Collector Wind Farm - Telecommunications Impact Assessment

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Ratch-Australia Pty Ltd

Parsons Brinckerhoff Australia Pty Limited
ABN 80 078 004 798

Level 15
28 Freshwater Place
SOUTHBANK VIC 3006
PO Box 19016
SOUTHBANK VIC 3006
Australia
Telephone +61 3 9861 1111
Facsimile +61 3 9861 1144
Email melbourne@pb.com.au

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Author: Adam Trethowan, We-Ki Chua, Ben Inkster .....

Signed: .....

Reviewer: Ross Cooper, Andrew Kerley .....

Signed: .....

Approved by: Taraz Saba .....

Signed: .....

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Glossary

ACMA	Australian Communications and Media Authority
AM	Amplitude Modulation
CWF	Collector Wind Farm
EMI	Electromagnetic Interference
FM	Frequency Modulation
GIS	Geographic Information System
ND	Non-directional (in relation to an antenna radiation pattern)
RADCOM	ACMA Registry of Licensed Radio Communicators
RATCH-Australia	RATCH-Australia Pty Ltd
RF	Radio Frequency
TV	Television
UHF	Ultra High Frequency
V112	Vestas V112 3MW Wind Turbine Generator
VHF	Very High Frequency

Executive summary

As part of the development of the Collector Wind Farm, RATCH-Australia engaged PB to investigate the potential impact of the wind farm to radio communication services in the area. The scope of the assessment was to consider potential impacts to registered point-to-point services, point-to-multipoint services and broadcast services.

For this investigation, PB identified existing radio communication sites and services and their associated paths. This data was obtained from the Australian Communication and Media Authority's database of registered radio communication licenses (RADCOM). Several radio communications sites were surveyed by PB to determine the location of these sites with greater accuracy than provided by the ACMA

Forty-six radio communication sites were found within a 25 km distance of the wind farm boundary, with an associated 478 registered assignments. This data was mapped against the proposed wind farm layout, provided by RATCH-Australia. Communication towers and service paths that were within five kilometres of the wind farm were selected for further investigation. To this selected data, standard exclusion zones were calculated and the wind farm was assessed considering these zones.

No turbines were assessed to intrude on near field exclusion zones surrounding the identified radio towers.

PB recommends that, to avoid obstruction interference, no turbines or blades intrude on the calculated 2nd Fresnel zone for point-to-point radio links. PB has determined that six turbines encroach on the 2nd Fresnel exclusion zones for a single radio path licensed to Vodafone Australia Pty Ltd, depending on the orientation of the rotor. Following consultation with license holders, Vodafone Australia Pty Ltd, has commented that they expect interference from the proposed turbine locations. PB acknowledges that turbine micrositing may mitigate any impact on this radio path by appropriately relocating turbines and blades to be located outside of the 2nd Fresnel zone for this radio path. PB recommends that RATCH-Australia liaise with Vodaphone to verify the RADCOM data is correct and to verify Vodaphone's specific requirements, and investigates micrositing and other mitigation options to avoid any interference.

A previous assessment was conducted by Percom Technology Pty Ltd during which licensee clearance zones were obtained. PB evaluated the current layout against these zones. All clearance zones were respected excluding several microwave links licensed to Optus Pty Ltd. PB notes that Optus' requested clearance zone is significantly larger than the 2nd Fresnel zone for these links, that no turbines encroach into the 2nd Fresnel zone, and that no impacts on these links should therefore be expected. PB notes that turbine micrositing will mitigate any impact on these microwave links, and notes Optus request to move a single turbine by 134 m to the west. PB recommends that RATCH-Australia liaise with Optus to verify Optus' specific requirements and investigates micrositing and other mitigation options to avoid any interference..

PB has contacted or attempted to contact all potentially impacted licensees that operate services within five kilometres of the wind farm boundary and notified them of the proposed development. These licensees were consulted to verify the correctness of the data in the RADCOM database and ascertain their position on the proposed wind farm development. A number of items were identified for clarification with licensees including service status and tower coordinates.

As per the assessment scope, reflection and scattering impacts were not calculated. It is recommended that these are calculated, if required, following receipt of any special requirements of the identified licensees.

PB believes point-to-multipoint impacts should be minimal. However, PB recommends the position of registered point-to-multipoint license holders is sought with respect to the wind farm development. PB has initiated consultation with these license holders that are located within 5 km of the wind farm. Given the phase out of analogue television signals by 2013, PB considers it quite likely that analogue television will be phased out by the time the wind turbines are operational at CWF, thereby mitigating the impact the turbines will have on the analogue television signals. Digital television signals are generally not degraded due to interference from wind turbines.

GIS data has been supplied to RATCH-Australia for their own use. This data includes the radio towers, paths and exclusion zones derived in this assessment.

1. Introduction

RATCH-Australia Pty Ltd (RATCH-Australia) are developing the Collector Wind Farm (CWF) in New South Wales, close to the town of Collector (see Figure 1). RATCH-Australia has advised PB to consider a wind farm consisting of 68 Vestas V112 wind turbines – a 3.0 MW machine with an 112 m rotor diameter (V112) as this model of turbine is the largest of the models being considered by RATCH-Australia, and thereby represents a worst-case for telecommunication impacts.

Figure 1: Location of Collector Wind Farm relative to local population centres (source: Google Earth)

As part of the site development, RATCH-Australia requested PB undertake an assessment of potential impacts to telecommunications in the area. The scope of the investigation included the following (scope from the proposal italicized[1]):

1. *Identify existing radio communication services and the related communication paths near to the wind farm site*

2. *Determine any high risk issues and constraints posed by the presence and operation of identified communications services with respect to the CWF layout*

3. *Initial contact with potentially impacted communications licensees* – we understand RATCH-Australia has continued consultation following the submission of Rev5 of this report

[1] *201003001 Collector Wind Farm – Telecommunications Assessment (December 2009)*

4. *Provide recommendations on any further steps to be taken to mitigate radio communication impact risks*

This report documents the undertaking of this scope.

GIS data has been supplied to RATCH-Australia for their own use. This data includes the radio towers, paths and exclusion zones derived in this assessment.

2. Wind farms and electromagnetic interference

Communication systems using radio waves are heavily utilised in Australia. Mobile phones, television, commercial radio and emergency radio are common examples of systems that rely on radio communication. These systems generally use radio towers to help transmit and receive signals across a wide area. In the context of wind farm development, electromagnetic interference is the impact of a wind farm on radio communication services resulting in an unacceptable detrimental effect to the radio service. Radar services (civil and weather) can potentially be impacted by wind farms also.

The objective in considering electromagnetic interference during the wind farm development stage is to mitigate potential impacts caused by locating wind turbines in the vicinity of radio communication services.

2.1 Types of impacts

The different effects wind farms can have on communication services are summarised below.

- *Near field impact*
  A property of a transmitting and/or receiving antenna is a “near field” zone that is present around the antenna. Any object that can conduct or absorb radio waves, placed within the near field zone, can alter the behaviour of the antenna.

- *Obstruction impact*
  If an absorbing object is placed within the advancing wavefront of a radio wave, wave obstruction can occur, detrimentally affecting the signal detected at the receiver.

- *Reflection and scattering impacts*
  If an object that’s reflective to radio waves exists in the advancing wavefront, it may reflect energy away. The reflected signal may be reflected to the transmitting or receiving antenna which can interfere with the desired signal.

- *Electromagnetic fields / RF interference*
  The operation of a wind turbine generator, and associated electrical transmission infrastructure, creates an electromagnetic field which can theoretically interact with radio communication.

2.1.1 Characterising impact with exclusion zones

In many cases, impacts can be sufficiently characterised and mitigated using calculated “exclusion zones” and ensuring these zones are free from wind turbines. In other cases, such as when exclusion zones are not feasible to calculate or not appropriate for the communication service, other options are available. Details of the calculated exclusion zones are given below.

- *Near field impact*
  Recommendations for determining exclusion zones to mitigate near field impacts are given by Bacon (2002). Exclusion zones for the CWF site have been calculated

using this method and are discussed in Section 4.2. In many cases, these exclusion zones are very small. However, PB recommends a minimum standard 500 m radio tower exclusion zone as a precautionary measure for any reflection and scattering impacts that may be produced. In general, this is easily achievable and has been achieved at CWF.

- *Obstruction impact*
  Recommendations for determining exclusion zones to mitigate obstruction are given by Bacon (2002). Exclusion zones have been calculated at CWF using this method (2nd Fresnel zone method) and are discussed in Section 4.3.

- *Reflection and scattering impacts*
  The accepted methods for calculating these impacts generally require information on signal performance requirements specific to each service and client. Additionally, impact calculations from this effect require complex modelling to determine. PB has consulted the licensees with services that would be susceptible to these impacts to determine their position regarding the development. The scope of this assessment does not include the calculation of reflection / scattering impacts. The recommendations for considering these impacts are given in Section 3.1.

- *Electromagnetic fields / RF interference*
  These effects are not considered in this assessment. Providing appropriate standards and guidelines are observed in the wind turbine and balance of plant design, these electromagnetic fields are not expected to cause impacts that are relevant to this assessment. PB's scope does not include assessing this type of interference.

The possible wind farm electromagnetic impacts have only been briefly discussed. See the supplied references (Section 7) for further information.

2.2 Relevant categories of radio communication services

In assessing radio communication impact by wind farms, radio systems are commonly broken into a number of different categories based on type. For the purposes of electromagnetic impact investigation, the following categories of services are considered: point-to-point, point-to-multipoint, and radar.

- *Point-to-point*
  Radio links that transmit and receive between two fixed points fall under this category. For example, network backhaul commonly utilises point-to-point communication.

- *Point-to-multipoint*
  A central location transmits to, and receives from, a number independent of locations. Television and radio broadcasting and reception, mobile phones (to the mobile phone mast) and land mobile systems fall under this category.

- *Radar*
  Radar transmits a signal which is reflected back to the transmitting station (some systems involve communication between a radar station and a transponder). Services that utilise radar technology include aircraft detection and weather services.

Point-to-point and point-to-multipoint impacts are considered separately in this assessment. Radar impacts are not part of the scope of this assessment; however PB suggests RATCH-Australia consults with the following radar operators (PB can provide further assistance with this consultation) to determine their position on the CWF development:

- Department of Defence
- Air Services Australia
- Bureau of Meteorology

2.3 Impacts and mitigation

The objectives of investigating wind farm electromagnetic interference is to identify potential electromagnetic impacts based on the information available, and also to reach agreement with impacted radio licensees. This is so the design of the wind farm, including any impact mitigation strategies, will allow the wind farm to coexist with the present radio services.

This is achieved using a variety of methods, depending on the radio service category in question.

- *Point-to-point*
  Abide by calculated and recommended minimum exclusion zones.

  Consult with relevant licensees that may be affected by the wind farm development.

- *Point-to-multipoint*
  Abide by calculated and recommended minimum near-field exclusion zones from the base station radio tower.

  Consult with relevant, registered point-to-multipoint licensees that may be affected by the wind farm development. Users of radio equipment under a Class C license will not be present in the ACMA database and therefore cannot be assessed. It is believed the potential impact to these users will be low, however, PB recommends RATCH-Australia includes discussion of EMI impacts with these users in their community consultation process.

Generally, mitigation of radio impacts involves manipulation of the turbine layout so that impacts are acceptably controlled. However, the wind farm proponent's considerations may make other options feasible (providing there is agreement amongst the relevant parties). The Draft National Wind Farm Development Guidelines (see Section 7 for reference) provides the following hierarchy of mitigation options (in order of most preferable to least preferable):

1. Re-location / removal of turbines
2. Replacement of existing radio communications service equipment with another less affected type (e.g., replace UHF link with microwave link; replace analogue TV with digital TV)
3. Re-location of radio communications services to another existing radio communications site
4. Re-location of radio communications services to a new telecommunications site

5. Substitute radio communication for underground or overhead optical fibre

6. Enhance radar filters

2.4 Construction, maintenance and decommissioning

It is recommended that the exclusion zones that are established and applicable for the final layout, that is, those zones agreed upon by the license holders and the wind farm proponent, are also respected during construction, maintenance and decommissioning. Crane booms and raising and lowering of turbine parts may cause interference. It is recommended that management plans for these activities include these considerations.

3. Methodology

Based on a number of existing guidelines (see Section 7), and considering PB's knowledge of the CWF status, PB has taken the course outlined below.

1. Identify any registered, licensed radio communication sites and services within a 25 km distance from the wind farm boundary
2. Investigate sites and services within a 5 km distance from the wind farm boundary, determine near-field and obstruction exclusion zones using standard methods
3. Assess the wind farm layout against the exclusion zones calculated in step 2
4. Identify local commercial broadcasting stations and their location relative to the wind farm and assess potential shadow zones
5. For point-to-multipoint (including broadcast) services, determine potential zones of signal shadowing
6. Contact any registered and licensed radio communication site (and service) clients within a 5 km distance from the wind farm boundary notifying them of the proposed development and request their impact mitigation requests (if applicable)

3.1 Reflection and scattering impacts

These impacts were not determined as part of this assessment. PB generally suggests these impacts are calculated, if required, following the receipt of any specific requirements from the potentially impacted radio stakeholders.

3.2 Australian Communications and Media Authority

The Australian Communications and Media Authority (ACMA) is the Australian government body that regulates the use of Australia's radio spectrum. They maintain a register of radio licenses, radio communication towers and radio services (RADCOM).

PB utilised the ACMA issued RADCOM CD dated 1/01/2010 to conduct the assessment.

ACMA also maintains a register of licensed commercial broadcasters which was accessed via the ACMA webpage[2].

The ACMA RADCOM database has been known to contain inaccurate information. Additionally, the precision of some tower location measurements can be considered low for the purposes of this assessment. As part of the consultation process, PB requested verification of the ACMA information relevant to each of the contacted stakeholders (see Section 6).

[2] http://www.acma.gov.au/WEB/STANDARD/pc=PC_9150; *accessed 25/01/2010*

3.3 Inputs to assessment

PB received an updated turbine layout from RATCH-Australia for the CWF on 23 November 2011 that included a total of 69 turbines. At the request of APP, the turbine number 64 was removed from the final assessment. The final layout of 68 turbines is shown in Figure 2, and supplied in Appendix A. RATCH-Australia also advised that the turbine expected to be used is the Vestas V112. This turbine is noted to have a 112 m rotor diameter or alternatively a 56 m rotor radius.

Figure 2: Collector Wind Farm layout

4. Assessment results

4.1 Assignment search

A search of the RADCOM database was conducted using a defined search area of 25 km from the wind farm boundary. Forty-six sites were found within the defined search area. Details of these sites can be found in Appendix B.

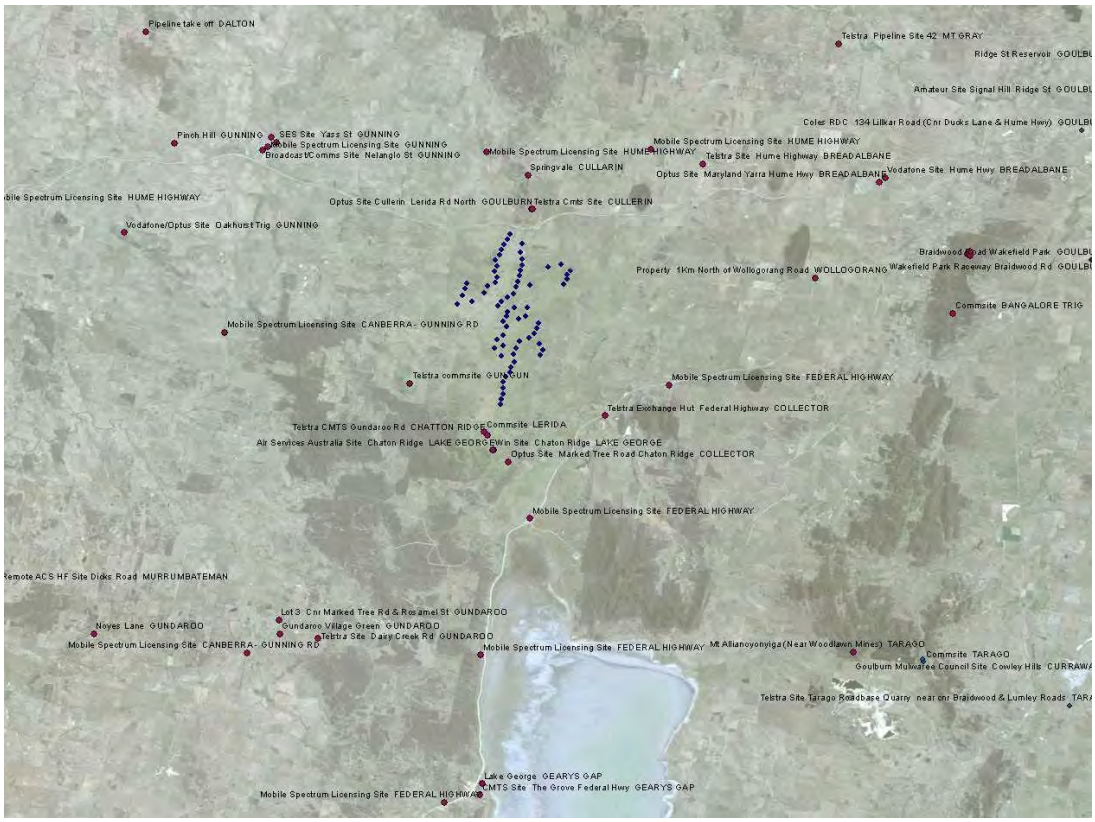


Figure 3: CWF (blue) and surrounding radio sites (maroon)

Associated with these 46 sites were 478 registered assignments. These sites and assignments were mapped to determine those radio communication services that were proximal to the wind farm site. Within this mapped dataset, PB identified all sites and assignments within a 5 km radius of the wind farm boundary. An analysis of these sites and assignments is given in Table 1.

Further investigation by PB, revealed that the locations of several sites, as detailed by the ACMA, were inconsistent with other references such as satellite imagery. The locations of site ID numbers 9506, 9507, 9508 and 10726 were surveyed by PB due to inconsistent location data supplied in the RADCOM database. The surveyed locations are included in Table 1. As part of PB's consultation work, it has specifically requested confirmation of the coordinates of these towers from the licensee to gain a greater degree of accuracy.

