

Mount Emerald Wind Farm - Electromagnetic Interference Assessment

28 July 2011

Transfield Services 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*

Certified to ISO 9001, ISO 14001, AS/NZS 4801

Revision	Details	Date	Amended By
00	Original	28 July 2011	We-Ki Chua

©Parsons Brinckerhoff Australia Pty Limited (PB) [2011].

Copyright in the drawings, information and data recorded in this document (the information) is the property of PB. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by PB. PB makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information.

Author: We-Ki Chua

Signed:

Reviewer: Ross Cooper, Ben Inkster

Signed:

Approved by: Taraz Saba

Signed:

Date: 28 July 2011

Distribution: Transfield, PB Library.....

Please note that when viewed electronically this document may contain pages that have been intentionally left blank. These blank pages may occur because in consideration of the environment and for your convenience, this document has been set up so that it can be printed correctly in double-sided format.

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

Our reference 2161336A-REP-001

28 July 2011

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

Certified to ISO 9001, ISO 14001, AS/NZS 4801
A+ GRI Rating: Sustainability Report 2009

Terry Johannesen
Transfield Services
Level 13, 90 Albert Street
Brisbane
QLD 4000

Dear Terry

Mount Emerald Wind Farm - Electromagnetic Interference Assessment

Please find attached the draft report for the Mount Emerald Wind Farm Electromagnetic Interference Assessment using the 75 WTG, Enercon E-82 layout you have provided.

Please do not hesitate to contact me should you have any questions or wish to discuss this.

Yours sincerely



We-Ki Chua
Wind Engineer
Parsons Brinckerhoff Australia Pty Limited

Contents

	Page number
Glossary	iv
Executive summary	v
1. Introduction	1
2. Wind farms and electromagnetic interference	2
2.1 Types of impacts	2
2.1.1 Characterising impact with exclusion zones	2
2.2 Relevant categories of radio communication services	3
2.3 Impacts and mitigation	4
2.4 Construction, maintenance and decommissioning	5
3. Methodology	6
3.1 Reflection and scattering impacts	6
3.2 Australian Communications and Media Authority	6
3.3 Inputs to assessment	7
4. Assessment results	8
4.1 Assignment search	8
4.1.1 Site ID 440244 – Lotus Glen Prison via MAREEBA	10
4.1.2 Site ID 440245 – Lotus Glen Prison Farm via MAREEBA	11
4.1.3 Site ID 21708 – QAS Site HANN TABLELAND	12
4.1.4 Site ID 441034 – 2 Middlemiss Street MAREEBA	13
4.1.5 Site ID 130248 - Optus/Vodafone Site Water Tower Basalt Street MAREEBA	14
4.1.6 Site ID 440803 – 65 Rankine Street MAREEBA	15
4.1.7 Site ID 20804 – Miles Site LAMBS HEAD	16
4.1.8 Site ID 21158 - Radio Terminal 38 km SSE of Cairns MT BELLENDEN KER	17
4.1.9 Site ID 9006997 - 331 James Street MALANDA	18
4.1.10 Site ID 22010 - Powerlink Site 8.7 km W of Atherton MT WALLUM	19
4.1.11 Site ID 22000 – 45 Mabel Street ATHERTON	20
4.1.12 Site ID 22009 – QAS Site Hallorans Hill ATHERTON	21
4.1.13 Site ID 130247 – Optus Site Dalziel Avenue ATHERTON	22
4.1.14 Site ID 152887 – Broadcast Site Lot 1 Griffin Rd TOLGA	23
4.1.15 Site ID 152747 – Broadcast Site Bones Knob TOLGA	24
4.1.16 Site ID 9006996 – Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD	25
4.2 Near field exclusion	26
4.3 Point-to-point services	26

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

4.3.1	Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD (Site ID 9006996) to 65 Rankine Street MAREEBA (Site ID 440803)	27
4.4	Point-to-multipoint	27
4.4.1	AM and FM radio broadcasting	28
4.4.2	Mobile radio	28
4.5	Digital and analogue television	28
5.	Licensee consultation	30
6.	References	31

Appendices

Appendix A

Proposed wind farm layout (WGS 84, Zone 55)

Appendix B

ACMA RADCOM site search results (AGD 66, Zone 55)

Appendix C

Registered assignments within 5 km of MEWF

Glossary

ACMA	Australian Communications and Media Authority
AM	Amplitude Modulation
Transfield	Transfield Corporation Pty Ltd
MEWF	Mount Emerald Wind Farm
EMI	Electromagnetic Interference
FM	Frequency Modulation
GIS	Geographic Information System
OD	Omnidirectional (in relation to an antenna radiation pattern)
RADCOM	ACMA Registry of Licensed Radio Communicators
RF	Radio Frequency
TV	Television
UHF	Ultra High Frequency
VHF	Very High Frequency
SHF	Super High Frequency

Executive summary

As part of the development of the Mount Emerald Wind Farm, Transfield Services Australia (Transfield) engaged Parsons Brinckerhoff (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.

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).

28 radio communication sites were found within a 10 km distance of the wind farm boundary, with an associated 222 registered assignments. This data was mapped against the proposed wind farm layout, provided by Transfield. Communication towers and service paths that were within three 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.

At the time of writing of this report, PB is attempting to contact all potentially impacted licensees that operate services within three kilometres of the wind farm boundary and notify them of the proposed development. These licensees are being 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 the operational status and tower coordinates.

PB recommends that, to avoid obstruction interference, no turbines intrude on the calculated 2nd Fresnel zone for point-to-point radio links. PB suggests if the consulted licensees verify the RADCOM data is correct and there is agreement over radio path and tower setback distances, Transfield investigates mitigation options to avoid any interference. PB has determined that one turbine is located 4 m away from a 2nd Fresnel exclusion zone, presenting the possibility of the turbine encroaching on the exclusion zone depending on the orientation of the rotor. PB is in the process of seeking more precise coordinates from the relevant telecommunications tower operators/licensees.

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 3 km of the wind farm.

1. Introduction

Transfield Services Pty Ltd (Transfield) is developing the Mount Emerald Wind Farm (MEWF) in Queensland, in between the towns of Atherton and Mareeba (see Figure 1). Transfield has advised that the wind farm consists of 75 Enercon E82 wind turbines – a 2.3 MW machine with an 82 m rotor diameter.

