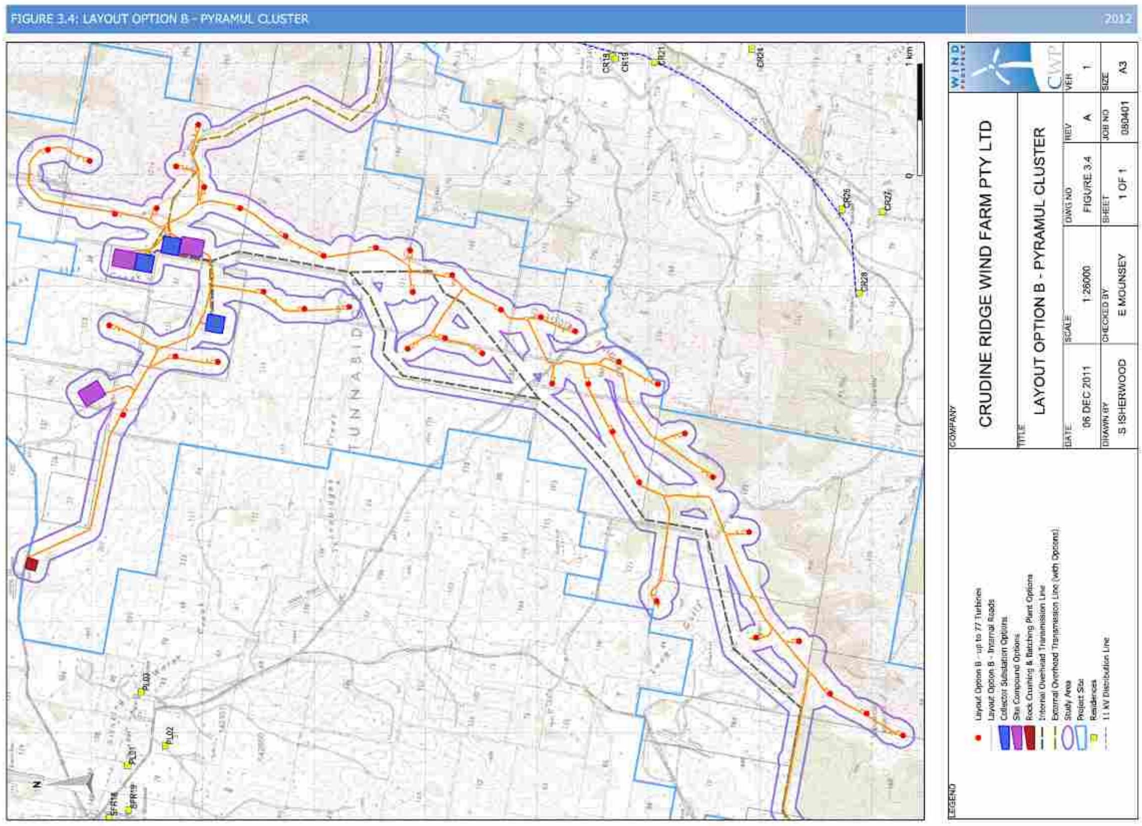

Figure 3.4 Layout Option B - Pyramul Cluster

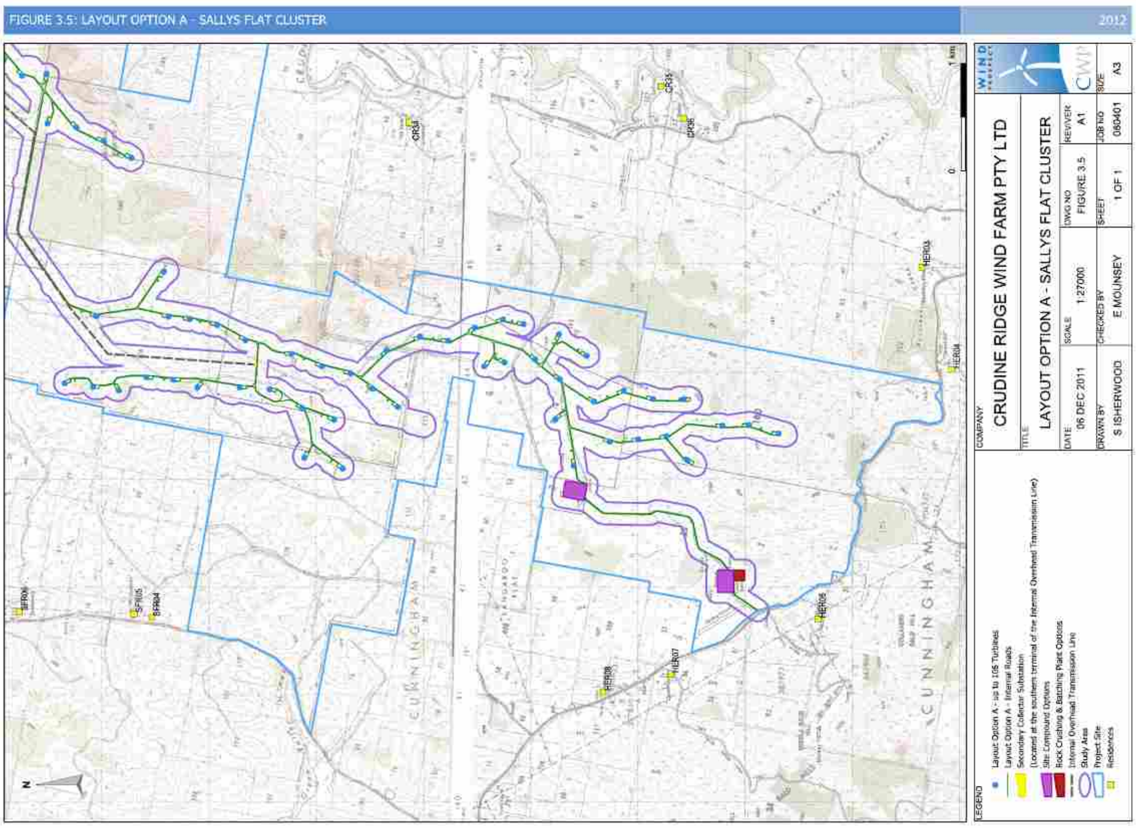

Figure 3.5 Layout Option A - Sallys Flat Cluster
(*A3 size versions of these Figures are displayed in Volume 2*)

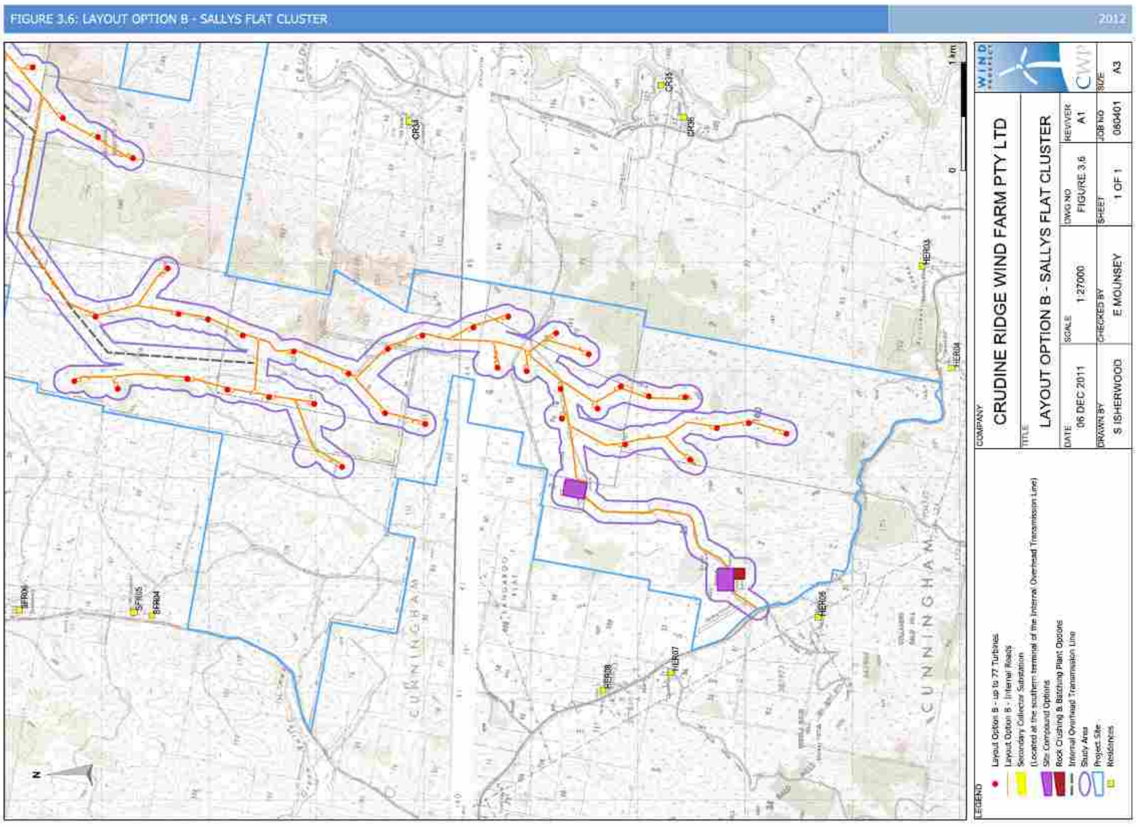

Figure 3.6 Layout Option B - Sallys Flat Cluster

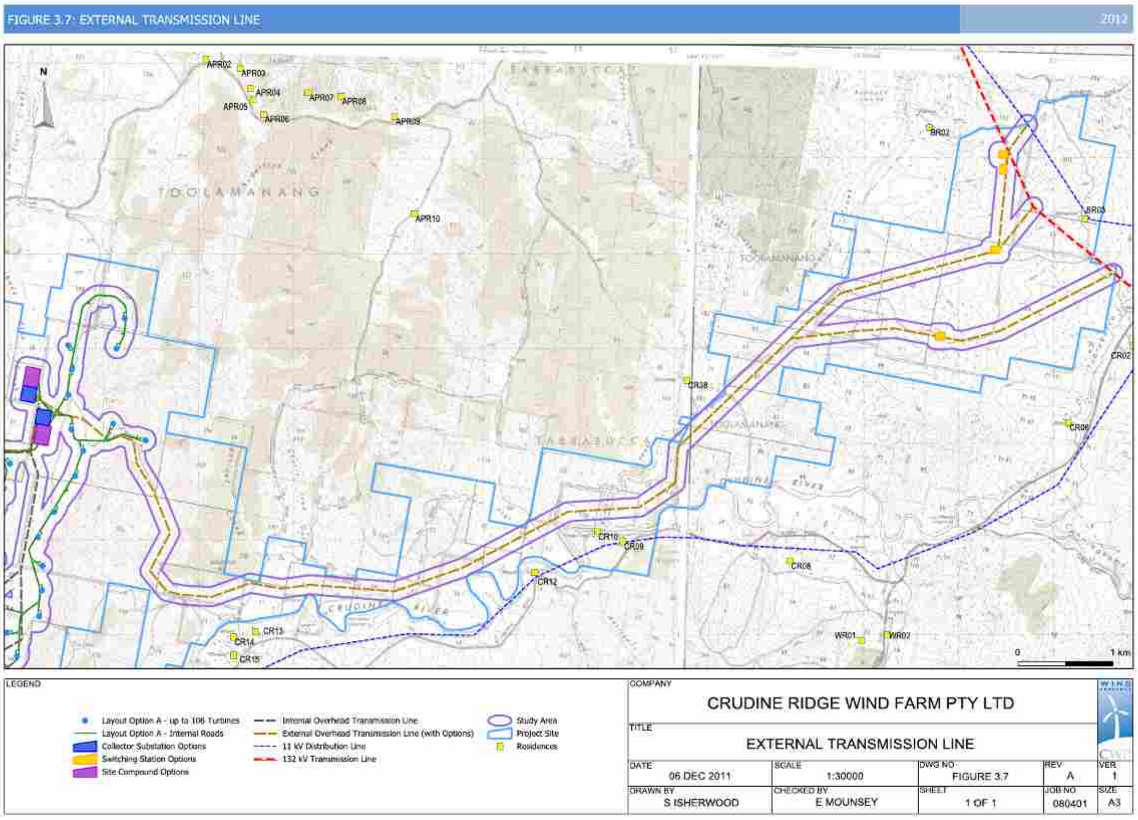

Figure 3.7 External Transmission Line
(*A3 size versions of these Figures are displayed in Volume 2*)

3.3 Wind Farm Infrastructure

It is not yet known which model of wind turbine will be used for the Project as final turbine selection will occur through a competitive tender process pending Development Consent. However, in terms of generation capacity, the wind turbines currently available in the market place that are under consideration for this Project vary in the range upwards from 1.5 MW. By way of example the Suzlon S88, 2.1 MW machine (as installed at the Capital Wind Farm, east of Lake George, NSW) is typical of the type of wind turbine that could be used. **Image 3.1** below displays a picture of a typical wind turbine, detailing the component parts.

Consideration will also be given to the use of different turbine sizes and manufacturers across the site to better utilise the on-site wind resource profile. Under this circumstance, turbine dimensions would still fall within the permissible turbine sizes considered in this EA.

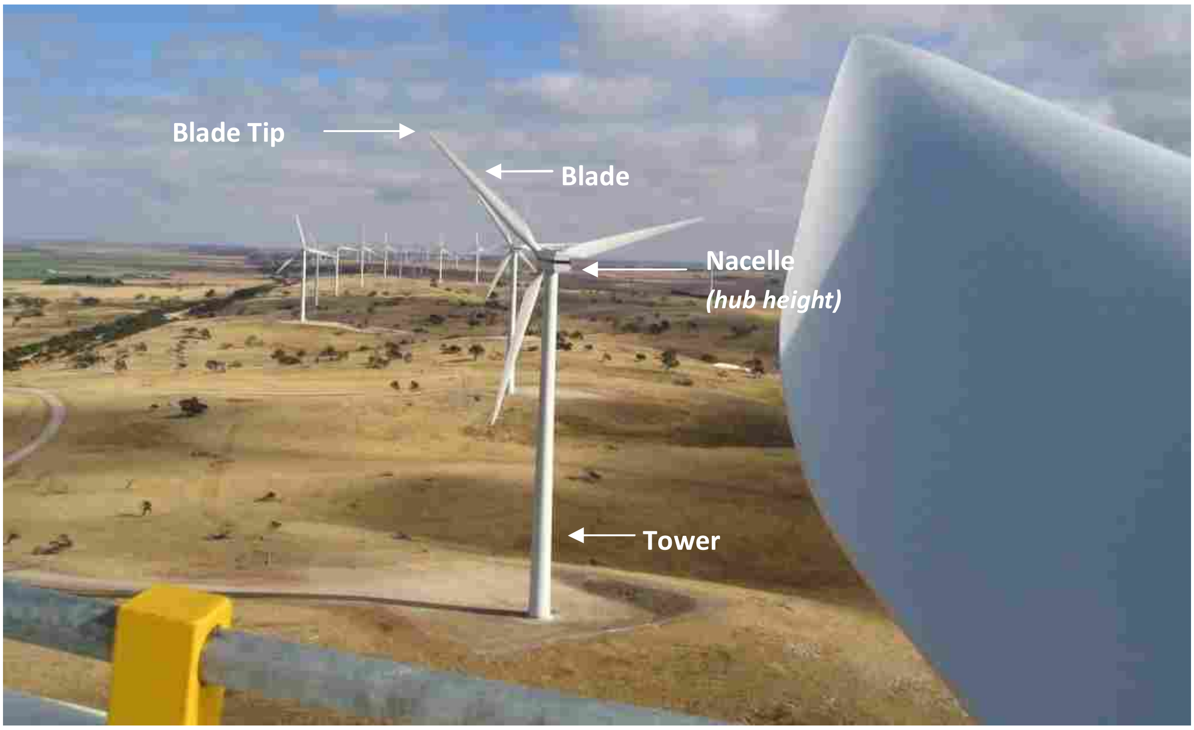

Image 3.1 Components of a wind turbine

3.3.1 *Turbine Rotor*

The turbines that will potentially be used for the Project will be three-bladed, semi-variable speed, pitch regulated machines with rotor diameters between 74 and 126 m and a swept area of 4,300 to 12,470 square metres (m^2). Typically, turbines of this magnitude begin to generate energy at wind speeds in the order of 3.5 to 4 metres per second (m/s) (approximately 13 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph). Wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 revolutions per minute (rpm) at low wind speeds and up to 18 rpm at higher wind speeds.

3.3.2 *Towers and Blades*

The supporting structure is comprised of a reducing cylindrical steel tower fitted with an internal ladder or lift. The largest tower height under consideration is 110 m with an approximate diameter at the base of 4.5 m and 2.5 m at the top. However it is important to note that the rotor diameter suitable for this wind turbine is 100 m and therefore falls within the maximum proposed blade tip height of 160 m. Similarly, the longest blade length under consideration is 63 m, however the associated maximum tower for this wind turbine is 94 m and therefore also falls within the maximum proposed blade tip height of 160 m. Alternative tower heights between 80 and 110 m are also under consideration however, this is not exhaustive since new models and certified designs are continually entering the market place. The tower will typically be manufactured and transported to site in three to five sections for on-site assembly.

For the purpose of the Landscape and Visual Impact Assessment report (see **Chapter 8**) a tower height of 100 m and a blade length of 60 m have been used for the visual analysis.

3.3.3 *Blade Tip*

The blade tip will comprise the highest point of the wind turbine when in a vertical position. Given the turbines under consideration, a blade tip height of 160 m is considered to be the maximum. As new turbine models are regularly appearing on the market, blade tip height may vary by up to 5 m to accommodate potential changes to tower heights and blade lengths of new machines.

3.3.4 *Nacelle*

The nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower and can be 10 m long, 4 m high and 4 m wide. It encloses the gearbox, generator, transformers (model dependant), motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine.

3.3.5 *Footings*

Three types of foundation for the turbines will be considered pending geotechnical investigation of the ground conditions at the Project site.

Slab (gravity) foundations would involve the excavation of approximately 450 cubic metres (m^3) of ground material to a depth of approximately 2.5 m. Approximately 200 m^3 would, if suitable, be used as backfill around the turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. A slab foundation would involve installation of shuttering and steel reinforcement, followed by the pouring of concrete. (Refer to **Image 3.2** for an example of a gravity footing).

If slab plus rock anchor foundations are required, the construction of the foundation for each machine would involve the excavation of approximately 300 m^3 of ground material to a depth of approximately 2.5 m. Slab plus rock anchor foundations require shuttering and steel reinforcement, drilling of rock anchor piles up to a depth of approximately 20 m, concrete pour, after which the rock anchors are stressed and secured once the concrete has cured sufficiently.

Alternatively, if a single mono-pile foundation is required (rock anchor), approximately 50 m^3 of ground material would be removed by a rock drill to a depth of approximately 10 m, of which 30 m^3 would, if suitable, be used as back fill. If a mono-pile foundation is used, a tubular section with tower connection flange attached is inserted in the hole and concrete is then poured in situ. (Refer to **Image 3.2** for an example of a rock anchor footing).

Image 3.2 Typical gravity (left) and rock anchor (right) footings

It is necessary for detailed geotechnical surveys to be carried out during pre-construction work to determine the foundation type per turbine. It is feasible that more than one type of turbine foundation may be required for the Project, following the assessment of the individual turbine locations. New turbines are continually coming on to the market and it is possible that minor variations to these typical foundation dimensions could occur prior to final turbine selection. Impact assessments undertaken for the Project assume the use of the largest foundation footprint for all turbines, i.e. slab (gravity) foundations.

3.3.6 *Crane Hardstand and Assembly Areas*

Site access roads would have areas of hardstand (approximately 30 by 50 m) adjacent to each wind turbine for use during component assembly and by cranes during installation. The clearing of native vegetation for the construction of access roads and hardstand areas will be minimised where practicable. If clearing is found to be unavoidable, this will be appropriately managed and carried out in accordance with Conditions of Approval. The roads would be surfaced with local stone to required load-bearing specifications. The nature and colour of surface stone would be selected to minimise visual impact prior to construction. The roads and hardstand areas would be maintained throughout the operational life of the Project and used principally for the periodic maintenance of the wind turbines. **Image 3.3** below shows a typical hardstand area adjacent to the wind turbine footing.

Image 3.3 Typical hardstand area adjacent to a rock anchor footing

3.3.7 *Monitoring Masts*

There are currently three temporary wind monitoring masts installed, one 60 m mast and one 100 m mast located in the Pyramul Cluster and one 100 m mast located in the Sallys Flat Cluster, recording wind data for Project development and planning.

Up to six permanent wind monitoring masts, up to 100 m high, are proposed to be installed on-site. Locations for these masts are yet to be determined and will be influenced by the final wind turbine selection, but may include the locations of the existing temporary monitoring masts. These permanent masts will provide information for the performance monitoring of the wind turbines. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design. **Image 3.4** below shows both typical tubular and lattice wind monitoring mast designs.

Image 3.4 Tubular (left) and lattice (right) wind monitoring masts

Permanent wind monitoring masts will require low voltage cable connection for power and also a communications cable to be laid. The trench required for this will be much smaller than for the cables between turbines. The connection would come directly from the closest turbine.

3.4 Electrical Infrastructure

The electrical works, including those incorporated in the wind turbine structures, will involve:

- Up to 106 wind turbine generator transformers (Layout Option A) or up to 77 wind turbine generator transformers (Layout Option B);
- The establishment of a 150 by 150 m main collector substation with 132 kV step up transformers, circuit breakers and isolators;
- The establishment of a 25 by 25 m secondary collector substation with up to 132 kV transformers and isolators;
- Approximately 100 km of up to 132 kV entrenched underground cables;
- Approximately 100 km of underground control cables;
- Approximately 15 km of up to 132 kV double circuit internal overhead electrical interconnection lines;
- The establishment of a 75 by 100 m switching station with 132 kV circuit breakers, isolators, metering, protections and communications assets;
- Approximately 15 km of up to 132 kV double circuit external overhead transmission lines; and,
- Establishment of a typical operation facilities building to house control and communications equipment.

3.4.1 *Generator Transformer*

The wind turbine generators typically produce electricity at 0.69 kV which is stepped up to 33 kV (or greater) by the transformer located either in the nacelle, the base of the tower or close to the base of the tower on a concrete pad. **Image 3.5** below shows an example of a transformer located outside of the tower.

The generator transformer may be oil-filled or a dry type depending on the wind turbine. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss reaching local water courses. The volume of oil used for generator transformers is in the order of 1,000 litres (L). The output from each of the turbines will be directed via 33 kV (or greater) underground reticulation cables that link to the main or secondary collector substations.

Image 3.5 Transformer adjacent to wind turbine

3.4.2 *Main Collector Substation*

The MCS locations have been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.6**). Three locations have been identified for the MCS which are at a minimum distance of 3 km from any surrounding residences. Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the MCS that are visible from the surrounding country to reduce noise and visual impact. Emergency backup power for the MCS will be supplied by a diesel generator and batteries onsite to maintain network communications and protections capability.

The MCS will include up to two transformers with capacities ranging between 80 megavolt ampere (MVA) or alternatively a single 180 MVA transformer to step-up the voltage to 132 kV, together with ancillary equipment. It will occupy an area approximately 150 by 150 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The MCS arrangement will include an array of busbars, circuit breakers, isolators, various voltage and current transformers and a static compensator-capacitor as agreed with TransGrid. A buried earth grid will extend one metre beyond the fence on all sides. The ground surface within the MCS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. As the transformer may contain upwards of 80,000 L of oil, provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components. This would involve constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the MCS compound. The 2.25 ha area includes a provision for a 20 m buffer of land surrounding the equipment.

3.4.3 *Secondary Collector Substation*

The SCS location has been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints. The SCS will occupy an area approximately 25 by 25 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The SCS would consist of up to three medium voltage transformers stepping up to 132 kV to minimise on site reticulation losses alongside other ancillary electrical assets such as transformer hardstands, environmental bunding, circuit breakers, busbars, voltage control and communication equipment.

3.4.4 *Switching Station*

The switching station (SS) locations have equally been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.7**). Four locations have been identified for the SS which are at a minimum distance of 850 m from any surrounding residences. Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the SS that are visible from the surrounding country to reduce noise and visual impact. The SS will require its own power supply from the local 11 kV distribution network, which is located within 400 m to 2 km from the proposed SS locations.

The SS will occupy an area approximately 75 by 100 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The SS arrangement will include an array of busbars, circuit breakers, isolators, various voltage and current transformers as agreed with TransGrid. A buried earth grid will extend one metre beyond the fence on all sides. The ground surface within the SS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. The 0.75 ha area includes a provision for a 15 m buffer of land surrounding the equipment required by TransGrid.

The SS will most likely require a communications tower to provide communications redundancy which is expected to be up to 20 m in height depending on geographic conditions. 24 hour lighting will need to be incorporated into the design of the SS. TransGrid requires lighting for operational safety reasons and will only be used intermittently for operational and emergency maintenance reasons.

The design of the SS will be developed in conjunction with TransGrid and comply with relevant technical, electrical and planning standards. As the SS will be owned and operated by TransGrid the operational period is likely to be beyond the timeframe of the Project. The SS will provide switching capability on TransGrid's 132 kV transmission line and could potentially increase network reliability and security of supply in the region and therefore TransGrid may wish to retain the SS beyond the operational life of the Project.

3.4.5 *Overhead and Underground Cables*

The electrical cables from the Pyramul and Sallys Flat Clusters will comprise a mix of underground and overground cabling and will connect either directly to the MCS or via the SCS. Where feasible, an internal overhead transmission line will be used to export power from the Sallys Flat Cluster to the

MCS (see **Figures 3.1** to **3.7**). **Image 3.6** shows a typical overhead line construction that could be implemented in this Project.

Image 3.6 Double-circuit overhead 33 kV power line

The underground cable routes will generally be between the turbines and follow the route of the internal access roads (refer to **Image 3.7** below). The final route will minimise vegetation clearing and avoid potential erosion and heritage sites, and will also depend on the ease of excavation, ground stability and cost. Markers may be placed along the route of the underground cables, if agreed by the participating landowners. Placement of these cables below ground will result in minimal visual impact.

Control cables will interconnect the wind turbine generators and the operation facilities building. Computerised controls within each wind turbine will automatically control start-up, speed of rotation and cut-out at high wind speeds and during faults. Recording systems will monitor wind conditions and energy output at each of the turbines. Remote monitoring and control of the Project will also be employed. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the groups of turbines.

The installation of buried earthing conductors and electrodes will also be required in the vicinity of the turbines, the facilities building and the substations as required.

A double circuit internal overhead transmission line of approximately 15 km and voltage up to 132 kV may be constructed for connection between the SCS and the MCS to minimise internal reticulation losses. The 132 kV overhead transmission line will be up to 30 m in height comprising of two cross arms with insulators with an average span length of 250 m. Above ground control cables would also be strung from the poles of the internal overhead line located between the SCS and MCS

A single or double circuit 132 kV external transmission line of approximately 15 km will be constructed between the MCS and SS for energy export into the grid. The 132 kV overhead transmission line will be up to 30 m in height comprising of two cross arms with insulators with an average span length of 250 m.

Image 3.7 Laying underground electrical cable within the road network

3.4.6 *Operation Facilities Building*

A facilities building will be constructed at the same location as the MCS. The general location has been chosen to minimise the length of overhead lines and underground cables and also to minimise the visibility of the facilities building and MCS. The building will house instrumentation, electrical and communications equipment, routine maintenance stores, a small work area and staff amenities.

The structure is proposed to be a slab-on-ground construction with steel frame, metal or brick walls and a sheet-steel roof, or alternatively a transportable type building constructed on piers. It will be of sturdy construction, suitable for the weather conditions it will be exposed to and will be compatible with the rural environment. Roof drainage will collect rainwater for domestic use. A septic or composting toilet system, which complies with Council requirements, will be installed to treat the small amount of waste water produced.

3.5 Site Access Works

3.5.1 *Site Entry*

The Project locality can be reached via a Northern route including several local roads leading from the Castlereagh Highway between Mudgee and Ilford and a Southern route from the Great Western Highway between Bathurst and Crudine.

Existing access roads are shown in **Figures 3.1** to **3.7** and can be classified into two broad categories:

- Classified Highways: Castlereagh Highway (SH 86), Hill End Road (MR 216) and the Great Western Highway (SH 32), which are maintained by Roads and Maritime Services (RMS); and
- Local Roads: The direct access to the site is provided by local roads maintained by Mid-Western Regional or Bathurst Regional Councils. The significant local roads are Windeyer Road, Pyramul Road and Aarons Pass Road for access from the north to the Project site. Turondale Road and

Hill End Road for access to the south of the Project site. Bombandi Road and Crudine Road for access to the external overhead electrical interconnection and SS.

RMS, Mid-Western Regional and Bathurst Regional Councils have ongoing maintenance and improvement programmes for the roads and bridges under their authority. There are no current proposals for major road improvements on the access roads under consideration.

Access routes and points for over-size and over-mass vehicles (primarily those vehicles carrying wind turbine and electrical components) have been investigated from the north and south. The northern access route comprises entry from the Castlereagh Highway onto Hill End Road north of Mudgee, and travels south to the Project site via Windeyer Road, Pyramul Road, and Aarons Pass Road. The southern access route comprises the Great Western Highway, passage through Bathurst (including Stewart Street and Eleven Mile Drive), the Mid Western Highway from Bathurst north to Duramana / Turondale and Hill End Roads.

Other roads in the locality may also be used both by over-size / over-mass vehicles, but will primarily be used by normal-sized vehicles such as tip-trucks, concrete agitator trucks (if required) and light vehicle transport both during construction and operation.

Note: Approximately 21 km of the arterial road access likely to be used for construction activities are unsealed. This has implications for water usage and dust suppression and is discussed later in this chapter. Of this total, approximately 10 km of unsealed access is along Crudine Road from the Castlereagh Highway intersection. This section of road would only be impacted if the construction of the external overhead powerline necessitated access from outside of the easement route.

All entrances to the Project site from the existing arterial roads will be designed to allow long vehicles to safely exit from or re-enter the road whilst minimising the disruption to traffic. Further consultation will be undertaken with Council and RMS to confirm the final design. Further details relating to safe access considerations are discussed in **Chapter 12** Traffic and Transport.

3.5.2 *On-site Access Roads*

Other access consists of new on-site roads between turbines, also comprising hardstand and turning head areas. The on-site roads will follow existing farm tracks, where practicable, that traverse the ridgelines and plateaus. All roads leading from the arterial roads and all on-site access roads are likely to require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation.

Construction of the internal road network will require earth works to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for Layout Option A and Layout Option B that include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works.

The roads will be surfaced with compactable, engineered base material with suitable drainage. Materials will be sourced locally where practicable and in consultation with the local Councils and landowners. Measures will be taken to minimise the risk of the spread of weeds from materials brought in for construction purposes through the CEMP.

The required on-site access for the Project site are shown in **Figures 3.1** to **3.7** and described below:

- Pyramul Cluster: Approximately 30 km of new internal on-site access track will be required; and
- Sallys Flat Cluster: Approximately 20 km of new internal on-site access track will be required.

3.5.3 ***General vehicle movements***

Access to turbines located at the end of a spur on a ridge generally requires a T or Y-section of road (referred to as a turning head) close to the hardstand area to allow semi-trailer trucks to turn around. These are graded the same as the proposed internal access roads and are typically 30 to 40 m in length.

Alternatively, semi-trailer trucks can reverse back out of an access route, provided the Project site safety regulations permit, or entrances made wider (bell-mouth) to allow manoeuvring.

Hardstand areas equal 30 by 50 m with additional area equal to 20 by 20 m to accommodate the turbine foundation, and roads up to 6 m wide during the construction phase are proposed as maximum permanent impacts. These dimensions would be sufficient to allow for passing and turning vehicles unless obstructed by a component such as a blade laid down on the hardstand awaiting assembly. In such an instance semi-trailer trucks could either turn around in the adjacent turning head, or continue to the next turbine hardstand area to turn around. Construction contractors generally avoid double-handling of components and as such manage the delivery and installation process under a just-in-time management process, thereby reducing the number of components laid down on site at any one time.

The proposed dimensions of the internal road and hardstand areas are sufficient for two cranes per turbine site to lift the components from the semi-trailer trucks, and for the trucks to drive on past to a suitable turning point, as described above.

3.5.4 ***Ancillary Roads and Remediation***

Some additional roads or tracks may also be required for construction of the internal and external overhead transmission line and for access to erosion control sites. The erosion control sites will benefit from the use of excess rock excavated from turbine footings and will be chosen based on the availability of excess material, the need for erosion repair, and minimising the distance for material transport.

If roads are not required for the ongoing operation and maintenance works of the Project they will be removed and rehabilitated on completion of the construction phase, and in accordance with landowner preferences and environmental controls.

3.6 Utility Services

The Project will be connected to TransGrid's 132 kV transmission network and when not generating will draw a minor amount of electricity from the grid. Backup and emergency power at the MCS will be supplied by on-site batteries and a diesel generator. Auxiliary power at the SS will be supplied by a local 11 kV distribution line.

A telephone connection to the proposed operation facilities building involving multiple telephone lines will also be provided to enable remote monitoring and control of the Project.

Mobile telephone coverage is available on most of the ridgelines and plateaus with limited service available on the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, operation and maintenance teams will communicate using both mobile telephones and radios.

Water will be provided to the proposed facilities and auxiliary services building from a storage tank designed to collect water from roof drainage. An approved septic system or composting system will be installed to treat minor quantities of waste water. The Proponent will be responsible for the removal of all other wastes from the Project site.

3.7 Resource Requirements

Resource requirements are typical of any new development site, including the provision of cement, gravel, sand, water and road base material.

Cement for foundations will be sourced by the civil construction company awarded to undertake the Project. This may be sourced locally or from alternative suppliers.

Gravel and sand will be sourced locally and as close to the Project area where it is practicable to do so. There are two disused gravel quarries located within the Project site; one at the northern entrance to the site off Aarons Pass Road and one at the southern entrance off Hill End Road, as well as additional quarries within the locality of the Project. These on-site quarries may be further utilised (subject to necessary permits) and have also been identified as preferred locations for any on-site concrete batching and rock crushing facilities. In addition, several landowners have expressed interest in allowing gravel extraction from their properties, which would require the necessary extraction permits prior to use. Both gravel and sand will be required to mix the high strength concrete to pour the wind turbine foundations. Gravel will also be required to dress the turbine sites, see **Image 3.5** above, and provide a low resistivity apron around the substations.

Water requirements will be met by sourcing water from within the locality as long as a zero share licence can be obtained under the current water sharing plan. Where available, groundwater will be purchased from involved or adjacent landowner properties who hold groundwater licences and have unused allocations. The use of regulated surface water allocations from the nearby Windermere Dam may also be an option. This source is controlled by State Water and its use would be subject to further discussions post consent. If water cannot be sourced locally, then it will be brought to site by external water suppliers under contract to the Project. It is estimated that in the order of 8.9 mega litres (ML) of water would be required to produce the quantity of concrete required for gravity footings for Layout Option A, and as such can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only 2.8 ML of water would be required if standard rock anchors were used for all footings in Layout Option A.

In addition, it is estimated that a further 11.7 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded internal road construction and dust suppression activities, including those associated with the 21 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to the NSW Office of Water (NOW). This will be undertaken pending Development Consent.

Road base material will be required for construction of access roads to turbine sites and the substations. Part of the road base requirement may be sourced from material extracted from turbine footings with the remainder sourced on-site (subject to permitting) or imported to the Project site. Where additional material is required, local supplies of the same geological type could be sourced from the quarries indicated above, local landowner gravel supplies or external aggregate suppliers.

Given the scale of the Project it is anticipated that there will be no waste material exported from the site during construction. Top soil cleared from surfaces during the construction phase will be used for remediation, and rock excavated for turbine footing preparations will be used for road base, back fill for foundations and / or erosion control purposes as far as practicable. Ancillary waste, such as packaging associated with component and stock pile deliveries, will be disposed of according to local Council requirements and will form part of the Construction Environmental Management Plan.

3.8 Potential Layout Design Variations

Generally, in the pre-approval phase of a wind farm, a development is designed with respect to basic civil engineering parameters, primarily because the final infrastructure design can change during the consent process. The cost of undertaking detailed civil design, high definition contour surveys and geotechnical surveys is prohibitive without the security of Development Consent. Wind farm projects are therefore designed to the best knowledge that is available at the time, whilst incorporating avoidance, mitigation and management measures determined by means of the key assessments undertaken prior to submission to the consent authority. With regard to the Project, the assessment has been undertaken with respect to maximum impact from the Project components (the roads, hardstands, cut and fill and turning head areas) to ensure the worst-case / greatest impact scenario is assessed.

Once approvals are obtained, activities are undertaken to reach financial close. Key to this is the selection of a preferred wind turbine supplier and the appointment of the construction contractor who will have specific requirements for road design. For example, each turbine is uniquely different requiring bespoke turning radii, access and exit gradients and crane requirements. As such, it is not until the construction contractor surveyor traverses the entire Project site and incorporates the Conditions of Approval, that detailed design of the roads and hardstands can be submitted to the turbine supplier for approval. It is therefore essential for efficient Project delivery that the consent authority provides for this flexibility within key Conditions of Approval by authorising the onsite Environmental Representative to permit minor modifications to the Project.

As indicated in the Gullen Range Wind Farm EA (Epuron 2008), in relation to the relocation of wind turbines, the EP&A Act allows for the relocation of equipment so long as it remains broadly consistent with the proposal as outlined, otherwise an application for the modification of the Project Approval would be required.

The Department of Planning also noted in its assessment of the Gullen Range Wind Farm:

> *"… the Environmental Planning and Assessment Act 1979 permits the Proponent to make minor amendments to the project where such amendments would not be inconsistent with the approved project, or to seek the Minister's approval to modify the approval if the amendments are in fact deemed to be inconsistent."*

It is possible that wind turbines and other infrastructure may be relocated up to 100 m from the submitted layouts, subject to the provisions of the EP&A Act. In respect of the points outlined above, and the Project site-specific avoidance, mitigation and management actions described in the subsequent chapters in relation to both the Study Area and Development Footprint, if the Environmental Representative determines that such a repositioning and its impacts remains consistent with the approved Project, then no modification of the approval would be required.

Similarly, the constant roll-out of new turbine models by a variety of manufacturers makes it impossible to select a preferred turbine model prior to consent. It is therefore requested that flexibility is provided for up to an additional 5 m for blade tip height to accommodate any new wind turbines which would be suitable for the Project, subject to a review of aviation impacts.

3.9 Wind Farm Development Phases – Development Consent to Operation

The following section provides a brief description of the detailed design, pre-construction and construction works, operation / maintenance and refurbishment / decommissioning work required at the Project site.

3.9.1 *Anticipated Project Timeline*

Approval is sought for the final positioning of up to 106 wind turbines and associated infrastructure within a radius of 100 m of the locations based on two preferred layouts, as indicated in **Figures 3.1** to **3.7**. The Proponent is applying for Development Consent to allow for substantial construction to begin within 5 years of the date of the granting of Development Consent. The actual timing of construction will principally be driven by the length of time taken to obtain other permits and authorisations, attaining Board approval / Project financing for commencement and the long lead times for wind farm components. An indicative Project timeline is presented in **Table 3.3** below. Staging of the development is also a consideration and some of those factors which may lead to a staged approach are discussed below in **Section 3.9.2**.

The following provides a guide to the anticipated activities subject to Development Consent for the Project.

Table 3.3 Anticipated Project timeline

		2013				2014				2015				2033 /2034
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	
Wind Farm Related Activities	Wind Farm Development Consent													
	Detailed Design and Contract Development													
	Preconstruction Works													
	Construction Works													
	Commissioning (in line with NER[1])													
	Operation													
	Maintenance													
	Decommissioning or Equipment Replacement													

[1] *National Electricity Rules*

3.9.2 *Construction Staging and Considerations*

The following section provides context into aspects that could have a bearing on a staged construction process and as such the Proponent is seeking flexibility in Conditions of Approval to allow for a staged development, subject to Development Consent.

Project scale: The Project comprises of two Clusters and is estimated to be constructed over a period of 12 to 24 months. Within this timeframe it is anticipated that activities will occur mainly within one of the Project Clusters at any one time. This is subject to commercial considerations and the Conditions of Approval placed on the development following Development Consent.

The Proponent requests that the Project could be either commissioned in stages or as a whole wind farm.

3.9.3 *Detailed Design and Contract Development*

Once all required permits and approvals have been obtained and tenders for the design and construction have been awarded the Project design can be finalised. This stage takes account of updated wind resource monitoring, revised energy modelling and the latest equipment and technology that is available to the Proponent at that time. It is at this stage that final micro-siting of the wind turbines and site infrastructure will occur, subject to Development Consent and the Conditions of Approval placed on the development.

Conditions of Approval and any licensing conditions will be used to prepare the Project Environmental Management Plans (EMPs) as outlined in **Chapter 20** Statement of Commitments (SoC). The Project EMPs would also be incorporated into the contract specifications for the required construction works and equipment supply to ensure compliance and achieve the Project environmental objectives.

Tenders will be issued using the abovementioned specifications and each tenderer's record of performance will be reviewed as part of the selection process to ensure that they are able to achieve the required specification of works.

The Contractor will also be required to produce / adhere to the Construction Environmental Management Plan (CEMP) to address its component of the Project works.

3.9.4 *Pre-construction Works*

Prior to the main construction commencing, a number of enabling works and further site planning would be undertaken by the selected Contractor, including:

- Detailed site investigation including geotechnical investigations involving a series of trial pits and / or boreholes;
- Detailed contour surveys;
- Upgrading the surfaces of local roads and access roads where required;
- Widening the junctions or corners of local roads, entrance / access points where required;
- Widening the existing gateways, or inserting new gateways as necessary along fence lines;
- Stripping and careful storage of existing soil from the areas which would be affected by construction activities, including the tower bases, the substation locations, access road areas, crane hardstand and assembly areas;
- The construction of a secure site compound, with Project owner and subcontractors field offices (portables), parking bays, and toilet facilities (temporary). A 75 by 75 m area is to be retained permanently;
- Erection of signage on roads;
- Enabling works for the locating of a mobile concrete batching plant (temporary, if required);
- Enabling works for the locating of a rock crushing plant (temporary, if required);
- Environmental survey and refinement (if necessary) of the EMP as required under the Development Consent;
- Survey of critical land boundaries and pegging of infrastructure locations;
- Detailed cultural heritage and flora / fauna surveys across entire site (if required);
- Preparation of works procedures and Project Implementation Plan; and
- Engineering design works and submission for Building Rules Consent.

3.9.5 *Construction Works*

Construction activities include activities that cross over with pre-construction works and comprise site establishment, earth works for access roads, footings and crane hardstand areas, erection of up to 106 wind turbines, approximately six permanent wind monitoring masts, substations, above and below ground cabling and site compound. Construction activity is likely to occur over a period of approximately 12 to 24 months with rehabilitation following the completion of works.

Community construction awareness programme: Prior to the commencement of the Project site construction activities, a programme of community awareness initiatives will be implemented. Information will be disseminated to the local community through the established Community Consultation Committee (CCC), local newspapers and direct mail to advise them of the nature of the construction activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or, if required, to express concerns or complaints.

Updates on the progress of construction works and relevant impacts will be provided during the construction period. The CCC will be available to guide and inform the Project owner on matters of interest to the community, and will provide an additional forum for communication between stakeholders.

Site Establishment and Compound: Site works will require the erection of temporary infrastructure such as a portable field office toilet facilities and parking bays, within the temporary construction compound (refer to **Image 3.8** below). This infrastructure will be typical of that used at construction sites; however it will not include accommodation facilities.

Image 3.8 Typical temporary site office

Four preferred areas for the construction compound have been considered. Three are located in the north of the Pyramul Cluster, off Aarons Pass Road, while the fourth is located at the southern end of the Sallys Flat Cluster, off Hill End Road (see **Figures 3.1** to **3.6**). The temporary site office facilities will be approximately 40 by 100 m located within the construction compound approximately 150 by 200 m, a combined area of approximately 3 ha. The area will be fully fenced with sufficient access to allow vehicle movement, stockpiling of materials, and office facilities. An area approximately 75 by 75 m will be retained for permanent use during the life of the Project. The selection criteria for identifying these locations were with respect to the following:

- Flat accessible location to the arterial roads to allow for vehicle movement to both Clusters;
- Minimising ecological impacts through avoidance of Endangered Ecological Communities (EECs), avoidance of hollow bearing trees (where practicable), away from recorded Threatened Species, and avoidance of major creeks;
- Minimising traffic and transport activity during construction;
- Minimising visual impact from publicly accessible locations; and
- Minimising noise impacts at receptor locations.

Pending Development Consent, a construction contractor will be appointed to the Project. If alternative locations for these facilities are sought then the same selection criteria will be considered to determine suitable locations.

Traffic signage required as part of traffic safety during construction will be installed by the contractor, in compliance with relevant regulations and in accordance with any permits obtained for traffic management.

Signage will be erected at critical locations from the outset of construction, directing all vehicles associated with the construction site to the Project site office. Sightseeing traffic will be managed towards safe, prominent viewpoints where they may view the Project, but not in a way that would jeopardise the safety of sightseers or the progress of construction. Additional signage would be located near to the Project site, providing information about the turbines, the companies involved in the Project and essential safety information and telephone numbers. The need for a pull-off bay for sightseers' cars on one of the local roads will also be assessed. Negotiations with the Mid-Western Regional and Bathurst Regional Councils, NSW RMS and other affected parties will be initiated to determine final signage locations and the various works required.

On-site Concrete Batch Plant / Rock Crusher: Two temporary concrete batching plant and rock crusher locations are proposed to supply concrete and aggregate for the wind turbine foundations and access tracks.

An on-site batching plant facility would occupy an area of approximately 50 by 100 m and likely consist of a trailer-mounted concrete mixer, cement bins, sand and aggregate stockpiles and a storage container for various equipment and tools. Sufficient area will be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles. A batch plant would be powered by a diesel generator and have a production capacity of approximately 40 cubic metres per hour (m^3/h).

A rock crusher would occupy an area of approximately 50 by 100 m and consist of a tracked mobile crushing unit, conveyor belts, feeder and engine. Sufficient area will be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles. **Image 3.9** below shows a typical mobile concrete batching plant facility and rock crusher.

The selection criteria for identifying these locations were with respect to the following:

- Minimising ecological impacts through avoidance of EECs, avoidance of hollow bearing trees (where practicable), away from recorded Threatened Species, and avoidance of major creeks;
- Minimising traffic and transport activity during construction;
- Minimising visual impact from publicly accessible locations;
- Minimising noise impacts at receptor locations; and
- Close to an accessible water source.

Pending Development Consent, a construction contractor will be appointed to the Project. If alternative locations for these temporary facilities are sought then the same selection criteria will be considered to determine suitable locations.

The final location of concrete batching plants and rock crushers will be determined at the construction planning stage and will be strategically sited to minimise impact on the local area.

Image 3.9 Temporary on-site concrete batching plant and rock crusher

Site Access Roads and Crane Hardstand / Assembly Areas: Site access roads and crane hardstand / assembly areas require surfacing in order to cater for construction traffic and machinery. This involves the excavation of the roads and hardstand areas to an agreed depth, prior to the laying of a compacted quarry rubble base. It is anticipated that all of the material retrieved from cuttings and excavations will be used on-site or in the immediate vicinity of the Project site. Site access points would be gated and secured, and appropriate warning signs erected.

During construction, site access roads are constructed at a width of 6 m to allow for passing construction traffic, large mobile cranes, and other long and wide loads. The crane hardstand and assembly areas will be sized at approximately 30 by 50 m.

Dust suppression is a key consideration during the construction and use of roads. A permit will be sought from the NOW for the extraction of the required quantity of water to enable the construction and dust suppression of up to 50 km of new and upgraded internal access roads and up to 20 km of unsealed arterial roads that are likely to be used for site access. If on-site water cannot be sourced from within the Project area, then water will be brought into the site from appropriate suppliers.

Footing Construction: If gravity foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 450 m^3 of ground material to a depth of approximately 2.5 m. Shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish approximately 0.5 to 1 m below ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete. Given the limited output capacity of the concrete batch plants, foundation designs can incorporate cold joints and construction joints. These can limit foundation pours to around 250 m^3, thereby allowing increased workmanship, less demand on the batching plant and a contingency plan in the event of plant breakdown, delays to material supplies or detrimental weather events (discussed below in more detail).

If rock anchor foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 100 m^3 of ground material to a depth of approximately 2.5 m. The rock anchor cores are drilled into the bedrock prior to concrete pour, and are up to a depth of approximately 20 m. The rock anchor tendons are grouted into place, stressed and secured once the concrete has cured sufficiently. Steel forms shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish at ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

Prolonged cold temperatures can cause heat loss from the limestone hydration process during foundations pours. If concrete loses too much heat there is a risk of plastic cracking and loss of durability within the concrete. This can be controlled to a degree by additives to the concrete mixture. The preferred approach is to avoid pouring concrete during prolonged periods of cold weather.

With hot temperatures, the concrete can be affected by water loss through evaporation and can dry out too quickly. Additives can again control the extent of this, however pouring concrete during the evening or when the temperatures are lower is preferred. Alternatively a tent can be erected over the base area to provide protection to the concrete pour.

On-site Electrical Reticulation: Either prior to or during turbine base construction, the underground site electrical system would be installed. This would involve the cutting or excavation of trenches to a depth of up to 1.2 m for the laying of the underground cabling that links the turbines. All trenches would be marked with warning tape and backfilled once the cables were in-situ.

The majority of the underground cabling will be located adjacent to the access roads. The general procedure for the laying of underground cables will be as follows:

- Preparation work, including installation of gates / temporary removal of fences as required;
- Use of an excavator or rock saw to dig a trench (0.45 m wide by up to 1.2 m deep);
- Material excavated is stored adjacent to the trench for subsequent back-filling;
- Laying of bundled cables within a bed of protective sand;
- Backfilling and compaction of previously excavated material in layers by use of a vibration plate compactor, all in accordance with Engineering Specifications; and
- Placement of tape warning of the presence of electrical cables at the required depth.

On completion the cable route may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

Main Collector Substation: Three locations for the MCS have been selected (**Figures 3.1** to **3.6**) with a total compound area of 150 by 150 m incorporating a 20 m Asset Protection Zone (APZ) area extending from the boundary of the installed equipment. The yard will be surfaced with compacted quarry rubble to form a hardstand area. Reinforced concrete footings will then be constructed to support electrical infrastructure and buildings. Infrastructure required within the yard includes 132 kV transformers, switchgear, power conditioning equipment and operation facilities building. **Image 3.10** below shows a typical substation design during construction.

Image 3.10 Transformer foundation (foreground) and electrical substation and switchgear infrastructure (background)

Secondary Collector Substation: The SCS will consist of up to three medium voltage transformers stepping up to a maximum of 132 kV to minimise on site reticulation losses alongside other ancillary electrical assets such as circuit breakers, busbars, voltage control and communication equipment. Physical footprint of the station should not exceed 25 by 25 m and will include transformer hard stands, environmental bunding and security fencing at 3 m high.

Turbine Erection: The turbine components would be delivered to the Project site on semi-trailers. The method of construction would involve the use of a small mobile crane (up to 100 tonne) for the ground assembly operation. A larger 600 to 1,000 tonne crane together with a small mobile crane would be required to erect the turbines once ground assembly is complete. Erection is likely to take approximately 2 to 3 days per turbine. Depending on the configuration, the crane may require up to 2 days to disassemble and remobilise to a new site. **Image 3.11** shows the sequential stages undertaken during the installation of a wind turbine.

Image 3.11 A range of typical turbine erection photographs

Internal and External Overhead Powerlines: Construction of the proposed internal and external powerlines require the following works to be undertaken in accordance with an appropriate Construction Environmental Management Plan (CEMP):

- Site establishment including the provision of access;
- Centreline surveying and service location;
- Excavation and power pole erection; and
- Conductor and earth wire installation (including pilot wire).

Complex line construction methods including helicopter installation and blasting of power pole foundations are not considered necessary. Equipment to be routinely used during line construction includes:

- Semi-trailer for transportation of power poles, wires and other materials;
- 20 tonne crane;
- Pole borer;
- Elevated work platform (EWP); and
- Concrete trucks.

Image 3.12 shows equipment typically used during power pole and wire installation.

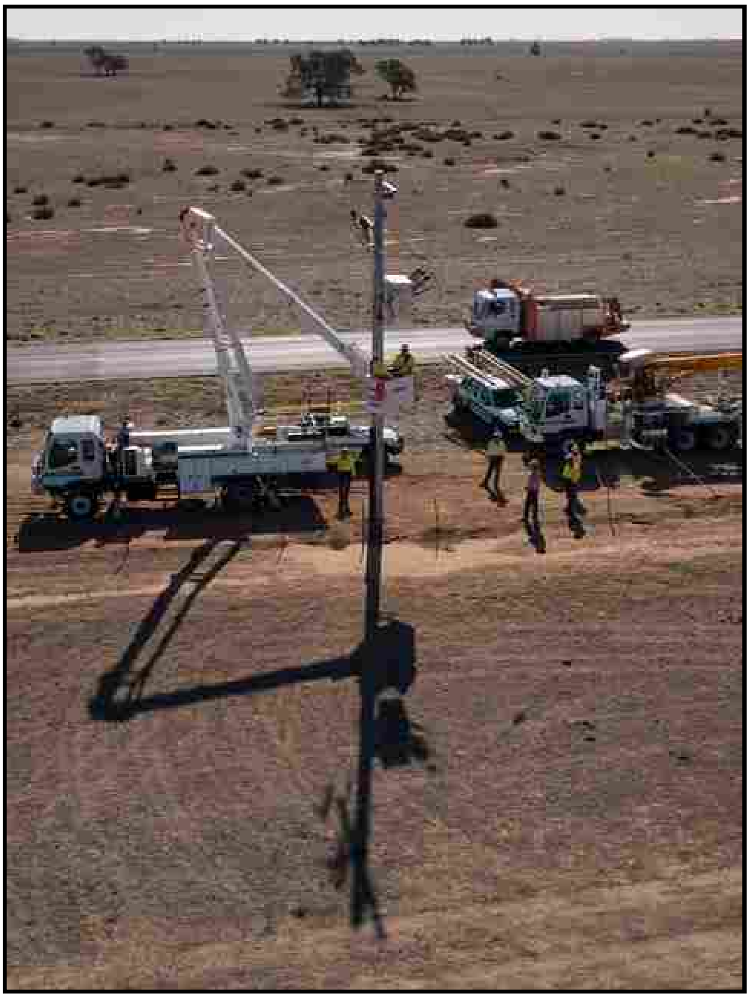

Image 3.12 Equipment typically used during power pole and wire installation

The majority of the proposed transmission line location can be readily accessed during construction via cleared agricultural land, following negotiations with landholders. In some cases, track creation or enhancement may be required where access cannot be gained or is not considered adequate to support machinery utilised during the construction of the line. A number of creek crossings may also be required to support the required machinery. Crossings not required for future maintenance activities will be decommissioned following the completion of construction works.

Existing access tracks will be utilised where practicable. Where it is not practicable, access tracks will preferably be restricted to the proposed transmission line corridor and will connect with existing tracks or public roads at the most convenient locations. Upgrading of the existing access tracks will be necessary to allow access by low-loaders to the SS site and other construction plant and equipment to the remainder of the line route. A protocol will be developed as part of a CEMP, to provide guidelines for minimising environmental impacts during the location and construction of access tracks.

Minimal clearing will be required for the construction of both the internal and external powerline. Any native vegetation removed will be dealt with in accordance with recommendations outlined in **Chapter 10** Ecology. Shrub and grass understorey species will be maintained where practicable to reduce the risk of soil erosion.

During construction, temporary lay down areas will be positioned along the proposed transmission line route to store hard equipment such as power poles and conductors. No fuel, oil or chemicals will be stored at these locations.

The centreline of the proposed transmission line corridor will be surveyed to allow for the correct placement of power poles. Alternate services, such as water, sewer or telecommunications, will also be identified at this time, will be clearly marked and all staff and subcontractors made aware of their location.

New power poles will be predominately of timber, steel or concrete construction with horizontal line posts that would be porcelain or polymer. Steel poles are typically used in areas of difficult terrain as they offer some advantages in steep or rocky areas. The power poles will be placed between 200 m and 250 m apart, with the final details of pole numbers, spacing and location to be determined during the detailed project design phase.

Power poles will be up to 30 m in height for a double circuit 132 kV line and up to 25 m for a 66 kV line, with pole diameters of approximately 0.5 m. Poles will be embedded between 3 m and 9 m into the ground, depending on ground conditions, or alternatively concrete pad and chimney foundations of up to 7 by 7 m may be used. The final height of individual poles will vary depending on the terrain and power pole design constraints.

The foundations for the power poles will be excavated where practicable using a truck mounted construction vehicle. If it is determined that larger poles and footings are necessary, larger vehicles and construction equipment will be required to access the study area to excavate the foundations. Earthing plates will be installed within the excavated pole foundations. In instances where large diameter poles are used and the slope of the location for the pole is greater than 4 degrees, a pad approximately 4 by 7 m will be excavated for stabilisation of the bore drilling plant. Once the power pole is in place, the hole will be backfilled with concrete. Steel power poles are constructed in sections in the field, with concrete power poles arriving on location in one piece, delivered to the site in advance of construction. Excavated material would be respread around the power pole and stabilised. Vehicle access to each power pole would be required during construction and operation.

Conductor and earth wires are strung by initially manually feeding light training lines between poles and then using mechanical equipment to pull the connected conductors from large drums mounted on the rear of specialised vehicles. A number of spans can be strung at once depending on the location and characteristics of the intervening terrain.

Switching Station: The SS will be designed and constructed in line with TransGrid requirements and any other relevant technical, electrical and planning standards.

The following earthworks would occur during construction of the proposed SS:

- Cut and fill works to create a stable hardstand platform;
- Digging of trenches and footings for the switching station infrastructure; and
- Construction of concrete foundations for the control / switch room building and establishment of pads for the installation of electrical infrastructure.

On-site trafficked areas would be limited to areas at the site entrance and surrounding the switch room and control building. The infrastructure compound area would be finished with coarse gravel and pebble material. The remainder of the site would be retained as grassland with landscaped planting as necessary.

High security weld mesh fencing would be constructed around the proposed SS compound area up to 3 m high and topped with barbed or razor wire. Fencing would include a lockable gate at the switching station entrance.

Access would be via Bombandi Road which is currently unsealed. As part of the proposed activity, the section of Bombandi Road between the Castlereagh Highway and the proposed SS would be upgraded with an all weather access road.

Within the proposed SS compound, an all weather access driveway incorporating provision for car parking would be constructed.

The electrical infrastructure to be included as part of the proposed SS includes:

- Termination power poles and associated connectors;
- Landing spans and 132 kV line bays and busbars;
- 132 kV circuit breakers and metering equipment;
- 20 m Communications tower (if required);
- 24 hour lighting for emergency operations;
- Low voltage (11 kV) transformers for auxiliary power supply; and
- A control building including protection relays and communications equipment.

The SS does not include substation infrastructure such as high voltage transformers and capacitor banks and hence does not include any significant noise generating sources. A small (5 MVA) 11 kV transformer will provide auxiliary power to the SS.

A line-of-sight communications tower approximately 20 m in height may be required to ensure communication with the MCS is maintained.

The proposed activity includes a building to house both the control room and switchroom. The design and materials of the building would be consistent with typical TransGrid infrastructure that incorporates visual cues from the surrounding natural and built environment.

A rainwater retention tank is to be placed on-site to collect rainwater from the roof of the control room / switchroom building. Connections to this structure are to be stratified to include provisions for fire hydrant supply.

An on-site waste water treatment system will be installed to treat domestic waste. This is to be installed in accordance with AS 1547:2000 - On-site Domestic Wastewater Management.

TransGrid requires the provision for night lighting for operational safety reasons that is not low-intensity. This is would only be used intermittently for operational and emergency maintenance reasons.

Landscaping would be undertaken to limit the potential visual impacts of the proposed SS. Landscaping would involve planting of locally endemic species planted in copses to break-up the visibility of the compound area. A minimum cleared buffer of four metres from the compound fence is required to meet public safety requirements.

3.9.6 ***Commissioning***

Pre-commissioning checks will be carried out on the high voltage electrical equipment prior to connection to the TransGrid transmission network. When the Project electrical system has been energised, the wind turbines will be commissioned and put into service.

3.9.7 ***Operation***

Once operational, the Project would be monitored both by on-site staff and through remote monitoring. Aspects of the Project operation to be dealt with by on-site staff would include safety management, environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Those functions to be overseen by remote monitoring include turbine performance assessment, wind farm reporting, remote resetting and maintenance co-ordination. Pro-active computer control systems monitor the performance of the wind turbines and ensure that any issues are dealt with by on-site staff or contractors, as appropriate.

The SS will be operated by TransGrid, and therefore separate Conditions of Approval relating to the subsequent SS EMPs are requested.

3.9.8 ***Servicing and Maintenance***

Maintenance staff are likely to be on-site throughout the year, making routine checks of the wind turbines on an ongoing basis. Major planned servicing would be carried out approximately twice a year on each wind turbine. Each major service visit would potentially involve a number of service vans (two technicians per van) on-site.

Should a problem occur with a wind turbine, then the on-site maintenance staff will attend to the machine to get it operational again. Depending on the situation, a turbine could be non-operational for several hours or days. Significant problems which require the replacement of major components, such as turbine blades, may require the use of cranes and ancillary equipment. This can result in a turbine being offline for several weeks whilst the appropriate equipment and materials are sourced.

Management of regrowth vegetation will be necessary within the powerline corridors to reduce the threat of fire and physical damage to the line, and to allow access for maintenance vehicles. This will be carried out using mechanical, manual and chemical clearing methods prior to construction activities commencing and as part of ongoing maintenance activities for the duration of the Project.

Following construction of the powerline, maintenance will most likely be limited to yearly inspections in a 4WD vehicle to check the integrity of the power poles and other associated infrastructure. Occasionally access by medium and heavy vehicles may be required to repair or maintain powerline components. Access will be gained via dedicated access tracks within the powerline corridor.

Again, the SS will be operated by TransGrid, and therefore separate Conditions of Approval relating to the subsequent SS EMPs are requested.

3.9.9 ***Refurbishment***

After approximately 20 to 25 years of operation (or sooner if deemed economically viable) the blades, nacelles (top section of the turbine) and towers could be removed and replaced. Old blades, nacelles and towers are removed from site for recycling and new components installed on existing or new foundations, as appropriate. Refurbishment would extend the life of the Project for a further 20 to 25 years.

Any material change to the Project layout, or significant changes to the turbine technology, will be referred to the relevant NSW planning authority at that time as an amended proposal. It would also be subject to the regulations and guidelines of the day. Refurbishment requires the equivalent transportation and installation equipment and facilities used during the initial construction.

3.9.10 ***Decommissioning***

At the end of the operational life of the Project, the turbines and all above ground infrastructure will be dismantled and removed from the site. This includes all the interconnection and substation infrastructure, but may exclude the SS. The tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result. The land will be returned to prior condition and use. A compressor and rock crusher may be needed to carry out the cutting work.

The access roads, if not required for farming purposes or fire access, would be removed and the Project site reinstated as close as possible to its original condition and use. Access gates, if not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

The underground cables are buried below ploughing depth and contain no harmful substances. They would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

All decommissioning work would be the responsibility of the Project owner and is a provision within the lease arrangements with the landowners. Further details relating to decommissioning are outlined in **Chapter 18** General Environmental Assessment.

3.9.11 *Fire Management*

A fire management plan is an important part of both wind farm planning and the community consultation process. All aspects of the Project will adhere to the current guidelines on bushfire protection as outlined in **Chapter 16** Fire and Bushfire.

Despite the low risk that wind farms present, fire management is a major concern within the region, and planning for fire prevention and an effective and informed response is of paramount importance. Planning with regard to fire management not only provides wind farm proponents with assurance that minimum damage would result from a fire incident, it also reassures the landowners / local community and enables the Rural Fire Service (RFS) to confidently plan and execute an effective response.

Appropriate fire management actions for all stages of the Project development (i.e. pre-construction, construction, operation and decommissioning) include:

- Adherence to all regulations;
- Installation of access tracks at least 4 m wide and with appropriate vertical clearance and suitability for all weather conditions;
- Provision of appropriate fire-fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions;
- Maintaining provision for mobile telephone and UHF radio communications;
- Provision of on-site identification of individual turbine locations and access gates for fire-fighting services, and an undertaking to provide local rural fire service groups with access to gates;
- Consideration of total fire ban days in regard to hours within which construction takes place;
- Providing the RFS with:
  - A construction works schedule;
  - Maps of final turbine layout and identification information for individual turbine sites;
  - Access road plans and locations of access gates;
  - Security information such as location of locked gates and restricted access areas;
  - Location of any additional water supplies installed for construction activities; and
  - Location of potential landing pads for fire-fighting aircraft or helicopters.

The RFS has been notified of the Project and further consultation will continue. Details of the Project site (such as turbines, access tracks and gate locations) will be provided to assist their internal response planning. Specific fire prevention and response measures are outlined in the Project EMP (see **Appendix 20**). Furthermore, an Emergency Response Plan (ERP) will be developed in consideration of RFS guidelines and further consultation with regional and local rural fire groups, and would include agreed notification protocols, contacts and response actions.