Table 1: Sites within a 5km radius of the CWF boundary (coordinates WGS84)

SITE_ID	LATITUDE	LONGITUDE	SITE_NAME	PRECISION	DISTANCE TO NEAREST TURBINE (KM)	SOURCE OF LOCATION DATA
9505	-34.901117	149.338955	Telstra commsite GUN GUN	Within 100 metres	4.3	ACMA
9506	-34.926188	149.376957	Commsite LERIDA	Within 10 metres	1.8	PB Survey
9507	-34.937191	149.379789	Win Site Chaton Ridge LAKE GEORGE	Within 10 metres	2.6	PB Survey
9508	-34.937455	149.379023	Air Services Australia Site Chaton Ridge LAKE GEORGE	Within 10 metres	2.6	PB Survey
9509	-34.797316	149.397639	Springvale CULLARIN	Unknown	3.4	ACMA
53802	-34.941478	149.388869	Optus Site Marked Tree Road Chaton Ridge COLLECTOR	Within 10 metres	3.3	ACMA
100726	-34.812980	149.400570	Telstra Cmts Site CULLERIN	Within 10 metres	1.7	PB Survey
100817	-34.929341	149.376848	Telstra CMTS Gundaroo Rd CHATTON RIDGE	Unknown	1.9	ACMA
134752	-34.814515	149.399583	Optus Site Cullerin Lerida Rd North GOULBURN	Within 10 metres	1.7	ACMA
9001402	-34.919472	149.436375	Telstra Exchange Hut Federal Highway COLLECTOR	Within 10 metres	4.6	ACMA
9913515	-34.785566	149.376658	Mobile Spectrum Licensing Site HUME HIGHWAY	Unknown	4.7	ACMA

4.1.1 Site ID 9505 – Telstra Commsite GUN GUN

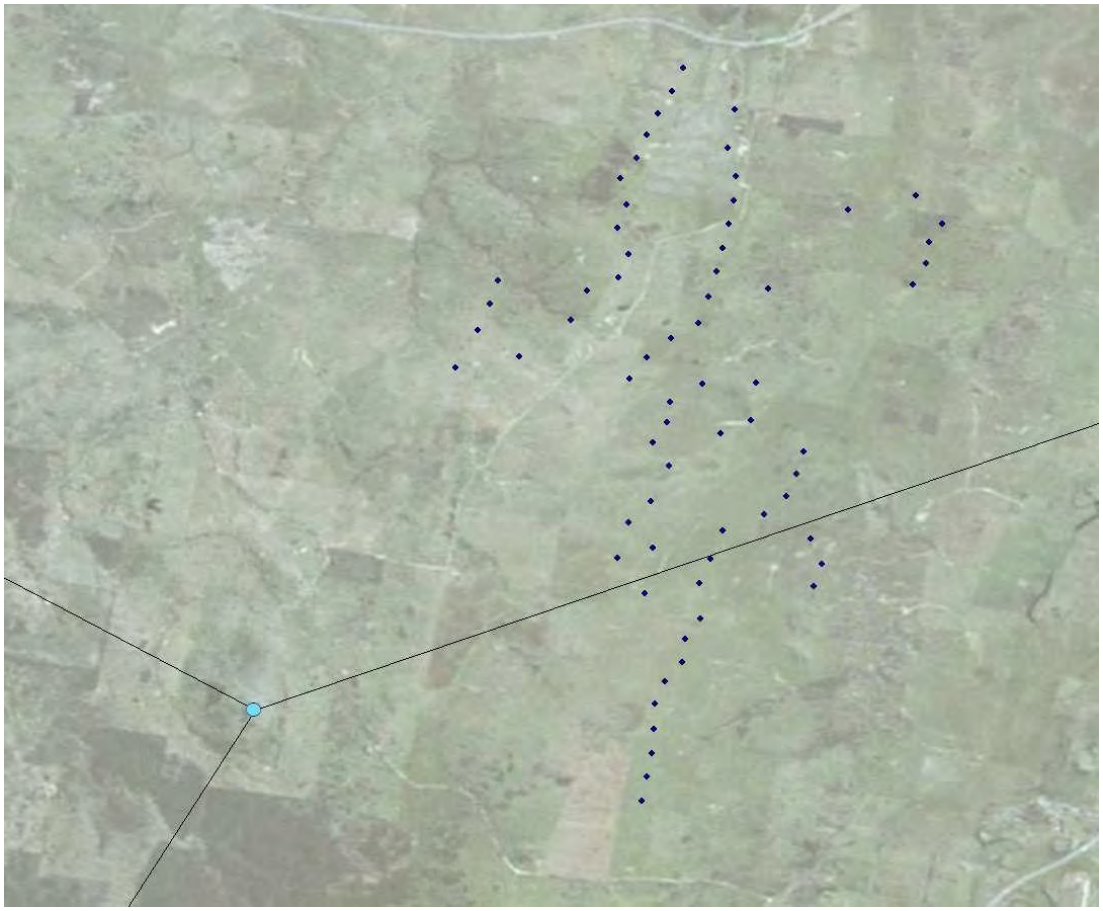


Figure 4: Telstra Commsite GUN GUN (light blue circle) and associated radio paths

- **69 degrees**
  These six assignments directed on the 69 degree bearing are, in the UHF to microwave frequency bands, are operated by Telstra Corporation Limited (Telstra). These links are directed towards the Telstra Site, Mt Gray (Site ID 9493) and pass through the wind farm. A 2nd Fresnel exclusion zone has been calculated for this radio path (see Section 4.3).

- **209 degrees**
  The radio path for these six assignments, directed towards Telecom Tower, Black Mountain (Site ID 9580) and licensed to Telstra, travels away from the wind farm. It is not expected to be impacted by CWF.

- **303 degrees**
  The radio path for these two assignments, directed towards Vodafone/Optus Site Oakhurst Trig GUNNING (Site ID 370254) and licensed to Telstra, travels away from the wind farm. It is not expected to be impacted by CWF.

4.1.2 Site ID 9506 – Commsite LERIDA

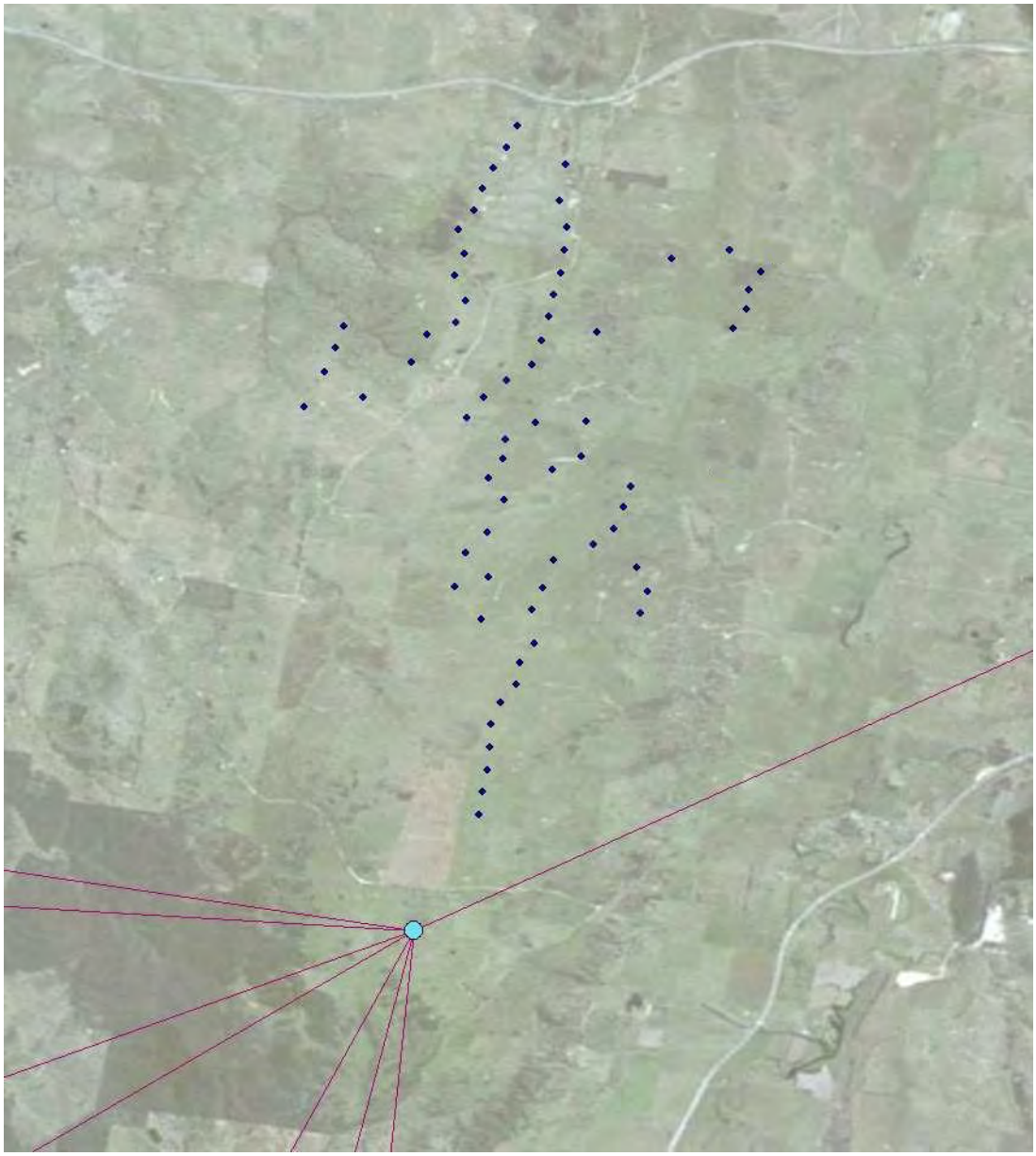


Figure 5: Commsite LERIDA (light blue circle) and associated radio paths

- **61, 62, 63 degrees**
  The assignments with bearings 61,62 and 63 degrees are all directed towards the same site: Pacific Power Site, Mt Gray (Site ID 9495). The links occupy the UHF and microwave frequency bands. The radio path comes within 1050 m from the wind farm – this is believed to be a sufficient distance to not cause impact.

- **71 degrees (not illustrated)**
  The assignment at 71 degrees, licensed to TransGrid, could not be linked to a receiving site. A non-directional antenna was linked to this assignment on the tower Comm Site Mackeys Ian Robertson (Access ID 1207512, Site ID 9453). However, this tower is over 120 km from the Commsite Lerida tower. PB has requested additional information regarding this link (see Section 6). Based on the azimuth entry, this link should not be impacted by the proposed development.

- **185, 186 degrees**
  The assignments with bearings 185 and 186 degrees travel to the site Police Site, Mt Eagle (Site ID 9705) NSW Police Force (185 degrees) and NSW Ambulance Service (186 degrees). The radio path travels away from the wind farm. It is not expected to be impacted by CWF.

- **194 degrees**
  Directed towards site The Ridgeway Reservoir, Queanbeyan (Site ID 9702), the two assignments licensed to the NSW Ambulance Service are directed away from the wind farm and are not expected to be impacted by CWF.

- **206 degrees**
  Six assignments are directed at a bearing of 206 degrees from the tower. Four of these run to site Fire Brigade Site, Isaacs Ridge (Site ID 9619) and the remaining two run to site Police Site, Isaacs Ridge (Site ID 9620). They're directed away from the wind farm and are not expected to be impacted by CWF.

- **236 degrees**
  These two assignments are linked to site Pacific Power Site Mt Spring, Canberra (Site ID 9532). They're also directed away from the wind farm and are not expected to be impacted by CWF.

- **248 degrees**
  These two assignments are linked to site Fire Tower Tumorrama Mountain, Tumorrama (Site ID 9953). They're also directed away from the wind farm and are not expected to be impacted by CWF.

- **275 degrees**
  Two radio links on bearing 275 degrees are operated by the NSW Ambulance Service. These are linked to Transgrid site Talmo (Site ID 9510). They are directed away from the wind farm and are not expected to be impacted by CWF.

- **280 degrees**
  The four assignments on this bearing, operated by Soul Pattinson Telecommunications Pty Limited, are linked to Yass RRS Above Transgrid Yass Depot Yass (Site ID 204072). They are directed away from the wind farm and are not expected to be impacted by CWF.

- **Non-directional**
  There are fifteen non-directional antennas on the Commsite Lerida tower. These are licensed to Transgrid (7), NSW Ambulance Service (2) and NSW Police Force (6). There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, it is north, northeast and northwest of the CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.3 Site ID 9507 – Win site Chaton Ridge Lake George

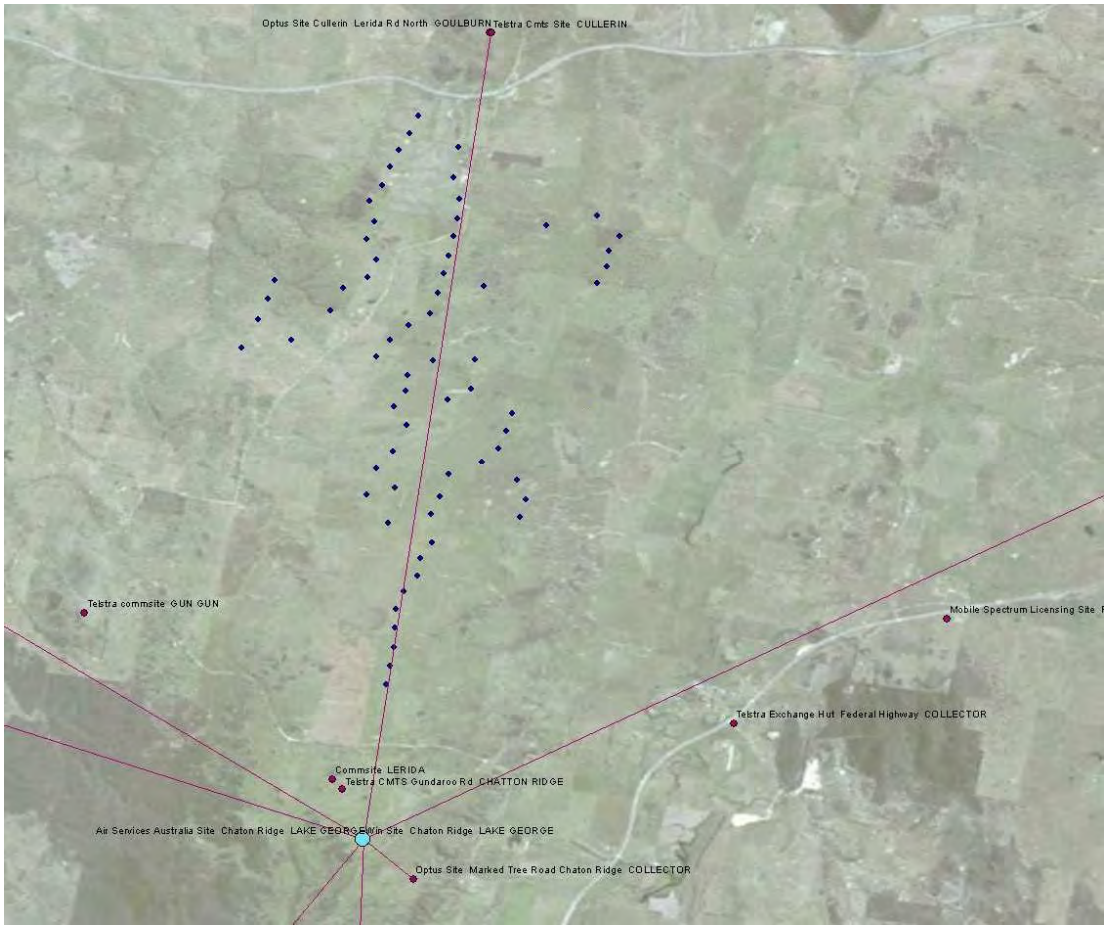


Figure 6: Win site Chaton Ridge Lake George

- **7.4 degrees**
  The two radio links between Win Site, Chaton Ridge and Telstra Cmts Site, Cullerin (Site ID 100726) are licensed to Vodafone Australia, Pty Ltd. This radio path is directed through the wind farm. A 2nd Fresnel exclusion zone has been calculated for this radio path (see Section 4.3). The links occupy the microwave frequency band (12-13 GHz), however, at the request of Vodafone, 2nd Fresnel zone analysis has been conducted using a microwave frequency of 6 GHz, to allow for link expansion.

- **61 degrees (not illustrated)**
  The eight links on a 61 degree bearing are directed towards three different towers: Optus & Vodafone Comm site, Mt Gray (Site ID 51071); Win Digital TV Tower, Mt Gray (Site ID 206196); and Win TV Tower, Mt Gray (Site ID 198042). These links are not illustrated due to their unique listing in the ACMA database. PB is contacting the licensees to seek more information on these assignments. These links are all microwave frequencies.

  The radio path for these assignments comes within approximately 2100 m of the wind farm.

- **62 degrees**
  Seven assignments are directed towards site South Site, Mt Gray (Site ID 9491) on

a 62 degree bearing. These assignments come within approximately 2300 m of the wind farm. They are not expected to be impacted by CWF.

- **134 degrees**
  Directed towards the Optus Site Marked Tree Road, Chaton Ridge, Collector (Site ID 53802), these radio paths are directed away from the wind farm and are not expected to be impacted by CWF.

- **183 degrees**
  The two assignments directed south to CMTS Site, The Grove, Federal Hwy, Gearys Gap (Site ID 54354) are not expected to be impacted by CWF.

- **213, 214, 215, 216 degrees**
  The assignments with azimuths of 213, 214, 215, and 216 degrees from this radio tower are all directed at Telecom Tower, Black Mountain (Site ID 9580). They are directed away from the wind farm and are not expected to be impacted by CWF.

- **291 degrees**
  The assignments on this bearing, directed at Trig Station 12 km E of Yass, Mt Mundoonen (Site ID 55602), come within 2600 m of the wind farm. At this distance, they are not expected to be impacted by CWF.

- **308 degrees**
  Assignments on this bearing are directed towards Vodafone/Optus Site Oakhurst Trig, Gunning (Site ID 370254). They come within 2250 m of the wind farm, which is not expected to be impacted by CWF.

- **Non-directional**
  According to the ACMA, there are 80 non-directional assignments registered to this tower, to several different licensees. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, it is north, northeast and northwest of the CWF. Reflection impacts may be observed if a user is near to the wind farm.

- **Blank**
  A single assignment, registered to Dianne Maree Nacson, was associated with the tower. The service is believed to be an omnidirectional broadcast. PB is contacting this licensee to request more information.