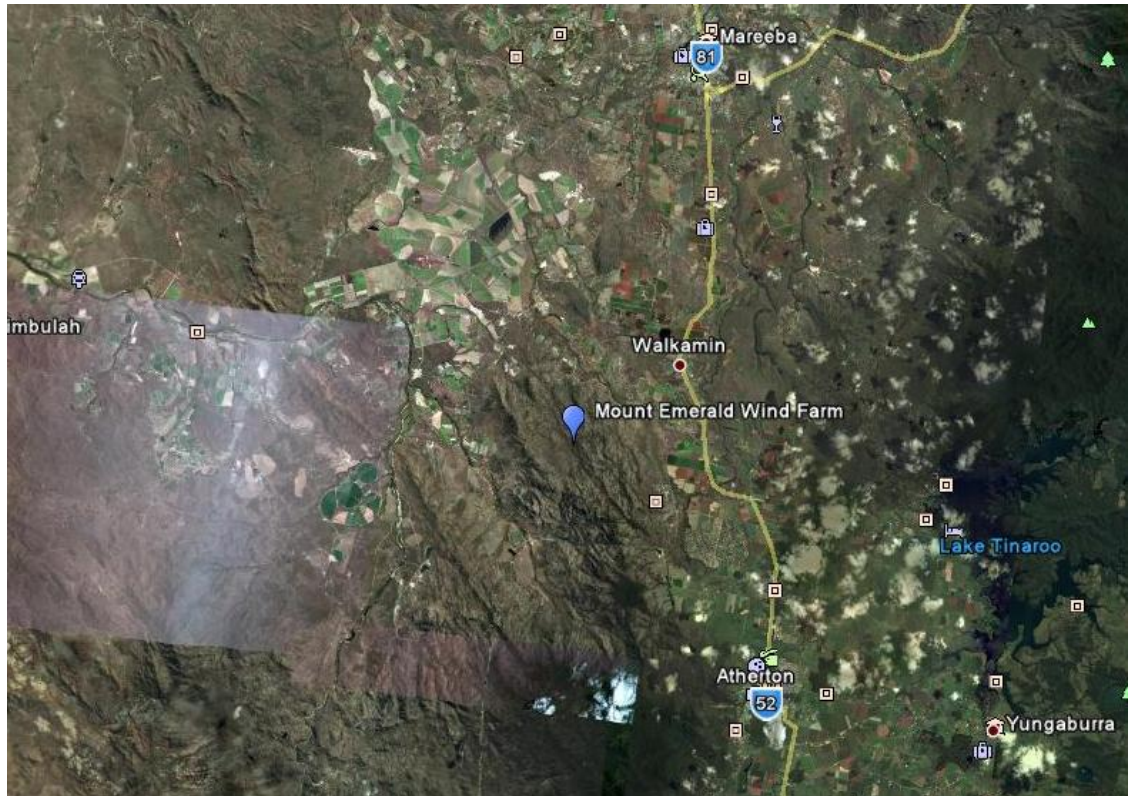


Figure 1: Location of Mount Emerald Wind Farm relative to local population centres (source: Google Earth)

As part of the site development, Transfield requested PB undertake an assessment of potential impacts to radio telecommunication services in the area. The scope of the investigation included the following:

1. *Identifying existing radio communication services and the related communication paths near to the wind farm site.*
2. *Determining high risk issues and constraints posed by the presence and operation of identified communications services with respect to the MEWF layout.*
3. *Initial contact with potentially impacted communications licensees.*
4. *Provide recommendations on any further steps to be taken to mitigate telecommunication impact risks.*

This report documents the undertaking of this scope.

GIS data has been supplied to Transfield 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, land mobile 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 communication service. Radar services (civil and weather) can potentially be impacted by wind farms as well.

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 a conductive object is placed within the advancing wavefront of a radio wave, wave energy can be absorbed, 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 emission that 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 MEWF 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 MEWF.

- *Obstruction impact*
Recommendations for determining exclusion zones to mitigate obstruction are given by Bacon (2002). Exclusion zones have been calculated at MEWF 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 emissions / 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 6) 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 sometimes receives from, a number independent of locations. Television and radio broadcasting and reception, mobile phones (to the cell site 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 Transfield consults with the following radar operators (PB can provide further assistance with this consultation) to determine their position on the MEWF 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 Transfield 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 6 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 applied to the final layout be respected during construction, maintenance and decommissioning. These exclusion zones should be agreed upon by the license holders and the wind farm proponent, Crane booms and the 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 6), and considering PB's knowledge of the MEWF status, PB has taken the course outlined below.

1. Identify any registered, licensed radio communication sites and services within a 10 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 3 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 1/07/2011 to conduct the assessment.

ACMA also maintains a register of licensed commercial broadcasters which was accessed via the ACMA webpage¹.

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 is requesting verification of the ACMA information relevant to each of the contacted stakeholders (see Section 5).

¹ http://www.acma.gov.au/WEB/STANDARD/pc=PC_9150; accessed 18/07/2011

3.3 Inputs to assessment

PB received a turbine layout from Transfield for the MEWF. This layout is shown in Figure 2, and supplied in Appendix A. Transfield also advised that the turbine expected to be used is the Enercon E82. This turbine is noted to have an 82 m rotor diameter or alternatively a 41 m rotor radius.

