# 7.0 Electromagnetic Interference

## 7.1 Introduction

This chapter considers the potential for the Project to result in electromagnetic interference (EMI) impacts and has been informed by the EMI assessment prepared by Garrad Hassan Pacific Pty Ltd (GH) for the Project (2011).

The GH report consisted of an independent analysis of the potential EMI issues associated with the Project. As some time has elapsed since the radio link data was sourced from the Australian Communications and Media Authority (ACMA) database, this summary chapter seeks to confirm or modify the location and alignment of any communication towers and/ or links, taking into account any new towers or links or where any towers or links have been decommissioned.

## 7.2 Scope of assessment

Wind farms have the potential to interfere with radiocommunications services. The main service most likely to be affected is microwave signals, used for line of sight connections for data, voice and video. The GH EMI assessment (2011) and this summary chapter consider the potential risks regarding interference with radiocommunications services operating in the vicinity of the Project and makes findings and recommendations to mitigate any potential impact.

To conduct the EMI assessment, up to date information regarding radiocommunication licences in the vicinity of the Project have been obtained from the ACMA database.

## 7.3 Legislative context

At the time of the GH EMI assessment (2011), there were no specific guidelines for the assessment of the electromagnetic impact of wind turbines in Queensland. The GH assessment was therefore conducted in accordance with the draft National Guidelines for Wind Farm Development (NWFD Guidelines) (EHPC, 2010). The NWFD Guidelines have not been progressed since 2010, however remain available to industry and planning authorities as a reference document.

In July 2016, the Department of Infrastructure, Local Government and Planning (DILGP) released the Queensland Wind Farm State Code and Planning Guideline (DILGP 2016) with the intent of providing a more consistent, state-wide approach to assessing and regulating the development of new or expanding wind farms in Queensland.

The Queensland Wind Farm State Code and Planning Guideline provides guidance for the assessment of EMI, including advice and methodologies to identify likely affected parties, assess the EMI impacts, consult with affected parties, and develop mitigation steps to address the likely EMI impacts.

To provide consistency with the Queensland Wind Farm State Code and Planning Guideline, the GH full EMI assessment, including the assessment of potential impacts and the recommendations regarding management and mitigation measures, has been reviewed. Where required, the findings of the GH full EMI assessment have been updated within this summary chapter to reflect the assessment methodology for potential EMI impacts presented in the Queensland Wind Farm State Code and Planning Guideline.

## 7.4 Methodology

GH carried out an independent analysis of the potential EMI issues associated with the Project. The assessment investigated the impact of the Project on:

- Fixed licenses (point-to-point links, point-to-multipoint links and other links)
- Radiocommunications assets belonging to emergency services
- Aircraft navigation systems
- Aviation and meteorological radar
- Trigonometrical stations
- Radio-frequency identification (RFID) tags

- Citizens Band (CB) radio and mobile phones
- Wireless internet
- Satellite television and internet
- Broadcast radio
- Broadcast television.

Where it has not been possible to assess potential impacts, a process of consultation with organisations operating services that may be impacted by the Project was undertaken. This involved dissemination of basic information on the Project, and a request for the organisation to respond regarding whether they foresee any potential impacts. The results of this consultation process are reported within the Appendix L in Volume 3 and summarised for this chapter.

It is not anticipated that there would be any significant deviations from the initial consultation that was undertaken in 2011. This is primarily due to there being no new communications towers identified nearer to the site than those identified in the GH full EMI assessment (refer to Section 7.5.1).

### 7.4.1 Electromagnetic interference

The term radiocommunications is used broadly to encompass all services that rely on electromagnetic or radio waves to transfer information. There are many methods of transmitting information via radiocommunication. If not properly designed, wind farms have the potential to interfere with radiocommunications services.

At the time of preparing the GH full EMI assessment, the two radiocommunication services most likely to be affected include analogue television broadcast signals and microwave signals (although the phasing out of analogue television broadcast signals had commenced). The phasing-out of analogue broadcast signals for domestic television has now been completed in all locations in Australia. No further consideration of the potential impacts of the Project on analogue signals used to broadcast domestic television are included in this chapter.

There is limited potential for wind farms to impact on digital signals used to transmit domestic television. Potential interference to digital television signals is further described in Section 7.6.9.

Microwave links are used for line of sight connections for data, voice and video. The interference mechanisms are different for each of these, and hence, there are different ways to avoid interference.

### 7.4.2 Parameters and data

Part of the methodology for assessing the potential radiocommunications interference involves locating all of the telecommunication towers within 75 km of the Project and then assessing the telecommunication licences attached to these towers. This is a conservative distance from the Project within which to assess the potential impacts and is an appropriate distance to ensure that all transmission vectors are captured in the licence survey.

An image of the ACMA database, dated December 2010, was used for the GH EMI assessment. From the database, there were 437 telecommunication towers within a nominal 75 km of the Project.

A new search of the ACMA database was conducted in March 2016 to refresh these findings. From this, 428 records within a nominal 75 km of the wind farm were detected. No new communication towers closer to the Project were identified.

The locations of these telecommunication towers derived from the search of the ACMA database in 2016 are shown in Figure 7.1, Volume 2. Other services operating within the vicinity of the Project have also been identified, and the potential for interference to those services discussed.

## 7.5 Existing environment

### 7.5.1 Fixed and other licences of type

**Point-to-Point (Microwave) Links**

Point-to-point or microwave link licence permits communication between two static sites, where the locations of the sites are detailed in the licence register. Point-to-point links are often used for line of sight connections for data, voice and video. Such links often exist on mobile phone and television broadcast towers.

