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APP Corporation

Traffic and Transport

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10.Traffic and Transport

A Traffic and Transport Assessment was completed by AECOM Australia Pty Ltd (AECOM) as part of the EA for the Proposal; this is presented in **Appendix I**. The assessment was undertaken in accordance with the NSW RTA Guide to Traffic Generating Developments and the DGRs. The assessment evaluated the traffic impact during construction and operation of the facilities in relation to traffic flows, road limitations and capacities, access and safety.

The traffic and transport assessment considered the requirements of a 68-turbine layout, which was the worst potential impact scenario before the noise assessment concluded the number of WTGs from the range of models being considered would need to be a maximum of 68 for the Proposal to comply with the relevant operational noise limits. The EA proposes a maximum of 68 WTGs.

10.1. Existing Environment

The Hume Highway is a major link connecting Sydney with Melbourne and is a vital link for road freight to transport goods to and from the two cities. The Hume Highway is a four lane, two-way, divided carriageway which intersects with Lerida Road South (a main local road) to the north of the proposed site. It is signed at 110km/h.

Lerida Road South provides a direct link through the project site between the Hume Highway and Collector Road, running north-south. Lerida Road South is currently an unsealed road and is signed at 100km/h. There are other short sections of crown road that run off Lerida Road South that would provide access to the WTG sites. The following roads will be used by the Proposal for the transport of large wind turbine components from Port Kembla, the nearest port, which has been assumed to be shipment point for these components:

- Picton Road – a two-lane, two-way undivided sub-arterial road which functions as the main east-west connection between the Hume Highway and the Princess Highway. It is signed at 90km/h; and
- Southern Freeway / Mount Ousley Road – the Southern Freeway/ Mount Ousley Road serves as a vital link for road freight to transport goods to and from Port Kembla. The road is signed at 80-100km/h.

Of the above, the Hume Highway south of Illawarra Highway carries the largest volume of traffic with 20,846 vehicles per day (vpd) (RTA 2007). The Hume Highway west of Federal Highway and Picton Road west of Princes Highway have significantly less traffic with 7,431 vpd (RTA 2007) and 13,639 vpd (RTA 2005) respectively.

The RTA Crash database contains accident records for the period from 2005 to 2009. These include:

- on the section of the Hume Highway from Goulburn to Gunning, there have been 256 crashes over the five-year period, with eight casualties and 95 injuries. Of the total crashes, 72% involved cars and 31% involved heavy trucks. Speeding (31%) and fatigue (21%) were listed as the main contributing factors for crashes; and

- in the vicinity of the proposed site access (Hume Highway / Lerida Road South intersection), there have been a total of seven crashes resulting in two injuries and four casualties. The crashes mainly involved a vehicle going off the road on a curve and hitting an object on the side.

10.2. Impact Assessment – Construction and Decommissioning

The transport of materials and equipment to the site during the construction phase would involve a temporary increase in the local traffic volume and the transport of oversize loads.

The proposed truck route from Port Kembla is along the Princes Highway, Picton Road, Hume Highway and Lerida Road South (**Figure 13**).

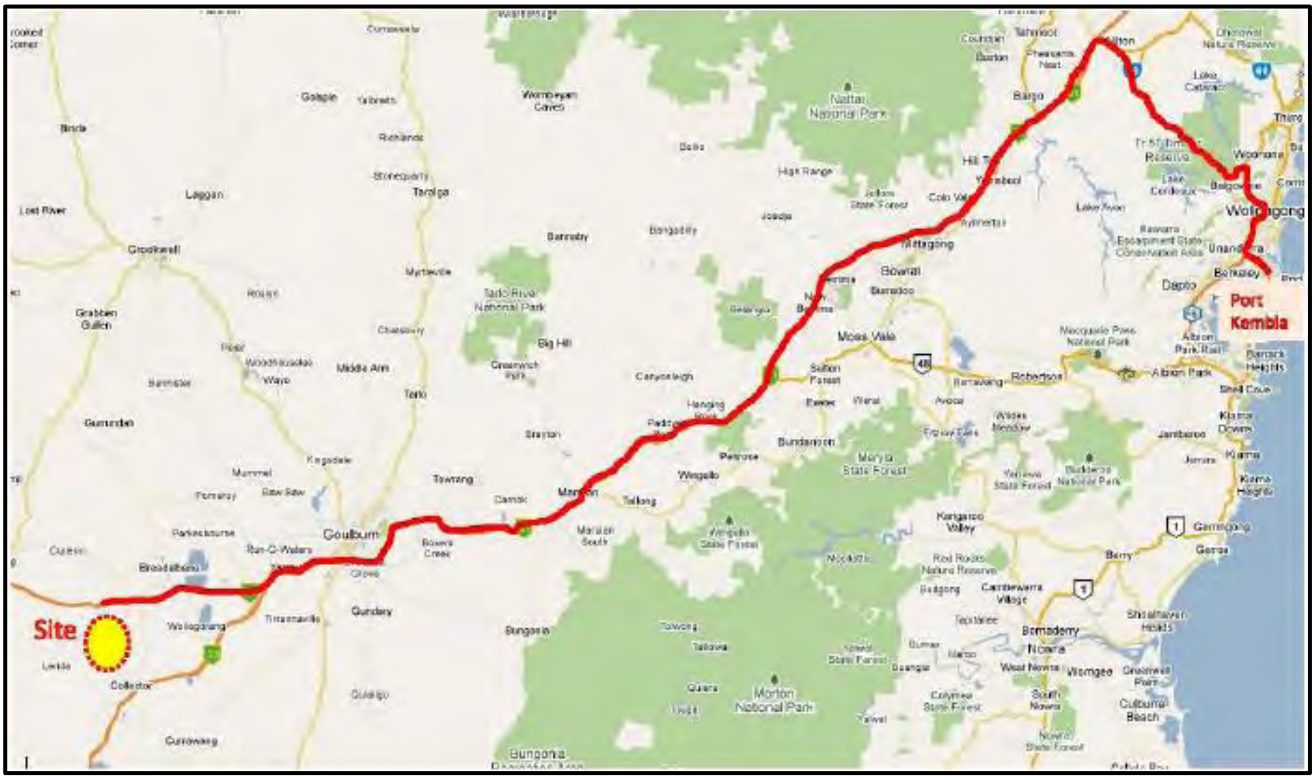

Figure 13 Proposed truck route from Port Kembla to the project site

The turbine components would include the tower sections, nacelles, blades, turbines, kiosk transformers, steel reinforcing (for the foundations), and substation components.

The towers will be delivered in three sections (approximately 30m in length each) transported on extended articulated trucks. A heavy-duty articulated truck could deliver the generators and nacelle assemblies. A-double trucks (total length 36.2m) may be suitable. Depending on the model selected, the turbine blades can reach up to 56m in length and would be transported on an oversize vehicle. The blades will be unloaded at the individual turbine sites.

The traffic impact will be concentrated at the entry point to the project site from the Hume Highway at Lerida Road South. The traffic impact of the trucks carrying large loads from Port Kembla to the site will be along the entire route, impacting traffic on the Southern Freeway/Mt Ousley Road, Picton Road and Hume Highway.

In terms of delivery of concrete requirements to the Proposal, the traffic and transport assessment considered two scenarios:

- use of an on-site concrete batching plant with aggregate and other requirements sourced locally; and
- concrete mixer trucks from batching plants outside the project site.

For the second scenario, in terms of the volume of concrete required for the Project, the best case (based on the use of rock anchor footings) would be 100m^3 per WTG. However, a worst case scenario (based on the use of gravity footings) has been used for this assessment, which would involve pouring up to 450m^3 of concrete per WTG foundation. This equates to 31,000m^3 and, as a conservative estimate, is considered enough to cover the concrete required for all the infrastructure (substation compound, building slabs and turbine footings included). This equates to approximately 3,880 concrete mixing trucks for the 68 turbines as outlined in **Table 26**.

Table 26 Construction Vehicles Visiting Site

Material	Number of Construction Trucks	
	Scenario 1 (concrete batching plant on site)	**Scenario 2 (no concrete batching plant)**
Tower sections	207	207
Nacelles	68	68
Blades	207	207
Hubs/cables/controllers	68	68
Steel reinforcing	68	68
Concrete mixer trucks	-	3,880
Sand and aggregate	1,311	-
Cement	173	-
Water tankers	242	242*
TOTAL	2,347`	4,743

** Worst case scenario*

To assess the potential impacts for a worst case scenario, it has been assumed that approximately 4,743 trucks are required, with most of the trip generation occurring during an 18-month period within the construction phase. If 68 turbines are constructed over this period, and assuming approximately 300 working days per year, there would be approximately 11 trucks accessing the site per day, or 22 truck movements per

day on average. However, during concrete pours for turbine foundations, where a continuous delivery of mixed concrete is required, there will be peaks in site deliveries of batched concrete. For a gravity footing which requires an excavation of 450m^3, the concrete requirement (assuming a volume of 8m^3 per delivery) would translate to approximately 56 trucks, equating to 112 truck movements per day.

With regard to employee-generated traffic, the construction workforce is expected to peak at 120 employees. Construction workers, either local or transient with, will commute daily to the site most probably from accommodations in the Goulburn area.

While the Proposal may provide shuttle buses for Goulburn-based workers, a worst case scenario has been assumed where workers would travel by private vehicles to the site. Based on the commute to work statistics from the *Household Travel Survey* (NSW Transport, 2010), a vehicle occupancy rate of 1.1 people per vehicle is appropriate. This would therefore generate 110 vehicles to and from the site. Therefore, a worst-case (or peak) scenario of a daily total of 166 vehicles (56 concrete mixer trucks and 110 staff vehicles) (322 movements) would be accessing the site during the construction phase.

10.3. Impact of Generated Traffic

The impact of the vehicle traffic generated by the Proposal has been assessed along the proposed truck and worker commuter routes:

- Hume Highway;
- Lerida Road South;
- Picton Road; and
- Southern Freeway / Mount Ousley Road.

Trucks bringing materials to the project site would most likely originate from the area east of the site. Large turbine materials would most likely be shipped to Port Kembla and trucked to the site. Concrete mixer trucks would most likely be coming from Goulburn (if an on-site batching plant is not established). With employee traffic assumed to be completely coming from Goulburn, all traffic accessing the site would travel along the Hume Highway and turn left into the site at Lerida Road South. Exiting traffic would return along the same route.

Outside of Lerida Road South, the entire truck and workforce vehicle route consists of four-lane, two-way roads on most of the sections, except for the 27km long Picton Road section from Southern Freeway / Mount Ousley Road to Hume Highway which is two-lane, two-way road with frequent overtaking lanes in either direction.

10.3.1. Hume Highway

The truck and vehicle traffic generated by the construction of the Proposal will result in an increase in the average daily traffic volumes on the surrounding road network over the construction period. The combined generated daily traffic movement of 332 vehicle movements is approximately 4.4% of the total daily volume on Hume Highway, which averages around 7,500 vehicle movements per day on that part of the highway west of

the Federal Highway. It is considered that the Hume Highway will be able to absorb this increase in traffic during the construction phase without any significant impact on its capacity.

There are two lanes in each direction on the Hume Highway at the Hume Highway/Lerida Road South intersection, with sufficient space to manoeuvre for normal goods vehicles. However, the intersection would not be able to accommodate the turning movement of the oversize trucks carrying large wind turbine components.

The Lerida Road South entry and exit would require upgrading to accommodate the oversize vehicles during the construction phase. It would need to have traffic control in place for the safety of the traffic as the marked speed on the Hume Highway is 110km/h. Adequate signage would need to be displayed to inform motorists approaching the intersection of turning construction traffic. The required traffic signage would form part of a Traffic Control Plan for the construction phase of works. This is governed by Australian Standard AS 1742.3 – 2009.

10.3.2. Lerida Road South

Construction traffic will result in a significant increase of traffic volume on Lerida Road South. This could increase the risk of accidents with vehicles and stock. Therefore, lower speed limits would need to be enforced on the roads at all times during construction. Review of the AUSTROADS *Guidelines for Single Carriageway Rural Road Width* identified that Lerida Road South will require upgrading to unsealed road class U1 (refer to Table 3 in **Appendix H**). For the construction phase, access roads/tracks would need to be up to 10m wide to allow access for larger equipment (e.g. mobile cranes).

The impact of the additional traffic on the Level of Service (LOS) of the Lerida Road South/Hume Highway intersection is expected to be minimal. However, there will be increased safety risks due to large construction vehicles turning to and from the Hume Highway at the intersection. Therefore, traffic control will be implemented at the Lerida Road South entry and exit during the construction phase.

10.3.3. Picton Road

The transport of large turbines and materials from Port Kembla on over dimensioned (OD) vehicles along Picton Road is expected to generate approximately 550 trucks (those carrying the tower sections, nacelles, blades and hubs/cables/controllers) over the course of the construction stage – approximately one vehicle per day. It is noted that only one OD truck is planned to arrive at site at any one time. Therefore, the OD trucks are not expected to have a significant impact on operations along Picton Road. The OD vehicles would be escorted by pilot vehicles and scheduled to travel at off-peak periods to affect the least amount of vehicles as possible.

10.3.4. Southern Freeway / Mount Ousley Road

As with Picton Road, the truck traffic from Port Kembla on the Southern Freeway and Mount Ousley Road is expected to generate no more than one truck per day. Therefore, the trucks are not expected to have a

significant impact on operations along Mount Ousley Road. The OD vehicles would be escorted by pilot vehicles and scheduled at off-peak hours to impact the least amount of vehicles as possible.

10.3.5. Long Vehicles at Intersections

Swept paths of recognised wind turbine component transporter vehicles (the Volvo FH16 8x4 + Broshuis Blade Trailer and the Volvo FH16 8x4 + Nooteboom Tower Trailer) have been reviewed and the larger vehicle was tested at two key points along the truck route, namely the intersection of the Hume Highway with Picton Road and the intersection of Mount Ousley Road with Picton Road. These analyses of swept paths are shown in **Appendix H**.

Based on this indicative analysis, some pavement widening and possible relocation of roadside infrastructure would be required at the Mount Ousley Road intersection with Picton Road, and at the Hume Highway off-ramp joining Picton Road. Once more details are known about the exact vehicles, routing and dimensions of the turbine components to be selected, a more detailed swept path analysis would be undertaken along the truck route to ascertain the need for road works. Any required road intersection upgrade works will be the subject of an environmental assessment under Part 5 of the EP&A Act.

10.3.6. Access

Where possible, existing farm tracks and Crown roads would be used as internal roads to provide access to each WTG site. However, it is likely that these roads would require upgrading to handle the construction loads. Where existing roads/tracks are not available, access routes would be chosen based on engineering requirements, optimal access for construction and operation, and avoidance of native vegetation.

The construction of new roads and upgrade of existing roads or tracks will require the delivery to site of gravel pavement material. The extent of road works and the required quantity of material would depend on the condition of the existing roads and tracks. For purposes of the EA, conservative estimates of the extent of road construction and upgrades have been adopted as follows:

- 4,000 truckloads for the upgrade of about 19.5km combined length of sections of Lerida Road South and crown roads connecting to internal access roads;
- 6,000 truckloads for the construction or upgrade about 30km combined length of internal roads which will branch off from crown roads.

The above road works will be staged to avoid congestion especially along Lerida Road South. The upgrade of Lerida Road South and crown roads will be carried out over six months at the pre-construction phase as these road sections will not be affected by the outcomes of the detailed design of the Proposal. The internal roads, whose alignment will depend on the final turbine location as determined from micro-siting, will be constructed during the first 12 months of the construction phase.

The road upgrade works during the six months of the pre-construction phase will involve 27 trucks accessing the site per day. This would equate to 54 truck movements per day. This volume is roughly half that of the continuous concrete pour scenario described in **Section 10.2**, and hence the impacts would be less.

Trucks bringing gravel materials to the site would most likely come from sites originating to the east of the site. Based on the assumed volume of gravel requirements and the staging of road upgrade works and of concrete and gravel deliveries to avoid congestion on Lerida Road South, the number of vehicle movements would be less than the worst case scenario and therefore the potential impact on the operation along the external road network is unlikely to be significant.

10.3.7. Decommissioning

The nature of site traffic generated during the decommissioning phase and its potential traffic and transport impacts will be similar to the construction phase of the Proposal. It is expected that traffic volumes will comprise floats to and from site of construction plant and haulage of decommissioned WTG equipment and demolition materials for offsite disposal or storage.

10.3.8. Operation

The operation phase of the Proposal is not expected to generate significant volumes of traffic with approximately seven maintenance trips expected per week. These would normally comprise only service vehicles carrying personnel for the operation and maintenance of the facility.

The traffic generated during operation is expected to have a minor impact only on Lerida Road South, an insignificant impact on the Hume Highway and would likely not impact Picton Road or Mount Ousley Road, unless specific maintenance activities required movement of large components from Port Kembla or to offsite maintenance facilities. In such cases, the potential traffic and transport impact is still considered minimal based on the expected relatively infrequent maintenance episodes requiring movement of large WTG components.

The number of permanent staff on site is not expected to exceed 25 people, which even in a worst case scenario would generate 25 vehicles per day. The combination of the 25 staff trips and one daily maintenance trip is considered to result in minimal traffic generation with minimal impact on the road network. Therefore, no further measures would be required to manage this traffic.

10.4. Mitigation Measures – Construction and Decommissioning

The following management and mitigation measures will be implemented to reduce the impact of traffic generation during the construction and decommissioning phases of the Proposal on the local and wider road network:

- provision of traffic controllers on Hume Highway to help assist large trucks exiting the site from Lerida Road South and improve any safety risks. Advance warning signs would be placed on each approach, 200 metres from the access road with “Prepare to stop” warnings when traffic controllers are present;
- large oversize materials would be transported overnight to reduce impacts on road network (subject to RTA NSW approval);

- a relatively significant increase of traffic volume on Lerida Road South could increase the risk of accidents with vehicles and livestock. Therefore, lower speed limits would be enforced on Lerida Road South and internal access roads at all times during construction;
- no oversize or large trucks associated with the construction would operate on the Hume Highway during the school bus hours of 7:30am and 8:50am, and between 3:20pm and 4:30pm on school days;
- once more detail is known about the exact type of transport vehicles and routing, more detailed swept path analysis would be undertaken along the truck route;
- removal of cattle bridges on Lerida Road South and farm roads / crown roads during construction. The internal roads and turns in the site are required to be widened up to 10m in order to transport the construction materials and the large turbines to the desired location, and will require surfacing upgrade through grading;
- assessment of the condition of existing pavements to ascertain the need and extent of pavement upgrade or construction works required;
- the road and intersection conditions would be established by the use of field surveys and regular site inspections. When required, rehabilitation of the pavement and/or edges of seal, shoulders and verges would be carried out. At the completion of the works the access roads would be in the same or superior condition than at the commencement of the works;
- establishing procedures to monitor traffic impacts on public and internal access tracks during construction, including noise, dust and travel times, and to implement modified work methods to reduce such impacts where possible;
- regular road dilapidation surveys during construction;
- retention and handover of internal access roads to be used for agricultural production and fire fighting purposes after the decommissioning of the Proposal.

10.5. Mitigation Measures - Operation

A procedure will be established to ensure the ongoing maintenance of access roads during the operation phase.

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APP Corporation

Hazards and Risks

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11.Hazards and Risks

11.1. Aviation Impacts

An aeronautical assessment of the Proposal was undertaken by Rehbein Airport Consulting; this assessment is presented in **Appendix J.** The assessment considered the aviation activities in the vicinity of the project site and the requirements of aviation organisations, including the Civil Aviation Safety Authority (CASA), Department of Defence (DoD), Airservices Australia (AA) and the Aerial Agricultural Association of Australia (AAAA). The local community was also consulted in relation to current local aviation activities.

11.1.1. Existing Environment

Civil Aviation Safety Authority (CASA) Requirements

CASA is responsible for regulating civil aircraft operations, including operational safety in and around aerodromes and along air traffic routes. In relation to wind farms, CASA has two concerns:

- the penetration of wind turbines into the obstacle limitation surface (OLS) and the Procedures for Air Navigation Services (PANS-OPS) around an aerodrome; and
- the potential for wind farms to be a hazard to aviation operations.

The OLS is the airspace around an aerodrome, defined by an imaginary surface, which is maintained free of obstacles to permit the safe arrival of aircraft under a visual approach. Similarly the PANS-OPS surface is to safeguard an aircraft from collision with an obstacle when using an instrument approach. The OLS and PANS-OPS surfaces are relevant to the approach routes of aircraft within a certain distance of an aerodrome, generally up to 20km depending on the nature of operations. The closest commercial aerodromes to the project site are Goulburn (30km north-east) and Canberra (50km south-west). CASA provided correspondence (15 October 2010) to the Proponent advising that: "*The proposed location of the Collector Wind Farm is not expected to have an impact on operations at either Goulburn or Canberra Aerodromes as it is considered to be located sufficiently away from both aerodromes.*"

The potential impacts of wind farms to aviation operations beyond the vicinity of aerodromes relates to the height of turbines and their potential to be an obstacle. In July 2007, CASA released advice under the *Civil Aviation Safety Regulations* (CASR) - Advisory Circular AC 139-18(0) *Obstacle Marking and Lighting of Wind Farms* – to require obstacle lighting of wind farms on the basis that obstacles extending more than 110m above ground level can be hazardous to aircraft operations. The Circular was withdrawn in 2008 as it only applied to obstacles within the vicinity of an aerodrome (approximately 30km). CASA is currently undertaking a risk review of man-made objects located away from regulated aerodromes.

Revisions to AC 139-18(0) may incorporate a requirement to provide obstacle lighting for structures 150m or more above ground level, unless an aeronautical study can show that the structure will not be an obstacle. If put in place, such requirement would be relevant to the Proposal as the tallest WTG model being considered has a height of 150m. Should a shorter WTG model be selected, the Proponent would still consider obstacle lighting following the recommendation in the aeronautical risk assessment (**Appendix J**) that obstacle lighting

should be installed on sufficient turbines to define the extremities of the site to discharge duty of care obligations to aviation operators. Any installation of obstacle lighting would be in accordance with CASA's Manual of Standards Part 139 – Aerodromes, and be operated in a manner consistent with a general duty of care towards aviation, such as during the period 30 minutes before and after sunrise and sunset, and during conditions of reduced visibility caused by smoke, dust or haze.