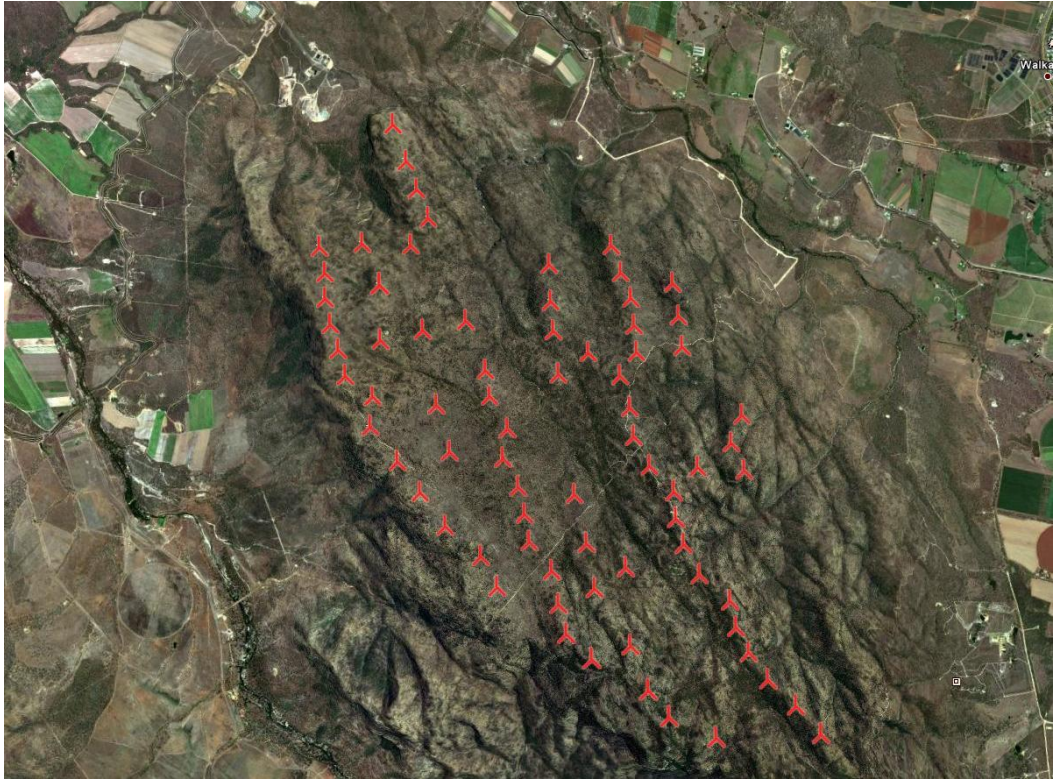


Figure 2: Mount Emerald Wind Farm layout

4. Assessment results

4.1 Assignment search

A search of the RADCOM database was conducted using a defined search area of 10 km from the wind farm boundary. Ten sites were found within the defined search area, bound in blue as shown in Figure 3. A total of 28 sites are associated with assignments that intersect the 10km search area. Details of these sites can be found in Appendix B.

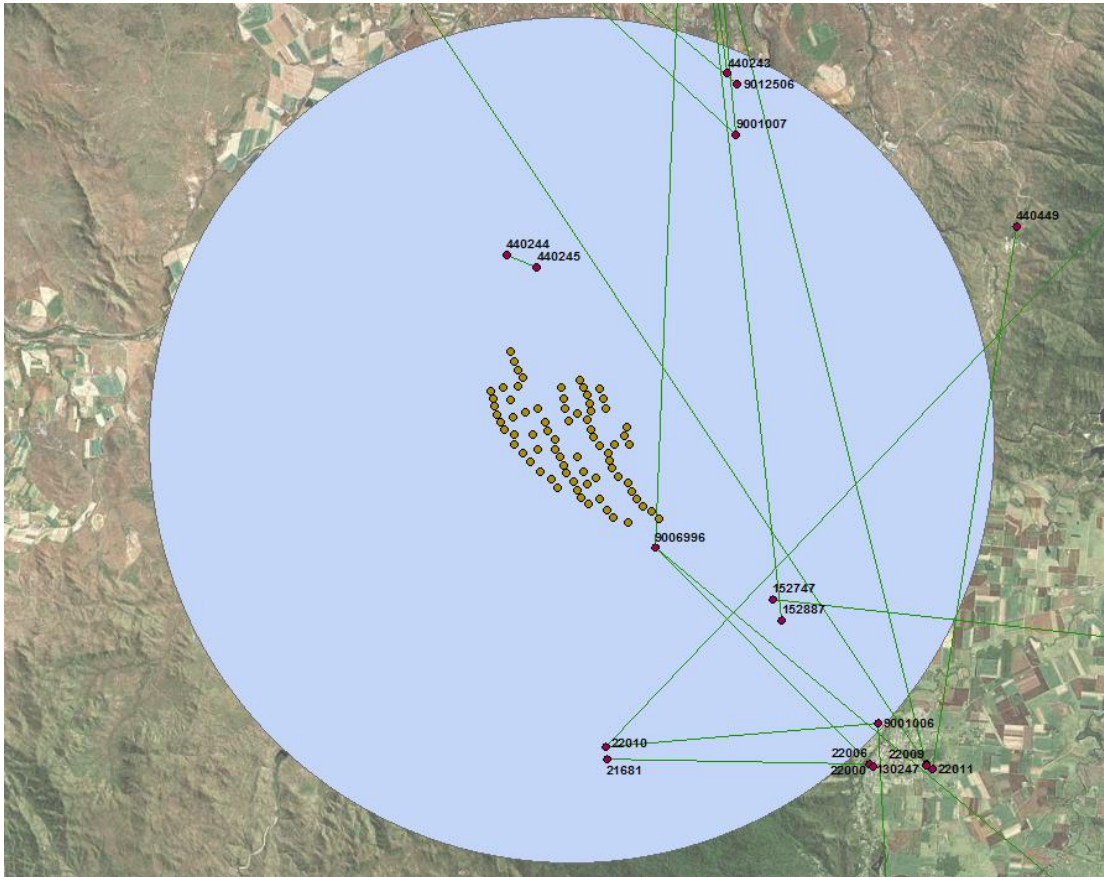


Figure 3: MEWF (yellow) and surrounding radio sites (maroon)

Associated with these 28 sites were 222 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, with the sites shown in Figure 4. PB has also identified all links (including towers further than 10 km away) that intercept the 5 km radius of the wind farm boundary. An analysis of these sites and assignments is given below.

