

Telecommunications Impact Assessment

White Rock Wind Farm – 2010



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1 EXECUTIVE SUMMARY

The objective of this report is to investigate the potential impacts of the White Rock wind farm on existing telecommunication services in the vicinity of the proposal and to propose appropriate mitigation strategies for any impacts identified. An assessment of possible electric and magnetic fields associated with wind farms and their implications on human health is also presented.

Telecommunication services, including television and radio broadcasts, mobile phone services and point to point microwave radio communication services occur in proximity to population centres and often utilise the same ridgelines that provide optimum locations for wind turbines. Theoretically, as with any large structure, wind turbines have the potential to cause interference with such signals.

In general, VHF and UHF frequency band radio signals and digital voice based technologies such as GSM mobile are essentially unaffected by wind turbines. This includes land mobile repeaters, radio, the audio component of analogue television and mobile phones.¹

For broadcast signals which are usually omni-directional (or point to area), interference can generally be avoided by locating wind turbines distant from the broadcast tower. A clearance of at least 500m is recommended, although a distance of 1km is preferred.²

No broadcast or communications towers have been identified within 500m of the White Rock wind farm project. Therefore the development of the proposed wind project is not expected to have any widespread adverse backscatter affect from being near to broadcast or communications towers.

Aviation navigation services such as radar may also potentially be affected by wind turbines depending on the location of the wind farm with respect to the position of radar installations and airports. This issue is likely to be overcome in the future, as aviation authorities across the world increasingly move towards the use of multilateration (MLAT) technology. At the time of writing, no objection to the proposal has been raised by Airservices Australia.

Following a review of the communication services near the wind farm site, the nature of potential interference and consultation with license holders and service providers, it is considered that the proposed wind farm would have minimal impact on existing telecommunications and aviation navigation services. Where applicable, mitigation strategies are proposed to ensure any identified impacts can be managed appropriately.

The electromagnetic fields associated with generation and export of electricity from a wind farm does not pose a significant threat to public health.

Consequently, no adverse electromagnetic interference issues are anticipated from the wind farm.

¹ <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIAnalysisIssue.pdf>

² *ibid*

2 GLOSSARY OF TECHNICAL TERMS

ABA	Australian Broadcasting Authority
ACMA	Australian Communications & Media Authority
Band 111	VHF TV Channels 5A - 12
CB Radio	Citizens Band Radio
CDMA	Code Division Multiple Access cellular mobile system
EMI	Electromagnetic Interference
FM	Frequency Modulation
Fresnel Clearance	Clearance to obstructions from the ray line on a radio path which does not produce any additional loss above free space loss
GSM	Global Systems Mobiles
ITU	International Telecommunications Union
LF	Low Frequency
MF	Medium Frequency
UHF	Ultra High Frequency (300MHz - 3GHz)
UHF Channels	TV Channels 28 - 69 (526 - 820 MHz)
VHF	Very High Frequency (30MHz - 300MHz)
VHF Channels	TV Channels 0 to 12 (45 - 230 MHz)