4.1.4 Site ID 9508 – Air Services Australia Site Chaton Ridge Lake George

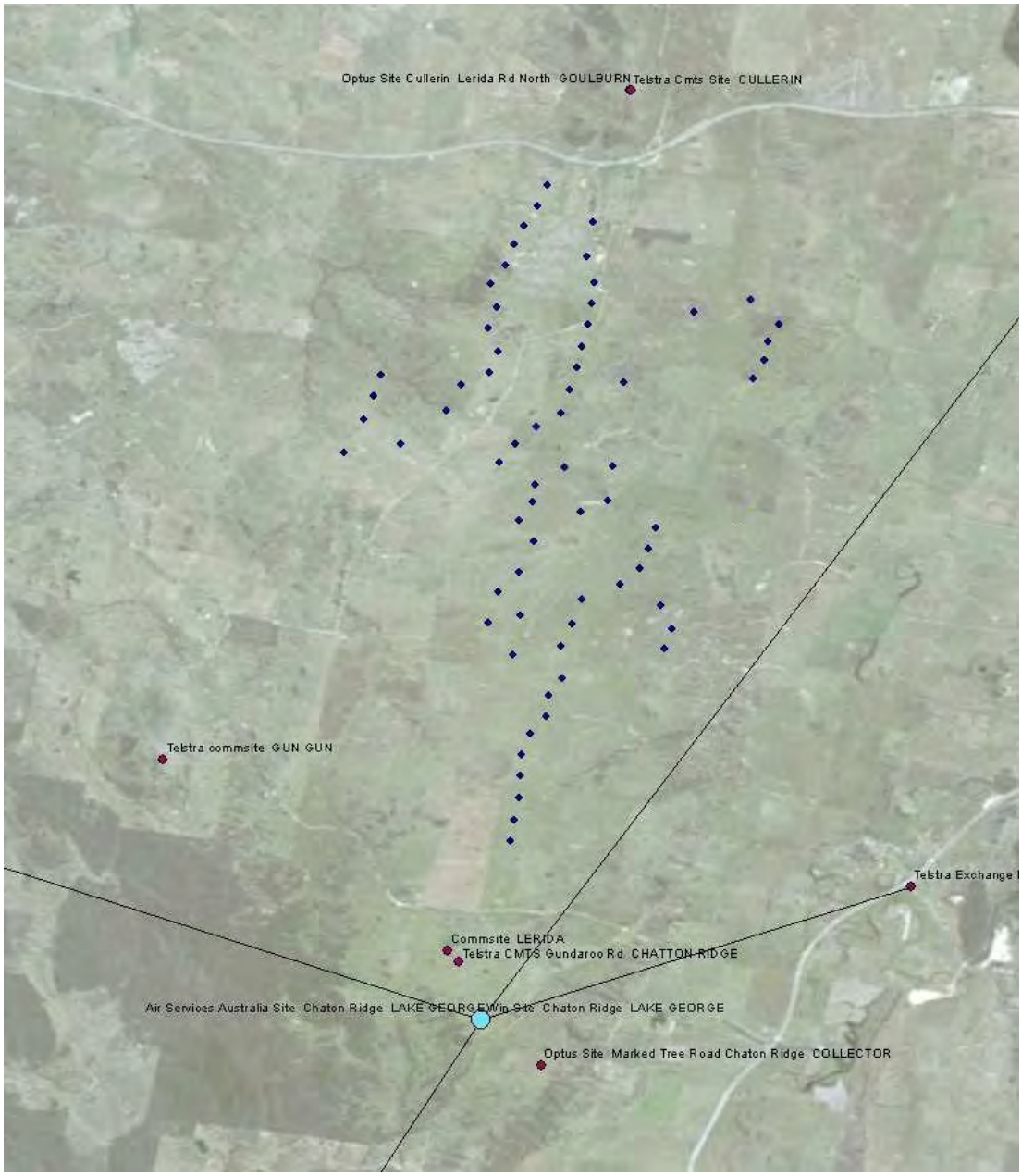


Figure 7: Air Services Australia site Chaton Ridge and associated radio paths

- **32 degrees**
  The two assignments licensed to Air Services Australia and directed towards site Air Services Site, Mt Macalister (Site ID 9496) pass within 1000 m from the wind farm. These assignments have been selected for Fresnel zone calculation (see Section 4.3).

- **69 degrees**
  Licensed to Telstra, and directed to Telstra Exchange Hut, Federal Highway, Collector (Site ID 9001402), these assignments are not directed towards the wind farm and should not experience any impact from CWF.

- **208, 209 degrees**
  The services with bearings 208 and 209 degrees are directed to Radar Station, Mt Majura (Site ID 9636). They are directed away from the wind farm and are not expected to be impacted by CWF.

- **291 degrees**
  Two assignments licensed to Telstra are on bearing 291 from this tower. They are linked to Telstra Site 12 km E of Yass, Mt Mundoonen (Site ID 9531). The link passes within 2600 m of the wind farm. It is not expected to be impacted by CWF.

- **Non-directional**
  According to the ACMA, there are two non-directional assignments registered to this tower, to Telstra. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, that would be north, northeast and northwest of the CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.5 Site ID 9509 – Springvale CULLARIN

There are no assignments registered to this tower.

4.1.6 Site ID 53802 – Optus Site Marked Tree Road Chaton Ridge

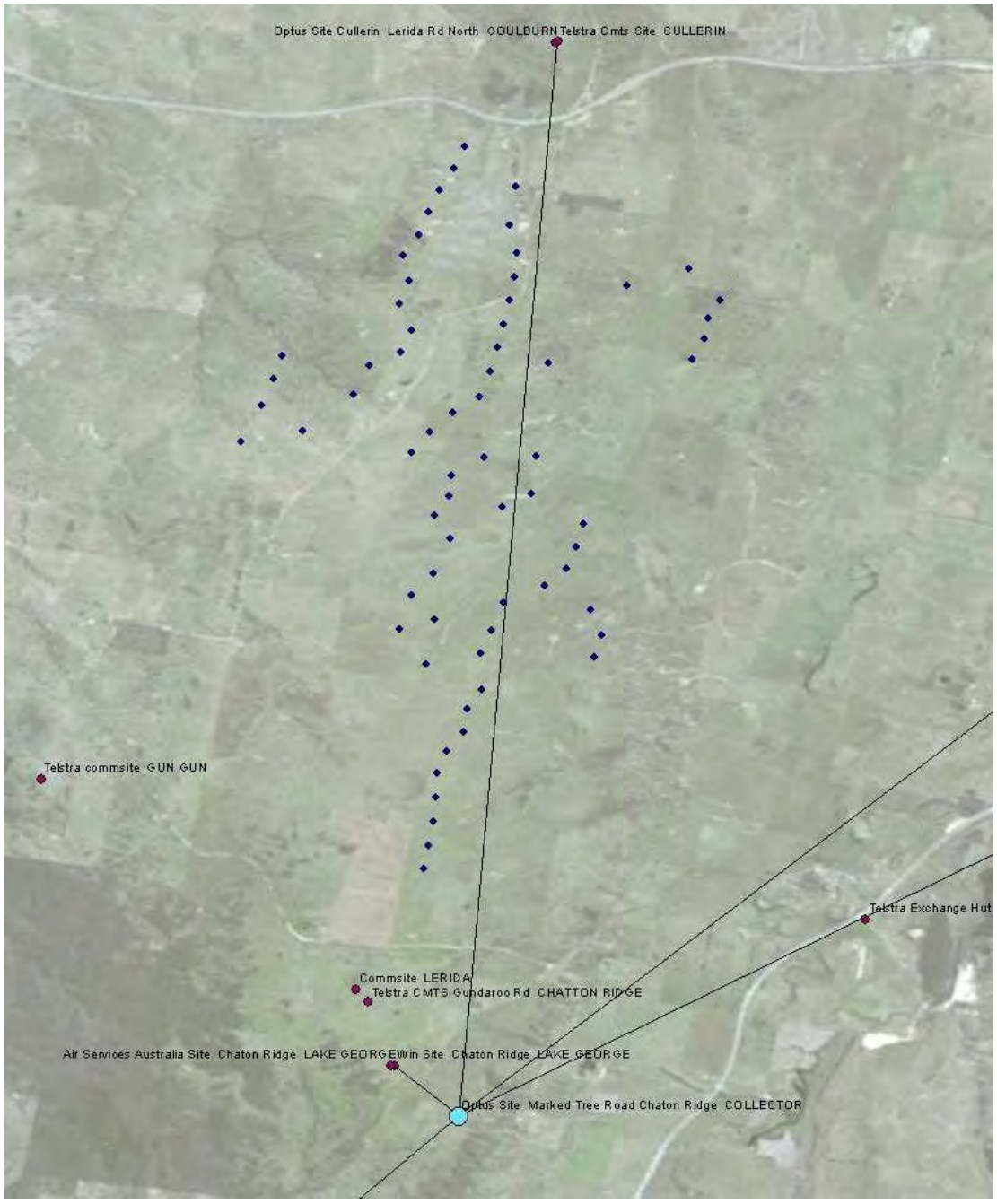


Figure 8: Optus Site Marked Tree Road Chaton Ridge and associated radio paths

- **4.3 degrees**
  Operated by Optus Mobile Pty Ltd, these two assignments are directed towards the wind farm. They have been selected for Fresnel zone calculation (see Section 4.3). The other tower in the link is Telstra Cmts Site Cullerin (Site ID 100726). PB has asked Optus to confirm the location of tower coordinates.

- **47 degrees**
  Four assignments, operated by Optus Mobile Pty Ltd, are linked to the site Optus Site, Maryland, Yarra Hume Hwy, Breadalbane (Site ID 202088). They pass within 2650 m of the wind farm. They are not expected to be impacted by CWF.

- **59, 61 degrees**
  Assignments on bearings 59 and 61 degrees are linked to site Optus & Vodafone Commsite, Mt Gray (Site ID 51071) these assignments are not expected to be impacted by CWF.

- **226 degrees**
  These assignments link to site Motorola Site, Oak Hill and are directed away from the wind farm. They are not expected to be impacted by CWF.

- **314 degrees**
  Linked to the nearby site Win Site Chaton Ridge, Lake George (Site ID 9507), these links pass within 2650 m of the wind farm. They are not expected to be impacted by CWF.

- **Non-directional**
  According to the ACMA, there are eleven non-directional assignments registered to this tower, to a number of licensees. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, that would be north, northeast and northwest of the CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.7 Site ID 100726 – Telstra Cmts Site CULLERIN

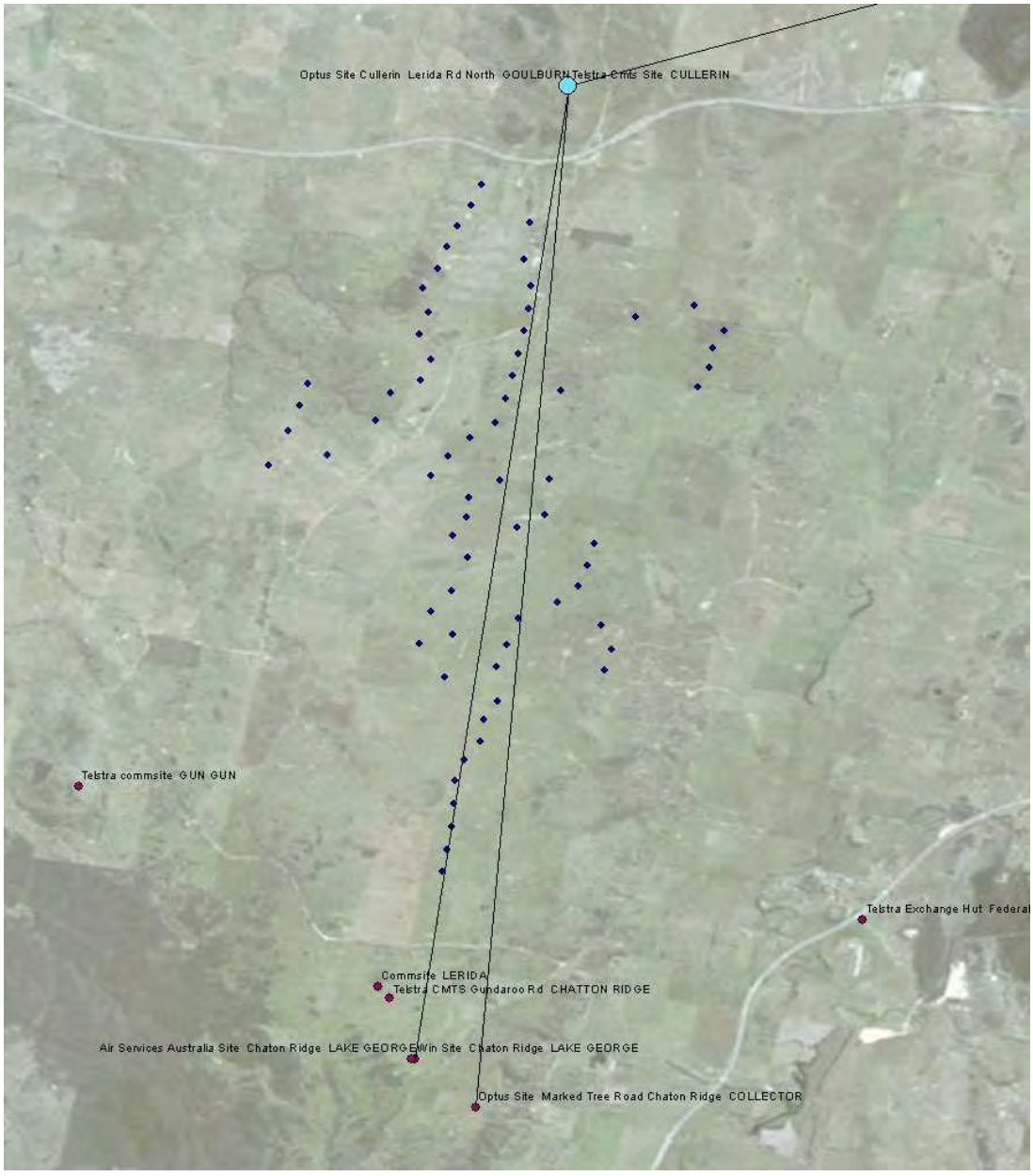


Figure 9: Telstra Cmts Site Cullerin and associated radio paths

- **50 degrees (not illustrated)**
  A number of assignments are listed on a 50 degree bearing, licensed to Telstra. These are 900 MHz, one sector panel antenna and are likely mobile services. A fifty degree bearing is directed away from the wind farm.

- **72, 73 degrees**
  The assignments with these bearings are linked to Telstra Site, Hume Highway, Breadalbane (Site ID 100725). They are directed away from the wind farm and are not expected to be impacted by CWF.

- **170 degrees**
  A number of assignments are listed on a 170 degree bearing, licensed to Telstra. These are 900 MHz, one sector panel antennas and are likely mobile services. A

170 degree bearing is directed through the wind farm. Shadowing of these mobile services is likely to occur if a receiver is situated with the wind farm between them and the radio tower. PB has contacted Telstra requesting their position on the development.

- **184 degrees**
  The radio paths on this bearing are directed through the wind farm to site Optus Site Marked Tree Road, Chaton Ridge (Site ID 53802). This radio path has been selected for Fresnel zone analysis (see Section 4.3).

- **187 degrees**
  The radio paths on this bearing are directed through the wind farm to site Win Site Chaton Ridge, Lake George (Site ID 9507). This radio path has been selected for Fresnel zone analysis (see Section 4.3).

- **285 degrees**
  A number of assignments are listed on a 285 degree bearing, licensed to Telstra. These are 900 MHz, one sector panel antenna and are likely mobile services. A 285 degree bearing is not directed through the wind farm. Shadowing of these mobile services is likely to occur if a receiver is situated with the wind farm between them and the radio tower. PB has contacted Telstra requesting their position on the development (see Appendix D).

- **Non-directional**
  According to the ACMA, there are twelve non-directional assignments registered to this tower, to a number of licensees. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, that would be south, southeast and southwest of the CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.8 Site ID 100817 – Telstra CMTS Gundaroo Rd CHATTON RIDGE

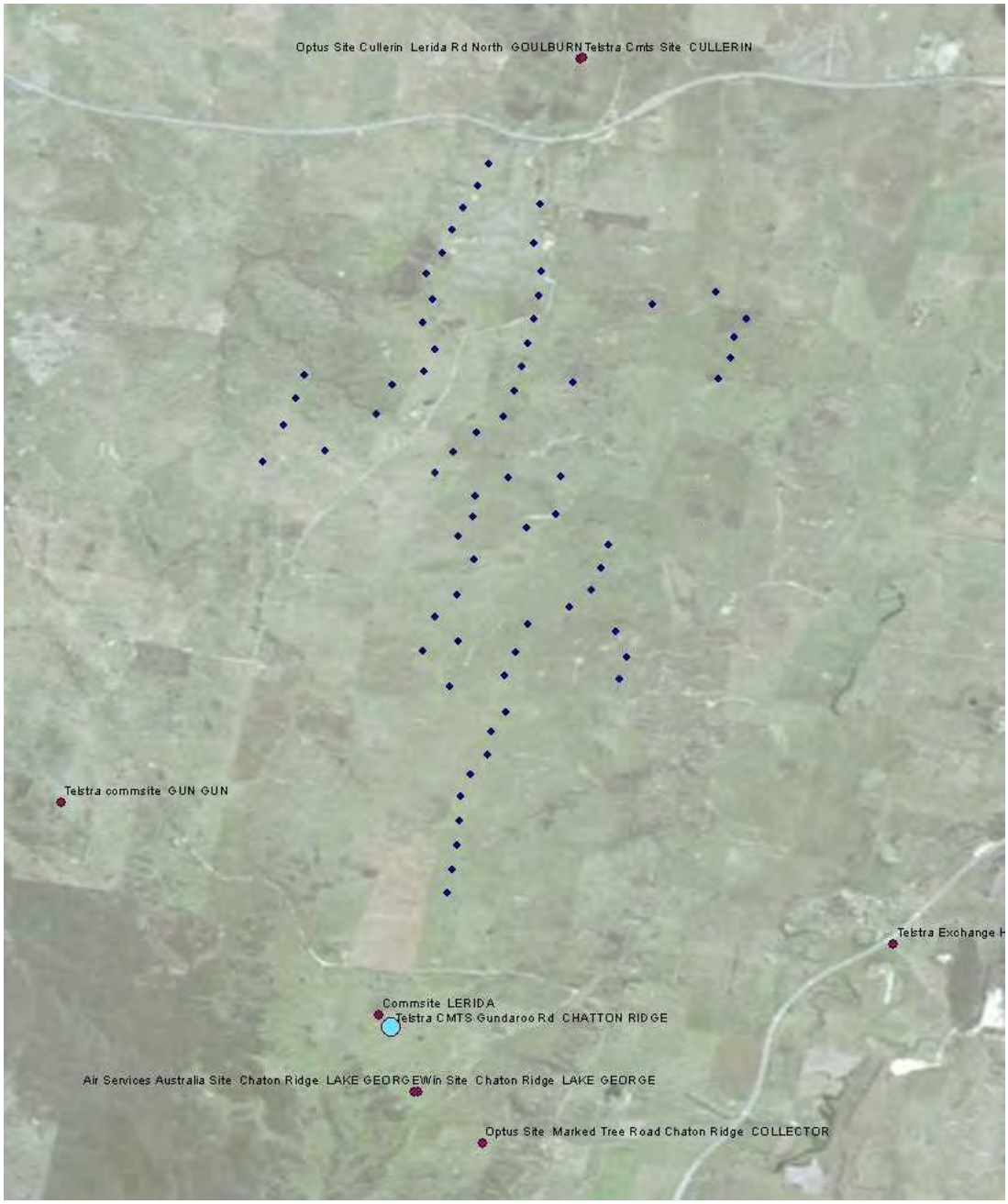


Figure 10: Telstra Cmts Gundaroo Rd and associated radio paths

- **Non-directional**
  According to the ACMA, there are seven non-directional assignments registered to this tower, to Telstra. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, that would be north, northeast and northwest of CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.9 Site ID 134752 – Optus Site Cullerin Lerida Rd North Goulburn

