Flyers Creek Wind Farm Pty Ltd

Flyers Creek WIND FARM

Environmental Assessment

CHAPTER 16
Safety Aspects

16. Safety Aspects

This chapter of the Environmental Assessment provides a description of potential impacts of the project on human health and safety and the measures to mitigate or eliminate any potential issues.

16.1 Introduction

The principal safety issues identified in connection with the proposed wind farm development relate to:

- Aviation
- Physical safety associated with the turbines themselves
- Electrical safety
- Bushfire risk
- Road safety
- Use of plant and equipment on steep slopes on the site
- Shadow flicker
- Noise
- Infrasound and Health

The project will be implemented in accordance with the relevant safety requirements to ensure the safety of the workforce at the site and the local community. Consideration of the specific aspects listed above is provided in the following sections.

16.2 Air safety

The development of the Flyers Creek Wind Farm involves the construction of up to 44 wind turbine structures that each has a maximum height of up to 150 metres to the top of the turbine blades. Due to the height of the structures the potential implications for aviation safety have been examined and consultation with relevant stakeholders undertaken. Transmission lines are of lower height than the wind turbines but have also been considered by the review. Air safety issues that have been assessed for the proposed project include:

- Proximity of the proposed wind farm to landing fields
- Proximity of proposed overhead power lines to landing fields
- Potential intrusion into air traffic zones and regulatory requirements
- Potential effects on activities such as aerial spraying of agricultural areas

These issues are described in the sections below.

16.2.1 Proximity to aircraft landing fields

There are various classifications of aircraft landing fields. They may be registered, have instrument landing systems or be unregistered and unregulated landing areas. A preliminary review has been undertaken to identify any aircraft landing fields in the area surrounding the wind farm site and findings are described in this section. Whether or not a proposed tall structure would constitute a hazard to the local aircraft using these air fields depends on:

- the orientation of the approaches for the air strips
- the distance and relative height differences between the air strip and the top of the relevant structure
- the local knowledge of the pilot flying to or from the air field

Civil Aviation Advisory Publication (CAAP 92-1) sets out advisory guidelines for unregulated aeroplane landing areas. A “landing area” is defined in CAAP 92-1 as an area of ground suitable for the conduct of take-off and landing and associated aeroplane operations under specific conditions. The figures provided in CAAP 92-1 indicate that the approach and take-off areas that extend to 900m beyond the runway strips should be clear of objects above a 5% slope for day and 3.3% for night operations. It is noted that all of the identified unregistered landing areas surrounding the proposed wind farm site are

either greater than two kilometres from the nearest wind turbine or are associated with landing strips oriented such that landing and take off directions are away from the wind farm.

Orange Aerodrome: There is one registered aerodrome (Orange Aerodrome) about 13 kilometres from the proposed wind farm site. The location of Orange Aerodrome is shown on Figure 16.1. Orange Aerodrome is located 12 kilometres south east of Orange and about 13 kilometres from the nearest wind turbine site. As the definition of "the vicinity" of an aerodrome is 15 kilometres, several of the Flyers Creek wind farm turbines are located within the 15 kilometres vicinity of the Orange aerodrome. Orange City Council, as the operator of the aerodrome, has been consulted about the proposed wind farm and has provided details of the aerodrome's Obstacle Limitation Surfaces (OLS). Orange Aerodrome is described further in Section 16.2.3

Pretty Flats Aerodrome: An additional aerodrome in the broader locality is the Pretty Flats aerodrome (not included in Table 16.1 below), located about eight kilometres east of the Orange aerodrome. It is heavily utilised with three runways. The wind farm site is beyond 15 kilometres from the Pretty Flats aerodrome and is therefore not in the vicinity of that aerodrome.

There are seven identified former, or current, unregistered Aeroplane Landing Areas (ALAs) within five kilometres of the wind farm site. Six of the unregistered landing areas are shown on the 1:25,000 map sheets for Millthorpe (printed 1988) and Carcoar (printed 1989). The maps are dated and many of these are currently not in use. These landing areas are also shown on Figure 16.1 and summary details provided in Table 16.1. Distances shown in Table 16.1 are from the airstrip to the nearest proposed turbine location. The Blayney Airfarmers landing area is also shown on the Carcoar 1:25,000 mapping sheet but is 9 kilometres to the east of the wind farm site.

Local landowners have indicated that there is an additional landing field, not shown on the mapping, to the south west of the wind farm site (See # 7 in Table 16.1).

