11. Telecommunications Interference

This chapter of the EA describes the potential telecommunications impacts that have been considered for the project and the measures proposed to mitigate the impacts.

11.1 Introduction

As with other large structures, wind turbines have the capacity to interfere with radio frequency signals, by scattering the signal by forward or backward reflections. The services that could theoretically be affected by wind turbines include aircraft navigation systems, radio signals, television signals, and microwave links.

Although complex, the phenomenon has been studied over many years and is well understood. Nevertheless, in the case of broadcast television signals, due to the variability of local conditions and the characteristics of the aerials used in particular installations, there is a degree of uncertainty regarding predicted levels of interference. The potential for interference to each of the above mentioned communication systems as a result of the wind farm development is described in the following sections. Where applicable, potential mitigation options are identified to address any impacts arising from the development

11.2 Radar

Wind turbines can have negative impacts on radar systems. The project site is located about 30 kilometres to the north-east of Canberra airport, which has an Airservices Australia radar installation operating on the nearby Mt Majura. There are two basic forms of radar, as follows:

- Primary surveillance radar (PSR), consisting of an antenna rotating through 360 degrees sending out pulses of electromagnetic energy, which result in reflections from objects
- Secondary surveillance radar (SSR) using a 360 degree rotating antenna transmitting interrogation signals which trigger responses from aircraft transponders

PSR is used for air traffic control and requires 'line of sight' to the target object for successful detection. Potential effects of wind farms on PSR include:

- Masking or shadowing of aircraft due to the reflection and deflection of radar such that aircraft flying in the "shadow" of turbines are not detected
- Radar clutter resulting from intermittent signals from rotating wind turbines creating a 'twinkling' effect on air traffic control systems
- Scattering, refraction and/or false returns of radar waves from genuine aircraft due to rotating wind turbines

SSR is less vulnerable to interference from wind turbines. Studies show negligible effects where the distance of the turbines from the radar is greater than 5 km.

The Airservices Australia facility on Mt Majura includes radar. A study into telecommunications interference of the wind farm is provided in Appendix J. This shows that some of the southern turbines are within line of sight of Mt Majura and will be just over 30 km from the radar site.

Mitigation measures to reduce the impact of potential radar interference include:

- Placing of turbines away from established flight paths
- Siting of turbines outside line of sight and at distances greater than 30 km

- Technical measures such as Moving Target Indicator (MTI) processing, which removes from the display any returned pulses which indicate no movement or which are within a specified range of Doppler shift.

According to UK Interim Guidelines on the siting of wind farms near civil and military aviation facilities, consultation should be undertaken between the appropriate aviation authorities where turbines are within 30 km of radar facilities or within line of site of these facilities. Renewable Power Ventures has made enquiries regarding potential impacts on the Mt Majura radar facility and its operations and has been informed by Airservices Australia that minor modifications will be required to mitigate any impacts arising from the wind farm development. Renewable Power Ventures will fund the work, which will be conducted by Airservices Australia.

11.3 Radio reception

Within the area surrounding the wind farm there are a number of neighbouring residents who will access various radio broadcasts. In addition, there are a number of locations that have licences to operate a radio frequency transmitter in accordance with their licence conditions.

Apparatus licences are issued by the Australian Communications Authority (ACA) under the *Radiocommunications Act 1992*. The ACA is the federal government authority responsible for regulation and management of the radio communications spectrum. It was formed in July 1997 by the merging of Austel and the Spectrum Management Agency. The ACA authorises licensees to operate radio communications devices, such as transmitters and receivers. In effect, they are licences to use specific segments of the radiofrequency spectrum for particular purposes. The ACA uses a system of apparatus licence types to apply common licence conditions and fee structures to categories of radio communications service. Most licence types allow a number of licensing options, which are differentiated on the basis of the licence conditions and fees payable.

Parts of Australia have been defined as High, Medium or Low density with respect to radio communications. The Capital Wind Farm is within an area classed as a Low Density Geographic Location.

Within about 20 kilometres of the wind farm site there are about 30 sites that are registered on the ACA's web-site for one or more radio communication licences. The licences are held by a variety of organisations including local councils, Rural Fire Services (RFS), Country Energy, Ambulance Service of NSW, NSW Police, Department of Defence, Telstra, Optus, Vodafone and various other local radio users. Many apparatus licences are classified as 'land mobile' licences and enable communications between base stations and land mobile (vehicle based) stations.