3 EXISTING ENVIRONMENT

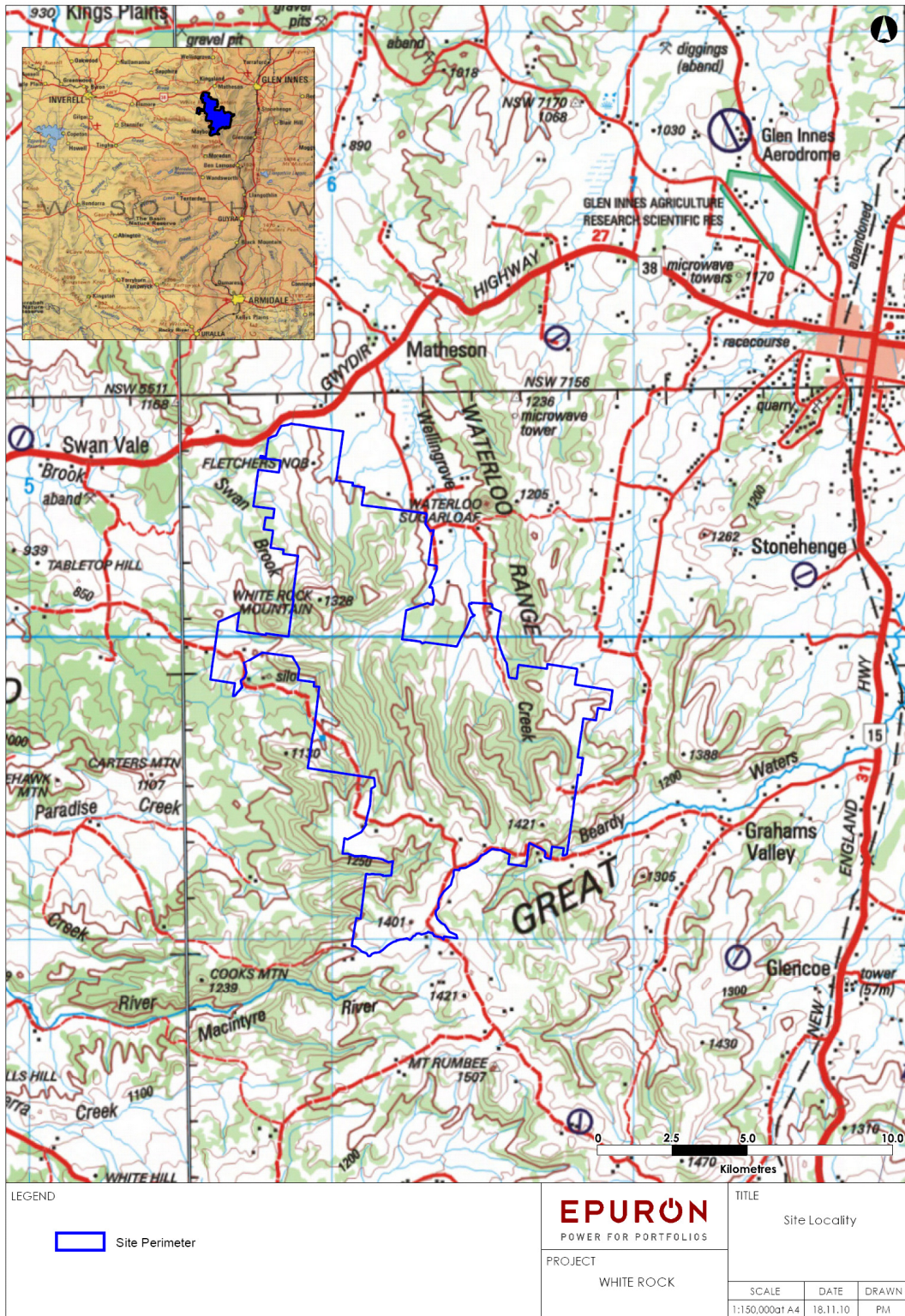


Figure 1 - White Rock wind farm site locality

The White Rock wind farm is located approximately 20km west of Glen Innes, NSW (between Glen Innes and Inverell) as shown in Figure 1. A review of the telecommunication technologies in use in the vicinity of the proposed White Rock wind farm identified the following:

- TV and radio broadcasting
- Mobile phone services provided by telecommunication companies
- Radio communication systems, including point to point microwave links, licensed by the Australian Communications and Media Authority (ACMA)
- Other radio links including mobile radio, CB radio; and
- Aircraft navigation systems

Electromagnetic interference (EMI) has the potential to cause degradation or total loss of signal strength and may cause poor TV reception and/or “ghosting” effects. EMI may also result in a reduction in the coverage of mobile phone, radio and aircraft navigation communications in certain instances. There are three principal mechanisms by which wind turbines may cause EMI: reflection or scattering, diffraction and near field effects.³

Reflection or scattering

When a signal sent between a transmitter and receiver becomes obstructed by an object located within the path of a signal, reflection and/or scattering may occur. If the rotating blade of a wind turbine receives a primary transmitted signal, a scattered time delayed (or out of phase) signal may be produced and transmitted to the receiver. The out of phase signal will be distorted in relation to the primary signal, causing EMI.⁴

Diffraction

In some instances when an object is located in the path of a signal wave front, the object can both reflect and absorb the signal. This phenomenon is commonly referred to as diffraction.⁵

Near field effects

Wind turbines may cause interference to radio signals due to the electromagnetic fields emitted by the generator and the switching components within the turbine nacelle. This is referred to as a near field effect.⁶

Due to advances in technology and compliance with the Electromagnetic Emission Standard, EN 61000-6-4 (AS/NZ 4251.2:1999) *Emission standard for industrial environments*, modern wind turbines will not cause active EMI due to near field effects.

The level of EMI produced by a wind turbine due to reflection or scattering, diffraction and near field effects is dependant on a number of factors, including placement of the wind turbine in relation to the signal path/s; the signal frequency; the characteristics / composition of the wind turbines rotor blades; the receiver characteristics; and the propagation characteristics of the radio wave in the local atmospheric conditions.⁷

3 D. F. Bacon, A Proposed Method for Establishing an Exclusion Zone around a Terrestrial Fixed Link outside of which a Wind Turbine will cause Negligible Degradation of the Radio Link, Radiocommunications Agency UK Report Ver 1.1, 28 Oct 2002

4 URS Woodlawn Wind Farm Environmental Impact Statement 2004

5 Ibid.

6 Ibid.

7 Ibid.

While the site proposed for the development of the wind farm is a rural area, a number of communications links and broadcast networks are present in the surrounding region.

As with any large structure, there may be circumstances where wind turbines can cause disruption to the electromagnetic signals used in a variety of commonly used radar, navigation and telecommunications services.

The following approach was adopted to identify the impact of the proposal on telecommunications:

- Identify radio license holders within a 25km radius of the proposed wind farm site, and point to point microwave radio links in the vicinity of the site, using information sourced from the ACMA RADCOM database⁸;
- Provide notification of the wind farm proposal and seek comments from each license holder identified via the ACMA RADCOM database within a 25km radius of the site;
- Record and review all responses received to identify any issues raised by license holders;
- Discuss any issues raised with relevant license holder with the aim to resolve or identify mitigation options;
- Carry out an assessment of the “Fresnel zone” associated with each fixed point to point microwave communications link crossing the site;
- Determine appropriate exclusion zones for proposed turbine layout based on Fresnel zone calculations and advice from relevant license holders;
- Confirm that all turbines (including blades) are located outside the calculated exclusion zone;
- Determine appropriate additional mitigation measures which may be required.

3.1 IMPACT ASSESSMENT

The possible impact of the proposed wind farm on the four most common communications services has been investigated separately. These services are television and radio broadcast services, mobile phone services, microwave radio point to point communication services and aircraft navigation services.

Any impacts would be confined to the construction and operational phases of the wind farm. Various measures are available to help mitigate potential impacts and are discussed below.

4 TELEVISION AND RADIO BROADCAST SERVICES

4.1 EXISTING SERVICES AND FACILITIES

The ACMA issue apparatus licences under the Radio communications Act 1992. The ACMA is the federal government authority responsible for regulation and management of the radio communications spectrum. It was formed in July 2005 by the merging of Australian Broadcasting Authority (ABA) and the Australian Communications Authority (ACA).