Table 1: Sites within a 5km radius of the MEWF boundary (coordinates AGD66 Zone 55)

Site ID	Easting	Northing	Site Name	Distance to nearest turbine
				m
440244	325680	8106990	Lotus Glen Prison via MAREEBA	3214
440245	326680	8106600	Lotus Glen Prison Farm via MAREEBA	2955
9006996	330611	8097300	Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD	981
152747	334500	8095600	Broadcast Site Bones Knob TOLGA	4606

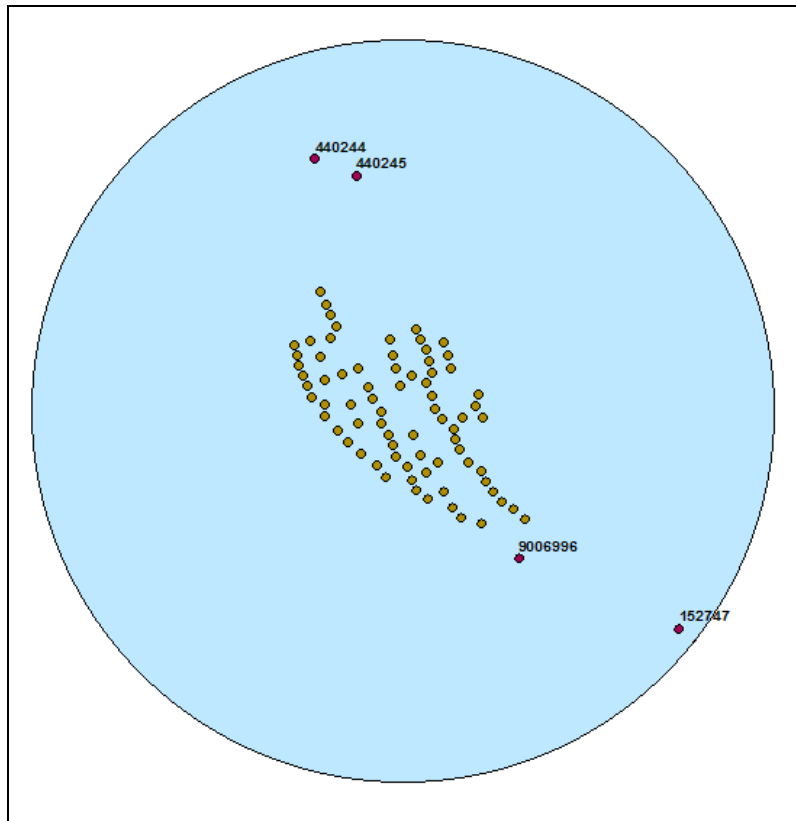


Figure 4: Sites within a 5km radius of the MEWF boundary

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.

4.1.1 Site ID 440244 – Lotus Glen Prison via MAREEBA



Figure 5: Lotus Glen Prison via MAREEBA and associated radio paths

- 111 degrees**

There are two assignments directed in the 111 degree bearing and are operated by the Queensland Corrective Services Commission. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.2 Site ID 440245 – Lotus Glen Prison Farm via MAREEBA



- **291 degrees**
There are two assignments directed in the 291 degree bearing and are operated by the Queensland Corrective Services Commission. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.3 Site ID 21708 – QAS Site HANN TABLELAND



- **146 degrees**
There are two assignments directed in the 146 degree bearing and are operated by the Department of Community Safety. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.4 Site ID 441034 – 2 Middlemiss Street MAREEBA



- **163 degrees**
There is an assignment directed in the 163 degree bearing and is operated by Coastal Broadcasters Pty Ltd. The tower and its associated assignment are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

**4.1.5 Site ID 130248 - Optus/Vodafone Site Water Tower Basalt Street
MAREEBA**



- **165 degrees**
There are two assignments directed in the 165 degree bearing operated by Vodafone Australia Pty Ltd. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.6 Site ID 440803 – 65 Rankine Street MAREEBA



- **182 degrees**
There are two assignments directed in the 182 degree bearing operated by Tablelands Regional Council. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.7 Site ID 20804 – Miles Site LAMBS HEAD

- **223 degrees**
There are two assignments directed in the 223 degree bearing operated by the Department of Community Safety (Queensland Fire and Rescue Service). The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

**4.1.8 Site ID 21158 - Radio Terminal 38 km SSE of Cairns MT BELLENDEN
KER**



- **277 degrees**
There is an assignment directed in the 277 degree bearing operated by Tablelands Broadcasting Pty Limited. The tower and its associated assignment are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.9 Site ID 9006997 - 331 James Street MALANDA



- **310 degrees**
There are two assignment directed in the 310 degree bearing operated by the Tablelands Regional Council. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.10 Site ID 22010 - Powerlink Site 8.7 km W of Atherton MT WALLUM



- **43 degrees**
There are two assignment directed in the 43 degree bearing operated by the Department of Community Safety (Queensland Fire and Rescue Service). The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.11 Site ID 22000 – 45 Mabel Street ATHERTON



- **315 degrees**
There are two assignment directed in the 315 degree bearing operated by the Tablelands Regional Council. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.12 Site ID 22009 – QAS Site Hallorans Hill ATHERTON



- **326 degrees**
There are two assignment directed in the 326 degree bearing operated by the Department of Community Safety. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.13 Site ID 130247 – Optus Site Dalziel Avenue ATHERTON



- **345 degrees**
There are two assignments directed in the 345 degree bearing operated by Vodafone Australia Pty Limited. The tower and its associated assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.14 Site ID 152887 – Broadcast Site Lot 1 Griffin Rd TOLGA



- **343 degrees**
There is an assignment directed in the 343 degree bearing operated by Coastal Broadcasters Pty Ltd. The tower and its associated assignment are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.15 Site ID 152747 – Broadcast Site Bones Knob TOLGA



- **97 degrees**
There is an assignment directed in the 97 degree bearing operated by Tablelands Broadcasting Pty Limited. The tower and its associated assignment are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

4.1.16 Site ID 9006996 – Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD



- **2 degrees**
 There are two assignments directed in the 182 degree bearing operated by the Tablelands Regional Council. The 2nd Fresnel Zone Analysis was conducted for this assignment and the results are discussed in Section 4.3.1. A Near Field Exclusion Zone analysis was undertaken for this site and WTG 42 was found to be outside this exclusion zone.
- **130 degrees**
 There are two assignments directed in the 2 degree bearing operated by the Tablelands Regional Council. These assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.
- **135 degrees**
 There are two assignments directed in the 2 degree bearing operated by the Tablelands Regional Council. These assignments are sufficiently far away from the wind farm and have been excluded from the Fresnel Zone and Near Field Exclusion Zone analyses.

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 MEWF 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 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 MEWF, 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 5 for information on consultation).

Based on the search results in Section 4.1, PB calculated the recommended obstruction exclusion zones (2nd Fresnel exclusion zone) for assignments that are potentially intercepted by the wind farm. As shown in Figure 6, there is only one assignment that is possibly intercepted by the wind farm, which is discussed in more detail in Section 4.3.1.