Overseas and recent local experience indicates that radio reception and the audio component of television reception are unlikely to be affected by operating wind farms. In regard to the Blayney Wind Farm that was commissioned in 2000, testing of radio reception for Council and RFS signals in the area around the operational wind farm showed that radio reception was not affected at the locations tested. The locations for testing included situations where the radio signal transmission path passed through the operating wind farm.

11.4 Mobile Phone and Microwave Communications

Mobile phone services (public telecommunications services) are provided by the establishment of base stations to provide services in a cell around the individual station.

In relation to the proposed wind farm, a number of mobile phone base stations exist in the area surrounding the wind farm site. These stations potentially provide cover to mobiles in a 360 degree arc around their location. During site investigations at the Capital Wind Farm, mobile phone coverage was

available for elevated locations but absent or intermittent in many of the valleys in the vicinity of the wind farm site. Advice obtained from mobile phone service providers indicates that the services in these rural areas are mainly focussed on the main transport routes such as the Federal Highway. In view of the separation distance between the base antennas and turbine structures, transmission of mobile phone signals may not be significantly affected by the operating wind farm.

Microwave communications use point to point transmission paths that typically occur between two elevated topographic features. The communications have the potential to be affected if part of a wind farm is in line of sight between two microwave stations, or within a zone (typically less than 1 km) of the line of sight. The extent of the impact zone, is often referred to in terms of the Fresnel Zone which varies with the distance between the transmitter and receiver, the frequency of transmission and the location of a particular point along the microwave path. The maximum extent of the Fresnel (interference) zone occurs at the mid-point along the path of the microwave link. Where a wind farm installation may obstruct microwave transmission, an obstruction analysis can be undertaken to ensure that no part of a wind turbine assembly will enter the 1st Fresnel Zone of the existing microwave path.

Appendix J provides an assessment of potential impacts on point to point radio communication services associated with the proposed wind farm layout. Paths of radio links in the vicinity of the wind farm are shown in Figure 11.1. That assessment identified three UHF Links and an Optus microwave link as traversing the wind farm area. It also indicated that the line of sight paths have either vertical or horizontal clearance based on the nominal turbine sites. The link with most potential to be impacted is the UHF link between Cowley Hills and Gibraltar Hill which passes close to the Hammonds Hill Group that is the most elevated Group of turbines for the wind farm. Appendix J found that in all cases the proposed layout has sufficient clearances from communication paths.

11.5 Television Reception

11.5.1 Nature and extent of potential interference

The rotating blades of a wind turbine can cause interference to the visual portion of a television signal. The audio component remains unaffected. The extent of the zone of interference around a wind farm is limited and can be calculated using techniques derived from various scientific literature.

The potential for interference to television reception in the area surrounding a wind farm is outlined below.

The zone of interference for a single wind turbine is primarily an elongated zone extending from the turbine structure in the direction away from the transmitter and a zone of shorter but wider extent on the transmitter side. The shape of the zone of interference from an individual turbine is shown in Figure 11.2. The zone of potential interference for a wind farm is the resultant total of the interference effects from all of the turbines.

The International Telecommunications Union Recommendation ITU-R BT.805 states that impacts beyond 5 kilometres are unlikely. However, it also indicates that interference may extend beyond 5km where the receiver location is shielded from the direct signal, but in direct line-of-sight to the turbine. In such cases the reception even without any wind farm interference is likely to be poor.

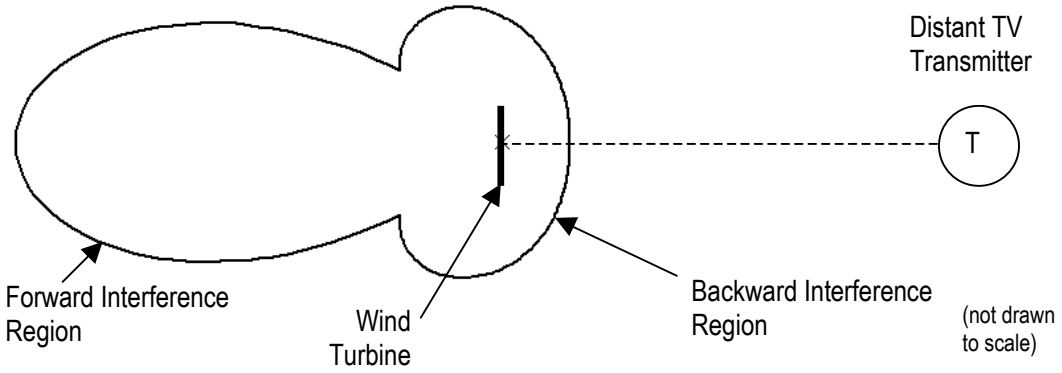

Figure 11.2 – Schematic Diagram of Television Signal Interference Zones around a Wind Turbine