The ACMA 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. A system of apparatus licence types are used to apply common licence conditions and fee structures to categories of radio communications service.

⁸ April 2010 data

The ACMA RADCOM database lists the following broadcasters for television and radio, under postcode 2370, Glen Innes, NSW.

Television broadcasting

Northern New South Wales TV1: ABC, NBN, NEN, NRN and SBS

Remote Central and Eastern Australia TV1: ABC, IMP and SBS

Remote Central and Eastern Australia TV2: QQQ

Radio broadcasting

Deepwater RA1: 2CBD

Inverell RA1: 2ABCN, 2ABCRR, 2GEM, 2GL, 2NZ, 2PNN

Remote Commercial Radio Service North East Zone RA1: 2ABCN, 2ABCRR, 2ABCN, 4ABCRR, 4BRZ, 4JK, 4QCC, 4RBL, 4TI, 4WP and ABC.

The closest transmitter of television programs is at Carpenters Hill located about 4 kilometres North West of Glen Innes. Transmission from Carpenters Hill is at low power (400 watts) and only serves Glen Innes and its immediately surrounding areas. Most properties immediately west of Waterloo Range do not receive the transmission from Carpenters Hill due to the topographic shielding by Waterloo Range. Residents to the east of Waterloo Range have indicated that they have good reception from the Carpenters Hill transmitter.⁹

Mt Dowe (Mt Kaputar), near Narrabri has strong transmission (72 kW to 600kW). The quality of reception of the Mt Dowe signals was much poorer in the Wellingrove Valley. Nevertheless, some residents in parts of Wellingrove Valley indicate that they receive signals from Mt Dowe. Reception of signals from Mt Dowe is expected to be poor immediately to the east of Waterloo Range and that area is more likely to use the Carpenters Hill service.¹⁰

Inverell also has a local television service that transmits at low power (25, 50 and 600 watts). The four Inverell channels transmitted at 600 watts were able to be received on top of Waterloo Range. However, these were not detected during brief testing at two locations in Wellingrove valley. The Inverell channels are unlikely to be received to the east of Waterloo Range.¹¹

The Armidale source broadcasts at high power ranging from 30kW to 120kW. Signal strength measurements undertaken on the top of Waterloo Range indicated that Armidale signals are not well received at the top of Ross Hill. This is considered to be due to the elevated area of Ben Lomond that presents a physical barrier to these signals.¹²

Satellite based television services are also received at various locations throughout the area. These services may either be used where local services are not able to be received or may be accessed as additional program content to complement local services. They are not subject to the same topographic screening that can affect the land based TV transmissions. Due to the distance of residences from the wind farm it is very unlikely that satellite based television services would be subject to interference due to the wind farm's operation.¹³

⁹ Glen Innes Wind Farm Environmental Assessment – Telecommunications interference October 2008, Connell Wagner.

¹⁰ Glen Innes Wind Farm Environmental Assessment – Telecommunications interference October 2008, Connell Wagner

¹¹ ibid

¹² ibid

¹³ ibid

Transmitter Location	Broadcaster	Call Sign / Channel	Band	Frequency (MHz)
Carpenters Hill (mainly received east of Waterloo Range)	NBN	NBN41	UHF	618.198
	Southern Cross Ten	NRN44	UHF	638.198
	Prime	NEN47	UHF	660.198
	ABC	ABUN50	UHF	681.198
	SBS	SBS53	UHF	702.198
	ABC (digital)	ABUN59	UHF	746.5
	SBS (digital)	SBS65	UHF	788.5
Note: All above channels broadcast with vertical polarisation and at 400 watts.				
Mt Dowe (mainly received west of Waterloo Range where not limited by topographic screening)	ABC	ABUN7	VHF	182.24
	ABC (digital)	ABUN8	VHF	191.625
	Prime	NEN9	VHF	196.24
	Prime (digital)	NEN9a	VHF	205.625
	SBS	SBS28	UHF	527.198
	SBS (digital)	SBS36	UHF	585.5
	NBN	NBN31	UHF	548.198
	Southern Cross Ten	NRN34	UHF	569.198
	Southern Cross Ten (digital)	NRN40	UHF	613.5

Figure 2 - “Free to Air” television broadcast services available around the wind farm facility¹⁴

License holders identified via the ACMA RADCOM database within a 25km radius of the wind farm were notified of the proposal in relation to potential impacts and asked to provide comments.

Consultation with Mr Greg Williams, Broadcast Engineering Manager at NBN Television revealed that the translator site at Carpenters Hill (which services Glen Innes town) receives its input signal from the parent site at Mt Dowe (ACMA site ID 35653). The input signal passes through the area proposed for the White Rock wind farm. However on further investigation, the wind turbines locations proposed were shown to be to the south and clear of the transmission corridor and therefore signal interference to the Carpenters Hill translator by the White Rock proposal is not expected.

At the time of writing, no other concerns had been raised from the license holders contacted regarding possible impacts to television or radio broadcasting services. The proponent will work with organisations to resolve issues, should any be identified.

4.2 TELEVISION BROADCASTING

4.2.1 Interference and impact analysis

Television Interference (TVI) is dependent on a range of factors including environmental factors (topography, direct signal strength, transmitter type, receiver type etc) and wind farm design factors (turbine elevation, rotor size and orientation, speed of rotation, blade material and pitch).

¹⁴ Glen Innes Wind Farm Environmental Assessment – Telecommunications interference October 2008, Connell Wagner

TVI caused by the operation of wind turbines is characterised by video distortion, while the audio component of the signal is not affected.¹⁵ Due to the variability of local conditions and the characteristics of antennae used in particular installations, there is a degree of uncertainty regarding predicted levels of interference.