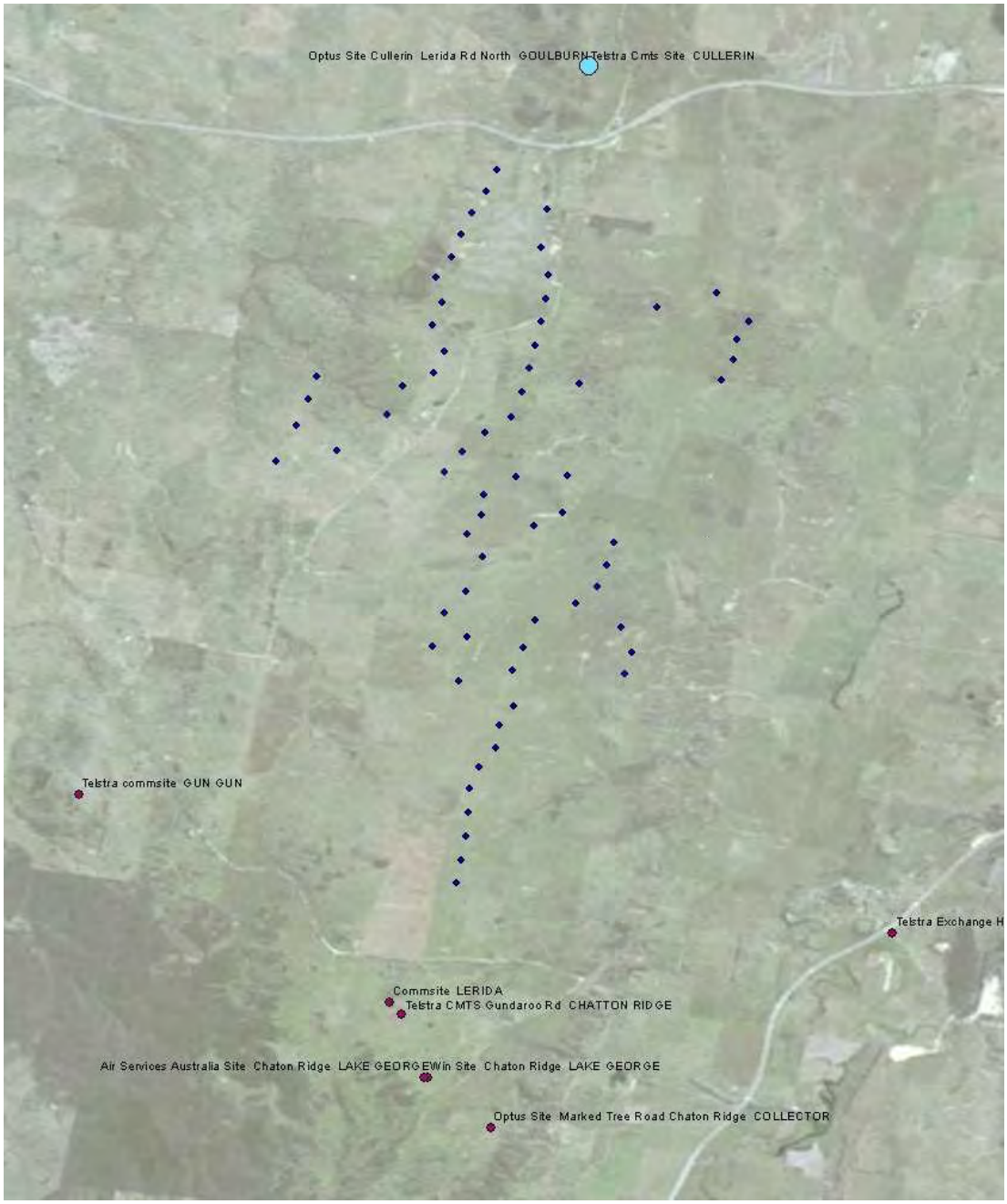


Figure 11: Optus Site Cullerin Lerida Rd and associated radio paths

- **Non-directional**
  According to the ACMA, there are seven non-directional assignments registered to this tower, to Telstra. There may be potential shadowing of these services when a user is situated with the wind farm between themselves and the radio tower. In this case, that would be south, southeast and southwest of CWF. Reflection impacts may be observed if a user is near to the wind farm.

4.1.10 Site ID 9001402 – Telstra Exchange Hut Federal Highway Collector

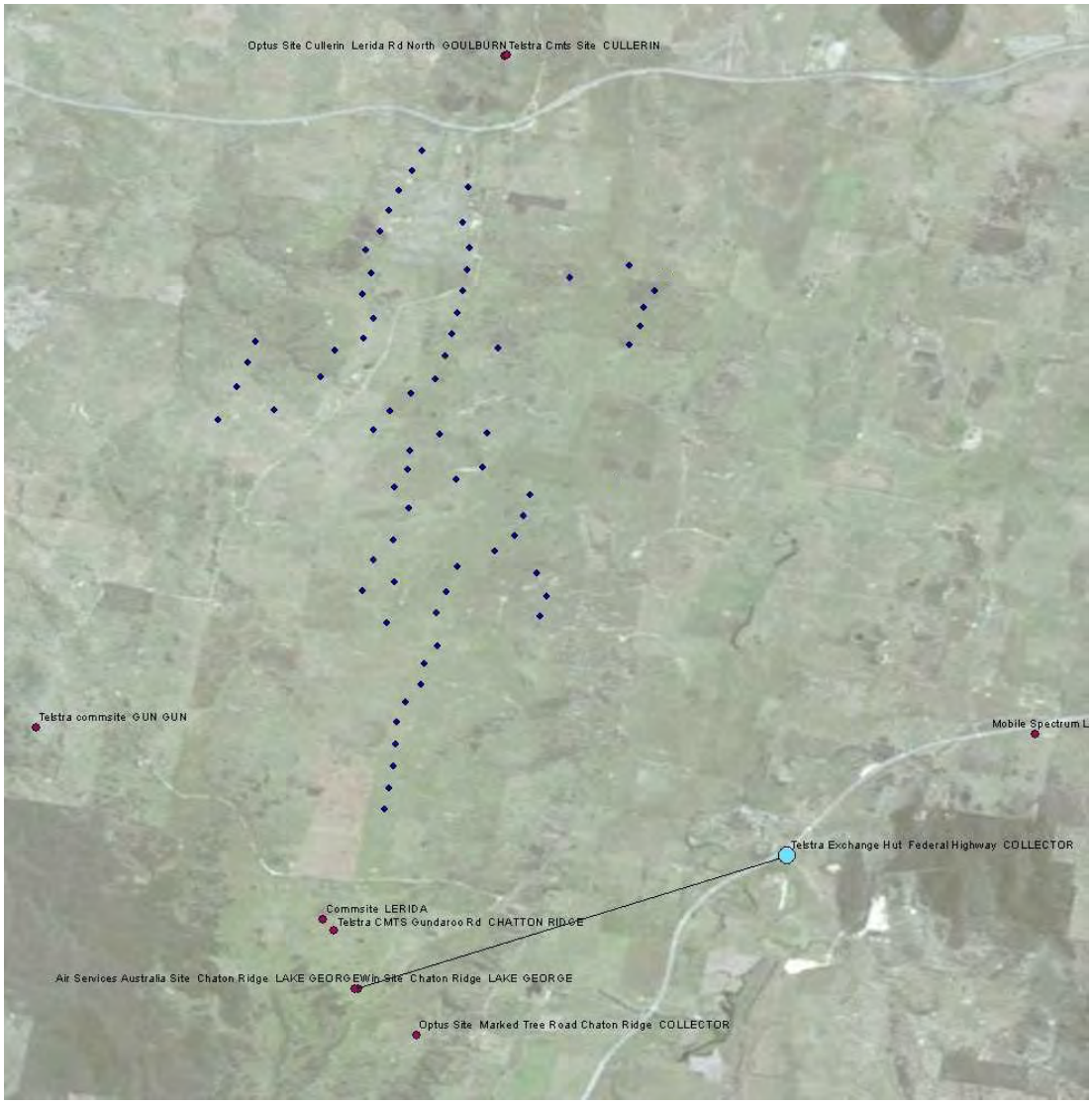


Figure 12: Telstra Exchange Hut, Federal Highway Collector and associated radio paths

- **249 degrees**
  The two assignments on this tower are directed towards the 9508 tower and run a distance 2330 m from the wind farm.

4.1.11 Site ID 9913515 – Mobile Spectrum Licensing Site HUME HIGHWAY

This site is actually not a physical tower but is used by the ACMA to allocate mobile spectrum licenses to certain areas. It is therefore not considered further in this assessment

4.1.12 Sites outside the 5 km buffer zone

A number of links were found travelling within 5 km of the site but the radio antennas themselves were outside this 5 km buffer zone (see Figure 13). These sites are presented in Table 2.

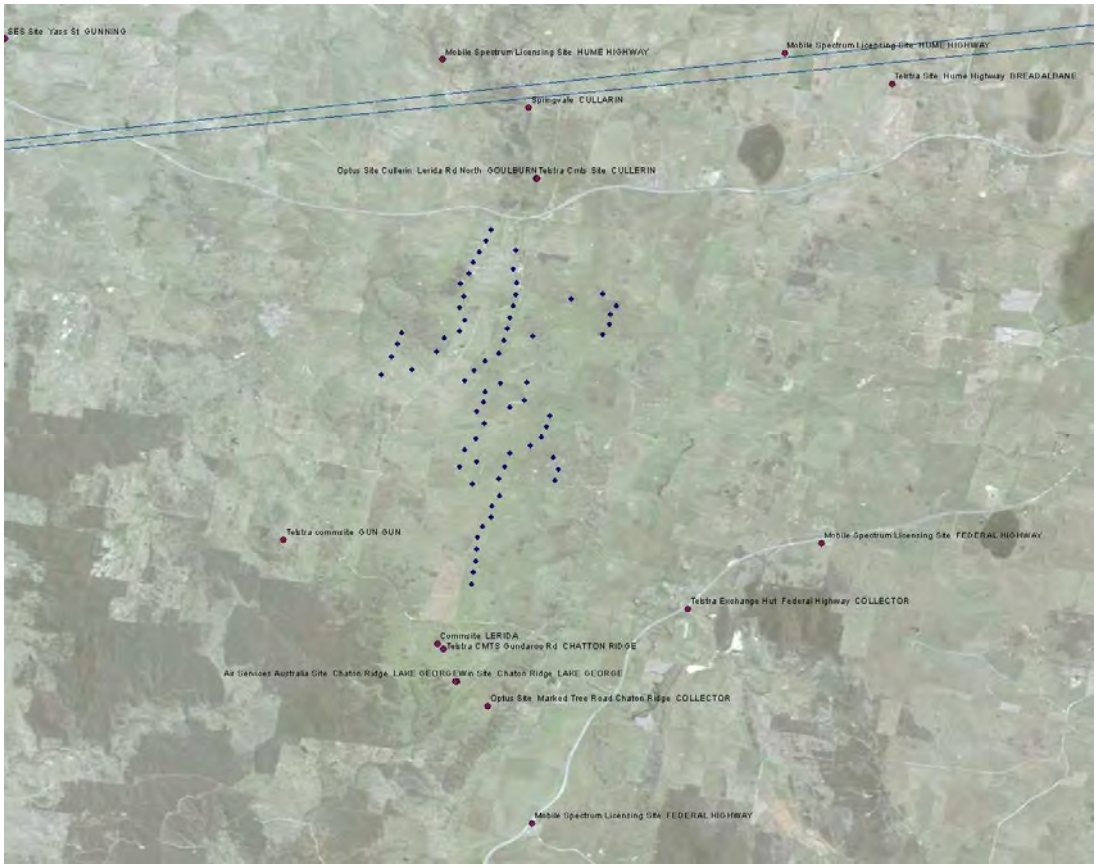


Figure 13: Links from sites outside the 5 km buffer zone (blue lines)

Table 2: Links from sites outside the 5 km buffer zone (coordinates WGS84)

SITE_ID	LATITUDE	LONGITUDE	SITE_NAME	PRECISION	DISTANCE TO NEAREST TURBINE (KM)
9530	-34.829695	149.041172	Airservices Site MT MUNDOONEN	Within 100 metres	>5km
9495	-34.752795	149.762664	Pacific Power Site MT GRAY	Within 10 metres	>5km
202294	-34.76584	149.695494	56-58 Knox Street GOULBURN	Unknown	>5km

The precision on the coordinates for site “56-58 Knox Street, Goulbourn” are considered poor. PB is contacting several licensees on this tower to gather more information (see Section 6). Based on the information available, these links pass within approximately 3.5 km from the wind farm and are not expected to be impacted by CWF.

Information on the assignments shown in Figure 13 is presented in Appendix C.

4.1.13 Incomplete point-to-point links

During the assessment, PB found several directive antenna registrations that appear to be part of point-to-point links. However, the second antenna in the link could not be found. These links are illustrated in Figure 14, which shows the radio path plotted as a 60 km line in the direction of the listed azimuth.

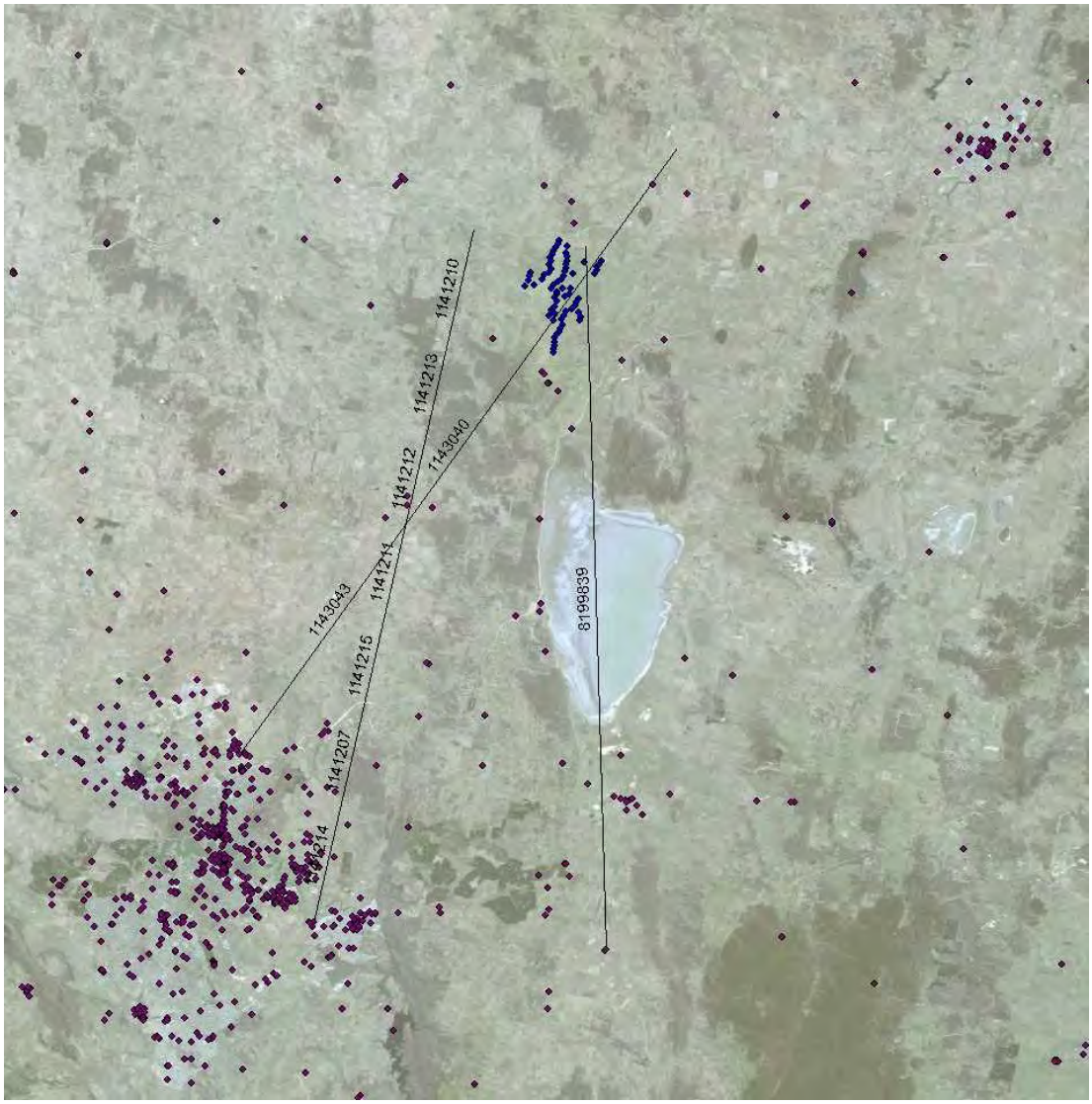


Figure 14: Lines illustrating radio paths on incomplete links (ACMA Access ID shown)

Access ID 1141214, 1141207, 1141215, 1141211, 1141210, 1141213 and 1141212
These links are licensed to Department of Defence and are in the microwave frequency band. Tilt levels of these assignments (~48 deg) indicate these antennae are used for satellite communications and are not expected to be impacted by the wind farm.

Access ID 8199839
Licensed to Telstra, the radio path mapping the link 8199839 does pass within a close distance to the wind farm. However, the radiation pattern and front-to-back ratio suggest an omnidirectional antenna. The frequency is listed as 885 MHz. This radio service is not expected to be impacted by CWF.

Access ID 1143043, 1143040
Licensed to Kordia Pty Ltd, these radio paths come within a close distance of the wind farm. Both antenna are parabolic operating at microwave frequencies. Tilt levels of these assignments (~44 deg) indicate these antennae are used for satellite communications and are not expected to be impacted by the wind farm.

Table 3: Details of incomplete links

ACCESS_ID	FREQUENCY	SITE_ID	LICENSEE
1141207	7946000000	39232	Department of Defence
1141208	8026000000	39232	Department of Defence
1141209	8170000000	39232	Department of Defence
1141210	8250000000	39232	Department of Defence
1141211	7296000000	39232	Department of Defence
1141212	7376000000	39232	Department of Defence
1141213	7520000000	39232	Department of Defence
1141214	7600000000	39232	Department of Defence
1141215	7749800000	39232	Department of Defence
ACCESS_ID	FREQUENCY	SITE_ID	LICENSEE
1143040	6225813000	135397	Kordia Pty Limited
1143043	4000813000	135397	Kordia Pty Limited
ACCESS_ID	FREQUENCY	SITE_ID	LICENSEE
8199839	885000000	9007514	Telstra Corporation Limited

4.2 Near field exclusion

For the services attached to towers discussed in Section 4.1, the near field exclusion zones were calculated. The exclusion zones were mapped with respect to the CWF layout. As discussed in Section 2.1.1, PB recommends an exclusion zone equal to the maximum of the calculated near field exclusion zone and 500 m (whichever is the greater). No turbines are located within these defined exclusion zones.

4.3 Point-to-point services

When investigating impact to point-to-point services, PB recommends that turbines and turbine blades do not intrude on the 2nd Fresnel exclusion zone. If turbines are found to intrude on exclusion zones, there are a number of mitigation options available (see Section 2.3). However, before investigating mitigation options for the CWF, PB recommends the coordinates of the transmitting and receiving towers, the status of the services and requirements of the licensees are verified during the consultation phase. The tower coordinates may not be accurate, the services may not be active or the requirements of the licence holders may influence the requirements for layout adjustment. PB has contacted or attempted to contact the licensees of links discussed in this section (see Section 6 for information on consultation).

For selected point-to-point services in the search results in Section 4.1, PB calculated the recommended obstruction exclusion zones (2nd Fresnel exclusion zone). Figure 15 illustrates the calculated Fresnel zones and their relation to the CWF.