Aircraft operating beyond the vicinity of aerodromes do so along transiting air routes using either visual flight rules (VFR) or instrument flight rules (IFR). VFR operations are only undertaken where visibility is acceptable, whereas IFR operations are undertaken where visibility is compromised, using cockpit instruments and navigation aids. Aircraft operating under VFR have few flight restrictions other than maintaining a minimum altitude of 500 feet (ft) above ground level and avoiding obstacles. As aircraft operating under IFR may have no outside visual reference when flying below 10,000ft they must follow a designated air route and observe the published lowest safe altitude (LSALT) for the particular route. The LSALT is determined by adding a 1,000ft clearance to the highest terrain or structure on the route.

Department of Defence

The Department of Defence (Defence) interest in wind farm projects relates to the safety of military aircraft operations and potential impacts on navigation aids and radars. Military pilots undertake flying training at low levels on routes designated as Military Low Jet Routes (MLJR), which are below 5,000 feet (1,524m) above ground level. These routes are carefully planned to avoid hazards.

Other Aviation Activities

There are two airstrips in the vicinity of the project site: Winderadeen (approximately 3km east) and Gundaroo (approximately 11km south). Both airstrips are uncertified, unregistered private aerodromes that are not regulated by CASA. Winderadeen airstrip, while marked on aviation charts at Canberra Airport, is permanently closed (R. Berry, *pers. comm*., 5 November 2010). Gundaroo is used by jet aircraft in private and business operations and by general aviation light aircraft.

The Aerial Agricultural Association of Australia (AAAA) is the industry association representing agricultural pilots conducting activities including crop spraying and fertiliser application. The AAAA's *Windfarm Policy* (2009) considers that wind farms are a direct threat to aviation safety, particularly to aerial application and it has adopted a policy of opposition to wind farm developments unless impacts on local operators are considered. The risks to operations include the wake effects of the wind turbine rotors.

In addition to aerial agricultural operations, other aviation activities that could occur in the vicinity of the subject site would include helicopter operations (e.g. emergency services, private operators) and fire fighting aircraft.

Radar & Radio Navigation Aids

Electromagnetic transmissions can be disrupted by tall structures, potentially causing reflection, deflection and/or interference with communication, navigation and surveillance systems used for air traffic management. These systems include aerodrome-based and en-route radio navigation aids and radar used for air traffic control (ATC).

The closest radar to the project site is the Canberra Terminal Area radar located at Mount Majura, approximately 30 km to the south-west of the project site. This sensor comprises primary radar and secondary surveillance radar (SSR). The closest radio navigation aid to the project site is the Goulburn non-directional beacon (NDB), 35km to the north-east.

11.1.2. Impact Assessment

CASA

The project site is located at a distance from Canberra and Goulburn airports sufficient (i.e. greater than 30km) not to impact on either the OLS or PANS-OPS surfaces. In terms of transiting air routes under VFR, the Proposal infrastructure will be clearly visible to air traffic operating in the area during daylight hours as VFR flights require a minimum flight visibility of 5,000m distance. As the project site is remote from aerodromes that are likely to be used for Night VFR operations, and the turbine structures will not exceed 150m, there is no requirement to install obstacle lighting.

In terms of IFR operations, the maximum turbine height at the project site will be approximately 3,400ft (1,036m) above mean sea level (AMSL), requiring a minimum flight altitude, or LSALT, of 4,400ft (1,341m) AMSL to ensure the wind farm is not an obstacle. The lowest published LSALT route that passes over or near the project site is at 4,600ft (1,402m) AMSL; hence the wind turbines will not be a flight obstacle.

Department of Defence

In correspondence dated 4 April 2012, Defence advised that it has assessed the proposal for impacts on its operations and concluded that "…*the Collector wind farm will not cause any unacceptable interference to Defence communications or airfield surveillance radar*". In relation to aircraft safety Defence noted that it considered it "…*more than prudent that the colour used for the wind turbines ensure that they are conspicuous to aircraft during daylight hours*".

Other Aviation Activities

Consultation with AAAA, undertaken by Rehbein Airport Consulting as part of its aeronautical assessment, suggested that aerial application operations would be impractical on properties in or near the project site. However, consultation with a local operator (David Todd, *pers. comm*. 14 January 2011) indicated that crop spraying has been ongoing within 1km of the Cullerin Range Wind Farm with few impacts to operations. On the contrary, the wind farm – being highly visible – was found to be a good indicator of when wind conditions would be unsuitable for aerial spraying. The operator also indicated that the main cause of turbulence in the locality was topography rather than the wind farm.

Aerial agricultural operations have not been undertaken at the project site for over 12 years and it is unlikely that these activities would recommence given the current agricultural regime, which is predominantly sheep grazing (Chris Clarke (Manager, Lerida Station) *pers. comm.*, 14 January 2011).

Helicopter operations in the vicinity of the wind farm would operate under similar rules to those for fixed-wing aircraft; hence, it is considered that there would be no significant impacts to these operations.

In terms of fire fighting operations the Victorian Country Fire Authority (2012) notes:

> *Fire suppression aircraft operate under "Visual Flight Rules". As such, fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan.*

The NSW Rural Fire Service has advised (via email dated 20 April 2012) that "…*the presence of wind turbines is unlikely to restrict…fire fighting operations. Rather we will adapt to the circumstances and may choose a method other than aerial water bombing if there would be difficulties flying close to the turbines*". Hence, it is considered that there would be no significant impact on aerial fire fighting operations arising from the Proposal.

Radar and Radio Navigation Aids

The 3,036ft (925m) elevation of the Mt Majura radar site ensures that the highest turbine at 3,583ft (1,092m) located approximately 20NM from the sensor will not penetrate the 0.5 degree radar protection surface originating from the base of the antenna. Shielding of primary radar returns from targets in Class C airspace is therefore considered unlikely. Given that there is overlap of SSR from the Mt Bobbara and Mt Majura sensors, it is expected that there would be no impact upon SSR in the vicinity of the project site. Also it is noted that since the lower level of controlled airspace is 6,500ft (1,981m) in the region of the project site, there would be no requirement to provide SSR coverage below this level because VFR aircraft operating in Class G airspace below 10,000ft (3,048m) are not required to carry and operate transponders.

The Goulburn airport non-directional beacon (NDB) and the Canberra airport NDB, VHF omnidirectional range (VOR), distance measuring equipment (DME) and Instrument Landing System (ILS) are not sufficiently close to the project site to be adversely effected by the proposal.

11.1.3. Mitigation Measures

When the project application is approved, the Proponent will provide CASA details of the location, extent and height of the wind turbines, along with construction start and completion dates. Similar details will be provided to the RAAF Aeronautical Information Service in accordance with Defence request.

11.2. Telecommunications Impacts

A telecommunications impact assessment report was prepared by Parsons Brinkerhoff (PB) to identify the potential impacts from the Proposal on existing telecommunications services and associated mitigation measures. The report is reproduced in **Appendix K**.

Telecommunication systems using radio waves are heavily used in Australia. Radio broadcast, mobile phones, television and fixed radio transmitters are common examples of systems that rely on radio communication. These systems generally use radio towers to help transmit and receive signals across a wide area.

Devices that generate, transmit or use electromagnetic energy can interfere with the normal transmission of radio signals used in other systems (EWEA, 2009). Wind turbines can potentially disrupt electromagnetic signals used in telecommunications, navigation and radar services. The degree and nature of the interference will depend on:

- the location of the wind turbine between receiver and transmitter;
- characteristics of the rotor blades;
- characteristics of the receiver;
- signal frequency; and
- the radio wave propagation in the local atmosphere.

Interference can be produced by three elements of a wind turbine: the tower, rotating blades and generator. The potential impacts of the Proposal on the different categories of radio communication services are considered in this section.

11.2.1. Point-to-point

A fixed link radio transmission is a point-to-point transmission path typically between two elevated topographical features. The transmission path may become compromised if a wind turbine is located within the line of sight between the sending and receiving antennae. Communication is only likely to be affected if a turbine is in the line-of-sight between the two sending and receiving antennae or within a zone surrounding the line-of-sight of these antennae.

The point-to-point communication links in the vicinity of the project site were identified and mapped to establish the line-of-sight paths. In order to ensure that no obstruction to transmission paths occurs, calculations of the exclusion zone of the point-to-point communications links in proximity to the Proposal were undertaken. Beyond these exclusion zones, the power of a scattered signal from a structure such as a wind farm would be small enough not to result in significant interference at the receiver.

11.2.2. Point-to-multipoint

A central location transmits to and receives from a number of independent locations. Television and radio broadcasting and reception, mobile phones (to the mobile phone mast) and land mobile systems fall under this category. The transmission path may become compromised if a turbine is located within a minimum exclusion zone from the base station radio tower. However, because of the nature of many uses of point-to-multipoint radio communication, the likelihood of a wind farm causing unacceptable impacts is considered to be generally low.

For example, for land mobile systems, a mobile receiver can generally receive an adequate signal by moving a short distance to an unobstructed area. However, there may be point-to-multipoint services with fixed receivers that could potentially be impacted.

11.2.3. Methodology

The following methodology was adopted by PB during the telecommunications impact assessment:

- Identification of any registered, licensed radio communication sites and services within 25km of the project site boundary;
- Investigation of sites and services within 5km of the project site boundary, determine near-field and obstruction exclusion zones using standard methods;
- assessment of the wind farm layout against the exclusion zones;
- identification of local commercial broadcasting stations and their location relative to the wind farm and assess potential shadow zones;
- for point-to-multipoint (including broadcast) services, determination of potential zones of signal shadowing; and
- establishing contact with any registered and licensed radio communication site (and service) clients within 5km of the project site boundary, notifying them of the Proposal and requesting their impact mitigation requests (if applicable).

The Australian Communications and Media Authority (ACMA) is the Australian government body that regulates the use of Australia's radio spectrum. They maintain a register of radio licenses, radio communication towers and radio services (RADCOM). The RADCOM database dated January 2010 was used to conduct the assessment. A search of the RADCOM database was conducted using a defined search area of 25km from the project site boundary. Forty-six sites were found within the defined search area.

A search of the analogue television broadcast stations in the area was completed. Based on ACMA information and the coverage patterns provided by the Australian Broadcast Corporation, the likely tower being used for transmission in the area would be the Telecom Tower on Black Mountain near Canberra.

11.2.4. Impact Assessment – Operation

The following discussion considers potential impacts during the operation phase of the Proposal. Impacts during the construction phase (for example, from crane operations) are considered to be negligible given the short duration of activities at any one location.

Point-to-Point

The assessment of point-to-point services identified communications paths licensed to Telstra, Vodafone and Optus. With the exception of two turbines which encroach on the Vodafone exclusion zones, no other proposed turbine sites would impinge on exclusion zones for these licensees.

Point-to-Multipoint

The likelihood of a wind farm causing unacceptable impacts to point-to-multipoint communications is considered to be generally low. For example, for land mobile systems a mobile receiver can generally get an adequate signal by moving a short distance to an unobstructed area. However, there may be point-to-multipoint services with fixed receivers that can be impacted, some of which may not be registered on the

ACMA database. An unregistered Cirrus Communications tower was identified during community consultation within close proximity to previously proposed wind turbine sites. As a result, several wind turbine sites were removed from the layout to minimise impacts on this facility.

AM and FM Radio Broadcasting

The impact to FM radio broadcasting reception is considered to be negligible and the impact to AM radio broadcasting is considered to be negligible beyond the boundary of the project site.

Mobile Radio

Mobile radio may be affected by interference from the Proposal. However, if this is the case, any problems can usually be rectified through a minor adjustment in the position of the receiver.

Digital and analogue television

Reflection of an analogue video signal can result in impact to analogue television services. The broadcast station for the local area, including Collector village, is situated on Black Mountain near Canberra. While the Proposal does not obstruct the broadcast station line of sight, there is the possibility that some local residences may be affected by reflection of the Black Mountain broadcast signal from the Proposal to their receiving antenna.

Residences close to the Proposal could potentially experience interference to their analogue television signals. Further modelling would need to be undertaken to determine the extent of that impact. Residences may also be located near the wind farm such that there is line of sight obstruction between the residence and the broadcast site.

11.2.5. Mitigation Measures

The Proposal layout has been adjusted through the re-location and removal of wind turbines during preparation of the EA to mitigate against potential telecommunications impacts. Once the final locations of wind turbines are determined, verification of the coordinates of the communications towers, the status of the services and requirements of the licensees would be undertaken. This process would verify the tower coordinates, determine if services are active or otherwise and confirm the requirements of the licence holders. The results of this process would allow micro-siting of individual turbines to minimise telecommunications interference.

At the commencement of operation, the Proponent shall offer to undertake a monitoring program of houses within 5km of the wind farm to determine any loss in television signal strength, if requested by the owners. If the source of interference can be reasonably attributed to the Proposal, the Proponent shall put in place mitigation measures at each of the affected receivers in consultation and agreement with the landowners.

Digital television signals are not degraded due to interference from wind turbines, therefore the most feasible mitigation option for analogue television impact is to convert an analogue television receiver to digital. The Australian government has declared analogue television will be phased completely out of service by the end of 2013 with service in many areas ceasing operation before that time. Given the likely construction schedule for

the Proposal, many television users will likely have converted to digital television before construction has completed.

11.3. Fire and Bushfire Impacts

11.3.1. Existing Environment

The bushfire danger period for the Upper Lachlan Shire Council is generally between the 1st of October and the 30th of April; this may vary subject to local conditions (ULSC, 2009a). Generally, the primary cause of bushfires is from camp fires; however, accidental fires can also be started from rural and farming activities, lightning strikes and arson. The elevated position of the project site may increase the frequency of lightning strikes. The existing level of bushfire protection for life and property on the project site is relatively high. This is due to the grazing of extensive areas of cleared land which acts to reduce fuel loads, and to the limited shrub and tree vegetation cover.

11.3.2. Impact Assessment – construction and decommissioning phases

During construction and decommissioning phases, an increased risk of fire could arise from the use of flammable materials and ignition sources (i.e. hot works) and the improper storage and handling of flammable substances.

11.3.3. Impact Assessment – Operation

Substations, ancillary infrastructure, wind turbines and transmission lines all have the potential to start or influence the spread of fire onsite due to the presence of electrical equipment and associated petrochemicals. Operation of the wind turbines at ambient temperatures outside of the safe operating range or overheating of the components could potentially initiate a fire.

According to an expert witness statement to the Stockyard Hill Wind Farm Planning Panel hearing in Victoria (White, 2010), the potential for fires occurring in wind turbines or fire caused by the operation of a wind farm was considered extremely low due to the following factors:

- wind farms do not store or use combustible fuels (i.e. coal, diesel, petrol and natural gas) on site;
- turbines are manufactured with high quality mechanical and electrical components which rarely cause fires;
- all electrical components are appropriately insulated, grounded and protected;
- all of the turbine electrical wiring and most of the switch gear is in the steel tower which provides protection to the surrounding environment;
- electrical protection equipment cut-off power to the turbine if any electrical faults occur;
- the wind farm monitoring system monitors component temperatures and shuts down turbines when threshold temperatures of critical components are reached;
- there is limited vegetation around the base of each turbine;
- the electrical reticulation system on the wind farm is underground;
- access tracks act as firebreaks and provide fire fighting access; and
- lightning protection systems are installed on every wind turbine.

This conclusion is supported by the Victorian Country Fire Authority (CFA, 2007) state that: "*While there cannot be any guarantee that an installation involved in electricity generation can never malfunction and cause a fire, the potential for fire in wind turbines is inherently low.*"

According to research undertaken by Garrad Hassan (GH), there are currently more than 150,000 wind turbines in operation worldwide (White, 2010). **Table 27** shows the growth in wind turbine numbers since 1995 and compares the annual wind turbine operational days to the number of reported fires.

Table 27 Fire incidents for WTGs worldwide

Year	Number of reported WTG fires	Number of WTG installed	WTG operational days	Operational days between WTG fires
1995	1	30,000	10,402,500	10,402,500
1996	0	32,000	11,315,000	11,315,000
1997	1	34,500	12,136,250	12,136,250
1998	1	38,500	13,322,500	13,322,500
1999	3	43,547	14,973,578	4,991,193
2000	4	49,238	16,933,263	4,233,316
2001	1	55,960	19,198,635	19,198,635
2002	24	61,496	21,435,720	893,155
2003	19	67,668	23,572,430	1,240,654
2004	16	74,416	25,930,330	1,620,646
2005	15	83,148	28,755,430	1,917,029
2006	12	94,275	32,379,688	2,688,308
2007	20	108,338	36,976,873	1,848,844
2008	16	128,211	43,170,193	2,688,137
2009	10	152,000	51,138,508	5,113,851
Totals/Average	**143**		**361,640,905**	**2,528,957**

Source: White (2010)

This comparison shows that wind turbine fires worldwide are a rare event. In the year 2009 for example there were approximately 5,000,000 operational days between turbine fires. With 152,000 turbines in operation this equates to an average one turbine fire in approximately 14,000 years. It should also be noted that the period between fires is increasing over time reflecting technological advances in wind turbine technology.

In Australia, there are currently approximately 1,000 commercial sized wind turbines in operation. Of these, fires have occurred in three wind turbines, one each at Lake Bonney, Cathedral Rocks and Starfish Hill wind farms. These fires were the result of a mechanical fault specific to the particular wind turbines used. The fires were managed by allowing it to burn out under observation from fire authorities and did not cause any fires in areas adjacent to the wind turbine.

11.3.4. Mitigation Measures

The NSW Rural Fire Service (RFS) was consulted in regard to its requirements during the construction, operation and decommissioning phases of the Proposal. Nika Fomin (pers. comm. 10 February, 2011) provided the following advice:

- RFS do not have any particular requirements specific to wind farms;
- the measures detailed in the Planning for Bushfire Guidelines should be followed; and
- RFS suggest a managed area around each WTG rather than requiring an Asset Protection Zone (APZ).

RFS further advised (via email dated 30 April 2012) that:

> *…response to a fire will be dependent on the incident and the officer in charge will determine the most appropriate strategy to deal with it. This is the same as* [RFS] *would approach a fire in any other structure such as transmission lines, power poles, telecommunication towers, houses, sheds or workshops*.

Bushfire impact during the construction phase would be managed in accordance with a Bushfire Risk Management Plan, which would be prepared in consultation with the RFS and NSW Fire Brigade. The following specific mitigation measures will be implemented:

- induction of construction personnel on bushfire risk management and other fire risks that could be present at the project site;
- on total fire ban days, restrictions would be placed on certain activities with the potential to cause fires; and
- 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.

The RFS will be provided with the final wind turbine locations, ancillary infrastructure, construction work schedule and locations of additional water supplies for construction, potential landing pads for fire fighting aircrafts and helicopters and access gates for fire fighting services.

Dedicated monitoring systems (e.g. SCADA) enable wind 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 create a fire. Wind turbines will be shut down if directed by the RFS in the event of nearby wildfire.

The substation would be surrounded by a gravel and concrete area free of vegetation to prevent the spread of fire from the substation and to reduce the impact of any bushfire on the structure. An Asset Protection Zone (APZ) would be maintained around the control room and substation buildings, compliant with the *Planning for Bushfire Protection* guidelines (RFS, 2006).

Wind turbines are occasionally struck by lightning; however each turbine is fitted with lightning arresters to protect the turbine blades, nacelle and tower assembly. Lightning conductors installed in the blades minimise the potential for lightning to cause a fire by transferring the high voltages and currents to the ground.

11.4. Health and Safety

There are a number of potential health and safety hazards associated with the operation of wind farms. These include operational noise, electromagnetic fields and shadow flicker. These matters are discussed in the following sections.

11.4.1. Wind Farm Noise and Health

Background

Concerns have been expressed by members of the Collector community over the potential impacts of wind turbine noise on human health. Similar concerns have been raised elsewhere in Australia in relation to wind farms, particularly in Victoria.

Much of the concern regarding potential health impacts from wind farm noise appears to relate to low frequency noise emissions. Low frequency noise is generally defined to mean noise in the range of 10-200 hertz (Hz), with noise levels at frequencies below 20Hz often referred to as infrasound. The range of human hearing is 20-20,000Hz (BWEA, 2005). Low frequency noise is part of the environment, with man-made sources including machinery and traffic, and natural sources including wind, sea and thunder. Older wind turbine designs, with the rotor assembly situated downwind from the tower, caused problems with low frequency noise generation. This issue has now been rectified by the wind industry with modern turbines designed with the rotor assembly upwind of the tower.

The South Australian EPA Noise Guidelines (SA EPA, 2003) note that:

> *Infrasound was a characteristic of some wind turbine models that has been attributed to early designs in which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower.*
>
> *Modern designs generally have the blades upwind of the tower. Wind conditions around the blades and improved blade design minimise the generation of the effect. The EPA has completed an extensive literature search but is not aware of infrasound being present at any modern wind farm site.*

Similarly, the *Draft NSW Planning Guidelines* (DoPI, 2011) note that *"Analysis of wind turbine spectra shows that low frequency noise is typically not a significant feature of modern wind turbine noise and is generally less than that of other industrial and environmental sources."*

When considering noise measurements from sound level meters, weighting networks are applied to measured sound pressure levels to adjust for certain characteristics. The A-weighting network (dBA) is the most common, and is applied to simulate the human response to sound in the most common frequency range. The G-weighting (dBG) network is used to determine the human perception and annoyance due to noise that lies within the infrasound frequency range. Sonus (2010a), in a review of the literature on environmental noise from wind farms, noted the following in relation to infrasound:

- the generation of infrasound was detected in wind turbine designs with the blade downwind of the tower structure. Modern turbines, with the blade situated upwind of the tower, produce much lower levels of infrasound;
- the threshold of perception for infrasound in humans is 85dB(G) or greater. Human perception of infrasound below the hearing threshold, as vibrations in the body, is not possible and only occurs at noise levels well above the hearing threshold;
- measurement of infrasound from modern wind turbines indicates that noise levels are 25dB below the hearing threshold of 85dB(G) at a distance of 200m.

The Queensland Department of Environment and Resource Management (DERM, 2004) draft guideline for the assessment of low frequency noise adopts 85 dB(G) as the acceptable level of infrasound from a noise source to protect against the potential for annoyance. Sonus (2010b) measured infrasound levels near the Clements Gap (South Australia) and Cape Bridgewater (Victoria) wind farms and compared these with the DERM guideline and existing sources of infrasound including the beach, power stations and the Adelaide CBD. The results of these measurements are summarised in **Table 28**.