The registered communications licences for each identified tower according to the ACMA database were analysed to determine the transmission paths of point-to-point licence links that may experience interference from wind turbines. Each individual link is given an "Assignment ID" by the ACMA so it can be readily identified. Not all of the identified transmission towers have a fixed licence of point-to-point type transmission vector. Some towers have no active licences associated with them, and some towers are used solely for point-to-area style transmissions, such as some Country Fire Authority (CFA) towers.

A review of the ACMA database shows that there is no link passing over the Project Site, with the closest tower approximately one kilometre south of the Study Area. These links are shown in Figure 7.2 in Volume 2.

The communication (mobile phone) tower closest to any proposed wind turbine within the Project is the Telstra Exchange Terminal at Cooranga North, which is approximately 1.8 km from the nearest proposed turbine.

AGL has also been made aware that Telstra have commenced planning to build a repeater tower on the eastern side of Cooranga North-Niagara Road, east – south east of the Project. This repeater tower would be around 1.5 km north of the existing Telstra Exchange Terminal at Cooranga North.

Consultation with Telstra Corporation is ongoing to confirm the location and layout of the proposed repeater tower.

**Point-to-Multipoint Links**

Fixed licences of the point-to-multipoint type are a variation of point-to-point type. The difference between them is administrative; where a point-to-point licence permits communication between two static sites, a point-to-multipoint licence allows communication between one or more static sites and multiple points or between the points. The point-to-multipoint type is usually licensed for a defined operational area.

Unlike point-to-point links, it is not possible to identify the locations of paths for point-to-multipoint links as only the base-station is licensed and contained in the ACMA database. The closest point-to-multipoint base station has been identified at approximately 17.5 km east - south east of the Project Site. This is the Mt Mowbullan station, owned by the Bureau of Meteorology (BoM) (Site ID 402542).

**Other licence types**

A review of the ACMA database for other licences was conducted. The licences identified can generally be described as base to mobile station style communications, including radio broadcasting, commercial and private mobile telephony. These licences are shown in Table 7.1.

**Table 7.1 Details of other licences identified within 75 km of the Study Area (GH, 2011)**

| Licence type | Licence category | Number of instances |
|---|---|---|
| ACA | ACA Assigned | 4 |
| Aeronautical | Aeronautical Assigned System | 19 |
| Amateur | Amateur Beacon | 1 |
| | Amateur Repeater | 5 |
| Broadcasting | Broadcasting Service | 69 |
| | Narrowband Area Service Station | 4 |
| | Narrowband Service Station | 30 |
| | Narrowcasting Service Station (HPON) | 3 |
| Earth Receive | Earth Receive | 1 |

| Licence type | Licence category | Number of instances |
|---|---|---|
| Fixed | Point to Multipoint – Land Mobile Spec | 1 |
| Fixed Receive | Fixed Receive | 1 |
| Land Mobile | Ambulatory System | 20 |
| | CBRS Repeater | 7 |
| | Land Mobile System - > 30MHz | 282 |
| | Land Mobile System 0-30MHz | 5 |
| | Paging System – Exterior | 19 |
| | Paging System – Interior | 7 |
| Public telecommunications service (PTS) | PMTS Class B (2110-2170MHz) | 36 |
| | PMTS Class B (935-960MHz) | 42 |
| Radiodetermination | Radiodetermination | 6 |
| Scientific | Scientific Assigned | 1 |
| Spectrum | 1.8 GHz Upper Band | 1 |
| | 2 GHz Upper Band A | 2 |
| | 2 GHz Upper Band B | 2 |
| | 500 MHz Lower Band | 26 |
| | 500 MHz Upper Band | 23 |
| | 800 MHz Lower Band | 47 |
| | 800 MHz Upper Band | 48 |

### 7.5.2 Emergency services

A review of the ACMA database was conducted to identify those emergency services with licences for radiocommunications assets operating in the vicinity of the Project. Six groups were identified, being:

- Queensland Police Service
- Department of Community Safety (Queensland Ambulance Service)
- Department of Community Safety (Queensland Fire and Rescue Service)
- St John's Ambulance Australia
- Moore Linville Bush Fire Brigade
- Queensland Fire and Emergency Services.

### 7.5.3 Aircraft navigation systems

The aviation assessment (see Chapter 8 Aviation) concluded that the Project would cause minimal impacts to civil aviation operations. Any impacts to aircraft navigation systems would be determined through discussions with the relevant stakeholders as identified in Chapter 8 Aviation.

### 7.5.4 Radar

**Aviation radar**

The aviation sector uses a combination of Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR).

PSR is used for air traffic control and requires line-of-sight to the target object for successful detection. PSR transmits a pulse of energy that is reflected back to the radar receiver by the target object. In Australia, PSR installations are located at major airports and typically have a range of approximately 50 nautical miles (93 km).

SSR does not rely on reflections from objects for detection, rather aircraft are required to carry a transponder, which replies to radar interrogations. SSR installations are also typically located at major airports, and have a range of approximately 250 nautical miles (463 km) when detecting aircraft at high altitude. However, at or near ground level, the range of SSR is expected to be less.

**Meteorological radar**

The BoM operates a network of weather stations across Australia and uses radar instruments for measuring wind speeds in the upper atmosphere (wind finding radar), and determining rain and storm activity (weather watch radar).