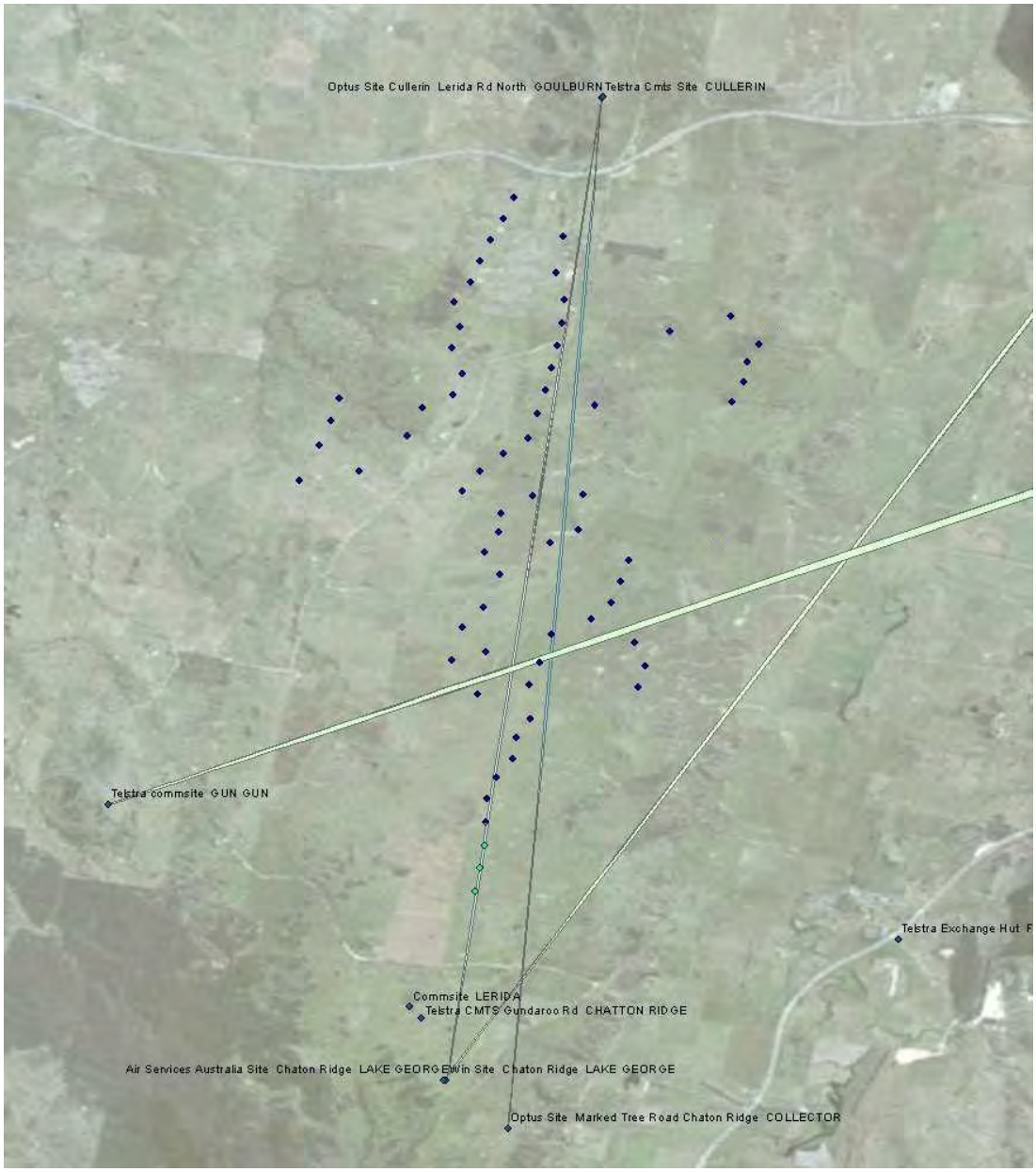
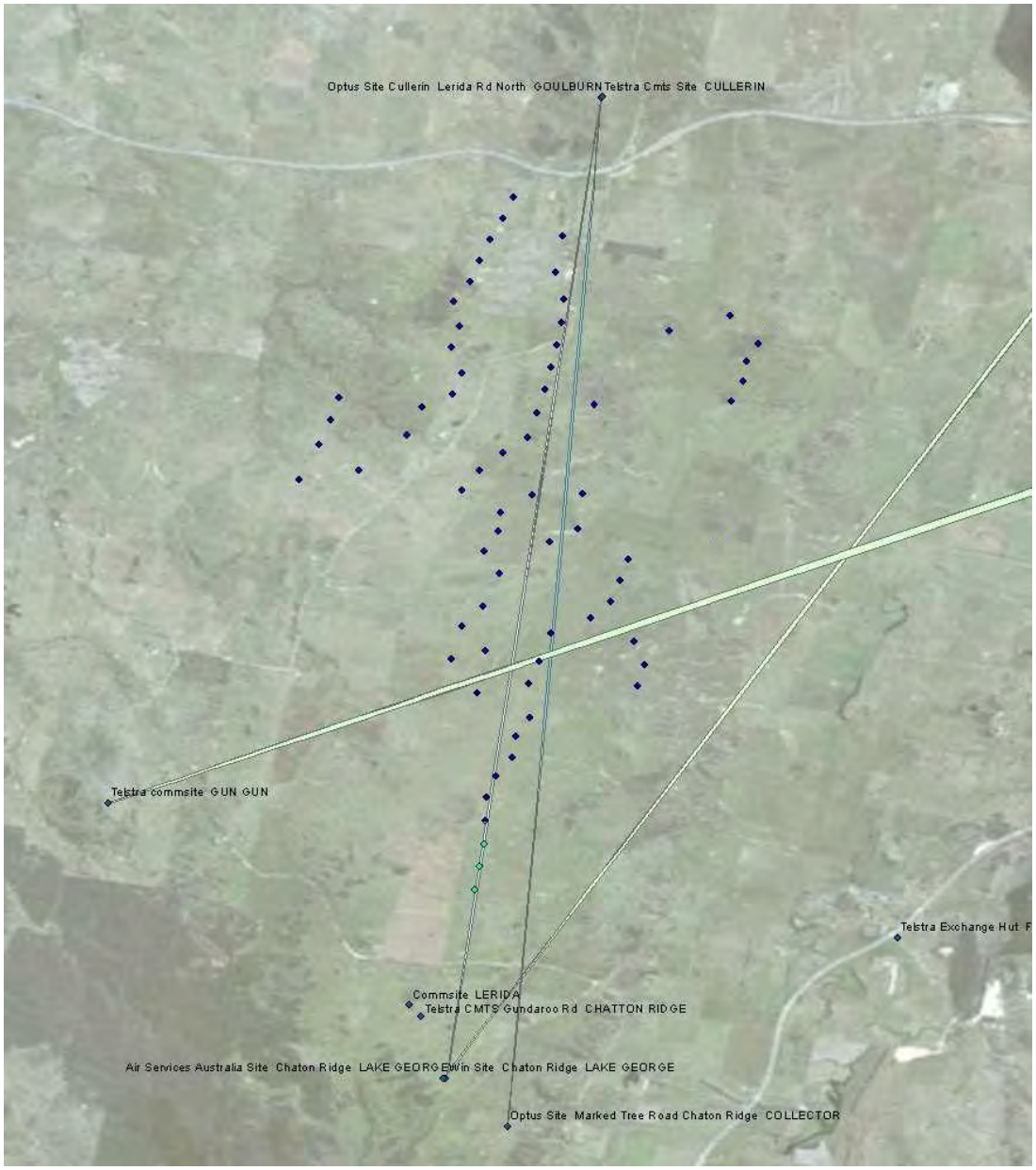


Figure 15: Selected Fresnel zones relative to the CWF

The Fresnel zone analysis shows that a number of turbines encroach on link Fresnel zones. The link running southwest/northeast between Air Services Australia Site, Chaton Ridge (Site ID 9508) and Airservices Site Mt Macalister (Site ID 9496) has a significant distance between the largest Fresnel zone and the CWF. No impact is expected on this link due to the CWF.

4.3.1 Telstra Commsite Gun Gun (Site ID 9505) to Telstra Site Mt Gray (Site ID 9493)

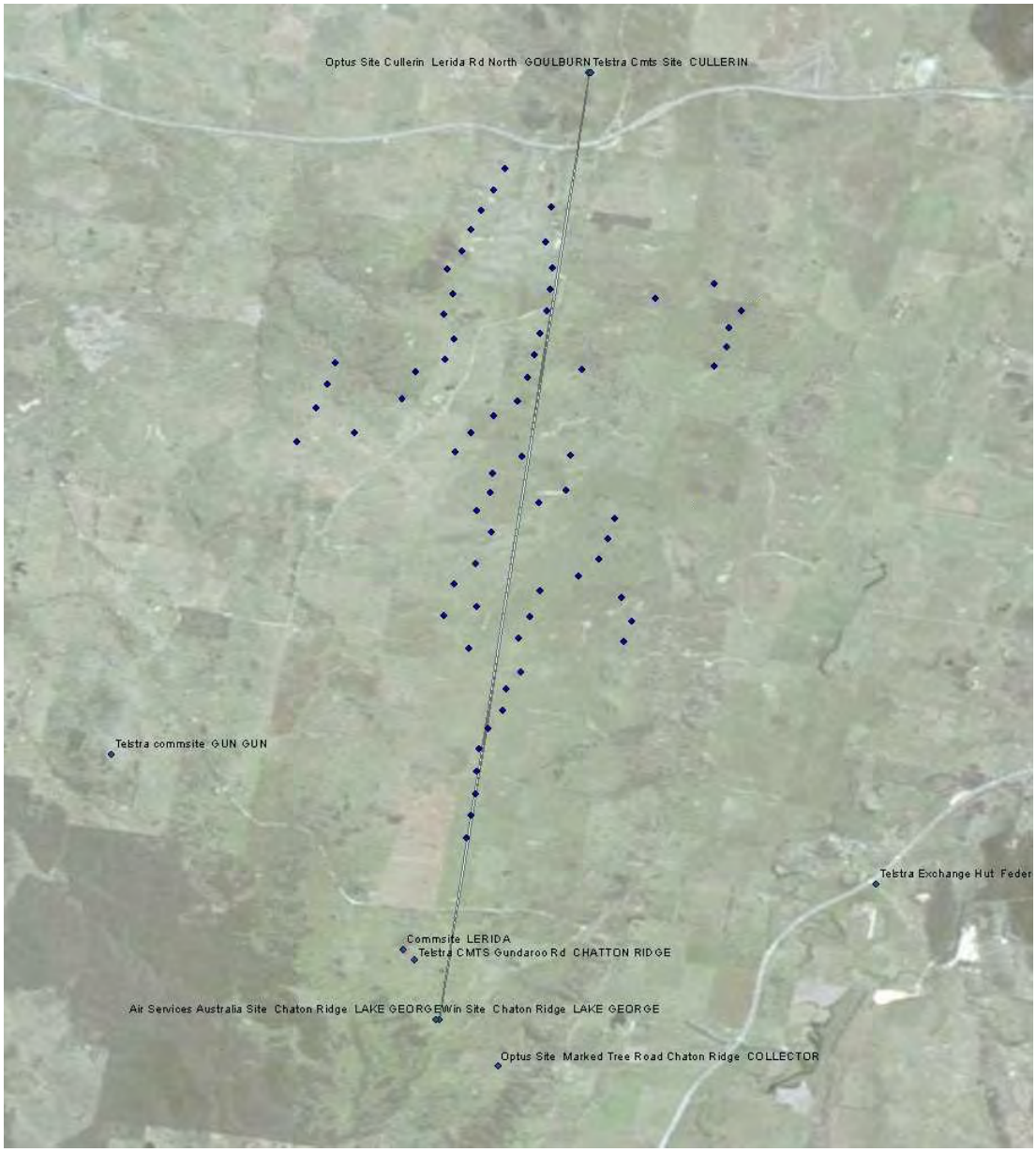
The links on this radio path are licensed to Telstra and occupy the UHF to microwave frequency bands (see Appendix C). The second Fresnel radius is calculated to be 60.3 m. Using this calculation as a basis for an exclusion zone, all turbines were observed to be at least a blade length from the exclusion zone and no impact is expected on this link due to CWF. Comments received by Telstra (see Appendix D) state that no interference is expected.



4.3.2 Win site Chaton Ridge, Lake George (Site ID 9507) to Telstra Cmts Site CULLERIN (Site ID 100726)

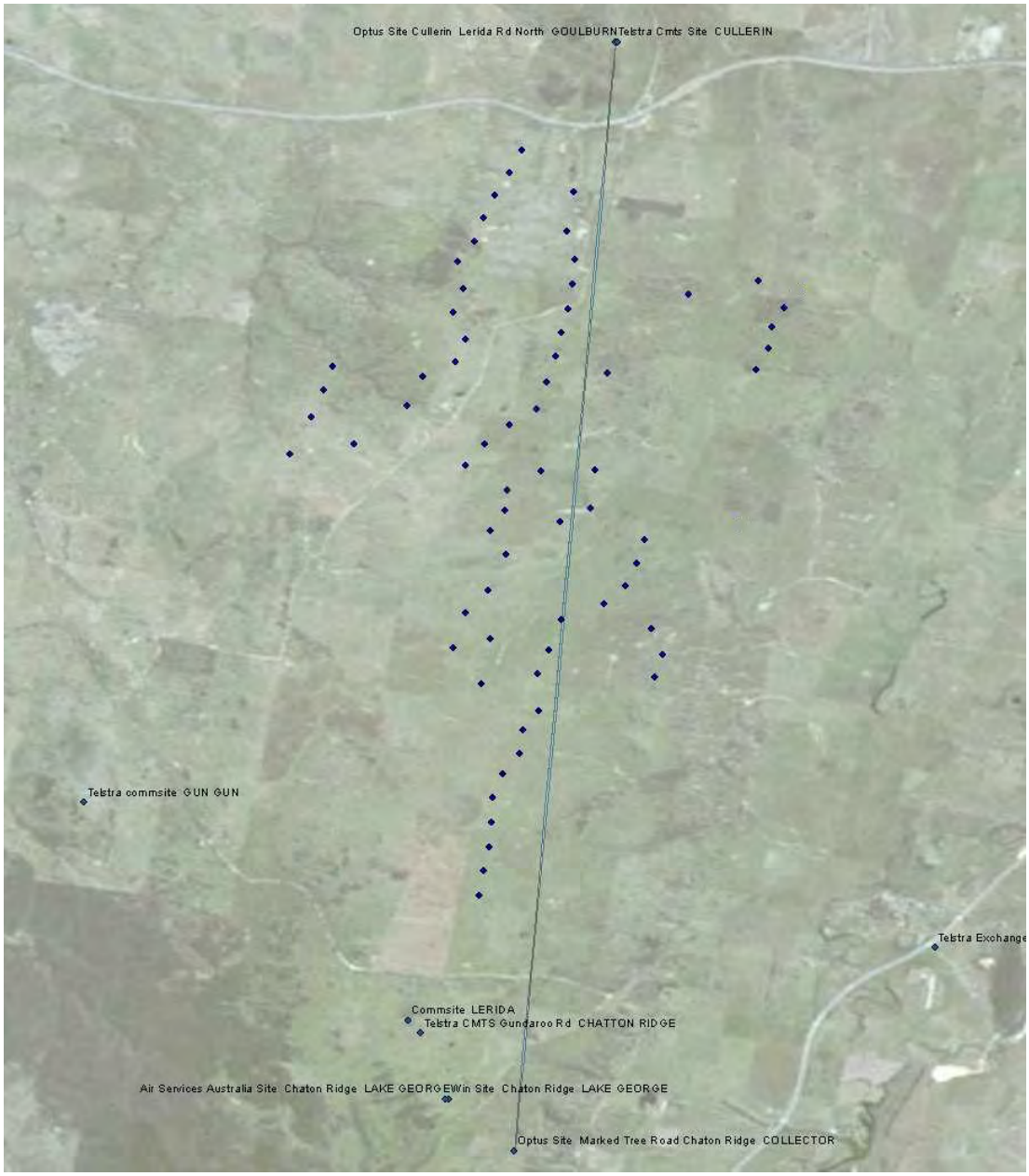
The links between these two sites are licensed to Vodafone Australia Pty Ltd. The 2nd Fresnel zone radius has been calculated to be 18.6 m. Using this as the basis for an exclusion zone, the turbines 55, 56, 57, 58, 59 and 60 were observed be within a blade length of the 2nd Fresnel zone, and interference on this link is expected due to CWF. All other turbines were observed to be at least a blade length from the exclusion zone. Comment from Vodafone indicates that there is potential for impact on their radio communication links caused by CWF.

RATCH-Australia has advised PB that micrositing is likely for these six turbines to relocate the turbine and rotor to be outside of the 2nd Fresnel zone. PB acknowledges that micrositing of this appropriate distance will mitigate any impact on this link.



4.3.3 Optus Site, Marked Tree Road, Chaton Ridge (Site ID 53802) to Telstra Cmts Site, Cullerin (Site ID 100726)

The links on this radio path are licensed to Optus Mobile Pty Ltd and are in the microwave frequency band. The calculated 2nd Fresnel zone radius is 12.2 m. Using this calculation as the basis for an exclusion zone, all turbines were observed to be at least a blade length from the exclusion zone and no impact is expected due to CWF. Comment from Optus (see Appendix D) states that interference is likely at Turbine 49, Optus have requested that this turbine is moved 134 m to the West.



4.4 Point-to-multipoint

Point-to-multipoint links are similarly susceptible to the types of impacts discussed in Section 2.1. However, because of the nature of many uses of point-to-multipoint radio communication, the likelihood of a wind farm causing unacceptable impacts is generally low. For example, for land mobile systems a mobile receiver can generally get an adequate signal by moving a short distance to an unobstructed area. However, there may be point-to-multipoint services with fixed receivers that can be impacted. Any registered services will be present and accounted for in the ACMA database used in this assessment. However, unregistered operators (such as Class licensees[3]) may not be detected. PB has consulted point-to-multipoint and broadcast licensees on towers within a 5 km distance from the wind

[3] http://www.acma.gov.au/WEB/STANDARD/pc=PC_481 *accessed on 20/02/2010*

farm boundary to determine their position on the development. PB recommends Ratch gathers information on fixed Class license receivers during their community consultation phase to determine if there are any users in the area.

4.4.1 AM and FM radio broadcasting

The impact to FM radio broadcasting reception is considered to be negligible. The impact to AM radio broadcasting is considered to be negligible beyond the boundary of the wind farm.

4.4.2 Mobile radio

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

4.5 Digital and analogue television

Reflection of an analogue video signal can result in impact to analogue television services. A search of the analogue television broadcast stations in the area was completed (see Figure 16). Based on ACMA information and the coverage patterns given by the Australian Broadcast Corporation[4], the likely tower being used for transmission in the area would be the Telecom Tower, Black Mountain and perhaps the Broadcast/Comms Site Nelanglo St Gunning. Further information would be required to determine which site(s) is being used by local receivers.