The theoretical reduction in noise level from a noise source is 6dB for every doubling of the distance from that source due to the "hemispherical spreading" of the sound wave. This reduction theoretically applies to noise at all frequencies, including below 20 Hz (Sonus, 2010b). Extrapolating the Clements Gap data from **Table 28** using this assumption, expected noise levels would be 55 dB(G) at 720m and 49 dB(G) at 1,440m. The shortest distance between a proposed WTG and non-involved residence at Collector is 1.5km.

Based on these monitoring results Sonus (2010b) concluded that:

- *Wind turbines generate infrasound, however measurements…at a variety of distances (significantly less than separation distances between wind farms and dwellings) indicate the infrasound produced by wind turbines is well below established perception thresholds; and*
- *The level of infrasound that has been measured in both a rural coastal and an urban environment is of the same order as that measured within 100m of a wind turbine.*

Table 28 Low Frequency Noise Measurements

Noise Source	Criterion dB(G)	Noise Level dB(G)
Clements Gap Wind Farm (@ 85m)	85	72
Clements Gap Wind Farm (@ 185m)	85	67
Clements Gap Wind Farm (@ 360m)	85	61
Cape Bridgewater Wind Farm (@ 100m)	85	66
Cape Bridgewater Wind Farm (@ 200m)	85	63
Cape Bridgewater Wind Farm (ambient)	85	62
Cape Bridgewater beach (25m from water)	85	75
Gas-fired Power Station (@ 350m)	85	74
Adelaide CBD	85	76

Source: Sonus (2010b)

Rogers et al. (2006) noted in relation to infrasound from wind turbines:

> *…it is particularly important to distinguish between turbines with downwind rotors and turbines with upwind rotors. Some early wind turbines did produce significant levels of infrasound; these were all turbines with downwind rotors. The downwind design is rarely used in modern utility-scale wind power turbines.*
>
> *Upwind rotors emit broad band sound emissions, which include low frequency sound and some infrasound. Note that the "swish-swish" sound is amplitude modulation at blade passing frequencies of higher frequency blade tip turbulence and does NOT contain low frequencies.*

Hence, while wind farm noise has an infrasound component, the actual levels of infrasound at receivers at greater than 200m distance from wind turbines would not be perceptible. The World Health Organisation (WHO, 1995) notes that "*There is no reliable evidence that infrasound below the hearing threshold produces physiological or psychological effects*".

Salt and Hullar (2010) investigated responses of the human ear to low frequency sound and infrasound and the potential relationships to wind turbines. The study cited measurements of infrasound sound power levels in the range of 90 to 100dB; however, there was no apparent consideration of the effect of increasing distance on these noise levels. The investigation, in conclusion, noted that "*The fact that some inner ear components…may respond to infrasound at the frequencies and levels generated by wind turbines does not necessarily mean that they will be perceived or disturb function in any way."* In addition, the authors noted that

"…some individuals (such as fighter pilots) can be exposed to far higher levels of infrasound without undue adverse effects."

Health Considerations

There has been considerable media attention to the alleged negative health effects from wind energy. This media attention has translated into widespread community concern, including amongst residents living in proximity to the Proposal.

The matter of wind farm noise and health was considered by Pierpont (2009), who described various health symptoms apparently related to infrasound emissions from wind turbines, and collectively termed "wind turbine syndrome". The thesis proposed by Pierpont – with conclusions drawn from case reports - is that low frequency noise and infrasound from wind turbines has a direct effect on the human body resulting from impacts to the body's motion sensing system (inner ear) and from vibrations to internal organs. Wind turbine syndrome is apparently associated with symptoms such as headaches, sleeplessness and anxiety. NSW Health (2011) made the following observations in relation to the Pierpont findings:

> *This 'study' is not a rigorous epidemiological study; it is a case series of 10 families drawn from a wide range of locations. This work has not been properly peer-reviewed, nor has it been .published in the peer-reviewed literature. The findings are not scientifically valid, with major methodological flaws stemming from the poor design of the study. This 'study' is not of sufficient scientific rigour. It raises hypotheses, it does not prove them.*

The Waubra Foundation has provided anecdotal commentary on similar symptoms to those identified by Pierpont apparently experienced in Australian situations. According to its website, the Foundation "...*is a national organisation formed to facilitate properly reviewed, independent research into the health problems which have been identified by residents living near wind turbines and other industrial sites which may have common cause*."

The Foundation has drawn extensively on the work of Pierpont (2009) and asserts that:

> *…the following serious medical conditions have been identified in people living, working, or visiting within 10km of operating wind turbine developments:chronic severe sleep deprivation;*
>
> - *acute hypertensive crises;*
> - *new onset hypertension;*
> - *heart attacks (including Tako Tsubo episodes);*
> - *worsening control of preexisting and previously stable medical problems such as angina, hypertension (high blood pressure), diabetes, migraines, tinnitus, depression, and post-traumatic stress disorder;*
> - *severe depression, with suicidal ideation;*
> - *development of irreversible memory dysfunction, tinnitus, and hyperacusis.*

The Foundation's CEO, Dr Sarah Laurie, has presented case studies to NSW Health as evidence for a causal link between these health effects and wind turbines. NSW Health (2011) noted, in relation to these matters, that:

> *There may be reports of illness, but these illnesses may have occurred in the community in any case, and no comparison population or other appropriate epidemiological evidence is available: making assertions of causal links to wind turbines without proper studies is unjustified.*

Furthermore, in relation to the veracity of case study data as the basis for evidence NSW Health (2011), noted:

> *There is a clear hierarchy in scientific evidence and case reports fall into the lowest category of scientific evidence. On this basis, such evidence can be regarded as hypotheses generating and not as hypotheses proving. In other words, they raise a question, but do not provide an answer. To be widely accepted as evidence for adverse health effects, the study design, methodology and analysis has to be peer reviewed. This is lacking for the critical information presented.*

In addition, NSW Health (2012), in correspondence to DoPI on the Draft Guidelines, notes

> *…that there is currently no health evidence to support a generic 2 km separation distance from a proposed wind turbine. Mandatory enhanced assessment of potential impacts for neighbours within a 2km radius of proposed wind turbines needs to be justified on non-Health grounds.*

The matter of public health and the relative contribution of fossil fuel and renewable energy generation is also a matter of public interest. Two recent publications by Doctors for the Environment (2011) and the Climate and Health Alliance (2012) address the this issue in terms of health impacts from energy generation, specifically the relative impacts of fossil fuels and renewable energy.

Doctors for the Environment Australia (DEA) – a voluntary organisation of medical doctors in all Australian states and territories working to address the diseases caused by damage to the Earth's environment – made a submission to the Senate Community Affairs Committee *Inquiry into the Social and Economic Impacts of Rural Wind Farms* (DEA, 2011). DEA has "…*an established policy that business as usual using fossil fuels is unsustainable and a health hazard and it strongly supports an urgent transition to renewable energy*." DEA made the following observations in relation to the health impacts of coal energy generation:

> *Coal is responsible for a significant disease burden in our community through its mining to its processing, transport and burning for power generation. The air pollution released by mining and burning coal is an unhealthy chemical cocktail including fine and coarse particles, sulphur dioxide, nitrogen dioxide and trace elements.*
>
> *Health impacts from air pollution include worsening of asthma and chronic bronchitis, increased risk of lung cancer, increased risk of heart attack in those with heart disease, increased risk of premature death, and poorer lung development in children. Mercury is also released into the atmosphere from the burning of coal may accumulate in the food chain, and is toxic, particularly to the developing nervous system.*

In comparing these impacts with those from renewable energy sources, DEA noted that "*Wind power and other renewable energies have the potential to reduce threats to health through reduction in air pollution and mitigation of climate change."*

The Climate and Health Alliance (CAHA) is "…*a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action*" and includes the Public Health Association of Australia (PHAA), Royal College of Nursing Australia (RCNA), Royal Australasian College of Physicians (RACP) and Australian College of Rural and Remote Medicine (ACRRM). CAHA (2012) recently issued a position statement on health and wind turbines, which noted the following:

> *An examination of the health effects of any form of energy generation is meaningless unless it is placed into the context of alternative means of energy generation.*
>
> *Australia's current energy systems are heavily reliant on the burning of fossils fuels such as coal and gas for electricity generation. These energy sources are not only implicated in driving climate change but, particularly in the case of coal, also pose significant risks to human health. A shift away from fossil fuels to clean renewable energy to reduce greenhouse gas emissions will therefore also reduce risks associated with the mining, transportation and combustion of coal, which contributes to increased risk of developmental delays, lung cancer, heart disease, chronic obstructive pulmonary disease, asthma and other conditions.*

In consideration of the relative health burdens of renewable energy and fossil fuels, CAHA concludes that "…*the deployment of wind turbines* [is] *an important source of zero emissions renewable energy for electricity generation to replace highly polluting and harmful fossil fuels to reduce climate risk as well as direct harm to human health*".

Both DEA and CAHA conclude that adverse health impacts from fossil fuel energy generation are a significant public health issue and that wind energy, comparatively, has a negligible impact on human health.

Reviews of Wind Farms and Health Impacts

A number of reviews of the perceived impacts of wind turbine operation on human health have been undertaken over the last five years, both in Australia and internationally. Some of these reviews are summarised below:

National Health and Medical Research Council (2010)

The National Health and Medical Research Council (NHMRC) - Australia's peak body for developing health advice for the community - undertook a review of literature on the potential impacts of wind turbines on human health (NHMRC, 2010a). The objective of the review was to ascertain if the following statement could be supported by the evidence: *There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines*. The review noted that this statement was supported by an expert review commissioned by the American and Canadian Wind Energy Associations (Colby et al. 2009), which is summarised below.

In a public statement accompanying the review (NHMRC, 2010b), the NHMRC noted that

> *Concerns regarding the adverse health impacts of wind turbines focus on infrasound, electromagnetic radiation, shadow flicker and blade glint produced by wind turbines. While there is currently no evidence linking these phenomena with adverse health effects, the evidence is limited.*
>
> *While a range of effects such as annoyance, anxiety, hearing loss, and interference with sleep, speech and learning have been reported anecdotally, there is no published scientific evidence to support adverse effects of wind turbines on health.*

The review (NHMRC, 2010a) noted that "*Based on current evidence, it can be concluded that wind turbines do not pose a threat to health if planning guidelines are followed*" and concluded:

> *The health effects of many forms of renewable energy generation, such as wind farms, have not been assessed to the same extent as those from traditional sources. However, renewable energy generation is associated with few adverse health effects compared with the well-documented health burdens of polluting forms of electricity generation.*
>
> *This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement 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.*

The public statement (NHMRC, 2010b), concluded that

> *…it is recommended that relevant authorities take a precautionary approach and continue to monitor research outcomes. Complying with standards relating to wind turbine design, manufacture, and site evaluation will minimise any potential impacts of wind turbines on surrounding areas.*

The review (NHMRC, 2010a) also noted that many factors can influence the way noise from wind turbines is perceived. Citing a study by Pedersen & Persson Waye (2007), the review noted that "…*being able to see wind turbines from one's residence increased not just the odds of perceiving the sound, but also the odds of being annoyed"*. This observation was corroborated by a study of 725 residents living near wind farms in the Netherlands (Pederson et al, 2009), which found that annoyance was strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape.

American and Canadian Wind Energy Association (2009)

An international panel of independent, scientific experts commissioned by the American and Canadian Wind Energy Associations was established to review the current literature on the perceived health effects of wind turbine noise in response to community concerns, particularly in the low frequency and infrasound range. The panel – comprising medical doctors, audiologists and acoustic professionals from the US, Canada, Denmark and the UK – concluded in its report (Colby et al, 2009) that:

- *there is no evidence that the audible or sub audible sounds emitted by wind turbines have any direct adverse physiological effects;*

- *ground-borne vibrations from wind turbines are too weak to be detected by or to affect humans; and*
- *the sounds emitted by wind turbines are not unique and there is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sounds in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."*

Knopper and Ollson (2011)

The purpose of this paper was to review the peer-reviewed scientific literature, government agency reports, and the most prominent information found in the popular literature. The report concluded:

> *Conclusions of the peer reviewed literature differ in some ways from those in the popular literature. In peer reviewed studies, wind turbine annoyance has been statistically associated with wind turbine noise, but found to be more strongly related to visual impact, attitude to wind turbines and sensitivity to noise. To date, no peer reviewed articles demonstrate a direct causal link between people living in proximity to modern wind turbines, the noise they emit and resulting physiological health effects. If anything, reported health effects are likely attributed to a number of environmental stressors that result in an annoyed/stressed state in a segment of the population. In the popular literature, self-reported health outcomes are related to distance from turbines and the claim is made that infrasound is the causative factor for the reported effects, even though sound pressure levels are not measured.*
>
> *In other words, it appears that it is the change in the environment that is associated with reported health effects and not a turbine-specific variable like audible noise or infrasound.*

The Massachusetts Department of Environmental Protection and Department of Public Health (2012)

The Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health (2012) engaged an independent expert panel to "…*identify any documented or potential health impacts* [or] *risks that may be associated with exposure to wind turbines*…". The Panel - comprising seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering - conducted an extensive review of the scientific literature as well as other reports, popular media, and public comments. A focus of the Panel's review was "…*to examine the plausibility or basis for health effects of turbines (noise, vibration, and flicker)*".

The Panel's findings in relation to operation of wind turbines and noise and vibration generated the following conclusions:

- *Literature on human response to wind turbines relates to self-reported "annoyance," and this response appears to be a function of some combination of the sound itself, the sight of the turbine, and attitude towards the wind turbine project.*
- *There is limited evidence from epidemiologic studies suggesting an association between noise from wind turbines and sleep disruption.*
- *There is insufficient evidence that the noise from wind turbines is causing health problems or disease.*

- *Impacts on the human body's vestibular system from wind turbine infrasound have not been demonstrated scientifically, with available evidence demonstrating that infrasound levels near wind turbines cannot impact the vestibular system.*
- *There is no evidence for a set of health effects, from exposure to wind turbines that could be characterised as a "Wind Turbine Syndrome".*
- *There is no demonstrable association between noise from wind turbines and measures of psychological distress or mental health problems.*
- *None of the evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine.*

World Health Organisation

The WHO has developed guideline exposure values for various types of community noise (WHO, 1999). These values are designed to avoid long-term deterioration in physical, psychological or social functioning. The guideline of most relevance to the potential impacts of wind farm noise is that for sleep disturbance. The WHO considers that night-time noise levels at the outside façade of a dwelling should not exceed 45dBA with windows open. The noise assessment using three different wind turbine models at reduced layouts indicates that residences at Collector would experience night time noise levels that are unlikely to cause sleep disturbance, with the exception of one project-involved receiver located in the central section of the project site. The Proponent is negotiating with this receiver the acquisition of his property or his relocation to mitigate the predicted noise impact.

NSW Parliament Inquiry (2009)

The NSW Parliament conducted an inquiry into rural wind farms in 2009, which included consideration of the potential health impacts of wind farms. The inquiry report (New South Wales Parliament Legislative Council General Purpose Standing Committee No. 5, 2009) noted that "…*the health effects associated with wind farm noise appear to be the most common concern…"* and observed that "…*it was clear that some people are significantly affected by their experience of wind farms, both existing and proposed"*. However, the inquiry report concluded that "…*many purported impacts have created little more than unfounded fear in local communities, for example vibroacoustic disease, wind turbine safety, shadow flicker and 'Wind Turbine Syndrome'"* and that "…*the level of concern for many impacts is not supported by evidence"* with "…*such impacts being promoted to support arguments against wind power in general, rather than being used to highlight fundamental problems with wind farms*."

Notwithstanding that current research has been unable to establish a direct relationship between wind farm noise emissions and health, the NHMRC review (citing Chapman, 2010), note that:

> *"It has been suggested that if people are worried about their health they may become anxious, causing stress related illnesses. These are genuine health effects arising from their worry, which arises from the wind turbine, even though the turbine may not objectively be a risk to health."*

Planning Panels Victoria (2010), in its report on the Stockyard Hill Wind Energy Facility, recognised that some people are apprehensive about possible health impacts from wind farms and that some uncertainty remains in relation to indirect health effects described above. On this basis, the report recommended a precautionary approach involving:

- strict adherence to recommended noise limits;
- provision of noise assessment reports to the public;
- a responsive noise complaints system; and
- offering visual screening on nearby properties as a means of reducing perceived health concerns.

The noise assessment undertaken for the proposal (**Appendix F**) indicates that noise levels at all neighbouring residences would meet the respective relevant criteria for project-involved and non-involved residences, with the exception of one project-involved residence located in the central portion of the project site.

Management Measures

The Proponent will establish a complaints management system to be implemented prior to the construction phase and maintained throughout the operation phase of the development to register noise and other health complaints and concerns about the Proposal from the community.

11.4.2. Electromagnetic Fields

Background

Electricity generates both electric and magnetic fields (EMF). These fields emanate from the wires delivering electricity to our homes and all devices which use electricity in the home. Therefore, Australians are routinely exposed to these fields in their everyday lives.

Electric fields are shielded by many common building materials and the earth and reduce with increased distance from the source. Magnetic fields, on the other hand, are more difficult to shield but diminish with distance from the source. Bundling individual wires closely together reduces the magnetic field emitted.

Studies have consistently demonstrated that prolonged human exposure to weak electric fields does not result in adverse health effects. Whether chronic exposure to weak magnetic fields is equally harmless remains an open question. While there is no evidence that these fields cause immediate, permanent harm, laboratory studies on animals and cell cultures have shown that weak magnetic fields can effect several biological processes (hormone and enzyme levels and the rate of movement of some chemicals through living tissue) (ARPANSA, 2009).

Human studies, known as epidemiological studies, are based on the occurrence and distribution of disease in the population or community. To date no epidemiological studies have produced solid evidence linking EMF exposure to disease. The majority of scientists, and Australian radiation health authorities in particular, do not regard chronic exposure to 50Hz EMF at the levels commonly found in the environment as a proven health

risk. Moreover, the evidence available is inconclusive and does not allow health authorities to decide whether there is a specific magnetic field level above which chronic exposure is dangerous or compromises human health (ARPANSA, 2009).

Guidelines

There are currently no Australian standards regulating exposure to EMF. The National Health and Medical Research Council (NHMRC, 1989) issued guidelines aimed at preventing immediate health effects resulting from exposure to these fields. The recommended magnetic field exposure limit for members of the public (24-hour exposure) is 1,000 milligauss (mG) and for occupational exposure (whole working day) is 5,000mG. **Table 29** shows the typical EMF measurements from various common sources.

Table 29 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

Source: Energy Networks Association (2006)

Impact Assessment – Construction and Decommissioning

Operational electrical infrastructure is required in order to produce EMF. During the construction and decommissioning phases, the Proposal does not include operational electrical infrastructure. Therefore, EMF impacts will be limited to the operational phase only of the Proposal.

Impact Assessment – Operation

There are three potential sources of EMF associated with the proposal as discussed in the following sections.

Grid Interconnection Power Line

The magnetic fields associated with a transmission line at any moment in time depend on a range of factors, including the amount of power flowing in the line and the distance of the measurement point from the conductors. Typical levels of magnetic field under a 330kV high-voltage transmission line range from 5-50mG

at a distance of 30m from the centre of the easement (NGH, 2008). The strength of the field falls away rapidly with increase distance. High-voltage lines can produce magnetic fields of up to 200mG under the line. These figures are far less than the 1,000mG limit recommended for 24-hour exposure.

Underground Cabling

The 33kV underground lines connecting the wind turbines to the substation would be located at a depth of approximately 1.2m below ground level. At this depth, a maximum magnetic field of 10mG could be expected, which is insignificant when compared with the 1,000mG limit recommended for 24-hour exposure.

Substation

EMF from the substation would be less than 100mG in the vicinity of the transformers and other electrical components (HPA, 2004). These levels are well below the NHMRC limit of 1,000mG for the public or 5,000mG for occupational exposure. The substation will not be accessible by the public due to the surrounding security fence. The fence will be placed at a distance where the level of electromagnetic radiation is negligible.

Mitigation Measures

To ensure that there would be no unnecessary exposure to EMF from the Proposal, the following mitigation and management measures will be implemented:

- electrical cables will be placed below ground where possible to shield electrical fields;
- wires will be bundled to reduce the magnetic field emissions;
- appropriate security around emitting structures (e.g. substation) will be placed and maintained to restrict public access and limit potential exposure; and
- non-staff that need to go near the emitting structures would be accompanied by a trained and qualified staff member.

11.4.3. Shadow Flicker

The rotating blades of wind turbines can cast intermittent shadows that appear to flicker for an observer at a fixed ground position. Since wind turbines are tall structures, shadow flicker can be observed at considerable distances but usually only occurs for brief times at any given location. Shadow flicker can cause physiological or psychological reactions in some people. These impacts are most closely associated with the duration of shadow flicker experienced above certain intensities. The duration of shadow flicker, its intensity and the locations it affects are most strongly determined by the relative position of the sun, the turbine, and the receptor. The relative position of the sun varies with latitude, time of day and time of year. Other factors include (Environment Protection and Heritage Council, 2010):

- the size of the wind turbine rotor and height of the tower;
- local topography;
- intervening vegetation;
- direction of the wind (and hence the rotor plane of the wind turbine);
- weather (particularly cloud cover); and
- general visibility (including presence of mist, smoke and other particulates).

A shadow flicker assessment was prepared for the Proposal by RATCH-Australia using the methodology described in the *Draft National Wind Farm Guidelines* (EPHC, 2010). The assessment report is attached as **Appendix L**. The following wind turbine models were considered in the analysis:

- REPower 3xM 104, with an overall height of 132m (80m tower height and 104m rotor size) as the representative case; and
- Vestas V112, with an overall height of 150m (94m tower height and 112m rotor size) as the worst case.

Additional model inputs included the path of the sun throughout the year, a topographic model and the location of dwellings and wind turbines.

The key risk associated with shadow flicker is annoyance to nearby residents, which is generally a function of shadow intensity and duration of exposure at a residence. While shadow flicker can theoretically extend many kilometres from a wind turbine, the intensity of the shadows decreases with distance. The *Draft National Wind Farm Development Guidelines* (EPHC, 2010) recommend an assessment distance of 265 times the maximum blade width of the turbine under consideration. For the wind turbines assessed this distance equates to a maximum of 1,060m, based on a maximum blade width of 4.0m. As a conservative assumption for this analysis, a distance of 2,000m has been adopted.