3.10 Summary

The Project will comprise one of two potential design layouts; one consisting of up to 106 wind turbines and the other up to 77 wind turbines and ancillary structures, both spread over 17 different properties, with a maximum blade tip height of 160 m. The Project will connect into the 132 kV TransGrid transmission line running north-south approximately 15 km east of the Crudine ridgeline.

The Proponent requests that consideration is given to a 100 m micro-siting allowance and 5 m turbine height allowance during the detailed design phase, and that the Project, if required, can be built and commissioned in stages. Pre-construction works involve final site surveys (for heritage and ecology, if necessary), detailed geotechnical investigations and preparation activities; as a result the Proponent requests that flexibility is considered in all Conditions of Approval including but not limited to providing authority to the onsite Environmental Representative to permit minor modifications to the Project. Construction works involve the grading and surfacing of access tracks and turbine footprints, and the installation of the Project and connection infrastructure as well as temporary works facilities. Land that is disturbed, but not part of the land-take for the life of the Project, will be reinstated.

Operation of the Project is controlled remotely, with the majority of site visits required being those of maintenance staff. At the end of the term of the Project the facility may either be refurbished or decommissioned. Decommissioning will involve the removal of all above-ground infrastructure and the reinstatement of the ground to a pre-construction condition.

CHAPTER 4

Project Justification

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4. PROJECT JUSTIFICATION

There has been growing global recognition of the need to mitigate the environmental effects associated with fossil fuel energy generation. Such thoughts have manifested into international, national and state wide commitments supporting the development of clean and sustainable energy projects. The Crudine Ridge Wind Farm will play an important role in contributing to both the increasing local and global need for such renewable projects and in tackling the issues of Global Warming and Climate Change.

4.1 Greenhouse Gas Emissions and Climate Change Science

There are naturally occurring greenhouse gases, including water vapour, carbon dioxide, nitrous oxide, methane and ozone in the atmosphere, which reflect and absorb heat from the Earth's surface. These natural greenhouse gases, in particular carbon dioxide, nitrous oxide and methane, in addition to human introduced gases such as halocarbons, chlorine- and bromine- containing substances and sulphur hexafluoride, are increasing in concentration and causing a rise in the normal levels of absorption, leading to the threat of elevated global temperatures.

Studies have found that the current rate of carbon dioxide emissions is greater than the natural rate of removal of carbon dioxide from the atmosphere (United Nation's Intergovernmental Panel on Climate Change (IPCC 2007, pg 38). As a consequence of this increased concentration of carbon dioxide equivalent, it is predicted that the Earth will warm between 2 and 4.5 °C (IPCC 2007, pg 38). According to the David Suzuki Foundation, increased global temperatures will see changes in extreme weather patterns, shortage of water supplies, imperilled ecosystems, increase in risks on human health and potential for economic risks (David Suzuki Foundation 2009).

The energy supply, transport and industry sectors are the primary drivers behind the rate of carbon dioxide equivalent emissions, which have increased by approximately 80 % from 1970 to 2004 (IPCC 2007, pg 36). Central to this is a heavy reliance on coal for low-cost electricity production, which is also recognised as having the highest output of carbon dioxide equivalent emissions (Garnaut 2008).

The consensus of scientific opinion as presented to world governments by the IPCC is that there is a link between humankind's actions and a variety of climate-related issues. Industrialisation and the resultant emissions of greenhouse gases from the burning of fossil fuels have created, and continue to exacerbate, a global environmental problem – Climate Change.

4.2 Global Response

The IPCC, established by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP), was set up in 1988 to provide a comprehensive forum in the fundamental understanding of linkages between greenhouse gas emissions and climate change.

The international consensus was summarised in the Geneva Ministerial Declaration, July 1996. This Conference of the Parties (COP2), addressing the United Nations Framework Convention on Climate Change (UNFCCC), concluded that there was a need for action from all tiers of government to avert the deleterious effects of climate change. This resulted in most participating countries to encourage renewable energy generation projects through sustainable development initiatives, in addition to complementary actions to develop energy conservation and efficiency measures.

In 1997, the Kyoto Protocol was established, which called for industrialised countries to reduce their collective emissions of greenhouse gases by 5.2 % below 1990 levels by 2008-2012. The year 2004 saw the Kyoto Protocol made legally binding in the European Union (EU) and ratified by the Russian government. This allowed for the Kyoto Protocol to establish the first binding international commitments to limit greenhouse gas emissions and an international emissions trading system to promote cost-effective reductions in 2005.

In 2007, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were is 1990. This was a watershed decision and an important step in determining Australia's position on climate change in the international arena.

4.3 Australian Greenhouse Gas Emissions and Response

Australia is the highest emitter of greenhouse gas emissions in the world at 27.3 tonnes of carbon dioxide equivalent per capita (The Climate Institute 2011). On a sectoral basis (stationary energy, transport, industry and agriculture) the greatest percentage of greenhouse gas emissions are attributed to stationary energy at 49 % (NSW Office of Environment and Heritage (OEH) 2011). Collectively, New South Wales (NSW), Queensland and Victoria account for over 80 % of energy supply greenhouse gas emissions throughout Australia (DCC 2009).

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM) published *Climate Change in Australia* (2007) based on the IPCC report *The Regional Impacts of Climate Change: An Assessment of Vulnerability* (2001). The following was concurred:

- Annual temperature increases of approximately 1.0 °C by 2030, with warming as large as 1.8 °C for some inland regions;
- Annual warming ranging from around 1.0 to 2.5 °C for the lowest assumed emission scenario, and 2.2 to 5.0 °C for the highest assumed emission scenario by 2070;
- Decreases in precipitation of 2 to 5 % in most regions, with decreases reaching 10 % in south-west regions. Later in the century the projected precipitation changes are larger and more variable, with the range of annual precipitation change being -30 to +20 % in central, eastern and northern areas in 2070;
- Global seal level rise is projected to be 18 to 59 cm by 2100, with possible addition from ice sheets of 10 to 20 cm; and
- Storm surges occurring in conditions of higher mean sea levels will enable inundation and damaging waves to penetrate further inland increasing flooding, erosion and the subsequent impacts on built infrastructure and natural ecosystems.

In 2007 the IPCC released their fourth assessment report, but again there was not sufficient information to determine the effects on Australia, so CSIRO and BoM created an update to accompany *Climate Change in Australia* and concluded:

- Concentrations of greenhouse gases are on the rise, with an unexpected increase in methane;

- Carbon sinks remove considerable amounts of anthropogenic carbon dioxide, but they are becoming less efficient;
- Sea levels are rising, with current projections of up to 80 cm by the end of the century;
- Southern Ocean acidity has increased, while salinity has decreased; and
- Rainfall in southern Australia has declined over a 30 year period, caused by changes in climate systems over the region (CSIRO and BoM 2009).

To combat these recorded and potential impacts, the Australian government and other agencies and participants in the climate change and energy sectors have come up with a number of responses in the form of Acts and policies, funds, programs and schemes.

Department of Climate Change and Energy Efficiency: In 1997, the Federal Government created the Australian Greenhouse Office (AGO) to provide a whole-of-government approach to greenhouse issues. In March 2000, the AGO became an Executive Agency of Government and as a result the Department of Climate Change (DCC) was established in December 2007. In 2007, Australia also ratified the 1997 Kyoto Protocol, making a commitment to limit greenhouse gas emissions growth. The DCC also developed a strategy to further reduce national emissions through the Carbon Pollution Reduction Scheme (an emissions trading scheme), the implementation of which, after being rejected by parliament twice, was deferred indefinitely. In 2010 the DCC became the Department of Climate Change and Energy Efficiency (DCCEE) and a similar carbon pricing instrument was proposed in the form of a carbon tax. This tax, implemented through the Clean Energy Legislative package, passed through parliament in 2011 and, now law, is intended to reduce greenhouse gas emissions by making carbon pollution more expensive.

Renewable Energy Target: The Renewable Energy Target (RET) legislation was passed by Federal Parliament in August 2009, providing an expansion on the Mandatory Renewable Energy Target (MRET), aiming to acquire 20 % of Australia's electricity from renewable sources by 2020. January 2011 saw the RET separated into the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). The LRET provides a target of 41,000 giga watt hours (GWh) to be generated from large scale renewable sources by 2020. After that, each year the target will remain at 41,000 GWh until 2030 when the RET will cease operation.

To meet the RET each retailer must obtain a target amount of electricity in megawatt hours (MWh) from renewable energy sources in order to avoid a financial penalty. Renewable energy is obtained with Renewable Energy Certificates (REC), which are created by accredited renewable energy generators. Once a REC is bought by a retailer, it is surrendered to the government regulator. From 2001 to 2007 the largest REC generating sources were from hydro, wind and solar water heaters (Office of the Renewable Energy Regulator 2008, pg 14).

Council of Australian Governments: The Council of Australian Governments (COAG), October 2008, agreed to develop a National Strategy on Energy Efficiency, to accelerate energy efficiency efforts across government levels and to help households and businesses prepare for the introduction of a future carbon price.

COAG in 2010 took original measures further, increasing residential and commercial efficiency ratings, and introducing mandatory disclosure of energy efficiency. COAG have also stressed the urgency to create a uniform scheme on renewable targets to provide consistency for investors looking to support Australia's renewable energy industry in the coming years.

Funding: The Australian Government has taken steps towards investing in a growing renewable energy industry. Under the recently legislated Clean Energy Future package, a number of initiatives have been established, including the Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC). These initiatives are intended to streamline investment in and support for a strong renewable industry with huge potential. ARENA was granted $3.2 billion in funding to fulfil the tasks of improving the competitiveness of and increasing the supply of renewable energy in Australia. This agency will also come to incorporate the Australian Solar Institute, recognising the role that both large-scale solar and large-scale wind will have in the future energy mix. The CEFC, granted $10 billion commercially oriented funding, will invest in firms and projects to assist in overcoming capital market barriers that hinder the financing, commercialisation and deployment of renewable energy.

GreenPower: GreenPower, started in 1997 to accredit and audit renewable energy retail products, now manages the program nationally. Over 900,000 residential electricity customers in Australia now purchase accredited renewable energy through the program.

4.4 Need for New Power Generation in New South Wales

According to the Australian Bureau of Statistics (ABS), throughout 2008 and 2009 the main sources of energy consumed in NSW were black coal (52 %) and petroleum (36 %) (ABS 2010). Energy demands in NSW are also increasing, with a 1,310 GWh increase in energy demand per annum over the past ten years, and an estimated 3.8 % annual increased energy demand over the next ten years (TransGrid 2010). It is predicted that NSW will have the second largest projected growth in peak electricity demand in Australia, closely following Queensland (Cuevas-Cubria & Riwoe 2006).

Compared to other states, NSW has a relatively unexploited wind resource, a large electricity market and an available transmission capacity, which makes it very suitable to accommodate wind power technology. Under the LRET, investors are seeking to utilise this wind resource as the demand for RECs increases.

The NSW Government has a policy of 20 % renewable energy in NSW by 2020 with the report *NSW 2021: a Plan to make NSW number one* committing to this target (Department of Premier and Cabinet 2011). Actions in the report include encouraging a more diverse energy mix and preparing a *Renewable Energy Action Plan for NSW* to identify renewable energy investment opportunities, including wind farms. Wind energy is the lowest cost form for achieving this target; however efforts to ensure that wind farms continue to be acceptable to the community are essential if the target is to be met.

In addition, a long term goal of a 60 % cut in greenhouse gas emissions by 2050 and a return to year 2000 greenhouse gas emission levels by 2025 were detailed.

Further to NSW 2021, the Draft NSW Renewable Energy Action Plan (2012) outlines the NSW Government's aim to increase wind energy investment in NSW. Acknowledging that NSW has excellent wind resources by international standards, the NSW Government will seek to attract a large proportion of the investment that will result from the RET. To this end, the report lists consideration of more strategic and integrated approaches to assessment of renewable energy projects as an action point to be taken by the DoPI (NSW Trade and Investment 2012).

4.5 Suitability of Wind Power

4.5.1 *Evolution of Wind Technology*

The ability to harness wind power has evolved from research in the 1980s, expansion and consolidation in the 1990s, to a competitive, mature and mainstream energy supply technology in the current market. At the end of 2010, the total international capacity of wind energy was 197,000 MW, with global wind power capacity increasing by 24.1 % in 2010 (**Figure 4.1**, GWEC 2010). It is predicted that by 2020 wind power will be supplying 12 % of the global demand for electricity (Martinez et al. 2009).

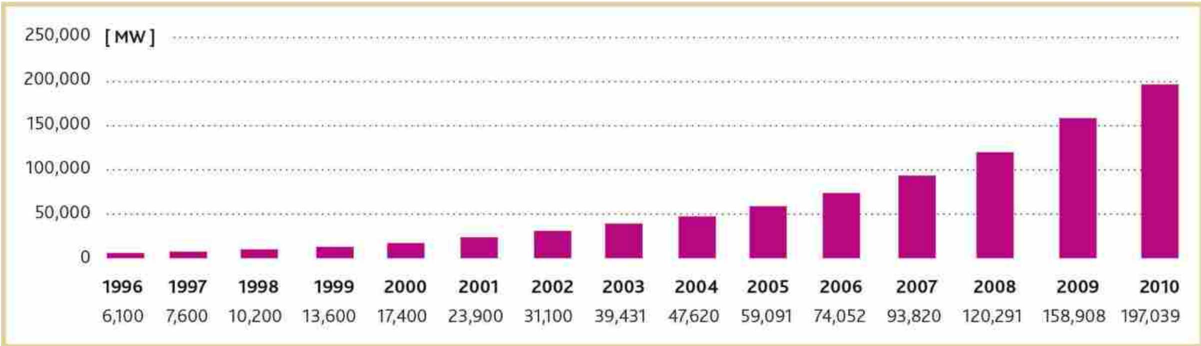


Figure 4.1 Global cumulative installed wind capacity 1996 – 2010

Source: Global Wind Energy Council (GWEC)

One of the advantages of wind technology is its high energy return on the energy invested. As seen in **Figure 4.2**, wind technology both on and offshore has a high energy return on energy invested compared to existing conventional energy sources, such as coal, and other renewable technologies. Due to high energy return from wind energy, the requirement to harness the wind more effectively has helped to drive the evolution of wind technology.

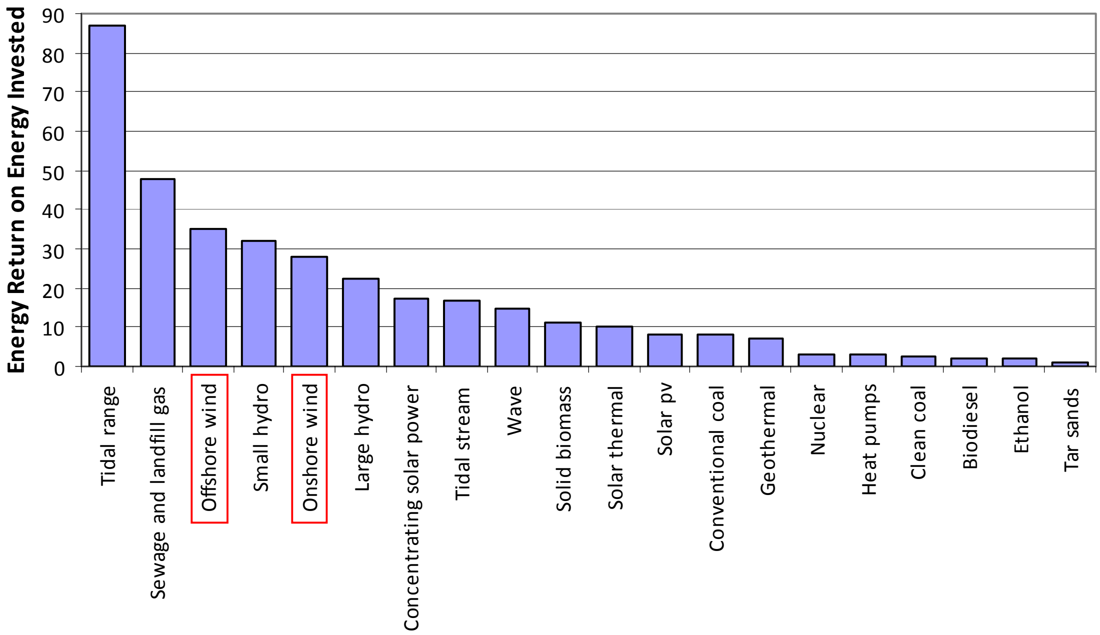


Figure 4.2 Energy return on energy invested – a comparison of power generation technologies

Source: Hughes and Anslow 2007

Wind energy is also well positioned to meet future targets and provide 12 % of the global demand for electricity by 2020, as it possesses one of the lowest production costs, uses no water during electricity production and is a mature technology acceptable to energy utilities in comparison to other renewable energy sources as seen in **Table 4.1**.

Table 4.1 Mainstream renewable energy available in the LRET

Generation Source	Technical Maturity	Water Use (L/MWh)	Cost ($/MWh)
Hydro	Mature	high	27-282
Wind	Mature	nil	75-90
Solid biomass	Research	2000 (wet) / 700 (dry)	47-120
Solar thermal	Emerging	2000 (wet) / 150 (dry)	120-150
Solar PV	Various	nil	400-800
Geothermal	Research	high	large range

Sources; Garnaut 2008; Owen 2009; Epuron 2008

4.5.2 *Community Support*

Renewable Energy Precincts: There are six Renewable Energy Precincts consisting of the New England Tablelands, Upper Hunter, Central Tablelands, NSW / ACT Border Region, South Coast and Cooma-Monaro. The Renewable Energy Precincts are a community partnership initiative, designed to give local communities a stake in renewable energy development. Resources that have been created to assist the Renewable Energy Precincts include:

- Pre-Feasibility Study for a Solar Power Precinct;
- Community Attitudes to Wind Farm in NSW;
- Clean Energy Jobs in Regional NSW;

- The Wind Energy Fact Sheet;
- Estimating Greenhouse Gas Abatement from Wind Farms in NSW;
- NSW Wind Farm Greenhouse Gas Savings Tool; and
- Impact of Wind Farms on Surrounding Land Values in Australia.

Community Attitudes to Wind Farms in NSW: DECCW commissioned AMR Interactive, a specialist research organisation, to undertake telephone interviews to study the attitude of communities to wind farms and renewable energy across the six renewable energy precincts over May and June 2010. A total of 2,022 residences and 300 businesses were interviewed with the following key results:

- Familiarity with wind power found 59 % spontaneously named wind power as a clean energy source, with 81 % of residents regarding wind power as an acceptable source for power generation when asked specifically. 68 % of residents knew about wind farms currently operating in NSW, however only 28 % knew of planned or under construction wind farms;
- Perceptions about wind power and its benefits and impacts found 32 % of residents believed wind farms would contribute to an increase in tourism, 69 % of residents did not perceive any health concerns, and 62 % did not perceive a negative impact on the environment;
- Level of support for wind farms found 85 % of residents supported wind farms being built in NSW with 80 % supporting wind farms in their local region. 79 % supported wind farms being built 10 km from their residence and 60 % at 1 to 2 km. 68 % of the residents which opposed a wind farm at 1 to 2 km saw an overall benefit for wind farms to the local region;
- Key drivers for support of a wind farm at 1 to 2 km included benefit to the local community and noise. Key drivers for opposition of a wind farm at 1 to 2 km included economic and community benefits, perceived visual and noise impacts, concerns about health, safety and heritage values and perceptions of wind power relating to clean energy and its potential in NSW; and
- 61 % of non-farming businesses in the Renewable Energy Precincts believed there would be no impact from a wind farm and 30 % anticipated positive effects on their businesses. Farming businesses were more likely to spontaneously express concern about the location of a wind farm; nevertheless, 57 % would consider a wind farm on their property.

National Telephone Survey: The Australian Wind Energy Association commissioned the Australian Research Group Pty Ltd (ARG) to conduct a telephone survey on renewable energy, in particular wind farms in August 2003. A total of 1,027 participants were surveyed with the following results:

- 94 % thought that a target to increase the contribution of clean energy from renewable resources was a good (32 %) or very good idea (62 %). Less than 3 % considered the current target to be too high or much too high;
- A substantial majority (76 %) said that they were prepared to pay 5 % more on electricity bills for 10 % more clean energy when faced with the option of having cheap electricity at any cost;
- 88 % said they wanted the government to increase support to the renewable energy sector, compared to 26 % wanting an increase in support for the fossil fuel sector;
- For 71 %, reducing greenhouse pollution outweighed protecting industries that rely on reserves of fossil fuel; and

- 95 % supported (27 %) or strongly supported (68 %) building wind farms to meet Australia's rapidly increasing demand for electricity and 91 % agreed it was more important to build wind farms for electricity than avoid building them in rural Australia.

The survey resulted in respondents supporting clean energy from renewable resources, even with a potential increase in price. It also highlighted that it is more important to reduce greenhouse pollution rather than support the fossil fuel sector, and instead place wind farms in rural areas.

NSW Southern Tablelands Survey: Wind farm developer Epuron Pty Ltd commissioned REARK Research to conduct a random phone survey on 300 residents in the Goulburn, Crookwell and Yass region to determine community perception of wind farm developments in the Southern Tablelands, July 2007 (Epuron 2008). The survey concluded that:

- 80 % were concerned right now with the threat of global warming and its impact on the environment, while 16 % were unconcerned;
- 89 % were in favour of wind farm projects being developed in the Southern Tablelands, while 5 % were opposed;
- 71 % favour a wind farm within 1 km of their home and 87 % support a wind farm within 25km; and
- 9 in 10 have seen a wind turbine and more than 8 in 10 have seen the Crookwell Wind Farm.

This survey showed that respondents are concerned about global warming and have seen the alternatives, such as the wind farm at Crookwell. This resulted in the majority of respondents willing to have a wind farm within 1 km of their residence.

CSIRO report 2012: CSIRO Science into Society Group released a report in 2012 detailing research into nine wind projects representing states with the greatest wind resources (including NSW), and wind projects at various stages of development (operational, under construction, proposed and rejected) (Hall et al. 2012). The report found that there is strong community support for wind farms, including from rural residents who do not necessarily publicly express their views. However, against this background, the CSIRO also performed a review of media coverage of wind farms. Their review found more citations rejecting wind farms (32 reasons) than supporting wind farms (19 reasons); a finding that suggests a media bias which does not correlate with the general public's view (Hall et al. 2012). The existing planning process and regulatory approach was found to be an appropriate mechanism for development approval, however, this could be improved by a stronger framework for community engagement.

4.5.3 *"Taralga Wind Farm" Judgement*

The 2007 Land and Environment Court hearing of the Taralga Landscape Guardians Inc. v Minister for Planning and RES Southern Cross Pty Ltd reviewed a number of key issues relating to wind farms in rural NSW. In particular, issues relating to visual impacts on the landscape from surrounding residencies and the village of Taralga were scrutinised.

The judgement stated that wind turbines were acceptable in the landscape at Taralga, and set out steps for determining how many wind turbines would be acceptable. Based on the economic viability, visual impact on the village and the broader public interest, it was decided that the original design of 69 wind turbines of the Taralga Wind Farm was acceptable. As for any residential visual or other associated impacts with the Taralga project, it was decided that any suggested mitigation measures need to be settled by RES Southern Cross Pty Ltd and the potentially affected residence.

By comparison, while there might be glimpses of the Project from Pyramul, views will be predominantly screened by undulating topography and roadside planting, as discussed in **Chapter 8** Landscape and Visual. However there have been concerns raised by individual property holders on potential visual impacts as discussed in **Chapter 6** Stakeholder Consultation and, similar to the Taralga judgement, any mitigation measures will be discussed between the Proponent and any affected landowners.

4.5.4 *Interaction with the Electricity Network*

The National Electricity Market (NEM) manages the supply and demand of the NSW market by ensuring power generation is available at each instant in time to meet the required consumption. The NEM is supported by baseload power stations, generally coal, to provide 100 % capacity at 100 % of the time. However, this is not always possible due to maintenance and failures of coal fired power stations which in NSW result in 28 days of planned maintenance per annum (Power System Planning and Development (PSPD) 2009). This requires the Australian Electricity Market Operator (AEMO) to source power from multiple energy generators to provide a secure baseload.

Despite common misconceptions that wind farms are inefficient and unreliable, they are in fact an efficient and reliable energy supplier in the NEM and can support baseload in the market. This is due to the fact that:

- Both wind farms and modern coal fired power stations are efficient in the order of 35 - 45 %;
- The NEM is strong enough to cope with output fluctuations of a wind farm;
- Wind turbines are reliable, with an availability of above 97 % which means that wind farms are able to operate for the majority of the year;
- Wind farms are in fact similar to hydro power and coal fired generators, which do not operate at 100 % capacity 100 % of the time;
- Wind is a free energy source and therefore mitigates risks to the existing electricity supply infrastructure from acts of terrorism and price risks from fossil fuels which are tied strongly to the international market; and
- Existing wind farms in NSW and Australia are providing evidence that wind energy production is clean, reliable and cost effective in meeting current market energy demands.

It is likely the Project will not result in the direct closure of any baseload or coal fired power stations, instead wind energy will become an increasing and important part of the energy mix as Australia transitions into a carbon constrained economy.

4.5.5 *Finite Resource Market*

As previously mentioned in **Section 4.4**, the dominant fuel consumption in Australia is fossil fuel combustion, through the long term usage of oil, natural gas and coal. Post-2000 prices have reached record highs compared to coal in the 1970s and oil in the 1980s. Therefore, not only are these forms of energy emitting large concentrations of carbon dioxide, they are becoming more expensive. Such costs are expected to rise further with the recent emergence of the carbon price legislation in Australia. New, renewable energy technologies are required to extend the limited amount of oil and natural gas and help minimise the impact on mining in remote and sensitive areas. Wind technology, with significant market growths annually, increasing support from international communities and with decreasing component costs, is one such technology.

4.5.6 *Life Cycle Assessment*

Wind turbines require energy to be spent during the manufacturing stage of its components and therefore a certain amount of carbon dioxide equivalents will be produced. In comparison to other forms of energy, such as coal and nuclear, onshore wind farms have relatively low carbon intensities, as seen in **Figure 4.3**.

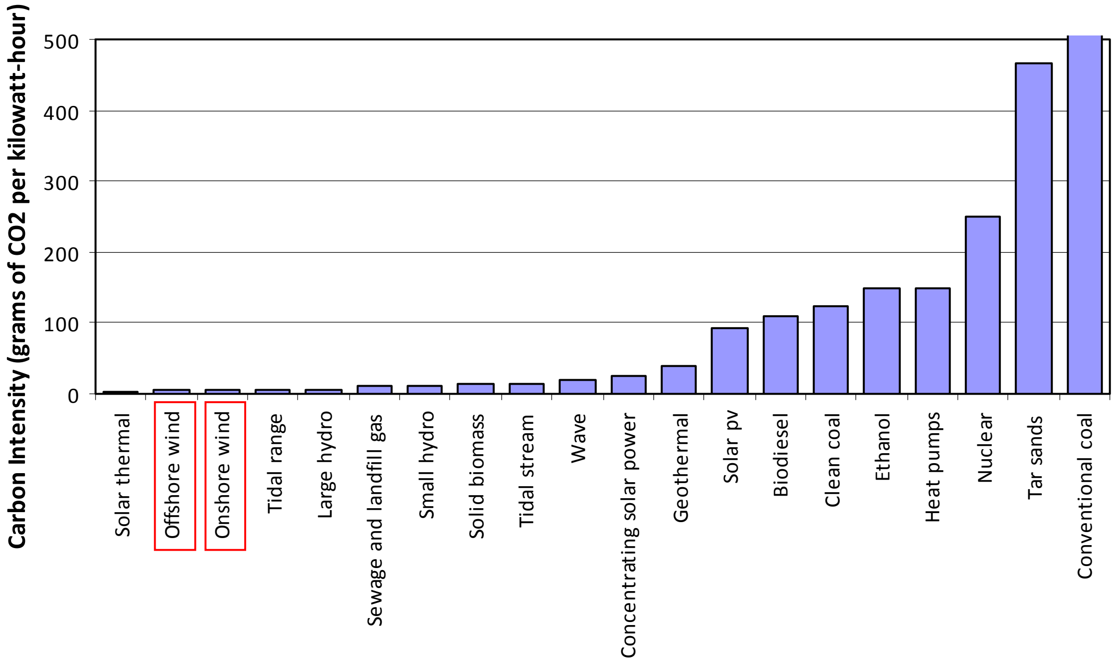
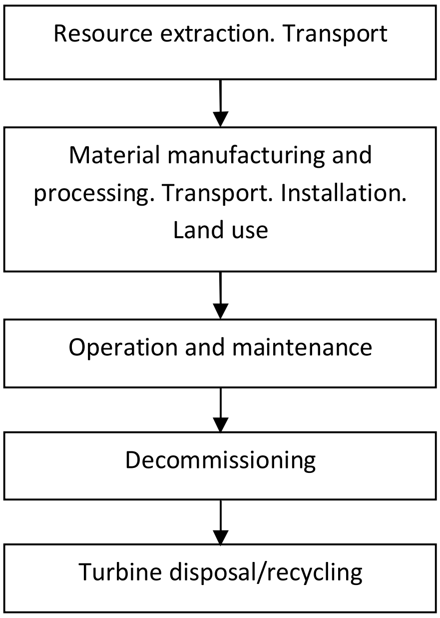


Figure 4.3 Typical industrial carbon footprints

Source: Hughes and Anslow 2007

To further analyse the carbon footprint of a wind turbine a Life Cycle Assessment (LCA) can be undertaken which identifies areas in the manufacturing and construction of the wind turbine where carbon dioxide emissions can be reduced. The main steps of the LCA for a wind turbine are displayed in **Figure 4.4**.



Note: 10 % loss in material when recycling occurs at the turbine disposal stage

Figure 4.4 Life Cycle Assessment model of a wind turbine

Source: Adapted from Martinez et al. 2009

In general, the time for a wind turbine to repay the energy used in construction ranges from five to eight months (Martinez et al. 2009; Tremeac & Meunier 2009; Elsam 2004). The time it would take for a wind turbine to repay the amount of global greenhouse gases emitted is not as widely researched, however initial studies have found it would take approximately six months (Tremeac & Meunier 2009). Of the processes involved, manufacturing has the largest impact. However it is balanced by the decommissioning and turbine disposal stages which consist of mainly recycling with its positive benefits for the environment (Martinez et al. 2009; Tremeac & Meunier 2009).

4.6 Contribution of the Crudine Ridge Wind Farm

4.6.1 *Land Suitability*

The proposed wind farm is consistent with the Rural Lands State Environmental Planning Policy (SEPP) as it is a development which can occur in unison with the continuing use of the land for rural purposes.

Although the proposed development temporarily reduces the available land for agriculture during construction, the long term use of the land for agricultural purposes will not be compromised during operation of the Project. In addition, the potential diversity of income gained by landowners would assist in ensuring traditional rural communities can remain on the land and continue farming during times of drought or other hardship. In response to the *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines, December 2011), NSW Primary Industries provided a submission on the siting of wind farms in regional areas, and the need for consultation with NSW Agriculture. In their submission, the department clarifies that NSW Agriculture recognises that wind farms comfortably co-exist with agriculture; they therefore do not require consultation for this type of development.

The Project is subject to two Local Environmental Plans (LEPs); the Mid-Western Regional LEP (2012) and the Bathurst Regional (Interim) LEP (2005). These LEPs identify minimum lot sizes for subdivisions of 100 ha or 40 ha in the Mid-Western Regional LGA (Clause 2.6[2]) and 100 ha in the Bathurst Regional LGA (Clause 27[1]) respectively. Discussions with Bathurst Regional Council and Mid-Western Regional Council have indicated there are no pending or approved subdivisions in the vicinity of the Project. Further, there are only a small number of lots owned by non-involved Landowners surrounding the Project area that could potentially be subdivided. Most of these occur off the steep Crudine ridge line. Despite this, potential impacts were assessed with respect to these lots, including noise and visual assessment in **Chapter 8** Landscape and Visual and **Chapter 9** Noise.

Visual and noise impacts were also assessed with respect to current and future dwelling entitlements on lots surrounding the proposed development site boundary in **Chapter 8** Landscape and Visual and **Chapter 9** Noise. Mid-Western Regional Council have advised that they do not maintain a register of land that could be approved for a dwelling entitlement (DE), with approval being established through a development application process. Bathurst Regional Council regulates DEs based on minimum lot size (100 ha) or existing holding. As such, the Proponent identified a small number of lots in the vicinity of the Project that have DEs or could potentially have DEs in the future (**see Figure 4.5**). Future impacts to neighbouring lots have therefore been considered with mitigation measures in discussion between the Proponent and any affected landowners, where appropriate. As a result, the Project is considered suitably placed in its current position.

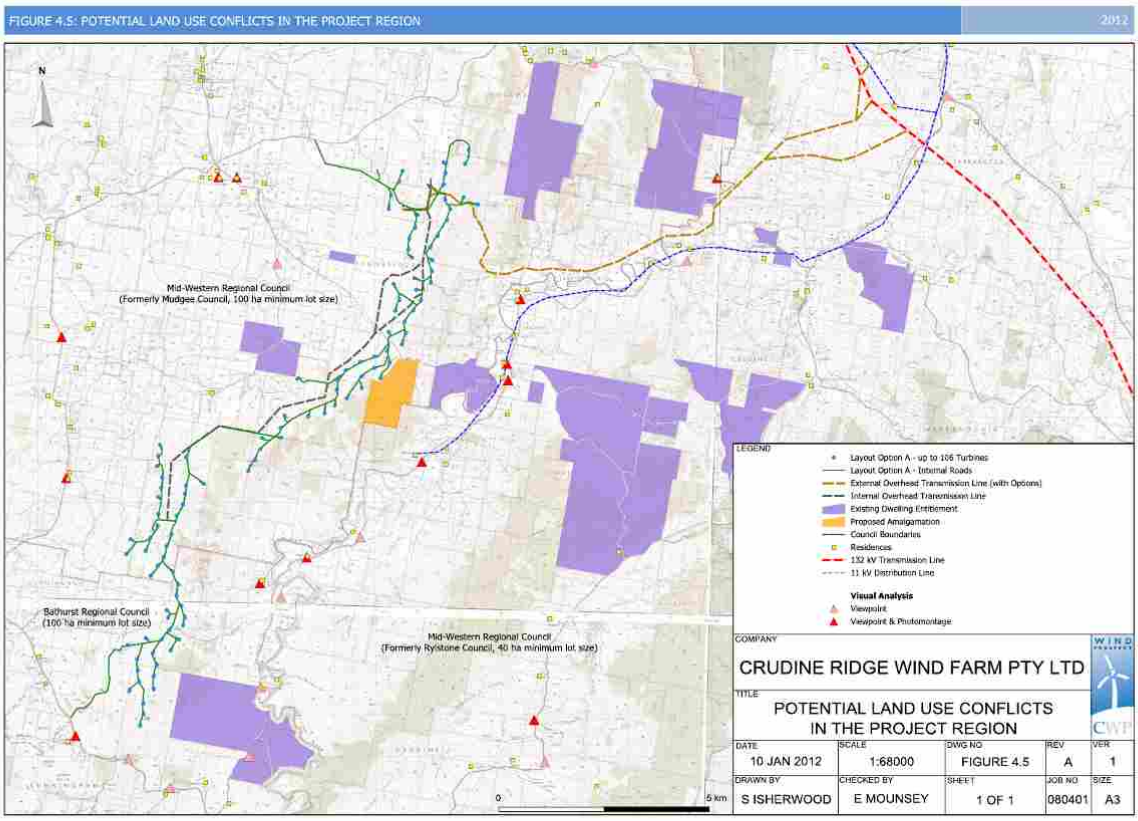


Figure 4.5 Potential Land Use Conflicts in the Project Region
(*An A3 size version of this Figure is displayed in Volume 2*)

There are four State Forests and one Nature Reserve in a 30 km radius of the Project. The State Forests include Clandulla State Forest (10 km east), Kandos State Forest (15 km east), Dungeree State Forest (20 km north east) and Airly State Forest (25 km south east) as shown in **Figure 4.6** below. The Avisford Nature Reserve is also located 25 km to the north of the Project site.

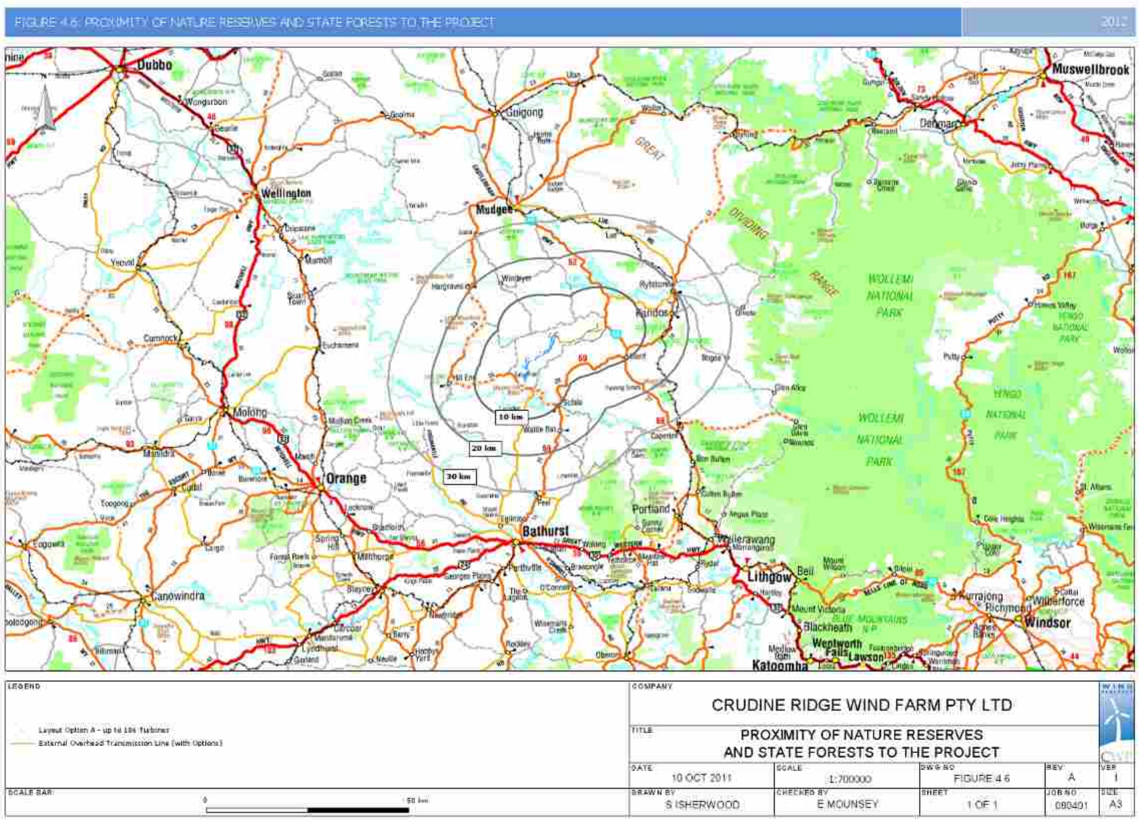


Figure 4.6 Proximity of Nature Reserves and State Forests to the Project
(An A3 size version of this Figure is displayed in Volume 2)

Avisford Nature Reserve, a natural backdrop to Mudgee, has areas of high ridgelines and sloping gullies with open forest and woodlands. While the Reserve is used by bushwalkers, recreational opportunities are limited, primarily because of the limited number of access points. All of the State Forests have limited access, and are managed to control widespread invasive flora and fauna species. Through the influence of distance, vegetation and topography, it is unlikely the Project would be visible from walking tracks or picnic areas within the Reserve or State Forests.

The Project site overlaps with five mineral exploration licences as shown in **Table 4.2** below. It is unlikely that the placement of turbines within or adjacent to mining operations (should they be economical, environmentally acceptable and approved) would result in conflict, based on the type of mining activity being undertaken in the area. Wind farms currently co-exist with mining areas in NSW, including the approved Woodlawn Wind Farm, adjacent to Veolia's Woodlawn Bioreactor near Tarago, NSW (a disused open cut mineral mine). Oroya Mining Limited, the holder of the five ELs, has been contacted about the proposed Project; see **Chapter 19** Socio-Economic Assessment for more detail.

Table 4.2 Exploration and Mining Licences overlapping the Project site

Company	Title(s)	Status
Oroya Mining Limited	6627 6628 6629 7548 7549	Expires 5th Sep 2012 Expires 5th Sep 2012 Expires 5th Sep 2012 Expires 21st May 2012 Expires 21st May 2012

4.6.2 *Layout*

A range of factors are considered during the 'site selection' phase, which affects the suitability of an area for a wind farm, and which can potentially constrain development. These include:

- Suitable wind resource;
- Ease of connecting to and capacity of the local electricity transmission network;
- Site access and general ground conditions, including slope and geology;
- Proximity to residential properties and the nature of surrounding land uses;
- Availability of turbine sites based on a range of constraints;
- Presence (or absence) of nationally and locally significant areas with regard to environment, landscape, nature conservation, archaeology and cultural heritage; and
- Interest within the community.

Wind Resource: Numerous investigations into the wind resource potential at several locations across NSW have revealed some general principles which can be applied to assess the merit of an individual site's wind resource. Wind speeds are likely to be adequate in areas that are:

- Exposed to open water or large areas of open grassland without intervening obstructions. These areas receive a very smooth airflow with a high-energy content; and
- On significantly elevated locations, surrounded by a smooth and gently rounded landscape, thus promoting wind speed-up. The ranges that make up the Project area offer excellent speed-up due to topographical detail.

The Proponent has installed wind monitoring equipment to record onsite wind data which, when modelled with long term BoM data from local area, shows wind speeds that are high and consistent making a wind farm project viable in the selected location.

Land Use: As the Project is located in a predominantly agricultural area, there is a low population density within and around the Project. Wind turbines are placed further from non-associated landowners than associated landowners, in order to minimise impacts; as discussed in **Chapter 6** Stakeholder Consultation, **Chapter 8** Landscape and Visual and **Chapter 9** Noise.

Electricity Transmission Network: Ease of connection to and capacity within the grid can be difficult to assess, given the commercially confidential nature of certain information concerning the electricity distribution and transmission networks, coupled with the complexity and variety of connection options that may be available. However, on a broad scale, areas remote from high voltage overhead transmission lines or from existing population centres are unlikely to offer many feasible opportunities for grid connection. Together with grid connection factors, actual grid capacity and the ability for the electricity grid to absorb wind generated electricity seem to be the principal limiting factors for wind farm development in NSW.

The high voltage transmission network that the Project will connect into is the TransGrid 132 kV single circuit overhead transmission line running north-south approximately 15 km east of the Project. A single or double circuit 132 kV external transmission line will be constructed for energy export to the grid.

Site Access and Condition: There is good road access to the Project site as discussed in **Chapter 12** Traffic and Transport, with the arterial roads intersecting with major State and Federal highways, making it a suitable site for the Project.

Community Interest: Landowners' interests are also important in determining the location of wind turbines, as a wind farm cannot be placed on land where the landowners are resistant to the development. Neighbouring landowners are not always receptive to the placement of wind turbines and appropriate consultation was carried out during the assessment of this Project, as discussed in **Chapter 6** Stakeholder Consultation. Turbines have been moved and / or removed to accommodate the varying opinions of wind turbines, to reduce the visibility and noise impacts from some properties / communities altering the layout of the Project (see **Chapter 6** Stakeholder Consultation).

4.6.3 *Scale*

In NSW, it was common for proposed wind farms to be no greater than 50 MW, consisting of up to 20 to 25 wind turbines. Recently, larger wind farm projects have been proposed, approved and constructed as listed in **Table 4.3**. This upscaling in size is a response to the LRET and the new target emission reductions for NSW, as discussed in **Chapter 5** Planning Context. Therefore the Project, with up to 106 wind turbines, is comparable in scale to more recently proposed wind farms and is of a suitable size to contribute to Australia's target of emissions reductions.

Table 4.3 NSW Wind Farms

Wind Farm	State of Development	Number of WTG
Capital	Constructed	67
Cullerin	Constructed	15
Blayney	Constructed	15
Crookwell	Constructed	8
Boco Rock	Approved	104-122
Conroy's Gap	Approved	15
Black Springs	Approved	9
Silverton	Approved (Proposed)	282 (598)
Gullen Range	Approved	84
Crookwell II	Approved	46
Glen Innes	Approved	27
Woodlawn	Approved	23
White Rock	Approved	119
Kyoto Energy Park	Approved	34
Capital II	Approved	55
Sapphire	Proposed	125-159
Yass	Proposed	152
Flyers Creek	Proposed	44
Crookwell 3	Proposed	30
Paling Yards	Proposed	50-60
Adjungbilly	Proposed	26
Collector	Proposed	60-80
Bodangora	Proposed	25-40
Rugby	Proposed	90
Rye Park	Proposed	80-110
Liverpool Range	Proposed	300-500
Bango	Proposed	100
Golspie	Proposed	100
Uungula	Proposed	250

Source: DoPI, Major Project Register, Accessed 6/2/2012

Generally, having a larger scale wind farm will result in higher energy production, leading to reduced capital costs and therefore lowering the cost per unit of energy generated.

4.6.4 *Size of Proposed Wind Turbines*

Wind turbines come in various sizes depending on use and location. **Figure 4.6** below provides a timeline of the different styles of turbines from the 1970s to the present. It is important to note that new turbine models are constantly being developed and this chart is only representative of the increasing scale of machines over time.

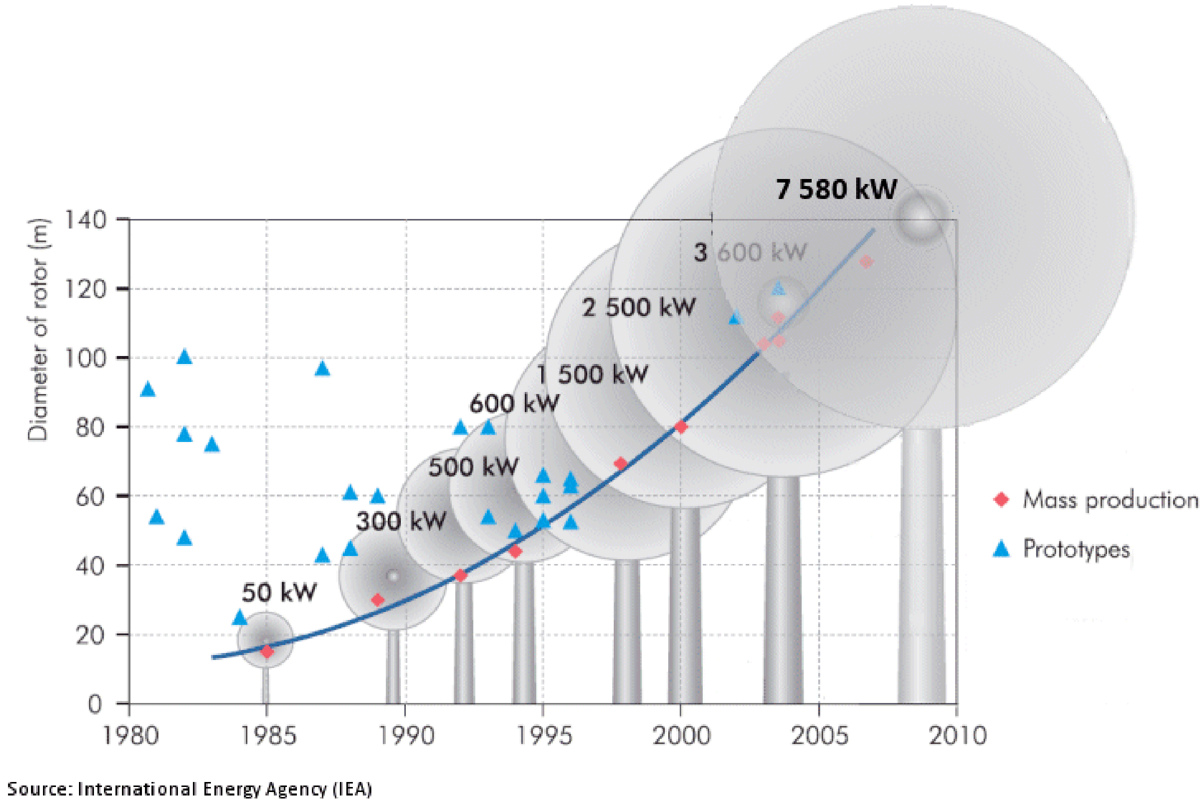


Figure 4.7 Evolution of wind turbine generators.

Source: Center for Climate and Energy Solutions, Accessed 23/10/2012

The Great California Wind Rush in the early eighties saw the introduction of 1,000 x 55 kW wind turbines in Palm Springs, California. In 1995, 39 x 600 kW wind turbines were installed in Denmark at the Rejsby Hede Wind Farm, representing the largest wind farm in Denmark at the time. With increasing generator and turbine size, the demand for wind turbines for larger projects grew, creating momentum towards a mature world market. Offshore wind farms increasingly became of interest to countries with high population densities and restricted onshore sites. Today, with an ever-increasing demand for renewable energy sources, wind turbines continue to increase in generator size and height for both onshore and offshore installations to maximise the capacity of wind farms, and significantly improve the provision of renewable energy on a global scale.

Crudine Ridge Wind Farm is a part of today's increasing trend towards the use of larger wind turbines that have the capacity to capture greater portions of the wind resource in NSW and deliver realistic baseload electricity generation. The Proponent will be reviewing a number of wind turbine models as discussed in **Chapter 3** Project Description, which will ultimately determine the number of turbines installed and the capacity of the Project.

4.6.5 *The NSW Wind Farm Greenhouse Gas Savings Tool*

As part of the Renewable Energy Precincts initiative the NSW Government has developed the NSW Wind Farm Greenhouse Gas Savings Tool, allowing community and industry to easily calculate the projected greenhouse gas savings from new wind farms in different Renewable Precincts across NSW.

The NSW Wind Farm Greenhouse Gas Savings Tool estimates savings by multiplying the output from a wind farm with the emissions intensity of the electricity supplied in the NEM. The emissions intensity of electricity supplied in the NEM varies according to the location and size of a new wind farm, so site specific emissions intensities must be used for different size developments within each Renewable Precinct.

The Project will have an installed capacity of approximately 135 MW, which is dependent on the final turbine model and layout selection, as outlined in **Chapter 3** Project Description. The NSW Wind Farm Greenhouse Gas Savings Tool, therefore, has been used to estimate the greenhouse gas savings at 135 MW using the Central Tablelands Renewable Precinct emission savings (results in **Appendix 4**).

The estimated annual greenhouse gas savings from an installed capacity of 135 MW is 363,500 tonnes of CO_2-e. At this capacity, the Project would generate 420 GWh of electricity annually, enough to power 57,600 homes each year (**Appendix 4**).

4.6.6 *Greenhouse Gas Emission Reductions*

The National Greenhouse Accounts (NGA) factors provide amounts of carbon dioxide equivalents (CO_2–e) for direct and indirect emissions. Indirect emissions are of primary consequence to this Project as they relate to the consumption of purchased electricity from the grid. These emissions are produced by the burning of fossil fuels (coal, natural gas, etc.) at the power station. By calculating the indirect emissions for the Project, it is possible to determine the amount of CO_2–e offset.

The megawatt hours (MWh) per year potentially produced by the Project, **based on both a conservative capacity factor and average installed capacity**, can be calculated by:

Total installed capacity (MW) x capacity factor x 8,760 (h/y)

135 MW installed capacity x 0.35 x 8,760 = 413,910 MWh/y (414 GWh/y)

Using the latest NSW indirect emission factor, Scope 2, from the NGA:

1 MWh produced for burning of fuels at the power station = 0.90 tonnes CO_2-e emitted

Wind energy is dispatched first into the grid, in doing so requiring less generation from fossil fuel power stations. As a result, wind generation can directly result in CO_2–e emissions savings in NSW. For example:

1 MWh produced from wind = 0.90 tonnes CO_2-e saved

Therefore the amount of CO_2-e emissions saved will be:

Predicted wind farm output per year (MWh/y) x Avoided CO_2-e emissions (tonnes/MWh)

Using the most recent figures published in the NGA Factors (DCCEE, 2010), it is estimated that the Project will displace 372,519 tonnes of CO_2-e per annum and 7,450,380 tonnes of CO_2-e over a 20 year operational life of the Project. This means that the Project would result in an annual reduction in CO_2-e emissions equivalent to taking approximately 93,130 cars off the road permanently (based on an average unleaded petrol car that emits approximately 4.0 tonnes of CO_2-e per year (Greenfleet 2010).

Using the calculations above as a guide, the Project, with an installed capacity of 135 MW at a capacity factor of 35 %, would supply energy for 56,700 homes (based on an average Australian household usage at 7.3 MWh/y (OEH, 2011d).

The Project and creation of wind farms are part of an upstream solution. It is part of the solution for not only reducing the generation of carbon dioxide equivalents from coal-fired power stations, but also providing alternate electricity to users in NSW for at least 56,700 homes, reducing the pressure on the finite resources of fossil fuels.

With respect to the above calculations, higher capacity factors and therefore increased renewable generation can be achieved through:

- Increasing the hub height to capture higher wind speed;
- Selecting a wind turbine most suited to producing the greatest yield with respect to the wind resource across the Project site; and
- Allowing flexibility in the size and range of machines which can be installed at each Cluster within Project site.

Optimising the Project site in this manner would displace more of the energy that would otherwise be generated from incumbent coal-fired power stations and thereby reduce carbon dioxide equivalent emissions.

Using the conservative generation figures presented above, the Project would contribute approximately 0.92 % of the 45,000 GWh Renewable Energy Target over a 20 year operational life of the Project. Alternatively, using the NSW Wind Farm Greenhouse Gas Savings Tool, the Project would contribute 0.93 % of the 45,000 GWh Renewable Energy Target by 2020.

4.6.7 *Consequence of not proceeding with the Project*

As can be seen, Australia has made significant progress towards establishing guidelines and targets that will reduce carbon emissions and promote both renewable energy and energy efficiency. With regards to a prominent target, the NSW Government has stated it will seek to attract a large portion of the investment that will result from the Renewable Energy Target (NSW Trade and Investment 2012). Without this Project, other projects will need to be developed to meet the RET, and there is potential for the NSW Government to miss out on the significant investment, estimated at an injection of $151 million into the Australian economy, that the Project is expected to deliver.

Similarly, on an International scale, Australia is currently on track to fulfil its Kyoto Protocol target on emission reductions (DCCEE 2012). As electricity demand increases, it will be vital for an increasing proportion of Australia's energy mix to be renewable energy, to remain on track to meet the target. Large scale wind energy production, and importantly this Project, will contribute to ongoing reductions in carbon emissions. Without this Project, and others like it, brown and black coal will continue to play a dominant role in meeting energy demand, and Australia's carbon emissions will continue to increase, making it harder to meet the Kyoto Protocol, and other such national and international targets.

Finally, coal mining, and coal fired power, is placing increasing pressure on limited natural resources in Australia, including land and water (McAlpine 2012). For example, coal-fired power stations use large volumes of water for cooling purposes during operation. The National Water Commission has identified that power stations often obtain their water at sub-commercial rates, so no economic incentives exist to encourage investment in more efficient technologies (Smart and Aspinall 2009). Equally, coal mining is generally not able to co-exist with farming activities, and often requires substantial areas of, often agricultural, land (McAlpine 2012). Wind farms, by contrast, use very little water during operation, and comfortably coexist with agriculture. Investment in low impact technology such as this Project will alleviate some of the concerning resource impacts that conventional energy sources make. Without such projects, dwindling natural resources will continue to be depleted at an unsustainable rate.

4.7 Summary

Increased greenhouse gases absorbing warmth from the earth are causing deleterious effects on the Earth's climate. Through ongoing research and a better understanding of carbon emissions International, National and State Governments are realising the benefits of clean, renewable energy generation. Policy implementation is now encouraging energy generation from renewable sources in order to both reduce harmful atmospheric emissions and meet future energy demand with diverse and secure supplies.

In 2008, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were is 1990; a watershed decision and an important step in determining Australia's position on climate change in the international arena.

The RET legislation was passed in Federal Parliament in August 2009, and has set a target of 20 % or 41,000 GWh of Australia's electricity to be generated from large scale renewable sources by 2020. Wind energy generation is a low cost, viable renewable energy source and can be readily implemented to meet a substantial percentage of this target.

The Project will play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of Global Warming and Climate Change; contributing up to 0.93 % (dependent on the model applied) additional renewable energy generation to meet the legislated Australian target. Moreover the Project site and size has been carefully selected using a number of factors and will displace carbon dioxide equivalents by an estimated 7,450,380 tonnes over the life of the Project.

CHAPTER 5

Planning Context

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5. PLANNING CONTEXT

This chapter of the Environmental Assessment (EA) addresses any relevant statutory provisions in relation to the Crudine Ridge Wind Farm.

The development of the Project requires:

- Project approval under Part 3A of the New South Wales (NSW) *Environmental Planning and Assessment (EP&A) Act, 1979*; and
- Consideration of the requirements of the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act, 1999.

In addition, relevant Federal, State and Local Government legislation, policy and guidelines are considered and described in the following sections.

5.1 Federal Government Legislation and Policy

5.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act is the central piece of environmental legislation for the Australian government. It provides the legal framework to protect and manage matters of national environmental significance, while also considering cultural values and society's economic and social needs.

Under the Act, the Proponent must conduct a Protected Matters Report to assemble technical information depending on the level of assessment. Eco Logical Australia, on behalf of the Proponent, conducted a Protected Matters Report on the 21st June 2011 using the protected matters search tool addressing the eight matters of National Environmental Significance (NES). The results of the report and the impacts on the Project are discussed in **Chapter 10** Ecology and **Appendix 12**.

The Commonwealth and NSW Government have an accredited assessment process in place for 'Controlled Actions' allowing assessments under the *EP&A Act* (Parts 3A, 4, 5) to be automatically accredited under the *EPBC Act*. A 'Controlled Action' is decided by the Commonwealth and the accredited assessment process reduces the amount of duplication that could occur in an EA for a project.

On 29th February 2012, the Federal Minister for the Environment determined that the Project would constitute a Controlled Action pursuant to Section 75F(3) of the *EP&A Act*. The Controlled Action decision enables the accredited assessment to occur under the *EPBC Act*. An accredited assessment, under the *EPBC Act*, is a written agreement between the Commonwealth and a State or Territory that allows for accreditation of State environmental processes and systems by the Commonwealth. In this context, an accredited process is one that is run by a State for which the Commonwealth agrees beforehand satisfies its own legal and / or policy requirements, thus doing away with the need for a separate process. Accredited assessments still allow the Commonwealth to decide if a proposal should go ahead after the completion of the State assessment process.

Subsequently, the Department of Sustainability, Environment, Water, Pollution and Communities (SEWPaC) provided the Proponent with supplementary Director-General's Requirements (DGRs), via the DoPI, in March 2012, which applies to the accredited assessment process.

The supplementary DGRs state that:

> *"The controlled action is likely to have a direct and indirect impact on matters of national environmental significance, in particular, threatened species and / or threatened ecological communities listed under sections 18 and 18A, and migratory species listed under section 20 and 20A of the EPBC Act."*

Matters relating to threatened species and communities are addressed in **Chapter 10** Ecology of this EA and in **Appendix 12**. The full list of DGRs is included in **Appendix 5** and **Table 5.2** below has been provided to ensure ease of reference and to demonstrate compliance with the supplementary DGRs.

5.1.2 *Civil Aviation Safety Regulations 1998*

To address the issue of wind turbine height, CASA's Manual of Standards Part 139 – Aerodromes states that, in general, an obstacle would require obstacle lighting unless an aeronautical study assesses it as being shielded by another object or that it is of no operational significance. For wind turbines occurring outside an aerodrome CASA released Advisory Circular *AC 139-18(0) Obstacle Marking and Lighting of Wind Farms* in July 2007 to provide advice regarding the requirements for obstacle marking and lighting of wind turbines and wind monitoring masts, under Civil Aviation Safety Regulations (CASR) Part 139 (see **Appendix 15**). In 2008 this advisory was withdrawn, and as such, CASA's statutory power to require obstacle marking and lighting only applies within the vicinity of an aerodrome (30 km). Therefore, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent, in consideration of their duty of care.

In March 2011, CASA indicated that a review would be undertaken by Department of Infrastructure and Transport (DIT) as the subject matter on obstacle marking and lighting outside of an aerodrome was raised in the DIT paper *Safeguards for Airports and the Communities around them*.

The Project will have turbines greater than 110 m in height as discussed in **Chapter 3** Project Description, so CASA and the RAAF have been informed as discussed in **Chapter 6** Stakeholder Consultation. The recommendations from CASA are discussed in **Chapter 13** Aviation.

5.1.3 *Radiocommunications Act 1992*

Part 4.1 'Standards and other technical regulation' of the *Radiocommunications Act 1992* is designed to make the introduction of infrastructure such as wind turbines efficient, flexible and responsive with regard to the interference of radio emissions. The standards also require an adequate level of immunity from electromagnetic disturbances.

As wind turbines and associated ancillary structures produce electromagnetic fields, the Project has the potential to interfere with radiocommunications as discussed in **Chapter 14** Communication Assessment.

5.1.4 *Directory of Important Wetlands in Australia*

The Directory of Important Wetlands is a database of Ramsar defined wetlands in Australia, developed by the Australian government and State and Territory nature conservation agencies.

There are no recorded Ramsar wetlands in the vicinity of the Project, as discussed in **Chapter 17** Water and **Appendix 22**.

5.1.5 *Renewable Energy Target*

The enhanced Renewable Energy Target (eRET), incorporating the large-scale renewable energy target (LRET) and the small-scale renewable energy scheme (SRES), is intended to insure 20 % of Australia's electricity from renewable sources by 2020. The eRET will commence with a target of 45,000 GWh to be generated from renewable sources by 2020. After that, each year the target will remain at 45,000 GWh until 2030 when the scheme will cease operation.

Chapter 4 Project Justification discusses how the Project will help to meet the targets of the eRET by producing renewable energy for Australia's electricity grid.

5.2 State Government Legislation, Policy and Guidelines

5.2.1 *Environmental Planning and Assessment Act 1979*

In NSW, wind farm developments are subject to the *EP&A Act* and relevant instruments that are created under it, including Part 3A Major Infrastructure, Section 75C 'Critical Infrastructure', Section 75I DGRs, Section 75JA Biobanking-Special Provisions and Part 1 Section 5. With regard to the provisions of Part 1 Section 5, the Project takes into consideration the following as listed in **Table 5.1**.

Table 5.1 Part 1, Section 5 and where addressed within the EA

Section 5	Chapter of EA
a) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	**Chapter 3** to **Chapter 19**
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	**Chapter 4**, **Chapter 18** and **Chapter 19**
(iii) the protection, provision and co-ordination of communication and utility services,	**Chapter 3, Chapter 4** and **Chapter 14**
(iv) the provision of land for public purposes,	n/a
(v) the provision and co-ordination of community services and facilities, and	**Chapter 19**

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	**Chapter 10**
(vii) ecologically sustainable development, and	**Chapter 4**, **Chapter 5**, **Chapter 10** and **Chapter 19**
(viii) the provision and maintenance of affordable housing, and	n/a
b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	**Chapter 5** and **Chapter 6**
c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	**Chapter 6**

The NSW Department of Planning and Infrastructure (DoPI) is responsible for ensuring that the requirements of the *EP&A Act* and its regulations are addressed for developments where the Minister for Planning has the Approval Authority.

5.2.2 *State Environmental Planning Policy (Major Projects) 2005*

The Major Project policy allows the NSW Government to focus on projects that are most significant and vital to the future of NSW as a whole. A proposal is classified as a Major Project depending on the location, economic importance, environmental impact or development type. The Project is classified under Schedule 1 as a Major Project, as it is part of the transport, energy and water infrastructure and under Part 24 it has "capital investment value of more than $30 million, or has a capital investment value of $5 million and is located in an environmentally sensitive area of State Significance". Once a proposal has been classified as a Major Project under section 75R of the *EP&A Act,* Parts 4 and 5 are no longer applicable, except under Division 6 and 6A of Part 4 which addresses development contributions.

A Major Project can also be classified as a critical infrastructure project under Section 75C of the *EP&A Act*, if the proposal is considered to be essential for the State for economic, environmental or social reasons.

The Critical Infrastructure provisions:

- Ensure the timely and efficient delivery of essential infrastructure projects;
- Allow the Government and the planning system to rapidly and readily respond to the changing needs of the State;
- Provide certainty in the delivery of these projects; and
- Provide for rigorous scrutiny to ensure environmental outcomes are appropriate focus on delivering outcomes essential to the NSW community.

A project that is declared to be essential to the State is the subject of a full and thorough environmental assessment by the Director-General, with particular emphasis given to ensuring the proposal goes ahead in an environmentally appropriate and sustainable manner. The environmental assessment process for Critical Infrastructure projects is the same as for any other major project.

The Crudine Ridge Wind Farm has been declared to be essential to the State and determined as Critical Infrastructure as it will be greater than 30 MW in capacity.

5.2.3 *Director-General's Requirements*

After the submission of the final Preliminary Environmental Assessment (PEA) on the 7th March, 2011, the Director-General of the DoPI established requirements, the DGRs, on 17th March. These DGRs were subsequently extended on the 18th August to stipulate more detail and transparency in the consultation process. Supplementary DGRs were issued in March 2012 after the Project was declared a Controlled Action under the EPBC Act. The DGRs, as listed in **Appendix 5**, include key issues for the Proponent to address in the EA with a focus on impacts, management and mitigation strategies. **Table 5.2** summarises the requirements, including those supplementary DGRs provided by SEWPaC, and where each issue is addressed within the EA.