The wind finding radar uses radar echoes from a target to determine the wind speeds and direction. The radar target is attached to a balloon and tracked by the ground radar. Wind profile measurements are used to ensure the safe and economical operation of aircraft and provide an important source of data for the Bureau of Meteorology general weather forecasting system.

The weather watch radar consists of a rotating antenna located on a building, and kept free from any physical obstruction. The antenna is used to direct a thin beam of radio energy upward into the atmosphere which is then reflected back by a cloud mass. Weather watch radars monitor weather situations and are able to indicate the possibility of severe storms out to a distance of 250 km or more.

It has been identified that BoM operates six weather stations within a 250 km range with the closest station being "Gympie (Mt Kanigan)" – approximately 136 km north-east of the Study Area. The details of each station are shown in Table 7.2.

**Table 7.2 BoM radar sites in the vicinity of the Project**

| BoM Radar Site | Location | Distance from the Project (km) |
|---|---|---|
| Brisbane | 27.718°S 153.240°E | 203 |
| Grafton | 29.620°S 152.970°E | 347 |
| Gympie | 25.957°S 152.577°E | 136 |
| Marburg | 27.610°S 152.540°E | 139 |
| Moree | 29.500°S 149.850°E | 341 |
| Warrego | 26.440°S 147.350°E | 397 |

### 7.5.5 Trigonometrical stations

A trigonometrical station, also known as a trig point or trig beacon, is an observation mark used for surveying or distance measuring purposes. Some trig points may host surveying equipment such as GPS antennas and Electronic Distance Measuring (EDM) devices. EDM devices measure the distance from the trig point to the target object by means of a beam of known velocity which is reflected back to the unit from the target object.

Throughout Australia there are a large number of trig points however, there are eight permanent trigonometrical stations equipped with EDM devices and GPS receivers that form the Australian Fiducial Network (AFN) – a crucial component of Australia's spatial data infrastructure – which transmits data to GeoScience Australia via phone lines, internet and/or satellite. The closest AFN station is found near Townsville, approximately 925 km away from the Project.

A review of the Primary Geodetic Network of Australia has also been undertaken and it has been observed that the Project is located outside a region of second-order triangulation, in a region of high-density trilateration. First-order triangulation depends on trigonometrical stations of known positions, baselines and heights, with the highest degree of accuracy. Points determined from first-order triangulation would then be used for second-order triangulation network and so forth, with the degree of accuracy decreasing for subsequent networks.

According to the database from Geoscience Australia, there are 49 trig points within 75 km of the Project. The details of all 49 trig points are contained in Table 8 and Figure 7 of Appendix L, in Volume 3 of this EIS.

### 7.5.6 Radio-Frequency identification

AGL has been previously advised of a company (Aleis International) operating in the vicinity of the Project, who develop and market a product for tagging and tracking of livestock. The product relies on passive radio-frequency identification (RFID) technology, which permits an exchange of information between a reader (which usually consists of a fixed antenna) and a small tag which can be easily embedded in a small card or device, or in this case implanted in an animal. The tag can be used to uniquely identify an animal as it passes a reader.

Aleis' livestock tracking system utilises an inductive loop antenna that transmits a signal at a frequency of 134.2 kHz. The antenna induces a current in the RFID tag that charges a capacitor and enables the tag to transmit a return signal at frequencies of 124 kHz and 134 kHz. This signal is then received by the antenna. Signals between the antenna and tag are filtered by a band-pass filter with a 3dB roll-off at 119 kHz and 140 kHz. The devices typically have a range of approximately 2 m.

Aleis have advised that strong electromagnetic fields can cause problems for their system. Discussions with Aleis have indicated that they have encountered problems when operating in close proximity to large electric motors such as those used in feed lots and abattoirs, or electricity transmission or distribution lines particularly when testing is being conducted.

Most of these interference problems have been encountered either at their factory in Jandowae (which is located approximately 50 m from electricity distribution lines), or at other sites such as abattoirs or feedlots. Problems have been caused by both radiated RF noise, and conducted RF noise interfering with power supplies.

The location at which Aleis conducts development and testing of its systems is understood to be in close proximity to dwelling CG (as shown in Table 11 and Figure 13 contained in GH (2011)) which is approximately 2 km from the nearest turbine. Based on consultation with Aleis, it is not expected that the operation of the Project would adversely affect the development and testing of their systems.

### 7.5.7 Citizen's Band Radio

Citizen's Band Radio, also known as CB radio, is a class-licensed two-way, short distance, communication service that can be used by any person in Australia, for private or work purposes. The class licence implies that all users of the CB radio operate within the same frequency range on a shared basis and no individual licence is required.

CB radio service can be used for voice communications activities, telemetry and telecommand applications. The radio service operates on two frequency bands; High Frequency (HF) – between 26.965 MHz and 27.405 MHz, and Ultra High Frequency – between 476.425 MHz and 477.400 MHz.

The 27 MHz CB radio service was legalised in Australia in the 1970s as a temporary move to switch to UHF CB over the following five years. 27 MHz CB transmit signals in either AM or SSB (Single Side Band) transmission mode. The actual range over which the signal is transmitted depend on the antenna used, the terrain and the interference levels. Over the last decade, the use of 27 MHz CB radio service has declined and has been replaced by UHF CB radio service.

UHF CB radio service is unique in Australia and uses the FM transmission mode. It provides clear communication over five to 20 km and is less susceptible to power line noise. However, UHF CB radio service requires line-of-sight and is easily hindered by hilly terrain and forested areas. If located on a hilltop, CB radio signals can be transmitted over at least 50 km. Repeater stations are set up on hilltops by community groups and commercial organisations to transmit signals from one channel to another.