Ten residences are situated within 2,000m of a proposed wind turbine at Collector, five of which are involved with the project. A further series of assumptions was made for the worst case shadow flicker analysis including:

- turbines operating continuously throughout the day;
- turbine blades perpendicular to the receptor at all times; and
- sun shining at all times of the day.

In terms of duration of exposure, the *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* (DPCD, 2009) state that the shadow flicker experienced immediately surrounding the area of a dwelling (garden fenced area) must not exceed 30 hours per year as a result of the operation of the wind energy facility. This limit has been adopted for the analysis.

The results of the shadow flicker analysis, using the worst case assumptions described above are shown in **Table 30**. The results indicate that at all non-involved residences shadow flicker would be less than 10 hours per year, compared with the allowable limit of 30 hours per year.

11.4.4. Blade Throw

The NSW Wind Farm Guidelines (DoPI, 2011) require consideration of the risk of blade throw. Blade throw involves the detachment of a turbine blade, or a fragment thereof, and its ejection from the turbine assembly. This poses a potential risk to nearby people and property. The Guidelines require consideration of the following matters, which are discussed further below:

- the probability of blade throw occurring;
- whether the proposed turbines are certified against relevant standards;

- overspeed protection mechanisms including 'fail safe' mechanisms (e.g. back up (battery) power in the event of a power failure);
- operational management and maintenance procedures including any regular maintenance inspections;
- provisions for blade replacement; and
- the separation distance between turbines, neighbouring dwellings and property boundaries.

Table 30 Shadow Flicker Results (hours per year) – Worst Case

Dwelling	REPower 3xM Wind Turbine		Vestas V112 Wind Turbine	
	Estimated hours	Allowable	Estimated hours	Allowable
G*	10:50	30:00	13:33	30:00
M*	7:12	30:00	8:57	30:00
N*	151:21	30:00	178:08	30:00
S*	11:11	30:00	15:03	30:00
T*	14:06	30:00	18:47	30:00
V	0:00	30:00	0:00	30:00
Z	0:00	30:00	0:00	30:00
AA	5:14	30:00	6:33	30:00
BB	3:41	30:00	5:08	30:00
FF	0:00	30:00	0:00	30:00

**Indicates residence involved with the project. Figure 10 shows the location of the above dwellings.*

Blade Throw Probability

An analysis of potential safety risks from the Kittitas Valley Wind Power Project (Kammen, 2003) assessed the human health risks of separation and throwing of a whole or partial wind turbine rotor blade. The analysis involved theoretical calculations of individual risk (IR) – the probability that a member of the public will die from an accident if he/she is permanently at a certain place without protection – and assessment of actual probabilities of a blade fragment striking a member of the public.

The theoretical calculations indicated that for a 2MW wind turbine with a rotor diameter of 80 metres, the IR is 1 in a million within 150m of a turbine. As stated above, this probability assumes that an individual is permanently at a certain place without protection. When considering the actual probabilities of a blade fragment striking a member of the public, Kammen (2003) noted the following:

> *The risk levels for a blade…thrown from a wind turbine…depends on the assumptions one makes about the probability of a person(s) being at the exact spot where a flying object might land at that exact moment in time. Given the rural, sparsely populated nature of the area…that probability appears to be very low.*

Kammen (2003) assessed the probability of a blade fragment striking a vehicle on an adjacent highway (with an average daily traffic volume of 2,800 vehicles) and causing a mortal accident. The assessed probability, using conservative assumptions, was 1 in one billion.

By way of comparison Kammen (2003) considered the relative risks of common day to day activities causing death and found that the following activities have a 1 in one million chance of causing death:

- Spending one hour in a coal mine, with death caused by black lung disease;
- Travelling 10 miles by bicycle, with death caused by accident;
- Travelling 300 miles by car, with death caused by accident;
- Living 2 months in an average stone or brick building, with death from cancer caused by natural radioactivity; and
- One chest x-ray taken in a good hospital, with death from cancer caused by radiation.

All the above risks are 1,000 times more likely than the risk presented by the proposed Kittitas Project. Kammen (2003) concluded that: "*It appears reasonable, therefore, to determine that the proposed project does not present a significant risk to public health or safety*." Given the similar circumstances of the Proposal, it is reasonable to conclude that the risk of blade failure causing death is greater than 1 in one billion.

Rogers *et al.* (2011) undertook research into setback standards for wind turbines aimed at minimising the probability of blade fragment impact with roads, structures and infrastructure (i.e. fixed objects) and concluded that a setback distance of 463 metres from these objects was desirable for a Vestas 2.0 MW turbine model. The research did not explicitly consider the risk of blade throw to people, or non-stationary objects, which would have a much lower risk of blade fragment impact when compared with stationary objects.

A key input to the Rogers *et al.* (2011) analysis was a "…*commonly accepted probability of blade failure per turbine per year*…" of 1 in 3,800 based on datasets analysed by Rademakers and Braam (2005). This probability was calculated following a statistical analysis of blade failures reported by EMD (Denmark) for the period 1984 to 2000 and ISET (Germany) for the period 1991 to 2001. It is important to note that the technical specification for structural testing of rotor blades (IEC 61400-23) was first introduced in 2001.

Turbine Certification and Operational Safeguards

All turbines under consideration for the Proposal will require certification against International Electrotechnical Commission (IEC) standards. IEC 61400 is a class of international standards, specifying design requirements made to ensure that wind turbines are appropriately engineered against damage from hazards within their planned lifetime. IEC standard 61400-23, introduced in 2001, applies specifically to structural testing of wind turbine blades. GL Garrad Hassan (2010) notes:

> *The occurrence of structural manufacturing defects in rotor blades has…diminished dramatically due to improved experience and quality control in the industry, centred on a small number of companies who make blade manufacture their main or sole business. Design practice has also evolved to improve structural margins against any manufacturing deficiencies. Even in the rare event of blade failure in modern machines, detachment of whole blades is highly unusual.*

GL Garrad Hassan (2010) undertook a literature review of wind turbine failure and certification processes and made the following observations:

> *The reduction in failures* [over the last 20 years] *coincides with the widespread introduction of turbine design certification and type approval. This process requires full scale strength testing of every certified design of turbine blades. It also often requires a dynamic test that simulates the complete life loading on the blade. The certification body will also perform a quality audit of the blade manufacturing facilities and perform strength testing of construction materials. This approach has effectively eliminated blade design as a root cause of failures. Unfortunately, this does not mean that blade failures do not occur, but when they do, the rootcause is some other factor.*
>
> *The main causes of blade and tower failures are now a control system failure leading to an over speed situation, a lightning strike or a manufacturing defect in the blade. The latter cause does not often lead to detachment of blade fragments.*

GL Garrad Hassan (2010) also notes in relation to lightning strikes that:

> *Lightning protection systems for wind turbines have developed significantly over the past decade and best practice has been captured in industry standards to which all modern turbines comply. This has led to a dramatic drop in events where lightning causes structural damage.*

Overspeed protection mechanisms for wind turbines are manufacturer-specific. REpower turbines, for example, incorporate an uninterruptible power supply (UPS) (i.e. a battery) in each wind turbine to shut the turbine down safely in the event of a power failure. Furthermore, each individual blade has an independent electronic pitch motor with its own UPS, so that each blade can be pitched out of the wind in an emergency. Pitching a single blade out of the wind is enough to stop the rotor from spinning. Other manufacturers have similar systems.

Turbine Separation Distances

Separation distances between individual wind turbines are not regulated by any standard. Rather the distance between adjacent turbines in a wind farm is a compromise that a proponent must make between:

- a greater number of turbines (leading to higher energy yield for the wind farm and potentially lower cost of infrastructure per turbine); and
- a reduced energy yield per turbine and greater turbulence due to increased wake effects from the adjacent turbines.

Final spacing is dependent upon site certification from the turbine manufacturer regarding the loads on the turbine (closer spacing means higher turbulence and thus higher loads) and finding an optimum generation balance between the number of turbines and wake effects. The separation distance varies according to the predominant wind direction. As a rule-of-thumb, if the wind is predominantly from one direction (eg the west) then the turbines can be spaced relatively close together (2 - 2.5 rotor diameters) perpendicular to this direction (eg north - south) as their wakes will not interfere with the adjacent turbines. However if there are turbines downwind, the spacing is generally 5 to 10 rotor diameters.

12

APP Corporation

Water Quality

12

12.Water Quality

This chapter describes the drainage features of the project site and the potential impacts on water quality resulting from the Proposal. In considering the potential impacts on surface water environments reference is made to the development envelope, as defined in **Section 2.1**. The development envelope encompasses the area of disturbance and plant operation during the construction phase.

12.1. Existing Environment

12.1.1. Groundwater

According to the *Upper Lachlan Shire Council 2009/2010 Annual Report* (ULSC, 2010) and the *Australian Capital Region State of the Environment Report* (ACT Commissioner for Sustainability and Environment, 2009), groundwater in the Upper Lachlan Shire is of moderate to good quality, with areas of high salinity around Dalton and Collector; however there has been a steadily decreasing water table, continuing a trend observed since 1991. This trend is likely to be due to the low natural rainfall and increased groundwater extraction.

As the Collector area does not have a town water supply, residents within the town and adjacent area source their own supply of water, via either surface or groundwater extraction, for both domestic and agricultural purposes (L. Moloney, Upper Lachlan Shire Council, pers. comm. 18 January 2011). There are a number of bores in the vicinity of the project site with standing water levels ranging from 5.5 to 12m below ground level (bgl) while the top of the water bearing zone was encountered at depths of between 27 and 33m bgl (DNR, nd). The large difference between the groundwater depth and standing water levels suggests a confined groundwater table.

12.1.2. Surface Water

The project site sits on the drainage divide between the Lerida Creek and Frankfield Creek catchments to the west, which are within the Upper Lachlan River catchment, and the Collector Creek catchment to the east. The majority of the project site is drained by intermittent (non-perennial) streams, including:

- Sandy Creek, to the north-west which drains north to Frankfield Creek;
- Cullerin Creek, Norfolk Creek and Mutmutbilly Creek to the north and north-east, which all drain north toward the upper reaches of Lachlan River;
- Boheara Creek, Boyds Creek and Stony Creek to the south-east, which all drain east and south to Collector Creek.

The most significant drainage features in the project site are Lerida Creek and Frankfield Creek which are both mapped as perennial watercourses. There are numerous farm dams on the project site, with water sourced for domestic uses and stock watering.

No significant waterways would need to be crossed in the construction and operation of the Proposal. The majority of the drainage lines in the vicinity of the development footprint are first order streams. (Under the Strahler stream classification system, a first order stream is any watercourse that does not have any other watercourse flowing into it.) Under the *Water Management Act 2000* there are provisions to protect surface water environments through the establishment of core riparian zones (CRZ), within which there are development restrictions. The prescribed width for a CRZ varies with stream order, with a first order watercourse requiring a CRZ of 10m width.

There are no significant aquatic environments or fish habitats in the vicinity of the development footprint (**Appendix C**). While the wind turbine sites are situated away from drainage features on ridge lines, the access track and cable routes would cross intermittent streams at five and eight points, respectively, based on the proposed wind farm layout. These watercourses would not be expected to provide habitat for aquatic species of conservation significance.

12.1.3. Salinity

Salinity in the landscape is predominantly a function of vegetation clearing, particularly tree clearing, which increases leakage to the groundwater system, contributing to watertable rise that could bring salt to the root zone and surface. As salts accumulate near the surface, they can cause poor plant health and dominance of salt-tolerant species.

According to the Upper Lachlan Shire Council 2009/2010 Annual Report (ULSC, 2010a), salinity is a problem that continues to grow within the shire predominantly around the lower part of the shire around Gunning, Dalton and Collector.

There is limited monitoring by ULSC of salinity and therefore the impacts of development and natural pressures such as the prolonged drought cannot be fully determined (ULSC, 2009a). However, ULSC has implemented a number of projects to address catchment water quality in general and salinity in particular. For example, the Council promotes the use of rainwater tanks to reduce reliance on groundwater to supply potable water demand.

12.2. Water Demand

As noted in **Section 2.6.1**, the construction phase of the project will require water for the following main uses:

- moisture conditioning of earth fill;
- equipment wash-down;
- dust suppression; and
- fire fighting.

The potential sources of water would depend on the water quality requirement for each application. Water for moisture conditioning of fill and for dust suppression will also be sourced from external sources. Opportunities will be taken to reuse any accumulated water in sedimentation basins or excavations. It is estimated that moisture conditioning and dust suppression would require about 20kL daily (or two 10kL water cart loads).

Potable water for the consumption of the construction workforce and site visitors has been conservatively estimated at about 42kL per day, based on a peak number of 120 workers and 20 site visitors. This requirement will be delivered by tankers from offsite sources. Potable water requirements during the operational phase will be significantly reduced as the number of permanent staff on site is not expected to exceed 25.

The construction compound (during construction) and control building compound (during operation) will be provided with water storage tanks for bulk potable water storage. Provisions will also be made to allow collection and storage of rainwater from the roof of site buildings. Water will be made available in site storages (water tanks and water carts during construction) for fire emergency response. If required, water will be accessed from an unregulated water source under the relevant water permits from the NSW Office of Water. The Proposal does not anticipate constructing any new bores to access groundwater for potable water during construction or operation.

12.3. Impact Assessment – Construction and Decommissioning

12.3.1. Groundwater

Based on data sourced from the NSW Natural Resource Atlas (DNR, nd), there are five registered groundwater bores located within 1km of the proposed site. For two of these groundwater bores no data for the standing water level or depth to the water bearing zone was available. In the remaining three groundwater bores, the standing water level ranges from 5.5 to 12m bgl while the top of the water bearing zone was encountered at depths of between 27 and 33 m bgl.

Potential impacts on groundwater from the construction phase relate to the installation of wind turbine footings, particularly where rock anchor foundations are utilised. Rock-anchor foundations involve drilling to depths up to 20m bgl with the potential to intercept the groundwater table. The alternative gravity foundations, which are expected to be utilised at the majority of wind turbine sites, would involve excavations to a maximum of 3m bgl. Similarly, cable routes would generally follow higher ground, with trench depths up to a maximum of 2m bgl. Hence it is highly unlikely that groundwater tables would be intercepted, given the apparent depths to the water bearing zone in the vicinity of the proposed site detailed above.

At the Proposal's detailed design stage a geotechnical assessment would be undertaken to establish the type of foundation to be used at each wind turbine site. The geotechnical assessment would also allow characterisation of the groundwater regime at each site.

Interception of the groundwater table during rock-anchor foundation installation would involve potential localised impacts to groundwater quality from foundation materials (e.g. concrete grout). As the quantities of material involved are relatively small at each turbine location and confined to the individual drill hole, impacts are unlikely to be significant.

Another risk to water quality (groundwater and surface water) is contamination from leaks and spills of oil and fuel from construction plant during construction and transformer oil from the substation transformers during operation and maintenance.

12.3.2. Surface Water

The construction phase of the development has the greatest potential for impacts on surface water environments. Construction activities involving earthworks - including hardstand and access track construction, and cable trench installation – would pose the highest risk to surface water quality.

Most of the Proposal infrastructure will be sited on elevated locations along the Cullerin Range which are sufficiently offset from drainage lines. However, some sections of access tracks and cable trenches will require crossing of water courses. Crossings and cable trenching could affect riparian and aquatic habitats during construction due to stream bed disturbance.

The proposed access road alignments generally follow site contours to avoid steep grades, thereby minimising the need to build vehicle creek crossings. However, cabling would need to be aligned along the shortest path and may need to cross water courses where required. This is to minimise cable length and associated transmission losses. As previously noted, most of the water courses that drain the project site are ephemeral. It is therefore possible to carry out cable trenching across watercourses during dry or low flow periods to minimise the risk of silting up the affected watercourses. Underboring techniques would be employed for cabling where required to avoid impacts to aquatic and riparian habitats.

Potential impacts on surface water environments arising from construction activities include:

- increased salinity resulting from vegetation clearance;
- modifications to flow paths (e.g., through access track installation and temporarily during cable trench installation) resulting in increased potential for erosion;
- sedimentation, caused by erosion of disturbed areas and stockpiles; and
- reduction in water quality from suspended sediment and other pollutants (e.g. accidental oil/fuel/chemical spills).

12.4. Impact Assessment – Operation

The impermeable surfaces to be maintained for the operation phase, mainly roads and hardstands, have the potential to increase local runoff which could erode flow paths and result in silted runoff discharging to watercourses. Roads and hardstands will be designed and constructed with appropriate grading and drainage structures (inlet and outlet structures, channels and energy dissipaters) to effectively collect and channel run-off while minimising the risk of erosion.

Water requirements for the operational phase of the Proposal would be limited to that required for domestic uses of on-site staff (e.g. kitchen and showers) and maintenance purposes. Water tanks will be installed to collect rain water from the control building or to receive water deliveries from external sources, for use of maintenance staff. These water storages would meet Council standards. No additional water connections are anticipated.

Infrastructure, including the substation transformers, would be designed to prevent any leakage of fuels or lubricants even during heavy rainfall events. The substation compound will be fenced to restrict unauthorised access and any associated risk of damage to the transformers.

12.5. Management and Mitigation

12.5.1. Groundwater

The following measures will be implemented to minimise the risk of pollution and contamination of groundwater and to minimise any potential adverse impacts on groundwater availability arising from the construction and operation of infrastructure for the Proposal:

- Suitable perimeter protection and bunding will be provided to the substation transformers to minimise the risk of transformer oil leaks or spills during operation and maintenance.
- In the instance that below-ground infrastructure intercepts the groundwater table, a suitable protective casing (for example a plastic pipe sleeve) would be used to pass through the ground water zone. This sleeve would allow the foundation/pile material to pass through and form a solid foundation without affecting the groundwater zone.
- Spill kits will be provided at or near the location of oil and fuel storage to contain potential spills and leaks.
- Concrete and cement-carrying vehicles will only be washed out in appropriate wash-down facilities.
- Hazardous material, waste and sewage will be managed in accordance with regulatory requirements.
- Wastewater produced from temporary on-site toilets during construction will be disposed off-site.
- All hazardous materials are to be stored and transported in accordance with relevant OEH and WorkCover guidelines and regulations.
- Any on-site refuelling must occur in an area greater than 100m from the nearest drainage line and ensure correct practices are implemented.

12.5.2. Surface Water

The following measures will be implemented to minimise the risk of pollution and contamination of surface water and to minimise any adverse impacts from changes in hydrology arising from the construction and operation of infrastructure for the Proposal:

- The construction of hardstands and sealed roads may cause minor alterations to drainage patterns due to reduction in infiltration resulting in localised increased runoff. The appropriate drainage structures and erosion controls will be incorporated in hardstands, access roads and tracks to manage run-off and reduce the risk of erosion.
- Outlet structures will be designed in accordance with the DWE guidelines to minimise construction and operation impacts on watercourse and riparian corridors. Considerations include, but are not limited to:
    - any stormwater outlets should aim to be ‘natural’, yet provide a stable transition from a constructed drainage system to a natural flow regime; and
    - All ancillary drainage infrastructure, e.g. sediment traps, should be located outside the riparian corridor. Runoff should be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse is allowed.
- Except for drainage line crossings of access tracks and cable trenches, ground disturbance activities, including road construction and track upgrades and the excavation of footings for turbines, crane pads,

control buildings and substation, as well as soil stockpiling would be located away from natural drainage features where possible.

- The storage of oils, fuels and other hazardous chemicals will be appropriately bunded and located away from watercourses.
- Any spoil stockpiles from foundation excavation and access road construction will be located away from drainage lines, natural watercourses, road surfaces and trees, Stockpiles will be protected against erosion and sedimentation.
- Sediment and erosion controls will be developed in accordance with *Managing Urban Stormwater: Soils and Construction* (Department of Environment and Climate Change (DECC), 2008).
- Water quality and sedimentation control devices will be regularly inspected and maintained to ensure functionality.

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General Environmental Assessment

13. General Environmental Assessment

13.1. Climate and Air Quality

A summary of climate data obtained from the Bureau of Meteorology (BoM) for Goulburn (station number 070037, elevation 702 m), the station nearest to the project site, is presented in **Table 31**.

Table 31 Summary of weather data for Goulburn Station (BoM, 2011)

Weather Conditions	Measurements
Annual rainfall	665.6 mm
Highest monthly rainfall	64.8 mm (January)
Lowest monthly rainfall	47.8 mm (July)
Annual minimum/maximum temperature	7.3˚C/20.1˚C
Highest mean monthly maximum temperature	28.1˚C (January)
Lowest mean monthly minimum temperature	1.3˚C (July)

According to the *Regional State of the Environment Report 2004-2009*, air quality in the Upper Lachlan Shire was generally considered to be acceptable apart from localised smoke from domestic wood fires and occasional dust storms associated with dry conditions. Since there is no routine air quality monitoring in the area there are no ongoing records which can be referenced to assess whether there has been any change in air quality over time.

Emissions from motor vehicles continue to have an impact on outdoor air quality across Australia, although this is most apparent in the larger population centres. Upper Lachlan Shire is unlikely to be exposed to noticeable reductions in air quality due to vehicle emissions, although large numbers of seasonal visitors or an increase in traffic through flow may cause some reduction in outdoor air quality.

13.1.1. Potential Impacts

The majority of the potential impacts to air quality will occur during the construction phase when fugitive dust can be result from a range of activities including:

- vegetation clearing and topsoil stripping;
- excavation;
- road works; and
- construction traffic.

A Construction Dust Management Plan (CDMP) will be implemented and dust deposition gauges will be installed to monitor dust emissions and ensure emissions do not exceed 4 grams per metre squared per month, in accordance with NSW OEH guidelines.

13.1.2. Management and Mitigation

To ensure appropriate mitigation measures are implemented for dust and other emissions a CDMP will be included in the Construction Environmental Management Plan and Operational Environmental Management Plan. Mitigation methods include:

- during excavation topsoil will be stockpiled for later use;
- stockpiled material will be covered with plastic, seeded or otherwise bound to reduce dust emissions.;
- during dry and windy conditions a water cart would be available and applied to access tracks and ground disturbance areas.