Table 16.1 – Details of the closest aerodrome and landing areas to the wind farm site

Ref. No.	Approximate Location		Height (m AHD)	Distance from wind farm (kilometres)	Air Strip Orientation
	Easting	Northing			
Orange Aerodrome	698,200	6,304,050	949	13 km to the north	NW-SE and NE-SW
1	692,300	6,282,750	825	Within project boundary	east – west
2	687,850	6,288,250	675	2.2 km west	east – west
3	694,600	6,293,950	925	3.2 km northeast	north – south
4	689,700	6,293,050	850	3.5 km northwest	east – west
5	689,800	6,278,050	675	3.6 km southwest	east – west
6	695,500	6,295,400	935m	5.2 km NNE	east – west
7				Southwest of wind farm site	Take-off & landing directions to the west only
8- "Blayney Airfarmers"	705,000	9,282,500	875m	9 km east	north - south and east – west

The landing areas are discussed below in terms of current usage and/or potential impacts associated with the wind farm development

Landing Area 1 is located on a wind farmer property within the project boundary placement. The proponent has discussed the use of the landing area with the landowner and has been informed that it has not been used for 30 years.

Landing Area 2 is more than two kilometres from the closest turbine and on neighbouring property. The proponent has discussed this landing area with the landowner who has indicated that the landing area is no longer used.

Landing Area 3 is more than three kilometres from the closest turbine and on property unconnected with the wind farm project. While the orientation of the airfield is generally north-south, and toward the wind farm locality, the separation distance and elevation of the landing area enable avoidance of flight paths passing through the wind farm.

Landing Area 4 is 3.5 kilometres from the nearest wind turbine, has an east-west orientation away from the wind farm site and therefore provides adequate clearance for potential take off and landing approaches from the wind turbine structures.

Landing Area 5 is located 3.6 kilometres southwest of the nearest turbine and has an east-west orientation that results in take off and landing directions that avoid the wind farm area.

Landing Area 6 is 5.2 kilometres from the nearest turbine and is oriented away from the wind farm site.

Landing Area 7 An additional landing area is also present in the vicinity of Burnt Yards area but the landowner has advised that both landing and take-off directions are only to the west of the landing area and therefore away from the wind farm site.

The above review has established that identified landing areas surrounding the wind farm site, and which may still be in use, are all more than 2.2 kilometres from the nearest turbine and/or do not have landing or approach paths that would be impacted by the proposed project.

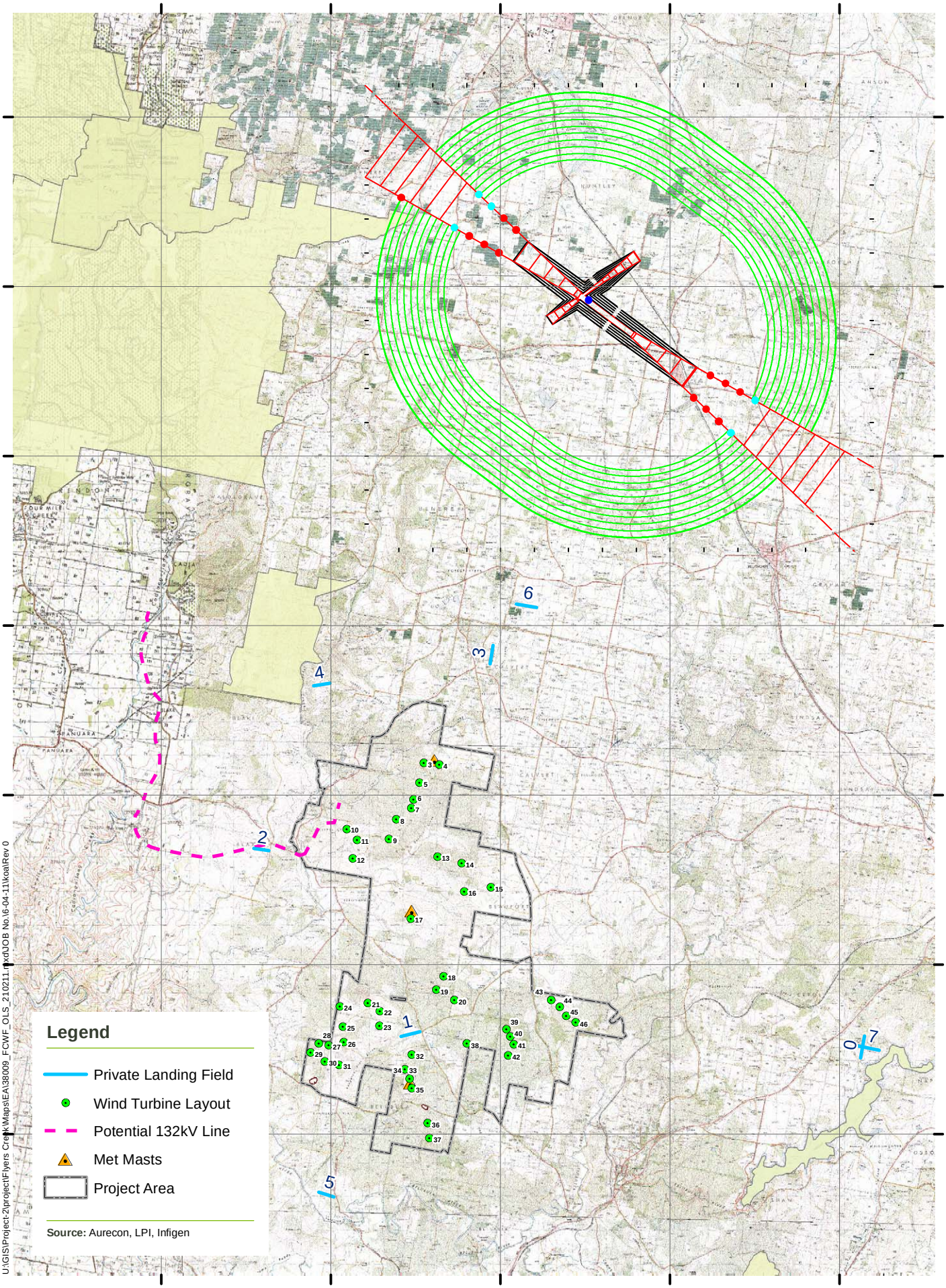
It is expected that usage of the local air fields by the relevant property owners or persons familiar with the respective properties will mean that the location of the wind farm relative to the respective air strip will be well known and as such aircraft movements for the small aircraft involved can avoid the wind turbine structures. Also, the small planes that could use the local air strips will use visual rather than instrument based landings and the turbines are readily identified from long distances.