The form of the interference if experienced, will depend on the relative positions of the wind farm, the transmitting station and the receiver. Television interference can take the form of either a "ghost" image that pulsates horizontally at the "blade pass" frequency or a fluctuation in picture brightness, also at the "blade pass" frequency. In the case of the Capital Wind Farm, the "blade pass" frequency would be about 0.75 cycles per second.

11.5.2 Television reception in the Capital Wind Farm locality

Canberra is the nearest and most likely television transmission source for the wind farm locality although in some places north of Bungendore, such as at Tarago, it is understood that residences receive transmission from the more distant Illawarra television transmitter at Knights Hill. Due to the elevated topography between Tarago and the wind farm it is unlikely that many residences immediately around the wind farm would receive the Illawarra television signals. The directions of television transmission from Black Mountain at the Capital Wind Farm site are shown in Figure 11.1.

Details of the Canberra signals transmitted from the Telstra tower located on Black Mountain about 40 kilometres to the south west of the wind farm site are provided in Table 11.1.

Table 11. 1 - Details of Canberra Television Channels

Broadcaster	Channel	Band	Frequency (MHz)
	65	UHF	765
Prime	34	UHF	569.198
WIN	31	UHF	548.198
SBS	28	UHF	527.26
ABC	9	VHF	196.2604
Capital	7	VHF	182.258

Details of the Illawarra signals transmitted from the Knights Hill transmitter on top of the Illawarra escarpment to the south west of Wollongong are shown in Table 11.2 below.

Table 11. 2 - Details of Illawarra Television Channels

Broadcaster	Channel	Band	Frequency (MHz)
Prime	65	UHF	786.198
WIN	59	UHF	744.198
SBS	53	UHF	702.224
ABC	56	UHF	723.224
Capital	62	UHF	765.198

Due to the distribution of neighbouring residences around the wind farm, it is unlikely that any obtaining reception from Illawarra will be adversely affected.

In general, with analog transmissions the potential for interference can increase with distance from the transmitter. In addition, reception in the vicinity of the wind farm can vary with the degree of topographic obstruction of the signal. Measurements of signal strength at locations on top of the ranges indicated good signal strength, while locations at the base of the range on the side away from the transmitter have a lower signal strength.

Signals from Black Mountain become patchy in lower elevation areas along Taylors Creek Road due to shielding from the elevated ridges to the south west. While reception is generally quite strong along the elevated ridges, it is probably very poor in many valleys. Where reception is poor and not viewable, the wind farm impact is irrelevant. However, where reception is viewable at receiver locations there may be potential for interference depending on the location of the receiver relative to the wind farm.

Previous experience at the Crookwell Wind Farm showed that interference was encountered for one neighbouring property about three kilometres to the north east of the wind farm. The Crookwell Wind Farm is more than 90 kilometres from Black Mountain and under the same circumstances has greater potential for interference than is the case for Capital Wind Farm which is much closer to Canberra. However, the topographic relief is much greater at the Capital Wind Farm locality than was the case at Crookwell and as such residences that are unable to receive viewable reception will not be further affected by the development of the wind farm. Some homesteads will already be using satellite TV transmission that is unlikely to be affected by the proposed wind farm.

The assessment of potential television reception interference for the Capital Wind Farm provided in Appendix J concludes that interference may occur as follows:

- VHF TV reception at dwellings within about 1 to 2 kilometres of the wind farm and within plus or minus 25 degrees from the transmission path through the turbines located between the receiver and the transmitter will have a probability of noticeable ghosting
- UHF TV reception at residences 2 to 3 kilometres of the wind farm and within plus or minus 20 degrees from the transmission path through the turbines located between the receiver and the transmitter will have a probability of time variant ghosting.