13.2. Soils and Landforms

13.2.1. Existing Environment

Upper Lachlan Shire Council's Annual Report (2008-2009) has identified soil erosion, salinity and acid soils as the main sources of land degradation in the Shire. The majority of gully erosion is classified as moderate to severe and the ongoing drought conditions only exacerbate this problem. Salinity is a problem that continues to grow within the Shire predominantly around the lower part in the vicinity of Gunning, Dalton and Collector. Acid soils form the majority of surface soils within the Shire (approximately 88%) (DLWC 2002b) and although many soils in high rainfall areas are naturally acidic, the level of acidity in agricultural areas may be partially due to the application of nitrogenous fertilizers, removal of produce, and build-up of soil organic matter (Upjohn et al. 2005).

The Shire has a particularly complex geology. The project site is situated across a north-south ridgeline of uplifted metasediments and volcanics within the eastern Lachlan Fold Belt. Another steep metasedimentary ridge occurs to the north-west of the site. The eastern edge of the Lake George fault features metasedimentary geology, with shallow, stony loams on steep slopes. West of the fault scarp slope is an undulating granitic plain with deeper, more fertile soils, sometimes with rounded boulders on the surface and in the soil profile. There are also discrete areas which contain Tertiary deposits of gravels, sand, clay, claystone and sandstone (Biosis Research 2004; Brunker and Offenberg 1968).

Slopes range from 0-10% on ridge crests and undulating plains and valleys, to over 20% on range side slopes. Soils within the project site are generally highly eroded.

The land use history within the project site, comprising a mixture of farming (grazing), has some potential to contaminate land through activities such as sheep and cattle dips and diesel refuelling. The Proponent would be in ongoing consultation with the landowners during the pre-construction and construction phases of the Proposal to anticipate any potential contamination issues from farming and grazing before ground is disturbed by construction activities.

13.2.2. Impact Assessment – Construction and Decommissioning

Construction of turbine footings and crane pads would be located on the crests of the undulating landform. Access roads would be constructed over all areas of the landscape; crests, side slopes and foothills. The majority of civil construction works would be located on soils documented as having high to extreme erosion potential. Therefore the management and control of potential erosion, associated landform stability and sediment mobilisation impacts will be undertaken during the construction and decommissioning phases.

Access tracks would be built (or upgraded in the case of existing tracks) to an average width of 8m and up to 10m in some cases to accommodate large loads during the construction stage. After construction the access tracks will be reconfigured to a standard 6m width, with the excess width rehabilitated.

13.2.3. Impact assessment - Operation

The operation of the wind farm is likely to require minimal traffic. Road and track upgrades will have been undertaken prior to the operation phase to accommodate heavy loads associated with the wind farm construction. No soil or landform impacts are anticipated to be generated during the operational phase.

13.2.4. Mitigation Measures

The following mitigation and management measures are proposed to reduce the impact of the Proposal on soils and landform:

- Detailed geotechnical investigations would be undertaken to assess ground conditions and determine the most suitable foundation design for the turbine sites;
- The foundation design will consider the volume of excavation spoil that would be generated and opportunities for reuse of the spoil in the construction of other site infrastructure;
- Where possible, access routes and tracks would be confined to already disturbed areas;
- Subsoil would be separated from topsoil for reinstatement purposes;
- The involved property owners will be consulted to identify any potential areas of contamination resulting from past land use. An unexpected finds protocol will be prepared to outline the procedures to manage any contamination identified or disturbed during excavation works.

13.3. Non-Indigenous Heritage

An assessment of the non-indigenous heritage values of the project site was undertaken by NSW Archaeology (**Appendix H**).

13.3.1. Methodology

The approach to the non-indigenous heritage assessment adopted by NSW Archaeology included the following steps:

- review of non-indigenous heritage registers (including the Australian Heritage Database, State Heritage Register and Local Environmental Plans) to determine whether or not listed historic items are present at the project site;
- review of local and regional historical reports and other relevant documents to provide a contextual framework to the assessment;
- historical overview of the region and local area; and
- comprehensive field survey of the development envelope aimed at locating non-indigenous heritage items.

The results of these reviews and the site survey are discussed in the following sections.

13.3.2. Existing Environment

The historical context of the project site can be considered in terms of the historical themes that have contributed to the history of the Collector locality. The theme of direct relevance to the project site is agriculture/pastoralism, with the land in the vicinity of the wind farm having been used for agricultural purposes for over 180 years. The present day landholding known as *Lerida* – which comprises the majority of the project site - would have been taken up as grazing land in the 1820s as part of a general expansion of pastoral land use southward from the Goulburn area.

The dominant agricultural activity at the project site has been sheep grazing; hence there is the potential for significant heritage items such as stock yards, fences, dams, roads, tree plantings and domestic buildings associated with pastoralism to be present at the project site.

Heritage Items under Local Environmental Plans

The Upper Lachlan Shire Council LEP 2010 and the Gunning LEP 1997, which covers the area within the Yass Valley Council local government area to the south of the project site, list a number of heritage items near the project site**.** The Collector Memorial Hall, Bushranger Hotel, St Bartholomew's Roman Catholic Church, Uniting Church and Cemetery are in the closest proximity to the project site, at a distance of approximately 3.5 km. None of these items are within the project site.

State Heritage Inventory

A search of the State Heritage Inventory database (28th September 2010) revealed that there are five items listed as being present in the local Collector area, four of which are in Collector township. The remaining listed item – Stone Lined Channel Outlet from Murray's Lagoon – is situated approximately 6km south of Collector.

Australian Heritage Database

A search of the Australian Heritage database (28th September 2010) by NSW Archaeology revealed that there are no items listed on the Register of the National Estate located within the project site.

Bicentennial National Trail

The Bicentennial National Trail (BNT) extends through the project site area, following the route of Lerida Road South. The BNT website - http://www.nationaltrail.com.au/ - describes the trail as follows:

The Bicentennial National Trail is the longest marked, non-motorised, self-reliant multi-use trekking route in the world, stretching 5,330 kilometres from Cooktown in tropical North Queensland, to Healesville in Victoria. Following the inspiration of the R. M. Williams, the BNT follows historic coach and stock routes, old pack horse trails, and country roads. The Trail has been designed to be a "living history" of our country, following the routes of early pioneers and highlighting historic sites and artifacts along the way.

The BNT is not listed on either the State Heritage Inventory or the Australian Heritage Database.

13.3.3. Impact Assessment

The desktop survey – involving searches of the Upper Lachlan LEP 2010 and the Gunning LEP 1997, the State Heritage Inventory and the Australian Heritage Database – did not identify any non-indigenous heritage items located within the project site.

A walk-over survey of the development envelope did not identify any items of non-indigenous heritage significance. While there are a number of heritage items in the locality of the project site, including items listed on the State Heritage Inventory, these are all situated more than 3km from the development envelope. It is considered that there would be no impact on these non-indigenous heritage items arising from the Proposal.

Correspondence received from the community and the Bicentennial National Trail Board raised concerns about the potential impacts of the Proposal on the BNT, including impacts on visual amenity for trail users, and access restrictions and safety issues for trail users during the construction phase. Similar concerns were raised through submissions on the now operational Cullerin Range Wind Farm project. The Submissions Report for that project noted that unlike many areas traversed by the BNT, the section along Lerida Road South passes through largely cleared agricultural land with limited heritage value and relatively lower visual amenity when compared with other sections of the BNT.

The presence of farm buildings, the Hume Highway and the twin 330kV transmission lines suggest that the Proposal would be situated in an area already significantly impacted by human activity. Safe access to the section of the BNT traversing the project site would be maintained at all times through all phases of the development. Minor delays could potentially be experienced if a user's visit was to coincide with deliveries of wind farm components; however, this would be unlikely to cause significant disruption. Warning signs would be erected at the entrance to the project site during the construction phase, advising trail users to exercise care when using this section of the BNT.

13.4. Waste Minimisation and Management

13.4.1. Waste Streams

It is anticipated that the construction phase of the project will generate the following waste and waste types in varying quantities:

- scrap metal – generated from surplus steel reinforcements or off-cuts. Scrap metal could be collected and recycled;
- timber – generated from formwork, off-cuts and packaging. This would be segregated for possible reuse but otherwise would be disposed offsite;
- excess concrete – normally generated in minor quantities from concrete deliveries. This could be collected and disposed offsite;
- waste oil, grease and lubricants – generated in minor quantities from repair and maintenance of plant and equipment. These would be collected and disposed offsite;
- office waste – generated from the construction site office. This would be sorted at source for recycling, with the rest disposed offsite;
- general rubbish – generated by the construction workforce. This would be sorted at source for recycling, with the rest disposed offsite; and
- sanitary systems waste – generated from the site office and various worksites. This will be collected and disposed offsite by licensed contractors.

During operation, the main waste streams anticipated would be the following:

- waste oil, grease and lubricants – generated in minor quantities from repair and maintenance of equipment, including transformers, and from the clean out of oil-water separators where installed. These would be collected and disposed offsite;
- office waste – generated from the site office. This would be sorted at source for recycling, with the rest disposed through an arranged Council or private collection service;
- general rubbish – generated by the on-site workforce and visitors. This would be sorted at source for recycling, with the rest disposed offsite; and
- sanitary systems waste – generated from the site office and various worksites. This will be collected and disposed offsite by licensed contractors.

13.4.2. Potential Impacts

The generation of the various waste streams during construction could have short-term and long-term impacts. In the short-term, the construction contractor would need to establish reuse opportunities or disposal destinations for wastes generated on site. Improper waste management could lead to pollution and contamination (for example, waste oils spilling into waterways), raise potential occupational health issues, create visual impacts, and take up valuable space in the construction sites or site compounds..

13.4.3. Mitigation Measures

Waste will be managed according to a Waste Management Plan based on the hierarchy principles of resource management of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) as follows.

- Energy and water conservation will be promoted through training and use of appropriate signage.
- Purchasing decisions will be made in consideration of recycled content and opportunities for reuse.
- Cleared vegetation will be chipped and used as mulch for revegetation works where practical.

- Bins will be provided in construction and office areas for the collection and segregation at source of wastes and recyclables.
- Liquid and solid waste generated from the wind farm construction shall be assessed and classified in accordance with the *Waste Classification Guidelines* (DECC, 2008).
- Any hazardous waste, including unwashed empty, containers will be stored in appropriate containers on site prior to collection by licensed contractors.
- All working areas will be kept free of rubbish and cleaned up at the end of each work day.
- Any contaminated waste will be contained then disposed of according to regulatory requirements.

13.5. Property Values

There is a community perception that wind farms can adversely affect property values. A community attitudes survey undertaken for the Proposal by Auspoll (2010) (**Appendix D**) indicated that 71% of respondents consider property values to be important, very important or extremely important in relation to the Proposal. According to a study undertaken in the United Kingdom by the Royal Institute of Chartered Surveyors (2004), visual impact, fear of blight and proximity to a wind farm are the main matters with the potential to impact property values. Similar concerns over property values were raised during the community consultation activities for the Proposal.

There are numerous factors with the potential to influence perceived and actual property values in general, including individual perceptions, location, existing land uses, proximity to employment, lifestyle considerations and amenity. Furthermore, in rural areas, the agricultural productivity of a landholding is a key determinant of land value.

More specifically, Hoen et al. (2009), Hinman (2010) and Carter (2011) examined a number of potential mechanisms potentially influencing property values in the vicinity of wind farms. Hoen *et al*. (2009) identified and analysed three potential impacts: area stigma, scenic vista stigma, and nuisance stigma. Hinman (2010) also proposed a fourth: wind farm anticipation stigma. These terms are defined below:

- Area Stigma - concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines.
- Scenic Vista Stigma - concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista. It has as its basis an admission that home values are, to some degree, derived from the quality of what can be seen from the property and that if those vistas are altered, sales prices might be measurably affected.
- Nuisance Stigma - concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values.
- Anticipation Stigma - concern surrounding a proposed or approved wind farm project that is primarily due to factors stemming from a fear of the unknown: a general uncertainty surrounding a wind farm project regarding the aesthetic impacts on the landscape, the actual noise impacts from the wind turbines, and just how disruptive the wind farm will actually be.

Hoen et al. (2009) examined the existence of area, scenic vista and nuisance stigmas. In relation to area stigma, based on a comparison of property values within and outside five miles from the nearest wind farm, the study concluded that there were "…*no statistically significant differences in sale prices between these homes*".

In terms of scenic vista stigma, Hoen et al. (2009) first examined "…*whether the sales prices of homes with varying scenic vistas - absent the presence of the wind facility - are measurably different*" and concluded that "…*not surprisingly, home buyers and sellers consider the scenic vista of a home when establishing the appropriate sales price*". However, in assessing whether homes with minor, moderate, substantial, or extreme views of wind turbines have measurably different sales prices, no statistically significant differences were apparent.

Nuisance stigma was assessed by Hoen et al. (2009) to establish whether the sales prices of homes situated inside one mile of the nearest wind energy facility were measurably different from those located beyond five miles. Noting that the sample size was relatively limited in this case, the analysis found "…*no persuasive statistical evidence that wind facilities measurably and broadly impact residential sales prices*."

Hinman (2010) found that "…*close proximity to an operating wind farm does not necessarily negatively influence property value appreciation rates or property value levels (in percentage terms). The estimation results strongly reject the existence of wind farm area stigma theory".* However, the study results did support the existence of anticipation stigma, although "…*during the operational stage of the wind farm project, as property owners…acquired additional information on the aesthetic impacts on the landscape and actual noise impacts of the wind turbines to see if any of their concerns materialized, property values rebounded*".

Carter (2011) examined residential sale transaction records near the Mendota Hills Wind Farm in Lee County, Illinois, with the analysis showing that "…*wind farms…have not had a statistically significant or reliably quantifiable impact on nearby residential property values*." Notwithstanding the analytical results, Carter (2011) recognised that it is difficult to reconcile public expectations of negative property value impacts with study findings that suggest wind farms do not affect values and noted that "*If the general public believes turbines affect property values, that belief should eventually show up in residential real estate transaction data*."

In August 2009, the NSW Valuer-General undertook an investigation into the impacts of wind farms on surrounding land values. This report, titled Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia, reviewed previous studies into the issue and investigated eight wind farms (in NSW and Victoria) using conventional land valuation analysis of actual market data. The main findings were that:

- wind farms do not appear to have negatively affected property values in most cases;
- the majority of wind farms erected in Australia appear to have had no quantifiable effect on land values;
- a small number of "lifestyle" type properties situated very close (less than 500m) to wind farms in Victoria were found to have lower than expected sale prices, with noise and visual impacts apparently contributing to this; and

- wind farm related impacts on property values can be mitigated by establishing a suitable separation distance between the wind turbines and residential dwellings, with average buffer distances established in NSW considered to be suitable.

The Lawrence Berkeley National Laboratory (Berkley Lab, 2009) conducted a study covering almost 7,500 sales of single family homes situated within 10 miles of 24 existing wind facilities in nine different states of the America and drew the following conclusions:

- no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities.
- although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact.
- to the degree that homes and wind facilities in this sample are similar to homes and facilities in other areas of the United States, the results presented here are expected to be transferable to other areas.

Much of the community concern and commentary around property value impacts is speculative. Qdos Research (2012), as part of community research near the Capital Wind Farm in April 2012, interviewed two real estate agents in the nearby village of Bungendore. Amongst the comments attributed to the agents were: "*The actual effect on sales has been minimal*"; and "*We're still selling properties with views of the wind farm, there's no effect on prices*". These contemporary accounts appear to indicate that the Capital Wind Farm is having limited negative impact on property prices. Given the similar socio-economic environment at Collector, a similar outcome could be anticipated.

A recent NSW Land and Environment Court decisions have found that property value impacts are not relevant considerations in the assessment of wind farms (or any other development). In *Taralga Landscape Guardians v. Minister for Planning and RES Southern Cross Pty Ltd*, in considering a request for compensation of nearby landowners in relation to a possible reduction in property value, Chief Justice Preston found that:

> *If the concept of blight and compensation, as pressed by the Guardians, were to be applied to this private property (a proposition which I reject) then any otherwise compliant private project which had some impact in lowering the amenity of another property (although not so great to warrant refusal on general planning grounds when tested against the criteria in S79C of the Act) would be exposed to such a claim.*
>
> *Creating such a right for compensation would 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 S5(a)(ii) for "the promotion and co-ordination of the orderly and economic use and development of land.*

13.6. Mineral Exploration

The Proposal lies within the Lachlan Fold Belt, a region which is known to contain gold and base metal mineralisation. Significant mineral deposits have been identified in proximity to the project site, including:

- the Wet Lagoon South Prospect; and

- the Breadalbane No.1 Prospect, located approximately 2.7km north of the Hume Highway, where limonite is currently being mined at the Breadalbane Ironstone Quarry.

The general region has been, and will continue to be, of interest to companies for mineral resources exploration. Several areas covered by exploration licences (ELs) exist to the east of the project site, and one EL overlaps slightly with the eastern boundary of the project site (EL 7388, held by Centrex Metals Ltd). No wind farm infrastructure is proposed in this area of the project site; hence no impact on potential mineral exploration or mining activities is anticipated.

13.7. Socio-Economic Considerations

Upper Lachlan Shire, the local government area where the Proposal is located, has a population of approximately 7,500 people, with approximately 2,000 living in the major centre of Crookwell, and the remainder living in other towns, villages and rural areas.

Despite its proximity to the major centres of Goulburn and Canberra, Upper Lachlan Shire is strongly rural in its character and agriculture has always been a feature of the economic and social fabric of the Shire. The Shire is known for its fine wool and potato production but major shifts are occurring in agriculture, including the introduction of new farming methods and diversification of many land holdings toward new ventures, such as olive growing, alpaca wool production and the development of horse studs (ULSC, 2008).

The Upper Lachlan Shire Council prepared a *Socio-economic Portrait* (ULSC, 2010b) which describes some of the socio-economic characteristics of the Upper Lachlan Shire. In the Portrait the characteristics of the workforce were examined, including age, occupation, working patterns and cultures. The main outcomes of the Portrait relating to wellbeing in the area are summarised below.

- The largest occupational groups in Upper Lachlan's workforce in 2006 were managers (43%), labourers (12%) and technicians and trades workers (11%).
- In August 2006, the average worker's income was $598 a week, which was 84% of the South-east NSW workforce average, $708.
- In Upper Lachlan in 2006, there were 3,219 working residents, 2,040 of which were employed locally. This means that approximately 37% of the employed residents were working in surrounding areas due to a shortage of local jobs. This statistic was consistent across all age groups.
- There were few occupations where there were more local jobs than resident workers. The smallest labour imbalances, offering possibly the best opportunities for getting local jobs, were among: female drivers & operators, female technicians & trades workers, female sales workers, and male administrative workers.

Industries and businesses in the Upper Lachlan were examined in the Portrait using Census and more recent data from the Australian Tax Office to investigate changes in production patterns since 2001. The main outcomes of the analysis relating to production in the area are presented below. The largest industry by employment is rural production employing 43% of the workforce in the area. **Table 32** shows the largest industries by employment for the Upper Lachlan Shire in 2006.

Table 32 Largest industries by employment for Upper Lachlan Shire in 2006

Industry Type	Counted size	Workforce Share (%)
Rural production	868	43
Health and social care	168	8
Retail trade	153	8
Education and training	130	6
Public service	116	6

13.7.1. Potential Impacts

SKM (2012) examined wind farm investment and employment impacts in Australia on a per megawatt (MW) basis, including calculation of the impacts of an example 50 MW wind farm. In terms of investment, the study found that a typical 50 MW wind farm:

- Has an estimated average construction workforce of 48 people with each worker spending $25,000 per year in the local area. This equates to some $1.2 million per year flowing into hotels, shops, restaurants, and other local service providers.
- Employs around five staff for operations and maintenance, equating to an ongoing local annual influx of $125,000.
- Provides up to $250,000 annually in payments to farmers, a proportion of which flows into the local community.
- Provides a community contribution of up to some $80,000 per year for the life of the project.

In terms of local/regional employment, a 50 MW wind farm could be expected to create 48 direct and 112 indirect construction-phase jobs and 5 direct and 12 indirect operation phase jobs.

The construction and decommissioning phases of the Proposal will generate significant employment opportunities for the local population arising from the need to hire a large temporary work force over approximately two years of construction. Employment opportunities include concreting, earthworks, steel works and electrical cabling during construction, and demolition and removal during decommissioning. Indirect employment and business opportunities would involve supply of food, fuel, accommodation and other services that contractors coming to the area would require. Where possible, the Proponent will source supplies and services from local providers.

There will be some short-term restriction on the involved landowners' agricultural operations during the construction phase. However, considering the relatively limited extent of landholding to be affected during construction, the potential impacts are considered unlikely to significantly disrupt agricultural production. All involved landowners will be compensated by the Proponent for any disruption to their operations.

To ensure that the local communities benefit from the construction phase of the Proposal, local contractors will be used where feasible. This will involve the Proponent liaising with local industry representatives to canvass the full potential of local resources. A number of local businesses have already made themselves and their services known to the Proponent.

Community wellbeing will be positively influenced by the Proposal in a number of ways, including:

- the short term increase in population resulting from the influx of workers during construction and decommissioning phases will infuse money to the local economy in Collector and surrounds;
- the investment of money from the Community Investment Fund (the Fund) into local community projects;
- the number of skilled, full-time job opportunities, both for the Proponent and for contractors which will provide maintenance services to the wind farm facility, will increase during the operation phase; and
- tourists attracted to the area during the operation phase of the project will bring money to the local economy.

There will also be an increase in the number of jobs available in Upper Lachlan Shire area during the construction of the Proposal. It is estimated that approximately 120 people will be hired for the construction phase of the Proposal, including contracted companies. This estimate is based on similar projects. For example, during construction of the Snowtown (Stage 1) Wind Farm in South Australia, which has 47 wind turbines and an installed capacity of 98.7MW, an average of 55 to 65 workers were on-site each week.

13.7.2. Community Division

Members of the community near the project site have raised concerns regarding social divisions in the community and the breakdown of long-term relationships. Planning Panels Victoria (2006), in its report on the Mount Mercer Wind Farm, made the following observations in relation to the potential for community division:

> *So far as social impacts are concerned…we would observe that a potentially negative 'social division' is…apparent between those who are participating in the project and those who are not. It seems to us that those in the community who are non-participants in the project are perhaps feeling that they have suffered or will suffer an injustice. They perhaps see themselves as potentially bearing a range of impacts from this project – with no compensation, while their neighbours are receiving financial recompense for the same impacts.*
>
> *It may be that social ties within the group arising from other factors are stronger – at least in the longer term. It is also possible that even if the wind farm permit was to be refused or the project did not proceed for some other reason, the social division might remain.*

Upper Lachlan Shire Council's *Community Enhancement Program Policy* (2009b) seeks to offset the potential negative impacts of state significant developments through the establishment of a funding mechanism to contribute to community facilities and services within the Shire. The quantum of funding under the revised Policy is $1,666 per wind turbine. The concept of community investment funding from wind farm projects has also been recognised by the DoPI. Recent project approval conditions have established a requirement for community enhancement funds to offset potential residual amenity impacts associated with wind farm projects.