16.2.2 Civil Aviation Safety Authority requirements

Under Civil Aviation Safety Regulations any person who proposes to construct a structure, the top of which will be greater than 110 metres above ground level, must inform the Civil Aviation Safety Authority (CASA) of that intention and the proposed height and location of the structure.

As the proposed wind turbine structures may have a height up to 150 metres, CASA was provided with details of the proposed layout of the wind farm. In addition, the proponent has consulted with the operator of the Orange Aerodrome, Orange City Council (see Section 16.2.3), and Airservices Australia. The coordinates and elevations of the turbines proposed for the Flyers Creek project are provided in Attachment 1 in Chapter 3.

In the event that the project is approved and proceeds to construction, updated details of the final turbine locations, their elevations and height of the turbine structures will be provided to CASA prior to their erection of the turbines and ‘as constructed’ details following turbine erection so that relevant databases and maps can be maintained with accurate details of the wind farm.



Flyers Creek Wind Farm **Environmental Assessment**

Projection: GDA 1994 MGA Zone 55

FIGURE 16.1: Orange Aerodrome Obstacle Limitation Surface and approaches relative to wind turbine sites

CASA assesses the potential for structures to represent hazardous objects due to location, height or lack of lighting. While CASA did issue guidelines for the lighting of wind turbines, this Advisory Circular has been withdrawn. Based on preliminary analysis and the proponent's experience with the Capital Wind Farm, which was not required by CASA to have obstacle lights, the proponent is confident that a wind farm without lighting will not represent a hazard to aircraft in this location. However, if after further studies and consultation with CASA, it determines that the wind farm does represent a night time obstacle, any lighting requirements specified by CASA will be implemented by Flyers Creek Wind Farm Pty Ltd. These lights would be narrowly focussed obstacle lights mounted on the nacelle as discussed in Chapter 9 to minimise visibility from viewpoints at ground level.

16.2.3 Orange Aerodrome, Obstacle Limitation Surface (OLS) and approaches

The Orange Aerodrome is 13 kilometres north east of the nearest wind turbine (Figure 16.1) and is operated by Orange City Council. The aerodrome is serviced by Regional Express Airlines who operate commercial services between Orange and Sydney. Every registered aerodrome has an Obstacle Limitation Surface (OLS) surrounding the aerodrome and proposed tall structures in the vicinity of the aerodrome must be assessed and should not impinge the OLS.

Obstacle Limitation Surfaces (OLS) are conceptual (imaginary) surfaces associated with a runway, which identify the lower limits of the aerodrome airspace above which objects are regarded as probable obstacles to aircraft operations and must be reported to the Civil Aviation Safety Authority (CASA) for advice. The operator of a registered aerodrome must monitor the airspace around the aerodrome to ensure that buildings and structures do not infringe the OLS.

Orange City Council was notified of the proposed turbine locations and their height. Figure 16.1 shows the relevant aircraft approaches to Orange aerodrome and the location of components of the OLS as advised by Council relative to the proposed wind farm. The OLS includes the inner horizontal surface and outer conical surface. As the OLS only extends 6.5 km from Orange Aerodrome, about half the distance from the aerodrome to the nearest wind turbine, it is clear that the Flyers Creek Wind Farm does not impinge on the Orange Aerodrome OLS.