The level of TVI may be influenced by a number of factors including:

- Where the receiver is located relative to the TV transmitter and the wind farm;
- The frequency of the transmitted TV signal;
- Whether there are any other tall structures in the vicinity of the receiver;
- The direction of the rotor blades and blade material;
- The nature of the receiving aerial e.g. design, height, directionality, power.

In general, the potential for interference at receiver locations can increase with distance of the receiver from the transmitter, as signal strength decreases with increasing distance from the source. As such, a wind farm in an area of already poor signal strength may potentially have a greater impact on reception than the same wind farm in an area of relatively strong signal strength. In addition, reception in the vicinity of the wind farm can vary with the degree of topographic obstruction of the signal.

A wind turbine has the potential to scatter analogue television waves both forward and back. Forward scatter will only occur if a wind turbine is located approximately between the dwelling and the broadcast site. The forward scatter region is as shown in the figure below, and generally does not extend further than 5 km for the worst combination of factors. Interference may extend beyond 5 km if the dwellings are screened from the broadcast tower, but do have line of sight to the wind turbines. The effect of the forward scatter is to potentially cause the brightness of the television picture to vary with the rotation of each blade. Modern television sets usually incorporate Automatic Gain Compensators (AGC) which act to lessen or eliminate variations in picture gain or brightness.¹⁶

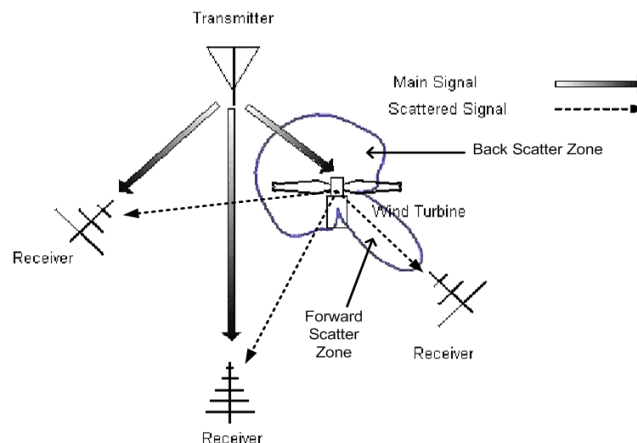


Figure 3 - Schematic diagram of potential analogue television signal interference zones around a wind turbine (Courtesy of CanWEA Guidelines V8.0)

¹⁵ David E Spera, Wind Turbine Technology, Chapter 9 ASME Press 1994

¹⁶ <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIAnalysisIssue.pdf>

The zone of potential interference for a wind farm is the resultant total of the effects from the individual turbines. The International Telecommunications Union Recommendation ITU-R BT.805 states that impacts beyond 5 kilometres are unlikely.

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. The form of 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.¹⁷

There are approximately 57 houses within 5km of the proposed wind farm site. The location of the wind farm with respect to the Carpenters Hill, Mt Dowe, Inverell and Armidale TV transmitters can be seen in Figure 4.

¹⁷ Connell Wagner Delta Electricity Gunning Environmental Impact Statement 2004

4.2.2 House and television tower locations



Figure 4 - Houses within 5km of the White Rock wind farm site

It is difficult to assess the likely impact on these specific house locations and once the wind farm is operational it is possible that analogue television reception could be affected at some of these locations unless some form of mitigation is introduced. However, houses further than 5km from the site are unlikely to be affected.

4.3 MITIGATION MEASURES

In the design of the project, the proponent will carry out the following mitigation measures to help minimise TVI:

- Use of primarily non-metallic turbine blades;
- Use wherever practical of equipment complying with the Electromagnetic Emission Standard, AS/NZS 4251.2:1999;

Once the wind farm is operational, the proponent will 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 affected resident. In the event that TVI is experienced by existing receivers in the vicinity of the wind farm, the source and nature of the interference will be investigated by the proponent.

Should investigations determine that the cause of the interference is genuinely attributable to the presence of the White Rock wind farm; the proponent will put in place mitigation measures at each of the affected receivers in consultation and agreement with the residents.

Notwithstanding the above, specific mitigation measures available are:

- Modification to, or replacement of receiving antenna;
- Provision of a land line between the affected receiver and an antenna located in an area of favourable reception;
- Improvement of the existing antenna system;
- Installation of a digital set top box or,
- In the event that interference specifically attributable to the wind farm cannot be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna with the affected landowner may be considered.

4.4 SATELLITE PAY TELEVISION

Some homes in the area may have satellite pay TV service antenna installations.

Unless a particular subscriber's antenna reception direction and elevation is aligned with a turbine, no impacts on TV reception are likely.¹⁸

4.5 RADIO BROADCASTING

The level of radio broadcast interference experienced can be influenced by a variety of variables including:

- Abnormal weather conditions;
- Multi-path distortion (reception of a signal directly from a transmitter and also a reflected signal from hills, structures etc.);
- Overloading (occurs when an FM receiver receives too strong a signal);

18 Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

- Electrical interference from household appliances etc;

4.6 MF SOUND BROADCASTING

Wind farm effects on MF radio are highly unlikely and therefore the stations serving the area have not been listed.¹⁹

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 tested included situations where the radio signal transmission path passed through the operating wind farm.²⁰

5 MOBILE PHONE SERVICES

5.1 EXISTING SERVICES AND FACILITIES

This section covers GSM services. High frequency point to point communications links used for mobile transmission networks are discussed in the next section: Radio Communication Services. Figures below show the existing local mobile phone coverage from the three providers at the time of writing. (Source: company websites)