[4] *http://www.abc.net.au/reception/freq/*

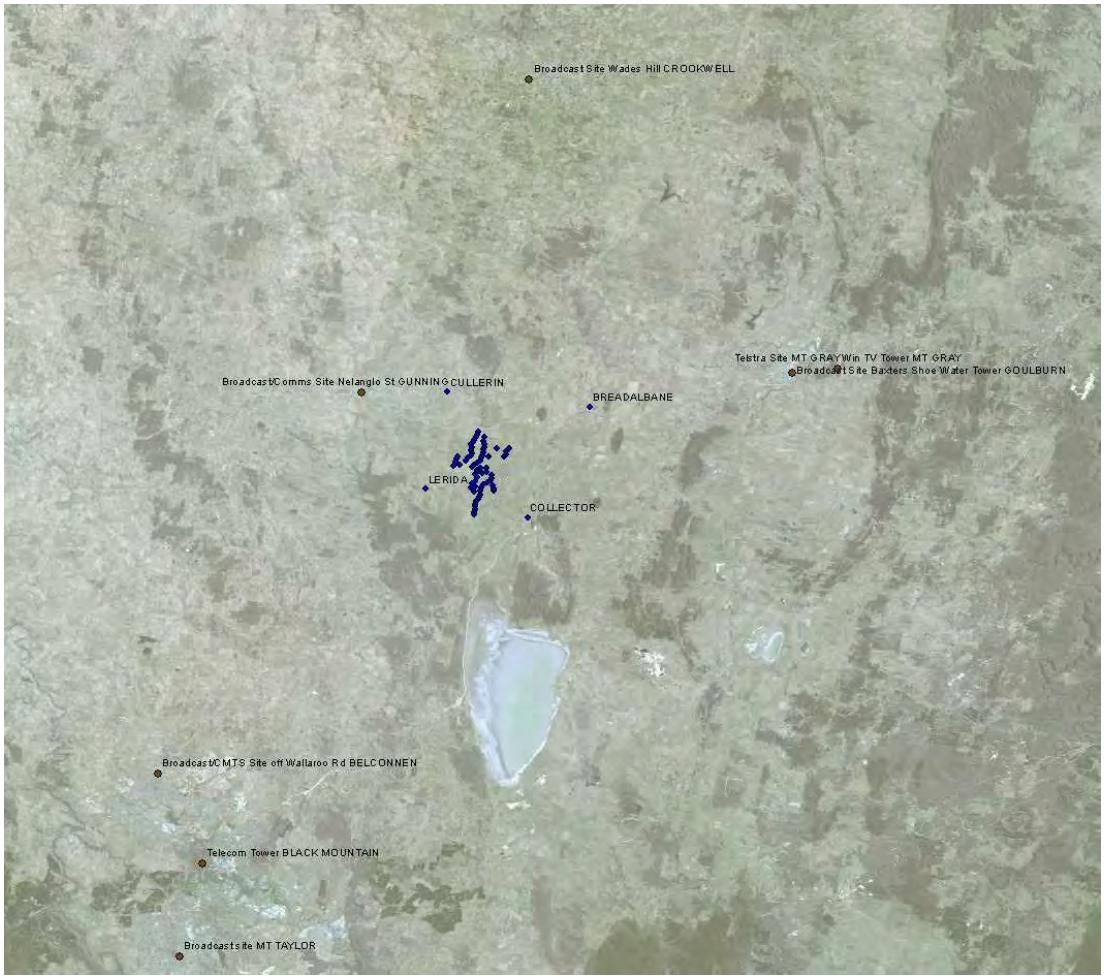


Figure 16: CWF (pale blue), populated areas (blue) and the surrounding broadcast stations (red)

A number of townships lie in close proximity to the wind farm. No population centre lies such that the CWF is obstructing either of these broadcast stations lines of sight. However, some residences of the township of Collector may be affected by reflection of the Black Mountain broadcast signal to their receiving antenna by the CWF.

The Australian government has declared analogue television will be phased completely out of service by the end of 2013 with service in many areas ceasing operation before that time. Given a reasonable construction schedule for CWF, many television users will likely have converted to digital television when construction has commenced. It is also quite likely that analogue television will have been phased out by the time the wind turbines are operational at CWF, thereby mitigating the impact the turbines will have on the analogue television signals. Digital television signals are generally not degraded due to interference from wind turbines.

5. Previous assessments

An EMI assessment has been conducted on the CWF by Percom Technology Pty Ltd (Percom) in late 2004 titled "Collector Windfarm Risk Assessment; Communications and Broadcasting Services". PB has conducted a new assessment of the telecommunications risks, but has considered the feedback obtained from potentially impacted licensees in the Percom assessment. The clearance requirements gathered during the Percom assessment are given in Table 4.

Table 4: Clearance zones given by licensees in Percom report

Point to Point	
Licensee	Requirements
Optus	100m either side of point to point link path
Prime Television	4th Fresnel zone
Commissioner of Police NSW Police	250m
Air Services Australia	70m

Tower	
NSW State Government Office of Information Technology	1200m clearance from tower

Mobile Basestation Clearances		
Licensee	Basestation	Clearance Requirements
Optus Mobile Pty Ltd	53802	55-190 degrees, 200-245 degrees
Telstra Mobile	100817	55-75 degrees, 163-183 degrees

5.1 Point-to-point clearance

Optus
The Optus request is for a clearance from the link 100 m of either side of the link path. The Percom report is not clear as to whether this is from the turbine base or the extended blade tip. PB has assumed it is from the blade tip. Using this clearance zone requirement, turbines intrude on the link from Optus Site Marked Tree Road, Chaton Ridge to Telstra Cmts Site Cullerin (access ID's 1232593, 1232594), see Section 4.3.2. Turbines encroaching on this exclusion zone are 58 and 59.

This link was selected for Fresnel zone calculation (see Section 4.3.3) and it was found that no turbines intrude on the 2nd Fresnel zone. PB will contact Optus to see if the clearance zone is still valid.

Prime Television
The closest turbine to a Prime Television link is approximately 2.3 km from the link path. This is well in excess of the 4th Fresnel zone. This satisfies the Prime Television clearance zone request.

Commissioner of Police, NSW Police
The closest turbine to a Commissioner of Police, NSW Police link is approximately 1.2 km from the link path. This satisfies the Commissioner of Police, NSW Police clearance zone request.

Air Services Australia
The closest turbine to an Air Services Australia link is approximately 0.5 km from the link path. This satisfies the Air Services Australia clearance zone request.

5.2 Tower clearance

The Percom report states that the NSW State Government Office of Information Technology requests a 1200 m clearance zone from their radio tower. The Percom report states the tower to which this clearance zone applies is the site Win Site, Chaton Ridge, Lake George (Site ID 9507). The CWF layout given in Appendix A is greater than 1200 m from this tower and satisfies this clearance request.

5.3 Mobile phone antenna clearance zones

Optus Mobile Pty Ltd
Based on the clearance arcs given in Table 4, no turbine in CWF layout encroaches into these arcs.

Telstra Mobile
Based on the clearance arcs given in Table 4, no turbine in CWF layout encroaches into these arcs.

5.4 Recommendations for previous clearance zones

Based on the analysis of the licensee clearance zones, turbines encroach upon the Optus clearance zones given, despite being outside the 2nd Fresnel zone. It is also noted that the encroaching turbines do so at the approximate bisection of the link (about half way between the towers) where reflection and scattering impacts will be at a minimum. Depending on RATCH-Australia's requirements and the implications of layout adjustment, there may be grounds to negotiate an agreement with Optus on the acceptability of the location of turbines 58 and 59.

The remaining licensee clearance zones have been satisfied.

6. Licensee consultation

All the potentially impacted licensees within Appendix C have been contacted or have been attempted to be contacted by PB to give them opportunity to comment on the development. The contact details, as of 26 July 2011, for each of the licensees are given below.

LICENSEE	CONTACT
Air Services Australia	Bruce Bilton, Terry Richards
Ambulance Service NSW	Bill Tripcony
Australian Federal Police	Les Laundon
Commissioner NSW Police	Level 4 151-241 Goulburn St SURRY HILLS NSW 2010
Department of Services, Technology and Administration	NSW GRN Helpdesk
Dianne Maree Narcson	Not available at time of writing
Digital Distribution Australia	Paul Davis
Optus Mobile Pty Ltd	Jayantha Wickramasinghe
Prime Television Southern Pty Ltd	David Searle
Soul Pattinson Telecommunications Pty Ltd	Chirs Burman
Telstra Corporation Limited	Russel Curtis
Transgrid	Ross Ebeling
Vodafone Australia	Ganesh Ganeswaran (Kordia)

Additionally, clarification has been sought for the following items:

- Coordinate precision for sites 9505, 9506 and 202294
- The receiving tower of the TransGrid link bearing 71 degrees from 9506
- Site 9507 bearing 61 degrees – unique ACMA entry.
- Panel antennas on 170, 285 degree bearing from site 100726
- Incomplete links with Access ID's 1143043 and 1143040
- Validity of previous assessment clearance zones

The responses from consulted licensee holders as of 26 July 2011 are included in Appendix D. Several licensee holders have not responded to consultations from PB as of the abovementioned date. PB has made every reasonable effort to contact each of these licensees to receive comment.

7. References

1. Bacon, D. F. (2002) – Fixed link wind turbine exclusion zone method. Ofcom.

2. National Wind Farm Development Guideline, Public Consultation Draft (2009) – Environment Protection and Heritage Council

3. ERA Technology (2009) - RF Measurement Assessment of Potential Wind Farm Interferences to Fixed Links and Scanning Telemetry Devices. ERA Technology Ltd.

Appendix A

Proposed wind farm layout

Wind farm layout coordinates as supplied 23 November 2011; turbine 64 removed from layout (WGS84, Zone 55)

ID	X	Y
1	718433	6143522
2	718303	6143229
3	718143	6142944
4	718016	6142661
5	717920	6142333
6	717869	6142028
7	717778	6141753
8	717667	6141456
9	717737	6141127
10	717665	6140808
11	717307	6140667
12	717140	6140259
13	716368	6140791
14	716269	6140490
15	716134	6140091
16	715885	6139665
17	716574	6139788
18	718978	6143004
19	718891	6142467
20	718960	6142121
21	718935	6141776
22	720164	6141628
23	718878	6141471
24	718785	6141111
25	718721	6140828
26	719303	6140601
27	718632	6140529
28	718527	6140218
29	718256	6140030
30	717952	6139751
31	717751	6139480
32	718184	6139157
33	718539	6139389
34	719192	6139375
35	718149	6138894
36	717986	6138660
37	718135	6138349
38	718725	6138734
39	719054	6138902
40	717678	6137581
41	717952	6137867
42	717564	6137136
43	717954	6137251
44	717848	6136663
45	719633	6138534
46	719531	6138241
47	719325	6137942
48	719170	6137671
49	718708	6137467
50	718574	6137092
51	718443	6136785
52	718448	6136312
53	718277	6136058
54	718233	6135757
55	718042	6135504
56	717976	6135216
57	717905	6134890
58	717877	6134568

59	717815	6134260
60	717758	6133946
61	719646	6136708
62	719793	6137054
63	719612	6137380
65	720847	6140638
66	721081	6140856
67	721100	6141132
68	721245	6141392
69	720925	6141697

Appendix B

ACMA RADCOM site search results (AMG66, Zone 55)

SITE_ID	SITE_NAME	EAST	NORTH	PRECISION
9481	Mt Allianoyonyiga (Near Woodlawn Mines) TARAGO	733740	6119590	Unknown
9493	Telstra Site, Mt Gray	752849	6150221	Within 10 metres
9496	Airservices Site, Mt Macalister	752901	6184496	Within 100 metres
9504	Broadcast/Comms Site Nelanglo St GUNNING	707090	6148475	Unknown
9505	Telstra commsite GUN GUN	713598	6135241	Within 100 metres
9506	Commsite LERIDA	716970	6132360	Within 100 metres
9507	Win Site Chaton Ridge LAKE GEORGE	717370	6131340	Within 10 metres
9508	Air Services Australia Site Chaton Ridge LAKE GEORGE	717340	6131340	Within 10 metres
9509	Springvale CULLARIN	719350	6146800	Unknown
9706	Lake George GEARYS GAP	716400	6112600	Unknown
34919	Commsite MT MARY	715302	6164662	Unknown
35499	Commsite BANGALORE TRIG	738800	6138550	Unknown
36676	Pipeline take off DALTON	701824	6155289	Unknown
37299	Telstra Pipeline Site 42 MT GRAY	733938	6153850	Unknown
39232	HMAS Harman Bonshaw	699937	6085937	Unkown
53802	Optus Site Marked Tree Road Chaton Ridge COLLECTOR	718054	6130657	Within 10 metres
54354	CMTS Site The Grove Federal Hwy GEARYS GAP	716267	6111967	Unknown
100656	Mahoneys Fire Trail 13 Km South West of GOULBURN	739600	6141860	Within 100 metres
100725	Telstra Site Hume Highway BREADALBANE	727454	6147247	Within 10 metres
100726	Telstra Cmts Site CULLERIN	719464	6144884	Within 10 metres
100817	Telstra CMTS Gundaroo Rd CHATTON RIDGE	717100	6132200	Unknown
102238	Lot 3 Cnr Marked Tree Rd & Rosamel St GUNDAROO	707230	6122010	Unknown
131026	Vodafone Site Hume Hwy BREADALBANE	735880	6146250	Unknown
132337	Telstra Site Dairy Creek Rd GUNDAROO	709025	6120929	Within 10 metres
134752	Optus Site Cullerin Lerida Rd North GOULBURN	719482	6144887	Within 10 metres
135397	MSCS Control DRP Site Kennards Hire 117 Flemington Road, Mitchell ACT	695033	6100250	Unkown
135529	Optus Site Collector 568 Off Currawang Road GOULBURN	739697	6141798	Within 10 metres
136015	Noyes Lane GUNDAROO	698656	6121420	Within 10 metres
137946	Property 1Km North of Wollogorang Road WOLLOGORANG	732514	6140704	Unknown
138598	CBRS site Mahoneys Fire Trail Komungla Range 13 kms SW of GOULBURN	739700	6142015	Within 10 metres
201545	Fire Control Centre 125 Yass St GUNNING	707500	6149200	Unknown
202088	Optus Site Maryland Yarra Hume Hwy BREADALBANE	735619	6146032	Unknown
202399	Pinch Hill GUNNING	703000	6149000	Unknown
205115	Gundaroo Village Green GUNDAROO	707243	6121234	Unknown
205534	New CMTS Site Grove Rd GEARYS GAP	716594	6108567	Unknown
370254	Vodafone/Optus Site Oakhurst Trig GUNNING	700548	6144014	Unknown
9001402	Telstra Exchange Hut Federal Highway COLLECTOR	722565	6133164	Within 10 metres
9007514	Telstra Site MOST, 1152 Hoskinstown Rd, Hoskinstown	720218	6083080	Within 10 metres
9009594	SES Site Yass St GUNNING	707715	6148923	Within 10 metres
9900430	Mobile Spectrum Licensing Site GUNNING	707340	6148667	Unknown
9909982	Mobile Spectrum Licensing Site FEDERAL HIGHWAY	716499	6119830	Unknown
9913458	Mobile Spectrum Licensing Site GUNNING - CROOKWELL RD	716158	6167390	Unknown
9913476	Mobile Spectrum Licensing Site GUNNING - CROOKWELL RD	711078	6156882	Unknown
9913515	Mobile Spectrum Licensing Site HUME HIGHWAY	717461	6148149	Unknown
9913527	Mobile Spectrum Licensing Site HUME HIGHWAY	725085	6148135	Unknown
9913528	Mobile Spectrum Licensing Site HUME HIGHWAY	694454	6145701	Unknown
9913561	Mobile Spectrum Licensing Site CANBERRA - GUNNING RD	705083	6138305	Unknown

9913571	Mobile Spectrum Licensing Site FEDERAL HIGHWAY	725576	6134858	Unknown
9913587	Mobile Spectrum Licensing Site FEDERAL HIGHWAY	718946	6127452	Unknown
9913634	Mobile Spectrum Licensing Site CANBERRA - GUNNING RD	705720	6120201	Unknown
9913666	Mobile Spectrum Licensing Site FEDERAL HIGHWAY	714643	6111586	Unknown

Appendix C

Registered assignments within 5 km of CWF

Site ID 9505 – Telstra Commsite GUN GUN

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
337027	1853500000	69	Telstra Corporation Limited
36071	1734500000	69	Telstra Corporation Limited
334577	6004500000	69	Telstra Corporation Limited
33411	6256540000	69	Telstra Corporation Limited
329567	5945200000	69	Telstra Corporation Limited
28316	6197240000	69	Telstra Corporation Limited
337029	1755500000	209	Telstra Corporation Limited
36073	1874500000	209	Telstra Corporation Limited
329566	5945200000	209	Telstra Corporation Limited
28315	6197240000	209	Telstra Corporation Limited
329517	6004500000	209	Telstra Corporation Limited
28265	6256540000	209	Telstra Corporation Limited
8182158	13087000000	303	Telstra Corporation Limited
8182155	12821000000	303	Telstra Corporation Limited

Site ID 9506 – Commsite LERIDA

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1235540	1505000000	61	Commissioner of Police NSW Police Force
1235541	1444500000	61	Commissioner of Police NSW Police Force
1233499	7543500000	062	Soul Pattinson Telecommunications Pty Limited
1233500	7718500000	062	Soul Pattinson Telecommunications Pty Limited
1233498	7704500000	062	Soul Pattinson Telecommunications Pty Limited
1233501	7557500000	062	Soul Pattinson Telecommunications Pty Limited
1103153	932300000	063	Ambulance Service of New South Wales
1103152	856300000	063	Ambulance Service of New South Wales
1408494	414300000	063	Ambulance Service of New South Wales
1408493	404850000	063	Ambulance Service of New South Wales
1207512	42650000	71	TransGrid
1235544	1511000000	185	Commissioner of Police NSW Police Force
1235542	1450500000	185	Commissioner of Police NSW Police Force
8161311	413600000	186	Ambulance Service of New South Wales
8161309	404150000	186	Ambulance Service of New South Wales
8196303	413850000	194	Ambulance Service of New South Wales
8196298	404400000	194	Ambulance Service of New South Wales
1807684	928962500	206	Commissioner of Police NSW Police Force
16076	852362500	206	Commissioner of Police NSW Police Force
318978	928362500	206	Commissioner of Police NSW Police Force
1807683	852962500	206	Commissioner of Police NSW Police Force
8196307	413850000	206	Ambulance Service of New South Wales
8196300	404400000	206	Ambulance Service of New South Wales
8196309	413850000	236	Ambulance Service of New South Wales
8196299	404400000	236	Ambulance Service of New South Wales
1103154	931500000	248	Ambulance Service of New South Wales
1103155	855500000	248	Ambulance Service of New South Wales
8233695	931500000	275	Ambulance Service of New South Wales
8233697	855500000	275	Ambulance Service of New South Wales
1233509	7704500000	280	Soul Pattinson Telecommunications Pty Limited
1233510	7557500000	280	Soul Pattinson Telecommunications Pty Limited
1233511	7718500000	280	Soul Pattinson Telecommunications Pty Limited
1233508	7543500000	280	Soul Pattinson Telecommunications Pty Limited
314173	44690000	ND	TransGrid
166193	78250000	ND	TransGrid
385521	80750000	ND	TransGrid
1207511	44650000	ND	TransGrid
1207618	78237500	ND	TransGrid
1207619	80737500	ND	TransGrid
1103574	462862500	ND	Ambulance Service of New South Wales
1103575	453362500	ND	Ambulance Service of New South Wales
1225452	460350000	ND	Commissioner of Police NSW Police Force
1225453	450850000	ND	Commissioner of Police NSW Police Force
1225496	78562500	ND	Commissioner of Police NSW Police Force

1225497	81062500	ND	Commissioner of Police NSW Police Force
6642	42690000	ND	TransGrid
1227368	459200000	ND	Commissioner of Police NSW Police Force
1227367	468000000	ND	Commissioner of Police NSW Police Force