No individual or organisation owns or has the right to use a channel exclusively. However, out of the 40 channels available, some of them would be allocated to emergency, telemetry or repeater inputs.

### 7.5.8 Mobile phones

Mobile phone network coverage maps have been obtained for Telstra, Optus and Vodafone. The overall site has small areas of 4GX and 3G coverage for Telstra with some locations covered only by 3G with an external antenna. The Optus and Vodafone mobile network coverage in the area is also marginal with some locations requiring an external antenna. In some locations, only mobile satellite coverage is available using any of Telstra, Optus or Vodafone as a carrier.

### 7.5.9 Wireless internet

A high level review of wireless internet service providers operating in the Cooranga region has been undertaken. Wireless internet access in the area surrounding the Project is likely to be provided via the 4G or 3G mobile phone network.

### 7.5.10 Satellite television and internet

In some rural or remote areas, television and internet access can be provided through satellite only. Satellite television is delivered via a communication satellite to a satellite dish connected to a set-top box. As part of the switch to digital television, viewer access satellite television was established to provide satellite-delivered, broadcasting service for people in remote areas who would not have received digital television once analog services were switched off in their licence area.

The satellite transmits television signals to the user's antenna at two frequency bands: the C band at between 4 GHz and 8 GHz, and the $K_u$ band at between 12 GHz and 18 GHz. Signals in the C band are susceptible to interference due to radio relay links, radar systems and other devices operating at a similar frequency while signals in the $K_u$ band are most likely to be affected by rain which acts as an excellent absorber of microwave signals at this frequency.

In case of satellite internet, the user's computer is connected to a satellite modem which is in turn linked to a satellite dish/antenna mounted on the building roof. When the user browses a webpage, a request is sent to the operation centre of the satellite internet provider via the satellite antenna. The webpage information is then sent back to the user's computer via the same path.

According to the Australian ISP directory, there are at least nine satellite internet providers operating in the vicinity of the Project.

A review of the Australian National Broadband Network website indicates that satellite service internet (Sky Muster) is also forecast to be provided to the area surrounding the Project with an anticipated availability date from early 2016. The Sky Muster service would see the launch of two satellites to provide remote and regional Australia with access to broadband speed internet. The first satellite, Sky Muster, launched in October 2015, with the service expected to be available in the first half of 2016. The second satellite is expected to launch in the second half of 2016.

The satellites would be supported by a network of 10 ground stations, each featuring two 13.5 metre satellite dishes. The ground stations have been built in specific locations across Australia to maximise both the availability and capacity of the system. The satellites are designed to enable the national broadband network (nbn) to deliver broadband services to more than 200,000 rural and remote homes and businesses with wholesale download speeds of up to 25 megabits per second.

A number of residents in the vicinity of the Project may have access to satellite television. The main satellite for Pay TV and free-to-air TV in Australia is the Optus C1 satellite. There are a number of other satellites broadcasting TV signals that can be received in eastern Australia, however it is considered unlikely that these satellites would be utilised by residents in the vicinity of the Project.

### 7.5.11 Radio broadcasting

For the purposes of this assessment it has been assumed that broadcast radio includes both Amplitude Modulation (AM) and Frequency Modulation (FM) radio used to broadcast audio signals. In Australia, AM radio operates in the Medium Wave (MW) band at frequencies of between 520 kHz and 1610 kHz, while FM radio operates in the very high frequency band (VHF) at between 87.5 MHz and 108 MHz.

**AM radio**

The distance over which AM radio waves can travel means that the signal may be weak and susceptible to interference by the time it reaches a receiver. Some of the possible sources of interference to AM radio waves include changes in atmospheric conditions, signals from distant AM broadcasters operating on a similar frequency, electrical power lines and electrical equipment including electric motors.

**FM radio**

FM radio signals are susceptible to interference from buildings and other structures, although they are less vulnerable than higher frequency signals. Reflection or scattering of radio waves by physical structures can

reduce signal strength at a receiver, or can cause multi-path errors through reception of a reflected signal in addition to the primary signal from the transmitter. This can cause hissing or distortion to be heard by the listener.

**Digital radio**

Digital radio services have been introduced in metropolitan licence areas from July 2009. The digital radio services offered use an updated version of the digital audio broadcasting (DAB) digital radio standard, DAB+, to broadcast digital radio to Adelaide, Brisbane, Perth, Melbourne and Sydney. According to the digital radio coverage map available on the ABC website, digital radio is not yet available in the Cooranga North region.

### 7.5.12 Terrestrial television broadcasting

Terrestrial television is broadcast in digital format in Australia by a number of networks, both public and commercial. The main transmitter used by residents in the vicinity of the Project is the Darling Downs transmitter, located on Mt Mowbullan approximately 18 km south east of the Project Site. The locations of digital terrestrial television broadcasting towers in proximity of the Project are shown in Figure 7.1, Volume 2.

## 7.6 Potential impacts

Appendix 1 of the Planning Guideline provides an assessment methodology for determining the potential impacts to radio communication services. This assessment methodology has been used in conjunction with the 2011 GH full EMI assessment (which applied the NFWD Guidelines) to determine the potential EMI impacts from the Project. This approach provides an assessment of potential impacts that are consistent with the Wind Farm State Code and Planning Guideline.

### 7.6.1 Fixed and other licences

A consultation process with operators of telecommunication assets located within 75 km of the Project was conducted in 2011, seeking feedback in regards to the potential impact of the Project on their operating services. Responses were obtained from the majority of the license owners, and none indicated that their services were likely to be impacted.