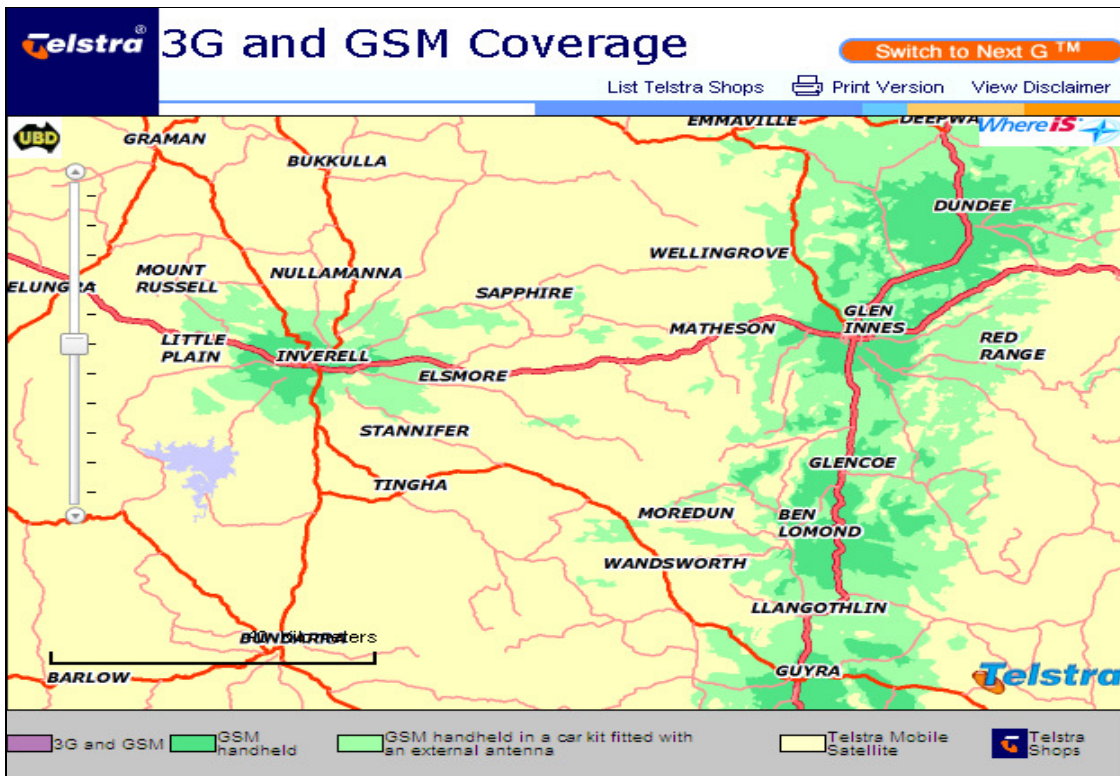


Figure 5 - Telstra 3G and GSM Coverage

¹⁹ Ibid

²⁰ Connell Wagner Glen Innes Wind Farm Environmental Assessment – Telecommunications interference October 2008