For example, the project approval for the Boco Rock Wind Farm nominates a figure of $2,500 per turbine as the required contribution to a community fund.

13.7.3. Management and Mitigation

The Proponent is proposing to establish a Community Investment Fund and contribute approximately $180,000 to the fund each year. The fund would be maintained throughout the operational life of the project for investment in community infrastructure and services, sustainability initiatives, local economic and tourist developments, community groups and events etc.

Discussions with the community during the preparation of this EA identified a number of projects in the local area that could benefit from funding. These include renovation of the Memorial Hall, upgrades to facilities at the Collector Oval and a new children's playground. In addition, it was suggested that funds could be made available to community organisations; or to local sporting and social clubs or other community groups to assist their activities and events (for example the Collector Pumpkin Festival). The allocation of funds would be administered by a Committee with representation from the Proponent, the community and Upper Lachlan Shire Council. Committee members and the fund administration model would need to be approved by the Department of Planning.

With the addition of the Fund and other flow on effects to the local economy from the construction and operation of the Proposal, the Upper Lachlan Shire is expected to experience an overall increase in community wellbeing.

13.8. Land Use

In 2004, the main land use in Upper Lachlan Shire was agriculture, accounting for 72% of the total Shire area (OCSE, 2011). This is the most recent land use data available for the area. The areas of cropping and mixed farming land increased by approximately 12,600ha and 19,000ha respectively, while land used for grazing decreased by a similar amount. It is possible that some of these changes may have been the result of prolonged drought conditions. The 2002–03 drought period was the third driest year since 1882.

The shift from grazing to cropping and mixed farming is part of a longer term trend within the Shire. Also, there was a shift in the types of animals being grazed, with a reduction in sheep grazing and increase in alpaca and cattle grazing. According to the Lachlan Catchment Management Authority, industry in the catchment is predominantly agricultural, with dryland cereal production and grazing enterprises being the main industries. Other major enterprises include wool and beef production, horticulture, dairy, feedlots, piggeries and viticulture, as well as a significant irrigation industry producing lucerne and other irrigated crops. Whilst the Lachlan Catchment is only 10% of NSW, it is estimated to produce 14% of the State's agricultural production (LCMA, 2011).

According to a government discussion paper on climate change priorities for primary industries (Fairweather and Cowie, 2007), changes that are likely to impact on agriculture in NSW due to climate change include:

- reduction in the annual average rainfall over much of NSW;

- increases in mean annual temperature and atmospheric carbon dioxide concentrations;
- increased frequency of extreme weather events such as flooding and drought;
- altered distribution and survival of pests and weeds, which are likely to have a significant impact on agricultural production in some regions;
- increased risk of heat stress especially for intensively housed animals and dairy cattle.

For these reasons, key agricultural leaders have publicly recognised that "…*climate change may be the greatest threat confronting Australian farmers and their productive capacity now and in the future"* (CSIRO, 2007). Therefore, the development of land with uses that are compatible with agricultural activities, such as electricity generation from wind power, have potential to provide increased economic security to rural industries. Wind power also provides a renewable and stable substitute for carbon based electricity production.

According to CSIRO (2007), agriculture has a significant role to play in carbon offsetting. This is particularly relevant to the Collector area where agricultural productivity has already been impacted by drought and where climate change projections indicate a continuation of this trend. The Proposal would provide a drought resistant supplementary income stream for involved land owners, compatible with current grazing practices.

13.8.1. Impact Assessment

The potential impacts on land use arising from the Proposal include the following:

- loss of grazing area due to the erection of wind farm infrastructure;
- loss of future productivity of the land;
- discontinuity or restriction to access to certain areas or features;
- conservation pressures from increased access provided by internal access tracks to previously inaccessible environmentally sensitive areas; and
- loss of amenity due to visual, noise and other impacts.

The area within the project site that would be lost to grazing would be limited to that of the development footprint, i.e. approximately 74ha (45ha during construction and 29ha during operation) and any immediate buffer areas. Areas disturbed during construction (extra widths of access roads, construction compounds and laydown areas, etc.) can be rehabilitated, reducing the overall extent of the impacted area. It is considered that the impact of this loss of grazing land on the agricultural productivity of the whole project site is will be very minor.

It is considered that the Proposal will not limit the future productivity of the land within the project site as the wind farm infrastructure will be decommissioned and removed at the end of the economic life of the facility, except for particular internal access roads which may be retained for reasons of fire management or landowner requirement.

While the siting of infrastructure may result in discontinuity or restriction of access to certain areas or features of the project site, the Proposal's wind farm layout has been developed in consideration of keeping all residential and agricultural infrastructure accessible from existing roads within the project site. In general, any

access restriction will be limited to the development footprint, with the wide gaps that will be maintained between rows of WTGs being accessible and useable for activities previously carried out on these areas.

The section of the Bicentennial National Trail within the project site generally follows the alignment of Gunning Collector Road on the south and Lerida Road South on the north. Public access to both of these roads would not be impeded by the Proposal.

New internal access roads may provide access to environmentally sensitive areas which were previously inaccessible. This could lead to a range of potential impacts, from land degradation due to weed infestation and vehicular traffic, to disturbance and possible destruction of fauna habitat from disruptive human activities. The Proponent, as part of its operations management of the wind farm, will restrict any unauthorised access to the project site, not only for reasons of public safety but also to minimise the potential for encroachment on environmentally sensitive areas. It is noted that the Proposal includes a commitment to carry out offsets which seek to restore degraded sections of the Box-Gum Woodland and protect the remaining areas in moderate to good condition.

13.8.2. Mitigation Measures

The following mitigation measures will be implemented to minimise the potential for adverse impact on the predominant land use of the project site, which is agricultural, in particular livestock grazing:

- where sections of the Bicentennial National Trail and other public roads approach operational areas, adequate safety and directional signage will be erected to guide vehicle and pedestrian traffic;
- access to previously inaccessible environmentally sensitive locations will be restricted to landowners and authorised personnel only through measures such as the installation of lockable gates on access tracks;
- the Proposal will carry out offsets to restore degraded sections of the Box-Gum Woodland vegetation community and protect the remaining areas in moderate to good condition within the project site; and
- the design, construction, operation and decommissioning of the Proposal will incorporate the mitigation measures recommended in the visual, noise and other technical assessments so as to minimise any potential impacts on local amenity.

14

APP Corporation

Community & Stakeholder Consultation

14. Community and Stakeholder Consultation

This chapter describes the community and stakeholder consultation activities conducted during the preparation of this EA. The discussion details the Proponent's approach to consultation, the identified project stakeholders, the responses received from the various stakeholders and the outcomes of the consultation activities.

14.1. Consultation Methodology

The Proponent's approach to community and stakeholder consultation reflected the requirements of the *Draft NSW Planning Guidelines: Wind Farms* (DoPI, 2011), which was to "…*undertake a comprehensive, detailed and genuine community consultation and engagement process*". The objectives of the community engagement program were to ensure that the community and stakeholders were:

- Informed about the Proposal, through an ongoing commitment by the Proponent to provide information, allowing a good understanding of the proposed development and the likely impacts;
- Actively engaged on issues of concern to them, to identify and consider options for eliminating or reducing impacts; and
- Given ample opportunity to provide views on the proposal.

14.1.1. Preliminary Consultation

The Proponent met with the DPI on 22 January 2010 to introduce the project and discuss the parameters of the planning assessment process. In consideration of the project scope and size (i.e. greater than 30MW generating capacity), the Proponent sought the opinion of DPI's Director-General on the Proposal's classification as a Major Project under Part 3A of the EP&A Act. The Proposal was declared a Major Project by the Director-General on 15 February 2010.

Subsequent to the declaration, DPI determined that a Planning Focus Meeting, involving Upper Lachlan Shire Council and State government agencies, was not to be convened given the logistical constraints and availability of stakeholder representatives. DPI advised that this consultation would occur via direct contact with the individual agencies, with responses to inform the development of the DGRs for the Environmental Assessment.

14.1.2. Stakeholder Identification and Consultation

The DGRs, issued on 15 October 2010, identified a list of parties to be consulted during the EA process. In addition to these stakeholders, a number of additional stakeholder groups were consulted during the preparation of this EA.

As a Planning Focus Meeting was not conducted for the Proposal, the Department of Planning undertook consultation by letter with the stakeholders identified in the DGRs. The Proponent also directly consulted these stakeholders. **Table 33** lists the stakeholders who were consulted during the preparation of this document.

Table 33 Collector Wind Farm Key Stakeholders

Group	Stakeholder
Local Council	Upper Lachlan Council
	Yass Valley Council
	Goulburn Mulwaree Council
Government	NSW Department of Environment, Climate Change and Water
	NSW Office of Water
	NSW Roads and Traffic Authority
	Department of Defence
	NSW Rural Fire Service
	Land and Property Management Authority
	Murrumbidgee Catchment Management Authority
	Lachlan Catchment Management Authority
	Civil Aviation Safety Authority
	Airservices Australia
	TransGrid
Community	The local community and landowners
	Collector Community Association
	Friends of Collector
Non-Government and Heritage	Aerial Agricultural Society of Australia
	Pejar Local Aboriginal Council
	Onerwal Local Aboriginal Land Council
	Ngunawal Native Title Claimant Group
	Gunning Historical Society
	Goulburn and District Historical Society

The *Draft NSW Planning Guidelines: Wind Farms* (DoPI, 2012) require a Community Consultation Committee be formed. The Collector Community Forum will be established following the commencement of public exhibition of this document. Governance arrangements will be in accordance with Guideline requirements.

14.1.3. Consultation Activities

Summary of Key Stakeholder Engagement and Consultation Activities

A summary of key stakeholder engagement and consultation activities undertaken throughout the course of the Proposal's development up to the stage of project application under Part 3A of the EP&A Act is shown in

Table 34. Further discussion on these activities and the stakeholders involved is provided in the following sections.

Table 34 Stakeholder Consultation Program

Date	Stakeholders	Description
2 December 2009	Upper Lachlan Shire Council (ULSC)	Preliminary introduction to the project. Views and opinions of Council sought regarding planning, consultation and ongoing involvement.
12 February 2010	Department of Planning	Preliminary Consultation – Proponent sought Minister for Planning's opinion on project status under *State Environmental Planning Policy (Major Development) 2005* (Major Development SEPP).
15 February 2010	Department of Planning	Minister for Planning forms opinion that development falls under Major Development SEPP. Assessment of the proposed development will be in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979.*
3 September 2010	Department of Planning	Submission of Major Project Application and Preliminary Environmental Assessment
7 September 2010	Government agencies and other stakeholders	Agency Consultation – Preliminary Environmental Assessment forwarded to agencies seeking comment on matters to be addressed in Environmental Assessment.
21 September 2010	Community, ULSC Councillors, State and Federal MPs	Introductory letter advising of Community Open House and issue of Newsletter #1 (September 2010)
28 September 2010 & 4 October 2010	Local community	Media release and advertisement for Open House #1 via Goulburn Post newspaper, Town and Country Magazine & Lions Club of Gunning Noticeboard.
14 October 2010	Local community	Community Open House #1. Held at Collector Memorial Hall and attended by approximately 100 local residents. Preliminary project information provided together with summary booklet.
14 October 2010	All Stakeholders	Website Update – RATCH-Australia Wind Farm website (www.windfarms.net.au) launched

Date	Stakeholders	Description
21 October 2010	Upper Lachlan Shire Council	Presentation to Upper Lachlan Shire Council to provide overview of project (including planning process and update on technical studies).
October – December 2010	Local community	Ad hoc discussions/meetings with local residents on various aspects of the project.
November 2010	Local community/ULSC Councillors/MPs	Question and Answer Newsletter (in response to issues raised at the Community Open House) distributed to local residents, ULSC Councillors and State and Federal MPs.
10th - 14th November 2010	Local and regional community	Community Attitudes Survey (Auspoll). Undertaken as a component of the ongoing community consultation, the phone survey sought views about the project from 400 residents in the region.
13 December 2010	Collector Community Association (CCA)	Meeting with CCA to discuss community issues/concerns and receive feedback on the Proposal.
14 January 2011	Department of Planning	Submission of revised Major Project Application and Preliminary Environmental Assessment following revisions to wind farm layout and inclusion of additional land portions within the project site
21 February 2011	All residents within 5km of project site, ULSC Councillors and State and Federal MPs	Issue of Newsletter #2 (February 2011) providing update on progress, advertising Community Open House #2 and offering one-on-one consultation sessions with community members.
Late February 2011	Local community and other stakeholders	Media release and advertisement for Open House #2 via Goulburn Post newspaper and Town and Country Magazine.
Late February/early March 2011	Local residents	One-on-one consultation sessions with 10 local residents
3 March 2011	Local community	Community Open House #2. Held at Collector Memorial Hall to provide update on progress through planning process. Attended by approximately 50 local residents and others

Date	Stakeholders	Description
7 March 2011	Friends of Collector	Meeting to discuss concerns over the project held by the Friends of Collector
18 July 2011	Member for Burrinjuck	Briefing on Proposal and consultation activities to Katrina Hodgkinson, member for State electorate of Burrinjuck.
September 2011	Local community and other stakeholders	Media release and advertisement for Open House #3 via Goulburn Post newspaper and Town and Country Magazine.
13 October 2011	Local community	Community Open House #3. Held at Collector Memorial Hall to provide update on progress through planning process and summary of environmental study findings. Attended by approximately 30 local residents
14 October 2011	Upper Lachlan Shire Council	Project update to Council planning and engineering staff
12-13 October 2011	Local residents	One-on-one consultation sessions with 5 local residents
27 November 2011	Friends of Collector	Meeting to discuss concerns over the project held by the Friends of Collector.
May 2012	Local residents	Letters to three residents within 2km of proposed WTG sites seeking consent in accordance *with Draft NSW Planning Guidelines: Wind Farms*.

In addition to the programmed consultation activities described above, the Proponent maintained ongoing open dialogue with stakeholders throughout the environmental assessment period via phone, meeting, email and letter.

Local Councils

Upper Lachlan Shire Council (ULSC), Yass Valley Shire Council and Goulburn Mulwaree Shire Council were consulted during the preparation of this environmental assessment. While the project site falls entirely within the ULSC local government area, the neighbouring Councils were also consulted in accordance with the DGRs. A letter describing the Proposal, accompanied by the Preliminary Environmental Assessment (PEA), was sent to the respective planning managers of the abovementioned Councils.

ULSC, in correspondence to DPI dated 5 October 2010, endorsed the Director-General's Requirements and identified the following additional issues:

- traffic and transport on public roads, including pavement and structure analysis, road safety auditing and horizontal and vertical alignment analysis (see **Chapter 10**); and
- proposed community enhancement program (see **Chapter 13**).

In addition to the consultation in accordance with the DGRs, the Proponent consulted ULSC as follows:

- **Council Presentation** - A formal presentation outlining the Proposal was made to ULSC at its meeting on 21 October 2010;
- **Invitation to Community Open House** – an invitation to the Open House meetings in October 2010, March 2011 and October 2011 was extended to all ULSC councillors and the General Manager; and
- **General Correspondence** – the Proponent's Community Newsletters and community information were forwarded to ULSC.

Whilst the approval for the Proposal resides with the DPI, the Proponent has attempted, where reasonable, to consider and incorporate ULSC's planning requirements into the planning and EA phase of the Proposal, including the *Wind Power Generation Development Control Plan* (as adopted in November 2008) and *Community Enhancement Program Policy* (May 2009). These documents are considered in **Section 3.5**.

Goulburn-Mulwaree Council identified the following issues in relation to the Proposal:

- access to the development, including the route for heavy vehicles (see **Chapter 10**);
- visual amenity (see **Chapter 6**);
- TV reception (see **Section 11.2**); and
- minimal/nil impact to Goulburn Mulwaree landholders from noise (see **Chapter 7**), dust (see **Section 13.1**) and shadow flicker (see Section 11.4.3).

Yass Valley Shire Council identified the following issues:

- visual impacts (see **Chapter 6**); and
- heavy vehicle movements within the Council area (see **Chapter 10**).

Government Stakeholders

Government stakeholders were consulted by both DoPI and the Proponent. **Table 35** outlines the issues raised by government stakeholders and where these issues have been addressed in this EA. **Appendix A** includes the correspondence received from Government stakeholders.

14.2. Community Consultation

The Proponent's approach to community consultation was detailed in the first project newsletter in October 2010, when the following commitments were made:

Table 35 Summary of Government Stakeholder Issues

Stakeholder	Issues Raised	Section
NSW Office of Environment and Heritage	- Threatened species and habitats; - Indigenous Heritage; - Noise and Vibration; - Greenhouse Gas Benefits.	Chapter 8 Chapter 9 Chapter 7 Chapter 4
NSW Office of Water	- Water Quality Impacts; - Soil Erosion and Salinity;	Chapter 12 Section 13.2
NSW Department of Industry and Investment	- Fish Habitat and Passage; - Floodplain and hydrology; - Threatened Species (Fish); - Riparian Vegetation;	Chapter 12 and Appendix G
NSW Roads and Traffic Authority	- Traffic impacts; - Site Access; - Roadworks/Construction impacts.	Chapter 10
TransGrid	- Grid connection	Section 2.4
NSW Rural Fire Service	- No response provided	Section 11.4
NSW Land and Property Management Authority	- Crown lands - Aboriginal Land Claims;	Chapter 3
Murrumbidgee CMA	- Catchment Action Plan; - Biodiversity Assessment; - Soil Erosion.	Chapter 12 Chapter 8 Section 13.2
Department of Defence	- Aviation hazards	Section 11.1
Civil Aviation Safety Authority	- Aeronautical Hazards and Risks; - Obstacle Height and Lighting;	Section 11.1
Airservices Australia	- Infrastructure locations; - Impact on aerodromes and airspace	Chapter 2 Section 11.1
Aerial Agricultural Society of Australia	- No response received	Section 11.1

- Early and inclusive engagement - community engagement activities commenced at the beginning of the development approval process, allowing incorporation of community feedback into the wind farm design and scoping of the detailed environmental studies;

- Open and transparent consultation – the Proponent provided the local community with all relevant information about the project so that they could actively and constructively participate in the project development phase;
- Timely and responsive feedback – the Proponent established a stakeholder database, recording and responding to comments in a timely manner and committed to providing feedback to the community on how their comments have influenced the project;
- Maximise community benefits – The Proponent committed to work closely with the community and Upper Lachlan Shire Council to design the community investment program; and
- Conflict resolution - The Proponent proactively engaged with groups/individuals in an effort to understand concerns and resolve conflict.

The *Draft NSW Planning Guidelines: Wind Farms* (DoPI, 2011) details requirements for consulting with the community, specifically:

> *The proponent must undertake a comprehensive, detailed and genuine community consultation and engagement process. This process must ensure that the community is informed of the proposal, 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 likely impacts. Consultation needs to be genuine and aimed at identifying and considering options for eliminating or reducing impacts, not merely informing communities.*

The Proponent has addressed these requirements throughout the planning phase as described below.

14.2.1. Providing Information to the Community about the Proposal

The Proponent has provided detailed information about the Proposal to allow the community an understanding of the proposed development, the planning process, the technical environmental studies and changes to the proposal. Detailed information was provided formally to the community at three key milestones via three Community Open House events:

- Project Inception – in October 2010 the Proponent hosted the first Community Open House at Collector to introduce the project to the community and other stakeholders. Basic information about the Proposal, together with details of the planning process and the proposed environmental studies, was included in a newsletter.
- Environmental Study Findings – in March 2011, the Proponent hosted a second Community Open House to provide the community with a summary of the environmental investigations undertaken over the previous six months, including the noise, visual, ecological, aeronautical and traffic assessments. In addition, feedback was sought from the community on the structure and operation of the community fund.
- New Ownership – in July 2011, the Proposal was sold by Transfield Services to RATCH-Australia Corporation (RAC). The third Open House was held in October 2011 to introduce the new proponent and

to provide details of the planning approval process and the opportunities for formal public participation through the Public Exhibition.

All information provided to the community and stakeholders is published on the Proponent's website – windfarms.net.au. This website has been maintained since October 2010, and will continue to be the central repository for information about the Proposal.

Provision of information to the community will continue during the public exhibition phase, when the Environmental Assessment will be available to all stakeholders for review and comment.

14.2.2. Engaging the Community on Issues of Concern

The Proponent engaged the local community from the commencement of the development approval process, seeking to understand the community's views, together with issues of concern. The main forums for community engagement were the community Open House events, which provided an opportunity for the community to seek information about the Proposal, engage with the Proponent, and have questions and concerns addressed.

The Proponent also engaged with the community through local community groups – specifically the Collector Community Association (CCA) and Friends of Collector (FoC).

The Collector Community Association "…*was established in 2006 with the purpose of enhancing the amenity of the Collector community*". The CCA's position on the Proposal is to be "…*recognised as a key stakeholder and active participant in the planning process for the proposed wind farm to ensure that the outcome of the proposal…remains aligned with the CCA's purpose*" (CCA Submission to *Senate Inquiry into Social and Economic Impact of Rural Wind Farms*, 10 February 2011). The Proponent met with CCA on 13 December 2010, seeking assistance with the community engagement program and to gain the Association's perspectives on the development. Dialogue with the CCA was maintained throughout the development approval phase.

FoC was established on 23 January 2011 as "…*an incorporated association formed by members of the community to oppose the establishment of a proposed wind farm at…Collector*" (FoC Submission to the *Draft NSW Wind Farm Planning Guidelines*, 13 March 2012). The Proponent initiated engagement with the FoC in January 2011 with the aim of establishing an open dialogue and understanding the association's concerns. An initial meeting with the FoC was held on 7 March 2011, with a further meeting on 27 November 2011. The Proponent maintained email, letter and phone correspondence throughout the approval phase in an attempt to address FoC's concerns.