Airservices Australia was also contacted in regard to the proposed wind farm. Details of the proposed turbine locations, their elevation at ground level and turbine height were provided. Airservices used the information to review the positions of wind turbines relative to the Orange and Bathurst Airports. The vast majority of flights to Orange Airport utilise one of the two published approach paths. However, a Non-Directional Beacon approach (NDB-A) is also available as a back-up. Based on its assessment, Airservices Australia have indicated the proposed wind farm does not have any adverse impact on the published approach routes.

Airservices did recently identify Turbines 3, 4, 19, 20 and 33 as affecting the current NDB-A (approach) procedure. Airservices Australia have indicated that it is very likely that they could make the small modifications necessary to the NDB-A approach plan to accommodate the proposed wind turbine layout. They are currently in the process of confirming this advice.

16.2.4 Aerial agricultural operations

The wind turbine structures are not considered to be safety hazards to aerial agriculture operations as the structures are readily visible and the pilots can easily avoid them. It is noted that where the aircraft undertaking the aerial agriculture operations are taking off with a full load, this would involve a more gradual ascent than would otherwise be the case. Also, they may not be quite as manoeuvrable under full load conditions and some variation to their normal pattern of aerial spreading may be needed. However, experienced agricultural pilots take such issues into account.

As the wind turbines are generally set back from neighbouring properties it is unlikely that the turbine positions would reduce the areas of neighbouring paddocks that can be treated using aerial based methods. It is expected that aerial fertilizing can still be undertaken for neighbour properties if required or as previously has been the case without impediment.

The Aerial Agricultural Association of Australia (AAAA) has been provided with details of the proposed wind farm and invited to comment on the proposal. A response was received in December 2009 and was accompanied by copies of the AAAA standard policies relating to wind farms and transmission lines. The AAAA was also provided with an update on project details once the proposed turbine sites had been selected.

AAAA does not provide advice on specific developments but suggests developers engage local agricultural pilots with expertise in risk assessments and potential impacts. The proponent contacted the late Cliff Kearney of Blayney Airfarmers early in the project development phase, and he indicated that the proposed wind farm site did not concern him.

Beyond identifying numerous risks relating to safety and economic impacts, AAAA policy suggests that provision of detailed information, maps etc. and engagement with local aerial applicators as early as possible in the development process is essential to minimising safety and economic risks. Furthermore the policy suggests new powerlines are clearly marked and developed underground where possible or aligned with paddock boundaries and road easements.

While the views of the AAAA are understood, the wind farms are located on properties where landowners have agreed to the development and understand the implications of the development and potential constraints for aerial applications that may occur within the wind farm. It is expected that aerial operations over neighbouring properties will be unaffected.

16.2.5 Airborne geophysical surveying

The presence of wind turbines has the potential to deter airborne geophysical surveys of areas in close proximity to the wind turbines. The potential risks posed to safety of airborne geophysical operations are similar to those relating to aerial agricultural practices as geophysical survey flights can involve flying as low as 25 metres above the ground. As with aerial agricultural operations, the prominent and highly visible nature of the wind turbines means that they will be able to be easily avoided by pilots.

The NSW Mineral Exploration Handbook and The Airborne Geophysical Survey Major Hazard Standard prepared by WMC Environment, Health and Safety Management reiterate that, as with impacts on aerial agricultural practices, proper planning and identification of risks (turbines, transmission lines etc.) are important processes that must be followed.

As the wind turbines are generally set back from neighbouring properties, it is unlikely that the turbine positions would reduce the areas of neighbouring areas that could be safely surveyed using aerial based methods.

It should also be noted that airborne geophysical surveys of the project area have recently occurred and can continue to be undertaken without any issues up until erection of the wind turbines begins, likely to be no earlier than 2013.

16.2.6 Recreational activities

Recreational use of air space can involve hot air balloons, micro-light and ultra -light aircraft, gliders and parachuting. While these activities could occur within the locality, no such activities have been observed during site visits. The wind farm will be readily apparent to participants in such activities who will be able to avoid the turbines.

16.2.7 Defence Force low altitude flights

The Department of Defence operates low level flights at various rural locations and needs to be aware of the locations of any tall structures. The Department has been advised of the proposed location of the wind farm and its response of 15 November 2010 is provided in Appendix B2. A summary of key points set out below.

- Met masts need to be clearly identified with aviation marker balls
- Wind turbines will not require specific aviation marking if they are painted to contrast with the sky and their surroundings
- Defence Department requires details of the locations and heights of the turbines and met masts as they are above 45 metres height. This information is to be provided before construction commences and 'as constructed'.

The Department of Defence also supplied contact details in case further information was required by the proponent.

16.2.8 Records of data relating to wind turbine structures

CASA, Airservices Australia and the Department of Defence (Royal Australian Air Force (RAAF)) all maintain databases and/or maps of objects or structures that may be relevant to the safety of flying operations.