As of March 2016, there were no new telecommunication towers or point-to-point radiocommunication links in locations sufficiently close to the Project to present a new potential EMI risk to the operation of telecommunications equipment. No additional impacts are therefore considered likely.

In general, VHF and UHF band radio signals, and digital voice based technologies such as cellular phones (often called Global System for Mobile Communications, or GSM phones), and third and fourth generation phones (often called 3G and 4G phones) are essentially unaffected by wind farm development. This includes land mobile repeaters, radio and mobile phones.

**Obstruction to radio line-of-sight path**

As no fixed point-to-point links cross the Project Site, partial or full obstruction of radio line-of-sight would not be expected to occur. The closest communication tower is located 1.8 km from the Project Site and is operated by Telstra Corporation.

**Near-field and scatter – point-to-point**

The Planning Guidelines identify the possibility of interference to point-to-point microwave links from two additional mechanisms; near-field effects and reflection/ scattering.

According to the Planning Guideline, near-field effects are usually limited to approximately 720 m from a communication tower and it is recommended that consultation is required if a turbine is within one kilometre of a telecommunication site. The Planning Guideline also state that scattering is best avoided by placing wind turbines more than 2 km from a communication tower.

The near-field zone for the point-to-point link operating from this tower has been calculated in the GH full EMI assessment and it was determined that the nearest turbine is not located within the near-field zone. Additionally, as the link is directed away from the Project, it is unlikely that interference would occur due to scattering.

Telstra was contacted in 2011 to provide feedback on the potential impact of the Project on their services. Telstra indicated that they did not foresee any impact to their services, but noted that they require “protection of their underground telecommunications infrastructure that may be impacted by activities on the site”. This requirement

refers to avoiding physical damage of their underground infrastructure during construction of the Project, rather than the risk of electromagnetic interference.

The search of the ACMA database dated March 2016 has not identified any new point-to-point links in the area which may be impacted by the Project. No additional impacts are therefore considered likely.

AGL will investigate potential improvements to local telecommunications where appropriate.

**Point-to-multipoint**

A consultation process to seek feedback from the operators of point-to-multipoint stations in the vicinity of the Project was carried out in 2011 to determine the potential for interference to their services. This consultation process involved an initial request for feedback, and follow-up correspondence if no response was received. For the majority of the licenses considered, either the operator responded to indicate that they do not foresee any interference to their services from the Project, or GH deemed that the station was sufficiently distant from the Project that interference is unlikely.

The search of the ACMA database dated March 2016 has not identified any new point-to-multipoint links in the area which may be impacted by the Project. No additional impacts are therefore considered likely.

**Other licences**

These licence types are generally not affected by the presence of wind turbines any more than other effects such as terrain, vegetation and other forms of signal obstruction. Should reception difficulty be encountered, the amelioration method consists of the user simply moving to receive a clearer signal.

Some of the licences are of type aeronautical or radio determination, both of which are often used for aircraft navigation. These licences are mainly operated by the Department of Defence and AirServices Australia. As identified in Chapter 8 Aviation, ongoing consultation with these parties is occurring to determine potential impacts of the Project on their operations.

### 7.6.2 Emergency services

Emergency services operating radiocommunications assets in the vicinity of the Project have been identified and contacted to determine if their services are likely to be affected by the Project. To date, none have indicated that their services are likely to be impacted, however the Queensland Police Service raised a question regarding impact to UHF mobile communications. Interference to these services is considered to be unlikely, and is addressed in Sections 7.6.1 and 7.6.6.

### 7.6.3 Radar

**Aviation radar**

Some combinations of turbine orientation and blade angle can cause significant Doppler returns to the illuminating radar, thereby creating false targets on the radar screen. The sporadic nature of these false positives makes them difficult to filter with current radar software. Further, turbines may create a radar obstruction or “shadow” where aircraft are not detected.

Secondary surveillance radar (SSR) is less vulnerable to interference from wind turbines however, SSR may still be affected by a wind farm as an aircraft obstructed by a wind farm similar to PSR.

The Planning Guidelines do not specify a distance from the Project within which consultation with radar operators should be undertaken. However, the Draft NWFD Guidelines recommend that radar operators be notified of the development of wind farms within 250 nautical miles (463 km) of aviation radar operators. Radar installations are typically located at major airports. The Study Area is approximately 176 km from Brisbane International Airport, 800 km from the Sydney International Airport and 970 km from Canberra Airport.

Consultation with the Department of Defence, CASA and AirServices Australia has been carried out by SGS Hart Aviation to determine the likely impact of the Project on radar services. Feedback from this consultation identified that the Project would not impact on radar systems.

**Meteorological radar**

Whilst the uninhibited operation of meteorological radars may not be as critical as aviation radar, there are implications for public safety if severe weather is not predicted or if its approach is masked due to EMI.

Wind farms located at distances greater than 5 km from a BoM field station are unlikely to affect wind finding operations. However, wind farms can impact upon weather watch radar when located within several hundred kilometres of a radar station. Generally, the optimal coverage area for weather watch radar extends approximately 200 km from the radar installation at a height of approximately 3,000 m, and approximately 100 km at a height of 1,000 m. Due to the curvature of the earth, and intervening terrain, the range at or near ground level is generally less.

The Planning Guidelines do not specify a distance from the Project within which consultation with operators of weather stations should be undertaken. However, the Draft NWFD Guidelines specify that consultations with operators of weather stations within 250 nautical miles of the Project should be undertaken.