Site ID 9507 – Win site Chaton Ridge Lake George

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1226603	12765000000	7.4	VODAFONE AUSTRALIA PTY LIMITED
1226604	13031000000	7.4	VODAFONE AUSTRALIA PTY LIMITED
1108577	7592500000	61	VODAFONE AUSTRALIA PTY LIMITED
1108576	7431500000	61	VODAFONE AUSTRALIA PTY LIMITED
8186149	6580000000	61	Digital Distribution Australia Pty Ltd
8186144	6920000000	61	Digital Distribution Australia Pty Ltd
8186147	6500000000	61	Digital Distribution Australia Pty Ltd
8186143	6840000000	61	Digital Distribution Australia Pty Ltd
8181115	7445500000	61	Soul Pattinson Telecommunications Pty Limited
8181131	7606500000	61	Soul Pattinson Telecommunications Pty Limited
1130109	7851475000	062	Australian Capital Television Pty Ltd
1130108	8044195000	062	Australian Capital Television Pty Ltd
1130107	7732875000	062	Australian Capital Television Pty Ltd
1101272	852137500	62	Australian Capital Television Pty Ltd
128108	8192445000	62	Prime Television Southern Pty Ltd
372860	7881125000	62	Prime Television Southern Pty Ltd
1101271	928137500	62	Australian Capital Television Pty Ltd
8201296	38913000000	134	VODAFONE AUSTRALIA PTY LIMITED
8201295	37653000000	134	VODAFONE AUSTRALIA PTY LIMITED
1370564	10586000000	183	VODAFONE AUSTRALIA PTY LIMITED
1370563	10651000000	183	VODAFONE AUSTRALIA PTY LIMITED
1101273	928562500	213	Australian Capital Television Pty Ltd
1101274	852562500	213	Australian Capital Television Pty Ltd
8186150	6920000000	214	Digital Distribution Australia Pty Ltd
8186148	6580000000	214	Digital Distribution Australia Pty Ltd
8186146	6840000000	214	Digital Distribution Australia Pty Ltd
8186145	6500000000	214	Digital Distribution Australia Pty Ltd
372858	8073845000	215	Prime Television Southern Pty Ltd
128106	7762525000	215	Prime Television Southern Pty Ltd
1130102	8044195000	216	Australian Capital Television Pty Ltd
1130104	8162795000	216	Australian Capital Television Pty Ltd
1130103	7732875000	216	Australian Capital Television Pty Ltd
8218998	7592500000	291	Soul Pattinson Telecommunications Pty Limited
8218999	7431500000	291	Soul Pattinson Telecommunications Pty Limited
1370565	10651000000	308	VODAFONE AUSTRALIA PTY LIMITED
1370566	10586000000	308	VODAFONE AUSTRALIA PTY LIMITED
1815187	87600000		Dianne Maree Nacson
1211891	413137500	ND	Department of Services Technology And Administration
1211890	403675000	ND	Department of Services Technology And Administration
1211893	413150000	ND	Department of Services Technology And Administration
1211892	403687500	ND	Department of Services Technology And Administration
1211889	413125000	ND	Department of Services Technology And Administration
1211894	403700000	ND	Department of Services Technology And Administration
1211895	413162500	ND	Department of Services Technology And Administration
1211888	403662500	ND	Department of Services Technology And Administration
1211909	413175000	ND	Department of Services Technology And Administration
1211910	403725000	ND	Department of Services Technology And Administration
1211913	413187500	ND	Department of Services Technology And Administration
1211914	403737500	ND	Department of Services Technology And Administration
1211915	413200000	ND	Department of Services Technology And Administration
1211896	403712500	ND	Department of Services Technology And Administration
382094	406687500	ND	Department of Services Technology And Administration
152909	416387500	ND	Department of Services Technology And Administration
382095	406937500	ND	Department of Services Technology And Administration
152910	416637500	ND	Department of Services Technology And Administration
382096	407187500	ND	Department of Services Technology And Administration
152911	416887500	ND	Department of Services Technology And Administration
382097	407437500	ND	Department of Services Technology And Administration

152908	416137500	ND	Department of Services Technology And Administration
1211916	403750000	ND	Department of Services Technology And Administration
1211887	413112500	ND	Department of Services Technology And Administration
1211881	412625000	ND	Department of Services Technology And Administration
1211882	403175000	ND	Department of Services Technology And Administration
1211883	412800000	ND	Department of Services Technology And Administration
1211884	403350000	ND	Department of Services Technology And Administration
1211885	413100000	ND	Department of Services Technology And Administration
1211886	403650000	ND	Department of Services Technology And Administration
1211931	403862500	ND	Department of Services Technology And Administration
1212042	415112500	ND	Department of Services Technology And Administration
1211947	405575000	ND	Department of Services Technology And Administration
1212030	415037500	ND	Department of Services Technology And Administration
1212031	405587500	ND	Department of Services Technology And Administration
1212032	415050000	ND	Department of Services Technology And Administration
1212033	405600000	ND	Department of Services Technology And Administration
1212034	415062500	ND	Department of Services Technology And Administration
1212035	405612500	ND	Department of Services Technology And Administration
1212036	415075000	ND	Department of Services Technology And Administration
1212037	405625000	ND	Department of Services Technology And Administration
1211929	403850000	ND	Department of Services Technology And Administration
1212039	405637500	ND	Department of Services Technology And Administration
1211944	413400000	ND	Department of Services Technology And Administration
1212043	405662500	ND	Department of Services Technology And Administration
1212044	415125000	ND	Department of Services Technology And Administration
1212045	405675000	ND	Department of Services Technology And Administration
1386578	955900000	ND	Vodafone Australia Pty Ltd
1386579	910900000	ND	Vodafone Australia Pty Ltd
8251760	417137500	ND	Department of Services Technology And Administration
8251762	407687500	ND	Department of Services Technology And Administration
8251761	417387500	ND	Department of Services Technology And Administration
8251764	407937500	ND	Department of Services Technology And Administration
1399518	956200000	ND	Vodafone Australia Pty Ltd
1212038	415087500	ND	Department of Services Technology And Administration
1211934	413337500	ND	Department of Services Technology And Administration
1211918	403800000	ND	Department of Services Technology And Administration
1211920	413262500	ND	Department of Services Technology And Administration
1211921	403812500	ND	Department of Services Technology And Administration
1211922	413275000	ND	Department of Services Technology And Administration
1211923	403825000	ND	Department of Services Technology And Administration
1211924	413287500	ND	Department of Services Technology And Administration
1211925	403837500	ND	Department of Services Technology And Administration
1211928	413300000	ND	Department of Services Technology And Administration
1211930	413312500	ND	Department of Services Technology And Administration
1399519	911200000	ND	Vodafone Australia Pty Ltd
1211946	415025000	ND	Department of Services Technology And Administration
1211933	403875000	ND	Department of Services Technology And Administration
1211945	403950000	ND	Department of Services Technology And Administration
1211935	403887500	ND	Department of Services Technology And Administration
1211936	413350000	ND	Department of Services Technology And Administration
1211937	403900000	ND	Department of Services Technology And Administration
1211938	413362500	ND	Department of Services Technology And Administration
1211939	403912500	ND	Department of Services Technology And Administration
1211940	413375000	ND	Department of Services Technology And Administration
1211941	403925000	ND	Department of Services Technology And Administration
1211942	413387500	ND	Department of Services Technology And Administration
1211943	403937500	ND	Department of Services Technology And Administration
1211917	413250000	ND	Department of Services Technology And Administration
1211932	413325000	ND	Department of Services Technology And Administration

Site ID 9508 – Air Services Australia Site Chaton Ridge Lake George

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1103597	7524250000	32	Airservices Australia Att Bruce Bilton
1103596	7685250000	32	Airservices Australia Att Bruce Bilton
8169949	19315000000	69	Telstra Corporation Limited

8169945	18305000000	69	Telstra Corporation Limited
1103595	7692250000	208	Airservices Australia Att Bruce Bilton
1103594	7531250000	208	Airservices Australia Att Bruce Bilton
348096	7648500000	209	Telstra Corporation Limited
47824	7487500000	209	Telstra Corporation Limited
336994	1741500000	209	Telstra Corporation Limited
36038	1860500000	209	Telstra Corporation Limited
8172219	7606500000	291	Telstra Corporation Limited
8172218	7445500000	291	Telstra Corporation Limited
1374857	894200000	ND	Telstra Corporation Ltd attn R Preston
1374856	939200000	ND	Telstra Corporation Ltd attn R Preston

Site ID 53802 – Optus Site Marked Tree Road Chaton Ridge

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1232593	15194000000	4.3	Optus Mobile Pty Limited
1232594	14550000000	4.3	Optus Mobile Pty Limited
8245874	8073845000	47	Optus Mobile Pty Limited
8245879	7762525000	47	Optus Mobile Pty Limited
1215826	19680000000	47	Optus Mobile Pty Limited
1215825	18670000000	47	Optus Mobile Pty Limited
8240157	8251745000	59	Optus Mobile Pty Limited
8240156	7940425000	59	Optus Mobile Pty Limited
8189523	930950000	61	Australian Federal Police
8189524	854950000	61	Australian Federal Police
8240779	930250000	226	Australian Federal Police
8240778	854250000	226	Australian Federal Police
8201296	38913000000	314	VODAFONE AUSTRALIA PTY LIMITED
8201295	37653000000	314	VODAFONE AUSTRALIA PTY LIMITED
1383666	947600000	ND	Singtel Optus Pty Limited
1383667	902600000	ND	Singtel Optus Pty Limited
1387464	955900000	ND	Vodafone Australia Pty Ltd
1387465	910900000	ND	Vodafone Australia Pty Ltd
8190334	485975000	ND	Australian Federal Police
8190339	480787500	ND	Australian Federal Police
1399591	911200000	ND	Vodafone Australia Pty Ltd
1397292	947600000	ND	Singtel Optus Pty Limited
1397293	902600000	ND	Singtel Optus Pty Limited
1399590	956200000	ND	Vodafone Australia Pty Ltd
8190337	480775000	ND	Australian Federal Police

Site ID 100726 – Telstra Cmts Site CULLERIN

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
8218871	877500000	50	Telstra Corporation Limited
8218880	832500000	50	Telstra Corporation Limited
8218885	840000000	50	Telstra Corporation Limited
8218867	885000000	50	Telstra Corporation Limited
8171814	19425000000	72	Telstra Corporation Limited
8171817	18415000000	72	Telstra Corporation Limited
1135813	18590000000	73	Telstra Corporation Limited
1206523	18710000000	73	Telstra Corporation Limited
8218863	877500000	170	Telstra Corporation Limited
8218862	885000000	170	Telstra Corporation Limited
8218870	840000000	170	Telstra Corporation Limited
8218877	832500000	170	Telstra Corporation Limited
1232594	14550000000	184	Optus Mobile Pty Limited
1232593	15194000000	184	Optus Mobile Pty Limited
1226604	13031000000	187	VODAFONE AUSTRALIA PTY LIMITED
1226603	12765000000	187	VODAFONE AUSTRALIA PTY LIMITED
8218869	885000000	285	Telstra Corporation Limited
8218868	877500000	285	Telstra Corporation Limited
8218872	832500000	285	Telstra Corporation Limited
8218874	840000000	285	Telstra Corporation Limited

1150877	88000000	ND	Andy Brown
1377434	939200000	ND	Telstra Corporation Ltd attn R Preston
1377435	894200000	ND	Telstra Corporation Ltd attn R Preston
9323724	839800000	ND	Telstra Corporation Limited
1394937	910900000	ND	Vodafone Australia Pty Ltd
1394936	955900000	ND	Vodafone Australia Pty Ltd
8227014	877500000	ND	Telstra Corporation Limited
1399508	956200000	ND	Vodafone Australia Pty Ltd
1399509	911200000	ND	Vodafone Australia Pty Ltd
8227028	832500000	ND	Telstra Corporation Limited
8227025	840000000	ND	Telstra Corporation Limited
9331078	884800000	ND	Telstra Corporation Limited

Site ID 100817 – Telstra CMTS Gundaroo Rd CHATTON RIDGE

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
8227189	832500000	ND	Telstra Corporation Limited
8227174	840000000	ND	Telstra Corporation Limited
8227121	877500000	ND	Telstra Corporation Limited
9333090	884800000	ND	Telstra Corporation Limited
9323724	839800000	ND	Telstra Corporation Limited
1377489	894200000	ND	Telstra Corporation Ltd attn R Preston
1377488	939200000	ND	Telstra Corporation Ltd attn R Preston

Site ID 134752 – Optus Site Cullerin Lerida Rd North Goulburn

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1396371	902600000	ND	Singtel Optus Pty Limited
1396370	947600000	ND	Singtel Optus Pty Limited
1392245	902600000	ND	Singtel Optus Pty Limited
1392244	947600000	ND	Singtel Optus Pty Limited

Site ID 9001402 – Telstra Exchange Hut Federal Highway Collector

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
8169949	19315000000	249	Telstra Corporation Limited
8169945	18305000000	249	Telstra Corporation Limited

Sites outside the 5km buffer zone with links within it

Site ID 9495 – Pacific Power Site, Mt Gray

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1210477	404425000	264	Ambulance Service of New South Wales
1210489	413875000	264	Ambulance Service of New South Wales
1408498	404500000	264	Ambulance Service of New South Wales
1408499	413950000	264	Ambulance Service of New South Wales

Site ID 9530 – Airservices Site Mt Mundoonen

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
1210477	404425000	84	Ambulance Service of New South Wales
1210489	413875000	84	Ambulance Service of New South Wales
1408498	404500000	084	Ambulance Service of New South Wales
1408499	413950000	084	Ambulance Service of New South Wales
8160667	451025000	85	NSW State Emergency Service
8160668	460525000	85	NSW State Emergency Service

Site ID 202294 – 56-58 Knox Street, Goulburn

ACCESS_ID	FREQ_ASS	ANT_AZ	LICENSEE
8160667	451025000	265	NSW State Emergency Service
8160668	460525000	265	NSW State Emergency Service

Appendix D

Consultation responses

Air Services Australia:

Inkster, Benjamin

From: Bilton, Bruce <bruce.bilton@AirservicesAustralia.com>
Sent: Thursday, 19 May 2011 7:33 AM
To: Inkster, Benjamin
Cc: Richards, Terry; Gilbert, Ben
Subject: RE: Wind Farm Radio Communications - Update

Dear Ben,

Airservices Australia endorses the new positioning of the proposed Collector Wind Farm near the town of Collector, NSW. With this new position proposal there will be no impact on our radio link between Chatton Ridge and Mt MacAlister.

Thank you for your consideration.

Regards,

Bruce Bilton

Communications Section
Planning and Integration
Airservices Australia
GPO Box 367
Canberra City 2601

Ph (02) 6268 4020
Fax (02) 6268 5191
E-mail
bruce.bilton@airservicesaustralia.com

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Tuesday, 3 May 2011 5:32 PM
To: Bilton, Bruce; Richards, Terry
Subject: Wind Farm Radio Communications - Update

Dear Bruce and Terry,

I am a Wind Engineer with Parsons Brinckerhoff (PB) conducting consultations regarding the proposed Collector Wind Farm, near the town of Collector, NSW. I have reviewed previous correspondence you may have had with Adam Trethowan (PB) regarding radio communications impact from this wind farm and I would like to inform you of a change to the proposed wind turbine dimensions and the proposed turbine layout coordinates.

The new dimensions for the proposed wind turbine are a hub height of 94 m and a rotor radius of 56 m. I have attached a copy of the new turbine locations provided in AMG66 Zone 55 coordinates. Could you please treat this information as confidential as it is provided to you for your own assessment only and should not be passed on to other parties.

PB is seeking comment from Air Services Australia regarding this update to the proposed wind farm related to radio communications impact. If you have any queries about this assessment or require any specific information, please do not hesitate to contact me.

Kind regards,

_____
Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

Ambulence Services NSW:

Inkster, Benjamin

From: TRIPCONY, Bill <BTripcony@ambulance.nsw.gov.au>
Sent: Thursday, 14 July 2011 4:42 PM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update
Attachments: Collector_Lerida.doc

Ben,

I thought I had replied.

Turbines placed in the locations given will not interfere with our radio network.

Bill Tripcony
Telecommunications Manager

9320 7830

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Thursday, 14 July 2011 2:51 PM
To: TRIPCONY, Bill
Subject: RE: Wind Farm Radio Communications - Update

Hi Bill,

I am reviewing the responses regarding Collector wind farm and I noticed that I have not heard back from you since May. Could you please make comment regarding the turbine coordinates and the potential for radio communications impact?

Thanks,

Ben Inkster
Wind Engineer
Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
Southbank, VIC
Australia 3006
+61 3 9861 2484

binkster@pb.com.au

www.pbworld.com

From: TRIPCONY, Bill [mailto:BTripcony@ambulance.nsw.gov.au]
Sent: Wednesday, 4 May 2011 8:36 AM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Ben,

Thanks for the locations, I will have to plot them to see if they obstruct any of our services.

Not being a mapinfo nerd, it might take me a while.

I will be in touch when I have analysed thebdate.

Bill Tripcony

93207830

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The Ambulance Service of New South Wales has enabled e-mail filtering and monitoring.

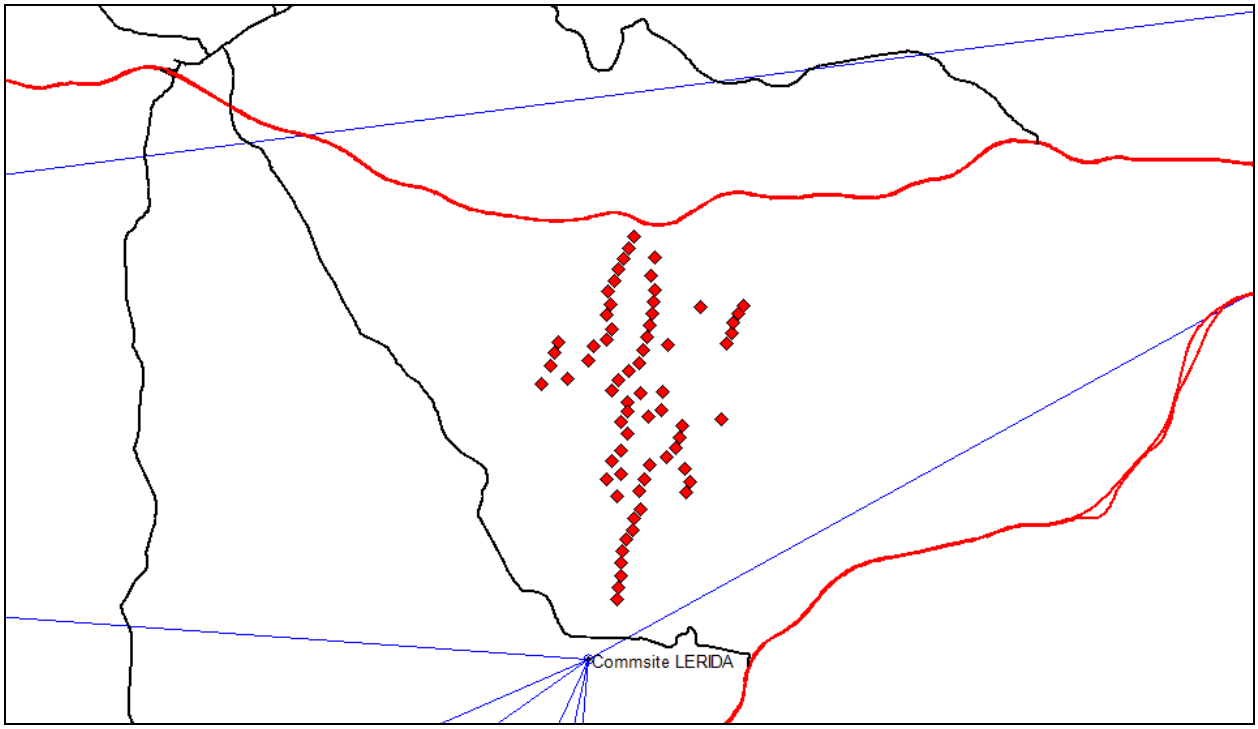

Figure 17: Extract from Collector_Lerida.doc as attached to the email detailed above, provided by Ambulance Services NSW

Australian Federal Police:

PB has attempted to contact Les Laundon of the Australian Federal Police seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received no response or receipt from the Australian Federal Police regarding this matter.