Prior to construction of the proposed wind farm, Flyers Creek Wind Farm Pty Ltd will provide a plan of the final locations of the wind turbines and details of the height of each wind turbine to CASA, Airservices, Department of Defence and AAAA so that these organisations can record the details in their databases and on relevant maps. The "as constructed" details will also be provided to these organisations once construction is complete.

Having regard to the foregoing, the proposed development will not present an obstacle to aviation.

16.3 Physical safety

As with any tall structure, the safety implications of structural or mechanical failure need to be addressed in the design and installation of the wind turbines.

The issue of physical safety will be addressed primarily through ensuring that all plant and equipment meets the relevant Australian and/or overseas standards. In particular, the turbine structures will be designed and constructed in accordance with the following Standards:

- AS/NZS 1170.2 - Structural Design Actions- Wind Loads
- AS/NZS 1170.4- Structural Design Actions-Earthquake Actions
- AS 2550 - Cranes - Safe Use
- AS 3600 - Concrete Structures
- AS 4100 - Steel Structures (except tower)
- Steel Tower – DIN 18 800
- IEC 61400-1 Wind Turbine Generator Systems - Safety Requirements

In addition, construction works will be carried out in accordance with all relevant requirements of the WorkCover Authority and other statutory requirements.

Other physical safety issues which may be relevant in relation to wind turbines include potential for tower failure, blade separation, ice throw and contact with moving blades. These issues are discussed below.

World wide, rare instances of tower failure and blades being separated from turbines have been reported. Damage may occur as a result of storms, materials fatigue, poor maintenance practices or lightning. However, the risk of such an event occurring is extremely low for the following reasons:

- Catastrophic structural failures of major turbines very rarely occur and when they do it is usually for a very specific reason. For example, a 500 kW Mitsubishi turbine collapsed in Portugal largely as a result of a blade being wrongly installed during routine maintenance (International Energy Association, 2005)
- In Australia, wind turbines are sited in rural areas away from built up areas. Siting turbines in less densely populated areas means there will be less visitation to the wind farms, which reduces the likelihood of a person being present in the highly unlikely event of turbine failure.
- During storm events it is very unlikely that a member of the general public will be in the exposed areas of land where wind turbines will be located. There would have to be exceptional circumstances for people to be in the vicinity of a turbine during a storm event. The people who would be at most risk would be the landowners, their visitors and maintenance personnel. During periods of high wind speeds the turbines incorporate fail-safe shut down mechanisms to avoid damage that might otherwise occur.

Risks are further reduced by a number of design features of modern turbines. For example, the potential for damage due to lightning is reduced by fitting the blades with metal lightning strips and the risk of blade separation is reduced through built in detection systems that warn of impending failure and shut the equipment down for maintenance.

In cold climates, ice may be thrown from the blades from time to time. In these instances a distance equal to the maximum turbine height is generally accepted as the extent of the area that could be affected. The landowners will be advised to avoid the area around the turbines during the few periods of below freezing temperatures each year to avoid the very unlikely possibility of ice formed on the blades becoming dislodged.

The physical safety of the Flyers Creek Wind Farm installation will be further enhanced by:

- its location generally distant from public roads
- provision of signage at property entry points warning people not to enter the private land and approach the turbine
- the incorporation of design features whereby the turbine automatically shuts down when maximum wind speeds for safe operation are exceeded

Another potential physical safety issue is that associated with contact with the moving turbine blades. During operation, there will be at least 30 metres clearance between the turbine blades and the ground below and, accordingly, the risk of people or equipment coming into contact with the moving blades will be negligible.

16.4 Electrical safety

Because of the well known dangers inherent in the generation and transmission of electricity, electrical safety will be a key design consideration. As with mechanical and structural considerations, electrical safety will be achieved through ensuring that plant, equipment and the overall installation are in accordance with the relevant standards or, where necessary, that approval is obtained for an alternative specification. Some of the standards considered include:

- AS/NZS 4853 – Electrical Hazards on Metallic Pipelines
- AS 3000 – Australian SAA Wiring Rules – Some components are pre-wired (eg Nacelle and Control Cabinets) and where non-compliance has been identified they are being re-designed such that they either abide with AS 3000 or approval for any exemptions is obtained via the relevant Electricity Authority
- IEC 61024-1 – Protection of Structures against lightning – Part 1: General Principles
- Specific lightning standards may also apply for the selected wind turbine
- IEEE STD 80 – Guide for Safety in AC Substation Grounding
- IEC 60034 – Rotating Electrical Machines

- BS 4999 – General Requirements for Rotating Electrical Machines.
- BS 5000 – Specification for Rotating Electrical Machines of Particular Types or for Particular Applications Compliance with BS 5000 subject to review.
- IEC 60076-1 – Power Transformers: Part 1 General
- IEC 60146.1.1 Semiconductor converters – General requirements and line commutated converters.
- IEC 62271.100 High-voltage switchgear and control gear – High-voltage alternating-current circuit-breakers
- IEC 60282.1 – HV Fuses (for Rated Voltages greater than 1,000 volts)
- IEC 62271.200 High-voltage switchgear and control gear – A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
- IEC 60529 – Degrees of Protection Provided by Enclosures
- IEC 60947 – Low Voltage Switchgear & Control gear
- IEC 60439.1 – Low Voltage Switchgear & Control Gear Assemblies
- IEC 60269.1 – Low Voltage Fuses - General Requirements

In addition to addressing the above Standards, protective equipment will be installed to detect faults and disconnect the faulted equipment from the system.