It is not expected that the Project would cause interference with BoM radar installations, due to the distance between the site and radar installations, and the nature of the intervening terrain, making it likely that radar signals would be intercepted before they are able to be influenced by the Project.

The BoM was contacted to provide feedback on the potential impacts of the Project on their meteorological radar operations. The BoM conducted an analysis to determine interference zones for nearby BoM radars, and concluded that the Project should not cause interference to nearby radars under nominal atmospheric and microwave propagation conditions.

### 7.6.4 Trigonometrical stations

The effective range of EDM devices depends on the wavelength bands used. Light wave and infrared systems have an effective range of 3 km to 5 km while microwave systems can measure distances up to 150 km. However, such systems are not limited by the line of sight or affected by visibility.

A review of the AFN has been undertaken and the closest station is found near Townsville, approximately 925 km away from the Project. Due to the significant distance of the station from the Project, it is unlikely that the station would be impacted.

Although it is unlikely that the trig points in close proximity to the Project host EDM devices or other equipment that is likely to be subject to EMI, Geoscience Australia and DEHP were contacted regarding the potential for interference from the Project. Both these organisations responded indicating that they did not foresee any impacts to trigonometrical stations in the vicinity of the Project.

Renewed consultation with these agencies was not identified as being required given the negligible potential for impacts identified in the GH full EMI assessment and the outcomes of the 2011 consultation.

### 7.6.5 Radio frequency identification

There are two mechanisms by which wind turbines could hypothetically cause interference with an electromagnetic signal. The first is by electromagnetic radiation or electromagnetic conduction from the turbine, and the second is by the physical structure of the turbine itself.

The turbine's physical structure is unlikely to cause interference to RFID signals, as the signal would need to be transmitted through or in close proximity to a wind turbine for it to be influenced. Given that the range of the RFID signals is very short, and the Aleis development and testing location is approximately 2 km from a wind turbine, this is extremely unlikely.

Regarding electromagnetic radiation and conduction, wind turbines operating in Australia are generally designed and certified to International Electrotechnical Commission (IEC) standard 61400-1 (Wind Turbines – Part 1: Design requirements). Assuming the wind turbine type to be installed at the Project site has been designed and certified according to IEC 61400-1, it should have satisfied the same standards to ensure electromagnetic compatibility, as required by ACMA in order for a device to achieve C-Tick compliance or apply a Regulatory Compliance Mark (RCM). This would mean that electromagnetic emissions from the wind turbine should be within allowable levels, and are not expected to cause interference to Aleis' devices.

Testing of electromagnetic radiation and magnetic fields in the vicinity of wind turbines have concluded that the level of electromagnetic radiation emitted from a modern wind turbine is very low, and in most cases is undetectable from background radiation levels beyond approximately 100 m from the base of a wind turbine.

Aleis have also indicated that they have successfully operated the system at a distance of approximately 750 m to one kilometre from the Portland wind farm, which also suggests that interference from wind turbines is unlikely to be a problem for their systems.

### 7.6.6 Citizens Band Radio

Since users of CB radio service do not require a licence, there is no record of users of the service and their locations and the channels are shared among the users and the repeater stations without a right of protection from interference. The impact of the Project on CB radio service is expected to be minimal. In the event of interference from the wind turbines, simple steps such as moving a short distance until the signal strength improves would help to mitigate the impact.

### 7.6.7 Mobile phone and wireless internet

Mobile phone and wireless internet coverage are provided in areas surrounding the Project via the 4G and/ or 3G mobile network. Refer to Sections 7.5.8 and 7.5.9 for further details regarding the mobile phone network.

In cases of marginal network coverage, simple mitigation procedures such as moving a short distance to a new location until the signal strength improves or installing an external antenna may improve the signal quality.

### 7.6.8 Satellite television and internet

The satellite internet providers operating in the vicinity of the Project were contacted to determine if their services were likely to be impacted. All but three of the providers responded, and none indicated that they foresaw an impact to their services. One of the providers (Skymesh) recommended that as a “precautionary measure, remote sites using these services should be located more than one kilometre away from Coopers Gap site”. Garrad Hassan (2011) considers that this recommended buffer is overly conservative.

Associated with the roll-out of the nbn in Australia is the Sky Muster service by nbn co limited (nbn co), involving the launch of two satellites to provide remote and regional Australia with access to broadband speed internet.

Skymesh uses the IPStar service which relies on the Thaicom-4 satellite. From the Project Site this satellite has an elevation of approximately 42.9°. A review of the line-of-sight between the Thaicom-4 satellite and houses identified in the region of the Project has been undertaken. It has been found that no turbines are likely to intercept the line-of-sight between this satellite and the houses considered.

A review of the line-of-sight between the Optus C1 satellite and houses identified in the region of the Project has been undertaken. It has been found that no turbines are likely to intercept the line-of-sight between this satellite and the houses considered. Some houses are located in valleys where the terrain is likely to intercept the line-of-sight to the Optus C1 satellite.

There are a number of other satellites broadcasting TV signals that can be received in eastern Australia. However, the assessment conducted by GH considered it to be unlikely that these satellites would be utilised by residents in the vicinity of the Project.

### 7.6.9 Radio broadcasting

#### AM radio

As AM radio signals are able to propagate around obstructions such as turbines, it is expected that a wind farm would not cause significant interference for a receiver. Additionally, due to the long wavelength of the signal, interference is only likely in the immediate vicinity of a turbine. Any interference problems are likely to be easily resolved through the installation of a high quality antenna and/or amplifier.