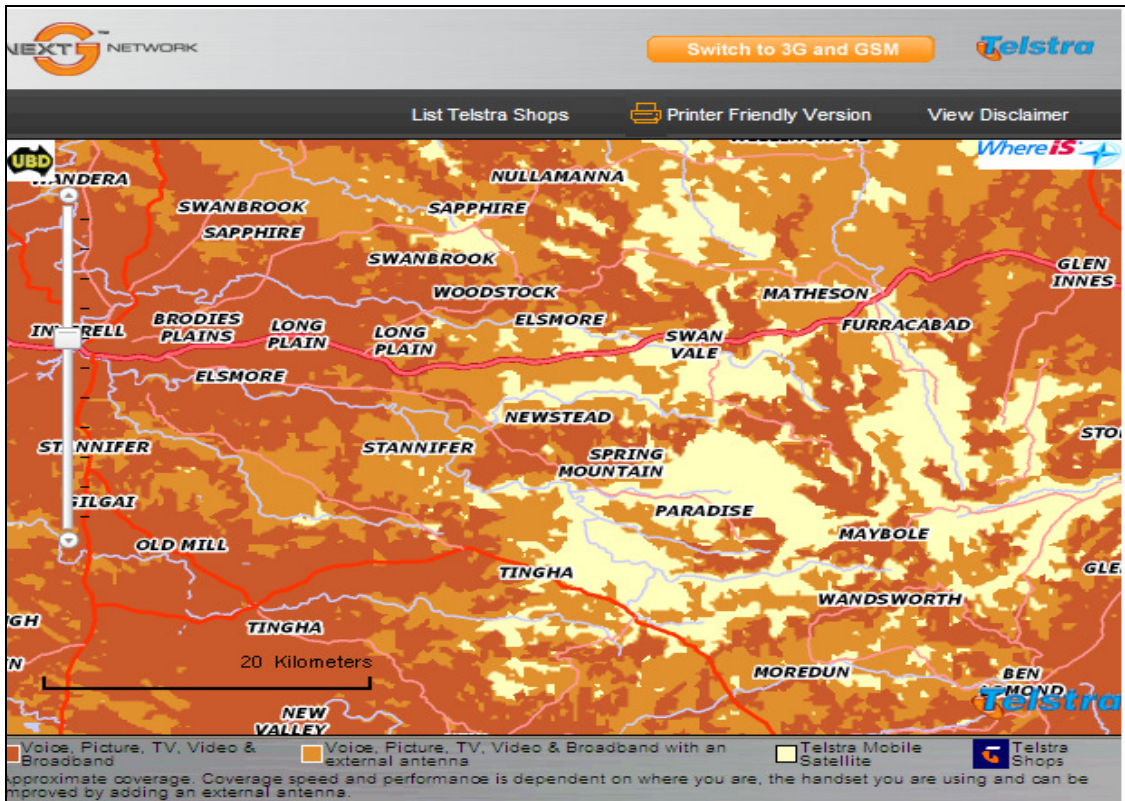


Figure 6 - Telstra Next G Network Coverage

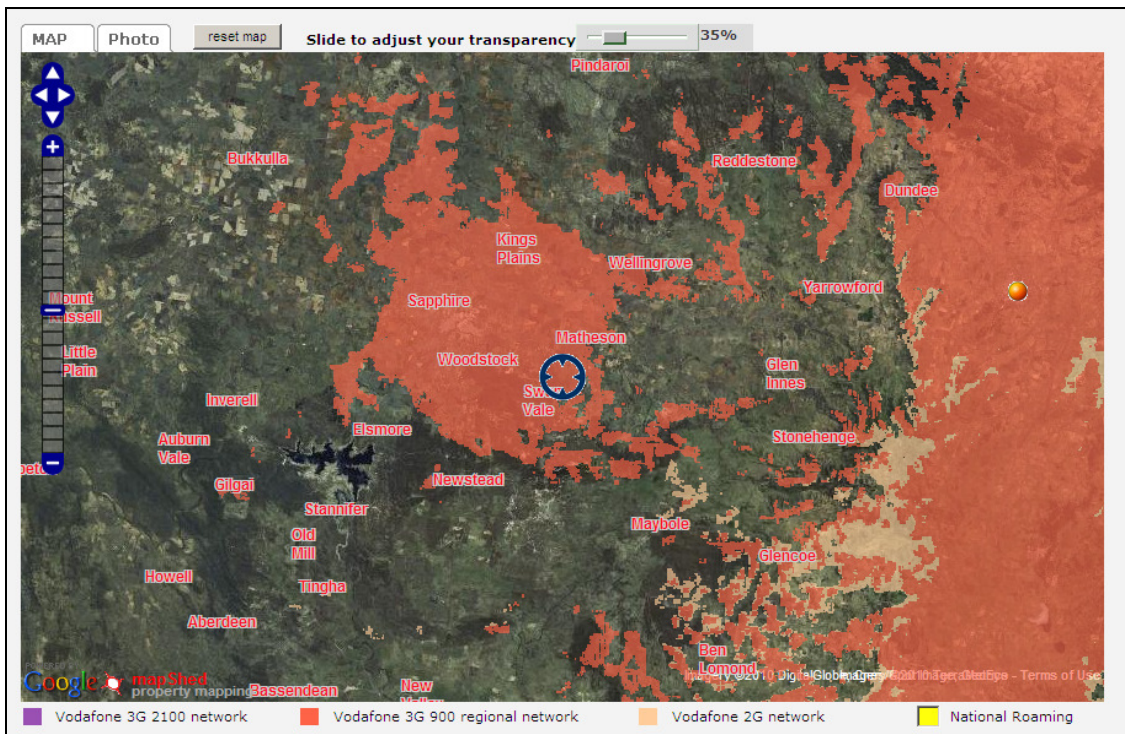


Figure 7 - Vodafone GSM Network Coverage

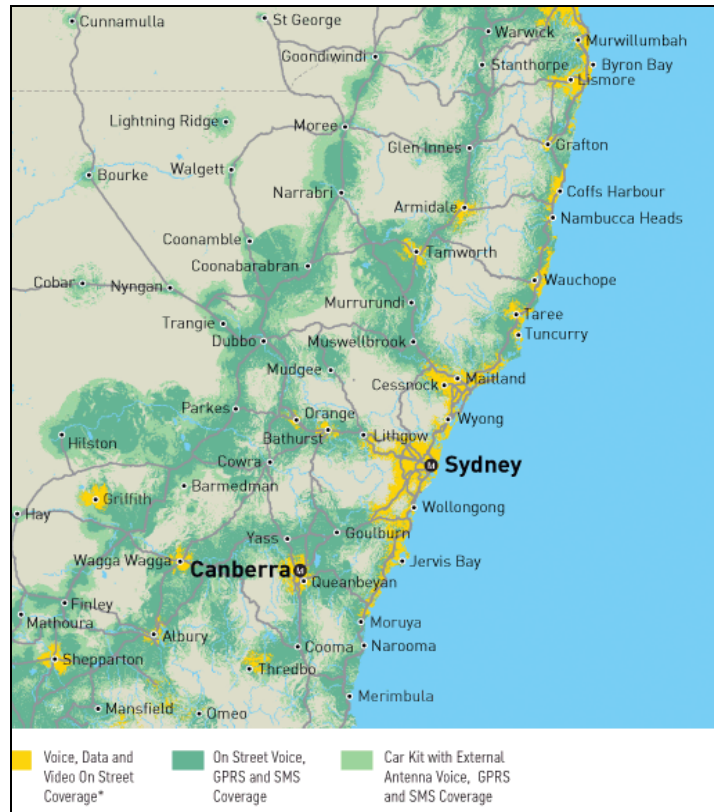


Figure 8 - Optus GSM (3G) Coverage

5.2 INTERFERENCE AND IMPACT ANALYSIS

A mobile phone network consists of a system of adjoining zones called ‘cells’, which vary in size with a radius of 2 - 10 km. Each cell has its own base station that sends and receives radio signals throughout its specified zone. Mobile phone antennas need to be mounted clear of surrounding obstructions such as buildings to reduce ‘dead spots’ and allow the base station to effectively cover its intended cells.²¹