Table 5.2 Outline of DGRs as issued by the DoPI and where addressed within the EA

Director-General's Requirements	Chapter of EA
General Requirements	
Executive summary	**Chapter 1**
Detailed description of the Project	**Chapter 3**
Relevant statutory provisions	**Chapter 5**
Assessment of issues (outlined below)	**Chapters 7** to **19**
Statement of Commitments	**Chapter 20**
Conclusion justifying the Project	**Chapter 21**
Certification of the authors of the EA	**Cover and Contents**
Assessment Requirements	
Project Justification	**Chapter 4**
Assessment of key issues	**Chapter 7**
Visual	**Chapter 8**
Noise	**Chapter 9**
Ecology	**Chapter 10**
Cultural heritage	**Chapter 11**
Traffic and transport	**Chapter 12**
Aviation hazard	**Chapter 13**
Communication	**Chapter 14**
Electromagnetic fields	**Chapter 15**
Fire and bushfire hazard	**Chapter 16**
Water	**Chapter 17**
General environmental assessment	**Chapter 18**
Socio-Economic	**Chapter 19**
Consultation Requirements	
Appropriate and justified level of consultation with agencies and community	**Chapter 6**

Director-General's Requirements	Chapter of EA
Director-General's Supplementary Requirements (Consultation) – 16th August 2011	
Comprehensive, detailed and genuine community consultation and engagement must be undertaken. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them, and is given ample opportunity to provide its views on the proposal. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the impacts. There should be a particular focus on those non wind farm associated community members who live in proximity to the site.	**Chapter 6**
The Environmental Assessment must clearly document and provide details and evidence of the consultation process and who was consulted with	**Chapter 6**
All issues raised during the consultation process must be clearly identified and tabulated in the Environmental Assessment.	**Chapter 6**
The Environmental Assessment must state how the identified issues have been addressed, and how they have informed the proposal as presented in the Environmental Assessment. In particular, the Environmental Assessment must state how the community's issues have been responded to.	**Chapter 6**

Director-General's Supplementary Requirements (Matters of National Environmental Significance)	Section of Appendix 12	Chapter of EA
General Information	n/a	**Chapters 1** to **5**
Description of the controlled action	**Chapter 2**	**Chapters 3** and **4**
Description of the relevant impacts of the controlled action	**Chapter 2**	**Chapters 3** and **4**
An assessment of all relevant impacts with reference to the *EPBC Act* Policy Statement 1.1 *Significant Impact Guidelines on Matter of National Environmental Significance* (2009) that the action has, will have or is likely to have on relevant migratory and threatened species and / or ecological communities listed under sections 18, 18A, 20 and 20A of the *EPBC Act*, including but not limited to: a) White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland); b) Regent Honeyeater (*Anthochaera phrygia*); c) Small Purple-pea (*Swainsona recta*); d) Cannon's Stringybark (*Eucalyptus macrorhyncha subsp. Cannonii*); and, e) *Prasophyllum* sp. Wybong.	**Appendix J**	**Chapter 10**

Director-General's Supplementary Requirements (Matters of National Environmental Significance)	Section of Appendix 12	Chapter of EA
Information must include: a) A description of the nature, location and extent of all vegetation types occurring on-site; b) Justification of the likelihood of occurrence within the proposed development envelope for each relevant threatened species and ecological community;	**Section 4.3**	**Chapter 10**
c) A description and analysis of significance of the potential *inter alia*, direct, indirect, cumulative and facilitative impacts, both in the short and long term, of the action to each relevant species and ecological community;	**Appendix J**	
d) Evidence and outcome of consultation with experts in relation to potential impacts to the Regent Honeyeater;	**Section 5.5.2**	
e) Relevant technical data or other information, within the context of the proposed development site or region, for example; and,	**Section 4.3, Appendix A & J**	
f) A statement as to whether any relevant impacts are likely to be unknown, unpredictable or irreversible.	**Appendix J**	
These impacts should be described for the construction and operation phases of the controlled action.	**Section 5.5 - 5.9**	
Where there is a potential habitat for EPBC Act listed species, surveys should be undertaken, or justification for why surveys are not necessary. Any surveys must be timed appropriately and undertaken for a suitable period of time by a qualified person.	**Section 4.2**	**Chapter 10**
Proposed safeguards and mitigation measures.		**Chapters 10** and **20**
A description of feasible mitigation measures, changes to the controlled action or procedures, which have been proposed by the Proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts.	**Section 5.2 & 5.3**	**Chapters 5, 10** and **20**
Offsets		**Chapter 10**
Should any residual impact exist that cannot be mitigated it may be necessary for offset measures to be considered in order to ensure the protection of matters of national environmental significance in perpetuity.	**Chapter 6**	**Chapter 10**
Other approvals and conditions	n/a	**Chapter 5**
Economic and social matters	n/a	**Chapter 19**
Environmental record of the person proposing to take the action	n/a	**Chapter 2**

Director-General's Supplementary Requirements (Matters of National Environmental Significance)	Section of Appendix 12	Chapter of EA
Information sources	n/a	**Chapter 23**
Consultation	n/a	**Chapter 6**

Resources considered in this EA
Wind Energy Facilities draft Environmental Impact Assessment Guidelines (Planning NSW, June 2002)
Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (Auswind, 2006)
Wind Farms and Landscape Values: National Assessment Framework (Australian Wind Energy Association and Australian Council of National Trust, June 2007)
Cumulative Risk for Threatened and Migratory Species (Commonwealth Department of Environment and Heritage, March 2006)
Wind Farms and Birds: Interim Standards for Risk Assessment (Auswind, July 2005)
Assessing the Impacts on Birds - protocols and Data Set Standards (Australian Wind Energy Association)
Threatened Biodiversity Survey and Assessment - Guidelines for Developments and Activities (Working Document) (DEC, 2004a)
Advisory Circular 139-18(0) Obstacle Marking and Lighting of Wind Farms (Civil Aviation Safety Authority, July, 2007). Note: this advisory is currently withdrawn; however a replacement has not been issued to date.
The NSW State Groundwater Quality Protection Policy (DLWC, 1998)
The NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002)
Department of Water and Energy's Guidelines for Controlled Activities (February 2008)
Draft Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation (DEC, 2005)
Draft Guidelines for Threatened Species Assessment (DEC, 2005)
Wind Farms - Environmental Noise Guidelines (South Australian Environment Protection Authority, 2003)
NSW Industrial Noise Policy (EPA, 2000)
Environmental Criteria for Road Traffic Noise (NSW EPA, 1999)
Environmental Noise Control Manual (EPA, 2004)
Assessing Vibration: A Technical Guideline (DECC, 2006)
Wind Farm Greenhouse Gas Savings Tool (DECCW)

5.2.4 *State Environmental Planning Policy (Infrastructure) 2007*

The *State Environmental Planning Policy (SEPP) (Infrastructure) 2007* was developed to improve the efficiency of the existing planning system in delivering essential public infrastructure and services, by repealing 20 existing environmental planning instruments. The *SEPP Infrastructure* also overrides most other environmental planning instruments in the event of inconsistencies, excluding *SEPP (Major Projects) 2005, SEPP 14* and *SEPP 26*.

The *SEPP Infrastructure* outlines the planning processes for infrastructure projects under Part 3A, Part 4, Part 5 and exempt development. It also outlines the circumstances for the exempt development of wind monitoring masts in Clause 39(2) (a). Up to six permanent wind monitoring masts will be required for the duration of the wind farms operation, which is discussed in **Chapter 3** Project Description.

5.2.5 *State Environmental Planning Policy (Rural Lands) 2008*

The *State Environmental Planning Policy (SEPP) (Rural Lands) 2008* primary aims are to:

- Facilitate the orderly and economic use and development of rural lands for rural and related purposes;
- Identify the Rural Planning Principles and the Rural Subdivision Principles so as to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State;
- Implement measures designed to reduce land use conflicts;
- Identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations; and
- Amend provisions of other environmental planning instruments relating to concessional lots in rural subdivisions.

The *Rural Lands SEPP* does not directly impact the land use suitability of the proposed development, rather the aims of the *Rural Lands SEPP* are to ensure agricultural lands are not compromised by the pressure for other land uses, especially more intensive uses. The proposed wind farm is consistent with the *Rural Lands SEPP* as it is a development which can occur in unison with the continuing use of the land for rural purposes.

A further consideration in relation to the *Rural Lands SEPP* is that it has been used as a vehicle to restrict subdivision of rural lands where conflicts occur. The *Rural Lands SEPP* does not require councils to review their minimum lot size(s) or change those lot sizes in an existing Local Environment Plan (LEP). Councils have the option to transfer the existing minimum lot size(s) currently applying in its Local Government Area (LGA) into a new LEP. The *Rural Land SEPP* does not enforce change in the local controls, with the exception of concessional lot provisions.

5.2.6 *State Environmental Planning Policy 44 (Koala Habitat)*

State Environmental Planning Policy (SEPP) 44 (Koala Habitat) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

Section 75R of the *EP&A Act* excludes, with respect to critical infrastructure projects, all environmental planning instruments (other than SEPPs that specifically relate to the project) and council orders under Division 2A of Part 6. An assessment under SEPP 44 is, therefore, not required. However, as a threatened species, Koala habitat has been assessed as part of the proposed development impacts in **Chapter 10** Ecology and **Appendix 12**.

5.2.7 *National Parks and Wildlife Act 1974*

The *National Parks and Wildlife (NPW) Act 1974* outlines matters relating to flora and fauna and Aboriginal heritage. To ensure accordance with the relevant parts of the *NPW Act*, Eco Logical Australia has conducted an assessment on flora and fauna in **Appendix 12** with an overview provided in **Chapter 10** Ecology.

As the Project is classified under Part 3A of the *EP&A Act*, Part 6 approvals of the *NPW Act* are not required, unless approval for an activity which will impact on any Aboriginal objects or declared Aboriginal Places is required. As the Project has the potential to impact on Aboriginal objects or declared Aboriginal Places, the *Interim Guidelines for Aboriginal Community Consultation – Requirements for Applicants* (IGACC) has been implemented with this Project to engage interested parties for Aboriginal Assessment and Advisory Services along with NSW Archaeological Pty Ltd. The completed assessment on Aboriginal heritage is attached in **Appendix 13**, with an overview provided in **Chapter 11** Cultural Heritage.

5.2.8 *Protection of the Environment Operations Act 1997*

The *Protection of the Environment Operations (POEO) Act 1997* is administered by the Office of Environment and Heritage (OEH), Environmental Protection Authority (EPA), local councils and other public authorities. The EPA issues licences to control the air, noise, water and waste impacts of a scheduled activity. Schedule 1 of the *POEO Act* lists the activities which require a licence.

As the source of energy generation is wind power, the *POEO Act* does not require a licence for the operation of the Project. However, during the construction phase a licence is expected to be necessary for:

- Mobile concrete batch plants if the total exceeds 30,000 tonnes per year of pre-mixed concrete or concrete products; and
- Crushing, grinding or separating if the activity has the capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year.

5.2.9 *Threatened Species Conservation Act 1995*

The purpose of the *Threatened Species Conservation Act 1995* is to prevent impacts, conserve and protect biological diversity and ensure ecologically sustainable development. The *Threatened Species Amendment Act 2004* further enhanced the purpose of the original Act by integrating conservation with main-stream decision making, under the *EP&A Act* on land usage and structure of the economy.

Eco Logical Australia Pty Ltd has undertaken a flora and fauna assessment to determine the significance for threatened species, presented in **Appendix 12** and summarised in **Chapter 10** Ecology.

5.2.10 *Threatened Species Conservation (Biodiversity Banking) Regulation 2008*

Biodiversity Banking (BioBanking) provides the means to address the loss of biodiversity in NSW. Landowners have the ability to establish biobank sites, which can be 'bought' by developers to secure the conservation of biodiversity in perpetuity.

BioBanking provides the means to address the loss of biodiversity from particular developments which impact upon the environment in NSW. It is a market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme, as well as an opportunity for rural landowners to generate income by managing land for conservation.

The Proponent undertook a Biobank assessment across the Project site to ensure the principles in the DGR's are maintained and suitable sites are located for offsetting threatened areas as discussed in **Chapter 10** Ecology and **Appendix 12**.

5.2.11 *NSW Catchment Management Authority Act 2003*

The *NSW Catchment Management Authority (CMA) Act 2003* aims to establish authorities for decision-making and provide natural resource planning at a catchment level. This is done through applying scientific and local community knowledge to achieve a fully functioning and productive landscape. Under the *CMA Act*, Catchment Management Authorities are required to prepare a Catchment Action Plan (CAP).

Chapter 17 Water and **Appendix 22** discuss how the Central West Catchment Management Authority CAP is applicable to the Project.

5.2.12 *Native Vegetation Act 2003*

The main objectives of the *Native Vegetation Act 2003* are to promote ecologically sustainable development, prevent broad scale clearing and protect and improve native vegetation.

Eco Logical Australia conducted vegetation surveys to identify species potentially affected and the total area of disturbance. The results are in **Appendix 12** and findings are summarised in **Chapter 10** Ecology.

5.2.13 *Noxious Weeds Act 1993*

The *Noxious Weeds Act 1993* defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The Act sets up categorisation and control actions for the various noxious weeds according to their potential to cause harm to the local environment.

Any weeds found on-site, as discussed in **Chapter 10** Ecology, will be managed in accordance with assigned Control Categories determined by the Act.

5.2.14 *Contaminated Land Management Amendment Act 2008*

The *Contaminated Land Management Amendment Act 2008* stipulates the management of contaminated land, where contamination is significant enough to warrant regulation. The amendment to this Act allows contaminated sites to be cleaned more efficiently.

As discussed in **Chapter 17** General Environmental Assessment, if any contaminated sites are found during construction, the appropriate authorities will be notified and actions taken in accordance with the Act.

5.2.15 *NSW Rural Fire Act 1997*

The *NSW Rural Fire Act 1997* imposes obligations on the land managers to take all reasonable measures to prevent the occurrence and spread of wildfire to adjoining lands from lands under care and management. Fire management is implemented under an EMP sub-plan (**Appendix 20**).

Chapter 16 Fire and Bushfire discusses further impacts and possible mitigation methods.

5.2.16 *Roads Act 1993*

The *Roads Act 1993* addresses authorities, functions and regulation of activities relating to the use and type of roads.

Consultation with the Roads and Traffic Authority, Mid-Western Regional Council and Bathurst Regional Council, as outlined in **Chapter 6** Stakeholder Consultation, is required to determine access and necessary upgrading of access points, which could require permits under the Act. Further detail is provided in **Appendix 14**, with a summary in **Chapter 12** Traffic and Transport.

5.2.17 *Surveying Act 2002 No. 83*

Clause 24 (1) of the *Surveying Act 2002 No. 83* states that "A person must not remove, damage, destroy, displace, obliterate or deface any survey mark unless authorised to do so by the Surveyor-General". The Department of Lands has been consulted, as discussed in **Chapter 6** Stakeholder Consultation, in regards to the close proximity of turbines to any Trigonometrical Stations (TS). While the Project does not directly impact on any TS, full results are discussed in **Chapter 17** General Environmental Assessment.

5.2.18 *Water Policies and Plans*

The Project, under the DGRs, must consider the following policies and plans with regard to water usage and quality during construction / dust suppression and concrete batching plant(s) facilities:

- Water Management Act 2000;
- Water Act 1912;
- NSW Wetlands Policy;
- NSW Weir Policy;
- NSW Groundwater Quality Protection Policy;
- NSW State Groundwater Dependant Ecosystem Policy;
- Central West Catchment Action Plan (CAP);
- Macquarie and Cudgegong Regulated Rivers Water Source Water Sharing Plan
- Draft NSW Murray Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan;
- Draft Macquarie Unregulated and Alluvium Water Sources Water Sharing Plan
- NSW Water Quality and River Flow Objectives for the Macquarie-Bogan River Catchment; and
- NOW Guidelines for Controlled Activities.

This EA addresses how the Project will consider each of these policies and plans in **Chapter 17** Water and **Appendix 22**.

5.2.19 *Noise Regulation and Guidelines*

The SA Environment Protection Authority's *Noise Guidelines for Wind Farms 2003* provides guidelines for the predicted equivalent noise levels from wind turbines. Recorded noise levels at relevant receivers should not exceed 35 dBA or 5 dBA above background noise levels, whichever is the greater. These guidelines are formally applied in NSW and as advised in the DGRs have been used in the assessment of the Project as discussed in **Chapter 9** Noise and **Appendix 10**.

During construction the Project will be regulated by the *NSW Industrial Noise Policy 2000* and chapter 171 of the *Environmental Noise Control Manual 2004*.

5.2.20 *NSW State Plan*

The NSW State Plan aims to support jobs and boost investment and growth. To meet these aims, the Plan has a number of priorities including a *reliable electricity supply with increased use of renewable energy* and *cleaner air and progress on greenhouse gas reductions*.

The Project aligns with these priorities by supplying NSW with new renewable energy generation and by displacing the output of greenhouse gas emissions from alternate power generation sources as discussed in **Chapter 4** Project Justification.

5.2.21 *NSW Renewable Energy Action Plan*

The NSW Government is preparing a Renewable Energy Action Plan to support the achievement of the national target of 20 % renewable energy by 2020. This target is the primary driver of wind farm development proposals across NSW.

5.2.22 *Guidelines for Wind Energy and Related Facilities*

Draft NSW Wind Energy EIA Guidelines 2002: This draft was designed to ensure early identification of issues in relation to ESD. The guidelines provide the basic requirements for a wind farm development in NSW, addressing necessary policies and regulations within the *EP&A Act*, general key issues, consultation processes and an additional guideline for an Environmental Management Plan (EMP).

Auswind's Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia 2006: These guidelines were developed by a broad range of both industry and regulatory organisations and provide an outline of best practice processes for all stages of wind farm site selection, development, construction and operation. These processes ensure that Australia's wind industry provides safe, reliable, economically and environmentally sustainable energy to Australia (AusWind 2006).

Draft NSW Planning Guidelines: Wind Farms 2011 (Draft Guidelines)**:** The Draft Guidelines are under development by the NSW Government following their release on the 23rd December 2011 and exhibition through to the 14th March 2012. The purpose of the Draft Guidelines is to:

- Provide clear and consistent regulatory framework for the assessment and determination of wind farm proposals across the state;
- Outline clear processes for community consultation for wind farm developments; and,
- Provide guidance on how to measure and assess potential environmental noise impacts from wind farms.

The Draft Guidelines place a strong emphasis on upfront consultation with the local community where wind farm developments are proposed (refer to **Chapter 6**) and outline key assessment requirements that must be met for all projects to which the Draft Guidelines will apply.

Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent has given regard to their future incorporation within this EA. In particular, those aspects summarised in **Table 5.3** have been explicitly considered in this chapter and subsequent chapters of this EA.

Table 5.3 Aspects of the Draft Guidelines considered within the EA

Aspect of the Draft Guidelines	Chapter of EA
Local council planning controls • Consistency with Development Control Plans, where relevant.	**Chapter 5** (this chapter)
Proximity of turbines to existing residential dwellings (2 km Gateway)	**Chapter 6**, **8** and **9**
Consultation • A documented consultation process; • Tabulated issues raised during consultation, and how they have been addressed; and • Consultation with neighbours within 2 km, identify issues and mitigation measures proposed.	**Chapter 6**
Landscape and visual amenity • Photomontages from all non-host dwellings within 2 km of a proposed wind turbine; and • Zone of visual influence of the wind farm (no less than 10 km) and likely impacts on community and stakeholder values.	**Chapter 8**
Noise • Assessment based on separate daytime (7 am to 10 pm) and night time periods (10 pm to 7 am); • Predicted noise levels at dwellings within 2 km of a proposed turbine; and • Consideration of special audible characteristics, including tonality, amplitude modulation, and low frequency noise.	**Chapter 9**
Health	**Chapter 19**
Ecology	**Chapter 10**
Aviation safety	**Chapter 13**
Bushfire hazard	**Chapter 16**
Blade throw	**Chapter 18**
Economic issues	**Chapter 6** and **19**
Decommissioning	**Chapter 18**
Monitoring and Compliance	**Chapter 20**

5.3 Regional and Local Government Legislation / Policy

5.3.1 *Regional Policies*

The Project lies in the Central West CMA, within the Macquarie-Bogan Catchment. Under the DGRs, the Project must consider the Central West Catchment Management Authority CAP to conform to the principles of an ecologically sustainable landscape. Further information is provided in **Chapter 17** Water and **Chapter 10** Ecology.

5.3.2 *Local Environmental Plans*

The proposed site for the Project occurs within the Mid-Western Regional Council and Bathurst Regional Council, and as such is subject to two Local Environmental Plans (LEPs); the Mid-Western Regional LEP (2012) and the Bathurst Regional (Interim) LEP (2005). The LEPs are an established framework for development within local government areas. For the Project to be classified as a Part 3A of the *EP&A Act*, the proposed activity is required to be permissible under the relevant LEP. The Project occurs on land zoned RU1 Primary Production and 1 (a) Rural Zone respectively, which do not prohibit the erection of wind turbines on farms, as land can still be predominantly used for pastoral purposes. Turbines also provide additional income, allowing maintenance of rural properties without having to use alternative methods such as subdivision. The requirements for each LEP and how the proposal is addressing them are listed below in **Table 5.4**.

The DGRs also require the EA to address the suitability of the Project with respect to potential land use conflicts and future surrounding land use taking into account local and strategic land use objectives. Further detail is provided in **Chapter 4** Project Justification about mitigation methods for future potential land use conflicts.

Table 5.4 Local Environmental Plan requirements

Mid-Western Regional LEP 2012	Bathurst Interim LEP 2005	Relevance to Proposed Development
Planning		
To minimise conflict between land uses within Zone RU1 Primary Production and land uses within adjoining zones.	To provide interim or transitional planning controls for the local government area of Bathurst Region.	Addressed under the *EP&A Act,* Part 3A as Critical Infrastructure (s.75C) which excludes all environmental planning instruments (s.75R) except for SEPPs that specifically relate to the proposed development and council orders under Division 2A of Part 6 (related to enforcement).
	To allow detailed provisions to be made to control development by means of development control plans.	In preparing the environmental assessment requirements, the Director-General is to consult relevant public authorities and have regard to the need for the requirements to assess any key issues raised by those public authorities (s.75F(4)). Mid-Western and Bathurst Regional Councils have been consulted and provided input into the DGRs (s.75F(4)).
Agriculture		
To provide a secure future for agriculture through protection of agricultural land capability and by maximising opportunities for sustainable rural and primary production pursuits; and to minimise the fragmentation and alienation of resource lands.	To facilitate the orderly and economic development of land.	The proposed development temporarily reduces the available land for grazing (during construction). However in the long term agricultural use would not be significantly impacted due to the limited amount of land-take required for the Project. The proposed development would provide off-farm income to land owners assisting agricultural enterprises during times of drought or other hardship (discussed in **Chapter 19** Socio-Economic).
		The proposed wind farm is consistent with the *Rural Lands SEPP* as it is a development which can occur in unison with the continuing use of the land for rural purposes.
Environmental Protection		
To protect, enhance and conserve soil, water, minerals and other natural resources, and, native plants and animals.	To enhance the environmental qualities of the area.	This environmental assessment addresses the DGRs with regard to minimising environmental impacts and risks (see **Chapter 20** Statement of Commitments). Results demonstrate the Project will develop in a manner which minimises risks to the natural and physical environment.

Mid-Western Regional LEP 2012	Bathurst Interim LEP 2005	Relevance to Proposed Development
Cultural Values		
To protect, enhance and conserve places and buildings of heritage significance; and to foster a sustainable and vibrant economy that supports and celebrates Mid-Western Regional's heritage attributes.	To facilitate the orderly and economic development of land.	Aboriginal Cultural Heritage surveys and Non-Indigenous surveys have been conducted in accordance with the DGRs (full detail **Chapter 11** Cultural Heritage). This will protect and conserve the cultural heritage in the area. The community was contacted via a number of means as discussed in **Chapter 6** Stakeholder Consultation, including an open day, public opinion surveys, website, media releases, door to door and newsletters, to ensure that the opinions of the rural community were heard.
Residential		
To match residential development opportunities with the availability of, and equity of access to, urban and community services and infrastructure; and to promote growth and provide for a range of living opportunities throughout Mid-Western Regional.	To promote and strengthen the role of Bathurst as a regional centre.	The proposed development is located 45 km south of Mudgee and 45 km north of Bathurst. There is limited rural residential development in the vicinity of the proposed development (full detail **Chapter 4** Project Justification and **Chapter 18** General Environmental Assessment).
Financial		
To foster a sustainable and vibrant economy that supports and celebrates the area's rural, natural and heritage attributes.	To facilitate the orderly and economic development of land; and to facilitate the orderly and economic development of land.	The community will be provided with a Community Fund for the life of the Project, and there will be added benefits to the community with increased jobs and economic activity as discussed in **Chapter 19** Socio-Economic. Ratepayers will not incur any financial burdens as the Proponent will be responsible for any road upgrades and building of infrastructure required for the Project.

Mid-Western Regional LEP 2012	Bathurst Interim LEP 2005	Relevance to Proposed Development
Industry		
To encourage sustainable primary industry production by maintaining and enhancing the natural resource base; and to encourage diversity in primary industry enterprises and systems appropriate for the area.	To facilitate the orderly and economic development of land.	Increased road traffic may be generated by the development on local roads to view the Project. A viewing platform or parking bay could be constructed to account for a possible increase in tourism if Council requires it (discussed **Chapter 19** Socio-Economic). The proposal promotes an industry that would benefit the local community and wider population into the future. Due to the careful planning and proposed management of the Project there would be minimal nuisance caused by the proposed development (discussed **Chapter 4** Project Justification).

5.3.3 *Development Control Plans*

The Project is subject to the Bathurst Regional (Interim) DCP 2011; however, the document contains no objectives or regulations specific to wind farm developments. Similarly, while Mid-Western Regional Council has numerous DCPs, it has no standard DCP, and no regulations or objectives specific to wind farm developments.

5.3.4 *Cudgegong Draft Bushfire Risk Management Plan*

The Project will be subject to the Cudgegong Draft Bushfire Risk Management Plan and will comply with provisions contained in the bushfire plan, and it is suggested that issues associated with the Project are incorporated into the EMP sub-plan at its next review to ensure any concerns arising are addressed.

CHAPTER 6

Stakeholder Consultation

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6. STAKEHOLDER CONSULTATION

6.1 Preliminary Consultation

The Proponent submitted a draft Preliminary Environmental Assessment (PEA) for the proposed Crudine Ridge Wind Farm to the New South Wales (NSW) Department of Planning and Infrastructure (DoPI) on the 2nd September 2008. The draft PEA allowed the DoPI to identify key government and agency stakeholders who would provide input into the Director-General's Requirements (DGRs), and requested that they attend a Planning Focus Meeting (PFM) to discuss the Project.

A subsequent change to the Project required the submission of a revised turbine layout to the DoPI March 2011. A second PFM was considered unnecessary because of the minor modifications to the Project; however, the relevant government and agency stakeholders were re-consulted to ensure no additional issues had arisen as a result of the change. Once it was determined that there were no further issues, a final PEA was submitted to the DoPI on the 7th March 2011. DGRs were subsequently issued on the 17th March 2011 and supplemented in August 2011. Together these form the basis of this Environmental Assessment (EA).

Consideration has been given to the requirements of the Draft NSW Planning Guidelines: Wind Farms (Draft Guidelines). Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent has given regard to their future incorporation within this EA. In particular, liaison with landowners with a residence within 2 km of the Project and commencing steps to establish a Community Consultation Committee.

6.1.1 *Planning Focus Meeting*

A PFM for the Project was held on the 29th September 2008 at Pyramul Hall, Pyramul. Staff from Wind Prospect CWP were on-hand to introduce the Project, provide input to the meeting and answer any questions raised. Agency participants included:

- Dinuka McKenzie and Marek Cholinski (NSW DoPI);
- Andrew Helms (Office of Environment and Heritage);
- Nathan Burr (Mid-Western Regional Council);
- John Nelson (Mid-Western Regional Council);
- Brent Milton (Mid-Western Regional Council);
- Richard Denyer (Bathurst Regional Council);
- Jayne Leary (NSW Rural Fire Service); and
- Stephen Clipperton (NSW Department of Primary Industries).

Agencies invited but which were unable to attend the PFM included:

- NSW Office of Water (formerly Department of Water and Energy (DWE));
- Central West Catchment Authority;
- Civil Aviation Safety Authority (CASA);
- Airservices Australia (AsA); and
- Commonwealth Department of Defence (DoD).

Participants met in Pyramul for the PFM and then travelled to the site of the installed wind monitoring mast located within the Pyramul Cluster. From this location the participants were able to view the majority of the Project site.

6.1.2 *Director-General's Requirements*

Following the submission of the final PEA, on the 17th March 2011 the DoPI provided DGRs based on advice and input received from the government and agency stakeholders listed above. These DGRs were subsequently extended on the 16th August to stipulate more detail and transparency in the consultation process. The DGRs are summarised in **Table 5.2** in **Chapter 5** Planning Context indicating where each item is addressed in the EA.

In addition to the prescribed DGRs, the DoPI identified a range of other parties with whom consultation would be required. These are outlined in **Section 6.3** below, together with a much broader range of individual and group stakeholders identified by the Proponent in the course of preparing this EA.

6.1.3 *Commonwealth Supplement to the Director-General's Requirements*

The Project was declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the 29th February 2012. The Commonwealth issued a series of supplementary requirements for the assessment of the Project in order to satisfy the Controlled Action designation. These supplementary DGR conditions are listed in **Appendix 5** and are considered as part of the EA process.

6.2 Approach to Consultation

Public consultation for the Project commenced in March 2011 during the commencement of Project planning. Consultations at this time aimed to inform the general public, neighbouring residents, statutory regulators and other stakeholders of the Project in order to identify issues that may require addressing during Project planning and design. Extensive public consultation has taken place since the early stages of the Project and has targeted all interested and potentially affected parties. Consultation took the form of:

- Letters of notification to various stakeholders, including local, state and national groups and agencies;
- Face-to-face notification (or letter drop where necessary) of neighbouring residents within a 5 km radius of the Project;
- Newsletter (x2), Public Opinion Survey (x2), Project website, media releases and radio interviews;
- Two Public Open Days held in Pyramul Hall, Pyramul; and
- Ongoing consultation meetings with various stakeholders throughout the Project planning and design stages.

The Proponent has maintained the Project website (www.crudineridgewindfarm.com.au) since the Project's inception and has continued to maintain an 'open door' policy for consultation. The provision of the Project Manager's contact details on the website ensures that stakeholders can find out information about the Project at any stage of the development.

6.3 Stakeholder Identification and Consultation

The stakeholders listed below in **Tables 6.1**, **6.2** and **6.3** were provided with information regarding the proposed development. They were invited to provide any comment, information or guidance in the course of the Project's development and in the preparation of this EA. Copies of the responses (where given in writing) are included in **Appendix 6** and summarised in **Section 6.4**.

6.3.1 *Key Interest Groups*

Table 6.1 List of all individual and group stakeholders directly consulted

Group	Stakeholder
Key Interest Groups	
Immediate Community	▪ Participating Landowners ▪ Neighbouring Residents
Local Aboriginal Groups	▪ Bathurst Local Aboriginal Land Council ▪ Mudgee Local Aboriginal Land Council ▪ Orange Local Aboriginal Land Council ▪ Wiradjuri Traditional Owners Central West Aboriginal Corporation ▪ Dhuuluu-Yala Aboriginal Corporation ▪ Mingaan Aboriginal Corporation ▪ Wiradjuri Council of Elders ▪ Murong Gialinga Aboriginal & Torres Strait Islander Corporation ▪ Warrabinga Native Title Claimants Aboriginal Corporation ▪ Wellington Valley Wiradjuri Aboriginal Corporation ▪ Gundungurra Tribal Council Aboriginal Corporation ▪ Gundungurra Aboriginal Heritage Association Inc
Local Community and Businesses	▪ Locally elected members ▪ Title holders of mineral exploration leases and mining licences within the study area # ▪ Interested people in the broader community ▪ Local Businesses ▪ Central West Catchment Management Authority ▪ Hargraves Progress Association ▪ Hill End / Tambaroora Progress Association ▪ Sofala Progress Association ▪ Bathurst Community Climate Action Network ▪ Greening Bathurst ▪ Conservation Volunteers Australia ▪ National Trust ▪ Mid-Western Community Action Network

Indicates those stakeholder groups that were identified by the DoPI as key consultees and provided input into the DGR's.

Initial Consultations: Face-to-face contact was made with many neighbouring property owners during the week commencing the 21st March 2011, within approximately 5 km of the wind farm site. Approximately 40 neighbouring residences were visited. These residents were provided with information on key points of the Project proposal, Issue 1 of the Crudine Ridge Wind Farm Newsletter (see **Appendix 8**), office contact details, a Public Opinion Survey (POS) to complete and a Frequently Asked Questions (FAQ) brochure on generic wind farm facts. In the event of the resident being absent or unavailable (i.e. 'Private Property' or 'No Trespassing' signs on gates), a package containing the aforementioned material was left at the main door, letterbox or gate.

Website Launch: In March 2011, to coincide with initial consultations, the Project website was launched (www.crudineridgewindfarm.com.au) as a means of providing ongoing, up-to-date information to interested stakeholders. The website also provides a mechanism for people to provide feedback via an online POS, as well as contact details for the Proponent should they wish to discuss specific issues directly.

Public Open Day: Following three years of data collection, project refinement and ongoing consultation, a public open day was held for the proposed Crudine Ridge Wind Farm at Pyramul Hall, Pyramul on the 13th July 2011. Residents within the district were advised of the public open day by way of a mail out of the second Crudine Ridge Wind Farm Newsletter as well as advertisements in the local newspapers (Mudgee Guardian and Western Advocate) for the two weeks leading up to the event. A press release was also issued to local media outlets, including the aforementioned newspapers, as well as the Wellington Times, Newcastle Herald, Prime Television, 2MG Central Tablelands Radio and ABC Western Plains, inviting people to participate.

The public open day, attended by almost 100 people, presented details of the proposed Crudine Ridge Wind Farm and associated electrical infrastructure. Display panels were used to present a wide range of information including maps of layout options and photomontages of the likely appearance of the Project. Also displayed was information collected during the preparation of the EA and general wind farm fact and figures. A DVD presentation from the British Wind Energy Association (BWEA) was also shown, outlining the key features of wind farms during planning, construction and operation. Copies of the second issue of the Crudine Ridge Wind Farm newsletter, FAQ brochure and company information relating to Wind Prospect CWP were also made available. Five members of the Wind Prospect CWP team were on-hand to answer questions and explain the details of the proposed development.

A second public open day was held for the proposed Crudine Ridge Wind Farm at Pyramul Hall, Pyramul on the 28th February 2012. Residents in the district were advised of the public open day through the same media channels as detailed above.

The second public open day took the same form as the first, and was attended by approximately 70 people, a reflection of effective on-going information dissemination. At this public open day the Proponent provided a project update on key assessment findings and presented the final layout designs which have been submitted to the DoPI in this EA for exhibition and assessment.

Project Refinement: There have been few modifications to the Project site since the original layouts were presented in the draft PEA. This is primarily owing to the remoteness of the site with regard to neighbouring landowner dwellings. However, prior to the submission of the final PEA in March 2011, the Project layout underwent some modifications to the wind turbine positions in order to take into account the following:

- Updated wind modelling across the site;
- Availability of new wind turbine models in the market;
- Appreciation of a changing regulatory framework in other states that may be adopted in NSW; and,
- Findings from ecological assessments which commenced in 2008.

This resulted in a robust approach to developing two wind farm Layout Options which are proposed and assessed in this EA.

6.3.2 *Key Government Consultees*

Table 6.2 List of all Key Government Consultees

Group	Stakeholder
Key Government Consultees	
Local Councils	▪ Mid-Western Regional Council # ▪ Bathurst Regional Council #
NSW Government Departments	▪ NSW Aboriginal Land Council ▪ NSW Office of Environment and Heritage (OEH) # ▪ NSW DPI # ▪ NSW Office of Water (NOW)# ▪ NSW Department of Lands (DoL) - Crown Lands / Native Title ▪ NSW DoL - Surveyor General ▪ NSW Roads and Maritime Services (RMS) # ▪ NSW Rural Fire Service (RFS) – Cudgegong Region # ▪ Central West Catchment Management Authority (CMA) #
Federal Government Agencies	▪ Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) ▪ DoD # ▪ CASA # ▪ AsA #
Service Providers	▪ TransGrid #

 # Indicates those stakeholder groups that were identified by the DoPI as key consultees and provided input into the DGRs.

6.3.3 *Other Government and Non-Government Consultees*

Table 6.3 List of all Other Government and Non Government Organisation Consultees

Group	Stakeholder
Other Government and Non Government Organisations	
Other Government and Non Government Organisations	▪ Australian Conservation Foundation ▪ Greenpeace ▪ Planet Ark ▪ Nature Conservation Council NSW ▪ Office of the Renewable Energy Regulator ▪ Aerial Agricultural Association Australia # ▪ Bureau of Meteorology (BoM) ▪ Companies with operational communication services in the area: ▪ Australian Communications and Media Authority ▪ NSW Government Network Radio Service ▪ NSW Police Service ▪ NSW Ambulance Service ▪ NSW State Emergency Service ▪ Broadcast Australia (incl. ABC) ▪ SBS Corporation ▪ PRIME ▪ NBN Channel Ten ▪ Channel Seven ▪ WIN (Channel 9) Television

 # Indicates those stakeholder groups that were identified by the DoPI as key consultees and provided input into the DGRs.

A Stakeholder Consultation Plan created from the outset of the Project is summarised in **Table 6.4** below. The Plan details the timeline by which the dissemination of information and consultations occurred with all three stakeholder categories. Throughout this period, consultation continued with all stakeholders that expressed an ongoing interest in the Project.

Table 6.4 Key stages in the consultation process

Approximate Timing	Category / Group / Stakeholder	Nature of consultation
2008 - ongoing	Participating landowners	Initial approach, licence negotiation, ongoing development liaison.
	TransGrid	Initial approach, ongoing grid connection studies, consultation on connection options.
September 2008	DoPI	Opinion sought and Project declared to be a Major Project under Part 3A of the *Environmental Planning and Assessment (EP&A) Act, 1979.*
October 2008 - March 2011	DoPI OEH NOW DPI Mid-Western Regional Council Bathurst Regional Council DoD	PFM, submission of the Project Application, PEA, receipt of initial DGRs.

Approximate Timing	Category / Group / Stakeholder	Nature of consultation
	CASA AA	
March 2011 - ongoing	Neighbouring Residents	Information disseminated via door-knocking within 5 km of the Project site and feedback sought.
	Local Aboriginal Groups	Information disseminated via phone call and / or letter / email accompanied by Newsletter #1 and feedback sought.
	Local Community Groups	Information disseminated via letter / email, accompanied by Newsletter #1 mail-out and feedback sought.
	NSW Government Departments	Information disseminated via phone call and / or letter / email accompanied by Newsletter #1 and feedback sought.
	Federal Government Departments	Information disseminated via phone call and / or letter / email and feedback sought.
	Other Govt. And Non-Govt. Organisations	Information disseminated via letter / email and feedback sought.
March 2011	All	Crudine Ridge Wind Farm website launched and media release issued.
March 2011	Participating landowners Mid-Western Regional Council Bathurst Regional Council RMS DoL	Notification of all landowners upon whom the proposed development may occur or impact, of the Major Project Application in accordance with Clause 8F of the *Environmental Planning and Assessment Regulation 2000.*
March 2011	Mid-Western Regional Council	Presentation to Council on Project progress.
July 2011	Key Interest Groups and Local Councils	Public Open Day held in Pyramul incorporating maps, facts and figures and finding from key assessments under taken to date.
July 2011	Mid-Western Regional Council	Presentation to Council on Project progress.
August 2011	DoPI	Additional DGRs issued.
September 2011	Local Aboriginal Groups	Archaeological and cultural heritage survey participation.
November 2011	Mid-Western Regional Council	Presentation to Council on Project progress.
November 2011	SEWPaC	Referral of proposed action with respect to the *Environment Protection and Biodiversity Conservation (EPBC) Act, 1999*.
February 2012 [#]	Key Interest Groups and Local Councils	Public Open Day held in Pyramul incorporating maps, facts and figures and finding from key assessments under taken to date. Expressions of interest sought from members of the local community and interested stakeholders to submit nominations for a **Community Consultation Committee**.
February 2012	SEWPaC	Determination of 'Controlled Action' status under the EPBC Act.

Approximate Timing	Category / Group / Stakeholder	Nature of consultation
March 2012	SEWPaC	Receipt of supplementary assessment requirements provide by SEWPAC.
March 2012	Bathurst Regional Council	Presentation to Council on Project progress.
March 2012 - ongoing #	Neighbouring resident (within 2 km)	Neighbour Agreement discussions with sole neighbour with a dwelling within 2 km of a proposed wind turbine location.
May 2012 #	DoPI, SEWPaC and Proponent	Submission of EA to DoPI for Adequacy. Review expressions of interest received for the **Community Consultation Committee**.
May 2012	Bathurst Regional Council Mid-Western Regional Council	Discussions regarding EA adequacy.
June 2012	DoPI, SEWPaC and Proponent	Formal adequacy response provided.
Future		
From December 2012	All	Public Exhibition of the EA during which submissions can be made.
Q1 2013	Proponent	Prepare Preferred Project Report / Submissions Report in response to submissions. First meeting of the Community Consultation Committee.
Q2-Q3 2013	DoPI and SEWPaC	Development Consent decision.

Specific reference to the requirements of the Draft Guidelines.

6.4 Stakeholder Response

6.4.1 *Key Interest Groups*

A number of Key Interest Group stakeholders have provided input into the Project, highlighting a broad range of issues for consideration. Such input from local groups and individuals is important during the development of the Project in order to mitigate adverse impacts to the local community as far as practicable.

Other issues raised by the Key Interest Groups concerned broader aspects of the development that are considered throughout this EA, detailed below in **Table 6.5**.

Table 6.5 Summary of the broader Key Interest Group issues and where addressed within the EA

Key Interest Group	Issue Raised	Addressed
Local Aboriginal Groups	Archaeological and cultural heritage survey participation	**Chapter 11**
Neighbouring Residents and Local Community and Businesses	Visual impact	**Chapter 8**
	Noise impact	**Chapter 9**
	Economic value	**Chapters 4** and **19**
	Community fund	**Chapter 19**

Key Interest Group	Issue Raised	Addressed
	Bushfire risk	**Chapter 16**
	Health	**Chapter 19**
	Decommissioning	**Chapter 18**
	Greenhouse emissions	**Chapter 4**
	Dissemination of information	**Chapter 6** (this chapter)
	Communication impacts	**Chapter 14**
	Aviation impacts	**Chapter 13**

Throughout the Project planning stage POSs were distributed to Key Interest Group stakeholders. In addition, a "*Have Your Say*" feature of the website provided the same functionality via a different media to capture stakeholder views, comments and concerns about the Project. The following tables show the number of responses received and their opinion on the proposed development for each question asked.

1. Do you approve of wind being used to generate renewable electricity?

No Answer	0	0 %
Yes	35	78 %
No	6	13 %
No view	4	9 %
Respondents	45	

2. On hearing of our proposal, what was your initial view?

No Answer	1	2 %
I support it	29	65 %
I don't support it	9	20 %
Undecided	6	13 %
Respondents	45	

3. How close do you live to the proposed wind farm?

No Answer	0	0 %
<15km	28	51 %
>15km	27	49 %
Respondents	55	

4. Does the website provide adequate information?

Yes	6	50 %
No	6	50 %
Respondents	12	

Note: Respondents did not always answer each question posed, resulting in a range of respondent sample groups as evident above.

Whilst the number of returned surveys and questionnaires are statistically too small to determine any trend in overall positive or negative support for the wind farm development, they do provide a 'snap shot' of local community views as received.

6.4.2 *Key Government Consultees*

Various environmental stakeholders have provided advice on flora and fauna species of potential significance in the area. Such stakeholders include the OEH, the DoPI, Bathurst Regional Council, Mid-Western Regional Council, the NOW and SEWPaC. Consultation with such agencies is ongoing, with their input into the development process being critical for the appropriate environmental management of the Project site.

In addition to receiving the DGRs for the Project, the DoPI also provided broader agency input that was used in defining assessment requirements. Again, these are summarised below with respect to the relevant chapter of the EA in which the issue is addressed. Also, there are a number of additional Key Government Consultees that did not have the opportunity to provide input from the outset. However, through identification and subsequent consultation, their opinions have been sought and are also summarised below.

Generally the requirements of the Key Government Consultees are more prescribed in their nature and easily captured in the general requirement, key assessment and general environmental assessment chapters of this EA.

Table 6.6 Summary of the broader Key Government Consultee issues and where addressed within the EA

Key Government Consultee	Issue Raised	Addressed
Mid-Western Regional Council	Cumulative Impact	Relevant **Chapters**
	Noise Impact	**Chapter 9**
	Erosion and Sedimentation Control	**Chapter 18**
	Gravel and Material Provision	**Chapter 18**
	Roads and Maintenance	**Chapter 12** and **18**
	Socio-Economic Impacts	**Chapter 19**
Bathurst Regional Council	Weed Control	**Chapter 10**
	Bushfire Risk Management	**Chapter 16**
	Roads and Maintenance	**Chapter 12** and **18**
	Gravel and Material Provision	**Chapter 18**
	Socio-Economic Impacts	**Chapter 19**
OEH	Water	**Chapter 17**
	Air quality	**Chapter 18**
	Noise	**Chapter 9**
	Cultural Heritage	**Chapter 11**
	Waste	**Chapter 18**
	Construction Staging	**Chapter 3** and **10**
	Contaminated Land	**Chapter 18**
	Threatened Species	**Chapter 10**

Key Government Consultee	Issue Raised	Addressed
	Vegetation Clearing	**Chapter 10**
DPI	Weed Control	**Chapter 10**
	Aquatic biodiversity	**Chapter 17**
	Agricultural Issues	**Chapter 3**, **13** and **10**
	Waste	**Chapter 18**
	Erosion and Sedimentation Control	**Chapter 18**
NOW	Water supply	**Chapter 3** and **17**
	Water courses, riparian corridors and Groundwater Dependant Ecosystems	**Chapter 17**
DoL	Trig. Stations	**Chapter 17**
LPMA	Crown Land / Native Title	**Chapter 18**
RMS(No response)	Roads And Maintenance	**Chapter 12**
RFS (No response)	Fire And Bushfire Risk	**Chapter 16**
DoD	Aviation Hazard	**Chapter 13**
	Communication Impact	**Chapter 14**
CASA (No response)	Aviation Hazard	**Chapter 13**
AsA	Aviation Hazard	**Chapter 13**
SEWPaC	Environment Protection And Biodiversity Act 1999	**Chapter 3** and **10**
Andrew Gee MP	Community Consultation	**Chapter 6** (this chapter)
TransGrid	Grid Connection	See below

The Proponent has entered into a Connection Investigation Network Agreement (CINA) with TransGrid to progress the connection of the wind farm to the grid. This process is a formal arrangement that incorporates TransGrid and the Australian Electricity Market Operator (AEMO) in determining the electrical connection requirements.

6.4.3 *Other Government and Non-Government Organisations*

Consultation also occurred with a range of Other Government and Non-Government Organisations, and a full list of these stakeholders is provided in **Table 6.3**, in **Section 6.3**.

The Aerial Agricultural Association of Australia (AAAA) provided a response with respect to the proposed impact from the wind farm on neighbouring airstrips. AAAA indicated that, due to internal resource constraints, the organisation was unable to provide a full assessment of the proposed impact. A thorough assessment of aviation related hazards in conjunction with the responses received from the DoD, CASA and AsA can been seen in **Chapter 13** Aviation.

Some users or managers of various radio communications, telecommunication and television services have provided advice on the likely effect of the proposed wind turbines on their transmission signals. All advice received has been used in conjunction with results of electromagnetic interference studies (see **Chapter 14** Communication) to develop a compliant turbine layout or to propose mitigation measures in the event of concerns over interference from the Project.

6.5 Detailed Stakeholder Consultation in relation to the Draft Guidelines

A number of detailed discussions were held with stakeholders in the vicinity of the Project in order to address their concerns or matters raised in subsequent meetings.

There are a total of seven dwellings within 2 km of the Project. Five of these dwellings are inhabited, with two belonging to involved landowners (associated dwellings) and three to neighbouring landowners (non-associated dwellings). The two uninhabited dwellings also belong to involved landowners. **Table 6.7** summarises the existing situation with respect to the seven dwellings identified within 2 km of the proposed wind farm layouts.

Table 6.7 Proximity and Status of Dwellings within 2 km of the Proposed Layouts

Residence ID	Residence Name	Associated Dwelling	Inhabited	Minimum Distance (km)	
				Layout A	Layout B
CR28	***Willow Downs***	***No***	***Yes***	1.993	1.981
CR34	***Linwood***	***No***	***Yes***	1.992	1.996
HER04	***Round Hill***	***Yes****	***Yes***	1.719	1.656
HER06	Illoura	Yes	No	1.764	1.735
HER07	Clare Hills	Yes	Yes	1.994	1.990
HER12	Oakhills	Yes	No	1.367	1.522
PL03	Glenmore	Yes	Yes	1.612	1.654

**A Neighbour Agreement has been obtained.*

The Draft Guidelines encourage wind farm proponents to seek agreement from non-associated landowners within 2 km of any proposed wind turbines (the Gateway). Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent considers it prudent to seek such an agreement. As such, with respect to **Chapter 8** Landscape and Visual Impact and **Chapter 9** Noise the Proponent has entered into a Neighbour Agreement with the owner of HER04.

In relation to CR28 and CR34, the Proponent considers the current minimum distances to be sufficiently close to 2 km not to warrant a separate agreement. This position is with regard to findings presented in **Chapter 8** and **9**. Furthermore, if deemed necessary by the DoPI, there is the potential to micro-site the nearest wind turbines to locations outside of the Gateway, a minimum movement of 5 to 20 m from current locations.

Community Consultation Committee: The Proponent has acted to establish a Community Consultation Committee (CCC) following the release of the Draft Guidelines. Prior to the second public open day information was placed in local media which sought expressions of interest from local stakeholders who would be willing to participate in a CCC for the proposed Project. It was noted in the media that further information would be provided at the second public open day or via direct request of the Proponent. It was stated that nominations would close on 30th April 2012.

A double-sided A4 summary of the requirements that participants of a CCC would be undertaking, in addition to general selection criteria questions for interested local stakeholders to complete and return, was provided at the second public open day (**Appendix 7**). The closure date for this process was again included in this documentation.

Due to low levels of response from the community to participate in the CCC (only one expression of interest by this date), the Proponent extended the date for nomination closure to 31st May 2012, with advertisements made through the local newspapers and project website.

In July 2012 the Proponent sought to formally establish a CCC in consultation with the Director-General. The response received indicated that, pending the finalisation of the Draft Guidelines, the DoPI does not have a role in appointing the independent chair or community representatives of the Committee. As such, and in light of local Council elections which occurred in September 2012, the Proponent is now proceeding to establish a CCC.

6.5.1 *Mineral Exploration and Mining Licence Holders*

Consultation letters and maps showing the layout of the Project were sent to all mineral exploration licence and mining lease holders identified in the Minview database, (DPI 2011a). The details of these licences and the status of communications are outlined in **Table 6.8** below.

Table 6.8 Exploration Licences overlapping the Project site

Company	Titles	Status	Response
Oroya Mining Ltd	EL 6627 EL 6628 EL 6629 EL 7548 EL 7549	Expires 5th Sep 2012 Expires 5th Sep 2012 Expires 5th Sep 2012 Expires 21st May 2012 Expires 21st May 2012	Oroya Mining Ltd indicated potential land use conflicts are still to be determined with regard to completion of their exploration efforts.

Initial correspondence via email and phone conversation with Oroya Mining Ltd occurred in April 2011, in which the Proponent detailed the proposed Project and included a map showing how the Project overlapped their five ELs. Further phone correspondence occurred throughout 2011 (August and December) again informing the licence holder of the Project and requesting consultation over the interface between the Project and potential mining activity in the area. A formal response was received on the 12th December 2011 and is located in **Appendix 6**.

Where achievable, the Project has avoided direct impact with any mining lease holders within the Project site. As exploration licences can be considerable in their geographic extent, it has not been possible to avoid direct impacts on such licences over the Project site. However, given there is no active mining taking place in those areas until a mining lease is granted, the development of the Project is not restricted in any way at this time. Under the NSW Mining Act 1992, Division 2, should the wind farm be built prior to the granting of a mining licence, the wind farm would constitute a 'significant improvement' over the land (Clause 23A, Schedule 1) and would therefore limit the amount of mining activity which could take place in the vicinity of the Project.

The Proponent intends on maintaining an open dialogue with Oroya Mining Ltd.

6.6 Summary

Consultation for the Crudine Ridge Wind Farm proposal was conducted by way of letters of notification to stakeholders, face-to-face contact with neighbouring residents, public open days and consultation meetings with various stakeholders. The Project website presents an ongoing, active consultation medium for people to track the development of the Project and provide comment (www.crudineridgewindfarm.com.au).

Stakeholders included statutory bodies, local interest groups and regional residents. A number of consultees responded, including local community groups concerned about the development, and provided input or advice for the Project. The Proponent maintains an ongoing consultation process; including the establishment of a Community Consultation Committee once the Draft Guidelines are incorporated.

CHAPTER 7

Assessment of Key Issues

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7. ASSESSMENT OF KEY ISSUES

A number of issues require assessment in the development of a wind farm. Each issue has varying importance depending on the type and scale of the project. The classification of an issue determines the level of assessment required.

Issues are identified in a number of ways, including:

- Relevance to guidelines, strategic plans or policies produced by the New South Wales government or other governing bodies;
- Reference to other projects, especially those in similar locations;
- Association to research and reference material on wind farms; and
- Outcomes from consultations with stakeholders.

The Director-General's Requirements (DGRs), under the *Environmental Planning and Assessment Act 1979*, requires key or additional issues be identified as these issues have the potential to create environmental or human impacts. This Environmental Assessment is structured to address the requested key issues and **Table 7.1** summarises each key issue and the investigation strategies employed. **Chapters 8** to **17** provide greater detail including the methodologies, results and mitigation measures recommended by these investigations for each key issue individually. Additional issues not directly required by the DGRs are identified in **Chapter 18** General Environmental Assessment and **Chapter 19** Socio-Economic Assessment.

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

Table 7.1 Key assessment areas related to the Project and methods of investigation

Key Issue	Addressed	Investigation Strategy
Landscape and Visual	**Chapter 8**	Assessment by Moir Landscape Architecture Pty Ltd, and broader stakeholder communication
Noise	**Chapter 9**	Assessment by Sonus Pty Ltd, and broader stakeholder communication
Ecology	**Chapter 10**	Assessment by Eco Logical Australia Pty Ltd, and broader stakeholder communication
Cultural Heritage	**Chapter 11**	Assessment by New South Wales Archaeological Pty Ltd, and broader stakeholder communication
Traffic and Transport	**Chapter 12**	Assessment by Samsa Consulting Pty Ltd
Aviation	**Chapter 13**	Consultation with key government agencies, the Hart Aviation Services Pty Ltd and broader stakeholders
Fire and Bushfire	**Chapter 14**	Assessment by Eco Logical Australia Pty Ltd
Electromagnetic Fields	**Chapter 15**	Desktop review
Communication	**Chapter 16**	Assessment by Lawrence Derrick and Associates, and broader stakeholder communication
Water	**Chapter 17**	Consultation with key government agencies and associated landowners
General Environmental Assessment	**Chapter 18**	Assessment by Eco Logical Australia Pty Ltd and desktop review
Socio-Economic Assessment	**Chapter 19**	Consultation with associated parties and desktop review

CHAPTER 8

Landscape and Visual Impact Assessment

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8. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

The Proponent commissioned Moir Landscape Architecture (MLA) to prepare a Landscape and Visual Impact Assessment (LVIA) for the Crudine Ridge Wind Farm. The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the Project would be located, and an assessment of the potential landscape and visual impacts that may result from the construction and operation of the Project, taking into account appropriate mitigation measures.

This chapter presents a summary of the LVIA methodology as well as the key results and findings arising from the assessment. The detailed results of the LVIA are included in **Volume 4**.

The LVIA addresses the Director-General's Requirements (DGRs) for the Project assessment, as well as issues raised separately in consultation with local stakeholders and residents. Neither Mid-Western Regional Council nor Bathurst Regional Council have relevant policies or guidelines regarding landscape or scenic quality that may apply to developments of this nature.

On the 23rd December 2011 the NSW Government released *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines) for public consultation. The Crudine Ridge Wind Farm LVIA report was commissioned in June 2011 to address the DGRs that were issued in March 2011. Correspondingly the Project has been assessed against the DGRs.

The Australian Wind Energy Association and Australian Council of National Trust's publication *Wind Farms and Landscape Values National Assessment Framework* (June 2007), was utilised to form the methodology of the LVIA, which also encompasses the general assessment framework outlined in the National Assessment Framework. In addition to the National Assessment Framework, the LVIA has also included a review of the *National Wind Farm Development Guidelines* (Public Consultation Draft V2.4 2010).

The National Assessment Framework outlines four steps as follows:

- Step 1: Assess the Landscape Value;
  - Preliminary Landscape Assessment; and
  - Full Landscapes Assessment.
- Step 2: Describe and model the wind farm in the landscape.
- Step 3: Assess the impacts of the wind farm on landscape values.
- Step 4: Respond to impacts.

8.1 Method

The LVIA methodology adopted by MLA has been applied to a number of similar LVIA Part 3A Major Projects assessed and approved by the New South Wales (NSW) Department of Planning and Infrastructure (DoPI), including wind farms in rural NSW.

The LVIA methodology included the following activities and assessments:

- Site and Regional Context:
  - Overview of the regional and site context including both natural and cultural features.
- Landscape Character:

  - Description of the regional landscape character and significant features;
  - Classification and description of the local landscape into different character types; and
  - Determination of the landscape's ability to absorb different types of development based on the physical and environmental character of the landscape.
- The Proposal**:**
  - Overview of the proposed wind farm development and associated infrastructure.
- Visual Impacts**:**
  - Computer modelling to determine the Zone of Visual Influence (ZVI) based on topography (to represent 'greatest impact' scenario);
  - The undertaking of a viewpoint analysis to identify sites likely to be affected by development of the site and a photographic survey; and
  - Visual modelling of the wind farm from key viewpoints in the form of photomontages to depict the potential visual change.
- Visual Effects**:**
  - Overview of potential visual effects including Shadow Flicker, Blade Glint and Reflectivity and Night Lighting.
- Cumulative Visual Impacts**:**
  - Assessment of the cumulative visual impacts based on existing and proposed development in the area.
- Visual Impact Summary**:**
  - Assessment of the overall visual impact and summary of visual impact on residents and public receptors.
- Community Perceptions**:**
  - Overview of the community perception and consultation process and outcomes.
- Mitigation Methods**:**
  - Preparation of recommendations for impact mitigation and suggestions for suitable development to maintain the area's visual quality.

8.1.1 ***Visual Prominence, Visual Sensitivity and Visual Quality***

A core component of the LVIA is defined by the description, assessment and determination of the visual prominence, visual sensitivity and zone of visual influence associated with the Project.

Visual Prominence: The distance of each viewpoint to the closest turbine was a significant determining factor in ranking visual prominence of the Project. The visual impact decreases or increases in direct relation to the distance. **Table 8.1** outlines the potential visual prominence of the development in relation to the distance from the object.

Table 8.1 Visual Prominence of the Project

Distance from turbine	Potential Visual Prominence
>12 km	Visually insignificant – A very small element in the viewshed, which is difficult to discern and will be invisible in some lighting or weather circumstances. Rotor blade movement can often be seen on a clear day.
6 to 12 km	Potentially noticeable but will not dominate the landscape - The development will be noticeable. The degree that it intrudes on the view will increase as distance decreases.
2.5 to 6 km	Potentially noticeable and can dominate the landscape – The development may be highly noticeable.
1 to 2.5 km	Highly visible and will usually dominate the landscape – The development may be highly noticeable.
<1 km	Will always be visually dominant in the landscape – The development may be highly noticeable.

Visual Sensitivity: A measure of how critically a change to the existing landscape is viewed by people from different areas (see **Table 8.2**). The assessment is based on the number of people affected, land use, and the distance of the viewer from the proposal (EDAW 2000). Generally, visual sensitivity decreases as the viewer distance increase; decreases as the viewing time decreases; and can also be related to viewer activity (for example, recreational activities or passing in a car).

Table 8.2 Sensitivity Rating based on landscape features

Visual Use Area	Foreground		Middle-ground		Background
	Local Setting		Sub-regional setting		Regional Setting
Distance (km)	**0 - 1**	**1 - 2**	**2 - 4.5**	**4.5 - 7**	**>7**
Townships	High	High	High	Moderate	Low
Rural residences	High	High	High	Moderate	Low
Main highway	Moderate	Moderate	Low	Low	Low
Local roads	Moderate	Moderate	Low	Low	Low
Railway line	Low	Low	Low	Low	Low
Agricultural land	Low	Low	Low	Low	Low

Visual Quality: Visual quality is a largely subjective assessment of aesthetics, and how viewers may respond to designated scenery. Scenes of high visual quality are those which are valued by a community for the enjoyment and improved amenity they can create. Conversely, scenes of low visual quality are of little value to the community with a preference that they be changed or improved, often through the introduction of landscape treatments. There is evidence to suggest that certain landscapes are consistently preferred over others, with preferences related to the presence or absence of certain elements.

The rating of visual quality for this study is based on scenic quality ratings and on the following generally accepted assumptions arising from scientific research (Department of Planning 1988):

Visual quality increases:

- As relative relief and topographic ruggedness increase;
- As vegetation pattern variations increase;
- Due to the presence of natural and / or agricultural landscapes;
- With increases in land use compatibility; and
- Owing to the presence of water-forms and related to water quality and associated activity.

8.1.2 *Zone of Visual Influence, Visual Absorption Capability and Visibility*

Zone of Visual Influence (ZVI): The ZVI represents the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM). The ZVI usually presents a bare ground scenario – i.e. a landscape without screening, structures or vegetation and is usually presented on a base map. It is also referred to as a zone of theoretical visibility (Horner and MacLennan & Envision 2006). Three ZVI diagrams have been prepared and are illustrated in **Volume 4.**

These include:

- Layout Option A - 106 turbines (Figure 10, **Volume 4**)
- Layout Option B - 77 turbines (Figure B2, **Volume 4**)
- External Transmission Line (Figure 11, **Volume 4**)

The ZVI identifies the areas of surrounding land from which the Project may be partially or completely visible. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be considered as representing the greatest or worst case impact scenario. In reality, the zone of visibility of the Project is far less than that shown. A summary of the ZVI analysis is included in **Volume 4**.

Visual Absorption Capability: Visual Absorption Capability (VAC) is used to assess a landscape's susceptibility to visual change cause by human activities. A landscape with a high VAC would be able to accept alterations with little or no loss to the landscape character or visual condition.

Visibility: In order to facilitate objective assessment of visibility, a set of key criteria was developed. The key criteria against which the visibility of the Project was assessed from each viewpoint include the distance of the viewpoint from the Project, the potential visual prominence of the Project, the number of visible turbines and the context in which the turbines are viewed. A number of factors existing at a local level can influence the visibility of the Project, including the visual backdrop of the proposal, local influences and visual desensitisation.

8.2 Existing Situation

The Project site is situated on 17 properties, with a total of seven dwellings within 2 km of the Project. Five of these dwellings are inhabited, with two belonging to involved landowners (associated dwellings) and three to neighbouring landowners (non-associated dwellings). The two uninhabited dwellings also belong to involved landowners. **Table 8.3** summarises the existing situation with respect to the seven dwellings identified within 2 km of the proposed wind farm layouts.

Table 8.3 Proximity and Status of Dwellings within 2 km of the Proposed Layouts

Residence ID	Residence Name	Associated Dwelling	Inhabited	Minimum Distance (km)	
				Layout A	Layout B
CR28	***Willow Downs***	***No***	***Yes***	1.993	1.981
CR34	***Linwood***	***No***	***Yes***	1.992	1.996
HER04	***Round Hill***	***Yes****	***Yes***	1.719	1.656
HER06	Illoura	Yes	No	1.764	1.735
HER07	Clare Hills	Yes	Yes	1.994	1.990
HER12	Oakhills	Yes	No	1.367	1.522
PL03	Glenmore	Yes	Yes	1.612	1.654

**A Neighbour Agreement has been obtained.*

The Draft Guidelines encourage wind farm proponents to seek agreement from non-associated landowners within 2 km of any proposed wind turbines (the Gateway). Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent considers it prudent to seek such an agreement. As such, with respect to the findings of this chapter and **Chapter 9** Noise, the Proponent has entered into a Neighbour Agreement with the owner of HER04.

In relation to CR28 and CR34, the Proponent considers the current minimum distances to be sufficiently close to 2 km not to warrant a separate agreement. This position is with regard to both the Noise and Landscape assessments referred to above. Furthermore, if deemed necessary by the DoPI, then there is potential to micro-site the nearest wind turbines to a location outside of the Gateway, a minimum movement of 5 to 20 m from current locations.

Viewpoint analysis and photomontages (where appropriate) have been prepared for CR28, CR34 and HER04, see **Volume 4**.

The landscape character of a site refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects a particular combination of geology, landform, soils, vegetation, land use and human settlement and creates a particular sense of place for different areas within the landscape (Horner and MacLennan & Envision 2006).