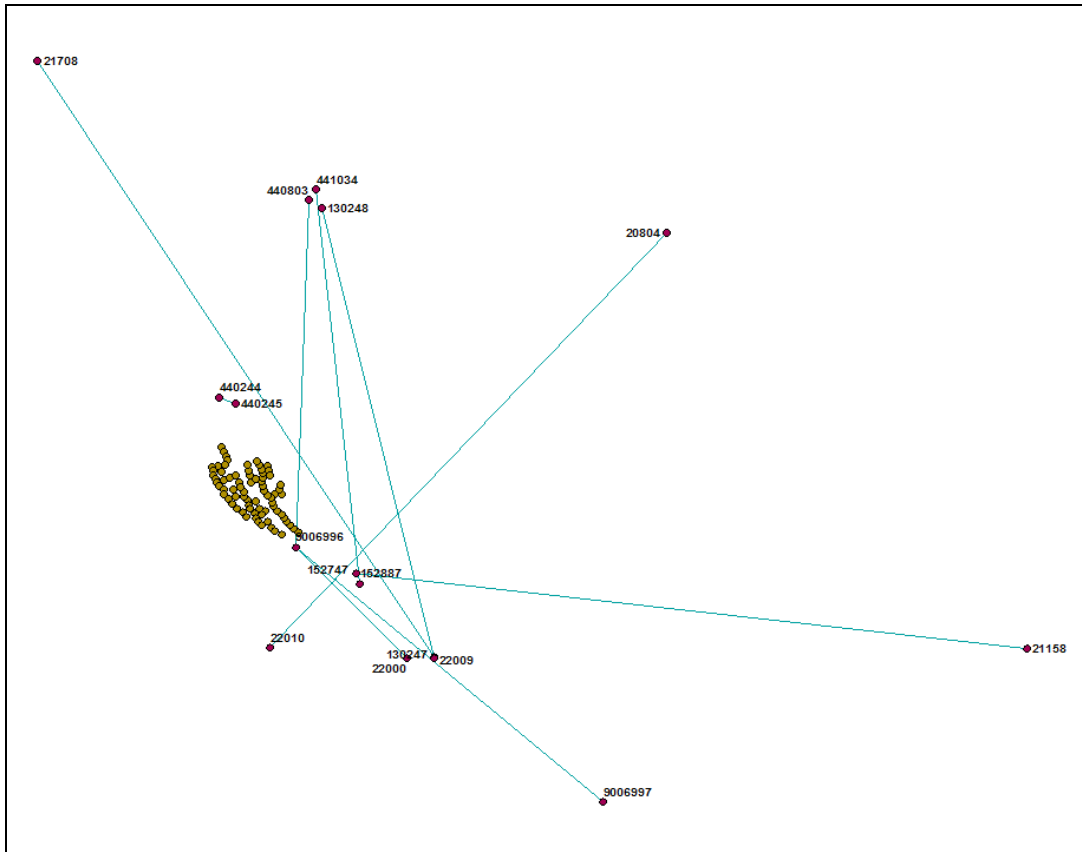


Figure 6: Assignments of nearby radio communications towers relative to the MEWF

The Fresnel Zone analysis shows that one turbine possibly encroaches on the 2nd Fresnel Zone of the link between Site 9006996, which is within the 5 km radius of the wind farm boundary, and Site 440803, which is approximately 15 km from the wind farm boundary. This is discussed in the following subsection.

There are six other links that pass through the 5 km radius from the wind farm boundary, but these links have a significant distance between the outermost 2nd Fresnel Zone point and the MEWF and hence are not expected to be impacted by the wind farm, and are not discussed any further in this report.

4.3.1 Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD (Site ID 9006996) to 65 Rankine Street MAREEBA (Site ID 440803)

The links on this radio path are licensed to the Tablelands Regional Council and occupy the 8 GHz frequency band (see Appendix C). PB is attempting to contact the operators of both these sites at the time of writing to confirm the precise coordinates of the sites. PB has calculated that there is a 4 m distance from the edge of the 2nd Fresnel Zone to the centre of WTG 42. The blades and nacelle of the WTG are within the 2nd Fresnel Zone. It should be noted that this analysis is based solely on the information provided by ACMA which has an accuracy of +/- 100 m. PB has also compared the coordinates of these towers with alternative sources of information such as satellite imagery and found inconsistencies in telecommunication tower locations. PB is in the process of confirming the precise coordinates of the telecommunications towers with the operators/licensees.