Mobile phone coverage is available in much of the area around Glen Innes but is patchy further away from Glen Innes and the main highways and where topography limits coverage. During site investigations for the environmental assessment of the Glen Innes wind farm by Connell Wagner, mobile phone coverage was observed to be available for elevated locations on Waterloo Range and most areas between Waterloo Range and Glen Innes. However, coverage was absent or intermittent in the valleys to the west of the Glen Innes wind farm site.²²

Advice obtained from mobile phone service providers indicates that mobile phone services in these rural areas are mainly focussed on the main transport routes such as the New England and Gwydir Highways. In view of the separation distance between the base antennas and turbine structures and the wind farm location relative to areas of existing coverage, transmission of mobile phone signals may not be significantly affected by the operating wind farm.²³

²¹ URS Crookwell II Wind Farm Environmental Impact Statement .

²² Glen Innes Wind Farm Environmental Assessment – Telecommunications interference October 2008, Connell Wagner

²³ ibid

The ACMA RADCOM database identified three mobile phone companies as using base stations within the vicinity of the proposed wind farm. The table below lists the companies and ACMA site ID numbers.

Mobile Phone Companies	ACMA Site ID No.
Optus Mobile Pty Ltd / Singtel Optus Pty Ltd	130216, 130217
Telstra Corporation Ltd	6905, 6910, 6948, 9007743
Vodafone Network Pty Ltd	6955, 130216

All companies were contacted by EPURON regarding potential impacts and asked to provide feedback as to any potential conflicts with their existing networks. No objections were received.

5.3 MITIGATION MEASURES

No additional mitigation measures are required.

6 RADIO COMMUNICATION SERVICES

6.1 EXISTING SERVICES AND FACILITIES

The ACMA issues radio communications licenses in accordance with Part 3.5 of the Commonwealth Radiocommunications Act 1992. The ACMA issues licenses to use specific segments of the radio broadcasting frequency spectrum for different purposes and maintains a register (the ACMA RADCOM Database) of all the licenses issued.

The register allows the ACMA to create a ‘density’ classification of areas across Australia as high, medium or low depending on the number of licenses in operation in a particular area. According to the ACMA RADCOM database, the area in the vicinity of the proposed wind farm is classified as a “Low Density Area”.

License holders operate a range of radio communications services, including fixed link microwave communication and mobile communication systems within a 25km radius of the proposed wind farm. Multiple license holders use some sites, while sole users employ others. Radio communications sites within a 25km radius are listed below.

acma.gov.au

Register of Radiocommunications Licences

Found 51 sites within about a 25 kms radius of Latitude: -29 50 32.64 Longitude: 151 33 48.6
[\[Show Nearby Sites \]](#) [\[New Site Search \]](#)

Sorted by Approx Distance.

Site ID	Name	District	State & Postcode	Approx Distance
6889	34 Finch Street BINGARA		NSW 2370	6.1 kms SE
6837	NPWS site ROSS HILL		NSW 2370	10.9 kms NE
6863	Telstra Radio Terminal Ross Hill via GLEN INNES	GLEN INNES	NSW 2370	11.0 kms NE
404373	Eaglehawk Mtn off Gwydir Hwy 35 km SE of INVERELL	INVERELL	NSW 2370	12.1 kms W
250676	Glen Innes Amateur Radio MOUNT RUMBEE		NSW 2365	13.2 kms S
6898	RFS Site MOUNT RUMBEE		NSW 2365	13.9 kms S
9911855	Mobile Spectrum Licensing Site GWYDIR HIGHWAY		NSW 2370	14.3 kms NW
9911841	Mobile Spectrum Licensing Site GWYDIR HIGHWAY		NSW 2370	15.6 kms NE
6943	Substation Site 1 GLEN INNES		NSW 2370	19.1 kms NE
9911863	Mobile Spectrum Licensing Site NEW ENGLAND HIGHWAY		NSW 2365	19.2 kms E
6955	Broadcast Site Carpenters Hill 4 km NW of GLEN INNES	GLEN INNES	NSW 2370	19.7 kms NE
151348	Commercial Broadcast Site CARPENTERS HILL		NSW 2370	19.7 kms NE
151349	Broadcast Site Carpenters Hill 4 km NW of GLEN INNES		NSW 2370	19.8 kms NE
6892	CB Repeater Site Bandoole GLEN INNES		NSW 2365	19.8 kms SE
130217	Optus Site Abbots Road Carpenters Hill GLEN INNES	GLENN INNES	NSW 2370	19.9 kms NE
6905	Telstra Exchange GLENCOE		NSW 2365	20.3 kms SE
280220	Attenborough Fertilizers Armidale Road GLEN INNES	Glen Innes	NSW 2370	20.3 kms E
6944	Substation Site 2 GLEN INNES		NSW 2370	20.4 kms NE
402069	Cnr Ferguson & Derby Sts GLEN INNES		NSW 2370	21.0 kms NE
204416	RTA works depot GLEN INNES		NSW 2370	21.2 kms NE
280046	Boral Gas Gassworks Road GLEN INNES	GLEN INNES	NSW 2370	21.5 kms NE
9911868	Mobile Spectrum Licensing Site NEW ENGLAND HIGHWAY		NSW 2365	21.7 kms SE
205033	Glen Innes TAFE Grey St GLEN INNES		NSW 2370	21.8 kms NE
9911858	Mobile Spectrum Licensing Site GWYDIR HIGHWAY		NSW 2360	21.9 kms W
6952	Town Hall Grey Street GLEN INNES		NSW 2370	22.1 kms NE
51302	Bourke Street GLEN INNES	GLEN INNES	NSW 2370	22.2 kms NE
9010429	Glen Innes Hospital 94 Taylor Street GLEN INNES NSW 2370		NSW 2370	22.3 kms NE
132029	303A Grey Street GLEN INNES		NSW 2370	22.3 kms NE
6928	Fire Station 202 Bourke Street GLEN INNES		NSW 2370	22.3 kms NE
9007743	Telstra Site 110 Meade St GLEN INNES		NSW 2370	22.4 kms NE