The existing landscape context of the site and its surrounding environment are classified into distinct and relatively homogenous units of landscape character. As the landscape encompassing the study area varies greatly, seven landscape character units (LCU) were defined using a combination of aerial, topographic and soil landscape maps and site photographs:

- LCU 1 – Pyramul
- LCU 2 – Aarons Pass
- LCU 3 – Sallys Flat
- LCU 4 – Crudine Valley

- LCU 5 – Sofala
- LCU 6 – Turon River
- LCU 7 – Turondale

The landscape quality of the seven LCUs were rated on a number of factors including; landform and scale, land cover, settlement and human influence, movement, rarity and inter-visibility with adjacent landscapes. Settlement and human influence had a low landscape quality rating across most of the LCUs, except for Crudine Valley while land cover was medium to high across the area, except for Sallys Flat. Some of the LCUs already contain a substantial amount of roadside and property screen planting, which will aid in screening the Project.

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

8.2.1 *Perception and Public Consultation*

Individual perception is an important issue to consider in any visual impact assessment, as the attitude or opinion of an individual receptor adds significant weight to the level of potential visual impact. These attitudes or opinions of individual receptors toward wind farms can be shaped and formed through a multitude of complex social and cultural values.

It is unlikely that wind farm projects will ever conform or be acceptable to all points of view. Some receptors accept and support wind farms in response to global or local environmental issues, others support the environmental ideals of wind farm development as part of a broader renewable energy strategy, but do not consider them appropriate for their regional or local area, whereas others find the whole concept of wind farms unacceptable.

The Proponent conducted two separate opinion surveys during the course of 2011 and early 2012 and received responses from the community. Submissions were also taken through the Project website. From a total of 45 Public Opinion Surveys received by the Proponent:

- 29 respondents supported the Project;
- 9 respondents did not support the Project;
- 6 respondents were undecided; and
- 1 respondent did not answer the question.

From a total of 13 Landscape Values Questionnaire received by the Proponent:

- 3 respondents considered that the Project would have a positive impact on the landscape;
- 5 respondents considered that the Project would have a neutral impact on the landscape;
- 3 respondents considered that the Project would have a negative impact on the landscape; and
- 2 respondents did not provide an answer on what impact the Project would have on the landscape.

As discussed in **Chapter 6** Stakeholder Consultation, these returned surveys and questionnaires are statistically too small to determine an overall trend, however they do provide a 'snap shot' of local community attitudes.

Whilst published research into the potential landscape and visual impacts of wind farms is limited in Australia, there are general corresponding results between those that have been carried out when compared to those carried out overseas.

In 2010, AMR Interactive on behalf of DECCW survey polled 2,022 residents across the six Renewable Energy Precincts, including the Central Tablelands. The key findings of the survey indicated that:

- 85 % of people supported the construction of wind farms in NSW and 80 % within their local region; and
- 79 % supported wind farms being built within 10 km of residences and 60 % of people surveyed supported the construction of wind turbines within 1 to 2 km from their residences. This level of support for wind farms within 1 to 2 km dropped to 63 % in the Central Tablelands Precinct.

These results are reflected in other surveys including the community perception survey toward wind farms undertaken by Epuron for the Gullen Range Wind Farm Environmental Assessment in 2008. The results of the survey, which targeted a number of local populations within the Southern Tablelands, suggested that around 89 % of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71 % of respondents accepting the development of a wind farm within 1 km from their residential dwelling.

This year CSIRO Science into Society Group released a report detailing research into nine wind projects representing states with the greatest wind resources (including NSW), and wind projects at various stages of development (operational, under construction, proposed and rejected) (Hall et al. 2012). The report found that there is strong community support for wind farms, including from rural residents who do not necessarily publicly express their views. However, against this background, the CSIRO also performed a review of media coverage of wind farms. Their review found more citations rejecting wind farms (32 reasons) than supporting wind farms (19 reasons); a finding that suggests a media bias which does not correlate with the general public's view (Hall et al. 2012). The existing planning process and regulatory approach was found to be an appropriate mechanism for development approval, however, this could be improved by a stronger framework for community engagement.

Whilst individual perception and local community attitudes toward wind farm development are an important issue, and need to be considered in terms of potential landscape and visual impacts, there is also the issue of the greater potential societal benefit provided by renewable energy projects, as discussed in **Chapter 4** Project Justification.

8.3 Potential Impacts

The potential significance of visual impact resulting from the construction and operation of the Project would result primarily from a combination of the following factors:

- The visibility or extent to which the Project structures would be visible from surrounding areas;

- The degree of visual contrast between the Project structures and capability of the surrounding landscape to visually accommodate the Project;
- The category and type of situation from which receptors may view the Project;
- The distance between receptor and Project wind turbines;
- The duration of time a receptor may view the Project from any static or dynamic view location;
- The visual sensitivity of receptors surrounding the Project; and
- The visual backdrop of the Project.

The criteria used to establish visibility and the significance of visual impact, and viewpoint locations are detailed in **Volume 4**.

The LVIA assessed the visual sensitivity and visual effect of a total of 32 viewpoints within 10 km of the Project. When combined, these factors result in an overall visual impact. An assessment of each viewpoint location indicated that for Layout Option A (106 WTGs) and Layout Option B (77 WTGs):

- Turbines would be visible from 30 of the 32 viewpoints, of which:
  - 10 viewpoints have a low visual impact;
  - 11 viewpoints have a moderate visual impact; and
  - 9 viewpoints have a high visual impact.

Of the nine viewpoints that were rated as having a high visual impact, seven were taken along Crudine Road, from clearings in vegetation and entries to properties to represent the worst case scenario for residents within the Crudine Valley. These rankings are used to make comparisons between viewpoints and do not necessarily reflect the actual visual impact. Each viewpoint has local influences (such as vegetation and topography) which may potentially screen the wind farm from view. These screening factors are described in **Volume 4**.

The LVIA also identified a total of 13 public receptor locations (public roads) with 10 of these determined to have a Nil or Low visual impact. Three of the roads assessed were determined to have Low – Moderate or Moderate visual impact. The public receptor locations assessed included major travel corridors, such as the Castlereagh Highway, local or tourist roads such as Hill End Road and Pyramul Road, and unsealed minor roads such as Bombandi Road.

Overall the LVIA determined that residential receptors beyond 10 km of the Project 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.

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.

8.3.1 ***Shadow Flicker***

Residential: Wind turbines can cast shadows on surrounding areas at a distance from the base of the tower due to their height. When viewed from a stationary position, the moving shadows can appear as a flicker giving rise to the phenomenon of ‘shadow flicker’.

A shadow flicker assessment was prepared for both the Layout Option A (106 WTG) and Layout Option B (77 WTG) to determine and illustrate the potential impact of shadow flicker on surrounding receptor locations. As there are no guidelines published in NSW by which to assess the impact of shadow flicker, the assessment adopted the Victorian Planning Guidelines that state:

"The shadow flicker experienced at any dwelling in the surrounding area must not exceed 30 hours per year as a result of the operation of the wind energy facility".

The results of the shadow flicker assessment for the Project determined that no associated or non-associated residential dwellings surrounding the Project would experience shadow flicker in excess of 30 hours per year, as detailed in **Volume 4**.

Motorists: There are no specific guidelines to address the potential impact of wind turbine shadow flicker across roads, although there are lighting standards that address the need to minimise the adverse effects of shadow flicker caused by some roadside or overhead objects. The standards suggest that the flicker effect will be noticeable and possibly cause annoyance for motorists between 2.5 and 15 Hz (2.5 to 15 flickers per second), and that a flicker effect between 4 and 11 Hz should be avoided for longer than 20 seconds. As the potential flicker frequency for the Project is likely to be around 1 Hz, it is unlikely that the flicker effect will cause annoyance or impact on a driver's ability to operate a motor vehicle safely whilst travelling along local roads surrounding the Project.

8.3.2 ***Photosensitive Epilepsy***

The Canadian Epilepsy Alliance (2008) defines photosensitivity as '*a sensitivity to flashing or flickering lights, usually of high intensity, which are pulsating in a regular pattern – and people with photosensitive epilepsy can be triggered into seizures by them*'. Both the Canadian Epilepsy Alliance (2008) and Epilepsy Action Australia (2008) estimate that less than 5 % of people with epilepsy are photosensitive.

Epilepsy Action Australia (2008) suggest that the frequency of flashing or flickering light most likely to trigger seizures occurs between 8 to 30 Hz (or flashes / flickers per second), although this may vary between individuals. It also suggests that 96 % of people with photosensitive epilepsy are sensitive to flicker between 15 to 20 Hz.

Given the low flicker frequency associated with the Project (around 1 Hz), which falls below the range suggested by Epilepsy Action Australia as a potential trigger for photosensitive epileptic seizures, it is unlikely that the Project would present a risk to people with photosensitive epilepsy.

8.3.3 ***Blade Glint and Reflectivity***

Blade glint refers to the reflection of sun from one or more rotating turbine blades. The occurrence of blade glint depends on a number of conditions, including the orientation of the nacelle, angle of the blade and angle of the sun. The reflectivity of the blades surface is influenced to some extent by the colour and age of the blade.

Blade glint can be mitigated through the use of matt coatings which, if applied correctly, will generally mitigate potential visual impacts.

8.3.4 *Electrical works*

The Project would include electrical infrastructure to collect and distribute electricity generated by the wind turbines to the existing electricity network. The proposed electrical works are discussed in **Chapter 3** Project Description.

While some of the electrical connections between the wind turbines and on-site collector substation will be via underground cabling, there will be both internal and external overhead transmission lines associated with the Project. The external overhead transmission line will be used to export power from the wind farm to the TransGrid 132 kV transmission line 15 km to the east of the Project. Zone of Visual Influence analysis was conducted on the external transmission line, and the potential visual impact assessed as low. The visual impact of the transmission line is detailed in **Volume 4**.

8.3.5 *Night Lighting*

The Project may require obstacle marking and lighting at night time and during periods of reduced visibility. The requirement for lighting would be subject to the advice and endorsement of the Civil Aviation Safety Authority (CASA) and Department of Infrastructure and Transport (DIT). As discussed in **Chapter 13** Aviation Assessment, CASA is currently undertaking a review on obstacle marking and lighting of wind farms.

However, with respect to duty of care, the Proponent commissioned HART Aviation, an independent aviation safety expert, to conduct an Aeronautical Impact Assessment and Obstacle Lighting Review to determine the risks posed to aviation activities by the Project. The HART Aviation report, as discussed in **Chapter 13** Aviation Assessment, recommended that the Project may require lighting as duty of care or other applicable mitigation measures if a blade tip height of 152 m is exceeded. The outcomes of the aviation assessment (**Appendix 16**) will be submitted to CASA and DIT for their consideration. Further discussion on the assessment process and requirement for wind turbine lighting is included within **Chapter 13** Aviation Assessment.

Epuron (2008), conducted studies in Victoria on night time lighting mounted on wind turbines and discovered that lights could be visible for a number of kilometres, however the actual intensity of the night time lighting was considered to be no greater than other sources of night time lighting, including vehicle head and tail lights. **Volume 4** provides an illustration of the visual effect of night time lighting mounted on wind turbines at the Waubra Wind Farm, Victoria.

Existing night lighting is present, associated with homesteads dispersed around the Project site. Headlights and brake lights from vehicles travelling through the area along local roads would also create an intermittent source of illumination. Potential night time light sources generated by the Project could result from:

- Control and auxiliary buildings;
- Collector substation and switching station;
- Wind turbines and wind monitoring masts; and
- Scheduled or emergency maintenance.

The visual impact from night lighting in the area is unlikely to have a significant visual impact on receptors including motorists and residents in the area.

8.3.6 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. Cumulative landscape and visual effects result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments or actions that occurred in the past or present, or are likely to occur in the foreseeable future (The Landscape Institute et al. 2008). The Environment Protection and Heritage Council (2004) defines the distance of over 12 km as having a low cumulative visual impact when considering other major infrastructure.

The Project is a relatively isolated development, set back from major transport routes and views from these major routes are generally obstructed by topography and vegetation. There are minimal opportunities to view the Project from Hill End Road or the Castlereagh Highway, and it is therefore unlikely it would be viewed in succession with another existing or proposed wind farm within the one journey. The region has the capability to visually accommodate the Project when assessed in conjunction with other proposed wind farms, without eroding the broad landscape character. As the cumulative impacts of the proposals in the region have been assessed as negligible, wind farms as an element will not emerge as a dominant feature. Further, as the nearest proposed wind farm, Uungula Wind Farm, is more than 40 km to the north west and there are no closer existing wind farms, the cumulative impact is considered negligible (**Table 8.4**).

Table 8.4 Other Wind Farm Developments in the region

Wind Farm	Distance from Project	Status	Number of Wind Turbines
Uungula Wind Farm	> 40 km North west	DGRs issued	Approx. 250
Bodangora Wind Farm	> 70 km North west	Exhibition phase	33
Flyers Creek Wind Farm	> 70 km South west	Proponent reviewing submissions	44
Liverpool Range Wind Farm	> 100 km North	DGRs Issued	Up to 550

8.4 Photomontages

Photomontages have been prepared to illustrate the general likely appearance of the Project following construction (**Table 8.5**). Fifteen locations were selected to represent a range of distances between the viewpoint and wind turbines (from 1.5 to 8.6 km).

The photomontages represent Layout Option A (106 turbines) as it comprises the greater number of wind turbines and would present a worst case visual impact. One photomontage has been used to represent Layout Option B (77 turbines) in order for a comparison between the two layouts to be made, and one photomontage represents the external transmission line running east from the Project.

Table 8.5 Photomontage Locations across the Project site

Photomontage	Viewpoint	Visual Impact	Road	Photo Location
PM1	CW04	Moderate	Sallys Flat Road	road corridor
PM2	CW05	High	Sallys Flat Road	adjoining an associated residence
PM3	CW08	Moderate	Hill End Road	road corridor
PM4	CW10	Moderate	Hill End Road	adjoining a non-associated residence
PM5	CW14	Low	Peel Road	road corridor
PM6	CW16	High	Crudine Road	adjoining a non-associated residence
PM7	CW18	High	Crudine Road	adjoining a non-associated residence
PM8	CW20	High	Crudine Road	adjoining a non-associated residence
PM9	CW21	High	Crudine Road	adjoining a non-associated residence
PM10	CW22	High	Crudine Road	adjoining a non-associated residence
PM11	CW23	High	Crudine Road	adjoining a non-associated residence
PM12	CW26	Moderate	Prices Lane	adjoining a non-associated residence
PM13	CW27	Moderate	Prices Lane	adjoining a non-associated residence
PM14	CW28	High	Sofala Road	road corridor
PM15	CW32	Low	Crown Road	adjoining a non-associated residence

The process used to generate the photomontages and A3 versions of the photomontages are detailed in **Volume 4**. Whilst a professional photomontage provides an image that illustrates a reasonably 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, partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

8.5 Management and Mitigation

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

- Use of a matt and / or off-white finish on the structures to reduce visual contrast between wind turbine structures and the viewing background (this is subject to final turbine selection and aviation safety requirements);

- Limit amount of advertising, signs or logos mounted on wind turbine structures, except those required for safety purposes;
- Undertake landscape planting where screening is deemed appropriate and in accordance with the outcomes of the assessment process;
- Appropriate selection where feasible of materials and colours, together with consideration of reflective properties for ancillary structures;
- Reinstate disturbed soil areas immediately after completion of construction and decommissioning, where practicable, which would include re-contouring and re-seeding with appropriate plant species and local materials where feasible;
- Enforce safeguards to control and minimise dust emissions during construction and decommissioning;
- Limit the height of stockpiles to minimise visibility from outside the Project;
- Minimise activities that may require night time lighting and, if necessary, use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the Project site to minimise glare;
- Location of the main and secondary collector substations, switching station and other ancillary infrastructure have been sited sympathetically with the nature of the locality and away from major roads and residences to mitigate visual impact;
- Tracks have been designed to follow contour lines, to ensure cut and fill in track construction is minimised, and where practicable local materials will be used to reconstitute the disturbed area to minimise colour contrast; and
- The majority of electrical connections within the Project site (i.e. cables between the WTGs) have been designed to be located underground (where possible), in order to further reduce potential visual impacts.

8.6 Summary

The LVIA report detailed the current landscape values, predicted visual influence of the Project and other potential visual effects. A variety of methods were used in the visual assessment of the Project, including public consultation, on-ground surveys, Zone of Visual Influence (ZVI) assessments, photomontage production and assessment of shadow flicker effects.

Landscape analysis has indicated that of 32 viewpoints surrounding the Project, two will have no visual impact, ten will have a low visual impact, eleven will have a moderate visual impact and nine will have a high visual impact. These are worst case estimates, and it is likely that a combination of angle and roadside or property vegetation will screen views of the Project.

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

There are a number of potential visual effects associated with the wind farm. The likely incidence of glinting is impossible to predict, but experience suggests that this occurs relatively rarely. Shadow flicker effects are unlikely to be experienced at any residences. Night time lighting has the potential to be visible from surrounding receptors, however the level of visual impact would diminish over distance and when screened by landform or vegetation. The Project will have some degree of visual influence, however it is unlikely that wind farm projects will ever conform, or be acceptable to all points of view.

The potential and switching station locations and transmission line options are unlikely to result in a significant visual impact for the majority of surrounding residential or public view receptors due to a combination of distance, undulating landform and tree cover.

Overall, the cumulative visual effect of the Project would not result in any significant ‘direct’, ‘indirect’ or ‘sequential’ cumulative impacts when considered against any existing or proposed projects.

CHAPTER 9

Noise Assessment

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9. NOISE ASSESSMENT

Wind turbines emit sound, and as such wind farms need to be carefully designed to ensure they do not pose an unacceptable noise impact on neighbouring residents. The management of wind farm noise is unique from other types of noise source management due to the relationship between wind speeds and subsequent changes in background noise and turbine noise (explained further below). Given these unique characteristics, specific wind farm noise assessment guidelines have been developed. Noise assessments are carried out to predict the likely noise levels for comparison with the South Australian Environmental Protection Authority (SA EPA) *Noise Guidelines for Wind Farms* (February 2003) (SA EPA Guidelines, **Appendix 9**). This document was developed to assess and manage environmental noise impacts from wind farms in South Australia and has been adopted by the NSW Department of Planning and Infrastructure (DoPI). The SA EPA has since prepared revised noise guidelines (*Wind Farms Environmental Noise Guidelines,* 2009); however, these are yet to be implemented in New South Wales (NSW) and are not considered here.

On the 23rd December 2011 the NSW Government released *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines) for public consultation. Proposed within the Draft Guidelines are specific NSW Wind Farm Noise Guidelines which are also subject to public consultation. The Crudine Ridge Wind Farm Environmental Noise Assessment report was commissioned in June 2011 to address the DGRs that were issued in March 2011. Correspondingly the Project has been assessed against those DGRs.

This chapter begins with a summary of noise fundamentals and a description of the phenomena of turbine noise, and then presents the SA EPA compliance criteria contained in the 2003 guidelines. The methodology for predicting noise levels at nearby residences is discussed and the predicted results are presented. Noise associated with wind farm construction activities is also discussed and potential mitigation measures are outlined.

9.1 Noise Fundamentals

Hearing is a fundamental human sense and is used constantly for communication and awareness of the environment. Noise is generally described as being ‘unwanted’ or ‘unfavourable’ sound and, to some extent, is an individual or subjective response because what may be ‘sound’ to one person, may be regarded as ‘noise’ by another.

The measurement and assessment of noise has been developed steadily over the last century, taking into account human response measures such as hearing damage and other potential health effects such as stress. Complex noise measurement and analytical devices have also been developed to facilitate the assessment process.

A-weighting and ‘dBA’: The overall level of a sound is usually expressed in terms of dBA (decibels), which is measured using the ‘A-weighting’ filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. A person’s hearing is most sensitive to sounds at mid frequencies (typically 500 to 4,000 Hertz (Hz)) and less sensitive at lower and higher frequencies. The level of a sound in dBA is considered a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (e.g. the loudness of human speech and a distant motorbike may be perceived differently, although they can be of the same dBA level).

A change of up to 1 dBA in the level of a sound is difficult for most people to detect, whilst a 1 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. **Table 9.1** below presents examples of typical noise levels.

Table 9.1 Typical Noise Levels

Sound Pressure Level (dBA)	Typical Sources	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Source: SLR, 2011

9.1.1 ***Turbine Noise***

There are two main sources of noise emissions from wind turbines. The first is aerodynamic noise from the rotation of the blades. Noise is generated by the blades passing through the air and passing the tower creating a 'swishing' sound, with the noise primarily arising at the tip and back edge of the rotor blade. The noise level increases with increasing wind speed, and thus rotation speed, until the rotation of the wind turbine blades is controlled (e.g. by feathering the blades) at a fixed speed.

The second source of noise is mechanical noise from the operating components of the turbine located in the nacelle. Mechanical noise has virtually disappeared from modern wind turbines, due to improved engineering, with more concern about avoiding vibrations. Technical improvements include elastically dampened fastenings and couplings of the major components in the nacelle, and a certain amount of sound insulation. The basic components themselves, including gearboxes, have developed considerably, with modern wind turbine gearboxes using 'soft' gearwheels; that is, toothed wheels with hardened surfaces and relatively ductile root material.

The noise emitted from turbines is a function of the wind speed, with higher wind speeds producing higher turbine noise levels until the rotation is modulated. However, in a similar way, background noise levels also increase with increasing wind speed, with background noise generally increasing at a greater rate than turbine noise at high wind speeds (SA EPA 2003).

9.1.2 *Substation Noise*

Transformer substations form an integral part of the Project, converting the incoming low voltage power generated by each of the wind turbines to higher voltages suitable for export to the neighbouring electricity network. The Main Collector Substation (MCS) and Secondary Collector Substation (SCS) components are discussed in detail in **Chapter 3** Project Description. Transformers emit a characteristic 'hum' which has been assessed in the context of their potential proposed locations for the purposes of this Environmental Assessment.

9.1.3 *Transmission Lines*

Transmission lines are typically silent in operation and are not normally a source of noise complaint. A slight crackling noise may be heard close to a line during some climatic conditions due to the corona effect, however these are considered negligible and temporary.

9.1.4 *Background Noise*

Background noise is a feature of the ambient acoustic environment and in rural areas it is generated primarily by wind action on vegetation. The level of background noise will vary with wind speed and over a site, depending on the surrounding topography, presence of vegetation and other sources of noise present in an agricultural environment. The ambient background noise of a site forms part of the noise assessment process of a wind farm.

9.1.5 *Construction and Decommissioning*

There will be some noise emissions from the construction and decommissioning of the Project, however such emissions will be localised and temporary. Sources of emissions during construction include vehicle traffic, concrete batching and possibly rock crushing and compressors.

9.1.6 *Scope of SA EPA Guidelines*

The core objective of the SA EPA Guidelines (the Guidelines) is to balance the advantage of developing wind energy projects in South Australia (and adopting States) with protecting the amenity of the surrounding community from adverse noise impacts when taking into account the acoustic environment of that community. The SA EPA Guidelines were also developed to provide guidance for acceptable levels of noise generation from wind turbines on those residents that do not have an agreement with the Project developer; that is, neighbouring landowners which are not part of the wind farm development (i.e., a relevant receiver). However, this does not exempt developers from responsibilities regarding noise amenity for participating landowners who may be affected.

The SA EPA Guidelines do not provide an assessment of the potential for low frequency noise or infrasound, but they do state that after an extensive literature search, the SA EPA is not aware of any infrasound being reported at modern wind farm sites (as opposed to sites containing earlier, downwind turbine models for which infrasound was a characteristic). It should be noted that this view is also maintained within the more recent 2009 SA EPA guidelines.

The SA EPA Guidelines require that neighbouring dwellings are part of an acoustic assessment of turbine noise. Whilst nearby dwellings (i.e., those within around 1-2 km of a wind farm) may perceive some level of turbine noise at particular wind speeds and directions, careful wind farm design and appropriate mitigation measures can ensure noise levels do not exceed guideline criteria.

9.1.7 *SA EPA Noise Criteria (February 2003)*

The SA EPA Guidelines state that:

"The predicted equivalent noise level ($L_{Aeq,\ 10min}$), adjusted for tonality in accordance with these guidelines should not exceed:

- *35 dB(A); or*
- *the background noise level by more than 5 dBA; or*
- *whichever is the greater, at all relevant receivers for each integer wind speed from cut-in to rated power of the WTG."*

The SA EPA Guidelines explicitly state that the "swish" or modulation noise from wind turbines is a fundamental characteristic. However, it specifies that tonal or annoying characteristics of turbine noise should be penalised. If characteristics such as tonality are identified, the predicted noise level is penalised by the addition of 5 dBA.

9.1.8 *Draft NSW Planning Guidelines: Wind Farms (December 2011)*

The DoPI has requested, as per the general approach of the *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines), that the assessment also consider noise criteria based on separate analysis of daytime and night-time background noise data.

The SA EPA Guidelines and the associated noise criteria are established based on analysis of background noise levels measured over a 24 hour period. It is noted that the UK Department of Trade and Industry has prepared guidelines that separate the background noise data into day and night periods. The baseline noise level for the night time period is increased to 43 dB(A) to account for sleep disturbance effects. A reason the SA EPA Guidelines do not require the assessment procedure to be separated into day and night periods is the onerous nature of the guidelines relative to the potential onset of sleep disturbance effects.

9.1.9 *World Health Organisation Guidelines*

The SA EPA Guideline criteria have been developed to minimise the impact on the amenity of those not involved with the Project (i.e., wind farm neighbours). It is recognised however, that where financial agreements exist, developers cannot absolve themselves of the responsibility of ensuring that an adverse effect on an area's amenity does not occur as a result of the operation of the Project. In light of the aforementioned requirement, the Proponent has referred to the World Health Organisation (WHO) criteria (for protection of amenity and avoidance of sleep disturbance) as published in the document *Guidelines for Community Noise*.

The criterion for Project involved residences within this assessment recognises the changed attitudinal response to noise from the wind farm for those financially involved with the Project. Furthermore, the implications of wind turbine noise have been discussed with each of the involved landowners in relation to their property. Therefore the assessment of the adopted external criteria of 45 dBA or the level provided by the SA EPA Guideline criteria, where higher, will be adopted. Effectively this becomes 45 dBA or background plus 5 dBA, whichever is the higher.

9.1.10 ***New South Wales Industrial Noise Policy***

The NSW Industrial Noise Policy (INP) requirements include site selection for background measurements, description of the site and equipment used, graphing of results and amenity noise criteria during each of three periods (Day, Evening and Night).

The proposed site for the Project is in a rural area and therefore the Amenity Criteria for rural residential receivers, as detailed in Table 2.1 in the NSW INP, is applicable.

The criteria vary as a function of time of day. The Day, Evening and Night Periods are defined as,

Day Period	7:00 am - 6:00 pm
	8:00 am - 6:00 pm (Sundays and Public Holidays)
Evening Period	6:00 pm - 10:00 pm
Night Period	10:00 pm - 7:00 am
	10:00 pm - 8:00 am (Sundays and Public Holidays)

The Amenity Criteria (L_{Aeq} level) for the residential noise sensitive locations for the Project are,

Day Period	50 dBA
Evening Period	45 dBA
Night Period	40 dBA

The Intrusiveness Criterion in the INP is based on the rating background level (RBL), where the Criterion is,

L_{Aeq}, 15 min $\leq$ RBL + 5 dBA

This is almost identical to the SA EPA Guidelines (**Section 9.1.7**), the difference being the measurement interval (15 versus 10 minute) and the determination of the background noise level (rating level, based on the 10th percentile of measured background levels, or using a line of best fit through the data points).

The INP states where the measured RBL is less than 30 dBA, then the RBL is considered to be 30 dBA.

In summary, it is evident that the non-Project related residential receivers assessed under the SA EPA *Noise Guidelines for Wind Farms* will generally comply with INP amenity criteria. Furthermore, intrusiveness is also covered by the SA EPA Guidelines.

9.1.11 ***Other Relevant Guidelines***

Other relevant guidelines that address noise impacts relevant to the Project include the *Interim Construction Noise Guideline* (DECCW, 2009), the DECCW *Assessing Vibration: A Technical Guideline*, the DECCW *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* and the *NSW Environmental Criteria for Road Traffic Noise (ECRTN, 1999)*.

Further guidance on noise measurement and prediction is contained within Australian Standard AS4959-2010 Acoustics - Measurement, prediction and assessment of noise from wind turbine generators.

9.2 Methods

The Proponent commissioned Sonus Pty Ltd (Sonus) to conduct an acoustic assessment of the Project, and the full report can be seen in **Appendix 10**. In general, the assessment procedure contains the following steps:

1. Predict and plot the L_{Aeq} 35 dBA noise level contour from the Project under reference conditions. Receivers outside the contour are considered to be within acceptable wind farm noise levels.
2. Establish the pre-existing background noise level at each of the relevant assessment receivers within the L_{Aeq} 35 dBA noise level contour through background noise monitoring. This includes consideration of separate daytime and night-time periods, as required in the Draft Guidelines.
3. Predict wind farm noise levels at all relevant assessment receivers for the wind speed range from cut-in to 12 m/s.
4. Assess the acceptability of wind farm noise at each relevant assessment receiver to the established limits.

9.2.1 *Turbine Noise*

Noise from the wind farm has been assessed based on two planning layout options, consisting of 106 and 77 turbines, respectively. The coordinates of turbines for each layout are provided in **Appendix 3**. The assessment considered the following turbine models with a hub height of 80 m for each layout:

- Layout Option A – 106 Acciona AW77 1.5MW turbines; and
- Layout Option B – 77 Siemens SWT2.3-101 2.3MW turbines.

These turbines were chosen based on the likely “worst case” (highest sound power level) turbine selection available to the Proponent at the time of the assessment. The process included consideration of a number of potential turbines for each layout and subsequent selection of turbines that would result in the highest noise level scenario for that layout. The predictions of noise from the turbines have been based on the sound power level data from the manufacturers which include the following:

- Acciona AW77 :
    - Warranted sound power levels for wind speeds between 3 m/s and 12 m/s; and
    - Octave band sound power level spectra for 8 m/s and 9 m/s, measured at 10 m AGL.
- Siemens SWT2.3-101:
    - Warranted sound power levels for wind speeds between 4 m/s and 18 m/s; and
    - Octave band sound power level spectra for 6 m/s and 8 m/s, referenced at 10 m AGL.

Prior to the predictions, the spectral data were extrapolated to obtain octave band sound power levels associated with the other wind speeds (**Tables 7 and 8**, **Appendix 10**).

The predictions have been conducted without a penalty for the presence of tonal characteristics.

9.2.2 *Substation Noise*

The noise from the proposed substations at the wind farm has been considered against the INP. Three location options are being considered for the MCS, and one location for the SCS. It is proposed that up to two transformers with capacities between 80 to 100 MVA, or a single 180 MVA transformer will be installed at the MCS, and up to three medium voltage transformers will be installed at the SCS. For a description on the potential locations and types of substation, refer to **Chapter 3** Project Description.

The sound power levels of transformers have been derived from the Australian / New Zealand Standard AS/NS60076.10:20097. The worst-case (i.e., highest predicted noise level) transformer selections associated with the potential collector substation arrangement have been used (Table 9, **Appendix 10**).

9.2.3 *Background Noise*

In order to establish the intrusive noise limit, background noise monitoring is required to establish the pre-existing ambient noise environment as a function of wind speed. As wind speed increases the ambient noise level at most receivers generally also increases as natural sources such as wind in trees, etc begin to dominate. The variation in background noise with wind speed is usually quite site specific and related to various physical characteristics such as topographic shielding and the extent and height of exposed vegetation.

Background noise levels were measured at seven locations in the vicinity of the proposed wind farm between the 20th July and the 27th September 2011. The measurements were conducted in accordance with the SA EPA Guidelines.

The seven monitoring locations, summarised in **Table 9.2**, were selected based on initial predictions of the wind farm noise. Preference was given to residences with the highest predicted noise levels and without commercial agreements, subject to access permission.

Table 9.2 Monitoring Locations and Periods

Residence ID	Residence Name	Monitoring Period
CR14	Athlone	21st July 2011 – 24th August 2011
CR18	Glen Daire	21st July 2011 – 24th August 2011
CR28	Willow Downs	21st July 2011 – 24th August 2011
CR33	Trelawney	24th August 2011 – 27th September 2011
HER04	Round Hill	21st July 2011 – 24th August 2011
HER07	Clare Hills	20th July 2011 – 24th August 2011
SFR05	Kotara	20th July 2011 – 24th August 2011

Each noise logger was located in accordance with the SA EPA Guidelines (e.g., at an equivalent distance from the facade of the dwelling and any significant trees whilst minimising the influence of fixed noise sources such as air conditioning units) and placed on the wind farm side of the dwellings.

The background noise level was measured in 10 minute intervals at each of the monitoring locations. Photographs of the noise monitoring equipment at each location are provided in **Appendix 10**.

During the background noise monitoring regime, Wind Prospect CWP measured the wind speed at two wind masts located locally within the wind farm area. The wind speed was measured in 10 minute intervals at various measurement heights on each wind mast.

A HOBO Micro Station Weather Logger H21-002 was also concurrently deployed at residence HER07 which measured rainfall and wind speed at the microphone height (approximately 1.5 m above ground level). The rainfall and wind speed data were collected to determine the periods when weather directly on the microphone may have influenced the measured background noise levels in the vicinity.

The noise data corresponding to any periods of measured rainfall and / or measured wind speed exceeding 5 m/s at the microphone height for more than 90 % of the measurement period were discarded.

Table 9.3 summarises the number of useable data points at each monitoring location, following the removal of wind data which may have been influenced by weather. Data below the cut-in wind speed of the turbine models considered (i.e., 3 m/s at 10 m AGL) have also been removed in accordance with the SA Guidelines. It is noted that the resultant number of useable data points achieves the SA Guidelines minimum requirement of 2,000 data points.

Table 9.3 Useable Data Points

Residence ID	Residence Name	Closest Monitoring Mast	No. of Usable Data Points
CR14	Athlone	SOF 1	2824
CR18	Glen Daire	SOF 1	2835
CR28	Willow Downs	SOF 1	2832
CR33	Trelawney	SOF 2	2595
HER04	Round Hill	SOF 2	2450
HER07	Clare Hills	SOF 2	2538
SFR05	Kotara	SOF 2	2535

Following data removal, the background noise data were correlated with the wind speed data measured at the closest wind mast. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations in accordance with the SA Guidelines. Based on the regression analysis, the background noise level ($L_{A90,10}$) at a range of wind speeds within the operating range of the turbines is provided in **Table 9.4**.

It is noted that where the background noise level could not be determined from the regression analysis due to insufficient data, generally at higher wind speeds, a conservative assumption was made that the background noise level does not increase with wind speed. This is indicated in **Table 9.4** using ***bold italic***.

Table 9.4 Background Noise Levels (dB(A)) – 24 Hour Period

ID	Background Noise Levels (dB(A)) at 10m AGL Wind Speed (m/s) – 24 Hour Period									
	3	4	5	6	7	8	9	10	11	12
CR14	28	30	32	34	36	38	39	40	41	***41***
CR18	29	30	31	32	33	34	35	37	40	***40***
CR28	22	24	26	29	31	33	35	37	38	***38***
CR33	25	28	31	34	37	39	42	44	45	47
HER04	25	27	28	30	32	34	36	37	37	***37***
HER07	29	31	34	37	40	42	43	44	***44***	***44***
SFR05	28	30	32	35	37	40	41	***41***	***41***	***41***

The background noise levels in **Table 9.4** have been used to established noise criteria for each residence, in accordance with the SA EPA Guidelines. Where background noise monitoring has not occurred at a residence, the measured background levels at the closest monitoring location, located on the same side of the wind farm as the residence, have been used to derive the criteria.

9.2.4 *Separated Day and Night Background Noise Levels*

Based on the background noise level data collected, data corresponding to the daytime (7 am to 10 pm) and night-time (10 pm to 7 am) periods were analysed. Based on the regression analysis, the background noise level ($L_{A90,10}$) at a range of wind speeds within the operating range of the turbines is provided in **Table 9.5** and **Table 9.6**.

It is noted that where the background noise level could not be determined from the regression analysis due to insufficient data, generally at higher wind speeds, a conservative assumption was made that the background noise level does not increase with wind speed. This is indicated using ***bold italic*** in **Table 9.5** (daytime period) and **Table 9.6** (night-time period).

Table 9.5 Background Noise Levels (dB(A)) – Daytime Period (7 am – 10 pm)

ID	Background Noise Levels (dB(A)) at 10 m AGL Wind Speed (m/s) – Daytime Period									
	3	4	5	6	7	8	9	10	11	12
CR14	32	33	34	36	37	38	40	41	43	***43***
CR18	30	31	32	33	34	35	37	39	41	***41***
CR28	24	26	28	30	33	35	37	38	***38***	***38***
CR33	26	29	33	36	39	41	43	45	46	47
HER04	28	28	30	31	33	35	36	37	***37***	***37***
HER07	31	33	35	37	40	42	44	45	***45***	***45***
SFR05	30	32	33	35	37	38	40	41	***41***	***41***

Table 9.6 Background Noise Levels (dB(A)) – Night-time Period (10 pm – 7 am)

ID	Background Noise Levels (dB(A)) at 10 m AGL Wind Speed (m/s) – Night-time Period									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CR14	24	26	28	31	34	36	37	***37***	***37***	***37***
CR18	27	28	29	30	31	32	33	33	34	***34***
CR28	19	21	23	25	27	29	31	33	35	***35***
CR33	23	25	37	29	31	32	34	35	***35***	***35***
HER04	22	23	26	28	30	32	***32***	***32***	***32***	***32***
HER07	26	29	33	37	40	42	***42***	***42***	***42***	***42***
SFR05	25	26	29	34	39	44	47	***47***	***47***	***47***

With the data set separated into the daytime and night-time periods, the available data points for regression analysis associated with the night-time period was no greater than 970 points, which is less than the 2,000 points. Further, the use of the night-time period delivers more onerous criteria than those of the SA EPA Guidelines.

9.2.5 *Site Establishment and Construction*

The site establishment and construction of a wind farm comprise 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, loaders, excavators, generators, cranes and, subject to local conditions, possibly blasting.

To assess construction noise in accordance with the DGRs, the DECCW's *Interim Construction Noise Guideline 2009* (the ICN Guideline) has been considered.

The ICN Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. However, the ICN Guideline does establish a quantitative approach, whereby "management levels" are defined based on the existing RBL. The management levels as defined by the ICN Guideline are provided in **Appendix 10**.

Construction: The equipment and activities on-site will vary throughout project construction, depending on the various stages of construction. The predicted noise from construction activity is presented as a worst case (highest noise level) scenario, where it is assumed all equipment is present and operating simultaneously on site for each stage of construction.

The weather conditions used for the predictions are the most conducive for the propagation of noise, comprising of an overcast day with a breeze from the construction activity to the receiver. Other weather conditions would result in lower noise levels than those predicted for daytime construction.

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.

The Technical Guideline provides an emphasis on construction activity implementing feasible and practicable vibration reduction measures and does not set mandatory standards or objective criteria.

Traffic Noise: Traffic generated by the Project during its construction phase has been evaluated in **Chapter 12** and **Appendix 14**. Traffic generated by the Project during its operational phase will be insignificant in the context of existing road use in the region.

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* (the ECRTN).

Traffic noise criteria are provided for a range of scenarios. The most appropriate classification for the Crudine Ridge 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 and as such provides a conservative (more stringent) approach.

The criteria are equivalent ($L_{Aeq,\ 1\ hour}$) noise levels of no greater than 55 dB(A) during the daytime (7 am to 10 pm) and 50 dB(A) during the night-time (10 pm to 7 am). This noise level is to be achieved outside, at a distance of 1.5 m from the facade of a dwelling.

9.3 Existing Situation

The Project is situated on 17 properties, with a total of seven dwellings within 2 km of the Project. Five of these dwellings are inhabited, with two belonging to involved landowners (associated dwellings) and three owned by neighbouring landowners (non-associated dwellings). The two uninhabited dwellings also belong to involved landowners. **Table 9.7** summarises the existing situation with respect to the seven dwellings identified within 2 km of the proposed wind farm layouts.

Table 9.7 Proximity and Status of Dwellings within 2 km of the Proposed Layouts

Residence ID	Residence Name	Associated Dwelling	Inhabited	Minimum Distance (km)	
				Layout A	Layout B
CR28	***Willow Downs***	***No***	***Yes***	1.993	1.981
CR34	***Linwood***	***No***	***Yes***	1.992	1.996
HER04	***Round Hill***	***Yes****	***Yes***	1.719	1.656
HER06	Illoura	Yes	No	1.764	1.735
HER07	Clare Hills	Yes	Yes	1.994	1.990
HER12	Oakhills	Yes	No	1.367	1.522
PL03	Glenmore	Yes	Yes	1.612	1.654

**A Neighbour Agreement has been obtained.*

The Draft Guidelines encourage wind farm proponents to seek agreement from non-associated landowners within 2 km of any proposed wind turbines (the Gateway). Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent considers it prudent to seek such an agreement. As such, with respect to the findings of this chapter and **Chapter 8** Landscape and Visual Impact, the Proponent has entered into a Neighbour Agreement with the owner of HER04.

In relation to CR28 and CR34, the Proponent considers the current minimum distances to be sufficiently close to 2 km not to warrant a separate agreement. This position is with regard to both the Noise and Landscape assessments referred to above. Furthermore, if deemed necessary by the DoPI, there is potential to micro-site the nearest wind turbines to a location outside of the Gateway, a minimum movement of 5 to 20 m from current locations.

The Castlereagh Highway is sufficiently far away to the east of the Project site that background noise levels at most receptor locations will not be affected by road traffic noise. All properties surrounding the proposed site have an ambient background noise environment that is determined by predominantly natural sources which are largely wind influenced.

With respect to the typical climactic conditions, the prevailing wind directions are east and west. The district receives approximately 650 mm of rainfall annually.

9.4 Potential Impacts

9.4.1 *Impacts from Turbine Noise*

The assessment figures contained within the Environmental Noise Assessment report, **Appendix 10,** depict the predicted WTG noise level curves and statistical results for each layout and WTG, as previously detailed in **Section 9.2.1**.

SA EPA Guidelines: The operation of the wind farm has been considered against the stringent SA EPA Guidelines based on Acciona AW77 turbines installed for Layout A and Siemens SWT2.3-101 turbines for Layout B, with a hub height of 80 m for both layouts. Based on predictions, the noise from the turbines is predicted to adhere to the SA EPA Guidelines at all dwellings for both layouts. For further detail refer to **Appendix 10.**

Based on the above, for any turbine model with sound power levels and hub height that are equal to or less than that assessed for the Acciona AW77 and Siemens SWT2.3-101 turbines, the respective proposed planning layouts can achieve the stringent requirements of the SA EPA Guidelines.

If a turbine model with higher sound power levels or an alternative turbine hub height is later considered, then the Proponent is committed to demonstrating compliance with the SA EPA Guidelines prior to construction, in a form similar to this assessment.

Draft Guidelines: The operation of the wind farm has also been considered against separate daytime and night-time background noise levels, as required by the Draft Guidelines. It is noted that as a result of the separation of data points, the night-time criteria are more stringent than the daytime criteria. Assessment of Layout A, based on installation of Acciona AW77 turbines, predicted compliance with the relevant criteria at all residences at all wind speeds, except at CR34, which exceeds the criteria by 1 dB for 6 m/s and 7 m/s wind speeds. To achieve compliance at all residences a number of noise reduction strategies have been considered. Several operating scenarios have been determined which are predicted to result in compliance at all residences (see **Table 13, Appendix 10**). Assessment of Layout B, based on installation of Siemens SWT2.3-101, predicted compliance with the relevant criteria at all residences at all wind speeds. For further detail refer to **Appendix 10.**

Compliance: Once the final turbine model has been selected, the noise assessment will be re-run to determine final noise modelling for the Project. Should there prove to be any exceedances at this stage, they will be resolved through micro-siting turbine positions, the removal of turbines, landowner agreements, or the reduction of turbine operational noise, whichever is deemed the most acceptable and appropriate solution to achieve compliance.

Predicted external noise levels will be further mitigated by shielding effects of the building and surrounding vegetation, with the anticipated internal noise levels similarly reduced by the façade of the dwelling itself. It should be noted that all predicted noise levels are considered to be conservative with the model assuming ‘hard ground’, average downwind propagation from all wind turbines to each receiver and a well developed moderate ground based temperature inversion, a scenario which cannot be re-created in reality.

9.4.2 *Tonality*

As indicated above, the predictions have been conducted without a penalty for the presence of tonal characteristics. To provide certainty, the Proponent will seek a guarantee from the manufacturer as part of the procurement process. The general form of the guarantee should be that a penalty for tonality is not applicable at any residence when tested in accordance with an accepted methodology. Such a methodology may include that provided in the Draft Guidelines.

9.4.3 *Modulation*

Amplitude modulation, or “swish”, is an inherent noise character associated with wind farms. The SA EPA Guidelines explicitly account for “swish” as a fundamental characteristic of noise from a wind farm regardless of its depth, provided that it is generated by a properly maintained and operated wind turbine or wind farm. This is a key reason for the stringency of the SA Guidelines.

The ability to hear “swish” depends on a range of factors. It will be most prevalent when there is a stable environment (temperature inversion) at the wind farm and the background noise level at the listening location is low. In addition, “swish” is greater when located cross wind from a wind turbine. It is noted that whilst the amplitude modulation is greater at a cross wind location, the actual noise level from the wind farm will be lower than at a corresponding downwind location (the predicted noise levels conservatively assume that each residence is located downwind of all turbines).

The conditions noted above are most likely to occur when wind speeds at the wind farm are low under a clear night sky. The Van Den Berg effect is an increase of the modulation depth from a wind farm under very specific meteorological and operational conditions which include those conditions described above.

The Van Den Berg effect was observed on a flat site in Europe under specific conditions and in the two matters before the NSW Land and Environment Court (Gullen Range Wind Farm NSW LEC 41288 of 2008 and Taralga Wind Farm NSW LEC 11216 of 2007), it has been determined by the relevant meteorological experts that the required meteorological conditions to trigger the effect were not a feature of the environment. In Gullen Range (NSW LEC 41288 of 2008), the meteorological analysis prepared by Dr Chris Purton concluded that suitable conditions for this effect were not a feature because of the elevated ridgeline location of the wind farm (Purton, evidence NSW LEC 41288 of 2008).

A specific assessment of the meteorological conditions of the Project with respect to the Van Den Berg effect has not been made. Notwithstanding, if suitable conditions did exist to regularly generate high levels of swish, then there is no scientific research to indicate that the stringent SA EPA Guidelines do not adequately account for it. Indeed, given the conditions are more likely to occur at night, then sleep disturbance would be the main issue to address, and the noise standards applied by the SA EPA Guidelines to wind farms are significantly more stringent than limits established for the potential onset of sleep disturbance. In addition, an assessment has been made against the background noise data collected during the night time period only, which is a more onerous assessment than that required under the SA Guidelines.

9.4.4 ***Low Frequency Noise and Infrasound***

Low frequency noise is not clearly defined but is generally regarded to mean noise in the range of 10-200 Hz. Noise occurring at frequencies below 20 Hz is often referred to as infrasound (**Appendix 11**). The range of human hearing is 20-20,000 Hz, with 1 dB being the smallest change in noise that humans can detect. Low frequency noise is almost always present in an ambient quiet background, produced, for example, by machinery, transport, structure-borne noise and natural sources such as wind, waves and thunder.

Notwithstanding, predictions of the C-weighted noise level (the C-weighting is used to indicate the low frequency content) at residences have been made based on the worst-case (highest noise level) sound power level spectra for the Acciona AW77 and Siemens SWT2.3-101 turbines, for Layouts A and B, respectively. The predictions have considered the available sound power level data for frequencies down to 20 Hz.

Based on the predictions, the low frequency noise from the wind farm will be no greater than 55 dB(C) and 50 dB(C) at all residences for Layouts A and B, respectively. These levels are well below low frequency noise limits considered by the NSW authorities for recent developments.

Older models of downwind turbines have had problems associated with low frequency noise and infrasound, however this has been taken into consideration by the wind industry and large, modern turbines use a well balanced upwind design which does not pose the same issues. Research has been carried out on both audible and inaudible noise from modern wind turbines in the UK, USA and Europe. Studies in Germany found that modern wind turbines emit sound at extremely low levels in the infrasound range (less than 20 Hz) which is far below the human detection threshold and far below levels which can cause any adverse human impacts (Klug 2002, in **Appendix 11**). Further, a recent study compared levels of infrasound emitted from two Australian wind farms with those emitted by waves on an Australian beach and with the Central Business District (CBD) of an Australian city. Results found that infrasound emissions from the wind farms were lower than, or on par with those found at the beach or within the CBD of Adelaide (Sonus 2010).

The main impact of low frequency noise to humans is that of annoyance. Research to date has not shown any health effects at the levels normally associated with operational wind turbines.

Furthermore, other research conducted into low frequency noise from modern wind turbines has shown that the levels of low frequency noise is below accepted thresholds and is therefore not considered to be a problem (British Wind Energy Association 2005).

9.4.5 *Substation Noise Impacts*

Noise from the MCS and SCS has been predicted and summarised in **Appendix 10**. Based on the predictions, the noise level at the worst-case residence (highest predicted noise level) will be no greater than 12 dB(A). This level comfortably achieves the conservative criteria of 30 dB(A) developed under the INP, and as such will not adversely impact on the amenity of residences in the locality of the Project.

9.4.6 *Transmission Lines*

Operational noise associated with the proposed transmission line is expected to be negligible as transmission lines are typically silent in operation and are not normally a source of noise complaint. There would be a small number of vehicular movements and occasional helicopter patrols during inspections and routine maintenance along the easement. These practices are generally considered acceptable across other transmission lines. In the unlikely event that complaints are received in relation to noise generation from maintenance activity, appropriate action would be taken by the Proponent to reduce any excessive noise impact.

9.4.7 *Impacts from Construction and Decommissioning*

Construction: The separation distance of 1.65 km is approximately that of the closest non-associated dwelling to a proposed WTG. Greater distances than 1.65 km will result in lower noise levels than that presented below in **Table 9.8**. The required separation distance in order to achieve 10 dB(A) above the RBL (i.e., a limit of 40 dB(A)) is provided in **Table 9.8**.

Table 9.8 Predicted construction noise levels

Phase	Main Plant and Equipment	Predicted Noise Level at 1650m (dB(A))	Separation to Achieve 40 dB(A) Criterion (km)
Site set-up and civil works	Generator Transport truck Excavator Low loader	40	1.65
Road and hardstand construction	Mobile rock crushing plant Dozer Roller Low loader Tipper truck Excavator Scraper Transport truck	46	2.4
Excavation and foundation construction	Excavator Front end loader Concrete batching plant Mobile rock crushing plant Truck-mounted concrete	46	2.4

Phase	Main Plant and Equipment	Predicted Noise Level at 1650m (dB(A))	Separation to Achieve 40 dB(A) Criterion (km)
	pump Concrete mixer truck Mobile crane Transport truck Tipper truck		
Earthing	Percussion drilling rig	44	2.1
Electrical installation	Rock trencher Concrete mixer truck Low loader Tipper truck Mobile crane	46	2.4
Turbine delivery and installation	Extendable trailer truck Low loader Mobile crane	41	1.8

Based on the predicted noise levels, it is expected that construction noise will be greater than 40 dB(A) and less than 75 dB(L_{Aeq}) at a distance of 1.65 km. In accordance with the ICN Guideline it is expected that a dwelling located 1.65 km from construction activity may be “noise affected” but not “highly noise affected”. Therefore, the Proponent will apply all feasible and reasonable work practices to meet the noise affected level, and will inform any impacted residents of the proposed construction work.

Construction Vibration: 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 Guideline are in the order of 20 to 100 m. The 100 m distance is a conservative estimate, with vibration from these activities unlikely to be detectable to humans at such a distance.

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

If construction activities do occur within 100 m of a dwelling, it is recommended that a monitoring regime is implemented during these times to ensure compliance with the Technical Guideline.

Traffic Noise: Construction activity will incorporate passenger vehicle and heavy vehicle movements to and from the site along local roads in the vicinity of the wind farm. These vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles.

The daytime criterion provided by the ECRTN is an equivalent ($L_{Aeq,\ 1\ hour}$) noise level of 55 dB(A) during any given hour. It is predicted that at a distance of 10 m 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, the noise level of 20 passenger vehicles and 6 heavy vehicle movements could be accommodated in an hour at a dwelling that is 20 m from the roadside. It is noted that care should be taken to avoid the acceleration of trucks and the use of truck engine brakes in close proximity to dwellings.

9.4.8 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. A development would need to be located within approximately 2 to 3 km of the Project in order to present a possible cumulative noise impact. The Project area is classified as rural and residences are dispersed across the landscape, and the main sources of current noise levels are farming activities. All known proposed and existing wind farms are outside a 3 km radius and so would not interact with the Project to produce a further cumulative noise effect.

9.5 Management and Mitigation

9.5.1 *Turbine Noise*

After final turbine selection and Project refinement, additional noise modelling will be carried out, pre-construction, to ensure that the predicted noise levels are within required criteria based on the chosen WTG.

If, during operation, it is found that WTG noise impacts are non-compliant with criteria used for the assessment due to temperature inversion, atmospheric stability or other reasons, then an 'adaptive management' approach can be implemented to mitigate or remove the impact. This process could include:

- Investigating the nature of the reported impact;
- Identifying exactly what conditions or times lead to undue impacts;
- Consideration of operating WTGs in a reduced 'noise optimised' mode during offending wind directions and at night-time (sector management);
- Providing acoustic upgrades (glazing, façade, masking noise etc) to affected dwellings; and
- Turning off WTGs that are identified as causing the undue impact.

9.5.2 *Substation Noise*

If the preferred substation location is non-compliant with NSW Industrial Noise Policy the following mitigation measures would be applied as appropriate:

- The use of transformer(s) with a lower sound power level output;
- Landscaping, including raised embankments and vegetation, around the substation; and
- Providing acoustic upgrades (glazing, façade, masking noise etc) to affected dwellings.

9.5.3 *Construction and Decommissioning*

Noise emissions from construction, major maintenance or decommissioning / refurbishment work can be minimised by continued adequate maintenance of construction vehicles, erection of temporary acoustic barriers and propriety enclosures around machines, and by ensuring work activities occur within recommended working hours, according to the SA EPA, where practicable (i.e., 7 am to 6 pm Monday to Saturday and 8 am to 1 pm Sundays). Any proposed work outside of these hours will entail close consultation with the affected community, including use of a feedback mechanism to allow the community to submit complaints and the Proponent or construction team to respond. Administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works may also be employed. Further, any noise emissions from construction activity will be localised and temporary.

To minimise potential noise impacts associated with night-time deliveries, there will be prior notification to the affected public and restricted use of exhaust / engine brakes in built-up areas.

9.6 Summary

Wind turbine noise has been predicted and assessed against relevant criteria prescribed by the SA EPA Guidelines, WHO guidelines and the *Draft NSW Planning Guidelines: Wind Farms* where appropriate.

When assessed against the SA EPA Guidelines, Layout A (106 WTG), equipped with the Acciona AW77 WTG was predicted to comply with all relevant noise criteria and WHO guidelines at all neighbouring dwellings. Layout B (77 WTG), equipped with the Siemens SWT 2.3-101 WTG was predicted to comply with all relevant noise criteria and WHO guidelines at all neighbouring dwellings.

Further, when assessed against daytime and night-time criteria provided by the DoPI in the Draft Guidelines, predictions indicate that Layout A (106 WTG), equipped with the Acciona AW77 WTG could achieve compliance with the relevant criteria at all neighbouring dwellings with the implementation of recommended noise mitigation strategies. Layout B (77 WTG), equipped with the Siemens SWT 2.3-101 WTG was compliant with the relevant criteria at all neighbouring dwellings.

Once the final turbine model has been selected, the noise assessment will be re-run to determine final noise modelling for the Project. Any exceedances will be resolved through landowner agreements, reducing turbine operational noise, micro-siting turbine positions or by the removal of turbines, whichever is deemed the most acceptable and appropriate course of action.

Construction activity has been assessed and the ‘worst case’ scenarios modelled were found to be generally acceptable given the temporary and limited duration of the works.

CHAPTER 10

Ecological Assessment

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10. ECOLOGICAL ASSESSMENT

Eco Logical Australia Pty Ltd (ELA) was commissioned to undertake an ecological assessment of the area proposed to be affected by the Project. The full report is available in **Appendix 12.**

This chapter draws from that report and summarises aspects of the methods used to capture data and the nature of the existing ecological features of the Project site. More pertinently an assessment of potential impacts, proposed avoidance, mitigation and management measures and an offset strategy with respect to those impacts are also summarised.

10.1 Legislative Framework

10.1.1 *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*

A Referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in November 2011 addressing the likely impacts of the Project on matters of National Significance, and in particular on the Box-Gum Woodland (BGW) within the Project Site, listed as Critically Endangered under the EPBC Act. Prior to this, discussions were undertaken between the Proponent and ELA and subsequent re-design work undertaken with the view to minimise impacts on BGW wherever practicable. However, the Project was designated a Controlled Action under the EPBC Act on the 29th February 2012 due to the residual level of impact which would result from the construction of the wind farm.

Consequently, Department of Planning and Infrastructure (DoPI) has requested that the assessment for the Project under Part 3A be subject to a one-off accredited assessment process and agreed that the assessment would be subject to the general administrative steps outlined in the New South Wales (NSW) Assessment Bilateral administrative procedure. Subsequently, in March 2012, SEWPaC provided the Proponent with supplementary Director-General's Requirements (DGRs) which apply to the accredited assessment process.

EPBC Act Significance Assessments have been conducted for those Matters of National Environmental Significance (NES) considered to have the potential to occur within the study area. All matters relating to threatened species and communities are addressed in this chapter and **Appendix 12**. The full list of DGRs can be found in **Appendix 5** and **Table 5.2** in **Chapter 5** Planning Context to provide ease of reference and to demonstrate compliance with the supplementary DGRs.

10.1.2 *NSW Legislation*

The Project is also assessed under the following NSW environmental acts and plans:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Threatened Species Conservation Act 1995;
- Fisheries Management Act 1994;
- Noxious Weeds Act 1993;
- State Environmental Planning Policy 44 (Koala Habitat);
- Mid Western Regional and Bathurst Regional Council's Local Environmental Plans (LEPs); and

- Bathurst Regional (Interim) Development Control Plan (DCP) (Mid Western Regional Council (MWRC) has no standard DCP, and no regulations or objectives specific to wind farm developments);

10.2 Methods

To determine the nature of the existing environment and any potential impacts, ELA conducted a literature review, site reconnaissance, vegetation mapping, flora and fauna surveys and Biobanking surveys of the study area.

10.2.1 *Literature Review*

A review of all readily available literature, database records, imagery and maps pertaining to the ecology of the study area and surrounding locality provided important background information which formed the basis of future assessment work. A full reference list is available in **Appendix 12**. The Roadside Management Guidelines (MWRC 2011) and Roadside Vegetation Assessment Report document***s*** were made available by MWRC and a review of these was also conducted.

10.2.2 *Site Reconnaissance*

Site reconnaissance was undertaken on 27th to 29th October 2008 prior to the detailed field surveys, to verify site access, broad vegetation types and condition, fauna habitat present on-site and to select locations for the detailed surveys. This information was then used in conjunction with the DGRs and Biobanking "species requiring survey" to determine the requirements for the detailed surveys.

10.2.3 *Vegetation Mapping*

Vegetation mapping occurred across six survey periods as a result of layout changes, October 2008, November 2008, January 2009, March 2011 (two survey periods) and April 2011. Vegetation boundaries were mapped using a number of tools including, aerial photographs, maps, ground-truthing, visual observations and predictions.

10.2.4 *Flora and Fauna Surveys*

Detailed flora and fauna surveys were undertaken across the study area from November 2008 to October 2011 in accordance with Department of Environment and Conservation (DEC) *Threatened Biodiversity Survey and Assessment Guidelines Working draft* (DEC 2004a), the DGRs and "species requiring survey" as determined by the Biobanking Credit Calculator. Survey periods were designed to target species when most detectable, active or in flower, as described in **Appendix 12**.

10.2.5 *Biobanking*

The Biobanking Assessment was undertaken in accordance with the Biobanking Assessment Methodology and Credit Calculator Operational Manual (NSW DECC 2009). The Biobanking Credit Calculator required targeted surveys for ten threatened flora and five threatened fauna species. Surveys were undertaken for all but two of the species listed, as no potential habitat was present at the site for one species, and another has since been delisted from the TSC Act.

10.3 Existing Situation

10.3.1 *Vegetation Types*

Four Central West Catchment Management Authority (CMA) Revised Biometric Vegetation Types are present across the Project site and surrounding locality, as displayed in **Figure 10.1** including:

- CW117: Broad-leaved Peppermint – Brittle Gum – Red Stringybark dry open forest of the South Eastern Highlands;
- CW176: Red Stringybark – Scribbly Gum – Red Box – Long-leaved Box shrub – tussock grass open forest of the NSW South Western Slopes Bioregion;
- CW206: Wet tussock grasslands of cold air drainage areas of the tablelands;
- CW209: White Box – Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion;

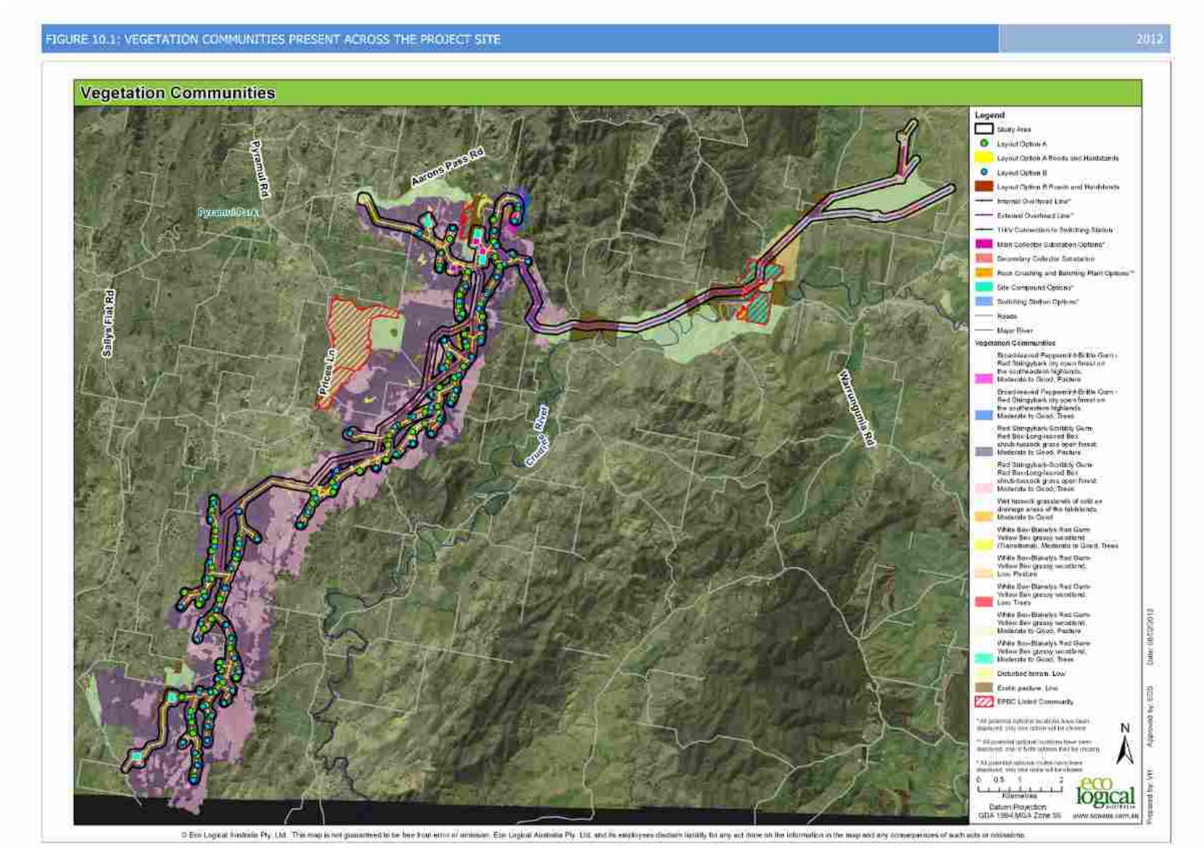

Figure 10.1 Vegetation communities present across the Project site
(An A3 size version of this Figure is displayed in Volume 2)

CW209 White Box – Blakely's Red Gum – Yellow Box (Box Gum Woodland equivalent) is listed as an Endangered Ecological Community (EEC) under the New South Wales *Threatened Species Conservation Act 1995* (TSC Act) and as a Critically Endangered Ecological Community (CEEC) under the EPBC Act. This vegetation type is considered to have been cleared significantly (85 %) within the Central West CMA.

As a general rule, condition of vegetation types across the Project site will vary according to the presence or absence of grazing, period of spelling, and rainfall. Given the study area is used mainly for agricultural purposes these vegetation types are impacted by weed invasion, grazing intensity and soil disturbance to varying degrees, depending on the land use practices implemented on each property.

Within the Project site, the vegetation corridors are somewhat fragmented, with dense native vegetation on the steepest slopes of the ranges, away from proposed wind farm infrastructure, with spurs and gentle slopes supporting lightly wooded areas. Grasslands occur over a majority of the Project area, within which the majority of the Project infrastructure has been sited. Further description of the vegetation types and dominant species can be found in **Appendix 12**.