#### FM radio

Generally any interference to FM radio signals would only be likely in the immediate vicinity of the wind turbine, and should be easily rectified through the installation of a high quality antenna and/or amplifier.

#### Digital radio

According to the digital radio coverage map available on the ABC website, digital radio is not yet available in the Cooranga region.

### 7.6.10 Terrestrial television broadcasting

**Interference to television signals**

For television broadcast signals, which are omni-directional or point-to-area signals, interference from wind turbines is dependent on many factors including:

- proximity of wind turbines to television broadcast tower
- proximity of wind turbines to receivers (dwellings)
- location of wind turbines in relation to dwellings and television broadcast towers
- the rotor blade material, rotor speed and rotor blade direction (always into the wind)
- type of receiving antenna (e.g. directional and height)
- frequency and power of the television broadcast signal.

For broadcast signals, large scale interference can generally be avoided by placing the wind turbines away from the broadcast tower. Broadcast towers may be either relay or primary transmitters. Relay TV transmitters are more commonly found in rural areas. Primary TV transmitter towers are higher power and are more commonly located near large urban areas. A clearance of at least one kilometre is recommended for relay TV transmitters, while a clearance of at least 6 km is recommended for primary TV transmitters.

Wind turbines cause interference to television signals by introducing reflections that may be received by the antenna at a dwelling, in addition to the signal received directly from the transmitter. This causes multipath errors, and can have different impacts for digital television signals. A wind turbine has the potential to scatter electromagnetic waves carrying television signals both forward and back. The combination of the forward and back scatter regions resembles a keyhole.

Forward scatter would only occur if a wind turbine is located between the dwelling and the broadcast site. The forward scatter region generally does not extend further than 5 km for the worst combination of factors. Interference may extend beyond 5 km if the dwellings are screened from the broadcast tower, but do have line-of-sight to the wind turbines. The shape of this region assumes a relatively high gain, directional antenna that has a beam width (or directional range) of approximately ±15° to ±20°. If a lower gain or omnidirectional antenna is being used, this region is likely to be larger.

Back scattered signals arrive at the dwelling delayed relative to the source signal from the broadcast tower. The back scatter region generally does not extend further than 500 m, assuming a high gain, directional antenna that has a relatively high front-to-back ratio (meaning the signal received by the front of the antenna is much higher than that received from the back). If an antenna with a lower front-to-back ratio, or an omni-directional antenna is used, this region is likely be larger.

Given the complexity and limited accuracy of television interference mechanism calculations, an alternative approach is to identify those dwellings or areas that are most likely to experience potential television interference based on likely forward and back scatter regions. A methodology known as the keyhole approach is to combine multiple keyholes that are placed over each turbine location. The union of each individual keyhole forms a region where there is an increased likelihood of interference to television signals occurring.

**Interference to digital signals**

Digital television signals are typically more robust in the presence of interference than the phased out analogue television signals were, and are generally unaffected by interference from wind turbines. GH have experience in situations where dwellings were able to receive adequate digital television reception in an area of adequate signal strength where the digital television signal is passing through a wind farm (GH, 2011).

Review of a document published by the UK telecommunications regulator Ofcom has also led to the following conclusions with regard to interference to digital television reception.

- Firstly that digital television is very robust and does not suffer from ghosting or brightness variation. In most cases it should be possible to receive a digital television signal in the vicinity of wind farm developments
- Secondly, that areas of weak signal can experience interruptions to their reception should new reflections appear, such as those from nearby wind turbines.

According to the ABC Reception Coverage Estimator website, the area around the Project is likely to be able to receive a digital television signal from the Darling Downs Mt Mowbullan transmitter. However, there are some areas around the Project where there is variable or no coverage from the Mt Mowbullan transmitter.

The Project is located in an area where television coverage appears to be adversely affected by the Bunya Mountains to the south east of the Project Site. As such, there is a risk that some dwellings in the vicinity of the Project may be screened from the transmitter, and may receive a reflected signal from the wind turbines that is stronger than the signal from the transmitter, potentially causing problems for digital television reception.

Therefore, although digital television signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate signal strength, interference could be encountered in areas where reception is marginal. If reception difficulties are encountered, there are a number of mitigation options available as described below. Additionally, there would be some dwellings in the vicinity of the Project that are unable to receive a digital television signal of acceptable quality prior to the installation of the Project.

**Potentially affected dwellings**

Interference is possible in areas where the television signal is marginal and antennas at dwellings may receive a reflected signal from a turbine that is stronger than the signal received directly from the transmitter.

Therefore, an analysis has been carried out to determine:

- dwellings that do not have a direct line-sight to the transmitters on Mt Mowbullan, and are therefore likely to have marginal or inadequate television reception
- turbines that have a direct line-of-sight to transmitters on Mt Mowbullan, and may therefore reflect a strong signal
- dwellings that have a direct line-of-sight to turbines, and are therefore likely to be capable of receiving a strong reflected signal from turbines.

Dwellings that have the potential to receive back-scattered or forward-scattered signals from a turbine, (assuming an antenna with a sufficiently narrow beam width and sufficiently high front-to-back ratio) is being used, have also been highlighted using the keyhole approach.

This assessment indicates that conditions exist at the site for interference to be caused to digital television signals by the Project. The majority of dwellings in the vicinity of the Project are expected to have marginal or no digital television reception, and the situation exists where dwellings are sheltered from the transmitter, but have a direct line-of-sight to turbines which have a direct line-of-sight to the transmitter.