Digital television signals are also transmitted from both Black Mountain and Knights Hill. Digital signals are not subject to ghosting as analog signals are, however some reduction of service area could result from reflection of signals at the limits of the service area. It is understood that the timing for the full implementation of digital television has been deferred.

At residences where impacts do occur, measures can be implemented to overcome the problems as outlined in Section 11.5.4.

11.5.3 Assessment of potential for interference at receiver locations

A review of the residences surrounding the Capital Wind Farm indicates that a number of them are at a location with some potential for interference. The primary locations that could potentially be affected are immediately to the north east of the wind farm particularly where there is a degree of topographic shielding from direct signals transmitted from Black Mountain near Canberra City. Where severe topographic shielding prevents residences receiving a viewable signal then assessment of interference is not relevant.

Where interference does occur its magnitude is proportional to the strength of the scattered signal from the turbines compared to the strength of the direct signal. In the case where a receiver in close proximity to the wind farm is partly shielded from the transmitter by topography and the turbines are receiving a direct signal, the interference is likely to be more pronounced. This may be the case for the general locality to the north east of the wind farm, but the affected zone would be limited by distance from the wind farm. The actual degree of interference is also related to the turbines orientation, blade section, antenna type and signal strength.

It is possible to perform calculations of the likely interference at a receiver location due to one or more wind turbines. The calculations are generally applicable where topographic variation is limited and have less certainty at locations with considerable topographic relief. In the case of Capital Wind Farm it is not realistic to present definite zones of interference due to the local variations in topography.

The approximate zone of potential interference around the proposed wind farm related to Canberra signals is shown by shading in Figure 11.3 that covers an area to about 2 kilometres from the nearest wind turbine and in the case of UHF time variant ghosting may extend to 3 kilometres from the wind farm. The zone may include some residences located along Taylors Creek Road.

Where the potential for interference exists, the “worst case” wind direction is from the south west or north east which, in practice, is only likely to occur for part of the time. In practice, the turbines are likely to be oriented in an east or west direction for most of the time with the blades at an angle to the signal transmission direction, rather than perpendicular. If interference were to be experienced, this would reduce the period of maximum interference, but would not eliminate the problem.

Factors that will affect the impact of the interference at specific residences are:

- topographic shadowing that limits reception such that reception was unacceptable prior to wind farm commissioning.
- elevated sights that receive a strong direct signal from Canberra may be less affected than sites that have partial topographic screening and receive a weaker signal.
- the degree of interference will reduce with distance from the wind farm.
- whether the residence receives broadcasts via satellite or from Canberra or Wollongong.
- the nature of the reception system used.

Signal strength monitoring for Canberra channels has shown that signal strength at locations to the north east of the turbine sites with some topographic shielding is very poor and further degradation of the signal is irrelevant. Residents in this area that use satellite receiver systems for television reception will not be affected by the wind farm.

Assessments of TV reception at potentially affected residences can be undertaken after commissioning of the wind farm to identify the need for any remedial actions and as required improvements implemented.

11.6 Mitigation Measures

The following mitigation measures are proposed in respect of potential impacts on existing communication services.

- Prior to construction commencing, and in accordance with Airservices Australia's stated requirements, Renewable Power Ventures will contact Airservices Australia to arrange for the required modifications to the Mt Majura Radar system to be undertaken.

- Prior to construction Renewable Power Ventures will ensure that any refinements of the turbine layout have been assessed in terms of their potential impact on fixed line radio links. Where necessary, the relevant communication service operator will be contacted to confirm operational details.

- Due to the potential for interference to television signals in some areas surrounding the wind farm, it is proposed that Renewable Power Ventures investigate and rectify any interference to television reception caused by the project that occurs following commissioning of the wind farm.

- Rectification of reception could initially include modifications to or replacement of the aerials being used or replacement with digital TV, where available. Experience with existing wind farms demonstrates that significant improvements can sometimes be achieved by modifying aerials and digital TV is not subject to ghosting, provided it is not at the limits of the service area.

- In the event that these initial measures are not satisfactory, other measures which could restore reception to a standard similar to that which existed prior to installation of the wind farm could include:

    - the installation and maintenance of a parasitic antenna system,
    - provision of a land line between the affected receiver and an antenna located in an area of favourable reception, or
    - in the event of interference not being able to be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna.

The above measures provide a suite of options by which any interference can be addressed to mitigate its impact.