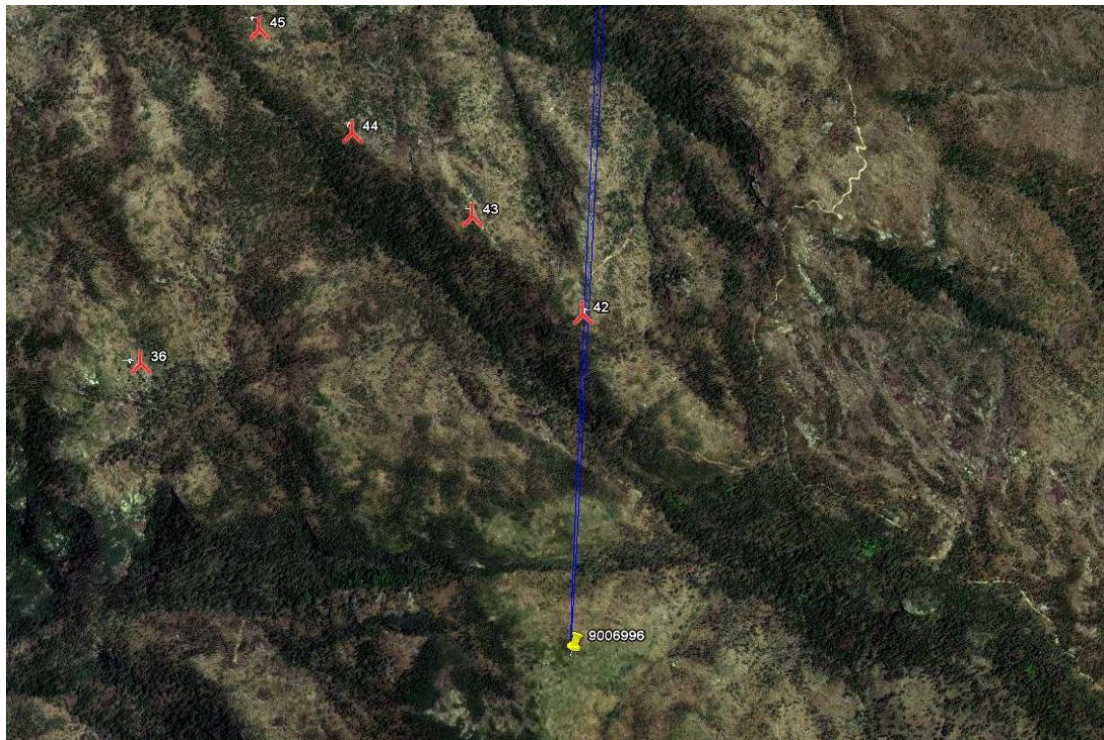


Figure 7: 2nd Fresnel Zone of links between 9006996 and 440803

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 licensees²) may not be detected. PB has consulted point-to-multipoint and broadcast licensees on towers within a 3 km distance from the wind farm boundary to determine their position on the development. PB recommends Transfield 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

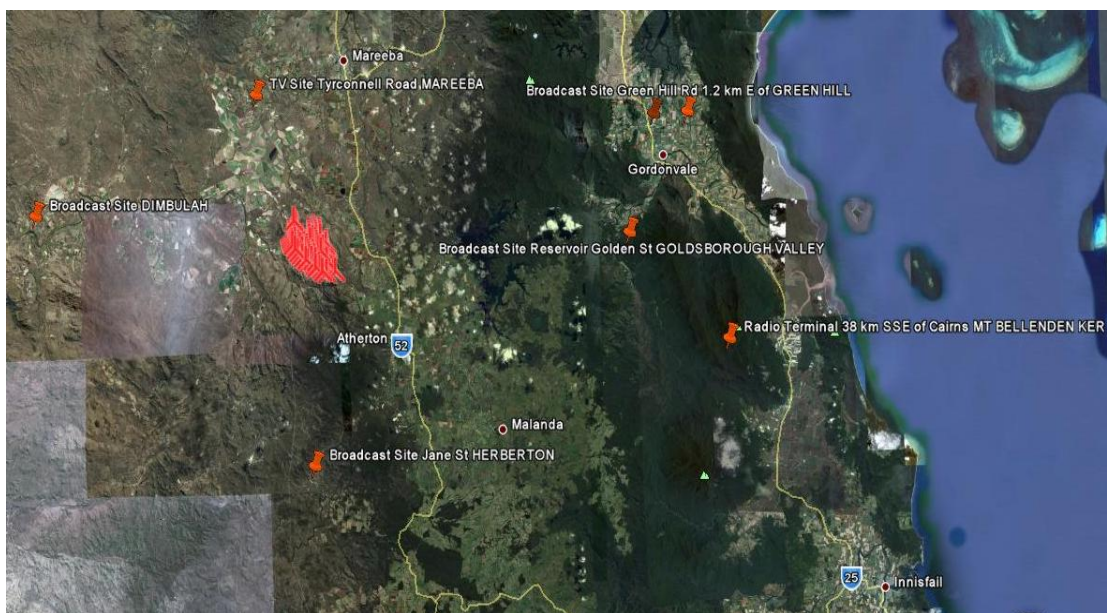
The impact to FM radio broadcasting reception is considered to be negligible. The impact to AM radio broadcasting is considered to be negligible beyond the boundary of the wind farm. In general, there are no known effects on AM/FM services caused by the wind farm as the wavelength of these services are relatively large compared to the size of the WTGs; hence any effect will be negligible.

4.4.2 Mobile radio

Mobile radio may be affected by the shadowing effects of the MEWF. 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 8). Based on ACMA information and the coverage patterns given by the Australian Broadcast Corporation³, the likely tower being used for transmission in the area would be the Mount Bellenden-Ker site, the Hallorans Hill site, and the Dimbulah Broadcast site. Further information would be required to determine which site(s) is being used by local receivers.



² http://www.acma.gov.au/WEB/STANDARD/pc=PC_481 accessed on 22/07/2010

³ <http://www.abc.net.au/reception/freq/>

Figure 8: MEWF, populated areas (red circles) and the surrounding broadcast stations (orange pins)

A number of townships lie in close proximity to the wind farm. No population centre lies such that the MEWF is obstructing either of these broadcast stations lines of sight. PB does not expect the townships east of the site, namely Mareeba, Atherton and Walkamin to be affected by the MEWF.

Residences close to MEWF may experience interference to their analogue television signals in the form of multipath reflections. Further modelling would need to be undertaken to determine the extent of that impact, if required. However, a potential mitigation option for analogue television impact is converting an analogue television receiver to digital. The Australian government has declared analogue television will be phased completely out of service by the end of 2013 with service in many areas ceasing operation before that time. Given a reasonable construction schedule for MEWF, many television users will likely have converted to digital television when construction has commenced. Digital television signals are more immune to interference from wind turbines compared to analogue signals .

Residences may also be located near the wind farm such that there is line of sight obstruction between the residence and the broadcast site. More information would be required to determine if this is the case.

5. Licensee consultation

All the potentially impacted licensees within Appendix C are being contacted by PB to give them opportunity to comment on the development.

Additionally, clarification will be sought for the following items:

- Coordinate precision for Site 9006996 and the azimuths of its associated links.
- Coordinate precision for Site 440803 and the azimuths of its associated links.

PB will reassess the impact of the wind farm on the two sites above following confirmation of precise coordinates from the operators/licensees.