The proposed substation will be equipped with an underground earth grid which will extend for a distance of one metre beyond the perimeter fence. Public access to the live electrical equipment within the substation will be prevented by the perimeter fence which will be of chain wire construction some 2 metres high surmounted by four strands of barbed wire.

It is envisioned that overhead cables will be utilised over the gas pipeline; however, there is a possibility that underground 33,000 volt transmission cables will be utilised to cross the gas pipeline that traverses the project area in an orientation roughly parallel to Hall Road. If underground cables are utilised in this area, careful design considerations will need to be given to separation distances between the cables and the pipeline in accordance with the Australian Standard 4853:2000 – Electrical Hazards on Metallic Pipelines.

As with any tall structure in an exposed location it can be anticipated that, from time to time, the wind turbines could be struck by lightning and lightning protection is a standard design feature of all modern wind turbines including:

- metallic conductors running throughout the turbine blades and electrically connected to the metalwork of the structure
- supporting structures sufficiently well earthed to limit the voltage rise during a lightning strike
- internal electrical equipment protected against voltage rises due to lightning

In addition, the 33,000/ 132,000 volt substation will be protected by surge diverters, lightning masts and an underground earth grid.

16.4.1 Electric and Magnetic Fields (EMF)

Wherever electrical equipment operates, electric and magnetic fields (EMFs) are created in the surrounding environment. Over the past 30 years the question has been raised as to whether or not these fields may be harmful to human health. Despite extensive research and numerous public inquiries, adverse health effects have not been established but the possibility has not been entirely ruled out for high voltage lines. In these circumstances, a prudent avoidance approach is warranted in designing and siting new facilities.

The main sources of EMFs that will be associated with the proposed wind farm will be the electrical equipment within the turbine structures, the substation and the interconnecting underground cables and any overhead transmission lines. The fields associated with all of these items will be very localised.

The Flyers Creek Wind Farm will be located in several groupings: Calvert, Fern Hill, Hopkins and Halls-Gap Road, each on elevated ridges that are only occasionally visited by landowners and farm workers. The substation will be approximately 14 kilometres from the Mid Western Highway and on private land at about 500 metres from the Beneree-Errowanbang Road. All equipment will be constructed according to industry accepted practices and standards. The EMFs associated with the proposed wind farm will be well within the relevant health standards and in all cases will be localised to areas not frequented by the general public. On this basis, the possibility of human health effects due to EMF is not considered to be an issue for the project.

16.5 Bushfire risk

A bushfire risk management plan will be prepared by the project contractor in consultation with the local Rural Fire Service and NSW Fire Brigade. The plan will be incorporated in the project EMP. Issues associated with the bushfire risk may involve:

- the potential for the construction activities to initiate a bushfire
- the potential for operational facilities to initiate a bushfire
- the impacts on the facility from a bushfire affecting the site, whether originating from the site or elsewhere and potential for impact on human safety or the facilities

These issues are reviewed in the following sections.

16.5.1 Bush fire risks associated with construction activities

Fires may eventuate from 'hot work' activities, fires within engines or from sparks from friction igniting dry-grass. Accordingly, during the construction phase the following measures will be implemented to manage any bushfire risk:

- The contractor will be required to comply with all relevant sections of the Bush Fires Act and the Fire Brigade Act and all Regulations thereto and will be required to liaise with the Rural Fire Service
- Where necessary, access tracks and work sites will be slashed to remove vegetation in excess of 100 mm high
- All construction vehicles will use diesel fuel
- A mobile 1,000 litre tanker unit complete with motor-driven pump, hose and nozzle will remain at the site during construction work
- Knapsack sprays and McLeod tools will be kept on hand at each actual work site
- In the event of welding, flame cutting or grinding being carried out in the open during periods of fire danger, an observer holding a knapsack spray will be on hand
- The contractor will be required to maintain the exhaust systems of all vehicles on site in sound condition and to avoid any build up of dry vegetation under vehicles
- The use of explosives will not be allowed during periods of high bushfire risk

16.5.2 Bush fire risks associated with operational activities

The potential fire risk associated with electrical failure will be managed by the following measures:

- Use of fully enclosed electrical equipment on turbine structures and padmount transformers
- Extensive use of underground cabling between turbines
- Design of any overhead lines in accordance with industry standards
- Exclusion of vegetation from within the substation enclosure
- Use of circuit breakers and fuses to interrupt any electrical fault
- Adoption of the lightning protection measures described in 12.4 above

16.5.3 Bush fire risk for installed facilities

The risk of damage to the facilities in cleared grazing land is low. For the proposed development, the wind turbine locations are in mostly cleared grazing land or in areas with occasional scattered trees over 100 metres away from the turbines. Therefore, the wind turbines are considered to have a low risk of bushfire damage. There are few signs of bushfire effects in the nearby remnant woodland.