10.3.2 *Flora*

A total of 244 species of vascular plants, 161 native and 83 exotic species, were recorded across the study area. Potential habitat exists for seven threatened species (**Appendix 12**), however only one species, *Swainsona recta* (Small Purple-pea), was recorded across the Project site. Only one Rare or Threatened Australian Plant (RoTAP) was found. There was no regionally significant species listed by either Mid-Western Regional or Bathurst Regional Councils, as both rely on the OEH databases for their vegetation information. **Table 10.1** below provides a brief overview of flora species in the area, **Figure 10.2** provides the locations of each flora survey and full details are presented in **Appendix 12**. The recorded locations of the threatened flora species, *Swainsona recta*, can be found in **Figure 10.4**.

Table 10.1 Flora present within the study area

Category	Species
Common General flora	*Eucalyptus macrorhyncha* (Red Stringybark), *E. polyanthemos* (Red Box), *E. goniocalyx* (Long-leaved Box), *E. rossii* (Inland Scribbly Gum), *E. dives* (Broad-leaved Peppermint), *E. mannifera* (Brittle Gum), *E. blakelyi* (Blakely's Red Gum), *E. melliodora* (Yellow Box), *Acacia dealbata* (Silver Wattle), *Indigofera australis* (Australian Indigo), *Cassinia arcuata* (Sifton Bush), *Joycea pallida* (Silvertop Wallaby Grass), *Bothriochloa decipiens* (Red Grass), *Microlaena stipoides (Weeping Grass)*, *Austrodanthonia* sp., *Austrostipa scabra*, *Lomandra filiformis* (Wattle Mat-rush), *Cymbonotus lawsonianus*, *Euchiton sphaericus*, *Juncus usitatus*, *Gonocarpus* sp., *Asperula conferta* (Common Woodruff), *Geranium* sp., *Veronica plebeia* (Trailing Speedwell), *Hydrocotyle pedunculatus*, *Goodenia hederacea* subsp. *hederacea* (Forest Goodenia), *Oxalis perennans, Olearia elliptica* (Sticky daisy bush), *Pteridium esculentum* (Bracken), *Wahlenbergia communis* (Tufted Bluebell), *Lagenophora gracilis* (Slender Lagenophora), *Haloragis heterophylla* (Rough Raspwort), *Eragrostis parviflora* (Weeping Lovegrass), *Carex appressa* (Tall Sedge), *Elymus scaber*, *Poa labillardierei* (Tussock Grass), *Pultenaea microphylla*, *Lissanthe strigosa* (Peach Heath), *Melichrus urceolatus* (Urn-heath), *Bothriochloa macra*, *Themeda australis* (Kangaroo Grass), *Aristida* sp., *Desmodium varians* (Slender Tick-trefoil)
Threatened flora	*Swainsona recta* (Small Purple-pea)
Rare or Threatened Australian Plant flora	*Discaria pubescens* (Hairy Anchor Plant)

Note: Not all species have a 'common name'.

Exotic Species: Five weed species listed as noxious weeds (NW) under the NSW *Noxious Weeds Act 1993* for the Mid-Western Regional and Bathurst Regional LGAs were recorded within the study area, three of which are also listed as a Weed of National Significance (WoNS).

Weeds accounted for approximately 34 % of all species recorded across the study area and often occurred in localised patches in paddocks, such as in sheep camps. Exotic species common throughout the study area, NW and WoNS are provided in **Table 10.2**.

Table 10.2 Exotic species present within the study area

Category	Species
Common exotic species	*Acetosella vulgaris* (Sorrel), *Bromus catharticus* (Prairie Grass), *Carthamus ianatus* (Saffron Thistle), *Centaurium* spp., *Cirsium vulgare* (Scotch Thistle), *Conyza bonariensis* (Flaxleaf Fleabane), *Eleusine tristachya* (Goose Grass), *Hypochaeris glabra* (Smooth Catsear), *Hypochaeris radicata* (Catsear), *Lolium spp.*, *Medicago spp.*, *Paronychia brasiliana* (Chilean Whitlow Wort), *Tolpis umbellate* (Yellow Hawkweed), *Trifolium dubium*, and *Vulpia* spp..
NW	*Hypericum perforatum* (St. John's Wort), *Nassella trichotoma* (Serrated Tussock), *Rosa rubiginosa* (Sweet briar), *Rubus fruticosus* [aggregate species] (Blackberry), and *Salix* spp. (Willow species).
WoNS	*Nassella trichotoma* (Serrated Tussock), *Rubus fruticosus* [aggregate species] (Blackberry) and *Salix* spp. (Willow species).

Note: Not all species have a 'common name'.

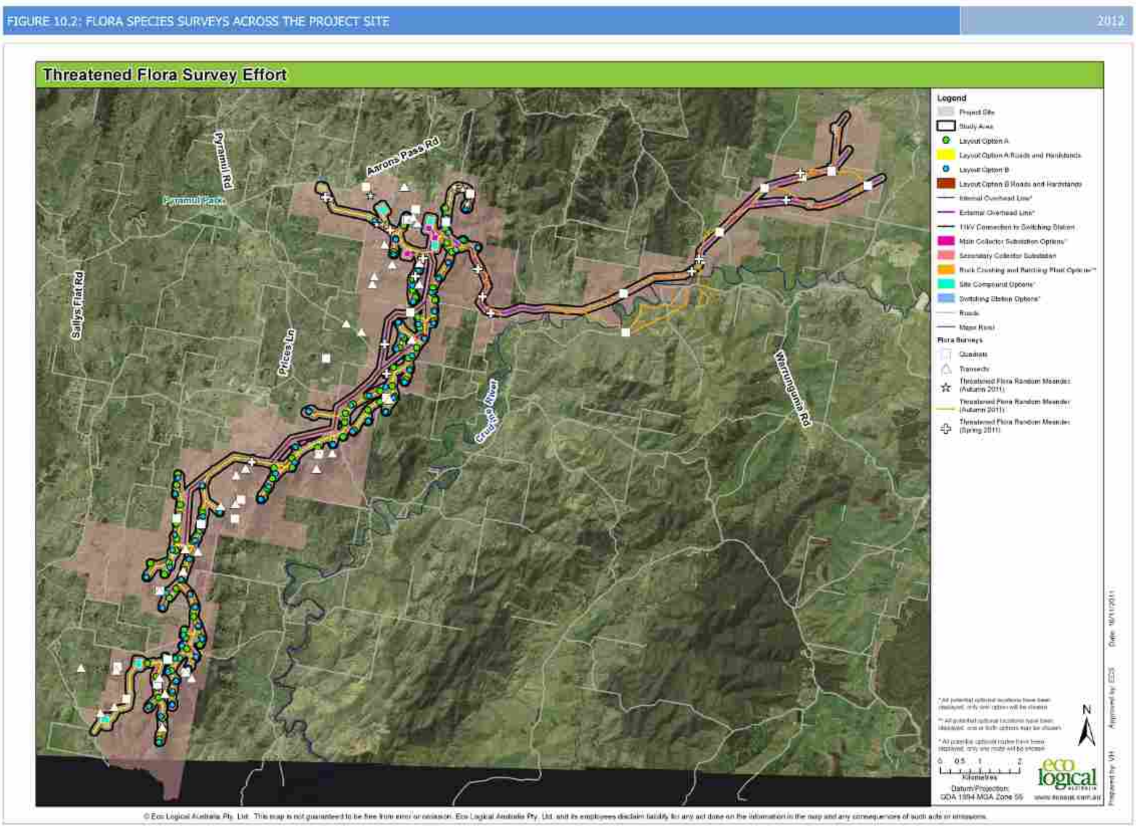

Figure 10.2 Flora species surveys across the Project site
(An A3 size version of this Figure is displayed in volume 2)

10.3.3 *Fauna Habitat*

The Project site supports a diversity of habitat types including woodland, grassland, farm dams, ephemeral creeks, rocky outcrops and hollow-bearing trees which provide habitat for birds, bats, mammals, frogs and reptiles, including some threatened species (see below). A summary of key habitats present is discussed in **Appendix 12**.

10.3.4 *Fauna Groups*

A total of 136 fauna species (130 native, 6 introduced) were recorded across the study area (see **Appendix 12** for full list):

- At least 93 bird species (three additional species may have been present, identified to genus level only), including 1 introduced;
- 11 reptile species;
- 5 frog species;
- 14 terrestrial / arboreal mammal species (including 5 introduced); and
- At least 13 microbat species (five additional species were identified to genus only, or with low certainty).

From these groups, a variety of threatened species have also been previously recorded within the locality. Those species previously recorded (BRC 2011; Birds Australia 2009; OEH 2011c) or considered to have the potential to occur (SEWPaC 2011) are listed in **Appendix 12** together with their conservation status and an assessment of the likelihood of occurrence. **Figure 10.3** provides the locations of each fauna survey and **Figure 10.4** provides the recorded threatened species found across the Project site.

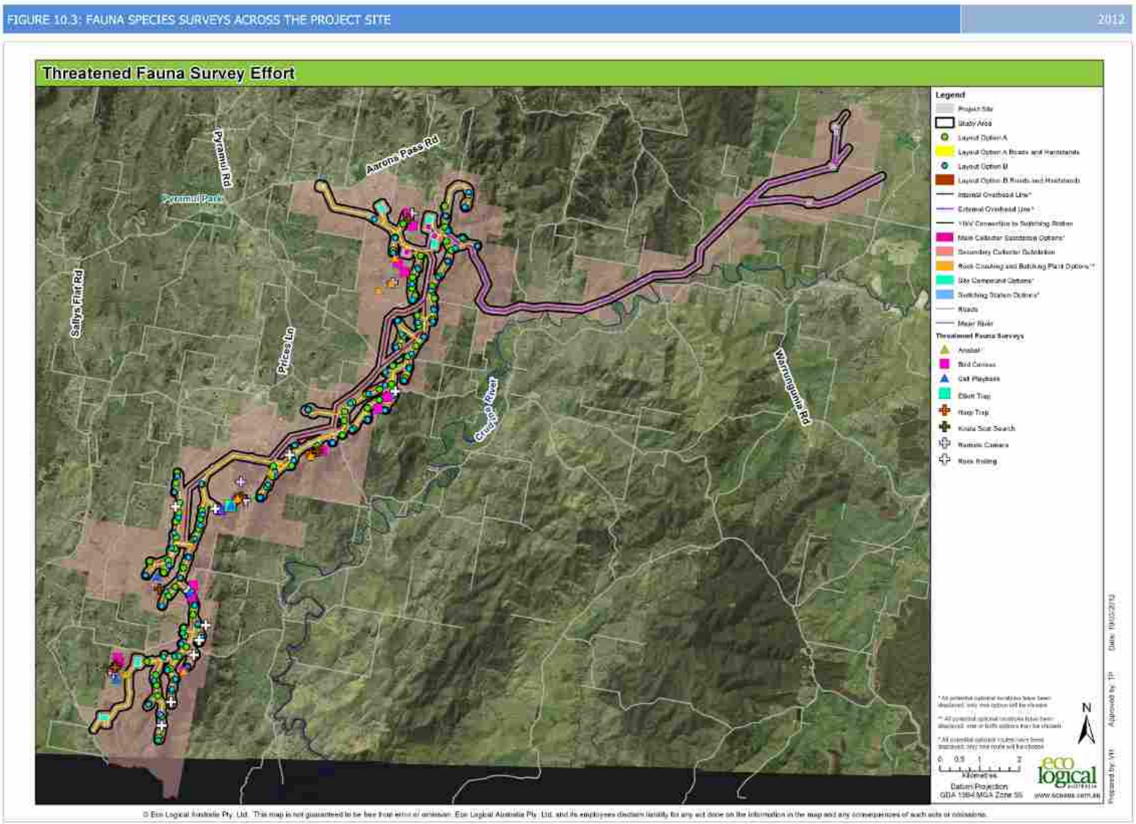

Figure 10.3 Fauna species surveys across the Project site

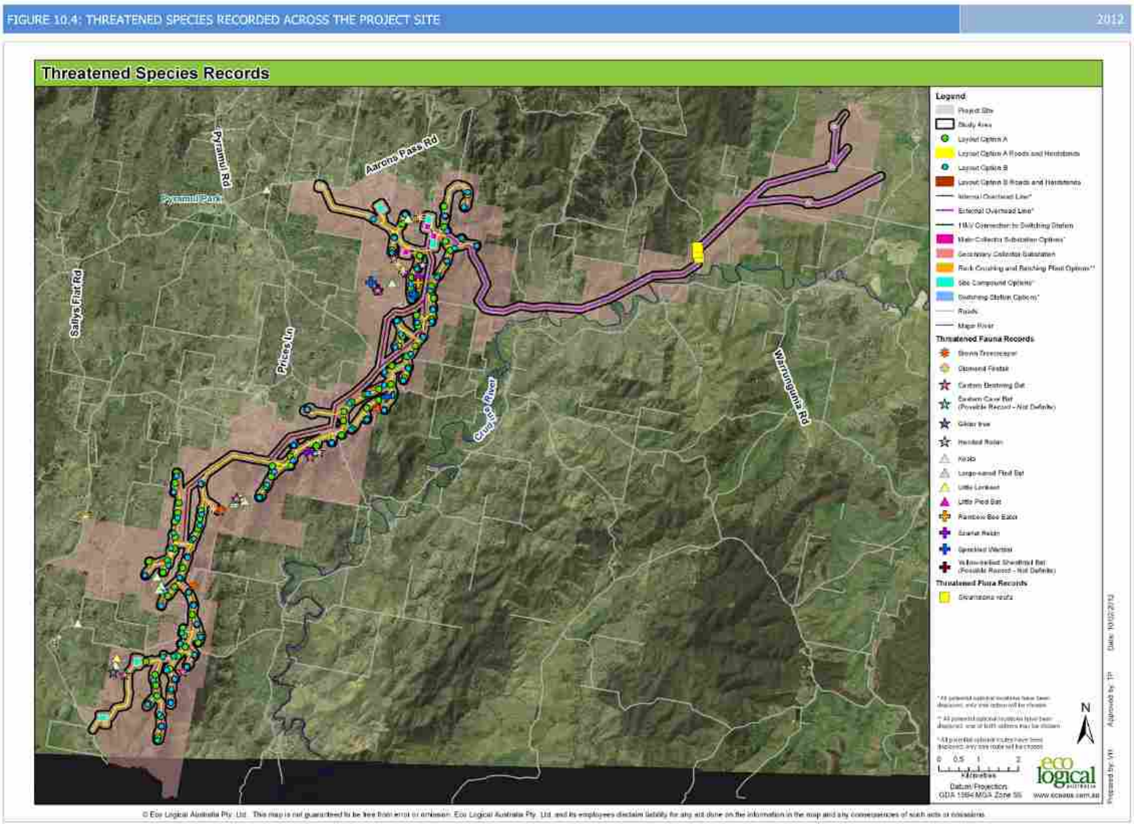

Figure 10.4 Threatened species recorded across the Project site
(A3 size versions of these Figures are displayed in Volume 2)

Avifauna: A total of 93 (92 native) bird species, including six threatened species, were recorded within the Project site during surveys. An additional three species were identified to genus level only. The vegetation types on-site support foraging, nesting and roosting habitat with numerous hollow-bearing trees and an abundance of native flora providing extensive resources throughout all seasons. **Table 10.3** provides an overview to the species surveyed on-site. Details on the occurrence of threatened bird species are discussed in **Appendix 12** and shown in **Figure 10.3**.

Table 10.3 Avifauna species present within the study area

Category	Species
Common bird species	Crimson Rosella (*Platycercus elegans*), Australia Magpie (*Gymnorhina tibicen*), Eastern Rosella (*Platycercus adscitus eximius*), Red Wattlebird (*Anthochaera carunculata*), Spotted Pardalote (*Pardalotus punctatus*), Australian Raven (*Corvus coronoides*), Black-faced Cuckoo-strike (*Coracina novaehollandiae*), Grey Fantail (*Rhipidura albiscapa*), Laughing Kookaburra (*Dacelo novaeguineae*), Noisy Friarbird (*Philemon corniculatus*), Pied Currawong (*Strepera graculina*), White-throated Treecreeper (*Cormobates leucophaeus*), Willy Wagtail (*Rhipidura leucophrys*), Yellow-faced Honeyeater (*Lichenostomus chrysops*) and Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*).
Nocturnal bird species	Australian Owlet-nightjar (Aegotheles cristatus), Southern Boobook (*Ninox boobook*) and Tawny Frogmouth (*Podargus strigoides*).
Birds of prey	Nankeen Kestrel (*Falco cenchroides*), Wedge-tailed Eagle (*Aquila audax*), Black-shouldered Kite (*Elanus axillaris*) and Brown Falcon (*Falco berigora*).
Waterbirds	Australaisian Grebe (*Tachybaptus novaehollandiae*), Australian Wood Duck (*Chenonetta jubata*), Eurasian Coot (*Fulica atra*), Pacific Black Duck (*Anas superciliosa*) and Straw-necked Ibis (*Threskiornis spinicollis*).
Threatened bird species	Brown Treecreeper (*Climacteris picumnus victoriae*), Diamond Firetail (*Stagonopleura guttata*), Hooded Robin (*Melanodryas cucullata cucullata*), Little Lorikeet (*Glossopsitta pusilla*), Scarlet Robin (*Petroica boodang*) and Speckled Warbler (*Pyrrholaemus saggitatus*).

Note: Not all species have a 'common name'.

Habitat for wetland birds across the site is largely limited to farm dams and the ephemeral drainage lines across the study area. Most farm dams had water during the survey period due, although their habitat value for waterbirds is limited.

The habitat on-site also has the potential to accommodate other threatened species, including the Regent Honeyeater (*Anthochaera phrygia*), which was last recorded at Ilford in 2004 (OEH 2011c). However, recent survey efforts did not record the species within the study area or Project site.

For a full description of avifauna, refer to **Appendix 12**.

Ground-dwelling and Arboreal Mammals: The Project area has limited habitat for ground-dwelling mammals due to grazing and limited shrub layer, although areas with woodland or tussock grasses and fallen timber provide suitable habitat for species such as the Eastern Grey Kangaroo (*Macropus robustus*), the Short-beaked Echidna (*Tachyglossus aculeatus*), the Swamp Wallaby (*Wallabia* *bicolour*) and the Red-necked Wallaby (*Macropus rufogriseus*) all of which were recorded within the study area.

Trees on-site provide habitat for arboreal mammals. Four threatened arboreal mammals were recorded during surveys; Sugar Glider (*Petaurus breviceps*), Common Ringtail Possum (*Pseudocheirus peregrines*) Common Brushtail Possum (*Trichosurus vulpecular*), and the threatened species Koala (*Phascolarctos cinereus*). Potential habitat also exists for two other threatened species; Spotted-tailed Quoll (*Dasyurus maculatus*), previously recorded in the locality and Squirrel Glider (*Petaurus norfolcensis*), not previously recorded in the locality. Despite surveys for these species, no individuals were recorded during field surveys.

Bats: Of the 13 species of bats recorded on-site (and 5 further potential species), up to six threatened species were identified. The hollow-bearing trees and vegetation types across the Project site provide potential roosting habitat and potential for abundant foraging for both common and the majority of threatened bat species recorded on-site (except the Eastern Bentwing Bat, Large-eared Pied Bat and Eastern Cave Bat). No caves exist within the study area within which the Eastern Bent-wing Bat, Large-eared Pied Bat or Eastern Cave Bat would roost.

There were no threatened bat species records within the Project site prior to ELA survey efforts (SEWPaC 2011). **Table 10.4** lists the common and threatened species recorded on-site. For a full list refer to **Appendix 12**.

Table 10.4 Bat species present within the study area

Category	Species
Common bat species	Chocolate Wattled Bat (*Chalinolobus morio*), Gould's Wattled Bat (*Chalinolobus gouldii*), Little Forest Bat (*Vespadelus vulturnus)* and White-striped Freetail Bat (*Tadarida australis*)
Threatened bat species	Large-eared Pied Bat (*Chalinolobus dwyeri*), Little Pied Bat (*Chalinolobus picatus*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Greater (Eastern) Long-eared Bat (*Nyctophilus corbeni* (*N. timoriensis*)) (assumed presence due to indistinguishable call) and Eastern Cave Bat (*Vespadelus troughtoni*).

Note: Not all species have a 'common name'.

Amphibians: Habitat is limited across the site with ephemeral drainage lines (Salters Creek, Long Gully, Tunnabidgee Creek, Sugarloaf Creek, Cowflat Gully and Bombandi Creek) and farm dams providing potential habitat for amphibians across the Project site and study area. Only five species were identified during surveys, none of which were threatened species.

The EPBC Act listed Booroolong Frog (*Litoria booroolongensis*) as having the potential to occur on-site (SEWPaC 2011), and was previously recorded twice south of the Project in the 1990s (BRC 2011). However, due to the lack of suitable habitat for the species no targeted surveys were undertaken by ELA.

Reptiles: Habitat for reptiles includes woodland, grassland, drainage lines and scattered rocky outcrops with woody debris and limited leaf litter present across the site.

Three threatened species, as listed in **Appendix 12**, were listed as having the potential to occur within the study area (OEH 2011a, SEWPaC 2011), however ELA determined that there was only potential habitat present for the Pink-tailed Worm-Lizard (*Aprasia parapulchella*), should it be found on-site. None were recorded during the site surveys.

Migratory Fauna: Ten migratory species were identified from the EPBC Act Protected Matter Search Tool (SEWPaC 2011), as listed in **Appendix 12**. No species were recorded during the surveys.

10.4 Potential Impacts

10.4.1 *Construction*

Vegetation Clearance: Although the Project involves the removal of vegetation across a large area, impacts are primarily restricted to a narrow, linear pathway with clearance occurring in narrow bands throughout an open woodland and grassland landscape (**Figure 10.1**). The Project is comprised of both permanent and temporary vegetation removal, with areas such as underground reticulation requiring trenching for installation which can then be filled and revegetated to prevent weed invasion and erosion once installed.

As detailed in **Chapter 3** Project Description, two road layout options are being investigated in order to reduce the likely vegetation clearance required for the Project:

- Roads and hardstand areas for Layout Option A; and
- Roads and hardstand areas for Layout Option B.

These layouts have been designed according to civil engineering requirements and with respect to minimising all unavoidable native vegetation clearance, particularly in areas containing threatened ecological communities or species. All remaining impacts have been quantified through the use of the Biobanking credit calculator (see **Section 10.4**) and in accordance with 'improve or maintain' principles.

Table 10.5 summarises the proposed worst-case scenario vegetation clearance for each component of the Project for each layout option (6 m road including cut and fill) and **Table 10.6** lists the total area of permanent and temporary vegetation loss for each vegetation type and condition.

Table 10.5 Table Proposed impact areas for each layout option

Project component	Estimated impact area – Layout Option A			Estimated impact area – Layout Option B		
	Permanent (ha)	Temporary (ha)	Trees Only (ha)	Permanent (ha)	Temporary (ha)	Trees Only (ha)
Roads	39.98			37.34		
Turbine footings and assembly	20.70			15.04		
Main Collector Substation (3)	2.38			2.38		
Secondary Collector Substation	0.06			0.06		
Switching Station (4)	0.76			0.76		
Internal overhead electrical interconnection / easement			2.70			2.70
External overhead electrical interconnection / easement			6.01			6.00
11kV electrical interconnection / easement			0.08			0.08
Temporary construction facilities						
Rock Crushing & Concrete Batching plant (2)		1.92			1.92	
Site Compound (5)	0.56	2.52		0.56	2.52	
Cut & Fill		28.24			34.33	
Total						
Study Area (ha)	1,663.80					
Project Site (ha)	5,697.00					
Development Footprint	64.52	32.68	8.71	56.22	38.76	8.70

Table 10.6 Estimated clearance of each vegetation type under each layout option

Revised Biometric Vegetation Type	Biobanking Condition	Ancillary Code	Area Mapped within Project Site (ha)	Area Mapped within Study Area (ha)	Estimated Impact Area Layout Option A			Estimated Impact Area Layout Option B		
					Permanent Clearance (ha)	Permanent Clearance – Trees Only (ha)	Temporary Clearance (ha)	Permanent Clearance (ha)	Permanent Clearance – Trees Only (ha)	Temporary Clearance (ha)
CW117	Moderate / Good	Trees	20.44	5.49	0.00	0.00	0.01	0.03	0.00	0.08
		Native Pasture	19.80	10.04	0.81	0.00	0.39	0.78	0.00	0.66
CW176	Moderate / Good	Trees	1,032.37	200.08	3.69	1.30	1.64	3.86	1.31	1.95
		Native Pasture	2,190.19	1067.68	58.46	1.99	29.41	49.97	1.97	34.46
CW206	Moderate / Good	-	29.71	15.98	0.06	0.06	0.02	0.06	0.06	0.05
CW209	Moderate / Good	Trees (EPBC)	65.74	14.85	0.00	2.99	0.00	0.00	2.99	0.00
		Trees	2.77	1.75	0.00	0.00	0.00	0.08	0.00	0.12
		Native Pasture	482.51	178.88	0.78	1.13	0.11	0.78	0.13	1.11
	Low	Trees	0.81	1.06	0.00	0.03	0.00	0.00	0.03	0.00
		Native Pasture	98.18	51.80	0.07	0.27	0.00	0.07	0.27	0.00
Disturbed terrain	Low	-	21.95	11.96	0.24	0.01	0.10	0.24	0.01	0.36
Exotic Pasture	Low	-	200.54	104.36	0.41	0.93	1.00	0.35	0.93	0.97
		Total	4,164.85	1,663.93	64.54	8.71	32.68	56.22	8.70	38.76

Threatened Ecological Communities: Under a worst-case scenario (Layout Option A), the Project would involve the permanent removal of up to 5.27 ha of CW209, in various conditions, from the study area. This includes clearance of 4.42 ha of CW209 trees only, for the external overhead line. This vegetation type is recognised as an EEC and occurs across the Project site as shown in **Figure 10.1**. Only a relatively small proportion of CW209 present within the Project site will be permanently cleared by the Project; i.e., 0.83 %. A further 1 ha will be temporarily cleared for roads, reticulation and construction facilities.

Loss of Riparian Vegetation: The Project involves the establishment of a small number of informal creek crossings across small creeks and drainage lines. An assessment of the impacts of these crossing is included in **Chapter 17** Water. Given the landscape is highly modified and riparian vegetation primarily consists of a grassy ground layer with no over-storey, the impacts are likely to be minimal.

Flora and Fauna Habitat Removal: Habitat for a variety of threatened flora and fauna species is present across the study area, and a worst-case scenario would involve permanent removal of up to 71.64 ha of potential habitat for a variety of species. Given the Project design is linear in structure, no large consolidated areas of clearing will occur and the proposed clearance will not isolate areas of potential habitat. Also, all threatened flora, including *Swainsona recta* (Small Purple-pea) recorded on-site have been avoided through careful site design, and mitigation measures will be implemented to prevent any indirect impacts.

Avifauna: There were a number of threatened birds, as listed in **Table 10.3**, which were recorded within the study area. Given the current amount of habitat present across the site for these species in comparison with that to be cleared (**Appendix 12**), it is considered unlikely that the proposal would result in a significant reduction in habitat for these species within the study area.

Arboreal Mammals: The Koala (*Phascolarctos cinereus*), Squirrel Glider (*Petaurus norfolcensis*) and Spotted-tailed Quoll (*Dasyurus maculatus*) have potential habitats of approximately 290 ha within the study area, with approximately 11 ha likely to be impacted by the Project. This is unlikely to represent a significant amount of habitat removal within the Project site in the context of the amount of habitat present, given that the impact occurs over a linear area rather than in a consolidated block.

Bats: A number of microchiropteran bats recorded within the study area have breeding habitats in the form of hollow-bearing trees. The construction of the Project will potentially remove up to 4.61 % of hollow-bearing trees predicted to occur across the site. This figure is only indicative as hollow bearing trees are not uniform across the site and access tracks and wind turbines have been sited to avoid hollow bearing trees where practicable. Therefore, it is likely to be a significant over-estimate (for a complete description about the calculation on hollow-bearing trees across the Project area, refer to **Appendix 12**).

Areas of woodland and grassland across the site provide potential foraging habitat for microchiropteran bats. Of the 1,548 ha of habitat present across the site, up to 71.64 ha (4.63 %) will be permanently impacted upon. Due to the extensive areas of available habitat in the locality and the linear impact area created by the Project, it is unlikely that habitat loss would significantly impact these species within the locality of the Project.

Pink-tailed Worm-Lizard: While the species was not recorded during targeted surveys by ELA, the study area does support potential habitat for the Pink-tailed Worm-Lizard. To reduce impacts, rocks of a suitable size to provide habitat for this species will be relocated to adjacent areas during construction. Of the 1,479 ha of habitat present within the study area, up to 71.15 ha (4.81 %) will be permanently impacted upon.

Migratory Species: No migratory species were recorded on-site during surveys by ELA, however as such species may travel long distances, there is the ever-present potential for impacts by operational turbines should any species visit or pass through the Project site. The proposal involves the permanent removal of up to 71.64 ha of potential habitat for migratory species. However, in terms of disturbance to habitat for these species, impacts are likely to be negligible given they forage widely and the minimal amount of clearing required comparative to the amount of habitat present within the Project site.

The Project is not in a core breeding location for the Regent Honeyeater (*Xanthomyza phrygia*), however one of the core breeding locations is located 40 km to the south east (Capertee Valley). As such, and given the transitory nature of the species, the study area could be used periodically for foraging and to a lesser extent breeding. Estimating the likely impacts on Regent Honeyeater breeding, however, is difficult as there is little known about the species and its movement pathways. The presence of the Project is unlikely to have a significant impact on the breeding activities of the Regent Honeyeater, although it is not possible to be definitive as there is not enough known about the movement patterns to say which areas they use most (*pers. comm.*, D. Ingwersen, Birds Australia 2012).

It is predicted that the Project will permanently remove up to 11.19 ha of foraging habitat present within the study area, which is only 1.14 % of the total area mapped. The main wooded corridor, which runs through the Project site, along the eastern slopes of Crudine Ridge will be largely retained, thereby ensuring an abundance of habitat is still available for this species.

Indirect Impacts: Indirect impacts relate to matters during the construction phase that are created as a consequence of the primary impact. A summary of the anticipated indirect impacts is provided below with further information contained within **Appendix 12** and, where indicated, the respective chapters of the Environmental Assessment (EA).

- Runoff, sedimentation and erosion (**Chapter 17** Water and **Chapter 18** General Environmental Assessment);
- Hydrological changes (**Chapter 17** Water and **Chapter 18** General Environmental Assessment);
- Edge effects / increased weed invasion;
- Wildfire (**Chapter 16** Fire and Bushfire); and
- Noise.

Weed management measures will be implemented during and post-construction to ensure the spread of weeds does not increase across the study area as a result of the Project. These will include the control of runoff that may contain seeds and the washing down of vehicles to prevent the transportation of weeds between areas when a significant weed risk has been identified. Revegetation of disturbed areas and ongoing weed management for a period of three years is also proposed.

Construction activities will generate noise that may disturb some fauna. The response of fauna to such noise is inconsistent between and within species, making it difficult to predict likely impacts. While noise may displace some fauna, the impacts are expected to be localised to the current area of noise-generating construction activity, temporary and short term.

10.4.2 *Operation*

Direct Impacts: Impacts on bird and bat species may occur during the operational phase. Impacts include the potential for birds and bats to accidentally collide with towers and moving turbine blades. Many studies have investigated the potential impacts of wind farms on birds and bats, most undertaken outside Australia. Reviewing the evidence, the impacts appear to be dependent on a number of factors including:

- Proximity of turbines to bird concentrations and migratory pathways (Brett Lane & Associates 2005);

- Wind farm layout, spacing between turbines and type of wind turbine used (Brett Lane & Associates 2005; Australian Greenhouse Office 2006);
- Location in the landscape, type of habitat and surrounding area, in particular proximity of turbines to forested areas and wetlands (Kevin Mills & Associates 2005; Australian Greenhouse Office 2006);
- Lighting used on turbines (Brett Lane & Associates 2005) (see **Chapters 8** Landscape and Visual and **Chapter 13** Aviation for further assessment of turbine lighting); and
- Location of turbines on forested ridges (Arnett 2005).

Further discussion specific to the species affected by this Project is contained within **Appendix 12**.

Bats: Direct impacts on bat species relate predominantly to turbine collision and blade strike. There may also be some potential for barotraumas. Based on the results of literature reviews and an understanding of bat behaviour, those species considered most likely to come into contact with turbine blades or otherwise be impacted by wind turbines include those which forage above the canopy, are migratory or have large foraging areas and may roost in hollows across the study area. Further discussion on pertinent bat behaviour and interaction with wind turbines is contained in **Appendix 12**.

Due to the open nature of the Project site, identification of potential flyways is difficult. The open woodland environment means that bats may forage relatively unobstructed across the majority of the site.

A risk matrix was prepared by ELA to assess the likelihood that bats present within the study area would be impacted by the Project, as is shown in **Appendix 12**. Of the species recorded across the study area, the White-striped Freetail Bat (*Tadarida australis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Bent-wing Bat *(Miniopterus orianae oceanensis)* and Southern Freetail Bat (*Mormopterus sp. 4*) were the only species considered to have a high potential for strike due to roosting in hollows, their migratory nature or foraging behaviour above the canopy.

Measures to prevent bat strike wherever possible will be implemented, including (where practicable) ensuring wind turbines are located no closer than 30 m from hollow-bearing trees following construction. However, based on the findings of past studies, it is likely that some collisions will be unavoidable even with appropriate mitigation measures (**Appendix 12**).

Aviation lighting did not appear to affect the incidence of foraging bats around turbines and there was no difference between numbers of bat passes at lit and unlit turbines. Preliminary evidence also suggests that bats are not attracted to the lighting attached to wind turbines (Arnett 2005; Kerlinger et al. 2006; Kunz et al. 2007).

Birds: Direct impacts on bird species relate predominantly to turbine collision and blade strike and avoidance of areas where turbines are present. Few studies have been conducted in Australia or have investigated agricultural landscapes such as those within the study area. However, it has been suggested that the vulnerability of a species to collision is species and habitat-specific (Erickson et al. 2001). Of the six threatened bird species recorded on-site, most are considered as having a low likelihood of collision with turbines as they are woodland birds which forage amongst woodland areas or close to the ground. The exceptions are the Little Lorikeet (*Glossopsitta pusilla*), Crimson

Rosella (*Platycercus elegans*) and the Eastern Rosella (*Platycercus adscitus eximius*), which are most at risk given their fast flight patterns and height of flight when moving between feeding areas.

Birds of prey are also at risk of collision with turbines. A number of birds of prey were recorded across the study area, although no nests were recorded within the study area. Birds of prey have large home ranges and low reproductive rates and, therefore, loss of these individuals is likely to have a greater effect on population numbers than it may on other species. Research to date has identified a range of potential impact rates. Some studies have shown that, in general, mortality rates for birds at wind farm sites is between 1 and 2 individuals per turbine per year (Illinois Department of Natural Resources 2007, Smales 2005). Alternative studies, however, conducted in the home range of one species found that likely impacts would result in a 0.001 % increase in mortality rate, which is not significantly different from that obtained in the absence of the wind farms (Smales & Muir 2005).

Migratory birds have been listed amongst the species most commonly impacted by wind turbines. Whilst wind turbines are likely to be below the flight altitude of most migratory species, weather and other factors have been suggested as potential causes of reduced flight height and therefore may result in migratory birds colliding with wind turbines (Erickson et al. 2001).

While the Project is not located within any known key migratory bird pathways, it has been noted that, in particular, the Regent Honeyeater may pass across the Project site during flowering seasons. During the operational phase of the Project, therefore, Regent Honeyeaters may collide with turbines or change their migratory path to avoid turbines. Little is known about the height at which the species flies (an important factor in considering risk), however it is an arboreal species, known to forage in the crowns of flowering trees, and fly as high as 50 m.

A risk matrix anticipating the likelihood of collision with turbines has been prepared by ELA for threatened bird species recorded within the study area (**Table 10.7**). Factors such as the flight character, distribution across the site and whether the species is migratory have been considered when determining the likely risk. Those species considered to be at greatest risk are those that fly at high altitudes, at speed and are migratory. Based on the risk matrix, it considered unlikely that many of the species common to the study area would be likely to collide with turbines, although the risk is considered to be slightly higher for raptors and birds of prey which may collide with turbines whilst hunting prey. Passerine species, due to their fast flight patterns and sometimes high flight, may also be at risk of collision.

Table 10.7 Risk of collision between turbines and threatened bird species recorded in the study area

Common Name (*Scientific name*)	**Conservation Status**	**No. of records**	**Flight characteristics**	**Migratory**	**Distribution across site**	**Risk of collision with turbines**	**Risk of collision with overhead cables**
Brown Treecreeper (*Climacteris picumnus victoriae*)	V	3	Moderate to low	No	Woodlands & grasslands	Low	Low
Hooded Robin (*Melanodryas*	V	5	Moderate to low	No	Woodlands & grasslands	Low	Low

Common Name (*Scientific name*)	Conservation Status	No. of records	Flight characteristics	Migratory	Distribution across site	Risk of collision with turbines	Risk of collision with overhead cables
cucullata cucullata)							
Diamond Firetail (*Stagonopleura guttata*)	V	10	Moderate to low	No	Woodlands & grasslands	Low	Low
Little Lorikeet (*Glossopsitta pusilla*)	V	1	Fast, high-low flight depending on activity	No	Woodlands & grasslands	Moderate	Low
Scarlet Robin (*Petroica boodang*)	V	3	Moderate to low	Partially	Woodlands & grasslands	Moderate	Low
Speckled Warbler (*Pyrrholaemus saggitatus*)	V	3	Moderate to low	No	Woodlands	Low	Low

Note: V = vulnerable

Lighting Impacts: There has been suggestion that the use of lighting on turbines increases the potential for avian collisions as some species are attracted to the lighting for navigation purposes or for feeding on the insects that often centre on the light source. However, results from studies are relatively inconclusive, with some studies identifying a relationship between lighting and avian collisions (US Department of Interior Fish and Wildlife Service 1993) and others identifying no significant difference between turbines lit with L-864 obstruction lights and those without (Jain et al. 2007).

Indirect Impacts: Indirect impacts relate to matters during the operation phase that are created as a consequence of the primary impact. A summary of the anticipated indirect impacts, with further information contained in **Appendix 12**, includes:

- Displacement of birds;
- Predation by feral animals; and
- Wildfire (**Chapter 16** Fire and Bushfire and **Appendix 20**).

No specific studies on the displacement of non-migratory birds from wind turbines in Australia were found during this assessment. However, overseas studies, such as Devereux et al. (2008), on wintering farmland birds in Europe can be used. By comparing similar species, such as seed-eaters and corvids, results may be applicable to Australian farmlands. Given the extensive nature of vegetation types across the study area and available habitat, bird species are unlikely to become displaced as a result of the wind turbines such that vegetation types that once provided foraging habitat would no longer do so due to turbine avoidance behaviour.

Studies of White-bellied Sea-eagles at wind farm sites conducted by Biosis Research also support this conclusion as White-bellied Sea-eagles have been known to continue to occupy operational wind farm sites in southern Australia, including the Bluff Point Wind Farm in Tasmania (Smales 2005). Furthermore, through post-construction monitoring of the Klondike, Oregon Wind Farm Johnson et al. (2003) found that avian and bat fatality rates were minimal, and that the wind farm did not appear to have resulted in displacement of breeding raptors.

Therefore based on the findings of these studies, and given potential habitat is widely spread across the Project site, it is considered unlikely that the proposed wind farm would permanently displace any local bird species.

10.4.3 ***Decommissioning***

Direct and indirect impacts anticipated from decommissioning works at the end of the life of the wind farm, as discussed in **Chapter 3** Project Description and **Chapter 18** General Environmental Risk Assessment, are likely to include:

- Disturbance of vegetation adjacent to turbines from machinery during deconstruction, cutting back of tower bases, and storing of turbine components prior to removal from site;
- Soils disturbance resulting in sedimentation and erosion;
- Spread of weeds through site disturbance;
- Accidental fire during cutting back; and
- Disturbance of fauna habitat from machinery and storing of turbine components prior to removal from site.

Further impact assessments will be conducted prior to decommissioning works to ensure impact assessment and management actions are up-to-date and respond to the environmental values present on-site at the time.

10.4.4 ***Cumulative Impacts***

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

The majority of the Project site is used for agricultural purposes, specifically grazing and cropping. The protection and management of a large parcel of land as part of an offset for the impacts of the Project will assist in protecting habitat for threatened species within the locality, which may otherwise be degraded and impacted by agricultural practices.

The Project is not located within any known migratory bird pathways, and given the distance of other proposed and existing wind farms from the Project, it is unlikely that any non-migratory species would forage across more than one Project site, as a result of their home ranges.

Cumulative impacts associated with multiple wind farms within the region (including the proposed Uungula Wind Farm) assessed as low to negligible, are likely to be restricted to highly mobile species and potentially the cumulative loss of vegetation communities across numerous wind farms.

10.5 Avoidance, Management and Mitigation

10.5.1 *Avoidance Measures*

The Proponent has made a number of amendments to the proposed layouts to minimise and avoid impacts on the ecological habitat across the site. Given the presence of EEC and threatened species across the site area, and the requirement for turbines to be placed on ridge tops, the opportunities to avoid all impacts are limited. Whilst it is also not practicable to completely avoid placing turbines in any areas supporting woodland, thereby impacting Project feasibility, a number of amendments have been made to minimise impacts in these areas. The linear layout of turbines along ridgelines, required for the wind farm to function at maximum capacity and be economically feasible, in some cases limits the areas to which turbines can be moved to avoid impacts, but on the other hand ensures no consolidated areas of clearing occur.

The avoidance measures that will or have been implemented to minimise impacts on the ecological integrity of the site whilst maintaining the engineering and economic feasibility of the wind farm are summarised below:

- Access tracks have been designed around tracks and roads that currently exist within the study area, where practicable, to avoid additional vegetation clearance for access;
- Turbines have been placed in cleared, treeless or low tree density areas, where practicable, to minimise the need for additional or excessive tree clearance and loss of hollow-bearing trees;
- Where turbines have been placed in woodland areas, they have been situated in areas where ground layer disturbance has previously taken place (e.g. sown areas);
- Construction compounds, collector substations, switching stations and rock crushing facilities have been located outside ecologically sensitive areas, where practicable;
- The Project has been designed such that tree removal has been minimised wherever practicable and will be further minimised during the detailed design phase, where practicable. All turbines will be placed at least 30 m from hollow-bearing trees where practicable;
- Access tracks and transmission line routes have been re-aligned so as to minimise the impact on the EEC, with disturbance occurring only for the installation of the external transmission line, where only the canopy will be removed, ensuring the understorey remains;
- Where necessary, transmission line poles will be realigned within the line easement to ensure there are no impacts on *Swainsona recta*, avoiding loss of all recorded individuals of this species; and
- The internal reticulation has been placed underground and within the road footprint where practicable to allow for temporary rather than permanent disturbance. Reticulation will pass overhead across gullies and waterways to further reduce impacts.

10.5.2 *Mitigation / Recommendations*

In order to protect the ecological values of the site a number of management and mitigation measures have been proposed. Given their extent, and to avoid duplication, these are generally outlined in **Chapter 20** Statement of Commitments together with the Project stage during which each would be implemented, as well as **Appendix 12**. A number of species-specific mitigation measures are included and it is envisaged that some of these would be implemented at both the proposed impact site and offset site with full details provided in the Construction Environmental Management Plan and Operation Environmental Management Plan post approval.

Management measures within MWRC's Roadside Management Guidelines (MWRC 2011) that are applicable to the Project have also been included in the mitigation measures listed in **Chapter 20** Statement of Commitments and **Appendix 12**.

10.5.3 *Offset Strategy*

As the Project has undertaken a Biobank Assessment, the quickest and simplest method of meeting the offset requirements is to purchase the correct number and type of biodiversity credits from the credit register, where available. The Proponent has explored the registration of a Biobank site as an offset option, but may still utilise other suitable methods for securing a conservation outcome depending on continued interest by landowners. Another option is to purchase sites to be managed for conservation by the Proponent (or contractors acting on their behalf) through an appropriate covenant or transferred to the Minister for the Environment and gazetted as Conservation reserves (subject to agreement with the Minister for the Environment).

During the preparation of the Ecological Assessment report by ELA, preliminary ecological investigations were carried out on several properties where landowners were interested in providing an offset. Such areas were considered based on their size and providing a "like for like" vegetation type to meet the 'improve or maintain' outcome consistent with the credit report from the Biobank Assessment.

There are seven properties considered as potential offset options, however three properties in particular have been verified as having equivalent vegetation types to and being in equivalent or better condition than the impact sites. Biobanking calculations have been undertaken to give an indication of the "quantum" of the offset required should the potential offset site be in moderate or benchmark (good) condition. **Table 10.8** shows the level of impact on the different vegetation communities and the required offset areas based on the Biobanking methodology. **Table 10.9** shows the impact and offset measures for Matters of NES (EPBC Act).

Table 10.8 Comparison of impact areas and calculated offset areas

Biometric Vegetation Type	Impact Area (ha)	Properties for Sale Area (ha)		Potential Conservation Covenant Area (ha)	Credits Required	Improve or Maintain Offset Target (ha)
Property		**S1**	**S2**	**C1**		
Broad-leaved Peppermint - Brittle Gum - Red Stringybark dry open forest on the South Eastern Hghlands	1.2	0	0	0	20	2.15-2.4
Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock	96.5		571	32	3,979	193-427

Biometric Vegetation Type	Impact Area (ha)	Properties for Sale Area (ha)		Potential Conservation Covenant Area (ha)	Credits Required	Improve or Maintain Offset Target (ha)
Property		S1	S2	C1		
grass open forest						
White Box - Blakely's Red Gum - Yellow Box grassy woodland	5.4	70.1	284	203	271	10.8-29.1
Total	**103.1**	**70.1**	**855**	**235**	**4,270**	**206-458**

Table 10.9 Offset measures for impacts to Matters of National Environmental Significance (EPBC Act)

Matters of NES (EPBC Act)		Impact Area (ha)	Tier 3-2 Offset Target (ha)	Offset : Impact Ratio
EPBC Listed Community	**Condition**			
White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Woodland	3.0	6 - 22	2 – 7.3#
EPBC Listed Species	**Habitat Type**			
Swift Parrot and Regent Honeyeater	Potential	14.33	205 – 458.5	14.3 – 31.9 : 1
Large-eared Pied Bat, Greater eastern Long-eared Bat, Superb Parrot, Satin Flycatcher and Spotted-tailed Quoll	Potential foraging	9.64	201.15 – 451.4	20.8 – 46.8
Grey-headed Flying-fox	Potential foraging	17.82	205.95 – 458.5	11.56 – 25.73
Prasophyllum sp. Wybong, Bothriochloa biloba and *Thesium australe*	Potential	103.08	205.95 – 458.5	2.0 – 4.45
Eucalyptus cannonii	Potential	97.70	195.15 – 429.4	2.0 – 4.4
Eucalyptus robertsonii subsp. Hemisphaerica	Potential	1.21	2.15 – 2.4	10.20 – 11.43
Great Egret	Potential	0.14		
Cattle Egret	Potential	93.22		
White-throated Needletail and Rainbow Bee-eater	Potential	31.58	195.15 – 429.4	6.18 – 13.60

Proportion of "woodland" White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions in the final offset area is likely to be significantly higher as these areas will be preferentially targeted.

A combination of these properties, and others that have been identified, will provide a suitable offset area and meet the "like for like or better" offsetting principles with a minimum 2:1 offset ratio. Further details regarding these options can be found in **Appendix 12** and **Figure 10.5** shows the location of each property.

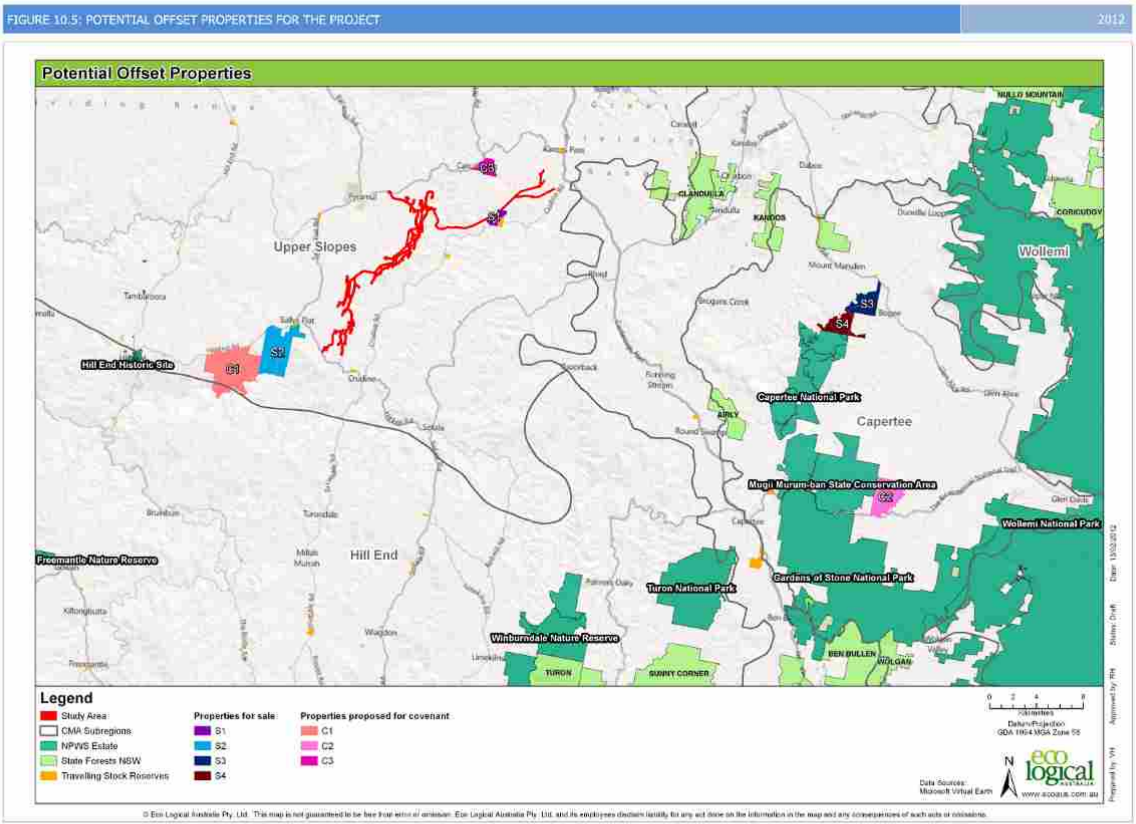

Figure 10.5 Potential offset properties for the Project
(An A3 size version of this Figure is displayed in Volume 2)

Potential foraging habitat exists across the site for a number of species that were not recorded on site. Impacts on these habitat types have also been addressed in offset properties considered. Further details on offset types and areas for Matters of National Environmental Significance can be found in **Appendix 12**.

10.6 Summary

Under Part 3A of the *EP&A Act*, the Project is required to meet the principles of the 'maintain and improve' test. Whilst complete avoidance of all impacts on threatened species, their habitat and areas of native vegetation is not practicable, a number of avoidance and impact minimisation measures, including the modification of the layouts to avoid areas containing threatened species and communities, have been implemented. Furthermore, mitigation measures will be implemented as part of the Project and will further reduce the potential impacts from the Project.

For those impacts that cannot be mitigated or avoided, offset options have been proposed that will make a substantial contribution to the protection of EECs, threatened species and their habitat on the Central Tablelands through in-perpetuity protection of large, viable offset areas.

Through the suite of avoidance, mitigation and offset measures outlined in this chapter, with further detail in **Chapter 20** Statement of Commitments and **Appendix 12**, the principles of the 'maintain and improve test' are upheld.

CHAPTER 11

Cultural Heritage Assessment

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11. CULTURAL HERITAGE ASSESSMENT

New South Wales Archaeology Pty Ltd (NSW Archaeology) was commissioned in June 2011 to undertake an archaeological and cultural heritage assessment of the proposed Project in accordance with the Director-General's Requirements (DGRs). The full report is attached in **Appendix 13**.

Both Aboriginal and European heritage is present throughout Australia's rural landscape, and is protected in accordance with Part 6 of the National Parks and Wildlife Act 1974, which provides protection for Aboriginal Objects and Aboriginal Places. The construction of a wind farm project has the potential to cause direct impacts to any Aboriginal objects (predominantly stone artefacts) or European items which may be present within the study area. As such, a heritage assessment has been undertaken to identify those groups (Aboriginal and European) with a heritage interest in the site, and to determine any heritage objects or places present within the Project site in order for the Project to avoid them where necessary.

11.1 Partnership with Aboriginal Communities

In accordance with the *Interim Guidelines for Aboriginal Community Consultation* (IGACC) – *Requirements for Applicants* (NSW Department of Environment and Conservation (DEC) 2004), as discussed in **Chapter 5** Planning Context, the Proponent and NSW Archaeology actively sought to identify stakeholder groups or people wishing to be consulted about the Project. Written notification about the Project, dated 14th June 2011, was sent to the following groups:

- OEH, Dubbo Office;
- Orange and Mudgee Local Aboriginal Land Councils;
- Office of the Registrar, Aboriginal Land Rights Act 1983;
- The National Native Title Tribunal;
- Native Title Services Corporation Limited (NTSCORP Limited);
- Mid-Western Regional Council;
- Bathurst Regional Council; and
- Central West Catchment Management Authority.

Following advice received from OEH, Teitzel & Partners, Bathurst Regional Council, Mid-Western Regional Council and the National Native Title Tribunal, further written notification was supplied to the following:

- Dhuuluu-Yala Aboriginal Corporation;
- Mingaan Aboriginal Corporation;
- Wiradjuri Traditional Owners Central West Aboriginal Corporation;
- Wiradjuri Council of Elders;
- Binjang Wellington Wiradjuri Heritage Surveys;
- Bathurst Local Aboriginal Consultative Committee;
- Wanaruah LALC;
- Wellington LALC;
- Dubbo LALC; and
- Gilgandra LALC.

For a full list of groups and individuals who registered an interest in the Project, refer to **Appendix 13.**

11.2 Methods

The heritage assessment was conducted using:

- A desktop study, search of relevant databases and literature review;
- Detailed field survey;
- Analysis and discussion of results, and
- Recommendations.

For the purposes of the field survey the Project was divided into 18 Survey Units defined according to landform morphological type and accounting for approximately 1,040 ha of the Project site. The field work occurred over a seven day period in September 2011. The survey was lead by NSW Archaeology with the assistance of a number of people from the local Aboriginal community including Debbie Foley, Larry Foley, Chad Morgan, Shannon Foley, Larry Flick Snr and Larry Flick Jnr.

Aboriginal: The Project study area was surveyed to identify any Aboriginal sites or objects present, known as artefact locales, and to determine the potential impacts upon them. A predictive model was also used to determine the nature of Aboriginal occupation across the land. The degree of Aboriginal occupation is based on a number of factors and, as a result, occupation may not have been uniform across the site. By studying these factors, the predictive model can determine the type and nature of archaeological sites which might be expected to occur across the study area.

The report by NSW Archaeology was written in accordance with the OEH *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005), which was prepared specifically for development applications assessed under *Part 3A* of the *NSW Environmental Planning and Assessment (EP&A) Act, 1979*.

European: The European component of this assessment has been conducted with reference to literature relating to European occupation within the area, a review of Parish maps and a field inspection aimed at locating historical items, features and potential archaeological sites. A review of the heritage database and previous archaeological investigations has also been undertaken to provide heritage context to the assessment.

Heritage items recorded were assessed against the State Heritage Register criteria and have been guided by the NSW Heritage Office update *Assessing Heritage Significance* (2001) and the Heritage Council of NSW update *Levels of Heritage Significance* (2008).

11.3 Existing Situation

Aboriginal: The assessment identified that the study area was traditionally occupied by the Wiradjuri peoples, who inhabited a widespread area which extended from the Great Dividing Range west to the Macquarie, Lachlan and the Murrumbidgee rivers (Coe 1989; Tindale 1974).

There have been no archaeological studies previously conducted within the local area; however numerous studies have been undertaken in the broader region. These studies were used to determine that the Wiradjuri functioned primarily in small groups, comprised of immediate relations, and that these groups could coalesce to form a collective band during feasting in times of plentiful food and for ceremony (Pearson 1981). Pearson (1981) also found that there may have been three distinct band territories in the local region, centred on Bathurst, Wellington and Mudgee / Rylstone; this could suggest that the proposal area is likely to have been one locale within the range of a single Wiradjuri band. However, given the ephemeral nature of the local catchments and creek lines, it is likely habitation would be closer to a more permanent source of water, such as the Cudgegong River. The predominant land use by Aboriginal people in the Project site is predicted to have been restricted to a limited range of activities including hunting and gathering forays conducted away from base camps and movement through the country. Such short-term activities are likely to have resulted in low to very low levels of object discard, diversity and complexity.

The early 1800s saw changes in the traditional land use of Aboriginal people with the introduction of European settlement.

European: European settlement of the area began after an 1813 expedition across the Great Dividing Range in search of much needed grazing land. The Bathurst area was originally settled in 1816, and by 1820, with the pressure of dry conditions and failing pasture, settlers began moving north through Sofala, Tabrabucca Swamp, Aarons Pass, and finally down into the Cudgegong Valley and the area now occupied by the township of Mudgee. Once settled, the Pyramul site was held as two private properties which were the only dwellings in the area until it was surveyed for a village in 1836. Then, as now, sheep grazing was the dominant land use in the Pyramul and Crudine areas, with Pyramul playing a significant role in the Australian sheep industry. The 1850s saw the gold fields open at Sofala and Hill End, which drew large numbers of people, some of whom turned to farming when the alluvial gold was finished.

Although no European heritage items have previously been recorded within the Project site, the historical theme of direct relevance to the Project is “agriculture and pastoralism”. For further detail on how this theme applies to the Project, refer to **Appendix 13**. Heritage items may be present as extant and standing structures or ephemeral sites and ruins. The locations of such items are difficult to predict, although the potential generally increases on level ground adjacent to existing homesteads, good water supplies and existing or former road alignments.

11.4 Survey Results and Potential Impacts

Of the 18 Survey Units (1,040 ha) created prior to the field survey of the Study area, 217 ha of this area was subject to survey inspection. Ground exposures inspected were estimated to have been 51.04 ha and, of this area, archaeological visibility (the potential artefact-bearing soil profile) was estimated to have been 45.59 ha. Effective Survey Coverage has therefore been calculated at 4.4 % of the Study area.

Aboriginal: A total of 44 Aboriginal object locales with stone artefacts were recorded within the assessed Survey Units, as listed in **Appendix 13**. All artefacts have been calculated as having very low density artefact distributions, and assessed as being significantly disturbed and without archaeological deposit. As such, the archaeological resource can be considered to be of correspondingly low significance. All Survey Units were assessed to be of negligible to low archaeological sensitivity.

Given the nature and density of the artefact locales recorded in the proposal area and the low scientific significance rating they have been accorded, an appropriate form of impact mitigation is recommended, such as minimising impacts to ground surfaces where feasible.

European: Eight European items were recorded during the survey, all located outside areas of proposed impacts. All items are associated with animal husbandry and most are sheep sheds and yards, some still in use (see **Appendix 13**).

A church and associated cemetery in the Pyramul area were identified by Mid-Western Regional Council in 2008 through the consultation process. These heritage items are located 2.65 km from the nearest proposed turbine. No construction activities are proposed to take place on or near the parcels identified; as such, no impacts to the heritage items are predicted.

11.4.1 ***Cumulative Impacts***

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. Given that the impact of the Project on aspects of cultural heritage are both isolated and minimal in nature, it is anticipated that there will be no cumulative effect on cultural heritage from the introduction of the proposed development into the area.

11.5 Management and Mitigation

Desktop and on-site survey results identified 44 Aboriginal locales and eight European locales. Impacts are predicted to be discrete in nature due to the relatively small development footprint within the overall Project site.

A full list of mitigation and management strategies is contained in **Section 10** of **Appendix 13**. Such strategies include:

- The Proponent, in consultation with an archaeologist, relevant Aboriginal communities and OEH, developing a Cultural Heritage Management Protocol which provides procedures to be followed for impact avoidance and accidental discovery; and
- Personnel involved in the construction and management phases of the Project trained in procedures to implement recommendations relating to cultural heritage, where necessary, to decrease impact.

The Project can continue as the Survey Units and Aboriginal object locales recorded do not surpass scientific significance thresholds. Also, no Survey Units have been identified to warrant further archaeological investigation, such as a subsurface test excavation.

The following mitigation and management strategies are suggested to minimise the impact on Aboriginal objects and places:

- Ground disturbance impacts associated with the Project be kept to a minimum and to defined areas, to ensure minimum impact on Aboriginal objects, which can be expected to extend in a relatively continuous, albeit very low to low density distribution, across the broader landscape encompassed by the Project;

- Strategies are to be implemented to ensure that inadvertent impacts to existing European heritage items outside proposed impact areas do not occur during construction;
- It is recommended that additional archaeological assessments are to be carried out if any new impacts are to occur outside the study area. If a significant Aboriginal object is identified, prior to impact, mitigation strategies will be implemented. It may be culturally appropriate to salvage artefacts from certain sites; and
- Aboriginal Site Impact Recording Forms are to be completed (and submitted to the OEH) for each Aboriginal object harmed during construction of the Project.

Mitigation measures to account for these recommendations are presented in **Chapter 20** Statement of Commitments.

11.6 Summary

During the different phases of the Project, ground disturbance will occur with the potential to cause direct impacts to any Aboriginal or European locales which may be present on-site. While Aboriginal objects can be expected to extend in a relatively continuous, albeit very low to low density distribution across the broader landscape encompassed by the Project, it has been proposed that due to the low archaeological significance, a strategy of impact mitigation is considered appropriate. The European items recorded were all located outside areas of proposed impacts.

Overall, the proposed impacts are predicted to be discrete in nature due to the relatively small footprint of construction activities and, therefore, impacts to the archaeological resource across the landscape can be considered only partial in nature.

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CHAPTER 12

Traffic and Transport Assessment

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12. TRAFFIC AND TRANSPORT ASSESSMENT

Samsa Consulting was commissioned to undertake a Traffic and Transport Assessment for the proposed Project (see **Appendix 14** for full report). The study was conducted in accordance with the NSW Roads and Traffic Authority (RTA) *Guide to Traffic Generating Developments* and the Director-General's Requirements (DGRs), and provides a technical appraisal of the traffic and safety implications arising from the Project. Information on internal road infrastructure is described in **Chapter 3** Project Description and preliminary designs can also be seen in **Volume 2**, **Figures 3.1** to **3.7**.

12.1 Methods

The traffic and transport assessment undertaken comprised of a desktop study, consultation and fieldwork. The desktop study involved reviewing maps of the area to identify features and revision of RMS data to establish existing traffic volumes. Consultation with the Proponent, RMS, Mid-Western Regional Council, Bathurst Regional Council and heavy vehicles operators experienced in handling wind turbine components provided base Project information, advice on existing traffic conditions and possible routes for heavy vehicles during construction. Fieldwork by Samsa Consulting involved inspection of Project involved roads and a traffic count was undertaken during September 2011 to establish existing traffic volumes and road conditions.

This assessment developed strategies and recommendations to minimise traffic impacts throughout the life of the Project. The main focus of this assessment, however, is the construction phase, as this is likely to generate greater traffic impacts on the existing public road network and internal access tracks, compared to other phases.

12.2 Existing Situation

To establish existing traffic conditions within the locality of the Project, Samsa Consulting reviewed traffic volumes and accident records.

North of the Project, the Castlereagh Highway north of Mudgee has the largest volume of traffic with 3,700 vehicles per day. Hill End Road has 1,200 vehicles per day, Windeyer Road / Pyramul Road has from 100 - 230 vehicles per day, Aarons Pass Road has 23 vehicles per day and Crudine Road and Bombandi Road both have less than 100 and less than 50 vehicles per day respectively (**Appendix 14**).

South of the Project, the Great Western Highway at Bathurst has the largest volume of traffic with 22,800 vehicles per day. A number of roads make up the passage of the southern route through Bathurst. The number of vehicles per day along these roads range between 13,800 vehicles per day along Stewart Street and 1,480 vehicles per day along Eleven Mile Drive. The Mid-Western Highway, outside of Bathurst, has 3,700 vehicles per day, Duramana Road / Turondale Road has between 150 and 550 vehicles per day, the relevant section of Hill End Road has less than 100 vehicles per day (**Appendix 14**).

In order to assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the Project, Samsa Consulting also assessed the potential impact of additional traffic on traffic flow. Road capacity was expressed and qualified along a section of the rural road network as its 'Level of Service' (LoS) (refer to **Appendix 14**). LoS is typically expressed in total vehicles per day and / or vehicles per hour.

The LoS descriptions are:

LOS A: Free flow conditions, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream. Individual drivers are virtually unaffected by the presence of others in the traffic stream.

LOS B: Zone of stable flow, reasonable freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS C: Zone of stable flow, but restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS D: Approaching unstable flow, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow generally cause operational problems.

LOS E: Traffic volumes close to capacity, virtually no freedom to select desired speed or manoeuvre within traffic stream. Unstable flow and minor disturbances and / or small increases in flow would cause operational break-downs.

LOS F: Forced flow conditions where the amount of traffic approaching a point exceeds that which can pass it. Flow break-down occurs resulting in queuing and delays.