9900466	Mobile Spectrum Licensing Site GLEN INNES		NSW 2370	22.4 kms NE
306347	Wilson Park Taylor street GLEN INNES	GLEN INNES	NSW 2370	22.5 kms NE
9009206	Within 20km of Town Centre GLEN INNES		NSW 2370	22.5 kms NE
130216	Optus/Vodafone Site Bonfield Property Inn Rd BEN LOMOND	BEN LOMOND	NSW 2365	22.6 kms SE
6909	Pacific Grid Site Trig Point BEN LOMOND	GLEN INNES	NSW 2365	22.7 kms SE
39063	VRA site BEN LOMOND		NSW 2365	22.8 kms SE
9008678	Grafton Street GLEN INNES		NSW 2370	22.8 kms NE
6941	Broadcast Site 1 GLEN INNES		NSW 2370	23.0 kms E
34912	Martins Lookout GLEN INNES		NSW 2370	23.4 kms NE
6910	Telstra Radio Terminal via Inn Road BEN LOMOND	GLEN INNES	NSW 2365	23.5 kms SE
35679	Martins Lookout GLEN INNES		NSW 2370	23.5 kms NE
202970	Impulse Airlines GLEN INNES		NSW 2370	23.5 kms NE
34847	Martins Lookout GLEN INNES		NSW 2370	23.6 kms NE
6948	Telstra Radio Terminal Martins Lookout GLEN INNES	GLEN INNES	NSW 2370	23.7 kms NE
6931	Airservices Australia NDB site GLEN INNES		NSW 2370	23.9 kms NE
136792	39 Robinson Avenue GLEN INNES	GLEN INNES	NSW 2370	24.1 kms NE
6939	Country Energy Site RRC 3286 GLEN INNES		NSW 2370	24.5 kms NE
9004089	Glen Innes Rd 23 km E of INVERELL		NSW 2370	24.9 kms W
200612	SES Lonewood GLEN INNES	GLEN INNES	NSW 2370	26.3 kms NE
6942	Police Site Glen Innes Golf Club GLEN INNES		NSW 2370	27.6 kms NE
9911877	Mobile Spectrum Licensing Site NEW ENGLAND HIGHWAY		NSW 2365	27.9 kms SE

Site proximity usage notes:

- Map display accuracy within 10 metres.
- Distances shown are approximations only (they are not latitude compensated).
- To view images correctly, browser's must be able to accept both Javascript and compressed SVG content.
- You can [download](#) the SVG viewer Ver 3.0 from Adobe to view site search results.
- If you do not wish to install the SVG viewer, the [List Nearby Sites](#) link will display the results in table format.
- Use right mouse button for additional SVG pan and zoom functions.
- GMDA 1M 2001 and MAPDATA-2.5M data © Commonwealth of Australia (AUSLIG) 2001.

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ACMA Licence Holder	ACMA Site ID No.
2KY Broadcasters Pty Ltd	6955
Airservices Australia	6931
Ambulance Service of NSW	6909
Australian Broadcasting Corporation	6941, 6955
Church Communities Australia Ltd	9004089
Country Energy	6909, 6939, 6943, 35679
David E Jones	9009206
Deepwater Districts Community FM radio	34912
Dept of Environment Climate Change and Water	6837, 6898
Digital Distribution Australia	6910, 6948
Glen Innes and District Amateur Radio Club	250676
Glen Innes Radio Cabs	34912
Glen Innes Severn Council	34847

ACMA Licence Holder	ACMA Site ID No.
Guyra Shire Council	6898
Guyra Volunteer Rescue Association	6898
Loanaoks Pty Ltd	280220
NBN Ltd	6955, 151348
Northern Broadcasters	35679
Northern River Television Pty Ltd	6898, 151348
Northern Tableland UHF users committee	6892
NSW Fire Brigades	6889, 34847
NSW Police Force	6909
NSW Rural Fire Service	6898, 34912
NSW State Emergency Service	51302, 250676, 9008678
NSW Volunteer Rescue Association	34847
Optus Mobile / Singtel Optus	130216, 130217
Origin Energy Holdings	280046
Prime Television (Northern)	151348
Radio 4GG Gold Coast Pty Ltd	136792
Roads & Traffic Authority	204416
Soul Pattinson Telecommunications	6863, 6948, 205033
Special Broadcasting Service Corporation	6955
St John Ambulance	306347
Sundown Pastoral Company	404373
Telstra	6905, 6910, 6948, 9007743
TransGrid	6909
Vertical Telecoms Pty Ltd	6898
Vodafone Australia Pty Ltd	6955, 130216
United Christian Broadcasters Australia Ltd	34847

Figure 9 - Radio communication license holders within 25km of the White Rock wind farm site

6.2 INTERFERENCE AND IMPACT ANALYSIS

A fixed link microwave radio transmission is a point to point transmission path typically between two elevated topographical features. The transmission path may become compromised if a wind farm is located within the direct line of sight or what is known as the ‘Fresnel Zone’ around the line of sight between the sending and receiving antennae.

The potential impact zone will vary with the distance between the transmitter and receiver, frequency of transmission and the location of any particular point along its path. Communications