As FoC's stated aim is to oppose the Proposal, it was difficult for the Proponent to constructively engage with these stakeholders to identify and consider options for reducing the impacts of the Proposal. Notwithstanding, the Proponent made best endeavours to engage with FoC and all members of the Collector community, by providing access to information and responding to enquiries. The FoC's concerns are addressed further in **Table 36**.

Community engagement will be further formalised through a community consultative committee, formed and administered in accordance with the requirements of the *Draft NSW Planning Guidelines: Wind Farms*.

Applications for membership of the committee will be sought, with the requirement that members represent the interests of the community, Upper Lachlan Shire Council, host landowners and the proponent. The committee - which is to be maintained for the life of the project - will be facilitated by an independent chairperson approved by the Department of Planning and Infrastructure.

14.2.3. Allowing Ample Opportunity for the Community to Provide Views on the Proposal

For the duration of the development approval process the Proponent is seeking to ensure that the Collector community are appropriately informed about the Proposal and given maximum opportunity for participation in the decision-making process. The Proponent has achieved this in a number of ways through various forums - including face-to-face, email, web-based and telephone communication - as described below.

A key aim of the community consultation process was to gather as broad a cross-section of community views as possible. The first community newsletter (September 2010) detailed the opportunities available for the community to contribute to the development process. Both active and passive engagement techniques were used to encourage all community stakeholders to participate, as described below.

- **Single Point of Contact**. The contact details (email and phone) for the proponent's Project Manager were published in the first community newsletter and the community was encouraged to make contact at any time;
- **Community Newsletters**. A series of community newsletters were issued by hand, mail and email to all stakeholders, including the community within 5km of the project site. Newsletters included information packages and invitations to consultation events such as the open house;
- **One-on-one Meetings**. Members of the project team maintained a standing offer throughout the development approval phase to meet with community members one-on-one to address queries or discuss concerns. This forum was relatively under-subscribed, with less than 15 community members requesting these meetings;
- **Community Open House**. The main forum for interaction with the community were the three Open House events, held at Collector Memorial Hall. Project team members were available from early afternoon to early evening, allowing community members to attend at their convenience. The Proponent chose this forum deliberately, as opposed to public meetings, to allow community members the maximum opportunity to interact with the project team. Approximately 100 community members and others attended the October 2010 Open House; 50 attended in March 2011; and 30 attended in October 2011. Other stakeholders including Upper Lachlan Shire Councillors and representatives from the Office of Environment and Heritage, also attended the Open House.
- **Media**. The various consultation forums were advertised in advance through local print media including the Gunning Lions Club Noticeboard, Goulburn Post and Town and Country Magazine.

These various forums provided ample opportunity for the community to provide views on the proposal. Further opportunity is now available through the statutory 60-day public exhibition phase. The Proponent will facilitate this consultation through a series of “shop-fronts” during the early stages of the exhibition period.

The Draft Wind Farm Guidelines require that agreement be sought with all residents with dwellings within 2km of a proposed turbine. There are three residences within 2km of proposed turbines at Collector and agreement was sought by letter in May 2012 in accordance with the Guidelines.

Table 36 summarises the key issued raised by the community and other stakeholders during the community engagement to date. Responses to these matters, and cross-references to the relevant sections of this document for further information are provided.

Table 36 Community Questions and Proponent Responses

Question	Proponent Response	Further Information
Will aviation obstacle lighting (red lights) be required at the Collector Wind Farm?	The Proponent does not anticipate installing aviation obstacle lighting at the Collector Wind Farm unless required to by the Civil Aviation Safety Authority.	**Section 11.1**
Does the Proponent propose to establish a community fund and how would this be administered?	The Proponent proposes to establish a community investment fund to provide assistance to community facilities and services in the locality of the wind farm. The fund will contribute $200,000 per annum to the local community and would be administered by a Committee comprising the Proponent, Council and members of the community.	**Section 13.7**
What is the proposed construction access route to the wind farm site and how will damage to local roads be repaired?	The proposed construction access is directly from the Hume Highway at Lerida Road South. Entering and exiting the site from this point would minimise the need to use local roads and will limit the construction phase impacts on nearby residents. The Proponent will repair any damage caused to local roads by the construction activities.	**Chapter 10**
How will the Proponent address the requirements of the Upper Lachlan Shire Council Wind Farms Development Control Plan (DCP)?	The provisions of the *Upper Lachlan Development Control Plan 2010* as they relate to wind farms are examined for consistency with the proposal **Section 3.5**. The Proposal is essentially consistent with the DCP prescriptions.	**Section 3.5**

Question	Proponent Response	Further Information
How long will it take to offset the greenhouse gas emissions associated with the construction of the wind farm?	The greenhouse gas emissions generated during the manufacture, construction, operation and decommissioning phases (including transport of components, production of concrete and steel) would be offset in less than nine months of wind farm operation.	**Section 4.4**
How will the visual impact of the wind farm be assessed and what is the cumulative impact associated with the Cullerin project?	A comprehensive landscape and visual impact assessment of the Proposal has been prepared. This assessment includes a landscape character assessment, consideration of the visual impact of the wind farm on the local landscape, and assessment of the cumulative visual impacts. The assessment has concluded that the cumulative impact associated with the Cullerin project is acceptable.	**Chapter 6**
Will property values decrease as a result of the wind farm?	A recent study by the NSW Valuer-General into the impacts of wind farms on property values concluded that in most cases wind farms do not appear to negatively affect property value.	**Section 13.5**
Will construction and maintenance workers be employed from the local area?	The Proposal would generate employment in the local area during construction and operation phases. It is estimated that the onsite workforce during the construction phase would peak at around 120 employees. The Proponent will look to recruit and train construction and maintenance workers from the local area and involve local contractors and suppliers in the construction phase of the development.	**Section 13.7**

Question	Proponent Response	Further Information
Who would be responsible for decommissioning the wind farm at the end of its operating life?	Decommissioning of the wind farm at the end of its operating life would be the responsibility of the Proponent. Current development approval conditions in NSW require that a wind farm site is returned to its pre-development condition within 12 months of decommissioning. Furthermore, conditions in lease agreements between the proponent and landowners require that all aboveground infrastructure be removed at the end of the lease. A Decommissioning Plan is included in **Appendix B**.	**Appendix B**
Will there be ongoing consultation with the community?	The Proponent will maintain its community and stakeholder engagement program throughout the development and operation phases of the project. The main forum for community engagement will be via a community consultative committee, in accordance with the requirements of the *Draft NSW Planning Guidelines: Wind Farms* (DoPI, 2011).	**Section 14.2**
The wind farm has the potential to supply electricity equivalent to the needs of 100,000 NSW homes. Is this amount of electricity produced at all times?	The figure of 100,000 homes is an annual average figure based on the expected energy generated by the wind farm, assuming a 230 MW wind farm (i.e. approximately 730 gigawatt-hours of electricity per annum). When wind speeds are too low to generate energy (approximately 5% of the time) no power would be supplied to the grid. On the other hand, when wind speeds allow maximum generation (approximately 10% of the time) the equivalent of approximately 250,000 homes could be supplied.	**Section 4.4**

Question	Proponent Response	Further Information
What is the fire risk associated with wind turbines?	The risk of fire associated with wind turbines is extremely low: approximately 1 fire very 14,000 years. This risk profile is supported by the Victorian Country Fire Authority's *Emergency Management Guidelines for Wind Farms* (2007): "*While there cannot be any guarantee that an installation involved in electricity generation can never malfunction and cause a fire, the potential for fire in wind turbines is inherently low.*"	**Section 11.3**
Will financial compensation be provided to residents within a 5km radius of the wind farm?	No direct financial compensation to individuals is proposed. The Proponent will establish a community investment fund, with a contribution of $200,000 per annum, allowing a share of the wind farm revenue to be directed toward community projects.	**Section 13.7**
Does the Proponent propose to acquire any properties affected by noise and other impacts?	The Proponent does not anticipate acquiring any properties. The wind farm layout will be designed to meet current NSW Government noise guidelines at all neighbouring residences. Other environmental impacts have been assessed and are considered acceptable.	**NA**
What studies are being conducted into the health and social impacts on the community?	The Proponent has undertaken a detailed review of the recent published literature on wind farms and health and has considered the advice of the National Health and Medical Research Council and NSW Health. NHMRC (2010a) states: *This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from*	**Section 11.4**

Question	Proponent Response	Further Information
	wind farms and that any potential impact on humans can be minimised by following existing planning guidelines. There is likely to be a beneficial socio-economic impact from the Proposal on the local community, through employment and local community investment.	**Section 13.7**
How will noise levels be monitored during the operational phase of the wind farm and what enforcement is there if levels are exceeded?	The conditions of approval for the development are expected to require a noise monitoring plan for the operational phase of the project. This would require monitoring of noise levels at nearby residences in the first months of operation. If noise limits are exceeded, the Proponent would be required to take steps to reduce noise levels to comply with the limits.	**Section 7.8**
What is the required separation distance between the wind turbine towers?	The spacing between wind turbines is based on the size of the towers and the wind conditions at the site. For the towers under consideration at Collector a separation distance of between 270 and 450 metres will be required.	**Section 2.3**
Why has the region around Collector been targeted for wind power development?	The Collector area falls within the NSW/ACT Border Region Renewable Energy Precinct, one of six such precincts identified by the NSW Government. These precincts have been established in areas of the state with the best-known wind resources. The Collector site is also very close to the electricity grid (limiting the need for new transmission lines) and has low environmental constraints.	**Section 4.7**

14.2.4. Community Opinions Survey

As a component of the ongoing consultation process, the Proponent engaged Auspoll to undertake a Community Opinion Survey canvassing the local community and businesses. Conducted via phone on 14 November 2010, the sample consisted of 400 residents within a catchment area of 50km (radius) around the proposed wind farm development envelope. The survey report is included as **Appendix C** and the key findings are summarized below.

a. Overall, there was a high level of support for the Collector wind farm development.

- A majority of respondents (68%) said that, based on what they know about wind farms in general and the Collector wind farm specifically, they support the Collector wind farm development.
- Only 14% of respondents oppose the Collector wind farm development.

b. When prompted to select from a list of the important aspects of the Collector wind farm, people tended to see economic effects as the most important.

- The creation of new jobs for the area (83% Important/ Very/ Extremely important); and
- Community investment program (77%).

c. When asked about the main disadvantages of the wind farm (unprompted) people said lifestyle disruptions.

- Turbines creating an eyesore (26%); and
- Operating noise (23%).

d. When asked about the main benefits of the wind farm (unprompted) people tended to talk about the general benefits of wind farms such as:

- Clean energy (44%); and
- An alternative to fossil fuels (15%).

e. The aspects of the landscape people said they enjoyed most were the hills/ the mountain range and the bush.

- The hills/ mountain range (34%);
- The bush/ trees and vegetation (25%); and
- The open landscape/ open space (18%).

f. A small proportion of survey respondents said that the Collector wind farm would have a negative impact on the landscape aspects they enjoyed most.

- the majority of respondents (60%) said *no impact/minimal impact*
- 13% said the wind farm would Ruin landscape/ view/ create an eyesore.

g. There was a low level of awareness of local historical or cultural landmarks.

- More than two thirds of respondents (67%) said they were unaware of historically or culturally significant local landmarks.
- The landmark of which respondents (9%) were most aware was the Bushranger Hotel/Memorial.

h. Sizable minorities were concerned about different aspects of additional wind farms being built in the area in the future.

- When presented with various scenarios involving additional wind farms in the area, a majority of respondents (57% - 65%) reported that they were *not very/not at all concerned*.
- Sizable minorities (34% - 42%), however, were *concerned/very concerned/extremely concerned* about the *prospect* of additional wind farms in the area.

i. Respondents tended to say they had a little information about the Collector wind farm but fewer than half the respondents wanted more information.

- A majority (58%) of respondents indicated that they had heard little about the Collector wind farm project.
- One third of respondents (33%) felt they had heard nothing;
- 42% did not want any more information about the proposed Collector wind farm;

j. Respondents tended to rate alternative energy sources as highly important.

- A large majority of respondents (79%) rated it as very/extremely important that Australia develops alternative energy sources such as wind, solar, tidal and hydro-electric power

Whilst survey results are limited to a sample size of 400, results provide a good indication of general community trends and opinions. These results show a close correlation to those obtained during a recent study conducted by AMR Interactive (2010) for the NSW Department of Environment Climate Change and Water - *Community Attitudes to Wind Farms in NSW*. The survey concluded that 80% of respondents support/strongly support the building of wind farms in their local region (i.e. <10km from their residence).

14.3. Conclusion

This chapter has outlined the various consultation activities which were launched and managed for each stakeholder group since the early stages of the planning and development of the Proposal. These activities were designed to maximise the flow of information between the Proponent and the stakeholders and thereby elicit as much input and informed response from the widest range of participants as possible.

The consultation process has placed a deliberate focus on engaging with residents and landowners from the local community. Aware of the potential limitations in access to broadcast and web-based media, the Proponent has ensured that residents and landowners within a 5km radius of the project site were contacted directly and provided information about the Proposal.

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Environmental Risk Analysis

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15.Environmental Risk Analysis

This chapter presents an environmental risk analysis (ERA) to assess the potential environmental impacts associated with the Proposal in the light of proposed mitigation measures and to identify potentially significant residual environmental impacts after the application of proposed mitigation measures.

For the risk analysis, a risk rating has been attributed to each environmental issue in consideration of the associated mitigation measure. The ERA considers the findings of the technical assessments, and information gathered from the consultation with project stakeholders. Consistent with the assessment headings in this EA, the ERA covers the following issues:

- visual amenity and landscape;
- noise and vibration;
- flora and fauna;
- indigenous heritage;
- traffic and transport;
- aeronautical;
- telecommunications;
- EMF;
- fire and bushfire;
- water quality;
- air quality;
- soils and landform;
- non-indigenous heritage;
- waste management; and
- social and economic.

15.1. Approach to Environmental Risk Assessment

The approach to the ERA is high level, using qualitative risk ratings. The analysis is generally in accordance with the Australian Standard AS/NZ 4360 Risk Management in respect of using multi-criteria matrix to identify the likelihood of occurrence ('probability') and the associated outcome ('consequence') of the individual issue. **Table 37** outlines the measure used to determine 'probability' whilst **Table 38** outlines the criteria utilised to determine 'consequence'. **Table 39** combines both probability and consequence in a matrix which is subsequently referenced to provide a risk rating.

Table 40 shows the results of the ERA undertaken for the Proposal. It identifies potential environmental impacts, mitigation measures and any significant residual risks.

Table 37 Measure of Probability Categories

Rank	Probability	Description
A	Almost Certain	Happens often and is expected to occur
B	Likely	Could easily happen and would probably occur
C	Possible	Could happen and has occurred elsewhere
D	Unlikely	Unlikely to happen but may occur
E	Rare	Could happen but only in extreme circumstances

Table 38 Measure of Consequence Categories

Rank	Consequence	Description
1	Extreme	Permanent and catastrophic impacts on the environment; Large impact area; Reportable incident to external agency; Large fines and prosecution; Operational Constraints; Substantial community concern.
2	Major	Permanent and detrimental impacts on the environment; Large impact area; Reportable incident to external agency; May result in large fines and prosecution; Operational constraints; high level of community concern.
3	Moderate	Substantial temporary or minor long term detrimental impacts on the environment; moderate impact area; Reportable incident to external agency; Action required by reportable agency; community interested.
4	Minor	Minor detrimental impacts on the environment; small impact area; Reportable incident internally; No operational constraints; some local community interest.
5	Low	Nil or temporary impacts on the environment; small or isolated impact area; Not reportable incident; No operational constraints; uncontroversial project no community interest.

Table 39 Risk Matrix

Probability	Consequences				
	1 Extreme	2 Major	3 Moderate	4 Minor	5 Low
A (Almost Certain)	E	E	E	H	H
B (Likely)	E	E	H	M	M
C (Possible)	E	E	H	M	L
D (Unlikely)	E	H	M	L	L
E (Rare)	H	H	M	L	L

Taking into account the mitigation measures detailed throughout this EA and within the associated technical studies, **Table 41** attributes an environmental risk rating to each of the potential environmental issues.

Table 40 Environmental Risk Assessment after Application of Mitigation Measures

Environmental Issue	Project Phase	Source of or Nature of Risk	Prob.	Cons.	Risk Rating
Visual Amenity and Landscape	O	Shadow Flicker	B	4	M
	C/O/D	Landscape Modification	B	4	M
	O	Obstacle (Turbine) Lighting	D	4	L
	C/D	Lighting of Works Area	C	5	L
	C/D	Landscape Scaring	B	4	M
	C/D	Materials stockpiling, dust and waste generation	D	4	L
Noise and Vibration	C/D	Construction noise and vibration	B	4	M
	O	Operation of wind turbines	C	4	M
	C/O/D	Increased vehicle movements	C	4	M
Flora and Fauna	C/D	Removal and/or disturbance of native vegetation	B	4	M
	C/D	Disturbance of habitat corridors	C	4	M
	C/O/D	Increased traffic and human movement	B	4	M

Environmental Issue	Project Phase	Source of or Nature of Risk	Prob.	Cons.	Risk Rating
	O	Blade strike and barotraumas from the operation of turbines	B	4	M
	C/D	Spread of noxious weeds	D	4	L
Indigenous Heritage	C/D	Damage or disturb areas/items of archaeological significance or cultural heritage	D	4	L
	C/D	Uncover unknown items of significance	C	4	M
	O	Reduction in cultural significance of the landscape	D	5	L
	C/O/D	Damage or disturbance of items/places of non-indigenous heritage	D	4	L
Traffic and Transport	C/O/D	Additional vehicle movements increasing adversely impacting local and regional traffic conditions	C	4	M
	C/D	Dilapidation of local/rural roads	C	5	L
	C/O/D	Additional vehicle movements increasing risk of vehicular accidents	D	3	M
	C/D	Restriction of local resident access to certain areas within project site	D	3	M
Aeronautical	C/O	Aircraft impact with infrastructure	E	2	H
	O	Disruption of flight paths and local aeronautical activities	E	5	L
Telecommunications	O	Disruption of telecommunications, navigation and radar signals Interference	C	4	M
EMF	O	Human exposure to elevated levels of EMF	E	4	L
Fire and Bushfire	O	Turbine Fire	E	4	L
	O	Substation/transmission line fire	E	4	L
	O	Ignition of fires due to lightning strike	E	4	L
	C/D	Ignition of fire from plant equipment and machinery	D	4	L
	O	bushfire resulting from the operation of the wind farm	E	1	M

Environmental Issue	Project Phase	Source of or Nature of Risk	Prob.	Cons.	Risk Rating
Water Quality	C/D	Pollution of local waterways and aquifers	D	4	L
	O	Damage to local aquifer recharge points	E	4	L
	C/D	Increased runoff causing concentrated flows	D	4	L
	C/O/D	Potential spills and leaks of fuels, oils and chemical used during construction and operation of the wind farm	C	4	L
	C/D	Removal/damage of riparian vegetation	D	4	L
Air Quality	C/D	Dust generation	C	5	L
Soils and Landform	O	Reduction in quality and potential beneficial use of land within the project site	D	4	L
	C/O/D	Increased erosion and land instability	E	3	M
	C	Exposure and/or disturbance of contaminated land	D	4	L
Waste Minimisation and Management	C/D	Release of hazardous waste through improper handling and disposal	E	4	L
Social and Economic	C/O/D	Changes in local employment	N/A – positive impact		
	O	Diminishing of neighbouring land values	C	4	M
	O	Community Division	D	3	M
	O	Impacts on amenity of the neighbouring properties	D	4	L

In conjunction with the mitigation measures outlined in **Chapter 16**, the residual environmental risks shown in **Table 41** are not considered to be significant and could be managed in the normal course of construction and operation. It is not anticipated that any potential environmental issues will result in extreme outcomes during the lifecycle of the wind farm.

The only environmental issue with a high risk rating is aircraft impact with infrastructure. The probability of this occurring is unlikely however the consequences would be major and likely to result in localised fire and damage to infrastructure.

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Statement of Commitments

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16.Statement of Commitments

In accordance with the DGRs, the Proponent outlines in this chapter its commitments in terms of environmental management and monitoring to mitigate the potential adverse environmental impacts and to gain a net environmental benefit from the Proposal. The draft Statement of Commitments (SoC) is a compilation of the various mitigation measures developed after the detailed impact assessment of the Proposal on identified key environmental issues. It is presented as a set of measures arranged according to environmental issues by project phases, with the desired environmental outcomes, and responsibilities for implementation clearly identified.

This SoC will inform the preparation of a Project Environmental Management Plan (PEMP), the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP), and associated sub-plans that provide more site- and project phase-specific details regarding the environmental management and monitoring measures to be implemented.

16.1. Project Environmental Management Plan

The PEMP is a management document prepared by the Proponent that expands on the final SoC and other project approval conditions into more detailed outcomes. The PEMP will provide the basis for:

- meeting all environmental requirements;
- assignment of environmental management responsibilities between the Proponent and contractors;
- inclusion of environmental requirements into tender documents; and
- continuing management and evaluation of the environmental performance of the project.

The PEMP will be an integral element of the detailed design phase and will form part of any contractual requirements. The PEMP will identify or describe:

- processes for the environmental evaluation of the Proposal;
- environmental risks which may be managed respectively by the Proponent and the contractor;
- the promotion of environmental awareness among employees, contractors and the community;
- the requirements for review and/or audit of environmental documents such as contractors' Environmental Management Plans.

16.2. Construction Environmental Management Plan

The CEMP will be prepared by the primary contractor, in consultation with the Proponent, based on the former's proposed work methods and the environmental outcomes required for the Proposal.

The main aim of the CEMP will be to avoid, minimise and manage any potential environmental impacts arising from construction activities for the Proposal. It will describe in a more detailed and site-specific manner the management measures to be carried out for the activities at various stages of construction. This will include

the definition and allotment of responsibilities among the Proponent, the primary contractor and its sub-contractors. It will also cover the conduct of ongoing stakeholder engagement, system of notification and complaints management during construction.