The existing levels of service for the northern route range from LOS A on Windeyer / Pyramul Road to LOS B/C on the Castlereagh Highway. For the southern route, levels of service range from LOS A on Hill End Road, and A/B on Duramana / Turondale Road to C/D on the Great Western Highway (see **Table 12.2**).

Mid-Western Regional Council (MWRC) has indicated that there are potential Endangered Ecological Communities (EECs) along the public roads identified as access routes. Consideration of these EECs, extracted from MWRC's Roadside Corridor Guidelines (MWRC, 2011a) has been included in **Chapter 10** Ecology.

12.3 Potential Impacts

A number of main and secondary roads, as discussed in **Chapter 3** Project Description and **Appendix 14**, will be used to access the Project site for construction, maintenance, refurbishment, decommissioning and visiting purposes. The major northern access links will be via the Castlereagh Highway, Hill End Road and Windeyer/Pyramul Road. The major southern access links will be Great Western Highway, Turondale Road and Hill End Road. Access to the external transmission line will be gained via Bombandi Road and Crudine Road.

12.3.1 *Construction*

Construction traffic for the installation of the Project will be present over a period of approximately 18 months to two years. The traffic will consist of:

- Articulated semi-trailers (extendible and regular trailer sizes), heavy duty low loaders, dolly / jinker arrangements and a variety of high power prime movers – for transporting initial establishment equipment, materials and turbine components;
- Tipper trucks – to bring stone for the access tracks and to remove soil;
- Bulldozers – for road works on-site;
- Concrete agitators – to transport concrete from the batching plant for use on-site;
- Cranes – one small mobile crane (up to 100 tonne) for assembly of turbines on the ground and a larger mobile crane (up to 600 – 1,000 tonne, or alternatively a 300-400 tonne crawler crane) for the erection of the wind turbine; and
- Conventional 4WD vehicles and sedans – use by on-site personnel.

During the construction period the largest number of vehicle movements is likely to occur during the delivery of the wind turbine components. Each of the wind turbines will require three or four escorted, extendible trailers for the tower, up to three for the blades and one for the nacelle. Additional loads will consist of concrete, steel reinforcement, base tower sections, road stone and other construction materials being delivered to the site.

Load weights and lengths of equipment and components will vary. The heaviest loads are expected to be the 600 – 1,000 tonne crane (weighing approximately 135 tonnes) and the nacelle (weighing approximately 70 tonnes). Over-mass loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the road surface. As such, over-mass vehicles will incur less loading stress on the road surface, especially when run under escort with limited speed, than normal heavy vehicle traffic. The longest loads will be for the blades, which will have trailer lengths approximately 50 m long.

On-site movement during the construction period will mainly consist of concrete mixers moving from the batching plants to the wind turbine bases, to pour tower footings. Each footing may contain up to 250 m^3 of concrete to be poured over an eight hour period, which would result in some 42 concrete mixer truck trips per day. Water carts for dust suppression may also be required, the number of trips dependant on the site conditions at the time of construction.

Traffic generation predictions used by Samsa Consulting for this assessment range from a moderate (average) scenario to a conservative (high) scenario (see **Table 12.1**). The moderate scenario is likely to apply for the great majority of the 18 month construction period, while the conservative scenario assumes that peak construction staff numbers would coincide with other peak traffic generating activities (such as concrete pours, access road construction and turbine component delivery). While the conservative scenario may occur for a discrete period, it is more likely that peak access road construction activities would be undertaken during the earlier stages of the construction program, and will not necessarily coincide with peak construction staff numbers or other peak construction activities such as concrete foundation pours. Nonetheless, this conservative overlap of activities was adopted to consider a worst-case scenario in addition to the more applicable moderate (average) scenario.

Traffic generation was classified into daily movement trips (i.e. two-way trips, generally involving vehicles travelling to site in the morning, and returning at the end of the day), shown as vehicles per day (vpd) and peak hour trips (where applicable), shown as vehicles per hour (vph). Traffic was also categorised by activity, including activities such as pre-mix concrete deliveries and steel reinforcement deliveries. Overall, estimates indicate that the moderate (likely) scenario traffic impact will contribute only approximately one third of the traffic volume that is estimated for the conservative (unlikely) scenario. Traffic generation for both the moderate and conservative (in brackets) scenarios is shown in **Table 12.1** below and, in more detail, in **Appendix 14**.

An increase in traffic volumes can impact on road safety and logistical issues. Potential impacts could include (full description **Appendix 14**):

- Traffic noise and delays;
- Vehicle collisions (with stock or due to obstruction by long loads) or loss of control;
- Dust from unsealed roads (see **Chapter 18** General Environmental Assessment); and
- Road surface deterioration, particularly during wet weather.

The Project is proposed to be built in stages to minimise the above-mentioned potential impacts and limit the increase on traffic volumes.

Table 12.1 Estimated Project-related traffic generation

Vehicle Type **vpd – vehicles per day (i.e. two way trips)** **vph – vehicles per hour (peak hour)**		**Total Estimated Vehicles**	
		Northern Access Route	**Southern Access Route**
Light vehicles (Construction staff)	vpd vph	40 (80) 20 (40)	40 (80) 20 (40)
Standard heavy vehicles (Miscellaneous construction)	vpd vph	21 (103) 5 (22)	21 (103) 5 (22)
Over-size vehicles (wind turbine components)	vpd vph	0 (10) n/a	0 (10) n/a
Total Vehicles	**vpd** **vph**	**61(193)** **25(62)**	**61(193)** **25(62)**

*Source: **Appendix 14** (conservative estimates in brackets).*

Road Capacity: These traffic estimates indicate that the operating conditions (LoS) along the rural road network will change negligibly from existing conditions after the addition of Project related construction traffic (see **Table 12.2**). The majority of the relevant rural road network has significant spare capacity and is operating at a high LoS. The addition of heavy vehicles and construction staff traffic during peak construction periods is able to be absorbed by the both the rural and urban networks with appropriate road infrastructure upgrades and construction traffic management.

Table 12.2 Rural road network capacity – existing and future LoS

Road Section	Existing LoS	Future LoS
Northern Access Route		
Castlereagh Highway	B / C	B / C
Hill End Road	B	B / C
Windeyer / Pyramul Road	A	A / B
Southern Access Route		
Great Western Highway	C / D	C / D
Mid Western Highway	B / C	B /.C
Duramana / Turondale Road	A / B	A / B
Hill End Road	A	A / B

Source: ***Appendix 14****.*

Heavy and Over-Sized Haulage: All wind farm component deliveries, including all over-sized vehicles, will be transported via both the northern and southern access routes, and arrive at the northern and southern Project site access locations. There are a number of options for a haulage route to Mudgee and Bathurst (as listed in **Appendix 14**). To minimise potential impacts, the final route will take into consideration the shortest route to the Project site with appropriate carriageway and clearance and the routes that cause least disruption to local transport and commercial activities. Final routes will be decided prior to construction between the Proponent, haulage contractor and road authorities and any required road modifications or upgrades designed and assessed at the time, as necessary.

Public Visits: Experience gained from operational wind farms at Hallett and Starfish Hill in South Australia, Albany and Esperance in Western Australia, Ravenshoe in Queensland, Crookwell and Blayney in New South Wales and Codrington in Victoria suggests that there will be a great deal of interest generated during the construction phase of the Project. This could be true for the Project as there are currently no operational wind farms in the area, and public awareness of wind farms is of growing interest.

12.3.2 *Operation and Maintenance*

Operational traffic will be restricted to maintenance and inspection vehicles, or other traffic use (e.g. visitors), which will make periodic visits to the site, as discussed in **Chapter 3** Project Description. Vehicles used will be standard 4WD vehicles, sedans or vans. Bulldozers / graders could be needed on an infrequent basis for maintenance of access roads during the life of the Project, which will allow for continued maintenance and inspection.

Also if a significant component of a turbine needs replacement, larger vehicles such as cranes and / or semi-trailers could be required, similar to that used during construction.

12.3.3 *Decommissioning*

The traffic and potential impacts will be similar to the construction phase of the Project. However, there will be less traffic volume as there will be no requirement for concrete mixer trucks, which in turn will reduce the potential impacts during decommissioning.

12.3.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. The main source of traffic within and around the Project is currently from agricultural activities and a small number of residential dwellings.

During construction, traffic levels will increase impacts; however, the Project may be built in stages, which would limit the number of roads that are impacted during the construction phase, thereby reducing cumulative impacts. During the operation phase, a small increase to existing traffic volumes can be expected resulting in a low level of cumulative impact.

The Project is of sufficient distance from Uungula Wind Farm and other existing and proposed wind farms that it is anticipated that there will be no increase to the volume of traffic on roads within the vicinity of the Project. Cumulative impacts would only result if the construction of one or more wind farms was to occur in parallel. Impacts would be localised to main arterial routes, such as the Castlereagh Highway, which should be able to accommodate the short-term increase in vehicle numbers.

12.4 Management and Mitigation

To ensure adequate road safety is maintained, a comprehensive management plan would be prepared in conjunction with the chosen transport contractor and relevant road authorities (including the local Council). The EMP sub-plan would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the Councils and RMS. It is acknowledged that on occasions local traffic will be inconvenienced. However, the management measures within the EMP sub-plan would endeavour to mitigate any impacts.

The following mitigation measures address all Project impacts, from construction through operation to decommissioning.

12.4.1 *Construction*

- Contract a licensed haulage contractor with experience in transporting heavy and over-size loads. The contractor would be responsible for obtaining all required approvals and permits from the RMS and Councils and for complying with any conditions specified in the aforementioned approvals;
- Develop an EMP sub-plan in conjunction with the haulage contractor and road authorities to include, but not be limited to, the following:
  - Scheduling of deliveries, timing of transport, limiting the number of trips per day, and reducing traffic during school bus route hours, i.e., 7:00 to 9:00 am and 3:00 to 4:30 pm;
  - Undertaking community consultation before and during all haulage activities and providing a dedicated telephone contact list to enable any issues to be rapidly identified and addressed;
  - Letterbox drop along affected routes;

  - Minimising disruption to local vehicles by ensuring average and maximum wait times due to Project related traffic along local roads are kept to a minimum (typically an average maximum of 3 minutes wait time);
  - Managing the haulage process, including temporary, short term road closures, the erection of warning signs and / or advisory speed signs posted in advance of isolated curves, crests, narrow bridges and changes of road conditions;
  - Placing of speed limits on all roads that would be used primarily by construction traffic to reduce the likelihood of any accidents and reduce maintenance costs;
  - Designing and implementing temporary modifications to intersections and roadside furniture as appropriate;
  - Producing a Transport Code of Conduct which would be made available to all contractors and staff detailing traffic routes, behavioural requirements and speed limits;
  - Establishing procedures to monitor traffic impacts on public and internal access tracks during construction, including noise, dust nuisance and travel times, and to implement modified work methods to reduce such impacts where practicable;
  - Where reconstruction or provision of a temporary crossing is required over a creek or drainage structure, the design of this structure will be discussed with the relevant authority; and
  - Reinstating pre-existing conditions after temporary modifications to the roads and pavements along the route where applicable, in consultation with the relevant authorities.
- Implement all aspects of the EMP sub-plan in co-ordination with the RMS, local Councils and property managers;
- Prepare road dilapidation reports covering pavement and drainage structures in consultation with the local Councils for all transport routes before and after construction. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent’s cost. Alternatively, the Proponent may negotiate other forms of compensation for road damage with the relevant roads authorities as appropriate; and
- Consideration for establishing a transport pool for employees from nearby towns to minimise traffic volumes.

Typical Route Upgrades: Full structural upgrades are not normally required for wind farm access routes. Exceptions include where access is via an under-rated bridge, or where there are obstructions that overhang the road or limit the width of the vehicle / load that can pass. Mitigation strategies could comprise the following measures. Selection of these measures will be dependent on a full technical assessment by a qualified structural engineer which will typically occur during the detailed design phase of the Project, once dimensions and loads are known.

Road Surface: Generally clearances as low as 300 mm should be considered for over-mass trailers. Mitigation measures may include;

- Review of road camber, rise, fall and undulations;
- Placement of speed limits on roads to minimise stresses on road surfaces; and
- Use of temporary surfaces of crushed rock or similar material for on on-site roads. Vehicles are designed to and capable of travelling on unsealed surfaces, and this measure is normally adequate to prevent loaded vehicles becoming bogged.

Road Width: Larger WTG loads require a road width of up to 5 m, which may be larger than the width of minor roads that service remote wind farm sites. Mitigation measures may include;

- Where road width is restricted (sealed or unsealed), clear sufficient vegetation from sides of the road to allow shoulders of crushed rock to be laid;
- Match the level of the surface preparation to that of the existing road to prevent tyre damage (and in the case of sealed roads, the break-up of the edge of the sealed section);
- Undertake a swept path analysis once WTG model has been determined, to ensure that obstacles such as ditches or traffic furniture can be identified and remedied ahead of time; and
- Regular maintenance of temporary or crushed rock road surfaces to be undertaken when over-size / over mass vehicles are travelling to / from the Project site.

Overhead Obstacles: Over-size vehicles can travel with a combined total height of 5.2 m without the need for an overhead pilot. Mitigation measures for overhead obstacles may include;

- Identification of any obstructions or height risks, such as low bridges, overhead power lines, hanging wires or tree branches;
- Where a bridge risk occurs, detailed calculations to be undertaken to ensure loads do not present any risk of bridge strike;
- Where overhanging wires occur, additional temporary support to be provided if required; and
- Overhanging tree branches to be cut back or restrained away from the path of the vehicle.

Bridges and Culverts: Where bridges and / or culverts are deemed not strong or wide enough (typically less than 5 m travel path width) to support WTG transport equipment, mitigation measures may include;

- Utilising a temporary diversion with a structure that will provide necessary support, while leaving the original structure in place;
- Reinforcing the existing structure by means of steel plates / girders as required, providing necessary support. Reinforcement can be provided either below the structure, or as additional support on top of the existing road surface; and
- As a last resort, where other options are not feasible or practicable, consideration may be given to the replacement of the bridge / culvert with a structurally suitable permanent upgrade to support the projected component loads.

12.4.2 *Operation and Maintenance*

Establish a procedure to ensure the ongoing maintenance of the Project site access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.

12.4.3 *Decommissioning*

Prepare and implement a revised EMP sub-plan reflecting the changes in traffic volumes, during time of decommissioning.

12.4.4 *Engagement of local Councils to undertake works*

MWRC have requested a level of involvement in undertaking any required upgrade works on Council maintained roads and bridges, or as a minimum works are to be carried out in conjunction with Council in a supervisory role to Council specifications. In particular, MWRC have sought:

- To undertake dilapidation reports on all roads and bridges;
- That all unsealed sections of the preferred route (or as a minimum unsealed sections in front of existing houses) are sealed prior to construction commencing;
- On-route practical assessments to be undertaken in conjunction with Council senior engineering staff to determine the extent of road works required; and
- To undertake all physical works on the roads (including the sealing of unsealed sections of road), bridge strengthening, road widening and corner removal.

During the Detail Design and Contract Development stage of Project establishment (**Chapter 3** Project Description) the Proponent will seek competitive tenders for both the supply of wind turbines and balance of plant (civil and electrical) works.

The Proponent will consider MWRC's requests during Detailed Design and Contract Development. Notwithstanding this, MWRC may bid for any aspect of the balance of plant works for the Project.

12.5 Summary

Samsa Consulting have estimated that the Project has the potential to create either a moderate impact of up to an additional 61 vehicles per day or a conservative (high) impact of up to an additional 193 vehicles per day. These impacts could have a significant impact on existing road users for up to two years along both the northern and southern access routes during the construction period. This would especially be the case on the minor and unsealed roads. These higher than normal impacts, however, are expected only during the construction and decommissioning periods, with only minor increases to traffic volumes during the operational phase.

Adoption of the strategies for minimising traffic impacts outlined in this section should reduce community disruption and the risk of traffic incidents, thus facilitating minimum disruption to the existing traffic conditions.

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CHAPTER 13

Aviation Assessment

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13. AVIATION ASSESSMENT

Existing aviation activity in the locality of the Project site was identified during planning and design through consultation with the Department of Defence (DoD), Civil Aviation Safety Authority (CASA), Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), the NSW Rural Fire Service and the local community. This chapter presents an assessment of the aviation activity in the Project locality, potential impacts from the Project and appropriate mitigation actions. This assessment includes the results of an independent Aeronautical Impact Assessment and Obstacle Lighting Review, **Appendix 16**, prepared by Hart Aviation.

13.1 Existing Situation

13.1.1 *Department of Defence*

Advice received from the DoD indicates that the Project will be outside any areas affected by the Defence (Areas Control) Regulations (**Appendix 16**). However, the DoD have noted that the Project will be wholly sited within Danger Area D538A which is used for Williamtown Military Flying Training. There is also an ongoing need to obtain and maintain accurate information about tall structures so that risks associated with inadvertent collision by low flying aircraft can be reduced. The Royal Australian Air Force Aeronautical Information Service (RAAF AIS) is responsible for recording the location and height of tall structures. The information is held in a central database managed by RAAF AIS and relates to the erection, extension or dismantling of tall structures the top measurement of which is 30 m or more above ground level, within 30 km of an aerodrome, and 45 m or more above ground level elsewhere.

The wind turbines and associated meteorological masts proposed for the development will meet the above definition of a tall structure. DoD requests that the Proponent provide RAAF AIS with “as constructed” details so that the structures can be appropriately shown on aviation charts.

13.1.2 *Civil Air Operations*

CASA is concerned with two main aviation issues with respect to wind farms. The first is the protrusion of wind turbines (obstacles) into the Obstacle Limitation Surfaces (OLS) of airfields. The OLS is essentially a defined area of airspace above and around a licensed aerodrome. The second issue is the height of turbines outside the OLS and Procedures for Air Navigation Services (PANS OPS), but still in areas of aviation activity (air traffic).

The two registered aerodromes closest to the Project site are Bathurst Aerodrome (45 km to the south) and Mudgee Aerodrome (50 km to the north). There is also an unlicensed airfield and an unlicensed aerodrome in the area, Dabee Station (34 km east) and Rylstone Aerodrome (35 km east). The Project is not expected to impact on procedures or operations at these sites.

To address the issue of wind turbine height, CASA’s Manual of Standards Part 139 – Aerodromes, states that, in general, an obstacle would require obstacle lighting unless an aeronautical study assesses it as being shielded by another object or that it is of no operational significance. For wind turbines occurring outside of an aerodrome CASA released Advisory Circular *AC 139-18(0) Obstacle Marking and Lighting of Wind Farms* in July 2007 to provide advice regarding the requirements for obstacle marking and lighting of wind turbines and wind monitoring masts, under Civil Aviation

Safety Regulations (CASR) Part 139 (see **Appendix 15**). In 2008 this advisory was withdrawn, and as such, CASA's statutory power to require obstacle marking and lighting only applies within the vicinity of an aerodrome (30 km). Therefore, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent, in consideration of their duty of care.

In July, 2011, the Department of Infrastructure and Transport (DIT) issued for comment the draft "Guidelines for Land Use Planners to Manage the Risk of Wind Turbines as Physical Obstacles to Air Navigation" addressing the issue of obstacle marking and lighting outside of an aerodrome.

Notwithstanding the withdrawal of the CASA Advisory Circular, in response to specific queries as to lighting standards to apply to wind farms that are remote from an aerodrome, CASA has previously advised:

- Even though a CASA assessment is not required it is important to point out the Proponent may have a duty of care to local aviators, such as aerial spraying and private flight operators, whose aeroplane landing area may be located in the vicinity of the wind farm, and who may want the wind turbines made conspicuous for night flying and during periods of low visibility;
- If the Proponent wishes to provide additional conspicuity, this may be achieved by installing obstacle lighting which meets the standards set out in the CASA Manual of Standards (MOS) Part 139 Aerodromes, Chapter 9, Section 9.4 – Obstacle lighting; and
- The Advisory Circular information (AC 139-18 (0)) is still valid as a recommendation if the Proponent wishes to do so as a risk mitigator.

The Proponent had HART Aviation prepare an independent Aeronautical Impact Assessment and Obstacle Lighting Review, **Appendix 16**, to determine whether the Project had an operational significance and would require obstacle lighting for the turbines.

13.1.3 ***Airservices Australia***

AsA are a government-owned corporation providing safe and environmentally sound air traffic control management and related airside services to the aviation industry. AsA provides air traffic management and aviation rescue and fire fighting services across Australia. They were consulted about the potential impact of the Project on their operations.

AsA has informed the Proponent that the Project will not affect any sector or circling altitude, nor any approach or departure at Bathurst, Mudgee or Orange aerodromes. AsA has also advised that the Project will not impact on Precision / Non-Precision Navigational Aids, HF / VHF Communications, Advanced Surface Movement Guidance and Control Systems (A SMGCS), Radar or Satellite / Links.

13.1.4 ***NSW Rural Fire Service***

The RFS often uses aerial fire fighting aircraft, both fixed and rotary wing, to assist ground crews in suppressing bush fires. Aircraft are regularly used in both initial attack and in ongoing fire operations in the New England area.

13.1.5 *Aerial Agricultural Association of Australia and Other Activities*

Agricultural aerial spraying is known to occur in the region. Pest management is likely to occur annually, while top-dressing (nutrient application) may occur every five years or so.

Seven airstrips are known of within the locality of the site (**Figure 13.1**), with the nearest wind turbine in the landing and take-off direction of the most impacted airstrip being 1.3 km distant. This would not impact operations from that airstrip, and all other airstrips are potentially less affected.

AAAA's position is that the organisation opposes wind farm developments and overhead transmission lines unless the developer has:

- Consulted in detail with local operators;
- Received independent expert advice on safety and economic impacts; and
- Considered the impacts on the aerial application industry.

An assessment of the potential impacts of the wind farm on agricultural aerial operations was undertaken by HART Aviation.

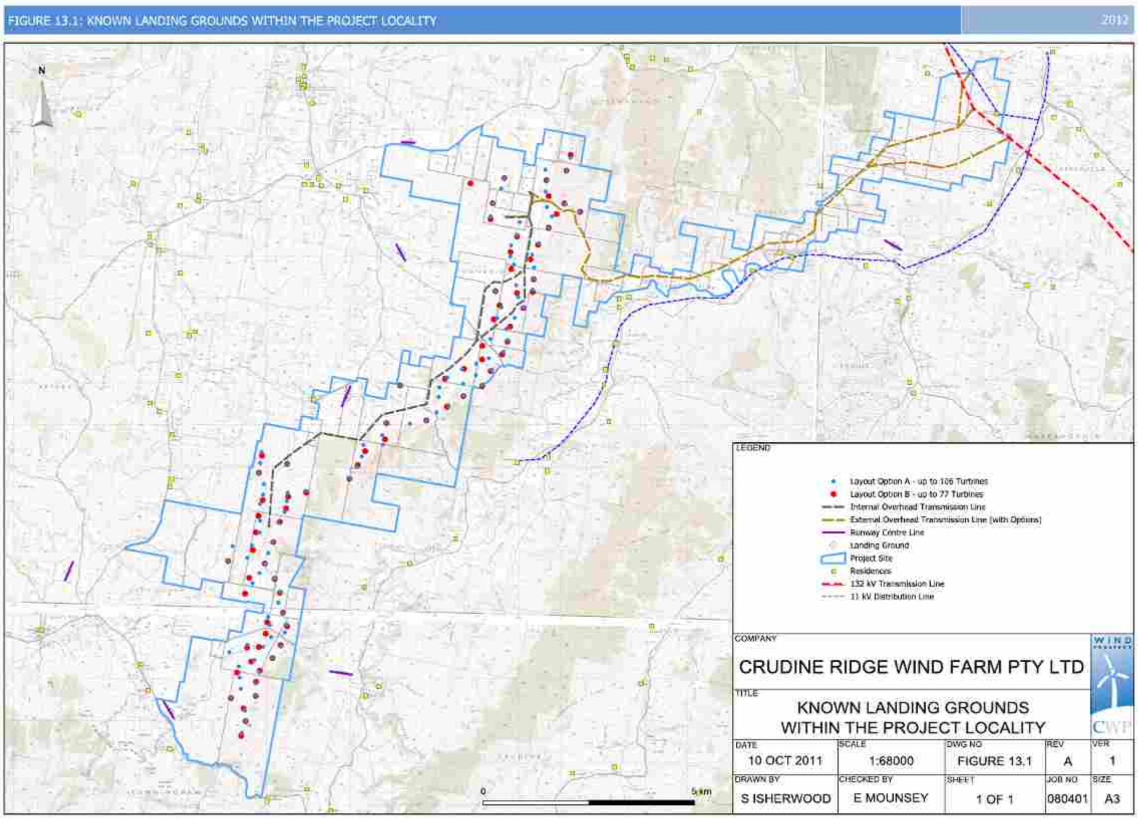

Figure 13.1 Known landing grounds within the Project locality
(An A3 size version of this Figure is displayed in Volume 2)

13.2 Potential Impacts

13.2.1 *Department of Defence*

The DoD has advised that the Project will not impact on defence operations (**Appendix 16**). Regarding Danger Area D538A, Williamtown Flying Training, the importance of the requirement to notify Department of Defence of the “Tall Structure” with “as constructed” details is emphasised.

13.2.2 *Civil Air Operations*

Tall structures have the potential to obstruct or present a safety hazard for aircraft, if sited in an OLS or in areas with high levels of air traffic. The maximum turbine height proposed for the Project is up to 160 m. Final turbine height will depend on the model of turbine deemed to be appropriate for installation and may fall below this maximum. The distance to the nearest aerodromes and airfields is sufficient to ensure operations at these locations will not be affected by the Project (**Appendix 16**).

This means that the Project is not likely to be assessed as an “Obstacle” or a hazard to the safety of aircraft and airport operations. However, the International Civil Aviation Organization (ICAO) which sets international standards and recommended practices, of which Australia is a member state, considers wind turbines in excess of 150 m an obstacle and as such, lighting is recommended. Although it should be noted that ICAO Standards and Recommended Practices (SARPS) do not necessarily apply to domestic aviation activities, which is the primary concern with wind farms in Australia. The outcomes of the Aeronautical Impact Assessment and Obstacle Lighting Review will be submitted to CASA for their comment pending Development Approval.

Lighting facilities on turbines or around wind farms have the potential to have two main negative impacts. The first is the visual amenity of the Project area at night (see **Chapter 8** Visual), both for local residences and visitors. The second impact relates to local bird and bat populations (see **Chapter 10** Ecology). Some bird and bat species are known to be attracted to some types of lights, for either navigational purposes or for feeding. This attraction may increase the probability of interaction with the wind turbine blades.

13.2.3 *Airservices Australia*

AsA has informed the Proponent that at the calculated maximum height of the highest turbine at 1,160 m AHD, the Project will not affect Precision / Non-Precision Navigational Aids, HF / VHF Communications, Advanced Surface Movement Guidance and Control Systems (A SMGCS), Radar or Satellite / Links. They have also advised that the Project will not affect any sector or circling altitude, nor any approach or departure procedures at Mudgee, Bathurst or Orange Aerodromes.

13.2.4 *NSW Rural Fire Service*

The RFS response to a fire is incident dependent and adaptable, and appropriate strategies are determined on a case by case basis. NSW RFS have communicated that response to a wind turbine fire incident would take the same approach as that taken with other infrastructure including transmission lines, power poles, telecommunication towers, houses, sheds or workshops. The organisation goes on to say that the presence of wind turbines is unlikely to restrict fire fighting operations; rather, individual circumstances will be adapted to as necessary.

13.2.5 *Aerial Agricultural Association of Australia and Other Activities*

The Project has the potential to impact on agricultural aerial spraying activities, as the turbines may potentially present physical obstacles that need to be negotiated when carrying out aerial spraying. This is likely to be more relevant to top-dressing, which can occur atop the ranges in the area. There is very little evidence of crop farming in the area, suggesting the use of aerial pest management would be limited, however, if present, it would be more likely to occur along the lower slopes of the ranges.

As such, HART Aviation considers the likelihood of any aerial agricultural operations occurring in this region is remote, but cannot be completely discounted. HART Aviation consider that the presence of wind turbines will adversely impact the ability of aerial agricultural operators to safely undertake aerial spraying, seeding or fertilising within the confines of the Project.

AAAA has previously provided guidance on this matter with respect to the Civil Aviation Authority CAAP 92:1(1), *Guidelines for Aeroplane Landing Areas* (1992) (see **Appendix 17**), with particular regard to runway splay or "clearway" distances for agricultural runways (Wind Prospect CWP, 2009). A "clearway" is defined as an area in which there are no obstacles penetrating a slope of 2.5 % rising from the end of the runway over a width of 45 m, see **Figures 13.3** and **13.4** below.

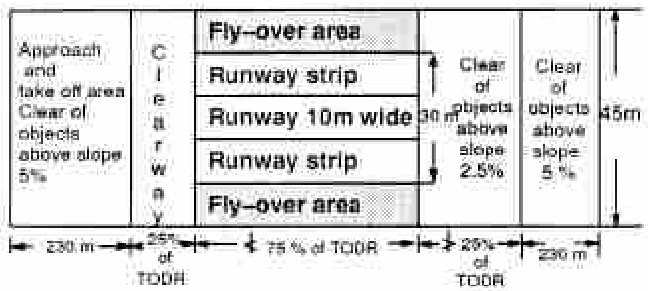

Figure 13.2 Landing ground dimensions – Agricultural Day Operations

Figure 13.3 Landing ground dimensions – Agricultural Night Operations

Source: Civil Aviation Authority CAAP 92:1(1), Guidelines for Aeroplane Landing Areas (1992) ***(Appendix 17)***

Agricultural operations that involve low level flying can only occur in good conditions (high visibility) in accordance with the aviation regulations, and wind turbines can be considered to be highly visible structures. Aerial operators engaged in low level flying and agricultural operations are required to undertake a risk assessment for each flight. This would identify specific obstacle hazards such as trees and power lines. Wind turbines should be treated no differently.

13.2.6 *Cumulative Impacts*

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

Local air operations would not be impacted by the combined presence of the proposed Uungula Wind Farm or other proposed or existing wind farms, as there are sufficient distances between these projects. Such separation distances mean that air operations will need to consider each wind farm in isolation when carrying out site-specific activities, such as agricultural spraying or pest control. As each wind farm development has to assess its potential impact on aviation activities in the area and provide mitigation measures if any impact is to occur, it is anticipated that any potential cumulative effect on aviation activities will be covered by appropriate mitigation measures highlighted in each project's Environmental Assessment.

If obstacle lighting is a consideration, then there could be a cumulative impact if all wind farms proposed for the area are constructed and fitted with appropriate lighting. However, given there is no mandatory requirement for such lighting at this time, the consideration of cumulative impact from obstacle lighting is not required. The Proponent will consult with CASA and DIT post-consent to ensure that the wind farm meets all mandatory requirements with respect to obstacle lighting, including the consideration of cumulative impacts if necessary.

13.3 Management and Mitigation

13.3.1 *Department of Defence*

The Proponent will provide the RAAF AIS with 'as constructed' details for entry on the Tall Structures Database and aviation charts.

13.3.2 *CASA Requirements*

The Proponent will provide CASA with turbine location and height details once final design positions are known and before construction commences. During construction, additional and separate notification will be required for the use of cranes (temporary obstacles) that exceed 110 m above ground level. After construction is complete, the Proponent will provide CASA with "as constructed" details.

On receipt of Development Approval for the Project, and with particular regard to the Aeronautical Impact Assessment and Obstacle Lighting Review, the Proponent will consult with CASA and DIT on the issue of obstacle lighting. The Proponent will be seeking a solution, which, if appropriate to do so, will consider the provision of obstacle marking and lighting. If CASA insist on full compliance with the requirements of the now withdrawn CASA Circulatory AC 139-18(0), the Proponent will commit to shielding provisions allowed under existing CASA guidelines. The shielding restricts the downward component of light to 5 % of nominal intensity emitted below 5° below horizontal and zero light emission below 10° below horizontal.

13.3.3 *Airservices Australia*

The Proponent will provide AsA with the location and height details of turbines with "as constructed" details.

13.3.4 *NSW Rural Fire Service*

NSW Rural Fire Service: The Proponent will provide NSW RFS with the location and height details of turbines once final turbine locations are known and before construction commences. After construction is complete, the Proponent will provide NSW RFS with "as constructed" details.

13.3.5 *Aerial Agricultural Association of Australia and Other Activities*

The Proponent will provide AAAA with the location and height details once final turbine locations are known and before construction commences. After construction is complete, the Proponent will provide AAAA with "as constructed" details.

Agricultural aerial spraying activities are not considered common in the area, however, it is expected that some impact on operation may occur as a result of the Project, although subject to individual pilot risk assessment. Appropriate information regarding the wind turbine layout and dimensions will be supplied to the RFS, if required, to assist in their planning and execution of fire response.

13.4 Summary

Wind farms have the potential to impact on aviation activity and aerodrome operations by introducing obstacles to aerial operations and interfering with aerial communication and navigation aids.

There are two registered aerodromes within the vicinity of the Project study area, Bathurst Aerodrome (45 km to the south) and Mudgee Aerodrome (50 km to the north). There is also an unlicensed airfield and an unlicensed aerodrome in the area, Dabee Station (34 km east) and Rylstone Aerodrome (35 km east). According to the aviation hazard assessment carried out by HART Aviation, the Project does not impact the OLS and PANS OPS of these airfields.

CASA administers regulations for the intrusion of obstacles into aerodrome OLS and PANS OPS and obstacles 110 m above ground level outside of aerodromes. On 1 March 2011 CASA indicated that a review would be undertaken of safety issues associated with obstacles remote from an aerodrome, which will now be conducted by Department of Infrastructure and Transport (DIT). As there is no current standard in place, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent.

HART Aviation recommends the Proponent consider the provision of obstacle marking and lighting as a duty of care obligation. On receipt of Development Approval for the Project, the Proponent will consult with CASA and DIT on the issue of obstacle lighting. The Proponent will be seeking a solution, which if appropriate to do so will consider the provision of obstacle marking and lighting. If CASA insist on full compliance with the requirements of the now withdrawn CASA Circulatory AC 139-18(0), the Proponent will commit to shielding provisions allowed under existing CASA guidelines.

Agricultural aerial spraying activity for pest management and pasture top-dressing is not considered to be a common activity across the Project site. Pest management spraying is unlikely to be affected by the Project. Top-dressing activity will require care by pilots applying the material to properties along the ridgelines.

Some private landing strips are present and these are not impacted by the Project’s wind turbine locations.

CHAPTER 14

Communications Assessment

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14. COMMUNICATIONS ASSESSMENT

Electromagnetic signals (or radio waves) are transmitted throughout the country as part of telecommunication systems by a wide range of operators. Such systems are used for radar, radio broadcast, television, mobile phones and mobile and fixed radio transmitters. Electromagnetic signals generally work best if a clear path exists between the transmitting and receiving locations, known as line of sight (LOS).

There is the potential for interference from any large structures, including wind turbines, which occur within or close to the signal path. Signals can be interfered with or be reflected by the rotating blades of a wind turbine, which could degrade the performance of the signal (Bacon 2002). Electromagnetic emissions from generators and other machinery also have the potential to affect signals; however with modern turbine generators and strict International Electrotechnical Commission (IEC) regulations for manufacturers, there are now negligible emissions from wind turbines (Auswind 2006).

This section describes the existing radio and communication systems that operate within the vicinity of the Project, as well as general television broadcast services. It also provides an assessment of potential interference effects caused by the Project and suggested mitigation measures.

14.1 Methods

Experts have been consulted to assess the potential interference to radio-communications and TV signals in the area of the Project from electromagnetic signals. Lawrence Derrick & Associates (LDA) conducted an assessment of the potential impacts of radio-communication services (see **Appendix 18**), while Broadcasting Australia and commercial television (TV) stations were consulted regarding potential TV interference and relevant operators were consulted regarding point to multipoint communication links (see **Appendix 19**). The following sections outline the approaches taken in measuring such interference.

14.1.1 *Radio-communication Investigations*

The Australian Communications and Media Authority (ACMA) Register of Radio-communications was reviewed by LDA to determine the location of any radio-communications links and towers within or close to the Project site. Once this was done, a corridor was created around each of the links or towers to ensure that the First Fresnel Zone (refer to **Appendix 18** for description) was not affected by any of the proposed wind turbines or blades.

14.1.2 *Television Investigations*

Broadcasting Australia (managers of the National Transmission Network transmitting both ABC and SBS channels), Prime Television, Channel Seven, Network Ten, Australian Capital Television and WIN Television were approached to determine what affects the Project, and in particular wind turbines, would have on any of their transmission towers or television services.

14.2 Existing Situation

14.2.1 *Radio-communications*

There are six paths with point-to-point links traversing the Project operated by TransGrid, Telstra, Optus, NSW Rural Fire Service (RFS) and Soul Pattinson Telecommunications. There are also two radio sites located outside the Project boundary which have the potential to be affected, also considered by LDA.

There are an additional seven point to multipoint (PMP) services in the Project region (see **Appendix 18**) which were considered by LDA. Given the distance of the base station locations from the Project site, it is unlikely that any related path would cross the Project. The PMP operators have been notified of the Project, and turbine locations.

Low power FM Broadcasting stations are located on Baldy Peak (18 km to the east of the Project), Endicott Hill (34 km to the north of the Project) and 2 km south of Capertee (39 km to the south-east of the Project). Low power Broadcasting stations also exist to serve the Portland / Wallerwang, Oberon and Bathurst areas, at much greater distances from the Project site. These sites are all of a sufficient distance from the Project to ensure no impacts on coverage will occur.

There are two other existing radio towers that occur near the boundary of the Project, on Monkey Hill, 2.4 km from the Project. There are a large number of radio systems installed on the towers, apart from the point to point systems, which include;

- Mobile Radio Base stations;
- Telstra Cellular Mobile Base stations;
- NSW RFS Paging service transmitter;
- An FM broadcasting service; and
- A CB UHF Repeater.

The 2.4 km distance between these towers and the Project is considered adequate to avoid any impacts on the services on Monkey Hill.

14.2.2 *Television*

Residences in the vicinity of the Project receive television reception primarily from the Central Tablelands and Central Western Slopes Main Television stations at Mt Canobolas (Central Tablelands, 68 km south west of the Project) or Mt Cenn Cruaich (Central Western Slopes, 184 km north of the Project), and possibly from lower power translator stations located on Baldy Peak, Endicott Hill, Garlands Hill, Falls Hill and a site 2 km south east of Capertee. The operators of these stations are ABC, SBS, Australian Capital Television Pty Ltd, Prime Television (Southern) Pty Ltd and WIN Television NSW Pty Ltd. The link centre lines between the Main Television stations and the lower power translator stations are all outside a 2.6 km buffer zone, an adequate distance to negate any disturbance to the signal.

14.2.3 *Air Services Radar*

While there are two Non Directional Beacons in the Mudgee and Bathurst regions, there are no registered Airservices Australia (AsA) Radar facilities within LOS of the turbines. The separation distance from the Project to these sites indicates no further buffer zones are required. AsA have been notified about the Project and further detail on Aviation-related communication systems is included in **Chapter 13** Aviation.

14.2.4 *Mobile Phones*

Vodafone currently has very limited 2G and 3G coverage with no mobile internet coverage across the Project locality as seen in **Figure 14.1**. Using the Next G Network, Telstra provides coverage for mobiles across the Project via Telstra Mobile where an external antenna is used. Telstra also provides some broadband access, as seen in **Figure 14.2.**

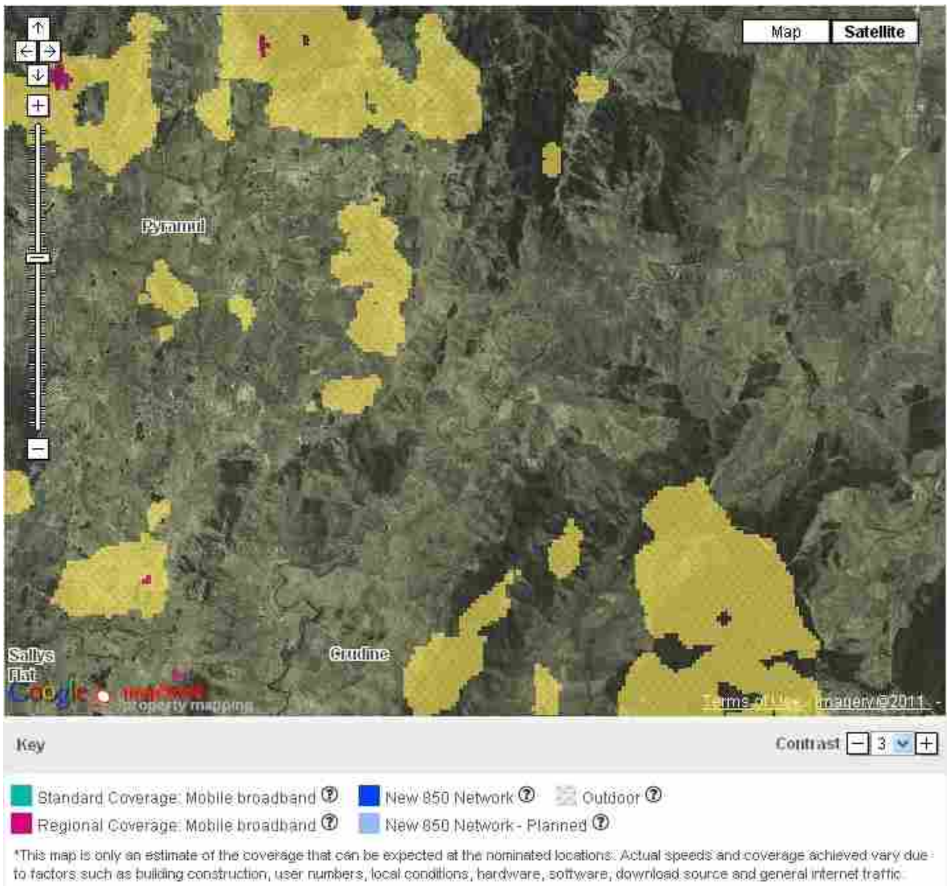

Figure 14.1 Vodafone coverage across the Project site

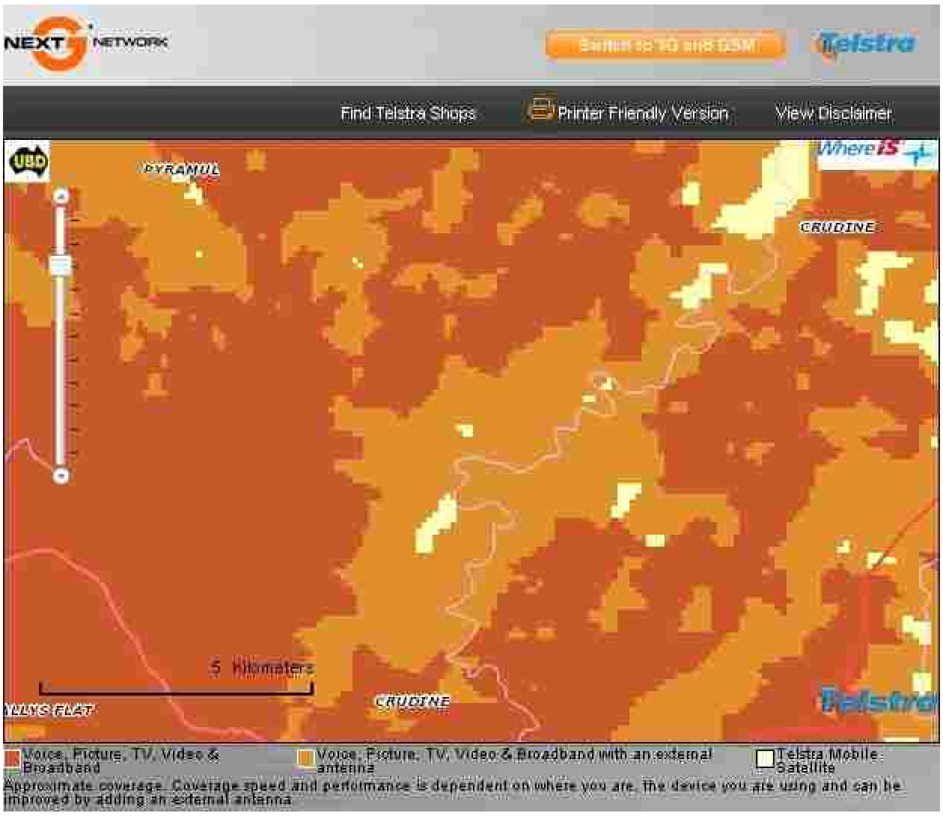

Figure 14.2 Telstra coverage across the Project site

14.3 Potential Impacts

Potential impacts on the communications services in the area vary depending on the type of signal link used and the proximity of the Project components to those links.

14.3.1 *Radiocommunications*

Point to point, or point to multipoint services require a high degree of LOS, and therefore can be easily affected by structures within the LOS pathway. As a general rule of thumb, if objects are placed outside of the First Fresnel zone (or zone of electromagnetic interference) then impacts can be avoided. The First Fresnel clearance zones of point to point radio-communication links that cross through or near the Project will not be impacted upon as seen in **Figure 14.3**. Also, no wind turbines are located within a disruptive distance of a transmitting or communication tower, which means the Project is not expected to have any negative impacts on existing point-to-point links using such towers.

For point to multipoint (PMP) services, usually only the base station is registered, so the remote end is not known, making it harder to determine turbine obstruction. Consultation with Endeavour Energy, operator of a PMP service at Kandos revealed the Project location does not present risk to the Endeavour Energy radio network (see **Appendix 19**). No other responses from PMP services have been received.

Radio Frequency broadband noise generated by power lines could be received by the radio receivers at radio repeaters or terminal sites if sites are close to the lines and if the links were operating at low frequencies. However, generally this is not an issue as transmission lines today are each built to standard specifications that reduce potential impact. Poles, towers and wires that are part of the transmission line could also physically obstruct the radio signal. However, due to the low height and limited dimension of the wires, there is minimal impact from such structures.

Amplitude Modulated (AM) and Frequency Modulated (FM) radio transmission systems are considered to be subject to negligible impacts from wind farm projects and effects only occur at very small distances from wind turbines (i.e. within 10 m) (National Research Council 2007). This will be no different at the Project site.

Mobile radio services do not require a high degree of LOS and so are less susceptible to interference by structures.

14.3.2 ***Television***

Wind turbines can interfere with analogue television signals by causing the picture to flicker or 'ghost' in time with the rotation of the blades, also known as scattering or reflection.

Broadcast Australia does not envisage any significant issues for ABC or SBS TV services due to the location of their sites in relation to the viewing audience and the Project site (see **Appendix 19**). No other responses to correspondence were received, however, 2.4 km distance to the nearest turbine is considered sufficient to have minimal impact on station coverage.

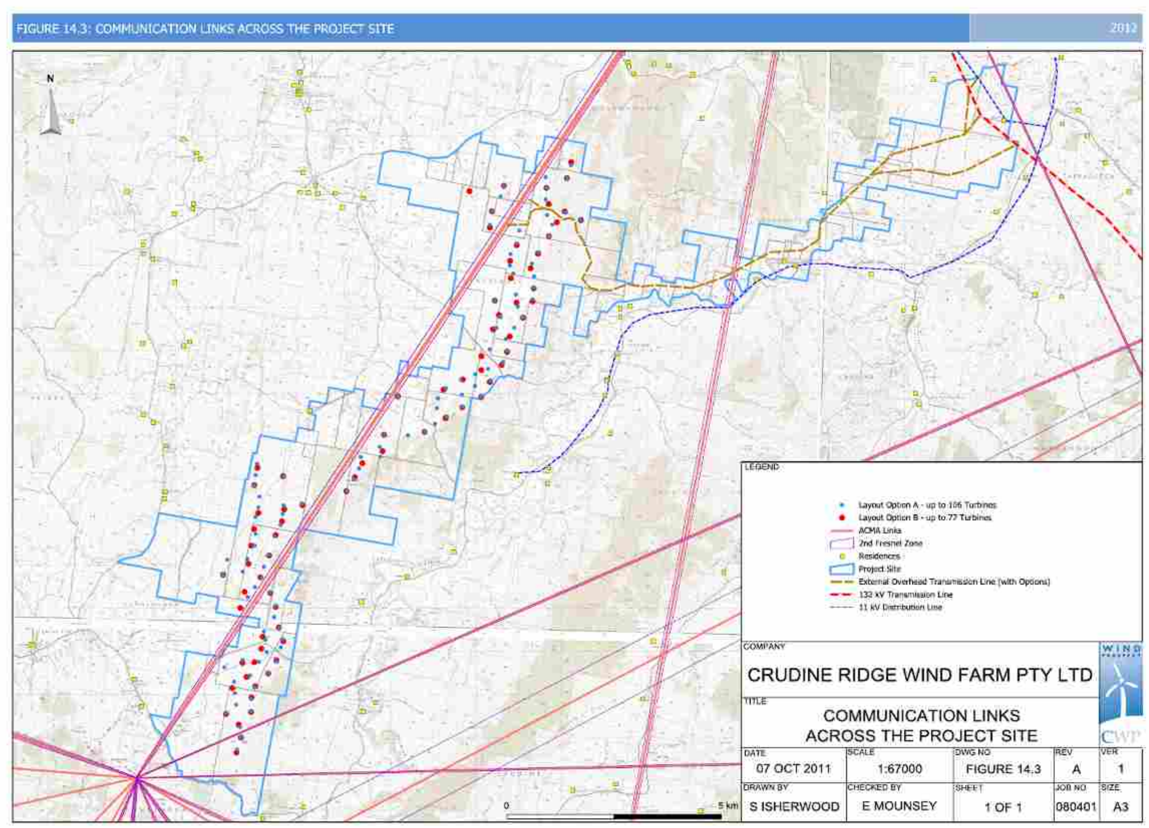

Figure 14.3 Communication links across the Project site
(*An A3 size version of this Figure is displayed in Volume 2*)

14.3.3 *Mobile Phones*

Mobile phone reception is mainly dependent on the position of the receiver. The position of the receiver is able to move around both natural and unnatural obstacles in the landscape and therefore wind turbines will have minimal impacts on signal quality.

Telstra's response to consultation indicated that results of rayline analyses revealed that there is no potential for undue interference from the Project. It was also indicated that Telstra will require protection or relocation of fixed telecommunications infrastructure should any be impacted by the Project (see **Appendix 19**). Communication from Optus indicated that no impacts to existing or planned Optus infrastructure are expected from the Project (see **Appendix 19**).

14.3.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. As each wind farm development has to assess its potential impact on communication links in the area and provide mitigation measures if any impact is to occur, it is anticipated that any potential cumulative effect on communications links from the proposed Uungula Wind Farm or other proposed or existing wind farms will be covered by appropriate mitigation measures highlighted in the respective project's Environmental Assessment.

14.4 Management and Mitigation

Typical general mitigation requirements include:

- Amend planned WTG positions if necessary and feasible within the Conditions of Approval, to create corridors to ensure minimal interference on links;
- A system for recording any complaints on interference, to allow for further investigations with the affected party, to reach an amicable solution;
- Use of primarily non-metallic WTG blades, to minimise disruption; and
- Where practicable use equipment complying with the Electromagnetic Emission Standard AS/NZS 4251.2:1999.

Although no impacts on radio and communications are expected, typical mitigation requirements for radio-communication, if impacts occur, could include:

- Modifications to or relocation of existing antennae;
- Installation of a directional antennae; and
- Installation of an amplifier to boost the signal.

If television interference is experienced and reported by an existing receiver in the vicinity of the Project, the source and nature of the interference would be investigated by the Proponent. Should the cause of interference be attributed to the Project, then the Proponent will put suitable mitigation measures in place after consultation and agreement with the affected landowner or television broadcaster. These could include:

- Re-orientation of existing aerials to an alternative transmitter;

- Provision of a land line between the affected receiver and an antenna located in a suitable reception area;
- Provision of satellite or digital TV where available; or
- Installation of a new repeater station in a location where interference can be avoided (this is more complex for digital transmissions but also less likely due to the structure of the digital signal).

14.5 Summary

There are a number of point-to-point links and omni-directional services which occur across and near to the Project. Assessment of these links has predicted that no impacts will occur on communications as a result of the Project. If the Project does cause any interference to any links, the Proponent will conduct an investigation with the afflicted parties and implement a suitable solution to the problem.

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CHAPTER 15

Electromagnetic Fields

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15. ELECTROMAGNETIC FIELDS

Electric and magnetic fields (EMFs) are associated with a wide range of sources and occur naturally and as a result of human activity. Naturally occurring EMFs are those associated with lightning or the Earth's magnetic field. Human caused EMFs occur wherever electricity is present, meaning we are constantly exposed to EMFs in our home and work environments.

Wind farms create EMFs from operational electrical equipment such as transmission lines, substations and the electrical components found within the wind turbines. This equipment has the potential to produce Extremely Low Frequency (ELF) EMFs, that is, the current will alternate direction between 30 and 300 times per second, or at 30 to 300 Hertz (Hz).

This chapter focuses on the theoretical health impacts and suitable mitigation strategies for ELF electromagnetic fields generated by the operation of a wind farm.

15.1 Existing Situation

There are currently no Australian standards regulating exposure to ELF EMFs. The National Health and Medical Research Council (NHMRC) has issued interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields, and are currently subject to a review by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The NHMRC recommended exposure limit for members of the public (24 hour exposure) is 1,000 milligauss (mG) for magnetic fields and 5 kilovolts per metre (kV/m) for electric fields. For exposure up to a few hours a day, the guidelines recommend exposure to be limited to 10,000 mG for magnetic fields, and 10 kV/m for electric fields (ARPANSA 2009).

Table 15.1 below provides typical magnetic field measurements and ranges associated with various EMF sources. Electric fields around most equipment / appliances are close to zero due to the shielding that is provided by the equipment itself. According to ARPANSA (2009) exposure levels to magnetic fields around the home are in the range of 0.1 to 2.5 mG. For homes near power lines, these levels may be as high as 5 to 10 mG.

Table 15.1 EMF sources and magnetic field strength

Source	Typical measurement (mG)	Range of measurement (mG)
Television	1	0.2 to 2
Refrigerator	2	2 to 5
Kettle	3	2 to 10
Personal computer	5	2 to 20
Electric blanket	20	5 to 30
Hair dryer	25	10 to 70
Distribution power line (under the line)	10	2 to 20
Transmission power line (under the line)	20	10 to 200
Edge of easement	10	2 to 50

Note: Owing to variations in the design of electrical appliances and the loadings on powerlines, the EMF levels may vary. The table above is based on a consistent set of measurements undertaken by power authorities in Australia using similar techniques and protocols to overseas measurements.

Source: Electricity Networks Association (2006)

15.2 Potential Impacts

ELF EMFs will be generated once the turbines and electrical infrastructure are energised (commissioned) and during the operation of the wind farm. The final configuration of the proposed Project will determine the profile and intensity of electric and magnetic fields across the Project site.

15.2.1 *Electrical Cables*

The proposed development comprises internal under and above ground electric cabling up to 132 kV and 132 kV double circuit overhead electrical cabling between the main collector substation and the point of connection into the transmission network. Below are examples of ELF EMFs from high voltage power lines, provided to illustrate existing knowledge. The field strength from an electrical cable is dependent on load current(s), distance from the emitting source, relative phasing of circuits and spacing of conductors. Known measurements on the strength of both magnetic and electric fields are provided below:

- Measurements using a gaussmeter from underneath a 220 kV transmission line resulted in a maximum recorded limit of 7.8 microTesla (µT) (or 78 mG) (Transpower 2009). Typical levels of magnetic field under a 330 kV high voltage transmission line range from 5 to 50 mG at a distance of 30 m from the centre of the easement (NGH Environmental 2008). Both of these measurements are in line with the range expected and presented in **Table 15.1**; and
- Similarly, electric field measurements from underneath a 220 kV transmission line, resulted in a maximum recorded limit of 3.2 kV/m (Transpower 2009) with levels of 0.07 kV/m and 0.01 kV/m recorded at 30 m and 60 m from a 115 kV power line (Hafemeister 1996).

These figures are far less than the NHMRC recommended limits for exposure of 1,000 mG and 5kV/m.

The strength of magnetic and electric fields can also change along a transmission line if there is an unbalanced load of energy within the line or there is line sagging due to excessive heat on the cables. Both of these effects could cause increased recordings directly underneath the transmission line, however, the effects are temporary and would not exceed the 24 hour exposure limit from the NHMRC.

15.2.2 *Substation*

Due to the function of a substation and the required components, substations have the highest variation in magnetic fields from 1 to 66 mG (recorded at the security fence around the substation) (Health Protection Agency 2004). Note that the recorded magnetic fields are still below the NHMRC limit of 1,000 mG.

15.2.3 *Wind Turbines*

An electromagnetic field is created in the generator and electrical equipment of a wind turbine whilst operational. The impact of electromagnetic fields on the surrounding environment is limited by the shielding of the electrical equipment in the turbine structure or small housing unit at the base of the tower and by the height of the generator which is encased 80 to 100 m above the ground. The test results from a 1.65 MW wind turbine in Canada show a measured magnetic field at the front door of the wind turbine of 0.4 mG with typical values at a distance of 10 feet (3 m) from the wind turbine base of 0.04 mG. Furthermore it was noted that at a distance of 25 feet (7.5 m) from a wind turbine, no measurable magnetic field is expected (Windrush Energy 2004). It is anticipated that an increase in generator capacity of up to 3.3 MW would still result in magnetic field measurements below the NHMRC limit of 1,000 mG for the Project.

15.2.4 *Receptors*

There is limited chance of the public being exposed to electric and magnetic fields from the wind farm, since the Project is wholly located on freehold land. Overhead transmission lines will run parallel to some local roads within the Project locality but remain at least 10 m away and the nearest residence to a proposed substation location is approximately 800 m away. All electrical components will therefore be a suitable distance away from receptors and fall within acceptable levels of exposure.

15.2.5 *Cumulative Impacts*

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

Cumulative impacts need to consider the presence of existing electrical infrastructure, such as under and over ground powerlines, substations, and transformers (pole-mounted or otherwise). The Project is of sufficient distance from other existing and proposed wind farms, and EMF impacts are sufficiently localised that no cumulative impact is anticipated.

EMF impacts will also be created from the cumulative operation of the proposed Project components within the development area. However as detailed above, in **Sections 15.1** and **15.2**, and the Management and Mitigation measures outlined below it is anticipated that the introduction of the Crudine Ridge Wind Farm will not have a significant cumulative impact.

15.3 Management and Mitigation

To ensure there is no unnecessary exposure to electromagnetic fields the following mitigation and management measures could include:

- Burying electrical cables where feasible to shield electrical fields;
- Placing overhead powerlines in isolated locations where practicable;
- Placing wires together to cause a cancellation between the fields of electrical phases for magnetic fields;
- Placing appropriate security around emitting structures (e.g. collector and switching substations); and
- Ensuring the public, including tourists, that need to go near emitting structures are accompanied by a trained and qualified staff member.

15.4 Summary

ELF EMFs are generated from operational machinery. The measurements of electromagnetic fields can vary within a wind farm, depending on the placement of equipment such as turbines, substations and internal electrical cables.

The *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* (NHMRC 1989) places guidelines on exposure to both electric and magnetic fields for the public and construction industry.

The typical strategy for reducing electromagnetic fields is distance from the source. Other strategies also include burying cables and placing cables together to cancel the fields emitted from them.

As most of the wind turbine electrical equipment is encased within the turbine, in housing at the base of the tower or located 80 to 100 m above ground level, the distance and shielding from electromagnetic fields decreases the impact from emitting sources.

Electromagnetic fields can be recorded highest at substations; however, appropriate fencing and remote placement of the substation within the landscape can greatly reduce any expose to electromagnetic fields.

CHAPTER 16

Fire and Bushfire Assessment

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16. FIRE AND BUSHFIRE ASSESSMENT

Fire and bushfire impacts of the Project on human life and property have been assessed in accordance with the Director-General's Requirements (DGRs) and the *Rural Fires Act 1997*.

In basing the risk management process on the AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009), the National Inquiry on Bushfire Mitigation and Management (Council of Australian Governments (COAG) 2004) and NSW Bushfire Coordinating Committee (BFCC) Guidelines (2008), an analysis and evaluation of bushfire risk and acceptable risk treatments have been undertaken. The complete report on Bushfire Risk Assessment and Risk Treatment Options conducted by Eco Logical Australia (ELA) can be found in **Appendix 20**.

16.1 Methods

The study was conducted using:

- Desktop study;
- Field survey; and
- Analysis of results.

Information was processed according to a methodology adapted from Dovey (1994) based on vegetation type (structure and available fuel loads) and condition (level of disturbance and regeneration), which allows the vegetation on-site to be classified into different fuel types. By comparing fuel types with the slope on which vegetation grows, a bushfire hazard class can be calculated resulting in a ranking of higher or lower potential fire behaviours compared to other sites in the area.

The risk classification scheme is developed through qualitative scales of likelihood and of consequences in methodology adopted from AS/NZ ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009) and NSW BFCC Guidelines (2008). The terminology for describing risk factors is also consistent with the bushfire risk management planning process adopted by the NSW Rural Fire Service for 'rural fire districts' of NSW. Review **Appendix 20** for an example of the qualitative scales of likelihood and consequences.

16.2 Existing Situation

The area in and around the Project site consists predominantly of cleared plains, native pasture and areas of both open forest and grassy woodlands in various conditions. The Project site is surrounded by grazing and cropping farms extending for many kilometres. For more information on vegetation communities and distribution refer to **Chapter 10** Ecology.

The Project site has not been affected by a major bushfire within the last 10-15 years. The Project location has experienced very little fire history due to the dominance of grazing and cropping in the area. The Cudgegong Bushfire Management Committee area experiences approximately three to five major fires a year.

Days with a higher fire index rating occur from September to April, with the peak fire season from October to March. The days with a higher fire index rating are generally associated with strong winds from the west accompanied by high daytime temperatures and low humidity. Easterly winds may also adversely affect fire behaviour and hamper control efforts during this time.

Generally, fires started by lightning strikes are most common, as are accidental fires started from rural and farming activities.

The existing level of bushfire protection for life and property in the surrounding Project site is relatively good. This is due to the extensive areas of cleared grazing land combined with the compartmentalisation of the landscape by roads, both of which act as fire breaks.

16.3 Potential Impacts

16.3.1 *Bushfire Impacts*

Using methodology adapted from Dovey (1994), it can be seen that the fuel types in the Study area vary from minimal to high. These results, in conjunction with the analysis of slope, produced **Figure 16.1**, a bushfire hazard map. Isolated pockets along the eastern and northern extremities of the site have a high bushfire hazard, and areas of woodland and open forest across the site have a medium fire hazard. The rest of the Project site, dominated by pasture grass and poor condition woodland and native grassland is a low or minimal fire hazard.

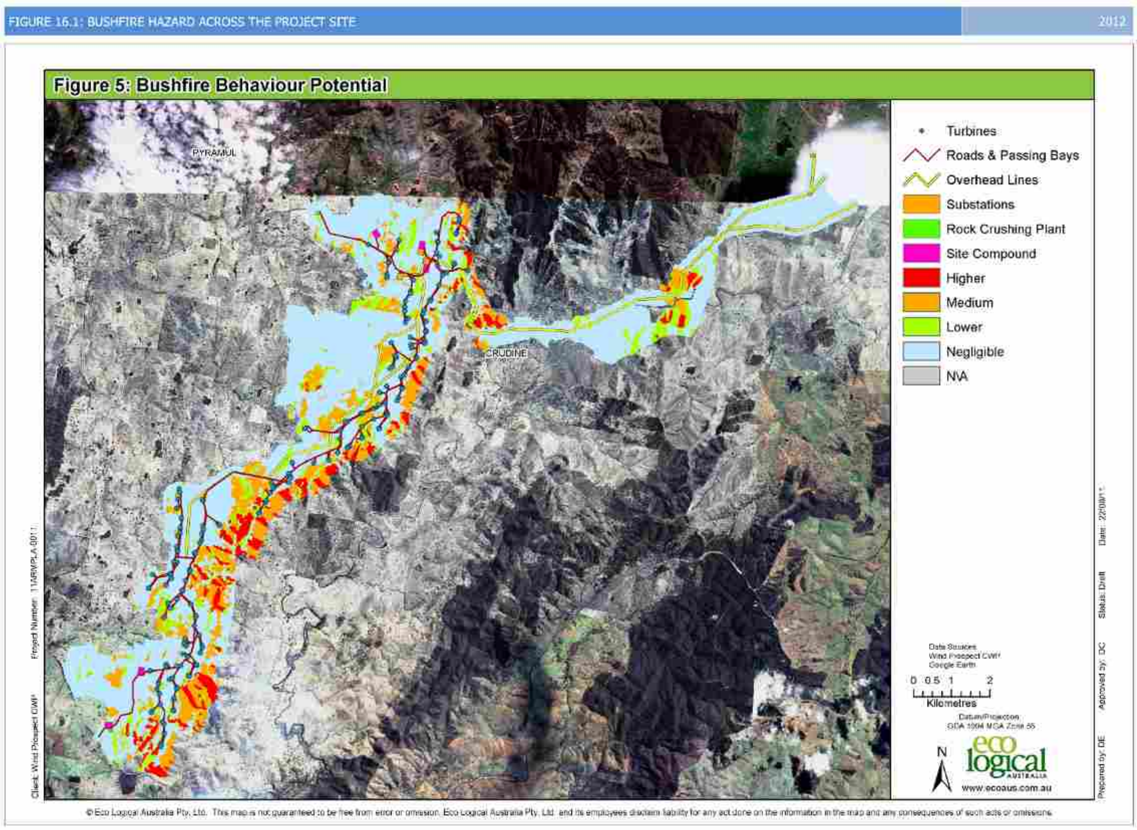

Figure 16.1 Bushfire hazard across the Project site
(An A3 size version of this Figure is displayed in Volume 2)

Applying the AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009) to life (human), property (built assets) and property (stock and crops), there were only two categories with a rating above low, these were moderate ratings for the possible chance of fatalities or major injuries to life, and the possible chance of damage to ecological values within or surrounding the Project site. For full results view **Appendix 20**.