Despite the low overall risk, where turbines are located adjacent to steep slopes that have considerable vegetation cover, there can be a greater risk than those further distant from slopes that include woodland areas. Based on a consideration of effective slope and vegetation, Table 16.3 provides a ranking of the turbine sites to indicate those that may present a greater risk of damage than others.

Table 16.3 – Relative risk of individual turbine being damaged by bushfire

Relative risk of damage from bushfire	Turbines in risk category
Very Low	5, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 27,28,29,30, 32, 33, 35, 36, 38, 42, 43, 44, 45, 46
Low	3, 6, 40,41, 37, 20
Low – Moderate	13,19,20, 31,34, 39

Where practicable and, as part of the ongoing wind farm maintenance, suitable buffers between vegetation and installed equipment, will be maintained.

The buildings at the substation are located within a cleared compound that is set well back from any areas of remnant woodland. It is also proposed that it be located on relatively flat land. The construction site office will satisfy the requirement for safe access and egress. The existing road network surrounds the wind farm site. Within the site, alternative access and egress routes will exist for most wind turbine sites should they be required in the event of an emergency.

The nature of the fire risk in the pastures that dominate the site will depend on the level of grazing. Serious grassfires can occur when not heavily grazed, particularly after a good spring season when grasses are fully cured (Cheney and Sullivan, 2008). Appropriate measures will be included in the site CEMP to protect working areas and control hot work during construction on high fire risk days.

16.6 Road safety

The principal road safety issues associated with the proposed development relate to the construction period and include:

- Increased traffic on roads surrounding the wind farm
- Presence of over-size/heavy loads at certain times during construction
- site entry points used by long loads associated with delivery of turbine equipment

Traffic and transport issues have been assessed Chapter 13 of the EA, including consideration of road safety.

The various traffic safety authorities already regulate the transport of materials and equipment over public roads and Flyers Creek Wind Farm Pty Ltd and its contractors will observe all relevant safety requirements of such authorities. In addition, a Traffic Management Plan will be established for the construction stage of the wind farm development. The Plan will be prepared in consultation with the local Traffic Management Committee.

At other wind farm sites, consideration has been given to motorists stopping along busy local roads to view the wind farm from an unsafe vantage point or being distracted by it. The Flyers Creek Wind Farm is generally more than 500 metres from local roads that all have relatively low traffic volumes. Additionally, the potential for the wind farm to be a distraction to local traffic is a road safety risk but the level is considered to be low and similar to many other aspects that have potential to distract driver. The proponent will work with the Blayney Shire and local landowners to identify a suitable site for a viewing platform including appropriate signage to further reduce the risk of driver distraction or vehicles parking at roadside locations that could present a road safety risk.

16.7 Construction near the gas pipeline

As indicated in Section 4.4, a high pressure natural gas pipeline crosses the wind farm site. The proponent has taken into account the presence of the gas pipeline in the design of the wind farm and as such, other than three to four access tracks and an overhead powerline, no other wind farm structures will be constructed in the pipeline easement.

APA Group has indicated that a risk assessment in accordance with AS 2885.1 – 2007 would need to be undertaken (Appendix B). An initial assessment of risks associated with the pipeline provided in Chapter 8 has identified that potential risks posed by the development of the Flyers Creek Wind Farm are able to be adequately addressed. A further detailed assessment would be undertaken in consultation with APA following granting of consent. The assessment would also identify mitigation measures and management practises which would minimise any possible risks and which would be included in the project environmental management plans.

16.8 Use of vehicle or plant and equipment on steep slopes

At some turbine sites and for parts of some access tracks located on or close to steep slopes there is a risk of accidents for mobile plant or vehicles leaving the track or work area and descending the slope. All such areas will be identified and measures implemented to mitigate the risk. This may include induction relevant to the risk, installation of barriers, warning signs, tapes to alert drivers to the hazard and in some cases observers to watch for and warn drivers of proximity to steep slopes. Access tracks on steep slopes will also be benched into the slopes to provide safe trafficable passage. The risk is reduced by the conduct of construction activities during daylight hours but poor weather, ice, snow and low cloud could increase the risk. Working conditions will be taken into account for the safe management of the works.