Commissioner NSW Police:

PB has written to Radio Network and Planning division of the NSW police seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received no response or receipt from the NSW Police regarding this matter.

Department of Services, Technology and Administration

PB has attempted to contact the helpdesk of the Department of Services, Technology and Administration, NSW seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received no response or receipt from the Department of Services, Technology and Administration, NSW regarding this matter.

Dianne Maree Narcson:

PB has not been able to contact Dianne Maree Narcson regarding Collector wind farm and potential for subsequent radio communications impact.

Digital Distribution Australia

PB has contacted Paul Davis from Digital Distribution Australia. Paul has advised PB that engineering staff from Digital Distribution Australia would assess the turbine coordinates for Collector wind farm and provide comment to PB regarding any potential for radio communications impact. At the time of writing, no response has been provided by Digital Distribution Australia.

Optus Mobile Pty Ltd

PB has been in contact with Optus regarding Collector wind farm. A transcript of email conversation is shown below. PB has also opened discussion with Optus regarding acceptance of proposed WTG coordinates with scope for micro-siting turbine locations within 100 m proximity. Optus has not commented regarding this proposition.

Inkster, Benjamin

From: Jayantha Wickramasinghe <Jayantha.Wickramasinghe@optus.com.au>
Sent: Friday, 24 June 2011 6:48 AM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Updated coordinates

Hi Ben
The location of turbine ID: 49 is still a concern and could interfere with the microwave radio link between Curtis & Cullerin Optus Mobile Base Station Transceiver sites, ACMA licence;

http://web.acma.gov.au/pls/radcom/licence_search.licence_lookup?pLICENCE_NO=1228759

The potential interference can be avoided if turbine ID 49 can be moved towards eastern direction by amending the 'Easting' to match that of turbine ID. 50.

Regards
Jayantha

Jayantha Wickramasinghe
Technical Specialist | Radio Transmission Planning - National | Networks | Optus

T: 02 8082 0353 | M: 0411 526 668 | F: 02 8085 5189 | 1 Lyonpark Road, Macquarie Park NSW 2113
http://www.optus.com.au

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-----Original Message-----
From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Wednesday, 22 June 2011 4:57 PM
To: Jayantha Wickramasinghe
Cc: Jayantha Perera
Subject: RE: Wind Farm Radio Communications - Updated coordinates

Hi Jayantha

As discussed earlier today, could you please provide written comment on the Collector wind farm?

I have spoken to my client regarding the source of the elevation data; they have said that is from contour data from the department of lands, I hope this is of some help.

Thanks,

Ben Inkster
Wind Engineer
Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
Southbank, VIC
Australia 3006
+61 3 9861 2484

binkster@pb.com.au

www.pbworld.com

From: Inkster, Benjamin
Sent: Friday, 3 June 2011 5:15 PM
To: Jayantha Wickramasinghe
Cc: Jayantha Perera
Subject: Wind Farm Radio Communications - Updated coordinates
Importance: High

Dear Jayantha,

I regret to inform you that I have previously supplied you with inaccurate coordinates for the proposed Collector wind farm, I apologise for this inconvenience.

Is it possible for you to re-analyse the attached coordinates and provide an updated comment based on the accurate coordinates. The file I have attached contains coordinates in UTM GDA94.

Please don't hesitate to contact me should you require further information.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Jayantha Wickramasinghe [mailto:Jayantha.Wickramasinghe@optus.com.au]
Sent: Monday, 23 May 2011 12:31 PM
To: Inkster, Benjamin
Cc: Jayantha Perera
Subject: RE: Wind Farm Radio Communications - Update May 2011

Hi Ben
The preferred Fresnel zone clearance is 100m at least (from tip of the Turbine blade), the therefore propose to locate turbine ID: 49 to be same as the Longitude of Turbine 50.

Regards
Jayantha

Jayantha Wickramasinghe
Technical Specialist | Radio Transmission Planning - National | Networks | Optus

T: 02 8082 0353 | M: 0411 526 668 | F: 02 8085 5189 | 1 Lyonpark Road, Macquarie Park NSW 2113
http://www.optus.com.au

Follow us on: http://twitter.com/optus; http://www.facebook.com/optus

2

Please think of the environment before printing this email

-----Original Message-----
From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 20 May 2011 4:17 PM
To: Jayantha Wickramasinghe
Subject: RE: Wind Farm Radio Communications - Update May 2011

Hi Jayantha
Is it possible to recommend a distance and direction that Optus would like to move Turbine 49 to prevent Fresnel interference?

Regards

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Jayantha Wickramasinghe [mailto:Jayantha.Wickramasinghe@optus.com.au]
Sent: Monday, 9 May 2011 12:11 PM
To: Inkster, Benjamin
Subject: FW: Wind Farm Radio Communications - Update May 2011

Hi Ben
We have reviewed and evaluated the impact on an existing Optus microwave radio transmission link between Collector & Cullerin.

The turbine ID: 49 has the potential to impact the Fresnel zone, a GIS plot attached.

Regards
Jayantha

Jayantha Wickramasinghe
Technical Specialist | Radio Transmission Planning - National | Networks | Optus

T: 02 8082 0353 | M: 0411 526 668 | F: 02 8085 5189 | 1 Lyonpark Road, Macquarie Park NSW 2113
http://www.optus.com.au

Follow us on: http://twitter.com/optus, http://www.facebook.com/optus

---

-----Original Message-----
From: Inkster, Benjamin [mailto:BInkster@pb.com.au]

Prime Television Southern Pty Ltd:

PB has attempted to contact David Searle of Prime Television Southern seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received no response or receipt from the Prime Television Southern regarding this matter.

Soul Pattinson Telecommunications Pty Ltd:

PB has attempted to contact Chris Burman of Soul Pattinson Telecommunications seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received no response or receipt from the Soul Pattinson Telecommunications regarding this matter.

Telstra Corportation Ltd:

PB has contacted Telstra Corporation regarding the proposed Collector wind farm. The following response was provided by Telstra:

6 June 2011

Network and Access Technology
Forecasting & Area Planning NSW and Wideband
L4/52-54 Railway Pde Burwood 2134
Telephone (02) 8576 0853
Facsimile (02) 9397 2030
Kham.Souksamlane@team.telstra.com

Benjamin Inkster
Mining and Industry Group
Australia Pacific

Re: Notification of Collector Windfarm

Dear Benjamin,

In response to your letter dated 3rd June 2011, with the revised co-ordinates, as the previously supplied has slightly inaccurate coordinates, a revised desk top study was undertaken of the area and nearby telecommunications infrastructure.

Based on the provided information relating to the proposed wind farm located approximately 5.3Km North-West of Collector, NSW, results of rayline analysis investigation reveals that there is no potential for undue interference from the proposed wind farm on or around the Telstra communication tower for all Wind turbines.

Telstra has no objection to development application in relation to the proposed wind farm subject to Parsons Brinckerhoff confirming its agreement to the conditions and matters set out in this letter.

Telstra requires Parsons Brinckerhoff to notify of any additional turbines, or any change to the proposed location of the Wind Turbine, so that impacts on Telstra's Network can be re-assessed.

Telstra will require the protection of/relocation of its fixed telecommunications infrastructure that may be impacted by activities on this site. To minimise risk of liability due to any damage, the DialBeforeYouDig 1100 Inquiry number should be contacted to obtain location of Telstra plant before commencement of construction work.

For future correspondence and enquiries regarding this matter, please contact the undersigned on (02) 8576 9853.

Yours faithfully,

K. Souksamlane

Kham Souksamlane
Area Planner

Transgrid:

PB has attempted to contact Ross Ebeling of Transgrid seeking comment regarding the Collector wind farm and potential for subsequent radio communications impact. PB has received a read email receipt from Ross Ebeling but no response or comment from Transgrid has been recieved the regarding this matter.

Vodafone Australia:

PB has had ongoing discussions with Vodafone Australia (represented by Kordia Solutions Pty Ltd on this matter) regarding Collector wind farm and the potential for subsequent radio communications impact. At the time of writing, Vodafone has indicated that there is potential for impact on their radio communication links caused by the proposed WTG locations. PB has requested that Vodafone revise their assessment using higher accuracy of transmission tower locations than those detailed in the ACMA database. Vodafone have acknowledged this request they have not provided results to PB at the time of writing.

A transcript of email discussions with Vodafone are detailed below.

*Transcript 1 between Ben Inkster (PB), Chris Thompson (*RATCH-Australia*) and Ganesh Ganeswaran (Kordia):*

Inkster, Benjamin

From: Ganesh Ganeswaran <Ganesh.Ganeswaran@kordia.com.au>
Sent: Tuesday, 14 June 2011 11:57 AM
To: Thompson, Chris; Inkster, Benjamin
Cc: Trevor Sharman
Subject: RE: Wind Farm Radio Communications - Update
Attachments: 20101209 CWF 69 WTG Layout.xls

Hi Chris

Coordinates as appearing in the ACMA database for the concerned sites are as below:

1) CULLERIN ACMA ID 100726
   DATUM: AMG 66 ZONE: 55 / 719464 E/ 6144884 S (-34.814554, 149.399385)

2) CHATTON RIDGE – ACMA ID 9507
   DATUM: AMG 66 ZONE : 55 / 717370 E / 6131340 S (-34.937032, 149.380025)

Coordinates appearing in the ACMA database may not be accurate as the ACMA requirement is + or -10m in high density areas and + or – 100m in low density areas. The above sites fall under the low density area.

For the wind turbine locations I have used coordinates supplied by BEN and copy of which is attached for your reference.

Regards

Ganesh Ganeswaran
KORDIA©
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Thompson, Chris [mailto:Chris.Thompson@app.com.au]
Sent: Tuesday, 14 June 2011 11:03 a.m.
To: Ganesh Ganeswaran; Inkster, Benjamin
Cc: Trevor Sharman
Subject: RE: Wind Farm Radio Communications - Update

Thanks Ganesh,

Following up from our conversation earlier, can I still assume that the 'Chaton Ridge' tower is still incorrectly positioned?

Could you please forward the coordinate which you have used to map this?

Regards,

Chris Thompson | Project Manager | **APP Corporation Pty Limited** | PO Box 1573 North Sydney | New South Wales 2059 | Phone: +61 2 9957 6211 | Fax: +61 2 9954 1951 | Mobile: +61 411 965 683 | app.com.au

---

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Tuesday, 14 June 2011 10:56 AM
To: Inkster, Benjamin; Thompson, Chris
Cc: Trevor Sharman
Subject: RE: Wind Farm Radio Communications - Update

Hi Ben / Chris

Attached file shows the proposed pylon locations in relation to the Microwave link of concern. In this I have labelled the Pylons.

Vodafone has nominated Trevor Sharman as the contact person for this work and I have copied this mail to him. His phone number is (03) 8359 0300.

Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Tuesday, 14 June 2011 9:25 a.m.
To: Ganesh Ganeswaran
Cc: Chris.Thompson@app.com.au
Subject: RE: Wind Farm Radio Communications - Update

Hi Ganesh,

Thank you for your help so far with the analysis of Collector wind farm. I have been in discussion with the application project managers for Collector wind farm (APP) regarding the concerns you have raised over the proposed layout.

I have included Chris Thompson (APP) in this email. Chris would like to discuss the requirements that Kordia and Vodafone have with the turbine layout and determine how to improve certainty in the transmission tower locations.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Monday, 6 June 2011 9:23 AM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Hi Inkster

Please see attached. Not good at all.

Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 3 June 2011 5:09 p.m.
To: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update
Importance: High

Dear Ganesh,

Could you please disregard the previous coordinates that I have sent you, I have had a conversion error and the coordinates that I have previously supplied are inaccurate.

I have attached an updated file with accurate coordinates in GDA94 and Lat and Long. Please feel free to contact me should you require any further info.

Regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
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AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Friday, 3 June 2011 1:41 PM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Thanks

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 3 June 2011 12:24 p.m.
To: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update

Hi Ganesh,

Please find attached the Turbine Coordinates in several different formats.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

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PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Friday, 3 June 2011 11:51 AM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Hi Inkster

Do you have these coordinates in Lat-long? Otherwise I need to convert them to Lat long. I will check these next week and let you know.

Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 3 June 2011 10:57 a.m.
To: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update

Dear Ganesh,

I received your automatic reply while you were away, I hope you had an enjoyable holiday!

I am seeking comment from Vodafone on the propose wind farm development near Collector in NSW. Are you able to provide comment on this? There are further details below in the previous email.

Please do not hesitate to contact me if you require further information.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Inkster, Benjamin
Sent: Tuesday, 3 May 2011 5:54 PM
To: Ganesh.Ganeswaran@kordia.com.au
Subject: Wind Farm Radio Communications - Update

Dear Ganesh,

I am a Wind Engineer with Parsons Brinckerhoff (PB) conducting consultations regarding the proposed Collector Wind Farm, near the town of Collector, NSW. I have reviewed previous correspondence you may have had with Adam Trethowan (PB) regarding radio communications impact from this wind farm and I would like to inform you of a change to the proposed wind turbine dimensions and the proposed turbine layout coordinates.

The new dimensions for the proposed wind turbine are a hub height of 94 m and a rotor radius of 56 m. I have attached a copy of the new turbine locations provided in AMG66 Zone 55 coordinates. Could you please treat this information as confidential as it is provided to you for your own assessment only and should not be passed on to other parties.

PB is seeking comment from Vodafone regarding this update to the proposed wind farm related to radio communications impact. If you have any queries about this assessment or require any specific information, please do not hesitate to contact me.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
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SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
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Email: binkster@pb.com.au

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6

*Transcript 2 between Ben Inkster (PB), Chris Thompson (*RATCH-Australia*), Gansesh Ganeswaren (Kordia) and Trevor Sharmon (Kordia):*

Inkster, Benjamin

From: Trevor Sharman <Trevor.Sharman@kordia.com.au>
Sent: Friday, 1 July 2011 12:04 PM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Ban,

I have just spoken to Ganesh and he is in the process of confirming how accurate his original analysis was based on the new coordinates that were given for the turbines. At the moment it looks like one of Vodafones microwave transmission links will cross through the wind farm and possible be affected. As soon as I get Ganesh's confirmed plot I will have it confirmed by our transmission design team and then advise Vodafone so they can review and advise.

I hope to have an answer back to you early next week.

Regards

Trevor Sharman
KORDIA®
Project Manager
Kordia Solutions Pty Ltd | Kordia Solutions | **DDI.** +61 3 8359 0300 | **M.** +61 404 884 477

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Tuesday, 28 June 2011 4:33 PM
To: Trevor Sharman
Cc: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update

Hi Trevor & Ganesh,

Could you please provide an update or official comment on behalf of Vodafone regarding the Collector wind farm? This will be greatly appreciated.

Kind regards,

Ben Inkster
Wind Engineer
Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
Southbank, VIC
Australia 3006
+61 3 9861 2484

binkster@pb.com.au

www.pbworld.com

From: Inkster, Benjamin
Sent: Tuesday, 21 June 2011 9:53 AM
To: Trevor Sharman
Cc: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update

Hi Trevor & Ganesh,

Is there any update on the Collector wind farm analysis that you can inform me on? Has Vodafone given approval for Kordia to conduct an analysis and provide comment?

Thanks,

Ben Inkster
Wind Engineer
Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
Southbank, VIC
Australia 3006
+61 (03) 9861 2484

binkster@pb.com.au

www.pbworld.com

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Tuesday, 14 June 2011 10:56 AM
To: Inkster, Benjamin; Chris.Thompson@app.com.au
Cc: Trevor Sharman
Subject: RE: Wind Farm Radio Communications - Update

Hi Ben / Chris

Attached file shows the proposed pylon locations in relation to the Microwave link of concern. In this I have labelled the Pylons.

Vodafone has nominated Trevor Sharman as the contact person for this work and I have copied this mail to him. His phone number is (03) 8359 0300.

Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Tuesday, 14 June 2011 9:25 a.m.
To: Ganesh Ganeswaran
Cc: Chris.Thompson@app.com.au
Subject: RE: Wind Farm Radio Communications - Update

Hi Ganesh,

Thank you for your help so far with the analysis of Collector wind farm. I have been in discussion with the application project managers for Collector wind farm (APP) regarding the concerns you have raised over the proposed layout.

I have included Chris Thompson (APP) in this email. Chris would like to discuss the requirements that Kordia and Vodafone have with the turbine layout and determine how to improve certainty in the transmission tower locations.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

Parsons Brinckerhoff
Level 15, 28 Freshwater Place
PO Box 19016
SOUTHBANK VIC 3006
AUSTRALIA

Direct: +61 3 9861 2484
Fax: +61 3 9861 1144

2

Email: binkster@pb.com.au

From: Ganesh Ganeswaran [mailto:Ganesh.Ganeswaran@kordia.com.au]
Sent: Monday, 6 June 2011 9:23 AM
To: Inkster, Benjamin
Subject: RE: Wind Farm Radio Communications - Update

Hi Inkster

Please see attached. Not good at all.

Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 3 June 2011 5:09 p.m.
To: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update
Importance: High

Dear Ganesh,

Could you please disregard the previous coordinates that I have sent you, I have had a conversion error and the coordinates that I have previously supplied are inaccurate.

I have attached an updated file with accurate coordinates in GDA94 and Lat and Long. Please feel free to contact me should you require any further info.

Regards,

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Thanks

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
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To: Ganesh Ganeswaran
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Hi Ganesh,

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Kind regards,

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Wind Engineer
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Hi Inkster

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Regards

Ganesh Ganeswaran
KORDIA®
Principal Transmission Engineer
Kordia Solutions Pty Ltd | **DDI.** 61298562681 | **M.** 61414209115

From: Inkster, Benjamin [mailto:BInkster@pb.com.au]
Sent: Friday, 3 June 2011 10:57 a.m.
To: Ganesh Ganeswaran
Subject: RE: Wind Farm Radio Communications - Update

Dear Ganesh,

I received your automatic reply while you were away, I hope you had an enjoyable holiday!

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Please do not hesitate to contact me if you require further information.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

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Direct: +61 3 9861 2484
Fax: +61 3 9861 1144
Email: binkster@pb.com.au

From: Inkster, Benjamin
Sent: Tuesday, 3 May 2011 5:54 PM
To: Ganesh.Ganeswaran@kordia.com.au
Subject: Wind Farm Radio Communications - Update

Dear Ganesh,

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The new dimensions for the proposed wind turbine are a hub height of 94 m and a rotor radius of 56 m. I have attached a copy of the new turbine locations provided in AMG66 Zone 55 coordinates. Could you please treat this information as confidential as it is provided to you for your own assessment only and should not be passed on to other parties.

PB is seeking comment from Vodafone regarding this update to the proposed wind farm related to radio communications impact. If you have any queries about this assessment or require any specific information, please do not hesitate to contact me.

Kind regards,

Ben Inkster

Wind Engineer
Energy Mining and Industry Group
Australia Pacific

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Level 15, 28 Freshwater Place
PO Box 19016
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