The CEMP will contain a suite of sub-plans to describe detailed management procedures for key environmental issues. Among the sub-plans projected for development for the construction phase are the following:

- **Threatened Species Management Plan** – this plan will describe measures to minimise the impacts on threatened species of flora and fauna and on Endangered Ecological Communities, including identification and marking of exclusion zones on site;
- **Weed Management Plan** – This plan will outline the protocols for the management noxious weed species onsite with the objective of minimising the potential of risk of introducing noxious weeds into the site or spreading it across and/or beyond the development footprint;
- **Indigenous Heritage Management Plan –** this plan documents the procedures to be followed for impact avoidance or mitigation, and will be developed in consultation with an archaeologist, the relevant Aboriginal communities and the NSW OEH.
- **Traffic Management Plan –** this plan will be prepared in consultation with RTA and ULSC, will outline traffic movements to and from the site as well as within the construction zones. The TMP will describe measures that promote traffic safety for local and regional traffic, construction personnel and landowners who may need to access the project site. The TMP will also establish protocols for construction deliveries, especially of large loads (e.g. cranes, turbine infrastructure);
- **Bushfire Risk Management Plan** – this plan, to be prepared in consultation with RFS and the NSW Fire Brigade, will identify and manage bushfire risks which may arise due to construction activities on site and will describe protocols for responding to a fire during the construction phase. The plan will also identify regulatory requirements relating to fire safety (*e.g.* relevant specifications for chemical storage and refuelling);
- **Emergency Evacuation Plan –** this plan will outline site protocols in the event of an emergency (*e.g.*, chemical spill), including lines of communications among construction personnel and affected residents, safe evacuation routes and muster points, and coordination procedures with State Emergency Response personnel who may respond on site.
- **Soil and Water Management Plan –** prepared in accordance with the Blue Book, the SWMP will describe sediment control procedures and methods to minimise erosion during the construction of the project. The SWMP will guide the preparation of erosion and sedimentation control plans which will cover discrete construction areas and which will account for the changing surface configuration at various stages of construction
- **Construction Waste Management Plan –** this plan will describe measures to minimise waste generation onsite and maximising opportunities for recycling and reuse; and
- **Construction Dust Management Plan –** this plan will describe measures for dust mitigation and control.

16.3. Operation Environmental Management Plan

An Operational Environmental Management Plan (OEMP) will be prepared by the Proponent to describe the environmental management measures to be implemented during the operational phase of the project. This plan will cover not only the operational and maintenance requirements of the wind farm but will also address ongoing monitoring and maintenance of the project site to minimise ecological impacts and to promptly respond to potential community amenity issues.

The OEMP will include the following:

- key operational and maintenance activities;
- identification of statutory obligations and planning approval commitments;
- description of the roles and responsibility of site personnel and visiting contractors;
- monitoring of the following key environmental issues;
    - noise;
    - fauna impacts;
    - dust emissions (from bare ground within the development footprint);
    - fire risks; and
    - operational traffic impacts.

The OEMP will be prepared in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004) and will be submitted for approval to the Director-General no later than one month prior to the commencement of operation of the wind farm.

16.4. Statement of Commitments

The DGRs require the Proponent to prepare a draft Statement of Commitments (SoC) outlining the suite of mitigation measures to avoid, minimise and manage potential environmental impacts resulting from the construction (C), operation (O) and decommissioning (D) of the Proposal. The elements of the Proponent's draft SoC which have been described throughout this EA after the detailed assessment of the key issues are compiled in **Table 41**.

Table 41 Draft Statement of Commitments

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
1.0	**Visual & Landscape**						
1.01	**Visual impact from turbines**	Reduce visual contrast	An off-white or grey colour for the structures will be considered to reduce visual contrast between turbines and the viewing background	Proponent		✓	
1.02	**Visual impact**	Provide screening through landscape planting	The Proponent will undertake landscape planting where screening is deemed appropriate and in consultation with landowners.	Proponent		✓	
1.03	**Visual impact from construction activities**	Reduce visibility of construction activities. .	Safeguards will be enforced to minimise dust emissions during construction. Height of stockpiles will be restricted.	Contractor	✓		
1.04	**Visual impact from night-time lighting**	Minimise light spill from project site	Activities that may require night-time lighting will be minimised and, if necessary, low intensity lighting will be used to minimise glare.	Proponent	✓	✓	
1.05	**Visual impact from site infrastructure**	Site infrastructure sympathetically	Substation and other ancillary infrastructure will be sited sympathetically to mitigate visual impact.	Proponent	✓	✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
2.0	**Noise**						
2.01	**Construction Noise**	Minimise noise impact on receivers	Construction and decommissioning activities will be carried out within the following periods only: • Weekdays – 7am to 6pm, • Saturdays – 8am to 1pm, No work or deliveries will be carried out on Sundays and public holidays, unless previously approved.	Contractor	✓		✓
2.02	**Construction Noise**	Minimise noise impact on receivers	All feasible and reasonable standard work practices specified in the *Interim Construction Noise Guidelines* (DECC, 2009) would be employed to minimise construction noise impacts	Contractor	✓		✓
2.03	**Construction Noise**	Minimise noise impact on receivers	Notification and ongoing consultation with potentially affected receivers will be carried out, especially where potentially noisy works are anticipated.	Proponent and Contractor	✓		✓
2.04	**Noise from Construction Traffic**	Minimise noise impact on receivers	Residents will be notified when deliveries of large loads are scheduled.	Proponent and Contractor	✓		✓
2.05	**Construction Noise**	Minimise noise impact on receivers	Construction plant will be selected on the basis of low inherent potential to generate noise and vibration.	Contractor	✓		✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
2.06	**Construction Noise**	Minimise noise emission from construction plant	Construction vehicles will be fitted with mufflers and low noise emission reversing alarms.	Contractor	✓		✓
2.07	**Construction and Operational Noise**	Management of Noise Impacts	Establishment of Complaints Hotline to allow affected residents to register noise complaints.	Proponent	✓	✓	✓
2.08	**Construction Noise**	Respond to noise complaints	When noise complaints are received, the affected resident will be contacted to identify the source of noise and remedial measures that may be required.	Proponent and Contractor	✓		✓
2.10	**Operational Noise**	Reduction of turbine numbers as required	The wind farm layout will be determined by the chosen turbine model. Turbine locations will be removed from the layout to permit compliance with the SA EPA 35dBA base criterion if required.	Proponent	✓	✓	
2.11	**Operational Noise**	Monitor compliance with noise criteria	Within the first twelve months of operation, monitoring of wind farm noise emissions would be undertaken to assess compliance with noise criteria.	Proponent		✓	
2.12	**Operational Noise**	Address any non-compliance with noise criteria	Where operational noise monitoring indicates the Proposal exceeds noise limits set in the development approval conditions, the following noise mitigation	Proponent		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			measures shall be implemented: • using active noise control functions of turbines; • rectify any manufacturing defects or control settings so that noise can be reduced; or • if excesses still occur, acoustic treatment of non-involved receiver dwellings.				
2.13	**Operational Noise**	Monitoring the effectiveness of operational noise mitigation measures	Should any of the measures in item 2.12 be adopted, their effectiveness will be verified through noise monitoring in the first 12 months following the implementation of mitigation measures.			✓	
3.0	**Flora and Fauna**						
3.01	**Reduction in local biodiversity**	Protect and conserve areas of high conservation value	At the design stage: Infrastructure will be micro-sited with input from an ecologist. Location of infrastructure in areas of moderate to good condition EEC, forest, and woodland will be minimised. Clearing of overstorey and mature vegetation will be minimised. A management plan for the removal of hollow-bearing	Proponent		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			trees will be prepared by an ecologist to minimise impacts to resident fauna. An offset plan will be finalised in consultation with OEH.				
3.02	**Reduction in local biodiversity from the construction footprint**	Minimise extent of construction impact	Impact areas would be minimised through the following measures: cabling would be laid within or adjacent to the road corridor to minimise additional impacts; any trench left open overnight would be inspected at first light for any trapped fauna; materials laydown and stockpiling would make use of existing areas of disturbance or other areas of low biodiversity value, where possible; all construction vehicles will be restricted within the construction zones; work or vehicle tracking within tree drip lines is to be avoided; all onsite staff are to undergo a site induction on the ecological sensitivity of the site;	Proponent and Contractor	✓		
3.03	**Reduction in local**	Retain habitat and	Habitat elements and biodiversity will be retained	Proponent and	✓	✓	✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	biodiversity through loss of habitat	biodiversity elements	through the following measures: impacts to hollow-bearing trees that have not been specifically identified for removal would be avoided; fallen timber would be left in place or moved to a nearby area to retain fauna habitat; where rocky outcrops could not be avoided, a preclearance survey would search and relocate captured reptiles; rocks would be placed in nearby areas, in consultation with an ecologist;	Contractor			
3.04	**Reduction in local biodiversity through introduction and spread of noxious weeds**	Control the introduction and/or spread of noxious weeds	Introduction and/or spread of noxious weeds would be controlled through the following measures: noxious weeds would be controlled according to a Weed Management Plan; where a specific weed risk has been identified, all machinery, equipment and vehicles are to be washed down before entering and leaving the project site; onsite staff and contractors will be educated on noxious weeds management; control of perennial weed grasses within the disturbance	Proponent and Contractor	✓	✓	✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			zone will be carried out 3 to 5 years after construction; and stock access during vegetation and soil disturbance will be managed in coordination with landowners.				
3.05	**Reduction in local biodiversity through degradation of disturbed areas**	Progressively rehabilitate disturbed areas	Rehabilitation would be undertaken progressively in all areas disturbed by the works. Local province native species would be sourced for all revegetation works within native vegetation.		✓		
3.06	**Reduction in regionally and nationally significant species**	Threatened Species Management	A Threatened Species Management Plan (TSMP) will be prepared to minimise impacts on threatened species, including: pre-clearance surveying and monitoring; handling and relocation of wildlife (if found); regular site inspections for injured wildlife; and rehabilitation of areas of high significance.	Proponent and Contractor	✓	✓	✓
3.08	**Bird and Bat Strike**	Monitoring of Bird and Bat Strike	An adaptive management monitoring program for birds and bats would be prepared and implemented. This would include: Intensive monitoring in the first six months of operation	Proponent in consultation with technical specialists		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			as birds and bats are in the process of habituating to the new development; Regular carcass searches, observation of bird avoidance/diversion behaviour and targeted surveys. The monitoring program will include identification of key 'at risk' species including: Little Eagle – searches for foraging activities at the project site. Eastern Bentwing Bat – monitoring during 'high risk' periods, when this species may be foraging in the area. The monitoring program will include a set of feasible management measures that can be implemented to reduce collision risks, if required.				
4.0	**Indigenous Heritage**						
4.01	**Damage or disturbance to sites or items of Indigenous heritage significance**	Minimisation of potential impacts on sites or items of potential indigenous heritage significance	An avoidance strategy will be adopted for recorded trees with possible Aboriginal scars. Previously recorded Aboriginal objects listed on the NSW OEH AHIMS will be avoided during construction, operation and decommissioning of the wind farm.	Proponent and contractor in consultation with Aboriginal Community	✓		

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
4.02	**Damage or disturbance to sites or items of Indigenous heritage significance**	Assess the potential Indigenous heritage impacts in development areas which have not been previously assessed	Additional archaeological assessment will be conducted in any areas proposed to be disturbed which have not been surveyed during the assessment completed to date prior to work commencing.	Proponent in consultation with Technical Specialists	✓		
4.03	**Damage or disturbance to sites or items of Indigenous heritage significance**	Minimisation of potential impacts on sites or items of potential indigenous heritage significance	An Indigenous Heritage Management Plan (IHMP) will be prepared In consultation with an archaeologist, Aboriginal communities and OEH, to document procedures for impact avoidance.	Proponent in consultation with Technical Specialists	✓	✓	
4.04	**Damage or disturb areas/items of Indigenous Heritage**	Management of undiscovered items of Aboriginal and/or archaeological significance	Any items of aboriginal cultural heritage significance (i.e. archaeological items) uncovered during construction will be salvaged prior to the recommencement of construction works. Should human remains be found during the proposed earthworks works will cease and the police notified immediately.	Contractor in consultation with the Proponent and OEH	✓		✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
5.0	**Traffic and Transport**						
5.01	**Adverse impact on traffic during the construction and decommissioning phases**	Minimisation of impact to local and regional traffic	Oversize loads would be transported in accordance with RMS required.	Contractor in consultation with RMS	✓		✓
5.02	**Traffic safety risks from construction vehicles**	Minimise traffic safety risks from movement of construction vehicles	The Lerida Road South entry and exit will be upgraded to accommodate oversize vehicles during the construction phase. Traffic controllers on Hume Highway will be provided to help assist large trucks exiting the site from Lerida Road South and manage any safety risks; Speed limits would be enforced on Lerida Road South and internal access roads at all times during construction.	Contractor	✓		
5.03	**Damage to existing road infrastructure**	Protect existing road infrastructure	Regular road condition surveys will be carried out during construction, operation and decommissioning; A procedure will be established to ensure the ongoing maintenance of access roads during the operation phase.	Proponent / Contractor	✓	✓	✓
5.04	**Amenity impacts**	Minimise potential	Procedures will be established to monitor traffic impacts	Proponent,	✓	✓	✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	from construction and operation traffic	amenity impacts from traffic from the Proposal	on public roads.	Contractor and Technical Specialists			
6.0	**Aeronautical**						
6.01	**Disruption of flight paths and local aeronautical activities**	Minimise risk to aviation	The following information shall be provided to the CASA, AAAA and DoD: as constructed coordinates in latitude and longitude of each WTG; final height of each WTG in mAHD; and elevation at the base of each WTG in mAHD.	Proponent in consultation with technical specialists	✓		
7.0	**Telecommunications**						
7.01	**Potential interference**	Avoid interference with existing telecommunications facilities	Locations of communications towers and requirements of licence holders will be confirmed and input into the micro-siting of individual turbines.	Proponent and Contractor	✓		
7.02	**Prolonged Interference or disturbance of**	Manage and minimise impacts	At the commencement of operation, the Proponent shall offer to undertake a monitoring program of houses within 5km of the wind farm to determine any	Proponent		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	communication links		loss in television signal strength.				
8.0	**Fire and Bushfire**						
8.01	**Bushfire risk during construction**	Manage bushfire risk	A Bushfire Risk Management Plan will be prepared in consultation with the RFS and NSW Fire Brigade. The mitigation measures will include: Construction personnel will be inducted on fire risks. On total fire ban days, restrictions will be placed on certain activities with the potential to cause fires. Basic fire fighting equipment at each active site will be provided, including fire extinguishers, knapsacks.	Contractor	✓	✓	✓
8.02	**Ignition of fire due to mechanical malfunction**	Minimise risk	Dedicated monitoring systems (e.g. SCADA) enable wind turbines to be automatically shut down if ambient temperatures exceed the safe operating range. Wind turbines will be shut down if directed by the RFS in the event of nearby wildfire.	Turbine Manufacturer		✓	
8.03	**Spreading of fire away from wind farm infrastructure**	Minimise risk	The substation would be surrounded by a gravel and area to prevent the spread of fire from the substation and to reduce any bushfire impacts. An Asset Protection Zone (APZ) would be maintained	Proponent and Contractor		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			around the control room and substation buildings, compliant with the RFS guidelines.				
8.04	**Fire due to lightning strike on turbines**	Minimise risk	Lightening conductors will be built into each of the turbines.	Turbine Manufacture		✓	
9.0	**Health and Safety**						
9.01	**Wind farm noise**	Manage community concerns with respect to wind farm noise	The Proponent will establish a complaints management system to respond to noise complaints from the community.	Proponent		✓	
10.0	**Electromagnetic Fields**						
10.01	**Exposure to EMF**	Minimise unnecessary exposure to EMF	The following mitigation and management measures will be implemented: electrical cables will be placed below ground; fencing around structures (e.g. substation) to restrict public access.	Proponent and Contractor		✓	
11.0	**Water Quality**						
11.01	**Pollution of waters**	Minimisation of	A Soil and Water Management Plan (SWMP) will be	Proponent and	✓		

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
		pollution risk to surface and ground water.	prepared to address: water retardation and diversion devices around construction areas; and monitoring and maintenance procedures for erosion and sediment control structures. Suitable perimeter protection and bunding will be provided to the substation transformers to minimise the risk of transformer oil leaks or spills during operation and maintenance.	Contractor			
11.02	**Pollution of local water ways and aquifers**	Minimising risk to water quality	Spill kits will be provided at oil and fuel storages and on vehicles. Hazardous material, waste and sewage will be managed in accordance with regulatory requirements.	Contractor and Proponent	✓	✓	✓
11.03	**Alteration to local hydrology**	Minimising adverse impacts on local hydrology	Appropriate drainage structures and erosion controls will be incorporated in hardstands, access roads and tracks to manage run-off and reduce the risk erosion and scour from concentrated flows.	Proponent, designers and Contractor	✓	✓	✓
11.04	**Pollution or contamination of**	Minimising pollution of surface water	Storages of oils, fuels and other hazardous chemicals will be appropriately bunded.	Contractor	✓	✓	✓

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	local water ways		All trenching works within drainage lines will be rehabilitated immediately. Any spoil stockpiles from foundation excavation and access road construction will be located away from drainage lines,				
12.0	**Soils and Landform**						
12.01	**Ground disturbance**	Minimise alteration to soils and landform	Detailed geotechnical investigations would be undertaken to assess ground conditions and determine the most suitable foundation design for the turbine sites; Soil compaction resulting from vehicle access and laying of materials will be remediated after construction activities Where possible, access routes and tracks would be confined to already disturbed areas.	Proponent and Contractor	✓		✓
13.0	**Waste**						
13.01	**Inefficient resource use and waste generation**	Promote waste hierarchy	Waste will be managed according to a Waste Management Plan as follows: unnecessary resource consumption will be avoided; resource recovery (including reuse of materials,	Contractor and Proponent	✓	✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
			reprocessing, recycling, and energy recovery); and disposal as a last resort.				
13.02	**Inefficient resource use**	Promote efficient use of water and energy	Energy and water conservation will be promoted through training and signage.	Contractor and Proponent	✓	✓	
13.03	**Missed opportunities for recycling and reuse**	Maximise opportunities for recycling and reuse	Purchasing decisions will be made in consideration of recycled content and opportunities for reuse. Cleared vegetation will be chipped and used as mulch for revegetation works Bins will be provided in construction and office areas for segregation of waste and recyclables.	Contractor and Proponent	✓	✓	
13.05	**Loss of amenity and potential contamination from waste generation**	Minimise risks from waste generation and waste handling	All working areas will be kept free of rubbish and cleaned up at the end of each work day. Any contaminated waste will be contained then disposed of according to regulatory requirements.	Proponent and Contractor	✓	✓	
14.0	**Community**						
14.01	**Regional community**	Community	The Proponent is proposing to establish a Community	Proponent		✓	

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	impacts	enhancement and benefit	Investment Fund and contribute approximately $200,000 to the fund each year.				
14.02	**Community information e**	Dissemination of project information	The current website (www.windfarms.net.au) shall be maintained and updated to include relevant project information.	Proponent	✓	✓	✓
14.03	**Community information**	Complaint handling and management	In addition to the wind farm website, a 24-hour hotline will be established and maintained by or on the behalf of the Proponent for the life of the project.	Proponent	✓	✓	✓
14.04	**Community information**	Dissemination of project information	The Proponent will issue newsletters on a regular basis providing information on the project.	Proponent	✓	✓	
15.0	**Land Use**						
15.01	**Access restriction and safety risks to users of public roads and the Bicentennial National Trail**	Minimise access restriction and safety risks	Where sections of the Bicentennial National Trail and other public roads approach operational areas, safety and directional signage will be erected to guide vehicle and pedestrian traffic;	Proponent in consultation with ULSC	✓	✓	
16.0	**Air Quality**						

Item	Impact	Objectives	Mitigation Task	Responsibility	Project Phase		
					C	O	D
	Generation of fugitive dust	Monitor and minimise the generation of dust from ground disturbance, spoil stockpiles and construction traffic	A Construction Dust Management Plan (CDMP) will be prepared as part of the CEMP. Dust levels will be visually monitored and dust suppression (e.g., water sprays) implemented if required. A water cart will be made available and applied to access tracks and ground disturbance areas. Set appropriate speed limits for construction traffic on internal roads.	Proponent and Contractor	✓		✓

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Conclusion

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17.Conclusion

The potential environmental impacts associated with the proposed Collector Wind Farm have been assessed in this Environmental Assessment. The proposed Collector Wind Farm involves the construction, operation and decommissioning (after the facility's economic life projected at 25 years) of up to 68 wind turbine generators and associated civil and electrical infrastructure along the Cullerin Range in the Upper Lachlan Shire and within the NSW/ACT Border Region Renewable Energy Precinct. There are already a number of operating and approved wind farms within this precinct.

With an installed capacity of up to 228MW, the Proposal would generate for the NSW network electricity from renewable energy, which translates to a reduction in greenhouse gases from fossil fuel-based power plants generating an equivalent output. The Proposal is consistent with the State's priorities to secure a reliable electricity supply with an increased renewable energy component, and contributes significantly to the achievement of the State's renewable energy target.

The operation of the Proposal would entail environmental and social impacts, in particular the introduction of visually prominent structures on the rural landscape of the project site, and the loss to agricultural production of land which will be occupied by wind farm infrastructure. As part of the iterative process of project development, the wind farm layout and siting of associated infrastructure have been optimised to avoid areas of environmental significance, minimise disruption to agricultural production, and reduce as much as possible visual, noise and amenity impacts on the host community. The same environmental and sustainability objectives will continue to be significant considerations in the final choice of model and micro-siting of the wind turbines.

The potential environmental impacts from the Proposal were assessed against relevant legislative requirements, government policies and planning instruments, and industry guidelines. The scope of the assessment covered the Director-General's Requirements, the requirements of other State and Federal agencies, and consideration of the wellbeing of community stakeholders. The environmental assessment process entailed systematic consultation with a wide range of project stakeholders. Specialists were also engaged to provide independent predictive modelling and impact assessment expertise in key environmental and technical areas.

The EA has shown that the potential impacts of the Proposal could be avoided or mitigated to reduce any residual environmental risks to insignificant levels. The environmental performance of the Proposal will be continually monitored so that positive environmental and social outcomes are achieved and maintained. The existing land use within the project site will continue concurrent with the operation of the wind farm, thereby maintaining the site's agricultural production capacity. Aside from the reduction in greenhouse gases, opportunities to offset residual loss of native vegetation and habitat through the protection and enhancement of existing habitat will help achieve a net environmental benefit from the Proposal.

It is therefore considered that the construction, operation and decommissioning of the proposed Collector Wind Farm is justified on the basis of the environmental benefits it will bring, even as the range of mitigation measures identified in this EA minimises its potential environmental impacts.

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APP Corporation

References

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18. References

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