16.3.2 *Construction and Decommissioning*

During construction and decommissioning, the use of flammable materials and ignition sources on-site increases the risk of fire (AusWEA 2001).

16.3.3 *Operation*

Substations, ancillary infrastructure, wind turbines and transmission lines all have the potential to start or influence the spread of fire on-site due to the presence of electrical equipment and associated petrochemicals. Wind turbines in particular can start or influence fires from malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation and electrical shorting or arching which occurs in transmission or distribution facilities (AusWEA 2001).

Fire in modern wind turbines is rare and dedicated monitoring systems (e.g. SCADA) enable turbines to be automatically shut down if ambient temperatures exceed the safe operating range, or if components overheat. Other remote alarming and maintenance procedures are required for electrical faults, which can still occur within the tower or nacelle and start a fire.

A wind turbine can influence its surrounding wind and temperature, which can ultimately impact on bushfires. However the amount of increase is approximately 0.7 °C in temperature and 0.6 m/s in wind speed at ground level (Baidya et al. 2004) which is negligible, considering existing vegetation is predominantly cleared pasture and grassland with low and minimal fuel loads.

Lightning strikes have the potential to occur at any wind farm location with the frequency of strikes dependent on the local climate and weather systems. Each wind turbine is built with lightning arresters to protect the turbine blades, nacelle and tower assembly. If the lightning is not grounded correctly, then minor damage can occur to the turbine, and potentially the surrounding area, starting a fire.

Underground electrical reticulation cables will be used where practicable, as discussed in **Chapter 3** Project Description, which will reduce the risk of electrical fires. Where underground placement is not suitable, overhead electrical interconnection lines will be used, which will have an increased risk of an electrical fire. The lines will be built, however, to appropriate specifications and routed to avoid trees and forest fragments where practicable. This will reduce the maintenance required for Asset Protection Zones (APZs), which in turn will minimise the start / spread of a fire.

The transformers are located in the substation facility which will contain oil for the purpose of cooling and insulation. The substation will be built with sufficient bunding to ensure all oil is contained if a leak occurs, reducing the risk of oil spreading and potentially catching fire. The substation itself will be surrounded by gravel and concrete to minimise the spread of fire and improve the APZ.

The Project will also provide added benefit for any fire fighting operations due to the presence of new access tracks over terrain which previously had only unmade tracks. This will allow fire fighters to reduce fire response times and provide an opportunity to more easily access fires on properties within and neighbouring the Project.

16.3.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. Each wind farm development has to be assessed for potential impact on fires and bushfires in the area and mitigation measures must be provided, including a Bushfire Emergency and Evacuation Plan. As such, it is anticipated that any potential cumulative effect to fire and bushfire from the proposed Uungula or other proposed or existing wind farms in the area will be covered by appropriate mitigation measures highlighted in the respective project's Environmental Assessment.

16.4 Management and Mitigation

For appropriate mitigation and management strategies to be adapted to the Project, the risk analysis provided in **Appendix 20,** should be applied when assembling an EMP sub-plan. This will then create a Bushfire Emergency and Evacuation Plan as shown in **Appendix 21**. The Bushfire Emergency and Evacuation Plan will become a sub-plan under the Emergency Evacuation Plan which aims to increase the awareness of the procedures during bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire impact.

Appropriate fire and bushfire management actions for all stages of the wind farm development (i.e. pre-construction, construction, operation and decommissioning) may include the following (a detailed list is provided in **Appendix 20**):

- Adherence to all regulations under the NSW *Rural Fires Act 1997* and the Cudgegong Draft Bushfire Risk Management Plan;
- The Rural Fire Service (RFS) and NSW Fire Brigade will be consulted regarding the adequacy of bushfire prevention measures to be implemented on-site during construction, operation and decommissioning. These measures will potentially cover hot-work procedures, APZs, safety, communication, site access and response protocols in the event of a fire originating in the Project infrastructure, or in the event of an external wildfire threatening the Project or nearby properties;
- Provide RFS with the locations of wind turbine generator (WTG) locations, ancillary infrastructure, construction work schedule, location of additional water supplies for construction, potential landing pads for fire fighting aircrafts and helicopters and access gates for fire fighting services;
- Installation of access tracks at appropriate width and vertical clearances with access suitable for all weather conditions;
- Education of construction crews and maintenance staff on the topic of bushfire risk management and risks that could be present at the Project;

- Provision of basic fire fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions with a minimum of one trained person on-site;
- Maintain provision for mobile telephone and Ultra High Frequency (UHF) radio communications;
- The collector substation will be surrounded by a gravel and concrete area, free of vegetation, to provide an APZ;
- The collector substation facility will be bunded with a capacity exceeding the volume of the transformer oil. The facility will be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater);
- Placement and maintenance of APZ will occur around WTGs, transmission line easements and ancillary structures to minimise the spread of fire. Workplace health and safety protocols will be developed to minimise the risk of fire for workers in the control room and amenities;
- WTGs will be shut down if monitored components reach critical temperatures or if directed to by the RFS in the case of a nearby wildfire being declared (an all-hours contact number would be available to the RFS during the bushfire period);
- Flammable materials and ignition sources brought onto the Project site will be handled and stored as per manufacturer's instructions;
- Total fire ban days will be considered in regard to hours within which construction takes place, minimising the risk of fire and bushfire ignition; and
- Lightning protection will be installed correctly to minimise risk of malfunction.

16.5 Summary

The Project occurs in an area of low bushfire risk due to the vegetation and agricultural practices in the area. By reviewing the possible ignition sources from the wind farm and analysing bushfire risk assessments on life and property it is possible to create mitigation and management strategies to minimise the Project's impact on fire and bushfire risk. Through implementing these strategies in a Bushfire Emergency and Evacuation Plan it is possible to increase the awareness of the procedures of bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire. The consideration of these mitigation and management strategies will allow the Project to decrease its impact on fire and bushfire hazards.

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CHAPTER 17

Water Assessment

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17. WATER ASSESSMENT

This chapter reviews existing water conditions in accordance with relevant legislation and policies from the Director-General's Requirements (DGRs) as listed in **Chapter 5** Planning Context. The Project is subject to the following water related policies and plans, which have been considered as part of this assessment (see **Appendix 22** Water and Soil Assessment).

- Water Management Act 2000;
- Water Act 1912;
- NSW Wetlands Policy;
- NSW Weir Policy;
- NSW Groundwater Quality Protection Policy;
- NSW State Groundwater Dependant Ecosystem Policy;
- Central West Catchment Action Plan (CAP);
- Macquarie and Cudgegong Regulated Rivers Water Source Water Sharing Plan
- Draft NSW Murray Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan;
- Draft Macquarie Unregulated and Alluvium Water Sources Water Sharing Plan;
- Policy and Guidelines for Aquatic Habitat Management & Fish Conservation;
- NSW Water Quality and River Flow Objectives for the Macquarie-Bogan River Catchment; and
- NOW Guidelines for Controlled Activities.

These regulations provide for a number of water management targets including water sharing, water quality, management of water supply and wastewater, water conservation and efficiency, and river and wetland protection and rehabilitation. Water required for the Project, as discussed in **Chapter 3** Project Description, will be sourced from on-site water sources, such as bores and dams, where practicable or alternatively brought in from off-site rivers and dams or suppliers.

17.1 Existing Situation

The Project site lies within the upland reaches of the Macquarie-Bogan Catchment. A number of small ephemeral creeks and gullies drain the ridges of the Project site including Stinking Water Creek, Tunnabidgee Creek, Long Gully Creek and Salters Creek. These streams then flow into Pyramul Creek, a major southern tributary of the Macquarie River. Drainage from the north-eastern arm of the Project is to the east / south-east into the Crudine River via several ephemeral creeks and gullies. The Crudine River is a tributary of the Turon River, which then flows into the Macquarie River.

17.1.1 ***Groundwater Source***

The average registered water bearing zone (WBZ) of boreholes in the vicinity of the Project site is approximately 20 m. Wet tussock grasslands have been identified in the northern extent of the study area, which may have some dependence on groundwater. If so, given the average depth to the regional water table, water for the grasslands is likely to come from a small local perched aquifer or water overlying an impermeable cap of rock. With this exception, the depth to groundwater suggests that it is unlikely groundwater is significantly influencing terrestrial ecosystems and is unlikely to be encountered during construction activities (see **Appendix 22** Water and Soil Assessment). There is potential for footings to be a slab plus rock anchor foundation design. These footings would require drilling of anchor piles up to a depth of up to approximately 20 m, and groundwater surveys will be undertaken prior to footing design and construction that requires drilling at depths.

The site is located within the Lachlan Ford Belt Ground Water Management Area (GWMA), which generally provides only small yields sufficient for stock and domestic supplies due to the limited permeability of the rock sequences (NOW 2010).

17.1.2 *Riparian / Watercourse Zone*

Most of the drainage lines in the study area are ephemeral, flow only for a short time post rainfall events and are minor tributaries draining off the ridgelines. Using the Strahler System (as detailed below), the streams on-site were generally categorised as:

- 1st Order – near the ridges as ephemeral drainage lines with limited vegetation;
- 2nd Order – Tunnabidgee Creek and Long Gully Creek; and
- 3rd Order – Stinking Water Creek and Salters Creek (the external transmission line will also cross Sugarloaf Creek, Cowflat Gully and Bombandi Creek).

There are three zones to be considered within riparian corridors:

- A Core Riparian Zone (CRZ) is the land contained within and adjacent to the channel;
- A Vegetated Buffer (VB) protects the environmental integrity of the CRZ from weed invasion, micro-climate changes, litter, trampling and pollution; and
- An Asset Protection Zone (APZ) is a requirement of the NSW Rural Fire Service and is designed to protect assets (houses, buildings, etc.) from potential bushfire damage.

Due to the study area being surrounded by rural land, the APZ component of the riparian corridor has not been considered. **Table 17.1** provides the different CRZ widths for different stream orders.

Table 17.1 Water Management Act 2000 CRZ widths

Types of Watercourses	CRZ Width
Any first order watercourse and where there is a defined channel where water flows intermittently.	10 m
Any permanent flowing first order watercourse or any second order watercourse where there is a defined channel where water flows intermittently or permanently.	20 m
Any third order watercourse or greater watercourse and where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	20 – 40 m

17.2 Wetlands

There are a small number of forested wetlands in the Central West CMA, within the Project locality. These wetlands were identified along the lower reaches of the Crudine River and Two Mile Creek within 10 km of the Project, and along the Turon River upstream and downstream of the confluence with the Crudine River. Forested wetlands occur along riverine corridors and on flood plains, and are characterised by trees and shrubs with standing water not present all year. The forested wetlands in the locality are not considered to be influenced by groundwater, instead relying upon ephemeral overland flows.

17.3 Aquatic

Most of the drainage lines in the study area are ephemeral, flow only for a short time post rainfall events and are minor tributaries draining off the ridgelines. Most of these streams surrounding the study area are considered to be first order streams, with two second order streams and some third order streams (see above). No significant aquatic species are present within the Project site (see also **Chapter 10** Ecology for consideration of the Booroolong Frog (*Litoria booroolongensis*), the Green and Golden Bell Frog (*Litoria aurea*) and Sloane's Froglet (*Crinia sloanei*) presence in the Project site).

17.4 Potential Impacts

17.4.1 *Groundwater Source*

It is not considered that there will be any impacts on groundwater unless water extraction for use during construction is sourced from groundwater bores within the Project site. Groundwater surveys will be conducted, and designs produced accordingly, prior to any drilling at depth for turbine foundations. There has been no research into groundwater directions, rates and physical and chemical characteristics at this time. Should the Project require bore water, detailed geotechnical studies will be undertaken to locate suitable bore holes, where permissible. This will be undertaken in combination with the necessary licensing requirements from the NOW and permissive occupancy rights of the affected landowners.

The wet tussock grasslands in the Project locality are likely to be reliant on water from a small local perched aquifer or water overlying an impermeable cap of rock. The Project is not likely to impact groundwater flows into these wetlands. As there are no other previously identified groundwater dependent ecosystems within the Project site, impacts are predicted to be minimal.

17.4.2 *Riparian / Watercourse*

The construction phase of the Project will have the highest potential for impact on the areas surrounding the development. For a full description of construction works on-site see **Chapter 3** Project Description, however a brief overview of potential impacts on riparian / watercourses is outlined below.

General construction activities could include excavation, trenching, concrete batching, and other earthworks. These activities can impact on surface waters by:

- Modifying surface drainage characteristics;

- Siltation from erosion and runoff;
- Siltation effects from catchment runoff; and
- Contamination of water resources.

Mitigation measures to minimise and avoid potential impacts from general construction activities and drainage line crossings are detailed below.

17.4.3 *Wetlands*

The forested wetlands in the Project locality are not considered to be influenced by groundwater, instead relying upon ephemeral overland flows. The Project is not likely to influence the hydrology of the surface water systems upon which these wetlands depend. Wet tussock grasslands have also been identified in the Project site, however the Project is not likely to impact groundwater flows into these wetlands.

The groundwater level data from surrounding bore holes suggests that the ridgelines are unlikely to support an ecosystem which is reliant on groundwater present at such depths. Therefore the potential impact on aquatic species is expected to be minimal, both within and external to the Project site.

17.4.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. The Project is of sufficient distance from other existing and proposed wind farms that it is anticipated that there will be no cumulative effect on groundwater, riparian and watercourse corridors and wetlands from the introduction of the proposed development into the area.

17.5 Water Requirements and Sourcing

Water requirements will be met by sourcing groundwater from within the Project site as long as a zero share licence can be obtained under the current water sharing plan. Where available, groundwater will be purchased from involved or adjacent landowner properties who hold groundwater licences and have unused allocations. If water cannot be sourced locally, then it will be brought to site by external water suppliers under contract to the Project (*pers. comm.*, L. Welsh, State Water 2011). The use of regulated surface water allocations from the nearby Windermere Dam may also be an option.

It is estimated that in the order of 8.9 ML of water would be required to produce the quantity of concrete required for gravity footings for Layout Option A, and as such can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only 2.8 ML of water would be required if standard rock anchors were used for all footings in Layout Option A.

In addition, approximately a further 11.7 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded internal road construction and dust suppression activities, including those associated with the 20 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to the NOW.

Based on the current regulatory provisions, if a company wishes to utilise water for dust suppression and concrete batching (both commercial / industrial purposes) from a bore licensed for stock and domestic purposes the following option is available:

17.5.1 ***Purchase and Trade in Entitlement***

- The Proponent will apply to the NOW under the Water Act 1912 to authorise an additional purpose of industrial / commercial with a zero entitlement. This will require proof of occupancy and involve the associated landowner(s).
- The Proponent will identify the volumes of water required within an annual period and purchase this from an existing licence holder with the necessary volumes and purpose. The purchase can be temporary or permanent. There are agents available which facilitate water trading who could assist. Following completion of the Project, the entitlement could be traded once it is no longer required.
- An application for a transfer under the Water Act 1912 / Water Management Act 2000 will need to be approved by the NOW to enable the trade to occur. This will require an assessment of the impact of the trade in accordance with relevant policy; and
- Under a Water Sharing Plan additional volumes may be able to be licensed for commercial activities in line with a controlled allocation policy.

Identification of appropriate water sources to enact this process will be determined post-consent, during the pre-construction phase of the Project. Should this approach not prove feasible, then water will be sourced from commercial suppliers within the vicinity of the Project at the expense of the Proponent.

17.6 Management and Mitigation

A management plan, also discussed in **Chapter 18** General Environmental Assessment, will be prepared in line with the '*Blue Book'* (Landcom 2004) as part of the Construction Environmental Management Plan (CEMP) for the Project site, given the extent of the proposed access tracks and the nature of the soil on-site (see **Chapter 20** Statement of Commitments) . The main objectives of the EMP sub-plan will be:

- To minimise soil disturbance;
- To minimise erosion events from increased surface runoff; and,
- To minimise disturbance of water resources in the area.

Specific soil and water management measures that will be considered for inclusion in the EMP sub-plan include:

- Adequate investigation of where soil disturbance is likely to expose and / or exacerbate pre-existing problems;
- Planning for erosion and sediment control concurrently with engineering design, prior to any works commencing, and integrate other landscape components (e.g. riparian, ecological);

- Install the necessary control measures prior to works commencing;
- Minimise the area of soil disturbed and exposed to erosion (include appropriate vehicle management to restrict traffic to nominated access roads);
- Install water slowing and diversion devices around construction areas including measures to manage surface run-off from hardstand areas and surfaced access tracks;
- Conserve topsoil for later site rehabilitation / revegetation;
- Divert clean run-on water around disturbed areas;
- Control water flow from the top of, and through the development area;
- Progressively rehabilitate disturbed lands as soon as practicable;
- Inspect and maintain soil and water management measures appropriately during the construction and operation phase, with regular inspections and maintenance scheduled;
- Detailed geotechnical investigations are required to ascertain the type and extent of footings; and
- Monitoring of low- and high- flow conditions is to be regularly undertaken prior to the commencement of works to determine baseline water quality parameters. Surface water monitoring locations should include:
    - Crudine River (downstream of the confluence with Sugarloaf Creek)
    - Cowflat Creek (upstream of the confluence with Stinking Water Creek)
    - Downstream of the confluence with Tunnabidgee Creek and Long Gully
    - Salters Creek (upstream of confluence with Tunnabidgee Creek).

Specific measures in the EMP sub-plan in relation to the design of access tracks and trenching would include:

- Site tracks located to reduce the risk of sediment entering drainage lines, avoid perched water tables, maintain effective vegetative buffers and to be kept above flood levels;
- Site tracks will have a slight grade to allow free surface drainage and to avoid ponding in wheel tracks;
- In areas of steep terrain (>20% or 10°) and dispersible soils bitumen or gravel surfacing may be required;
- Runoff to be minimised from concentrating and reaching erosive speeds; drain and channel linings may be required if flow velocities exceed erosive levels for the in-situ soil material; upslope clean water should be diverted away from disturbed areas through the use of catch drains and berm drains;
- Outfall and / or infall drainage will be used for cross bank construction and located such that flow is not directed back onto the track;
- Disturbance of soil and vegetation to be minimised as much as practicable, both on and adjacent to tracks and will follow land contours to minimise the amount of cut and fill;
- Drainage line crossing:
    - Drainage lines will be crossed with culverts and will not obstruct flows or create turbulent flows that will cause erosion;
    - Crossing approaches should be perpendicular (or nearly so) to the drainage line, unless using an angled approach for further reduced disturbance;
    - Culvert inlets and outlets to be adequately protected;

    - Maintenance of existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse; and
    - Stabilise and rehabilitate all disturbed areas in order to restore the integrity of the riparian corridor;
- Revegetation to be undertaken as soon as practicable following works and locally native species used as a base mix to stabilise soils to minimise erosion. In circumstances where 'Type D' soils are present and ecological values are low, a cover crop may be required using sterile seed sources; and
- Inspection of all tracks regularly and following heavy traffic use or heavy rainfall to be undertaken as part of both the Construction and Operational Environmental Management Plans.

All work within and across the CRZ of the riparian corridors has been designed to be in line with NOW and DoPI guidelines for watercourse crossings, through the use of causeways or bed level crossings on first order streams and box culverts on second order streams and above. Hardstands areas for the site office, concrete batching plants, rock crusher, substations, switching station and construction compounds will be located, where practicable, outside of the CRZ to minimise construction and operational impacts on watercourse and riparian corridors.

Specific measures in the EMP sub-plan in relation to riparian zones include:

- Drainage line crossings to not obstruct flows or create turbulent flows that will cause excessive erosion;
- Drainage line crossings will maintain existing or natural hydraulic, geomorphic and ecological functions of the watercourse;
- The approach of drainage line crossings should be approximately perpendicular to the drainage line to reduce the disturbance distance;
- Culvert inlets and outlets must be adequately protected;
- Any stormwater outlets to aim to be 'natural', yet provide a stable transition from a constructed drainage system to a natural flow regime;
- All ancillary drainage infrastructure, e.g. sediment and littler traps, should, where practicable, be located outside the riparian corridor. Runoff should be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse;
- All stockpiles are to be located away from drainage lines and natural watercourses and, where necessary, should be appropriately protected to contain sediment and runoff (e.g. sediment fencing); and
- Regular inspection, maintenance and cleaning of water quality and sedimentation control devices.

Specific measures in the EMP sub-plan in relation to the hydrology of the site would include:

- The establishment and operation of the concrete batching plants is to be in accordance with the Environment Protection Authority's Environmental Guidelines for the Concrete Batching Industry and Environment Protection Licence issued by OEH;
- Design measures to be implemented for concrete batching plant sites to contain spills and minimise loss of sediment and other contaminated material;

- Design measures to be implemented for primary and secondary containment of any oil that may leak or spill from transformers or associated components, such as constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the MCS compound;
- Concrete and cement carrying vehicles are to be washed out in appropriate wash-down facilities off-site;
- Management of hazardous materials, waste and sewage will ensure no undue contamination of water resources occurs;
- Wastewater produced during construction from temporary on-site toilets to be stored before being trucked off-site or disposed of via a septic or composting toilet system which complies with Council requirements and meets necessary health regulations;
- Any hazardous products are to be stored and transported appropriately in accordance with relevant OEH and Workcover guidelines and regulations, to avoid release to the environment;
- All hazardous materials are to be properly classified, stored away from flood prone areas and drainage lines. Appropriate spill kits and fire protection are to be provided on-site during construction; and
- Any on-site refuelling must occur in an area greater than 100 m from the nearest drainage line and ensure correct practices are in place, including:
  - Refuelling to be carried out in a specified bunded area, according to regulatory requirements;
  - Use of drip trays and spill mats; and
  - No refuelling to be carried out in the vicinity of a waterway.

17.7 Summary

The Project is not expected to significantly affect the watercourses or riparian vegetation within the site, the general locality or downstream. No groundwater impacts are expected, however further groundwater assessment is required if rock anchor turbine footings are required. No impacts on wetlands or groundwater dependent ecosystems are expected. An EMP sub-plan will be prepared which will address all potential impacts, with the aim of minimising the risk of remediation efforts being required on-site.

The sourcing of water for construction activities will be undertaken using appropriate regulatory licences to access bore water, as outlined previously. Should it not prove practicable to obtain water from within the Project site, then water will be purchased from local commercial suppliers and brought to site at the Proponent’s expense.

CHAPTER 18

General Environmental Assessment

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18. GENERAL ENVIRONMENTAL ASSESSMENT

This chapter, in addition to **Chapter 19** Socio-Economic Assessment, addresses aspects of the proposed Project beyond the key issues identified in the Director-General's Requirements (DGRs). In summary the following chapter contains sections on climate, air quality, soils and landforms, waste, responses to consultation and aspects relating to construction, blade throw, refurbishment and decommissioning.

18.1 Climate

The Central Tablelands of NSW has a temperate climate with warm summers and no dry season (OEH, 2011b). Rainfall is reasonably evenly distributed throughout the year, however, summer rainfall is often heavier and significant dry periods can be experienced (DPI 2011b).

A summary of climate data from Ilford (Warrangunyah) (Station No 62031, elevation 750 m), Sofala Old Post Office (Station No 63076, elevation 579 m), Mudgee (George Street) (Station No 62021, elevation 454 m) and Bathurst Airport (AWS) (Station No 63291, elevation 745 m) from the Bureau of Meteorology (BoM 2011) is presented in **Table 18.1**.

Table 18.1 Annual weather conditions

Weather Conditions	Measurements	
	Ilford (Warrangunyah)	**Sofala Old Post Office**
Annual mean rainfall	664.4 mm	638.8 mm
Highest mean monthly rainfall	68.1 mm (January)	66.0 mm (January)
Lowest mean monthly rainfall	45.1 mm (May)	39.5 mm (May)
	Mudgee (George Street)	**Bathurst Airport AWS**
Annual mean minimum / maximum temperature	21.4 °C / 25.4 °C	18.6 °C / 21.7 °C
Highest mean monthly maximum temperature	37.4 °C	31.3 °C (February)
Lowest mean monthly minimum temperature	10.2 °C	8.9 °C (July)

Source: BoM 2011

The Mudgee (George St) Station (Station No 62021, elevation 454 m) is the closest station that records the annual number of clear, cloudy and rainy days, which included 113 clear days, 108 cloudy days and 67 rainy days in 2011 (BoM 2011).

18.2 Air Quality

18.2.1 *Existing Situation*

Air quality in the Central West Catchment Management Authority area, including across Mudgee and Bathurst is generally considered to be very good (Central West CMA 2008). Impacts in the region tend to be limited to smoke / ash from wood heaters during winter and dust during dry and windy conditions. Drought, hazard reduction burning, bushfires and stubble burning are seasonal occurrences that also impact on air quality (Bathurst Regional Council 2010b). The region's few air quality exceedances occurred during periods of low rainfall, dust storms and bushfire incidents.

The Project site would not be expected to experience air quality issues from industry as it is located in a rural / agricultural setting. Low residential density means particulate emissions from wood heaters is not a significant issue. However, air quality could be affected by occasional bushfires, fuel reduction burns and dust particle generation from agricultural activity, development sites and unsealed roads during dry conditions.

18.2.2 ***Potential Impacts***

The majority of potential impacts to air quality from the Project will occur during the construction phase. Dust particles and other emissions can be released from a range of activities, including:

- Clearing of vegetation;
- Open exposed areas;
- Stockpiles;
- Excavation works;
- Mobile concrete batching plants;
- Rock crushing;
- Processing and handling of material;
- Construction activities;
- Transfer points;
- Loading and unloading of material; and
- Haulage activities along unsealed roads.

The expected quantities of dust produced as a result of construction can be appropriately managed in accordance with an air quality and dust management plan. This plan will be implemented to control potential air pollution, including the primary sources of emissions; dust, plant and vehicle emissions and odour. Under this plan, dust deposition gauges will be installed near Mobile Resource sites to monitor dust emissions and ensure emissions do not exceed 4 grams per metre squared per month, in accordance with NSW OEH guidelines.

Similarly, the EMP sub-plan will outline measures to conserve energy and reduce greenhouse gas emissions that will result from construction activities. Reports to the *Greenhouse and Energy Data Officer (GEDO)* within the Commonwealth Government will consolidate and capture emissions and energy usage data annually.

Cumulative Impacts: An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. The Project is of sufficient distance from other existing and proposed wind farms, and impacts limited to the construction timeframe, that it is anticipated there will be no cumulative effect of dust generation, or impact to air quality from the introduction of the proposed development into the area.

18.2.3 *Management and Mitigation*

The majority of work will not occur near residential areas. However, to ensure appropriate mitigation measures are utilised for dust and other emissions, an EMP sub-plan will be included in the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). Mitigation methods could include:

- During excavation topsoil will be stockpiled. After excavation topsoil will be replaced for seeding / fertilising and excess subsoil will be disposed of in an appropriate manner. If any excavation occurs on steep slopes the topsoil will need to be stabilised;
- Where practicable, loads will be covered to prevent windblown dust or other materials escaping;
- Any stockpiled material will be covered with plastic or otherwise bound to reduce dust where practicable. Dust levels at stockpile sites would be visually monitored. Dust suppression (e.g. water sprays) would be implemented if required;
- During dry and windy conditions a water cart or alternative non-chemical dust suppression would be available and applied to work areas;
- Progressive revegetation and stabilisation will be undertaken where practicable; and
- If blasting is required, Australia New Zealand Environment and Conservation Council guidelines for control of blasting impacts will be followed.

18.3 Soils and Landforms

18.3.1 *Existing Situation*

Eco Logical Australia prepared a Water and Soil Assessment for the Project (**Appendix 22**). The Project overlies the Hill End - Ngunnawal geological province which is comprised of Silurian to early Devonian clastic sediments including shale, siltstone, sandstone and conglomerate, limestone and some felsic volcanic (Geoscience Australia 2011). The associated sub-provinces include the Hill End and Capertee sub-provinces, with the majority of the Project infrastructure located above the Hill End sub-province. The characteristic terrain of the Hill End sub-province includes steep rolling hills and undulating low hills with exposed bedrock occurring on all slope classes. Slopes are susceptible to sheet, rill and gully erosion with drainage lines also prone to gullying.

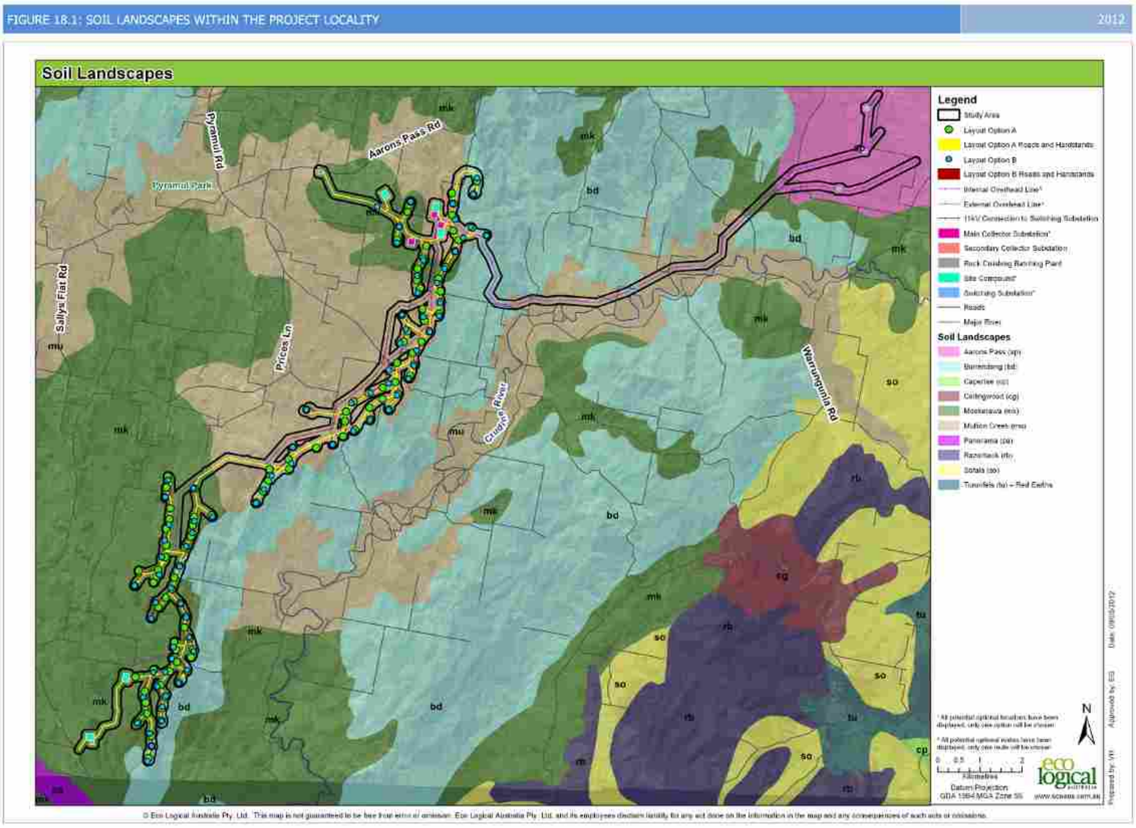

Figure 18.1 Soil landscapes within the Project locality
(An A3 size version of this Figure is displayed in Volume 2)

Soil characteristics for the Project site are based on soil mapping description by Kovac & Lawrie (1990) and Murphy & Lawrie (1998). The main soil landscapes in the Project locality are the Burrendong, Mullion Creek, Mookerawa and Aarons Pass units, with the bulk of the infrastructure occurring on the Mookerawa and Mullion Creek units (**Figure 18.1**).

Associated landowners were also consulted to determine if there were any known contamination sites on their land. Many landowners indicated that whilst potentially contaminating activities (e.g. sheep dips, fuel storage, and herbicide spraying) occur on-site, these activities do not take place on ridge top locations that will be disturbed by the proposed development.

Based on the Australian Soil Classification, the erosion hazard of the soil landscapes across the site is:

- Burrendong: High;
- Mullion Creek: Low; high erosion hazard under cultivation;
- Mookerawa: Low to high; high to very high erosion hazard under cultivation; and
- Aarons Pass: Generally low.

18.3.2 *Potential Impacts*

The majority of potential impacts will occur during construction and will therefore be limited to the timeframe of construction activity on the Project site. These impacts could include soil compaction, erosion and contamination. The degree of these impacts will be determined by the characteristics of the soil (see **Appendix 22**) found across the Project site.

As the area experiences low levels of rainfall, and low rainfall erosivity, there are expected to be minimal impacts from water erosion. However, any exposed soils will have higher susceptibility to water or wind erosion and this will need to be considered appropriately during the construction phase.

Cumulative Impacts: Other existing and proposed wind farms in the region are a sufficient distance from the Project site to ensure cumulative impacts will not occur. Construction activity is localised to specific clusters and turbine locations over the construction timeframe, therefore the likelihood of cumulative impacts is considered to be low given the distance between projects. It is therefore anticipated that there will be no cumulative effect to soil and landforms from the introduction of the proposed development into the area.

18.3.3 *Management and Mitigation*

A number of management actions will be implemented to manage surface runoff, exposed soil surfaces and contamination to surrounding soil. These methods will be included in the EMP sub-plan and will include:

- Procedures for personnel to manage suspected contaminated soils during earthwork construction;
- Planning for erosion and sediment control concurrently with engineering design, prior to any works commencing;
- Stabilisation of disturbed soil surfaces as soon as practicable after works have ceased in the area;
- Where practicable, all stockpiles covered to prevent the loss of material during wind and rain events. Where practicable stockpiles should be placed in areas sheltered from the wind; and
- Progressive rehabilitation of disturbed lands as soon as practicable.

The EMP sub-plan will consider *Guidelines for planning, construction and maintenance of tracks* (NSW Department of Land and Water Conservation 1994) and *Managing Urban Stormwater: Soils and Construction, 4th Edition* (Landcom 2004) when designing, constructing and maintaining the Project. The EMP sub-plan will require detailed geotechnical investigations, which will take place post consent.

Also to minimise soil compaction at the Project site, the EMP sub-plan will have specific measures for stock management, including:

- Management of stock access during periods of vegetation and soil disturbances; and
- Removal of stock access from construction areas for entire construction periods to allow for regeneration, subject to landowner participation.

18.4 Waste

During the construction of a wind farm there are a variety of wastes produced, including:

- Cleared vegetation;
- Packaging material;
- Building materials;
- Domestic wastes;
- On-site toilets; and
- Chemicals.

Under the OEH Waste Classification Guidelines there will be liquid waste and general solid waste (non-putrescibles) produced. All waste will be disposed of in line with Council and OEH guidelines.

To handle the waste on-site from packaging, building materials and domestic waste there will be both skip bins and recycling bins. Vegetation will be mulched and used on-site where feasible, with the remaining to be burnt on-site with permission from Council, provided as firewood to landowners or taken to the Mudgee waste facility or Kandos and Gulgong waste transfer stations. On-site toilets will either be drained by a septic tank or be an enclosed unit. All chemicals and oils will be treated as contaminated waste at the Mudgee waste facility or Kandos and Gulgong waste transfer stations. Any disposal of unsuitable excavated material will require development consent from the appropriate authorities, procedures for which will be outlined in the CEMP or sub-plan.

Cumulative Impacts: Other existing and proposed wind farms in the region will have in place mitigation and management measures to minimise and dispose of waste correctly. Also, post construction, the Project will produce minimal waste materials, similar to other wind farms, and it is therefore anticipated that there will be no cumulative waste production from the introduction of the proposed development into the area.

18.5 Response to Consultation

18.5.1 *Trigonometrical Stations*

The Department of Lands (DoL) were asked to provide advice on the proximity of the proposed wind farm to the Tunnabidgee Trigonometrical Station (TS) within the Project site. This TS is located 40 m from a proposed wind turbine location.

The DoL have not yet responded to our consultation in this matter. However, in previous dealings the DoL have indicated that the Surveyor General cannot insist on any additional conditions for construction for TSs which are not located on Trigonometrical Reserves, which is the case with the Tunnabidgee TS. It has been requested that during the construction phase, care is taken not to disturb or damage the TSs or the adjacent witness marks. Fines apply under current legislation should the TS locations be disturbed, damaged or destroyed and the Proponent would be required to reinstate them. The Proponent has therefore committed to avoid disturbing / damaging the TSs and adjacent witness marks.

18.5.2 *Crown Roads and Crown Land*

The DoL were also asked to provide input on aspects of the Project that may affect Crown Roads and Land (**Appendix 23**). As such a number of Crown Roads that are both held and not held under Enclosure Permits have been identified. Pending Development Approval, applications will be lodged with the DoL to either close and transfer, or seek a licence over the affected Crown Roads to the adjoining landowners. To expedite the process the Proponent, in consultation with the adjoining landowners, intends to submit letters of intent to close or licence the affected Crown Roads in readiness for the process to commence should Approval be granted.

18.5.3 *Native Title*

In consultations with the DoL advice was sought as to whether Native Title existed across any of the landholdings affected by the Project. The Land and Property Management Authority (LPMA) have confirmed that Native Title is extinguished over all lands affected by the proposed Crudine Ridge Wind Farm.

18.6 Construction

Construction Environmental Management Plan (CEMP): The CEMP will be developed prior to pre-construction and used to address environmental impacts identified by the risk analysis process in both the pre-construction and construction stages. The CEMP will consist of and address the following:

- A description of activities to be undertaken during construction of the Development (including staging and scheduling);
- Statutory and other obligations that the Applicant is required to fulfil during construction, including approval/consents, consultations and agreements required from authorities and other stakeholders under key legislation and policies;
- A description of the roles and responsibilities for relevant employees involved in the construction of the Development, including relevant training and induction provisions for ensuring that employees, including contractors and sub-contractors, are aware of their environmental and compliance obligations under the Conditions of Approval;
- An environmental risk analysis to identify the key environmental performance issues associated with the construction phase; and
- Details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the Development). In particular, the following environmental performance issues shall be addressed in the Plan:
    - Compounds and ancillary facilities management;
    - Noise and vibration;
    - Traffic and access;
    - Soil and water quality and spoil management;
    - Air quality and dust management;
    - Aboriginal and non-Aboriginal heritage management;
    - Soil contamination, hazardous material and waste management;
    - Ecological impact management; and
    - Hazard and risk management.

Operational Environmental Management Plan (OEMP): An OEMP will be developed prior to the completion of construction activities in order to address the broad range of the environmental impacts identified in this risk analysis.

18.7 Wind Turbine Safety Standards

18.7.1 *Existing Situation*

Wind turbines are designed to meet international engineering design and manufacturing safety standards. This includes tower, blade and generator design. There is an international quality control assurance program for turbines, and a number of relevant safety and design standards. The lead organisation for development of international standards for wind turbine generating systems is the International Electrotechnical Commission (IEC), and the most broadly applied standard covering machinery and structures is IEC 61400-1: '*Wind Turbine Generator Systems - Part 1: Safety Requirements*'.

Independent agencies are retained by wind turbine manufacturers to certify that the design and construction of a given turbine / tower assembly conform to accepted standards in terms of design load assumptions, construction materials and methods, control systems and safety measures. This is a generalised type of certification provided at manufacturers' expense. Once a specific system make and model are selected, the user then customarily funds a second independent certification attesting to the applicability of the system design and construction to the site-specific conditions. In addition, foundation design and commissioning checks address potential failure due to extreme events such as extreme wind loadings, as well as frequency tuning of the different parts of the structure to avoid failure due to dynamic resonance.

International experience to date has indicated very low risks associated with tower collapse, components falling from towers, ice throw and blade throw. Risks have been continually reduced as turbine technology has improved.

18.7.2 *Potential Impacts*

Wind Turbine Tower Collapse: Wind turbines and towers are designed to strict standards in order to withstand extreme weather events. Collapse of a turbine tower which has been constructed in accordance with international standards and local building codes is an extremely remote possibility. In the unlikely event of a turbine tower collapse, the potential worst case risk to the public is calculated from failure of the tower at its base, or of its anchorage to the foundation (EDP Renewables 2005). This creates a hemispherical hazard zone with a radius approximately equal to turbine tip height as illustrated in **Figure 18.2**. (Tubular steel towers could buckle at some point along their length. This failure mode would result in a smaller hazard zone due to the reduced radius).

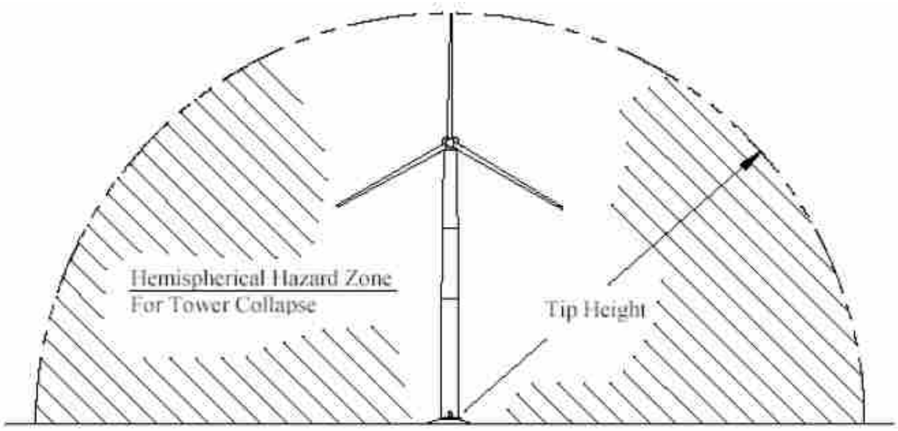

Figure 18.2 Turbine Tower Collapse - Potential Hazard Zone

Source: EDP Renewables 2005

Blade Throw: Extensive literature reviews on blade throw indicate that there are many approaches to modelling blade throw potentials, whether theoretical or experience based. This is likely due to the complexity of the analysis, coupled with the extremely low incidence of blade throw reports. Despite this there is a strong similarity in results from both predictive and incidence based studies, providing a robust and reliable framework within which to estimate blade throw and safety risk.

Modelling conducted for the Wild Horse Wind Power project (EDP Renewables 2005) presents a simplified worst case scenario, where loss of a whole blade would occur with the blade rotating at maximum speed, when oriented at 45° from the horizontal axis and rising. This is the classic maximum trajectory case from standard physics texts as illustrated in **Figure 18.3**. Review of these data indicates that for the maximum turbine envelope (the worst case scenario), blade throw distance is approximately one turbine tip-height.

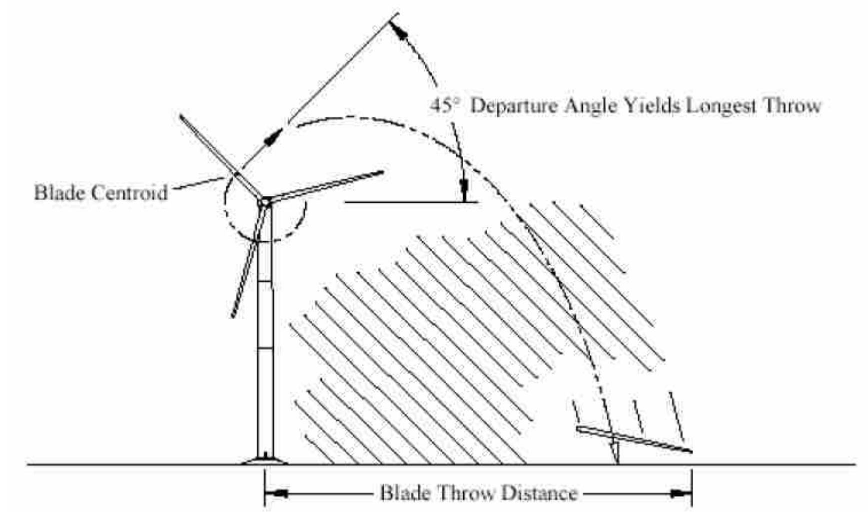

Figure 18.3 Blade Throw Distance

Source: EDP Renewables 2005

Blade fragment throw, where the blade is damaged (such as by lightning strike) and breaks apart, has also been estimated through use of a dynamic model of blade failure and Monte Carlo simulation techniques (Rogers et al. 2011). Using three turbine models, this study found that release velocity is an important factor in estimating blade fragment throw distance. Using an equation based on release velocity, turbine dimensions and acceptable risk, the study found theoretical blade fragment throws of up to 526 m for a 3.0 MW turbine (Rogers et al. 2011).

Cotton (2007) estimated impact probabilities at a wind farm site by comparing two methodologies based upon mathematical modelling techniques and risk contours. Whole blade throw was found to range between distances of 155 m and 203 m from the tower. In one situation, in order to model worst case impact, wind speeds equivalent to one-in-fifty year events were used and very small blade fragments were considered (10 % blade fragments). Under these conditions, there was a 1 % chance of throw distances up to 1,462 m.

Risks of turbine blade failure and throw reported in a Dutch incidence handbook have also been researched (Kammen 2003). The maximum reported throw distance documented was found to be 150 m for an entire blade and 500 m for a blade fragment (Braam et al. 2005). These distances again correlate with other modelled and predicted blade throw distances. In this handbook, reported blade failures (including non-throw events) ranged between 1 in 2,400 and 1 in 20,000 (Chief Medical Officer of Health 2010).

With regard to the Project, the nearest non-associated dwelling (as detailed in **Chapter 9** Noise) is approximately 1.65 km to the nearest wind turbine, and is located south of the southernmost wind turbine location. Similarly, the nearest associated and occupied dwelling is located 1.61 km from the nearest wind turbine location, and is located to the west of the centre of the Project. The nearest neighbouring property boundary is approximately 150 m from the nearest wind turbine location. In this instance, the corresponding landowners dwelling is located approximately 2.15 km from the same (nearest) wind turbine.

Probability Assessments: Probability of occurrence is critical to blade throw analysis. The probability associated with the Hazard Zone Distance scenarios modelled for the Wild Horse Wind Power project (as detailed above) provide a rational basis for assessing the risks of wind turbines within their surrounding environment. **Table 18.2** provides a uniform approach to determining the frequencies of occurrence of each of the described events, representing incidents reported in German, Danish and Dutch databases.

Table 18.2 Blade throw probabilities – frequencies of occurrence

Scenario	Recommended Value (1 / year)
Collapse of entire tower from base	3.2×10^{-4}
Loss of entire blade	8.4×10^{-4}
Loss of blade fragment	2.6×10^{-4}

Source: Braam & Rademakers 2004

A risk assessment of the Kittitas Valley Wind Power project was conducted using available research on risks of tower collapse, blade throw and ice throw, including published studies and guidance documents from the US and Europe. The highest probability of a blade or other object being thrown was found to be less than one in one billion (Kammen 2003). For comparative purposes, this was described as being lower than the risk associated with riding a bicycle 16 km or having a single chest x-ray at a modern hospital (Kammen 2003). The risk assessment summarised the public health and safety risks posed by the project as insignificant and less than the risks posed by other common energy generating technologies and countless other common activities (Kammen 2003).

Blade Icing and Ice Throw: The potential for ice throw poses similar concerns to that of blade fragment throw. While ice build-up on blades is an occasional problem for wind turbines, in terms of lost energy production, flying ice is considered less of a risk. When ice builds up on the blades, the blades turn very slowly (at only several revolutions per minute) until the ice is shed. This is because the airfoil has been compromised by the ice, and the blades are unable to pick up any speed.

As noted in the EDP renewable assessment (2005), while more than 55,000 wind turbine generators have been installed world-wide, there has been no reported injury caused by ice thrown from wind turbines. Reported data on ice throws indicates that ice fragments were found on the ground between 15 and 100 metres from turbines and were in the range of 0.1 to 1 kg in mass (EDP Renewables 2005).

Under certain conditions ice can form on wind turbine towers and rotor blades in a variety of ways. It has been observed that moving rotor blades are subject to heavier build ups of ice than stationary structures through the mechanism of rime icing. Rime icing occurs when a sub-freezing structure is exposed to moisture-laden air with significant velocity (Sagebrush Power Partners 2007). If the ice then becomes detached while the blades are rotating, there is the possibility of 'ice throw' over a considerable distance from the turbine.

Because of the large number of variables and the need for established guidelines in risk assessment, the 'Wind Energy in Cold Climates' study (WECO) commissioned by the European Unions' Environment Directorate has supplemented this modelling effort with continuation of an information outreach program originally initiated by the German Wind Energy Institute (DEWI) and the Finnish Meteorological Institute (FMI). This effort consists of gathering experiential data from a large number of wind turbine operators regarding occurrence of icing, and details of any ice throw events. Findings from this effort were presented by WECO team members at the BOREAS IV wind energy symposium in 1998. Significant findings included that the risk of being struck by ice becomes very small at distances greater than 100 metres from each tower at the proposed facility (EDP Renewables 2005; Chief Medical Officer of Health 2010).

The ice throw hazard area extends in a direction normal to the prevailing wind direction and downwind from the turbine and there is essentially zero ice throw hazard as little as 25 metres upwind from the plane of the rotor as illustrated in **Figure 18.4** (EDP Renewables 2005). Persons, animals and facilities within the ice throw hazard zone of approximately 100 metres could theoretically be at risk of being struck by an ice fragment.

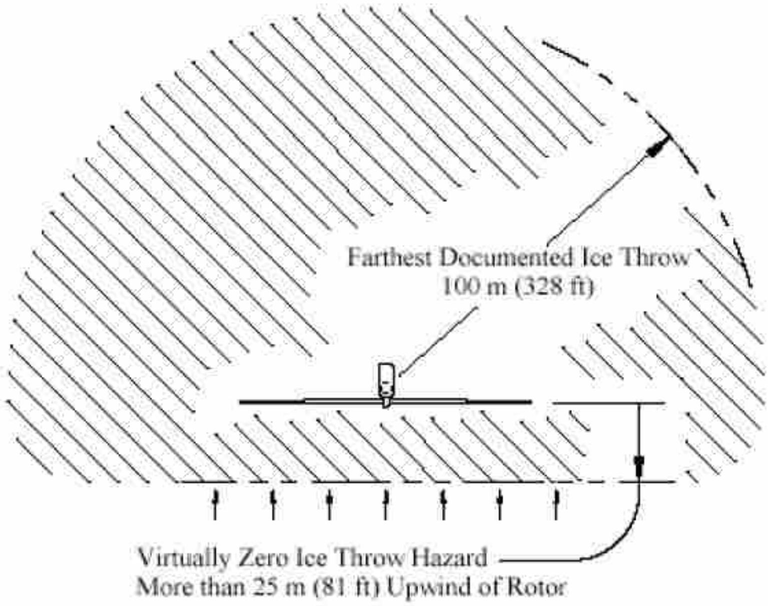

Figure 18.4 Blade Ice Throw and Blade Fragment Throw Hazard Zone

Source: EDP Renewables 2005

18.7.3 *Management and Mitigation*

Failure of Machinery and / or Structures: Wind turbine generators are equipped with multiple safety systems as standard equipment. As examples: rotor speed is controlled by a redundant pitch control system and a backup disk brake system; critical components have multiple temperature sensors and a control system to shut the system down and take it off-line if an overheating condition is detected.

Tower Collapse: The selected wind turbine generator / tower combination will be subjected to an engineering review to ensure that the design and construction standards are appropriate. This review will include consideration of code requirements under various loading conditions and give a high degree of confidence of structural adequacy of the towers.

Blade Throw: Certification of the wind turbine to the manufacturers' requirements will ensure that the static, dynamic and defined-life fatigue stresses in the blade will not be exceeded under the combined load cases expected for a specific site. The standard includes safety factors for normal, abnormal, fatigue and construction loads. This certification, together with regular periodic inspections, will give a high level of assurance against blade failure in operation.

Blade Icing and Ice Throw: If, subject to site conditions, it is deemed necessary to mitigate the risk of ice throw then the implementation of special turbine features can prevent ice accretion or turbine operation during such periods. These include:

- To keep the control system of the wind turbine in operation in icy weather conditions two heated wind vanes and two heated anemometers can be installed;
- Rime ice build up on the blades has a significant influence on the lift force and therefore on the power curve of the wind turbine. If average power is continuously out of synchronisation with the power curve for 2 minutes it is an indication that rime ice has accreted on the blades and the wind turbine will be stopped;

- Additional loads created by ice accretion cause vibrations on the blades which are monitored by the control system. When the vibrations exceed the adjusted limits the wind turbine will be stopped; and
- An ice sensor can be installed on the roof of the nacelle. It measures the temperature and the relative air humidity of the environment. If certain values are reached, the turbine will be stopped automatically by the control system. The meteorological values are determined by local conditions.

In the event of one of these control systems stopping the operation of the wind turbine, the turbine will remain switched off until it is reset manually by service staff. The secure function of all these measurements are checked by certified bodies and are confirmed in a certificate.

18.8 Wind Turbines and Microclimate Effects

A number of studies have investigated the potential microclimate effects of wind turbines. That is, the effect that wind turbines may have on the air and land immediately downwind of a wind turbine, or wind farm.

These studies have identified that wind turbines can generate additional downwind turbulence, that is, a mixing of air at high altitudes with air at low altitudes (Beyers and Roth 2012). It is thought that this turbulence can lead to enhanced vertical mixing when there is a contrast in temperature, having a warming effect during the night and a cooling effect during the day (Baidya Roy and Traiteur 2010). What has not yet been determined is whether this phenomenon has a detrimental, beneficial or harmless effect.

In Ontario, the organisation Grape Growers of Ontario engaged a consultant to investigate the effect of a wind farm on local grape production on the Niagara Peninsula. It was found that at night the turbines replicated the beneficial impacts of wind machines that are used to counter cold injury to grapes (Beyers and Roth, 2012). However, the same mixing could produce colder surface condition during the day. This study also found that seasonal and wind speed and direction conditions determined to what extent, if any, air temperature mixing persisted. Other studies into microclimate effects include long term modelling in Texas, USA, in a region with over 2000 turbines that found a marked localised warming effect on night-time temperatures and another study in Iowa, USA that found that air turbulence from turbines could possibly “ward off early fall frosts and extend the growing season” for crops such as soybeans and corn (Zhou et al. 2012; The Ames Laboratory 2012).

There is a likelihood that wind turbines interact with the climate in which they are sited, influencing local conditions, including surface air temperatures. These potential impacts, however, must be considered in the context of other microclimate influences. Microclimate conditions are influenced by numerous factors, including the slope of the land, shade, exposure and bodies of water, changes in precipitation and clouds (Zhou et al. 2012). Further, human-induced changes within an environment such as introduction of hedges, tree-lines, irrigation and dams and land cover and use also strongly influence the microclimate of an agricultural region (Liu and Kang 2006; Jaya et al. 2001).

18.9 Decommissioning and Refurbishment

On the 23rd December 2011 the NSW Government released *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines) for public consultation. Proposed within the Draft Guidelines are specific requirements relating to decommissioning. Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent has given regard to their future incorporation within this EA, and has therefore included further information with regard to decommissioning within this chapter.

Section 1.3(f) of the Draft Guidelines sets out two specific requirements:

- The Proponent / wind farm owner, rather than the host landowner, must retain the responsibility for decommissioning; and
- Applicants are to include a Decommissioning and Rehabilitation Plan (DRP) in their EA. (If the proposed DRP is considered inadequate but the Development Application is granted consent, a condition of consent will be imposed requiring the Proponent to pay a decommissioning bond).

As detailed in **Chapter 3** Project Description, Project refurbishment and decommissioning have been considered within this EA. A DRP would not be finalised until the pre-decommissioning phase, to ensure the relevant regulations of the day are incorporated into the DRP, however, the following additional detail provides a framework discussion for the DRP.

Responsibility: All decommissioning work will be the responsibility of the Project owner which is a provision within the lease arrangements with the landowners. In line with previous Conditions of Approval, the Proponent can provide a copy of the decommissioning clause in the lease documentation to the satisfaction of the Director General prior to commencement of construction.

Community construction awareness programme: Similar to the construction phase of the Project, prior to the commencement of decommissioning activities, a programme of community awareness initiatives will be implemented. Information will be disseminated to the local community through local newspapers and direct mail to advise them of the nature of the activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or if required to express concerns or complaints.

Updates on the progress of refurbishment or decommissioning works and relevant impacts will be provided during the period through various media and a Community Consultative Committee (CCC) to be established prior to activity occurring. The CCC will be available to guide and inform the Project owner on matters of interest to the community, and will provide an additional forum for communication between stakeholders.

Key considerations that will frame the DRP include:

- Timing and phasing of the works to minimise impacts on agricultural activities;
- Management of traffic along the preferred access routes; and
- Coordination of employment and contractor involvement to ensure local area participation is maximised.

A DRP will be prepared and updated every five years following the practical operation date of the Project.

Decommissioning: At the end of the operational life of the Project, the turbines and all above ground infrastructure will be dismantled and removed from the site. This includes all the interconnection and substation infrastructure, but may exclude the switching station which will form an integral part of the TransGrid network. The tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result. The land will be returned to prior condition and use as far as practicable. A compressor and rock crusher may be needed to carry out the cutting work.

The access roads, where not required for farming purposes or fire access, would be removed and the Project site reinstated as close as practicable to its original condition and use. Access gates, where not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

The underground cables are buried below ploughing depth and contain no harmful substances. They would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

The DRP will incorporate many of the measures outlined in the CEMP, however key considerations that will also frame the DRP include:

- Adherence to regulations and guidelines of the day;
- Recycling, reuse or disposal of on-site materials to pre-approved recycling / disposal locations or end users;
- Minimisation of additional impacts during decommissioning activities, whilst having regard for any refurbishment works that may occur post decommissioning;
- Consultation to include:
  - Host landowners with regard to the extent of decommissioning;
  - Neighbouring landowners with particular regard to traffic management and noise;
  - Local Councils and other road authorities with regard to the nature of required activities;
  - TransGrid with regard to the extent of decommissioning;
- Safe and careful disassembly of blades, nacelle and tower components;
- Removal of all liquids and other consumables (lubricants, oils, greases, coolants, etc.) from wind turbine generators and substation plant;
- Ongoing site monitoring and rehabilitation, which may include:
  - Spreading of additional subgrade material, backfill or topsoil;
  - Works to restore drainage to areas when ponding is occurring, or to prevent excessive stormwater runoff from causing erosion;
  - Aeration and / or fertilisation of soil to promote growth of grasses or foliage; and
  - Replanting of any impacted trees or reseeding of impacted grasses.

Funding for decommissioning: At present, it is considered likely that wind turbine generators will have significant resale value when decommissioned. As such, the process of dismantling the blades, towers and nacelle will be undertaken with care and precision to ensure their reuse and resale value is retained.

The Proponent is not aware of any instances where a wind farm has been decommissioned (and not refurbished) within 15 years from commencement of operations. The Proponent therefore proposes that from year 15 of the Project's operating life (and every two years subsequent) the Project owner undertakes a decommissioning cost versus resale / scrap value survey to determine the inherent value of the Project components.

Resale value for the latest models of wind turbines are not available, however data is emerging for small numbers of units being sold in Europe. **Table 18.3** provides a summary of those wind turbines currently available with models greater than or equal to 1 MW highlighted in blue.

Table 18.3 Summary of used wind turbines available for sale (March 2012)

Turbine	Size MW	Tower Height	Qty	Unit Price	Currency	Equivalent Price AUD	Age
Bonus 1000	1	70	1	240,000	Euros	300,000	11
Enercon E40	0.6	65	2	210,000	Euros	262,500	13
Enercon E44	0.6	65	1	205,000	Euros	256,250	13
Enercon E40	0.5	78	2	260,000	Euros	325,000	10
Enercon E40	0.5	65	3	180,000	Euros	225,000	15
GE 1.5SLE	1.5	77	6	1,100,000	USD	1,037,736	6
GE 1.5S	1.5	70	4	350,000	Euros	437,500	9
Mitsubishi MWT1000	1	69	15	720,000	USD	679,245	3
NEG Micon NM92	2.75	70	1	1,085,000	Euros	1,356,250	5
Enercon E44	0.6	65	3	175,000	Euros	218,750	12
Vestas V66	1.65	70	5	335,000	Euros	418,750	13
Enercon E44	0.6	65	8	175,000	Euros	218,750	12
Vestas V47	0.66	65	9	157,000	Euros	196,250	12
NEG Micon NM52/900	0.9	50	3	250,000	Euros	312,500	12
GE1.5S	1.5	80	6	300,000	Euros	375,000	12

Exchange rate used: 1 AUD = 0.8 Euro / 1.06 USD

A per unit analysis of these figures is provided in **Table 18.4**.

Table 18.4 Price analysis of used wind turbines available for sale (March 2012)

Description	Currency	Price
Av. price per unit (1-7 years)	AUD	1,024,410
Av. price per unit (8-15 years)	AUD	295,521
Av. price per unit ≥ 1,000 kW (1-7 years)	AUD	1,024,410
Av. price per unit ≥ 1,000 kW (8-15 years)	AUD	382,813

Wind turbines with a capacity of ≥ 1.5 MW are proposed for this Project. Assuming that the current average resale price per wind turbine ≥ 1 MW of approximately $383,000 (**Table 18.4**) will in some way be representative of the future, a decommissioning fund for the Project of up to $40.6 million (approximately) from resale of the wind turbines could be available to undertake the DRP.

Current cost estimates to undertake decommissioning works based on Wind Prospect's experiences in the United Kingdom suggest an approximate cost of $300,000 per wind turbine is necessary. This figure is based on costs associated with projects that have less than seven wind turbines and therefore it can be expected that economies of scale can be derived from this for much larger projects. However, if this cost estimate were a reflection of the cost to decommission the Project (as a worst case) then approximately $32 million would be required to fund the works. Therefore, assuming a resale value of $40.6 million, there would be a net profit of $8.6 million once decommissioning had been undertaken.

If as a result of the decommissioning cost versus resale / scrap value surveys from 15 years onwards there is a calculated deficit, then a percentage of revenue will be retained from the Project each year and held in a reserve account for future decommissioning requirements.

Refurbishment: After approximately 20 to 25 years of operation (or sooner if deemed economically viable) the blades, nacelles (top section of the turbine) and towers could be removed and replaced. Old blades, nacelles and towers are removed from site for recycling (where applicable) and new components installed on existing or new foundations, as appropriate. Refurbishment would extend the life of the Project for a further 20 to 25 years.

Any material change to the Project layout, or significant changes to the turbine technology, will be referred to the relevant NSW planning authority at that time as an amended proposal. Such changes would also be subject to the regulations and guidelines of the day. Refurbishment requires the transportation and installation equipment and facilities, similar to that used during initial construction.

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CHAPTER 19

Socio-Economic Assessment

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19. SOCIO-ECONOMIC ASSESSMENT

This chapter, in addition to **Chapter 18** General Environmental Assessment, addresses aspects of the proposed Project beyond the key issues identified in the Director-General's Requirements (DGRs). In summary the following chapter contains sections on land value, mineral exploration, tourism, community wellbeing, the Community Fund, the local economy, and health.

19.1 Land Value

As with any property and land holding there are many factors which can influence perceived and actual property values, including prevailing and permitted land uses, economic conditions, access / proximity to markets / workplaces and lifestyle considerations. In most agricultural areas the main determinant of property and land values is the productivity of the land for agricultural or livestock purposes.

It is a commonly held misbelief that wind farms can affect property and land values, and as such there have been a number of studies conducted to determine the significance, if any, of wind farms on such values. These studies, however, have predominantly concluded it is not possible to isolate the sole effect of wind farms on property and land values due to the myriad of factors (as outlined in the first paragraph) influencing value. By comparing the positive and negative impacts of the construction and operational stages of a wind farm to existing knowledge of what causes changes in property values, it is possible to predict the relationship between wind farms and property values.

Henderson and Horning Property Consultants (H&HPC 2006) conducted a study covering a fifteen year period into the relationship between wind farms and property / land values by assessing local property values around the operating Crookwell 1 Wind Farm in the NSW Southern Tablelands. The study also reviewed other overseas wind farms to compare with the Australian market. The United Kingdom perceptual study conducted by the Royal Institute of Chartered Surveyors (RICS 2004) concluded that the main negative impacts were visual impact, fear of blight (see **Section 19.1.1** below) and proximity of a property to a wind turbine. The conclusions from H&HPC relevant to this Project are:

- That agricultural productive capacity of the land subject to the wind farm and the surrounding property is not in any measured way affected by the wind farm;
- The associated property has additional revenue and benefits from the lease agreement, improved roads, erosion control and passive wind protection for stock from the substation and turbine towers;
- The future development of the land under existing planning controls would continue as zoned 1(a) Rural Zone;
- The wind farm development has the potential to slow down the shift of productive agricultural land to rural residential use in the short to medium term;
- There was no measurable reduction in values of properties that have a line of sight to the Crookwell 1 wind farm; and
- Soils, improvements and access to services are more important drivers of property values than visual impacts.

In a straw poll conducted by Nuridin (2009), she spoke with the Real Estate Institute of Australia and several other real estate agents operating in locations with wind farms to see if wind farms did influence property / land values. All interviewed agents replied that “there is no indication of any depreciation in the value of properties hosting wind farms, or those adjacent to, or in sight of turbines” (Nuridin 2009). In fact according to some agents in Albany, Western Australia, the wind farm is used as a marketing tool and in Ararat, Victoria, the wind farm has caused the town to prosper (Nuridin 2009).