16.9 Shadow flicker

Shadow Flicker is a visual effect that occurs when rotating turbine blades cause intermittent shadowing as the blades momentarily pass between the sun and the observer. The effect will occur under circumstances where the turbine location is such that at certain times of the day the sun's rays pass through the blades and affect the viewpoint.

There have been unsubstantiated postings on the internet that shadow flicker may induce seizures in people with photosensitive epilepsy. The turbines that would be used in the Flyers Creek Wind Farm will rotate at between 8 and 18 revolutions per minute. With three blades, this corresponds to a maximum flicker frequency of 1 cycle per second (1 Hz). It is uncommon for epileptics to be photosensitive at frequencies less than 5 Hz (The National Society for Epilepsy (UK), 2005). Therefore, the risk of shadow flicker inducing seizures is not significant.

A consultant was engaged to conservatively estimate the expected annual hours of shadow flicker at all nearby residences. The estimate was done using two conservative assumptions. First, the turbines were always assumed to be "facing" the residence with the axis of the turbine pointed toward the residence to maximise the potential for shadow flicker. Obviously, this "optimum" wind direction would not always be present. In addition, it was assumed that every wind turbine would be operating every minute of the year which means the wind never stopped blowing and no turbines were ever turned off for maintenance.

Even with these very conservative assumptions, no neighbouring residence would experience more than 2½ hours of shadow flicker annually which is well below the notional limit of 30 hours per year.

Details of the shadow flicker analysis appear in Appendix C2 and demonstrate that it is not a significant issue for this project. Health risks posed by shadow flicker on residents or passing motorists within the project area are therefore considered minimal.

16.10 Noise

The noise impacts of the development have been assessed in Appendix G and a summary of the results and the proposed mitigation measures is provided in Chapter 12 of the EA.

The assessment of the operational noise impacts of the wind farm indicates that it can be designed and operated such that it will comply with the very strict noise amenity criteria utilised in NSW.

Construction activities produce a range of noise impacts from a variety of equipment at various distances. At any neighbouring location any noise impact is likely to be of a temporary nature as works progress across the site. Additionally, construction work will occur predominantly during the day and controls will be incorporated to limit noise impacts to established cristeria as described in Chapter 12.

16.11 Infrasound and Health

Early wind turbines were constructed with blades located downwind of the tower. These turbines produced significant levels of infrasound (sound below 20 Hz) as a result of the wake caused by the tower. Modern wind turbines are constructed with blades upwind of the tower resulting in infrasound noise levels well below the level of perception and well below all infrasound criteria.

Much of the speculation regarding the potential health effects of the noise from wind farms is based on the assumption that the noise from wind turbines is unique and therefore has the potential to cause health effects that other noise sources cannot. The frequency content, character and level of noise from wind turbines at typical setback distances to residences is similar to the noise from many naturally occurring and man-made noise sources. The US and Canadian Wind Energy Associations formed an expert panel (Colby et al), which included expertise in medicine, acoustics, audiology and public health.

The panel reached consensus on the following conclusions:

- There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.
- The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.
- The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences.

Further NZ Standard 2010 includes the following statements:

- Measurements show that wind turbine sound does not contain a large proportion of low frequency components.
- Research claiming to show a causal link between wind turbine sound and vibro-acoustic disease has been reviewed during the preparation of the Standard. The research published at the time of this review does not show that a causal link exists.

New South Wales utilises the SA EPA Environmental Noise Guideline for assessment of wind farms which was updated in 2009. The 2009 SA EPA Wind farms environmental guidelines state on page 15, 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 downside 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 consulted the working group and completed an extensive literature search but is not aware of infrasound being present at any modern wind farm site."

In addition, a letter from Worksafe Victoria to the Berrybank Planning Panel in Victoria states:

"*Numerous international reviews on low frequency and infrasound noise, and case studies of actual wind farm noise emissions, have demonstrated that:*

- *there is insignificant infrasound generated from modern wind turbines; and*
- *levels of low frequency sound emitted from modern wind turbines are not at a level that would lead to direct health effects."*

This letter also states that the Victorian Chief Health Officer, Dr John Carnie, has also referred this matter to the National Health and Medical Research Council (NHMRC) for further consideration and advice.

The NHMRC, is Australia's peak Government body for supporting health and medical research and, for developing health advice for the community. It has found no scientific evidence that wind turbines have a direct adverse effect on people's health.

Professor John McCallum, NHMRC Executive Director on Health Evidence and Advice, said that the NHMRC's review of all known published results of infrasound from wind turbines has found that modern wind turbine designs, where rotor blades are in front of the tower, produce very low levels of infrasound.

Findings from the NHMRC report is consistent with advice from the World Health Organization which states that there is no reliable evidence that sounds below the hearing threshold produce physiological or psychological effects.

Based on independent scientific evidence available today, it is concluded that infrasound is not an issue for modern wind turbines.