6. 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 (WGS
84, Zone 55)

Wind farm layout coordinates (WGS 84, Zone 55)

Turbine Number	East	North
1	325809	8102197
2	325803	8103785
3	325956	8103457
4	326073	8103207
5	326217	8102937
6	326064	8102645
7	325581	8102596
8	325167	8102500
9	325263	8102243
10	325299	8101986
11	325387	8101730
12	325507	8101485
13	325916	8101631
14	326327	8101782
15	325617	8101231
16	325929	8101048
17	325934	8100748
18	326232	8100427
19	326493	8100143
20	326789	8099837
21	327190	8099583
22	327386	8099294
23	327471	8100310
24	327570	8100046
25	327652	8099781
26	327915	8099518
27	328230	8099829
28	328656	8099631
29	328367	8099407
30	328029	8099220
31	328146	8098962
32	328425	8098766
33	328786	8098927
34	329002	8098559
35	329234	8098320
36	329717	8098155
37	329260	8100722
38	328046	8100298
39	326981	8101460
40	326734	8100584
41	327737	8101507
42	330749	8098278
43	330489	8098504
44	330207	8098696
45	329988	8098935
46	329823	8099182
47	329729	8099441

Turbine Number	East	North
48	329404	8099649
49	329203	8099946
50	329091	8100198
51	329040	8100460
52	329738	8100745
53	329581	8101006
54	329659	8101299
55	328773	8100681
56	328578	8100955
57	328506	8101239
58	328368	8101559
59	328507	8101817
60	328450	8102087
61	328384	8102361
62	328250	8102610
63	328123	8102866
64	326730	8101936
65	328792	8102560
66	328891	8102237
67	328964	8101930
68	328019	8101756
69	327636	8101937
70	327578	8102225
71	327508	8102611
72	327279	8100581
73	327284	8100882
74	327063	8101191
75	326543	8101038

Appendix B

ACMA RADCOM site search results
(AGD 66, Zone 55)

Site ID	Site Name	Easting	Northing
20804	Miles Site LAMBS HEAD	354700	8117700
21158	Radio Terminal 38 km SSE of Cairns MT BELLENDEN KER	378034	8090678
21679	Ergon Energy Site LONGLANDS GAP	339090	8069311
21681	Forestry Site 8.7 km W of Atherton MT WALLUM	329000	8090300
21708	QAS Site HANN TABLELAND	313870	8128894
22000	45 Mabel Street ATHERTON	337850	8090055
22006	DPI Office Main Street ATHERTON	337700	8090150
22009	QAS Site Hallorans Hill ATHERTON	339575	8090130
22010	Powerlink Site 8.7 km W of Atherton MT WALLUM	328960	8090735
22011	Telstra Radio Terminal Hallorans Hill ATHERTON	339804	8089984
39608	Ergon Site LYONS LOOKOUT	327630	8170840
39610	Ergon Site HANN TABLELAND	313870	8128879
130247	Optus Site Dalziel Avenue ATHERTON	339613	8090103
130248	Optus/Vodafone Site Water Tower Basalt Street MAREEBA	332300	8119300
152747	Broadcast Site Bones Knob TOLGA	334500	8095600
152887	Broadcast Site Lot 1 Griffin Rd TOLGA	334797	8094912
440241	Pump Station Kennedy Hwy MAREEBA	332250	8118500
440243	Reservoir Kennedy Hwy MAREEBA	333000	8113000
440244	Lotus Glen Prison via MAREEBA	325680	8106990
440245	Lotus Glen Prison Farm via MAREEBA	326680	8106600
440449	Telstra Customer Mr CD Dudeck Lot 1322 Tinaroo Creek Rd TINAROO	342580	8107950
440803	65 Rankine Street MAREEBA	331500	8119850
441034	2 Middlemiss Street MAREEBA	331960	8120540
9001006	Ergon Substation off Grant St ATHERTON	337985	8091485
9001007	Ergon Substation Turkinje via MAREEBA	333282	8110968
9006996	Council Site 8 km WNW of Tolga (off Kennedy Highway) MT EMERALD	330611	8097300
9006997	331 James Street MALANDA	350548	8080712
9012506	Substation Substation Accs Rd off Kennedy Hwy MAREEBA	333340	8112657

Appendix C

Registered assignments within 5 km
of MEWF

Site ID 20804 – Miles Site LAMBS HEAD

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
54761	450000000	56	Miles Electronics Pty Ltd
57096	414000000	208	Queensland Police Service
350640	405000000	208	Queensland Police Service
171149	414000000	197	Department of Community Safety
171152	405000000	197	Department of Community Safety
1440514	414000000	45	Department of Community Safety (Queensland Fire and Rescue Service)
1440515	404000000	45	Department of Community Safety (Queensland Fire and Rescue Service)
1440518	414000000	223	Department of Community Safety (Queensland Fire and Rescue Service)
1440519	404000000	223	Department of Community Safety (Queensland Fire and Rescue Service)
1441665	414000000	55	Queensland Police Service
1441666	405000000	55	Queensland Police Service
8153065	404000000	198	Department of Community Safety (Queensland Fire and Rescue Service)
8153066	414000000	198	Department of Community Safety (Queensland Fire and Rescue Service)
8157092	10600000000	60	Miles Electronics Pty Ltd
8157093	10600000000	60	Miles Electronics Pty Ltd
8158744	461000000	285	Ergon Energy Corporation Limited
8158745	451000000	285	Ergon Energy Corporation Limited
8158805	461000000	63	Department of Transport and Main Roads (Queensland Transport)
8158806	451000000	63	Department of Transport and Main Roads (Queensland Transport)
8158807	461000000	63	Department of Transport and Main Roads (Queensland Transport)
8158808	451000000	63	Department of Transport and Main Roads (Queensland Transport)
8172632	414000000	51	Ergon Energy Corporation Limited
8172642	405000000	51	Ergon Energy Corporation Limited
8200929	404000000	317	Department of Community Safety (Queensland Fire and Rescue Service)
8200933	414000000	317	Department of Community Safety (Queensland Fire and Rescue Service)
8225556	414000000	285	Department of Community Safety (Queensland Fire and Rescue Service)
8225565	404000000	285	Department of Community Safety (Queensland Fire and Rescue Service)

Site ID 21158 – Radio Terminal 38 km SSE of Cairns MT BELLENDEN KER

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
40016	6700000000	129	Telstra Corporation Limited
340752	7040000000	129	Telstra Corporation Limited
40018	6800000000	129	Telstra Corporation Limited
340754	6460000000	129	Telstra Corporation Limited
44500	1870000000	118	Telstra Corporation Limited
345035	1750000000	118	Telstra Corporation Limited
1103604	7520000000	347	Airservices Australia
1103605	7690000000	347	Airservices Australia
1444514	461000000	347	Department Of Transport And Main Roads (Main Roads)
1444515	451000000	347	Department Of Transport And Main Roads (Main Roads)
8156900	6500000000	129	Southern Cross Telecommunications Pty Ltd
8156901	6840000000	129	Southern Cross Telecommunications Pty Ltd
8156902	6580000000	129	Southern Cross Telecommunications Pty Ltd
8156903	6920000000	129	Southern Cross Telecommunications Pty Ltd
8181810	7480000000	347	Australian Broadcasting Corporation
8181813	7640000000	347	Australian Broadcasting Corporation