The NSW Valuer General released a report summarising the impact of wind farms on land values in Australia, analysing impacts of eight wind farms across NSW and Victoria (NSW Valuer General 2009). This report found that wind farms do not appear to negatively affect property values across varying land uses, including rural, rural residential and residential. Results suggested that a property’s underlying land use may affect the property’s sensitivity to price impacts. There were no evident reductions in sale price for rural or residential properties located in nearby townships with views of the wind farm. Due to the remoteness of the wind farms, only a small number of samples were available for inclusion, limiting the conclusions that could be drawn, and highlighting the need for future studies.

The value of land suitable for subdivision or land which posses a dwelling entitlement could also be affected. In this regard, and as discussed in **Chapter 4** Project Justification, the Proponent has identified where potential land use conflicts occur surrounding the project, and is discussing potential impacts with relevant landowners. Beyond these, subdivision applications which have been approved in the region by Mid-Western Regional Council and Bathurst Regional Council will not be directly impacted upon. Moreover Council planning controls are set to limit the properties which can subdivide in the future. Conversely, due to the additional revenue from hosting wind turbines to associated landowners, subdivision of involved landowner properties is less likely to occur in the short to medium term and the land will continue to be used for sheep and cattle grazing.

Some surrounding landowners have raised the concern that construction and operation of the wind farm will decrease the number of potential buyers within the market, which in turn could diminish property values. As already discussed, there are many factors that influence an individual’s decision when purchasing a property and the presence of a wind farm may or may not have an influence on this decision. For example, a potential buyer may seek a life-style with a green energy aesthetic or have no issue with wind turbines.

It should be noted that the Project cannot be developed without some risk of property value impacts during the construction and operational phases, as personal perceptions and tastes will likely come into play. Due to the difficulty in assessing the real impacts on property values there are no suggested mitigation methods to apply. However as the Community Wellbeing and Local Economy (**Sections 18.4** and **18.5**) can be positively affected by the construction of the Project, such effects can be considered to contribute to the mitigation of any loss of property value that may occur.

19.1.1 ***The Concept of “Blight”***

Compensation for “blight”, relating to the loss of future property value or from loss of amenity, was scrutinised in the Land and Environment Court in the case of Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd, 2007. The Taralga Landscape Guardians Inc sought compensation in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* New South Wales (NSW). However the proposition presented a number of insurmountable hurdles according to Chief Judge, Justice Preston.

The Taralga Wind Farm was proposed by a private developer on land where the development was permitted. The Chief Judge summarised that if the concept of blight and compensation were to be applied to the Taralga project, then any otherwise compliant private project which had some impact in lowering the amenity of another property would be exposed to a claim. The Chief Judge went further in saying that:

> *"Creating such a right to compensation would not merely strike at the basis of the conventional framework of land use planning, but would also be contrary to the relevant objective of the Act, in s 5(a)(ii), for 'the promotion and co-ordination of the orderly and economic use and development of land'".*

The resulting decision from the Taralga judgement is relevant to the Crudine Ridge Wind Farm, as the Proponent has leased the land for a permitted land use.

19.2 Mineral Exploration

19.2.1 *Existing Situation*

The proposed Project is located in the Hill End – Ngunnawal geological province, along the Crudine ridgeline. The main geological domain surrounding the site is Silurian to early Devonian clastic sediments including shale, siltstone and conglomerate, limestone and some felsic volcanic (Geoscience Australia 2011).

There are five Exploration Licences (ELs - 6627, 6628, 6629, 7548 and 7549) in the area, held by Oroya Mining Limited. The ELs are for gold prospecting from which two mineral deposits have been recorded within EL 6629 and EL 7549. Both mineral deposits were recorded in the Crudine Creek. There are no mineral drill holes or major industrial mineral sites within the Project.

19.2.2 *Potential Impacts*

The Project has potential to inhibit any current or future exploration of the area for mineral resources during the construction and operation phases. To determine the degree of potential impact, the Proponent contacted Oroya Mining Limited, as discussed in **Chapter 6** Stakeholder Consultation and provided them with information relating to the proposed Project.

During the operation of the Project mineral exploration can still occur around the wind turbines and associated infrastructure, and the upgrading of roads can assist in the matter. There will be a limit on the proximity such activity can occur to a wind turbine, to prevent any instability in ground conditions leading to turbine failure.

Cumulative Impacts: Mining activity within the area is concentrated around Hill End which has no direct impact on the Project. Other existing and proposed wind farms in the region are a sufficient distance from the Project site, and exploration or mining licences tend not to overlap multiple projects. However, where broad-scale exploration licences exist it is impossible to predict where mining activity may take place. Therefore there are no anticipated cumulative impacts likely to occur from mining operations.

19.2.3 *Management and Mitigation*

The Proponent will continue to liaise with Oroya Mining Limited and provide updates of any modifications to the Project design that arise prior to and during the construction of the Project.

19.3 Tourism

Wind farms appear to be generating great public interest, as experienced in many regions of Australia, including the Esperance and Albany Wind Farms in the southern region of Western Australia, Windy Hill Wind Farm near Ravenshoe, Queensland, Lake Bonney Wind Farm near Tantanoola, South Australia and Capital Wind Farm near Bungendore, Canberra. Tourists are able to drive around these wind farms, and even walk up to a turbine at the Albany Wind Farm. Wind farms are even appearing on top destination lists with the Albany Wind Farm, Western Australia voted number 16 out of 20 for Western Australia's Top 20 Tourist Destinations and it is believed that more than 100,000 vehicles visit the wind farm annually (MAP Marketing 2008; Verve Energy 2008).

With the potential for increased traffic from visitors to the wind farm, other economic opportunities exist through activities such as wind farm tours, souvenirs, food and drink, accommodation, etc. which could form the basis of a wind tourism industry. Similarly, increased visitor numbers attracted by the wind farm could result in increased exposure to other local attractions and amenities not associated with the wind farm.

The Mid-Western Regional Council LEP (2012) notes the importance of fostering a sustainable and vibrant economy that supports the existing attributes of the area; including securing the future of agriculture through protection of agricultural land capability. The Council regularly holds community events, including:

- MudFest (Mudgee Short Film Festival);
- Grassroots Rugby Festival;
- Mudgee Bike Muster;
- Go Grazing Food Event;
- Mudgee Small Farm Field Days;
- A Day on the Green;
- Mudgee Food and Wine Festival;
- Gulgong Folk Festival;
- Trans Tasman Touch Tournament;
- Henry Lawson Festival;
- Rylstone Kandos Show;
- Gulgong Show; and
- Wings, Wheels, Wine and Wool Show.

Bathurst Regional Council also regularly holds community events including:

- Community Garage Sale;

- Bathurst 1000 Off-track Events;
- Proclamation Day;
- NAIDOC Celebrations;
- Bathurst Spring Garden Spectacular;
- Bathurst Motor Festival; and
- Australia Day Celebrations.

The Project will have the potential to increase visitor numbers to both councils, as demonstrated with other wind farms in Australia. However, as the Project occurs on private land, tourists will only be able to access the wind farm area from public roads. If increased traffic is recorded within the area, a parking / stopping bay to provide a vantage point for the wind farm could be considered on an appropriate local road by the Proponent, subject to the suitability and availability of land.

19.4 Community Wellbeing and Community Fund

19.4.1 *Existing Situation*

Mid-Western Regional Council has recently drafted a Comprehensive Land Use Strategy which outlines environmental, social and economic objectives for the area, and methods that may be used to achieve these. Overarching purposes of the Strategy include “optimising development opportunities within the area in accordance with the principles of ecologically sustainable development” and “to ensure that the economic sustainability of rural land is maintained and provide a mixture of agricultural uses” (MWRC 2010). The Project will positively contribute to a number of the outlined objectives, including supporting “the retention of the agricultural base and protect rural land from unnecessary fragmentation” and “encouraging the use of renewable energy sources to supplement existing sources of electricity for the region” (MWRC 2010). An understanding of the Project’s ability to contribute to environmental, social and economic sustainability of the region is highlighted through “support for the consideration of development of wind farms in rural areas” (MWRC 2010).

Bathurst Regional Council’s vision is to encourage an “environmentally sustainable community and to attract a range of businesses to the community to increase employment opportunities” (Bathurst Regional Council 2010a). In the context of these goals, the Council aims to provide for “opportunities to promote and educate the community regarding sustainability” and “retain unique environmental assets while also attracting business and employment” (Bathurst Regional Council 2010a). The Council also aims to “promote and support renewable energy industries within the council areas” and the Project is well suited to meet these goals and aspirations, encouraging sustainability and promoting employment in the region (Bathurst, Orange and Dubbo Alliance of Councils 2007).

19.4.2 *Potential Impacts*

Community wellbeing will be positively influenced by the Project during the construction and operation phases in a number of ways, including:

- A short term increase in population during construction due to the incoming work force;
- A potential increase in population during operation due to increased money in the economy, which supplies infrastructure;

- A small increase in full-time employment during operation for a select skilled workforce;
- With increased money in the economy and increased population, the potential for improved tertiary study; and
- The upgrade of roads to accommodate heavy vehicles during construction.

There will also be an increase in the number of jobs available in the area during the construction of the Project. At the Snowtown (Stage 1) Wind Farm in South Australia, which has 47 wind turbines and an installed capacity of 98.7 MW, there was an average of 55 to 65 workers on-site each week. Overall it is estimated that there were 130 people hired directly over the construction of the Project, including contracted companies (*pers. comm.*, Campbell 2009). The Crudine Ridge Wind Farm will have more wind turbines and a greater installed capacity, which could result in more people hired during the construction phase of the Project.

AGL Energy Ltd (AGL) own and have constructed several wind farms in the mid-north region of South Australia. In July 2010 AGL engaged Sinclair Knight Merz (SKM) to undertake an Economic Impact Assessment into the benefits that their Hallett Wind Farm projects have had on the economy in the region. The Hallett Wind Farm projects comprise 350 MW of installed, operating capacity in 2011, with a further 60 MW still to be constructed (SKM, 2010).

Regional employment outcomes of the Hallett Wind Farm projects include:

- To June 2010, total direct employment of 450 Full Time Equivalent (FTE) construction job years plus 15 in operations with an average annual employment of 98;
- To completion of Hallett 1, 2, 4 and 5 total direct construction employment would increase to 540 job years at a average annual employment of 90 plus 36 operations jobs over the life of the projects; and
- To completion of Hallett 1, 2, 3, 4 and 5 total direct construction employment numbers would increase to 640 job years at an average of 80 per annum plus 42 operations jobs over the life of the projects.

In addition to these raw figures, key qualitative highlights of the report include:

- Evidence of strong local business support for the Hallett projects;
- Accommodation and food service providers had a significant increase in sales over the construction period;
- Local contractors were employed directly in the construction of the wind farms;
- Other businesses benefitted from additional people and increased expenditure in the region; and
- Local businesses that benefitted from contracts with the wind farm included:
  - Domestic-scale electricians;
  - Transport operators;
  - Competent machine operators;
  - Quarries; and
  - Concrete businesses.

Capital Wind Farm: Independent research commissioned by Infigen Energy concerning the Capital Wind Farm in 2012 surveyed over 200 local residents and businesses about economic impacts resulting from the wind farm. 'Community perceptions of wind farms' (Qdos 2012) found that 64 % of local business operators thought local businesses had benefitted from the wind farm, and 68 % of respondents supported future wind farm developments.

Cumulative Impacts: It is not anticipated that the development of other proposed wind farms in the region will have an adverse cumulative effect to community wellbeing. Instead these wind farms will provide additional jobs and resources into the surrounding Councils and will help both Councils reach their aspirations and visions.

19.4.3 ***Management and Mitigation***

The Proponent is committed to providing a Community Fund to benefit the community in the vicinity of the Project. The purpose of the fund is to support community groups, programmes and activities that the community values or requires support for. Such programmes have been successfully established for Wind Prospect developments in South Australia and the United Kingdom.

The Proponent is proposing to contribute $1,250 per installed mega watt (MW) to a Community Fund as each stage of the Project commences commercial operation, as outlined in **Section 3.9.2**. Contributions will continue annually for the lifetime of the Project until such date that the Project ceases operation and is decommissioned. Based on the two layout options proposed for the Project this could total up to $200,000 per annum, equating to up to $4 million over an estimated 20 year Project life. It is proposed that decisions on how the funds are to be allocated should be determined by a committee made up of representatives from the local community, Council and the Proponent. The CCC may provide this forum.

The structure and administration of the Community Fund could include, but is not limited to:

- Consideration for landowners with an occupied residence within 2 km of a proposed wind turbine;
- The fund split appropriately between the two Councils;
- The fund managed by a publicly-elected group;
- Funding to sporting clubs, infrastructure, education, etc;
- Funding to local environment and cultural heritage projects; and / or
- Variable funding to groups based on their proximity to the Project.

With the addition of the Community Fund and other secondary effects from the construction and operation of the Project, both Councils and surrounding towns are expected to experience an overall increase in community wellbeing.

Cumulative Impacts: There is the possibility of a significant economic benefit to the council areas, supporting community-based projects from the combination of Community Funds provided by other proposed wind farms in the region.

19.5 Local Economy

19.5.1 *Existing Situation*

As previously discussed, the Project occurs across two Councils, Mid-Western Regional and Bathurst Regional, so any existing or potential impacts will be localised within these Council areas. Comparative employment figures for a range of industries in each Council area are displayed in **Tables 19.1** and **19.2**.

Table 19.1 Most common industries of employment for Mid-Western Regional Council, 2001.

Industry	Mid-Western (%)
Agriculture	17
Retail Trade	14
Manufacturing	12
Health and Community Services	8

Source: Adapted from MWRC Comprehensive Land Use Strategy, 2010.

Table 19.2 Most common industries of employment for the urban region of Bathurst Regional Council, 2008.

Industry	Bathurst (%)
Manufacturing	12.3
Retail Trade	12.3
Education and Training	11.6
Health Care and Social Assistance	10.7
Public Administration and Safety	8.4

Source: Adapted from Bathurst Regional Council Statistical Profile 2009

19.5.2 *Potential Impacts*

Of all the stages of a wind farm development, the construction and decommissioning stages of the Project will generate the largest economic gain for the greatest number of people and businesses in both Council areas. This is due to the hiring of a large temporary work force over approximately two years of construction and later approximately one year of decommissioning. Employment opportunities would involve concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area would require. Where practicable the Proponent will source from local companies (as has commonly been the case with other wind farm developments around Australia), which is likely to include the utilisation of nearby quarries during construction. The Proponent has created a form on the Crudine Ridge Wind Farm website (www.crudineridgewindfarm.com.au) to gather local business and contractor information. This is located under the 'Contact Us' section of the website, and by following the link to 'Contractors'.

Once the wind farm is operational there would be a small number of permanent jobs available. The Community Fund as discussed above and in **Chapter 4** Project Justification would also provide financial benefits and improved equity to the surrounding communities, improving the existing economic situation.

More broadly, it is also anticipated that the Project could inject up to $151 million into the Australian economy. This estimate of the financial benefit to the Australian economy is based on a typical approximation of cost associated with building a project of this size, whilst recognising that the associated components (i.e. wind turbines) will be manufactured and procured overseas.

Cumulative Impacts: Other proposed wind farms in the region will not have an adverse cumulative effect on the local economy through the introduction of the proposed development into the area. Instead these wind farms will provide additional jobs and utilise existing resources in the surrounding area where feasible.

19.5.3 *Management and Mitigation*

To ensure that the local Councils benefit from the construction of the Project, local contractors will be used where feasible. This will involve the Proponent liaising with local industry representatives to utilise the full potential of local resources. A number of local businesses have already made themselves and their services known to the Proponent.

19.6 Health

19.6.1 *Existing Situation*

On the 23rd December 2011 the NSW Government released *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines) for public consultation. Proposed within the Draft Guidelines are specific requirements relating to health. It is important to note that NSW Health, the Ministry that supports the executive and statutory roles of the NSW Minister for Health and Medical Research, in a submission to the Draft Guidelines, stated that “there is currently no health evidence to support generic 2 km separation distances from proposed wind turbines”. Although the Draft Guidelines do not specifically apply to existing projects such as the Crudine Ridge Wind Farm, the Proponent has given regard to their future incorporation within this EA, has therefore included further information with regard to health within this chapter.

Existing wind farm guidelines relating to noise, electromagnetic fields and visual amenity provide a robust framework which ensures that impacts, including health impacts, on the community are avoided, minimised or mitigated to an acceptable level. In July 2010 the Australian National Health and Medical Research Council (NHMRC) released a ‘rapid review of the evidence’ on ‘Wind Turbines and Health’. The evidence collected from peer reviewed research led to the conclusion that:

> *“There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines”.*
>
> *“Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans. Sub-audible, low frequency sounds and infrasound from wind turbines do not present a risk to human health”.*

The NHMRC review highlighted a number of studies which showed that the principle effects of wind turbine sound were not physiological but subjective. Furthermore, since the release of the NHMRC review, documents received under a Freedom of Information (FoI) request to NSW Health in January 2012 “found the claims of the anti-wind energy group to be of the ‘lowest category of scientific evidence', and having major methodological flaws". NSW Health goes on to say that the national approach, taken by NHMRC, is consistent with the international scientific opinion, which is based on lack of a current link between wind turbines and adverse health effects.

W. David Colby, the Acting Officer of Medical Health at Chatham Kent Health Unit in Canada, and one of seven experts involved in the AWEA and CanWEA 2009 review wrote in a 2009 letter to the Chatham Kent Council:

> *"In summary, there is no scientifically valid evidence that wind turbines are causing direct health effects… It is unlikely that evidence of adverse health effects will emerge in the future because there is no biologically plausible mechanism known by which wind turbines could cause health effects.*
>
> *"An annoyance factor undoubtedly exists to which there is individual variability. Associated stress from annoyance, exacerbated by all the negative publicity, is the likely cause for the purported erosion of health that some people living near rural wind turbines are reporting. Stress has multiple causes and is additive."*

A study by Pederson et al. (2009) of sound response in the Netherlands, published in the Journal of the Acoustic Society of America, found a high correlation between the absence of economic benefits and opinion of visual impact and annoyance. This indicates that the perception of sound is potentially subjectively driven, rather than purely a negative aural response.

Claims that wind farms generate physiological health effects such as "vibroacoustic disease" (VAD) or "wind turbine syndrome" (WTS) have been refuted by numerous studies. The 2009 AWEA and CanWEA expert panel review, comprising three medical doctors and four acoustics experts, specifically criticised studies showing a link between wind farms and VAD or WTS for failing to conduct an epidemiological study that is needed to show a causal association. Instead all such studies, unpublished in peer reviewed journals, rely on 'case studies', with self-selected cases being used to form an untested opinion. The expert panel review made it clear that only 'case controlled' or 'cohort' studies, where large sample sets are selected at random or in a controlled way to avoid biased results, are appropriate. As yet no such studies have been conducted into VAD or WTS.

As an alternative explanation for some of these reported health effects from wind farms, the idea of a 'nocebo effect' has been advanced. A 'nocebo' is a harmless substance or procedure which is perceived by the recipient to be harmful.

The 2009 AWEA and CanWEA study investigated the 'nocebo affect' concluding that:

> *"The large volume of media coverage devoted to alleged adverse health effects of wind turbines understandably creates an anticipatory fear in some that they will experience adverse effects from wind turbines. Every person is suggestible to some degree. The resulting stress, fear, and hyper-vigilance may exacerbate or even create problems which would not otherwise exist. In this way, anti-wind farm activists may be creating with their publicity some of the problems that they describe".*

Results from these studies and numerous other studies and reviews overwhelmingly indicate that there is no evidence to suggest a direct causal link between wind turbines and deterioration of human health.

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CHAPTER 20

Statement of Commitments

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20. STATEMENT OF COMMITMENTS

The Statement of Commitments (SoC) is a summary of all management and mitigation measures collated from chapters of this EA. The SoCs have been developed to inform Development Consent Conditions of Approval which are to be managed through Environmental Management Plans (EMPs) as the project is constructed and operated.

The Construction Environmental Management Plan (CEMP) outlines the environmental management practices and procedures that are to be followed during construction. The CEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Compounds and ancillary facilities management;
- Noise and vibration;
- Traffic and access;
- Soil and water quality and spoil management;
- Air quality and dust management;
- Aboriginal and non-Aboriginal heritage management;
- Soil contamination, hazardous material and waste management;
- Ecological impact management; and
- Hazard and risk management.

The Operational Environmental Management Plan (OEMP) outlines the environmental management practices and procedures that are to be followed during operation. The OEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Noise management;
- Landscaping;
- Bird and bat management;
- Telecommunication interference; and
- Decommissioning.

20.1 Impact, Objective, Responsibility and Timing

Table 20.1 provides a summary of environmental aspects identified in undertaking this EA. Each aspect is defined by an impact, objective, a proposed mitigation measure and the responsible party. Each aspect is further defined by Project stage, for the purposes of informing Development Consent Conditions of Approval. Stage timing is defined by the following:

- Pre-Construction (PC);
- Construction (C);
- Operation / Maintenance (OM); and
- Refurbishment / Decommissioning (RD).

To enable ease of referencing to chapters the SoC mitigation measures have been split into the associated chapters.

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	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
Landscape and Visual								
001	Impact to receptors	Minimise view of infrastructure	Procure matt and / or off-white wind turbine generator (WTG) structural components to reduce visual contrast with the viewing background (this is subject to final turbine selection).	Proponent	✓	✓		✓
002	Impact to receptors	Minimise view of infrastructure	Revegetate disturbed areas and use local material to minimise colour contrast where feasible.	Proponent in consultation with road engineers	✓	✓		✓
003	Impact to receptors	Minimise view of infrastructure	Undertake landscape planting where screening is deemed appropriate and in accordance with the outcomes of the assessment process.	Proponent in consultation with affected receptor		✓	✓	✓
004	Impact to receptors	Minimise view of construction	Reinstate disturbed soil areas after completion of construction and decommissioning which would include re-contouring and re-seeding with appropriate plant species and local materials where feasible.	Proponent		✓		✓
005	Impact to receptors	Minimise view of construction	Enforce safeguards to control and minimise dust emissions during construction and decommissioning.	Proponent		✓		✓
006	Impact to receptors	Minimise view of construction	Minimise activities that may require night time lighting and, if necessary, use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the Project site to minimise glare.	Proponent		✓		✓
007	Impact to receptors	Minimise view of construction	Procure materials of appropriate colour for ancillary structures in consideration of their reflective properties.	Proponent	✓			
Noise								
008	Impact to receptors	Compliance	Once final turbine selection and Project refinement has been undertaken, revised noise modeling will be carried out to ensure that the predicted noise levels of the chosen WTG comply with the relevant criteria.	Proponent in consultation with noise consultant and landowners	✓			

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
009	Operational noise exceedance	Compliance	If WTG noise impacts are non-compliant with stated criteria used for the assessment due to temperature inversion, atmospheric stability or other reasons, then an 'adaptive management' approach can be implemented to mitigate or remove the impact. This process could include: • Investigating the nature of the reported impact; • Identifying exactly what conditions or times lead to undue impacts; • Consideration of operating WTGs in a reduced 'noise optimised' mode during offending wind directions and at night-time (sector management); • Providing acoustic upgrades (glazing, façade, masking noise etc) to affected dwellings; and • Turing off WTGs that are identified as causing the undue impact.	Proponent			✓	
010	Construction noise exceedance	Minimisation	Where practicable, construction is to occur within recommended working hours. Wind turbine erection and concrete pours to be permitted outside of these set hours where climatic conditions are favourable to ensure construction programme is maintained. (Protocol to be provided within **Construction Environmental Management Plan** (**CEMP**)).	Proponent in consultation with DoPI		✓		✓
011	Construction noise exceedance	Minimisation	Prior notification of affected public and restricted use of exhaust / engine brakes in built up areas for night-time deliveries. (Protocol to be provided within **CEMP sub-plan**).	Proponent		✓		✓
012	Substation noise exceedance	Compliance	If selected substation locations are non-compliant with the NSW Industrial Noise Policy, mitigation measures would be applied as appropriate, including; • The use of transformer(s) with a lower sound power level output; • Landscaping, including raised embankments and vegetation, around the substation; and • Providing acoustic upgrades (glazing, façade, masking noise etc) to affected dwellings.	Proponent		✓		

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	 C	 OM	 RD
Ecology								
013	Spread of weeds	Minimise spread	Development of a **CEMP sub-plan**, which provides: • Soil which may contain exotic species to be piled at least 50 m from any water source, or areas of native vegetation; • All construction staff and sub-contractors educated on noxious weeds present at the Project site and ways to prevent spread; • Where a specific weed risk has been identified, all machinery, equipment and vehicles are to be washed down before entry and egress of the Project site; • Where practicable, topsoil that is limited in weeds to be harvested to salvage the native soil seed bank and reintroduced into disturbed areas. Otherwise, revegetate with locally native endemic species characteristic of the cleared vegetation type; • Control of perennial weed grasses within the disturbance zone for 3 to 5 years after construction; • Where practicable, and in consultation with host landowners, manage stock access during periods of revegetation; and • Imported soil and rubble to be certified as free of weeds and weed seeds.	Proponent in consultation with ecologist and associated landowners		✓	✓	✓
014	Loss of biodiversity value	Minimise impact	Development of a **CEMP sub-plan**, which provides: • Where practicable, Project vehicles are to remain within the extent of the earth works designed specifically for the Project to minimise vegetation disturbance; • Care to be taken when working in close proximity to trees to prevent damage to roots; • A pre-clearance protocol to be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing; • An Environmental Compliance Manager or field officer qualified in the handling of fauna to be present on-site during clearing to capture and re-release fauna (where appropriate); • Where practicable, and in consultation with host landowners, logs	Proponent in consultation with ecologist, OEH and SEWPaC	✓	✓	✓	✓

Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD

		and large rocks removed from within the proposed development area are to be redistributed following the completion of works in temporary clearance areas or adjacent areas to supplement habitat;
		• Where practicable, trenches to be dug at least 15 m away from the base of trees and outside drip lines;
		• Minimise dust creation during construction through the use of water carts;
		• If micro-siting of the Development Footprint occurs, where practicable, maintain a 30 m buffer between all turbines and hollow-bearing trees;
		• Where practicable, boundaries of the construction area are to be clearly marked to prevent breaches of construction boundaries;
		• Where practicable, suitable fencing to be erected along trenches to prevent fauna falling in;
		• Regular checking of trenches by the Environmental Compliance Manager to ensure any captured fauna are released according to the **CEMP** *(Note: this will not be carried out during the operation phase)*;
		• Pre-clearance surveys undertaken to determine if roosts, nests or dens are present in any trees proposed for clearing;
		• Outside of the Development Footprint tree clearance will be avoided where practicable;
		• Native vegetation that is removed will be chipped and mulched for on-site use where practicable;
		• Where practicable, native vegetation greater than 3 m in height to be retained during transmission line construction;
		• A bird and bat monitoring program will be prepared prior to operation of the wind farm that identifies:
		  ○ the frequency of monitoring and reporting;
		  ○ the thresholds at which impacts are considered unacceptable; and
		  ○ acceptable adaptive management approaches.
		• The frequency of report strike data will be determined during the preparation of the monitoring programme. The adaptive management measures that could be implemented should strike					

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
			thresholds be reached will be negotiated with OEH and SEWPaC when significant strike rates are detected to allow for a more tailored and species-specific approach to mitigation. Bird and bat strike monitoring will be undertaken with consideration for the monitoring guidelines provided by the Australian Wind Energy Association (Brett Lane & Associates 2005). • Where an adaptive management process is required, the following may be undertaken should any turbines be identified as having a high incidence of strike during monitoring: ○ Step 1: Feather the relevant turbine(s) to reduce strike or change the wind speed trigger at which the rotors being turning; and ○ Step 2: Based on further monitoring, if Step 1 does not reduce incidence, the relevant turbines may be temporarily shutdown during high risk periods. • Should WTGs require lighting, lighting that minimises the likelihood of attracting insects and hence foraging bats is to be selected, subject to CASA requirements; • Pre-clearance surveys will be undertaken during the flowering season for *Swainsona recta* (Spring) in areas of potential habitat within the transmission line easement impact area. This will ensure all individuals are identified and flagged for fencing during construction. Should new individuals be identified, poles will be shifted to avoid any direct impacts. Survey will only be undertaken when individuals on-site are in flower. • Populations or known individuals of *Swainsona recta* to be clearly marked / delineated in the field prior to construction work. Temporary fencing, incorporating a 5 m buffer, to prevent access is recommended; • Rehabilitation of internal access roads that are not required following construction to be undertaken; and • Landscaping around the main and secondary collector substations is to incorporate native species where appropriate.					
015	Loss of	Minimise impact	An appropriate offset package will be secured within 12 months of commencing construction to compensate for the loss of habitat within	Proponent in consultation with	✓			

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
	biodiversity value		the Study Area outlined within this EA. Final calculation of the offset area will be carried out during the pre-construction phase once turbine selection has taken place and the final Development Footprint is known.	ecologist, OEH, SEWPaC and associated land owners				
Cultural Heritage								
016	Loss of cultural heritage items	Minimise impact	Develop a **CEMP sub-plan**, which provides procedures to be followed for impact avoidance and accidental discovery.	Proponent in consultation with relevant Aboriginal communities and OEH	✓	✓		✓
017	Loss of cultural heritage items	Minimise impact	Construction personnel to be trained in procedures to minimise impact.	Proponent in consultation with archaeologist	✓	✓	✓	✓
018	Loss of Aboriginal heritage items	Minimise impact	While the Aboriginal stone objects recorded are very low density distributions and have low archaeological significance, limiting the extent of impacts to these locales is to be undertaken where practicable.	Proponent in consultation with archaeologist	✓	✓		
019	Loss of Aboriginal heritage items	Minimise impact	Ground disturbance impacts associated with the Project be kept to a minimum and to defined areas, to ensure minimum impact on Aboriginal objects (stone artifacts), which can be expected to extend in a relatively continuous, albeit very low to low density distribution, across the broader landscape encompassed by the Project.	Proponent in consultation with archaeologist		✓		✓
020	Loss of Aboriginal heritage items	Minimise impact	Aboriginal Site Impact Recording Forms are to be completed (and submitted to the OEH) for each Aboriginal object harmed during construction of the Project.	Proponent and contractor in consultation with archaeologist		✓		

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
Traffic and Transport								
021	Safety and asset protection	Minimise risk	Contract a licensed haulage contractor with experience in transporting heavy and over-size loads, to be responsible for obtaining all required approvals and permits from the RMS and Councils and for complying with any conditions specified in the aforementioned approvals.	Proponent in consultation with RMS and councils	✓			
022	Safety and asset protection	Minimise risk	Development of a **CEMP sub-plan**, to include, but not be limited to: • Scheduling of deliveries, timing of transport, limiting the number of trips per day, and reducing traffic during school bus route hours, i.e., 7.00 to 9.00 am and 3.00 to 4.30 pm; • Undertaking community consultation before and during all haulage activities and providing a dedicated telephone contact list to enable any issues to be rapidly identified and addressed; • Letterbox drop along affected routes; • Minimise disruption to local vehicles by ensuring average and maximum wait times due to Project related traffic along local roads are kept to a minimum (typically an average maximum of 3 minutes wait time); • Managing the haulage process, including temporary, short term road closures, the erection of warning signs and / or advisory speed signs posted in advance of isolated curves, crests, narrow bridges and changes of road conditions; • Placing of speed limits on all roads that would be used primarily by construction traffic to reduce the likelihood of any accidents and reduce maintenance costs; • Designing and implementing temporary modifications to intersections and roadside furniture as appropriate; • Producing a Transport Code of Conduct which would be made available to all contractors and staff detailing traffic routes, behavioural requirements and speed limits; • Establishing procedures to monitor traffic impacts on public and internal access tracks during construction, including noise, dust	Proponent in consultation with licensed haulage contractor and road authorities	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
			nuisance and travel times, and to implement modified work methods to reduce such impacts where practicable; • Reinstating pre-existing conditions after temporary modifications to the roads and pavements along the route, where applicable, in consultation with relevant authorities; and • Where reconstruction or provision of a temporary crossing is required over a creek or drainage structure, the design of this structure will be discussed with the relevant authority.					
023	Safety and asset protection	Minimise risk	Implement all aspects of the **CEMP sub-plan** in co-ordination with the RMS and local Councils.	Proponent in consultation with licensed haulage contractor and road authorities		✓		✓
024	Safety and asset protection	Minimise risk	Prepare road dilapidation reports covering pavement and drainage structures, in consultation with the Councils, for all of the routes before and after construction. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent's cost. Alternatively, the Proponent may negotiate other forms of compensation for road damage with the relevant roads authorities as appropriate.	Proponent in consultation with council and road authorities	✓	✓		✓
025	Safety and asset protection	Minimise risk	Consideration for establishing a transport pool for employees from nearby towns to minimise traffic volumes.	Proponent	✓			
026	Safety and asset protection	Minimise risk	Establish a procedure to ensure the ongoing maintenance of the Project site internal access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.	Proponent			✓	
027	Safety and asset protection	Minimise risk	Prepare and implement a revised **EMP sub-plan** reflecting change in traffic volumes, during time of decommissioning.	Proponent in consultation with council and road authorities				✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
028	Safety and asset protection	Minimise risk	Mid-Western Regional Council have requested a level of involvement in undertaking any required upgrade works on Council maintained roads and bridges, or as a minimum works are to be carried out in conjunction with Council in a supervisory role to Council specifications.	Proponent				
			During the Detail Design and Contract Development stage of Project establishment the Proponent will seek competitive tenders for both the supply of wind turbines and balance of plant (civil and electrical) works. The Proponent will consider MWRC's requests during Detail Design and Contract Development. Notwithstanding this, MWRC may bid for any aspect of the balance of plant works for the Project.		✓			
Aviation Assessment								
029	Creation of hazard	Minimise risk	The Proponent will provide the RAAF AIS, CASA, AsA, AAAA and NSW RFS with the final turbine locations and dimensions prior to construction. After construction is complete, the Proponent will provide RAAF AIS, CASA, AsA, AAAA and NSW RFS with the "as constructed" details.	Proponent	✓	✓	✓	✓
030	Creation of hazard	Minimise risk	The Proponent will provide CASA with notification of any cranes (temporary obstacles) that exceed 110 m above ground level.	Proponent	✓	✓		✓
031	Creation of hazard	Minimise risk	Appropriate information regarding the WTG layout and dimensions will be supplied to the Rural Fire Service, if required, to assist in their planning and execution of fire response.	Proponent	✓	✓		✓
032	Creation of hazard	Minimise risk	On receipt of Development Approval for the Project, and with particular regard to the Aeronautical Impact Assessment and Obstacle Lighting Review, the Proponent will consult with CASA and DIT on the issue of obstacle lighting.	Proponent in consultation with CASA	✓			
033	Impact to nearby properties	Minimise impact	If lighting is required, the Proponent will commit to shielding provisions allowed under existing CASA guidelines. Shielding restricts the downward component of light to 5 % of nominal intensity emitted below 5° below horizontal and zero light emission below 10° below horizontal.	Proponent in consultation with CASA	✓			

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
Communication								
034	Deterioration of signal strength	Minimise deterioration	Where practicable, use equipment complying with appropriate Electromagnetic Emission Standards.	Proponent	✓	✓		✓
035	Deterioration of signal strength	Minimise deterioration	Establish a system for recording any complaints on interference, to allow for further investigations with the affected party, and to reach an amicable solution.	Proponent			✓	✓
036	Deterioration of signal strength	Minimise deterioration	General mitigation methods for radio-communication, if impacts occur, include: • Modifications to or relocation of existing antennae; • Installation of a directional antennae; and • Installation of an amplifier to boost the signal.	Proponent			✓	✓
037	Deterioration of signal strength	Minimise deterioration	If television interference is experienced and reported by an existing receiver in the vicinity of the Project, the source and nature of the interference would be investigated by the Proponent. Should the cause of interference be attributed to the Project, then the Proponent will put suitable mitigation measures in place after consultation and agreement with the affected landowner or television broadcaster. These could include: • Re-orientation of existing aerials to an alternative transmitter; • Provision of a land line between the affected receiver and an antenna located in a suitable reception area; • Provision of satellite or digital TV where available; and • Installation of a new repeater station in a location where interference can be avoided (this is more complex for digital but also less likely to be required for digital television).	Proponent			✓	✓
Electromagnet Fields								
038	Exposure to EMFs	Minimise exposure	Bury electrical cables where feasible to shield electrical fields.	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
039	Exposure to EMFs	Minimise exposure	Place appropriate security fencing around emitting structures (e.g. collector substations and switching station).	Proponent	✓			
040	Exposure to EMFs	Minimise exposure	Ensure the public, including tourists, that need to go near emitting structures are accompanied by a trained and qualified staff member.	Proponent			✓	✓
Fire and Bushfire								
041	Increase risk of fire ignition or spread	Minimise risk	Adherence to all regulations under the NSW Rural Fires Act 1997 and the Cudgegong Draft Bushfire Risk Management Plans.	Proponent in consultation with relevant authorities	✓	✓	✓	✓
042	Increase risk of fire ignition or spread	Minimise risk	Implementation of fire prevention measures in accordance with the relevant **EMP sub-plan**.	Proponent in consultation with RFS and NSW Fire Brigade	✓			
043	Increase risk of fire ignition or spread	Minimise risk	The Rural Fire Service (RFS) and NSW Fire Brigade will be consulted regarding the adequacy of bushfire prevention measures to be implemented on-site during construction, operation and decommissioning. These measures will potentially cover hot-work procedures, asset protection zones (APZs), safety, communication, site access and response protocols in the event of a fire originating in the Project infrastructure, or in the event of an external wildfire threatening the Project or nearby properties.	Proponent in consultation with RFS and NSW Fire Brigade	✓	✓	✓	✓
044	Increase risk of fire ignition or spread	Minimise risk	Provide RFS with the locations of individual WTG locations, ancillary infrastructure, construction work schedule, location of additional water supplies for construction, potential landing pads for firefighting aircraft and helicopters and access gates for firefighting services.	Proponent	✓	✓	✓	✓
045	Increase risk of fire ignition or spread	Minimise risk	Installation of access tracks at appropriate width and vertical clearances with access suitable for all weather conditions.	Proponent	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
046	Increase risk of fire ignition or spread	Minimise risk	Train construction and maintenance staff on bushfire risk management and risks that could be present at the Project.	Proponent		✓	✓	✓
047	Increase risk of fire ignition or spread	Minimise risk	Provision of basic firefighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions with a minimum of one trained person on-site.	Proponent		✓	✓	✓
048	Increase risk of fire ignition or spread	Minimise risk	Maintain provision for mobile telephone and UHF radio communications.	Proponent in consultation with RFS and NSW Fire Brigade		✓	✓	✓
049	Increase risk of fire ignition or spread	Minimise risk	The collector substations will be surrounded by a gravel and concrete area, free of vegetation, to provide an APZ.	Proponent	✓	✓		✓
050	Increase risk of fire ignition or spread	Minimise risk	The collector substations will be bunded with a capacity exceeding the volume of the transformer oil. The facility will be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater).	Proponent	✓	✓	✓	✓
051	Increase risk of fire ignition or spread	Minimise risk	Placement and maintenance of APZ will occur around WTGs, transmission line easements and ancillary structures to minimise the spread of fire. Workplace health and safety protocols will be developed to minimise the risk of fire for workers in the control room and amenities.	Proponent	✓	✓	✓	✓
052	Increase risk of fire ignition or spread	Minimise risk	WTGs will be shut down if monitored components reach critical temperatures or if directed to by the RFS in the case of a nearby wildfire being declared (an all-hours contact number would be available to the RFS during the bushfire period).	Proponent in consultation with the RFS			✓	
053	Increase risk of fire ignition or spread	Minimise risk	Flammable materials and ignition sources brought onto the Project site will be handled and stored as per manufacturer's instructions.	Proponent		✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
054	Increase risk of fire ignition or spread	Minimise risk	Lightening protection will be installed correctly to minimise risk of malfunction.	Proponent		✓		✓
055	Increase risk of fire ignition or spread	Minimise risk	Total fire ban days will be considered in regard to hours within which construction takes place, minimising the risk of fire and bushfire ignition.	Proponent		✓		✓
Water								
056	Loss of integrity to riparian corridor	Minimise loss	Works and disturbances not identified as part of the Development Footprint within this EA (with the exception of crossings) should not be located in any riparian corridors.	Proponent in consultation with NOW	✓	✓		✓
057	Loss of integrity to riparian corridor	Minimise loss	NOW guidelines for river crossing designs, based on the Strahler Stream Order Categorisation to minimise environmental impact, will be followed in the design and upgrade of existing roads and river crossings.	Proponent in consultation with NOW	✓	✓		✓
058	Impact on watercourses	Minimise impact	All waterway crossings are to undergo detailed assessment and design post-approval, and are to be constructed in consultation with NOW and DPI (Fisheries) and in line with the NOW *Guidelines for Controlled Activities* and DPI (Fisheries) guidelines: *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why do Fish Need to Cross the Road* (2004).	Proponent in consultation with NOW and DPI (Fisheries)	✓	✓		
059	Impact on watercourses	Minimise Impact	All required watercourse crossings will be designed to protect and enhance water flow, water quality, stream ecology and existing riparian vegetation.	Proponent in consultation with NOW	✓	✓		
060	Loss of water quality and change to hydraulic regime	Minimise loss and impact on adjacent watercourses	A **CEMP sub-plan** will be developed to ensure soil disturbance and erosion from surface runoff is minimised and in order to minimise disturbance to water resources and riparian zones in the area. This sub-plan will include: • Construction and operation of the Project to comply with Section 120 of the *Protection of the Environment Operations (POEO) Act 1997*;	Proponent in consultation with NOW and in reference to Landcom 2004	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD

			• Project design and construction to not worsen existing flooding characteristics in the vicinity of the Project;
			• Monitoring of low- and high- flow conditions is to be regularly undertaken prior to the commencement of works to determine baseline water quality parameters. Surface water monitoring locations should include:
			  ○ Crudine River (downstream of the confluence with Sugarloaf Creek);
			  ○ Cowflat Creek (upstream of the confluence with Stinking Water Creek);
			  ○ Downstream of the confluence with Tunnabidgee Creek and Long Gully; and
			  ○ Salters Creek (upstream of confluence with Tunnabidgee Creek).
			• All ancillary drainage infrastructure, e.g., sediment and litter traps are to, where practicable, be located outside the riparian corridor. Runoff is to be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse;
			• All stockpiles are to be located away from drainage lines and natural watercourses, road surfaces and trees and, where necessary, are to be appropriately protected to contain sediment and runoff (e.g. sediment fencing);
			• Regular inspection, maintenance and cleaning of water quality and sedimentation control devices; and
			• Due regard for the Central West CAP in the preparation of the **CEMP** and **OEMP**.					

061	Loss of water quality and change to hydraulic regime	Minimise loss and impact on adjacent watercourses	Mitigate for any impacts on groundwater as a result of the construction or operation of the Project, including contamination and impacts on flow rates. Ensure that there are no lasting impacts on groundwater following decommissioning.	Proponent in consultation with Landcom 2004		✓	✓	✓
062	Loss of water quality and change to	Minimise impact on groundwater	Carry out a groundwater investigation prior to any blasting on-site (if required) to ensure that there is no adverse impact on groundwater for users or dependent ecosystems. If the investigation highlights areas of	Proponent in consultation with NOW	✓	✓		

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
	hydraulic regime		concern, then appropriate mitigation or alternative methods will be used.					
063	Supply of water for construction	Obtain water for construction	Calculate all necessary water demands once final Development Footprint has been determined. Identify water requirements, including the locality of proposed works, extraction points, times, volumes and rates. Secure the necessary water licensing permits required at the time of extraction.	Proponent in consultation with NOW	✓	✓		
064	Supply of water for construction	Obtain water for construction	Where available, and of appropriate chemical and biological quality, stormwater, recycled water or other water sources to be used in preference to potable water for construction activities, including concrete mixing and dust control.	Proponent	✓	✓		
065	Supply of water for construction	Obtain water for construction	Should the on or near-site provision of water be insufficient, water will be sourced from commercial suppliers as required.	Proponent	✓	✓		
Air Quality								
066	Deterioration of air quality	Minimise impact	Develop a **CEMP** sub-plan to minimise and manage impacts on air quality which shall include: • The identification of potential sources of dust; • Dust management objectives; • Mitigations measures to be implemented, including measures during weather conditions where high level dust episodes are probable; • A monitoring program to assess compliance with identified objectives; and • Mechanisms for the monitoring, review and amendment of this plan.					
067	Deterioration of air quality	Minimise impact	During excavation topsoil will be stockpiled. After excavation topsoil will be replaced for seeding and excess subsoil will be disposed of in an appropriate manner. If any excavation occurs on steep slopes the topsoil may need to be stabilised.	Proponent		✓		✓
068	Deterioration of air quality	Minimise impact	Where practicable, stockpiled material will be covered with plastic, seeded or otherwise bound to reduce dust. Dust levels at stockpile sites are to be visually monitored. Dust suppression (e.g. water sprays) will be	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
			implemented if required.					
069	Deterioration of air quality	Minimise impact	During dry and windy conditions a water cart or alternative (non-chemical) dust suppression would be available and applied to work areas.	Proponent		✓		✓
070	Deterioration of air quality	Minimise impact	If blasting is required, appropriate guidelines for control of blasting impacts will be followed. (i.e. Australian New Zealand Environment and Conservation Council).	Proponent in consultation with ANZECC		✓		✓
Soil and Landforms								
071	Disturbance to soil and water	Minimise disturbance	Soil and water management measures consistent with Landcom (2004) to be employed during construction to minimise soil erosion and the discharge of sediment and other pollutants to land and / or water.	Proponent in reference to Landcom 2004	✓	✓		
072	Disturbance to existing land formations	Minimise disturbance	Develop a **CEMP sub-plan** to provide specific measures for soil, including: • Procedures for personnel to manage suspected contaminated soils disturbed during earthworks; • All disturbed soil surfaces to be stabilised as soon as practicable after works have ceased in the area; • All stockpiles to be covered where practicable to minimise the loss of material during high wind and rain events. Where practicable, stockpiles to be placed in areas sheltered from the wind; • Planning for erosion and sediment control concurrently with engineering design, prior to any works commencing; • Progressive rehabilitation of disturbed land as soon as practicable; • Jute matting or similar to be used to stabilise the soil and minimise weed invasion; • Implementation of management measures to minimise sediment and runoff entering watercourses;	Proponent	✓	✓		✓
073	Soil compaction	Minimise impact	The **CEMP** sub-plan will have specific measures for stock management: • Removal of stock access from construction areas for entire construction periods to allow for regeneration – subject to landowner participation; and	Proponent in consultation with associated landowners		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
			• Before remediation works, grazing to be removed where practicable, and subject to landowner participation and the grass sward allowed time to recover and minimise areas of bare soil.					
Waste								
074	Waste generation	Minimise waste and maximise recycling	Provide skip bins and recycling bins on-site to handle packaging materials and domestic waste.	Proponent		✓	✓	✓
075	Waste generation	Minimise waste and maximise recycling	Mulch vegetation and use on-site where feasible, otherwise burn on-site with permission from Council, provide firewood to landowners or take to Mudgee waste facility or Kandos and Gulgong waste transfer stations.	Proponent		✓		✓
076	Waste generation	Appropriate disposal of waste	On-site toilets will either be drained by a septic tank or be an enclosed unit.	Proponent		✓	✓	✓
077	Waste generation	Appropriate disposal of waste	All chemicals and oils will be treated as contaminated waste at the Mudgee waste facility or Kandos and Gulgong waste transfer stations.	Proponent		✓	✓	✓
078	Waste generation	Appropriate disposal of waste	Any disposal of unsuitable excavated material will require approval from local Council.	Proponent		✓		✓
Crown Roads and Trigonometrical Stations								
079	Damage to Trigonometrical Stations	Avoid damage	Commitment to avoid disturbing and damaging the Trigonometrical Stations and adjacent witness marks.	Proponent		✓		✓
080	Crown roads	Liaise with DoL	Relevant permits will be sought from DoL where Project infrastructure impacts upon Crown Roads.	Proponent in consultation with DoL	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
Construction								
081	Environmental	Minimise impact	Micro-site on-site infrastructure within a 100 m radius of the proposed Project infrastructure with respect to the Study Area and Development Footprint assessed within this EA, whilst minimising impacts to non-involved residences and ecologically sensitive habitats and species.	Proponent in consultation with DoPI	✓	✓		✓
082	Environmental	Minimise impact	Onsite Environmental Representative to be granted authorisations to permit minor modifications to the project design with general regard to this EA following detailed design activities.	Proponent	✓	✓		✓
083	Environmental	Minimise impact	Development of a **Construction Environmental Management Plan** (**CEMP**) which outlines environmental practices and procedures to be followed during construction. The CEMP will be supported by a number of sub-plans, typically including: • Compounds and ancillary facilities management; • Noise and vibration; • Traffic and access; • Soil and water quality and spoil management; • Air quality and dust management; • Aboriginal and non-Aboriginal heritage management; • Soil contamination, hazardous material and waste management; • Ecological impact management; and • Hazard and risk management.	Proponent	✓	✓		✓
084	Environmental	Minimise impact	Development of an **Operational Environmental Management Plan** (**OEMP**), which outlines environmental management practices and procedures that are to be followed during operation. The OEMP will be supported by a number of sub-plans, typically including: • Noise management; • Landscaping; • Bird and bat management; • Telecommunication interference; and	Proponent			✓	

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
			• Decommissioning.					
085	Decommissioning	Manage process	A Decommissioning and Rehabilitation Plan (DRP) will be prepared during the pre-decommissioning phase, towards the end of the Project's life. The DRP will detail the process of decommissioning, including addressing whether components are to be removed or left in situ. All decommissioning work will be the responsibility of the Project owner, which is a provision within the lease arrangements with relevant landowners.	Proponent in consultation with Landowners				✓
Mineral Exploration								
086	Future land use for mineral exploration	Minimise impact	Liaise with relevant mining companies and provide updates of any modifications to the Project design that arise during the construction of the Project.	Proponent		✓		
087	Future land use for mineral exploration	Minimise impact	At the time of decommissioning, communicate with associated landowners and mineral title holders that may wish to retain roads.	Proponent				✓
Community Wellbeing								
088	Affect on local area	Maximise positive effect of proposal	A contribution of $1,250 per installed mega watt (MW) annually into a Community Fund as each stage of the Project commences commercial operation. This fund will be established in close cooperation with Mid-Western Regional and Bathurst Regional Councils with decisions on how funds are to be allocated determined by a committee made up of representatives from the local community, Council and the Proponent. The CCC may provide this forum.	Proponent in consultations with councils and community	✓		✓	✓
Economic								
089	Affect on local area	Maximise positive effect of proposal	Local contractors will be used where it is feasible, which will allow the Proponent to utilise the full potential of local resources.	Proponent in consultation with local industry representatives	✓	✓		✓

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CHAPTER 21

Conclusion

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21. CONCLUSION

This Environmental Assessment (EA) has assessed the potential environmental impacts that may result from the proposed Crudine Ridge Wind Farm (the Project), a proposal incorporating up to 106 wind turbines and capable of generating up to 135 MW of new renewable energy.

The Project has been assessed in accordance with the *Environmental Planning and Assessment Act 1979* and has taken into consideration the *Environment Protection and Biodiversity Conservation Act 1999*, along with other Federal, State and Local Government legislation, policy and guidelines.

The Project has incorporated the findings identified through the design phase, including consultation with the local community and associated stakeholders. The potential impacts of the Project have been assessed and appropriate avoidance, mitigation and management measures proposed. **Chapter 20** Statement of Commitments details all environmental aspects related to the Project which should be used to inform Development Consent Conditions of Approval.

Benefits of the proposal have been identified at a global, regional and local scale, including:

- Production of approximately 413,910 MWh per annum, sufficient for the average consumption of 56,700 homes (based on conservative calculations). A figure equal to up to 0.93 % of the 45,000 GWh Renewable Energy Target;
- Displacement of greenhouse gas emissions by approximately 372,519 tonnes of CO_2-e per annum, the equivalent of taking 93,130 cars off the roads (based on conservative calculations);
- Provision of local jobs, a Community Fund to benefit the local area in the vicinity of the Project and the injection of up to $151 million into the Australian economy; and
- Improved security of electricity supply through diversification.

The Proponent is committed to ensuring the measures proposed in developing the Project are best practice, and that they maintain the high standard set in all regions within which Wind Prospect CWP operate.

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CHAPTER 22

Acronyms and Glossary

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22. ACRONYMS AND GLOSSARY

Acronyms

AsA	Airservices Australia
AAAA	Aerial Agricultural Association of Australia
ABS	Australian Bureau of Statistics
ACMA	Australian Communications and Media Authority
AEMO	Australian Electricity Market Operator
AGL	Above ground level
AGO	Australian Greenhouse Office
AIS	Aeronautical Information Service
ALC	Aboriginal Land Claim
AM	Amplitude Modulated
APZ	Asset Protection Zone
ARG	Australian Research Group Pty Ltd
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ASB	Aviation Support Branch
AusWEA	Australian Wind Energy Association
Auswind	Australia Wind Energy Association
BFCC	Bushfire Coordinating Committee
BGW	Box-Gum Woodland
BioBanking	Biodiversity Banking
BoM	Bureau of Meteorology
BWEA	British Wind Energy Association
CAAP	Civil Aviation Advisory Publication
CAP	Catchment Action Plan
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations
CCC	Community Consultative Committee
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CINA	Connection Investigation Network Agreement
CMA	Catchment Management Authority
CMA Act	Catchment Management Authority Act 2003
CO2	Carbon dioxide
CO2 -e	Carbon dioxide equivalent
COAG	Council of Australian Governments
COP2	Conference of the Parties
CPRS	Carbon Pollution Reduction Scheme
CRZ	Core riparian zone
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Development Application
DACR	Defence (Area Control) Regulations
DCC	Department of Climate Change
DCCEE	Department of Climate Change and Energy Efficiency
DCP	Development Control Plan

DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DEWHA	Department of the Environment, Water, Heritage and the Arts
DGR's	Director General's Requirements
DIT	Department of Infrastructure and Technology
DLWC	Department of Land and Water Conservation
DoD	Department of Defence
DoL	Department of Lands
DoP	Department of Planning
DPC	Department of Premier and Cabinet
DPI	Department of Primary Industries
DoPI	Department of Planning and Infrastructure
EA	Environmental Assessment
ECO	Emergency Control Organisation
ECRTN	Environmental Criteria for Road Traffic Noise
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
ELF	Extremely Low Frequency
EMFs	Electric and magnetic fields
EMI	Electromagnetic Interference
EMP	Environmental Management Plan
EP&A Act	Environmental Planning and Assessment Act, 1979
EPA	Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation Act, 1999
eRET	Enhanced Renewable Energy Target
ESD	Ecologically Sustainable Development
EU	European Union
FM	Frequency Modulated
GWEC	Global Wind Energy Council
HF	High Frequency
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IGACC	Interim Guidelines for Aboriginal Community Consultation
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
L_{Aeq}	A-weighted equivalent noise level measured in decibels
LCA	Life Cycle Assessment/Landscape Character Areas
LEP	Local Environmental Plan
LGA	Local Government Area
LOS	Line of Sight
LPMA	Land and Property Management Authority
LSALT	Lowest Safe Altitude
LRET	Large-scale Renewable Energy Target

LVIA	Landscape and Visual Impact Assessment
MIC	Maximum instantaneous charge
MRET	Mandatory Renewable Energy Target
NEM	National Electricity Market
NES	National Environmental Significance
NER	National Electricity Rules
NGA	National Greenhouse Accounts
NHMRC	National Health and Medical Research Council
NOW	NSW Office of Water
NPS	NSW Police Service
NPW Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NW	Noxious Weeds Act 1993
OEMP	Operational Environmental Management Plan
OLS	Obstacle Limitation Surface
PANS OPS	Procedures for Air Navigation Services
PEA	Preliminary Environmental Assessment
PFM	Planning Focus Meeting
PM10	Particles effectively less than 10µm diameter
POEO Act	Protection of the Environment Operations Act 1997
PSPD	Power System Planning and Development
RAAF	Royal Australian Air Force
RBL	Rating background level
REC	Renewable Energy Certificates
REF	Review of Environmental Factors
RET	Renewable Energy Target
RFS	Rural Fire Service
RMS	Roads and Maritime Services
RoTAP	Rare or Threatened Australian Plant
RTA	Roads and Traffic Authority (NSW)
SA EPA	South Australian Environmental Protection Authority
SCADA	Supervisory Control and Data Acquisition
SEPP	State Environmental Planning Policy
SES	State Emergency Service
SoC	Statement of Commitments
SoE	State of the Environment Report
SRES	Small-scale Renewable Energy Scheme
TS	Trigonometrical Stations
TSC Act	Threatened Species Conservation Act
TV	Television
UHF	Ultra high frequency
UNEP	United Nations Environment Programme

UNFCCC	United Nations Framework Convention on Climate Change
VAC	Visual Absorption Capability
VFR	Visual Flight Rules
VHF	Very High Frequency
WBZ	Water Bearing Zones
WHO	World Health Organisation
WM Act	Water Management Act 2000
WMO	World Meteorological Organisation
WoNS	Weed of National Significance
WSP	Water Sharing Plan
WTG	Wind Turbine Generator
ZVI	Zone of Visual Influence

Units

°	degree
°C	degree Celsius
dBA	decibels (A range)
GWh	gigawatt hour
H	hour
ha	hectare
Hz	hertz
kg	kilogram
km	kilometre
kph	kilometres per hour
kV	kilovolt
kV/m	kilovolts per metre
kW	kilowatt
L	litre
L_{Aeq}	Amenity Criterion
m	metre
m^2	square metres
m^3	cubic metres
mG	milligauss
mm	millimetre
m^3/h	cubic metres per hour
mHz	mega hertz
ML	mega litre
m/s	metre per second
MVA	megavolt Ampere
MW	megawatt
MWh	megawatt hours
MWh/y	megawatt hours per year
rpm	revolutions per minute
y	year
µT	microTesla

Glossary

Ambient noise	The all-encompassing noise associated with a given environment. It is the composite of sounds from many sources, both near and far.
Artefact locale	The exact location of where the artefact was found within the Project site.
Asset Protection Zone	Is land cleared of vegetation, designed to protect assets (houses, buildings, etc.) from potential bushfire damage.
Biodiversity	First coined in 1998 as a contraction of biological diversity; diversity traditionally referring to species richness and species abundance. Biodiversity has been defined subsequently as encompassing biological variety at a genetic, species and ecosystem scales (DASETT 1992). The maintenance of biodiversity, at all levels, is acknowledged internationally as a high conservation priority, and is protected by the International Convention of Biological Diversity 1992.
Biodiversity Banking	The Biodiversity Banking and Offset Scheme (Biobanking) has been established by the NSW DECC to help address loss of biodiversity and threatened species.
Bund	An earthwork or wall to contain and control spillages, normally associated with fuelling and chemical storage facilities.
Buried earth grid	Refers to physically connecting a part of an electrical system to the ground, carried out as a safety measure, be means of a conductor embedded in the earth.
Capacity factor	Factor used to account for variation in wind speeds at the site and minor electrical losses when determining the electricity output of a wind farm compared to its installed capacity.
Clusters	A group of wind turbines which are likely to be constructed and commissioned in one stage.
Conditions of Approval	Conditions of Development Consent provided by the relevant State and Federal approval authority.
Construction Environmental Management Plan	An element of an Environmental Management Plan that addresses the control, training and monitoring measures to be implemented during the construction phase of a project in order to avoid, minimise or ameliorate potentially adverse impacts identified during environmental assessments.
Crown Land	Land that is owned and managed by State Government. Crown land accounts for over half of all land in NSW and includes Crown lands held under lease, licence or permit, community managed reserves, lands retained in public ownership for environmental or travelling stock route purposes, land within the Crown public roads network, and other unallocated lands.

Cumulative Impact	Refers to the accumulation of impacts at a locality from a range of developments of similar or different type over time.
dBA	The noise level in decibels, obtained using the 'A' weighted network of a noise level meter as specified in Australian Standards AS 1259-1990 Noise Level Meters. The 'A' weighting is designed to adjust the noise level (very approximately) in line with human hearing.
Study Area	200 m wide corridor in which the turbine footprint, roads and reticulation will be contained.
Development Consent	Issued by the relevant State and Federal authority including a date of endorsement, a date of expiration and a list of Conditions of Approval that must be adhered to while building the Project.
Development Footprint	The impact area from all proposed infrastructure related to the Project.
Ecologically Sustainable Development	Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future can be increased. Incorporates four key principles: the precautionary principle; inter-generational equity; conservation of biological diversity and ecological integrity; improved valuation and pricing of environmental resources.
Effective Survey Coverage	A percentage estimate of the proportion of the Survey Unit which provided the potential to view archaeological material.
Endangered Ecological Community	A community listed under Schedule 1, Part 3 of the NSW *Threatened Species Conservation Act 1995*.
Environment	The physical, biological, cultural, economic and social characteristics of an area, region or site.
Environmental Assessment	For a development that constitutes a Major Project under the State Environmental Planning Policy - Major Project, prepared pursuant to the *Environmental Planning and Assessment Act 1979*.
Environmental Management Plan	The control, training and monitoring measures to be implemented during the design, construction and operation phases of a project in order to avoid, minimise or ameliorate potentially adverse impacts, identified during environmental (being socio-economic, cultural, physical, biological) assessments.

Fauna	Animals
Flora	Plants
Fresnel Zone	In optics and radio communications the Fresnel zone is an elliptical region surrounding the line of sight path between transmitting and receiver antennas which must be obstruction free for a microwave radio link to work without interference.
Geotechnical	Relating to the form, arrangement and structure of the geology.
Grid	With reference to electricity, the electrical transmission and distribution network.
Groundwater	All water which is below the surface of the ground in the saturation zone and in direct contact with the ground of the soil.
Hydrology	Surface water and groundwater and their interaction with earth materials.
Indigenous objects and sites	A place where physical remains or modification of the natural environment indicate the past and 'traditional' activities by Aboriginal people. Site types include artefact scatters, isolated artefacts, burials, shell middens, scarred trees, quarries and contact sites.
Installed capacity	The maximum electrical output of wind turbines installed in a wind farm.
LA_{eq}	The average noise level over the sample period.
Locality	Area encompassing all lands within a 10 km radius around the Project site.
Monitoring	The checking of impacts of a proposal or an existing activity in order to improve or evaluate environmental management practices; To check the efficiency and effectiveness of the environmental impact assessment process; To determine if the requirements of environmental legislation and associated regulations are being met.
Operational Environmental Management Plan	An element of an Environmental Management Plan that addresses the control, training and monitoring measures to be implemented during the operational phase of a project in order to avoid, minimise or ameliorate potentially adverse impacts identified during environmental assessments.
Peak Demand	The greatest demand for electricity in a stated period of time, such as the greatest demand during a week or a year.

Photomontages	A composite image combining two or more photographs.
Precautionary Principle	The precautionary principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Procedures for Air Navigation Services	Allows aircraft to conduct an instrument approach to airports in poor weather conditions, by using a published Instrument Approach and Departure Procedures which apply varying minimum altitude requirements above terrain.
Project Site	Land within the cadastre boundaries of all properties likely to be directly impacted by the proposal.
Proponent	In relation to an activity, means the person proposing to carry out the activity.
Ramsar	Australia is contracting party to the Ramsar Convention on wetlands. This obliges us to designate and protect wetlands of international significance.
Riparian	Relating to the banks of a natural course of water.
Risk	Likelihood of a specific undesirable event occurring within a specified period or in specified circumstances. Listed as a frequency or probability.
Risk Assessment	A process used to determine whether people and the environment are at risk (e.g. health and safety) from exposure to hazardous substances used or produced (mainly in an industrial or work place) so that appropriate control measures or management practices can be introduced to prevent or minimise the risk.
Rotor	The assembly of blades and hub that is used to intercept the wind, producing rotational energy.
SCADA	Supervisory Control and Data Acquisition system. The term implies that there are two activities that are necessary: The acquisition of data (from a wind farm) and subsequent transfer to some central location, and the control of some process or equipment from this central location.
Statement of Commitments	A summary document detailing the Proponent's general management measures in relation to the Project to minimise and, where practicable, avoid impacts. The Statement of Commitments is to be used to inform Development Consent Conditions of Approval.

Soil profile	A vertical section of soil, which allows for the examination of soil structure.
Survey Unit	Area defined according to landform morphological type for cultural heritage field surveys.
Topsoil	The upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
Transformer	A device consisting of two or more insulated coils of wire wound around a magnetic material such as iron, used to convert one AC voltage to another or to electrically isolate the individual circuits. Usually used to increase generation voltage to transmission voltage.
Visibility	Measure of extent to which particular aspects of a development may be visible from surrounding areas.
Visual Catchment	The area from which the proposed wind farm would be potentially visible.
Weed	Naturalised, non-indigenous plant species which may be noxious weeds (or agriculture), environmental weeds or any other generally undesirable introduced species.
Wetlands	Areas largely inundated with water, yet offering elevated land as a habitat for wildlife, notably waterfowl. Can be landlocked.
Wind	The movement of air, caused by heating of the atmosphere, land and sea. Usually measured as metres per second, knots or kilometres per hour.
Wind Monitoring Mast	A guyed, narrow lattice or tubular steel design mast, in this case up to 100 m in height, with anemometers and wind vanes attached at different heights on the mast, to monitor and record the wind's characteristics.
Wind Turbine Generator	Electrical generators rotated by the movement of wind over blades that feed power into the mains electricity grid.

CHAPTER 23

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