Figure 13 and Table 11 of GH (2011) contained in Appendix K, Volume 3 of this EIS show the dwellings that are most likely to be susceptible to interference include those within the possible interference zone. However, if the signal received at a dwelling from the transmitter is sufficiently weak, or an antenna with insufficient directional discrimination is installed (i.e., a low gain or omni-directional antenna) then interference may also be expected in any areas where dwellings have a direct line-of-sight to turbines, but not to the transmitter.

Most of the areas identified as being susceptible to interference are likely to have marginal coverage, or in some cases no coverage prior to the construction of the Project. In this case, any additional interference caused by the Project may not be relevant.

In addition, most areas around the Project that have variable or no coverage, should be able to access the Viewer Access Satellite Television (VAST) service, which is a government funded digital TV service delivered via satellite.

The method used here to assess the potential interference to television signals from the Project represents a simplified approach which is expected to capture locations where interference is most likely to occur.

**Mitigation**

As television interference from wind turbines is readily identifiable, appropriate mitigation measures can be taken if required.

In the event that TV interference is an issue during wind farm construction or after wind farm commissioning, there are several amelioration options available, in approximate order of increasing cost:

1. Realigning the householder’s TV antenna more directly towards their existing transmitter
2. Tuning the householder’s antenna into alternative sources of the same or suitable TV signal

3. The installation of more directional and/or higher gain antenna at the affected dwelling
4. Relocating the antenna to a less affected position
5. The installation of satellite TV at the affected dwelling
6. Installation of a TV relay station.

In the event that digital television reception is not acceptable, satellite television represents a potential amelioration option. Satellite based television comprises of both free to air and subscription based broadcasts, although free to air satellite services are generally only available in remote coverage areas that are unable to receive terrestrial broadcasts. The majority of areas around the Project that are expected to have variable or no coverage should be able to access the VAST service.

**Television reception survey**

To assist with identifying dwellings where reception difficulties have occurred following construction of the Project, it can be useful to conduct pre- and post-construction surveys of television reception at potentially affected dwellings. The dwellings that are recommended for post-construction surveys are those located within the keyhole regions. It should also be considered that dwellings that have a direct line-of-sight to turbines, but not to the transmitter may also be susceptible to interference.

The main purpose of conducting a reception survey is to assess signal strength and reception quality prior to construction and operation of the Project to serve as a baseline for identifying reception issues after construction. However, the survey can also potentially serve as a useful test of whether there are any problems with the equipment used for receiving a television signal (i.e., antenna, cabling, etc.) that may result in problems after construction.

## 7.7 Summary and conclusions

Broadcast towers and transmission paths around the Project were investigated to see if EMI would be experienced. This investigation considered fixed point-to-point links, fixed point-to-multipoint links, other license types, emergency services, meteorological radar, trignometrical stations, RFID, Citizens Band radio, mobile phones, wireless internet, satellite television and internet, radio broadcasting and television broadcasting. No impacts on telecommunications systems were identified through consultation with relevant stakeholders. The closest telecommunications link to the Project has been identified as the Telstra Exchange Terminal at Cooranga North, which is approximately 1.8 km from the nearest proposed turbine. No impacts on this receptor are expected.

AGL has also been made aware that Telstra have commenced planning to build a repeater tower on the eastern side of Cooranga North-Niagara Road, east – south east of the proposed development. This repeater tower would be around 1.5 km north of the existing Telstra Exchange Terminal at Cooranga North.

Point to multipoint type fixed licences are located near to the Project site. The nearest licence is at Mt Mowbullan near Wengenville, around 17.5 km south east of the Project, and is operated by the BoM. Previous consultation with potentially affected operators of point to multi-point type fixed licences in the vicinity of the Project has been undertaken. For the majority of licences, the operator responded indicating that no impacts were foreseen or the GH full EMI assessment determined that the likely impacts would be negligible.

There are no foreseeable impacts to other licence types, emergency services, meteorological radar, trigonometrical stations or radio-frequency identification systems.

As of March 2016, there were no new telecommunication towers or point-to-point radiocommunication links in locations sufficiently close to the Project to present a new potential EMI risk to the operation of telecommunications equipment. No additional impacts are therefore considered likely.

There is low potential for impacts to occur to CB radio service and mobile telephone reception. However, should impacts arise they could easily be mitigated by moving a short distance in order to improve signal quality. Current mobile telephone reception in the area around the Project is variable and in some instances extremely marginal and the presence of the Project would not be expected to worsen the existing conditions.

FM signals may be susceptible to interference from wind turbines which could result in potential distortion of the FM signal. In the unlikely event that this occurs, this could be offset by the installation of a high-quality antenna.

Digital television signals could experience potential interference, although interference is typically limited to around 5 km from the broadcast transmitter and is a function of the visibility of the wind turbines and that transmitted from the receptor.

The Project is located in an area where television coverage appears to be adversely affected by the Bunya Mountains to the south east of the Project Site. As such, there is a risk that some dwellings in the vicinity of the Project may be screened from the transmitter and may receive a reflected signal from the wind turbines that is stronger than the signal from the transmitter, potentially causing problems for digital television reception. Therefore, although digital television signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate signal strength, interference could be encountered in areas where reception is marginal. If reception difficulties are encountered, there are a number of mitigation options available.

## 7.8 References

Garrad Hassan. 2011. *Assessment of electromagnetic interference issues for the Coopers Gap wind farm.* Dated 24 November 2011.

DILGP, 2016. Queensland Wind Farm State Code and Planning Guideline. Dated July 2016.