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8194398	7760000000	74	Telstra Corporation Limited
8194404	8070000000	74	Telstra Corporation Limited
8223539	8480000000	347	Australian Broadcasting Corporation
8294743	8490000000	277	Tablelands Broadcasting Pty Limited

Site ID 21708 – QAS Site HANN TABLELAND

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
56588	1550000000	224	Queensland Police Service
350453	1510000000	224	Queensland Police Service
61575	4140000000	76	Department of Community Safety
1440017	4040000000	76	Department of Community Safety
1442154	4140000000	18	Mossman Central Mill Company Limited
1442156	4050000000	18	Mossman Central Mill Company Limited
1444694	9320000000	256	Queensland Rail Limited
1444695	8560000000	256	Queensland Rail Limited
1444696	9330000000	115	Queensland Rail Limited
1444697	8570000000	115	Queensland Rail Limited
1481778	4610000000	146	Department of Community Safety
1481779	4510000000	146	Department of Community Safety
1481780	4610000000	224	Department of Community Safety
1481781	4510000000	224	Department of Community Safety
1444980	1500000000	317	Department of Community Safety
1444981	1550000000	317	Department of Community Safety
1444982	1550000000	77	Department of Community Safety
1444983	1500000000	77	Department of Community Safety
8225556	4140000000	105	Department of Community Safety (Queensland Fire and Rescue Service)
8225565	4040000000	105	Department of Community Safety (Queensland Fire and Rescue Service)

Site ID 22000 – 45 Mabel Street ATHERTON

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8195353	18300000000	315	Tablelands Regional Council
8195355	19300000000	315	Tablelands Regional Council

Site ID 22009 – QAS Site Hallorans Hill ATHERTON

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1481778	4610000000	326	Department of Community Safety
1481779	4510000000	326	Department of Community Safety
1481784	4600000000	181	Department of Community Safety
1481785	4510000000	181	Department of Community Safety

Site ID 22010 – Powerlink Site 8.7 km W of Atherton MT WALLUM

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1440518	414000000	43	Department of Community Safety (Queensland Fire and Rescue Service)
1440519	404000000	43	Department of Community Safety (Queensland Fire and Rescue Service)
8169114	451000000	85	Ergon Energy Corporation Limited
8169117	460000000	85	Ergon Energy Corporation Limited

Site ID 130247 – Optus Site Dalziel Avenue ATHERTON

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1134606	7590000000	345	Vodafone Australia Pty Limited
1134607	7430000000	345	Vodafone Australia Pty Limited
1442232	7660000000	346	Optus Mobile Pty Limited
1442237	7500000000	346	Optus Mobile Pty Limited
8260173	6030000000	346	Optus Mobile Pty Limited
8260183	6290000000	346	Optus Mobile Pty Limited
8260174	6000000000	346	Optus Mobile Pty Limited
8260177	6260000000	346	Optus Mobile Pty Limited
8260175	5970000000	346	Optus Mobile Pty Limited
8260184	6230000000	346	Optus Mobile Pty Limited
8260182	5950000000	346	Optus Mobile Pty Limited
8260188	6200000000	346	Optus Mobile Pty Limited
8263321	7880000000	136	Optus Mobile Pty Limited
8263325	8190000000	136	Optus Mobile Pty Limited

Site ID 130248 – Optus/Vodafone Site Water Tower Basalt Street MAREEBA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1134606	7590000000	165	Vodafone Australia Pty Limited
1134607	7430000000	165	Vodafone Australia Pty Limited
1442232	7660000000	166	Optus Mobile Pty Limited
1442237	7500000000	166	Optus Mobile Pty Limited
1426233	15100000000	266	Optus Mobile Pty Limited
1426234	14500000000	266	Optus Mobile Pty Limited
8260173	6030000000	166	Optus Mobile Pty Limited
8260183	6290000000	166	Optus Mobile Pty Limited
8260174	6000000000	166	Optus Mobile Pty Limited
8260177	6260000000	166	Optus Mobile Pty Limited
8260175	5970000000	166	Optus Mobile Pty Limited
8260184	6230000000	166	Optus Mobile Pty Limited
8260182	5950000000	166	Optus Mobile Pty Limited
8260188	6200000000	166	Optus Mobile Pty Limited
8295165	10700000000	266	Optus Mobile Pty Limited
8295168	11200000000	266	Optus Mobile Pty Limited

Site ID 152747 – Broadcast Site Bones Knob TOLGA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8294743	849000000	97	Tablelands Broadcasting Pty Limited

Site ID 152887 – Broadcast Site Lot 1 Griffin Rd TOLGA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
167941	851000000	343	Coastal Broadcasters Pty Ltd

Site ID 440244 – Lotus Glen Prison via MAREEBA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1440369	50900000000	111	QLD Corrective Services Commission
1440370	50400000000	111	QLD Corrective Services Commission

Site ID 440245 – Lotus Glen Prison Farm via MAREEBA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
1440369	50900000000	291	QLD Corrective Services Commission
1440370	50400000000	291	QLD Corrective Services Commission

Site ID 440803 – 65 Rankine Street MAREEBA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8195289	7730000000	2	Tablelands Regional Council
8195290	8040000000	2	Tablelands Regional Council

Site ID 441034 – 2 Middlemiss Street MAREEBA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
167941	851000000	163	Coastal Broadcasters Pty Ltd

Site ID 9006996 – Council Site 8 km WNW of Tolga (off Kenedy Highway) MT EMERALD

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8195286	7790000000	130	Tablelands Regional Council

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8195287	8100000000	130	Tablelands Regional Council
8195289	7730000000	182	Tablelands Regional Council
8195290	8040000000	182	Tablelands Regional Council
8195353	18300000000	135	Tablelands Regional Council
8195355	19300000000	135	Tablelands Regional Council

Site ID 9006997 – 331 James Street MALANDA

Access ID	Frequency Assignment	Antenna Azimuth	Licensee
8195286	7790000000	310	Tablelands Regional Council
8195287	8100000000	310	Tablelands Regional Council