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# Theodore Wind Farm

## Electromagnetic Interference Assessment

**Client:** **ERM Australia Pty Ltd**
**Revision:** Final
**Project:** Theodore Wind Farm EMI Assessment
**Doc no:** 23015-E-RPT-0001

**FINAL**

# Revision control

| Revision | Date | Description | Prepared by | Reviewed by | Approved by |
|---|---|---|---|---|---|
| A | 24.07.23 | Initial Draft for Client Review | Gayantha Paranawithana | Eric Bendtsen<br>Liam Jordan | Timothy Cervenjak |
| B | 29.01.24 | Final Draft for Client Review | Linh Vi | Eric Bendtsen | Timothy Cervenjak |
| C | 27.02.24 | Project Layout Update | Linh Vi | Eric Bendtsen | Timothy Cervenjak |
| 0 | 14.08.24 | Final Report | Heshna Uppadoo | Eric Bendtsen | Daniel Burn |

### Disclaimer

# Executive Summary

Middleton Group (MG) has been engaged by Environmental Resources Management Australia Pty Ltd (ERM) to undertake an Electro-Magnetic Interference (EMI) by desktop study methodology for the Theodore Wind Farm (the Project), situated in the Shire of Banana, Queensland (QLD).

This study assesses the impact of Theodore Wind Farm on the following telecommunication services:

- Point-to-point microwave links;
- Meteorological radar;
- Mobile voice-based communications;
- Wireless and satellite internet services;
- Broadcast and digital radio;
- Broadcast, digital and satellite television;
- Trigonometry stations; and
- GPS.

The ACMA database for point-to-point links within a 150 km radius of the site has been surveyed. One (1) active site was identified within the Project boundaries.

Based on our assessment, the Project area is unlikely to have a material impact on existing telecommunication services. As such, we expect that the Project area has been designed, located and sited to avoid, or minimise electromagnetic interference to pre-existing television, radar and radio transmission. Stakeholders have been contacted regarding impact on their services, and correspondence are collated in Section 6. The Bureau of Meteorology has expressed a high-risk on multiple scans of their Taroom radar based on their high-level technical assessment. They will be conducting a risk assessment and discuss with the Proponent on potential mitigation options.

# Contents

## Tables



## Figures

# 1 Abbreviations / Definitions

**Table 1 Abbreviations**

| Abbreviation | Explanation |
|---|---|
| **ACMA** | Australian Communications and Media Authority |
| **AM** | Amplitude Modulation |
| **BSL** | Broadband Service Locator |
| **BoM** | Bureau of Meteorology |
| **C/I** | Carrier-to-interference ratio |
| **$D_a$** | Diameter of antenna physical aperture (m) |
| **$D_{nf}$** | Near-field clearance distance |
| **DTV** | Digital Television |
| **EDM** | Electronic Distance Measurement |
| **EMI** | Electromagnetic Interference |
| **ERM** | Environmental Resources Management Australia Pty Ltd |
| **f** | Frequency (GHz) |
| **FM** | Frequency Modulated |
| **$F_n$** | *n*th Fresnel Zone; also, $F_1$, $F_2$, etc. |
| **G** | Maximum (boresight) antenna gain (dBi) |
| **GHz** | Giga-Hertz – 1 billion Hertz |
| **GIS** | Geographic Information System |
| **GNSS** | Global Navigation Satellite System Networks |
| **ICNIRP** | International Commission on Non-Ionizing Radiation Protection |
| **LoS** | Line of Sight |
| **MGE** | Middleton Group Engineering |
| **MHz** | Mega-Hertz – 1 million Hertz |
| **PO3** | Performance Outcome 3 |
| **QLD** | Queensland |
| **RPM** | Revolutions per minute |
| **the Project** | Theodore Wind Farm |
| **UHF** | Ultra-High Frequency |
| **WMO** | World Meteorological Organization |
| **$\eta$** | Antenna efficiency |

# 2 Background

The proposed Theodore Wind Farm (the Project) is planned to be constructed within the Shire of Banana and sits across 47,048 hectares of land. The Project area will be located 22 km east of Theodore, in the Shire of Banana, Queensland (QLD).

The Project area will consist of approximately 170 Wind Turbine Generators (WTGs), with a maximum height of 270 metres (to the top of the vertical blade).

Middleton Group (MG) has been engaged by ERM to undertake an Electromagnetic Interference (EMI) desktop study.

# 3 Scope

This EMI Study is a desktop study mapping the WTG locations along with telecommunication services and evaluating the impact of the WTGs on these services.

The study is confined to the analysis of publicly available information and consultation with key stakeholders.

The impact of the Theodore Wind Farm has been assessed with respect to the following services:

- Point-to-point microwave links;
- Meteorological radar;
- Mobile voice-based communications;
- Wireless and satellite internet services;
- Broadcast and digital radio;
- Broadcast, digital and satellite television;
- Trigonometry stations; and
- GPS.

# 4 Inputs

This assessment is based on ERM's provided information and key stakeholders' publicly available data, specified in Table 2 and Table 3, respectively.

**Table 2: Study Inputs – Project Infrastructure**

| Project Detail | Value |
|---|---|
| **WTG coordinates** | Final WTG layout received from ERM (Received 17.11.2023)<br>Final Project boundary from ERM<br>(Received 16.02.2024) |
| **WTG dimensions** | Tip Height: 272.5 m<br>Hub Height: 185 m<br>WTG Blade Diameter: 175 m |

**Table 3: Study Inputs – Stakeholder Infrastructure**

| Input | Source | Date Provided/Accessed |
|---|---|---|
| **Dwellings coordinates** | ERM | 10.07.24 |
| **Point-to -point microwave links, mobile voice-based communication, and internet services** | ACMA Site Location Map<br>RFNSA Website | 16.01.24 |
| **AM, FM, Digital Radio, Digital TV broadcasters** | List of transmitters with a licence to broadcast | 04.12.23 |
| **Meteorological Radar (Bureau of Meteorology)** | Queensland Radar Information | 04.12.23 |
| **Survey Marks** | Queensland Spatial Catalogue - QSpatial | 04.12.23 |
| **Trigonometrical Station and GPS** | GNSS Network Map | 04.12.23 |

# 5 Analysis

## 5.1 Assumptions

This study has been developed on the following basis:

- The study is desktop only. No site visit or on-site ground-truthing has been conducted.
- Information, including the spatial location of items, antenna heights, emission frequencies and the like, as sourced from ACMA are correct. While MG checked information against satellite imagery, MG has developed the report on the basis that information supplied by/through ACMA is correct, except where a stakeholder provides updated specifications.

## 5.2 Site Overview

An overview location of the Project area and relevant telecommunication services is shown in Figure 1. The meteorological radars, however, are not shown in this figure due to their large buffer requirement (up to 250 km buffer). Please refer to Section 5.4 for the Meteorological Radars Map.

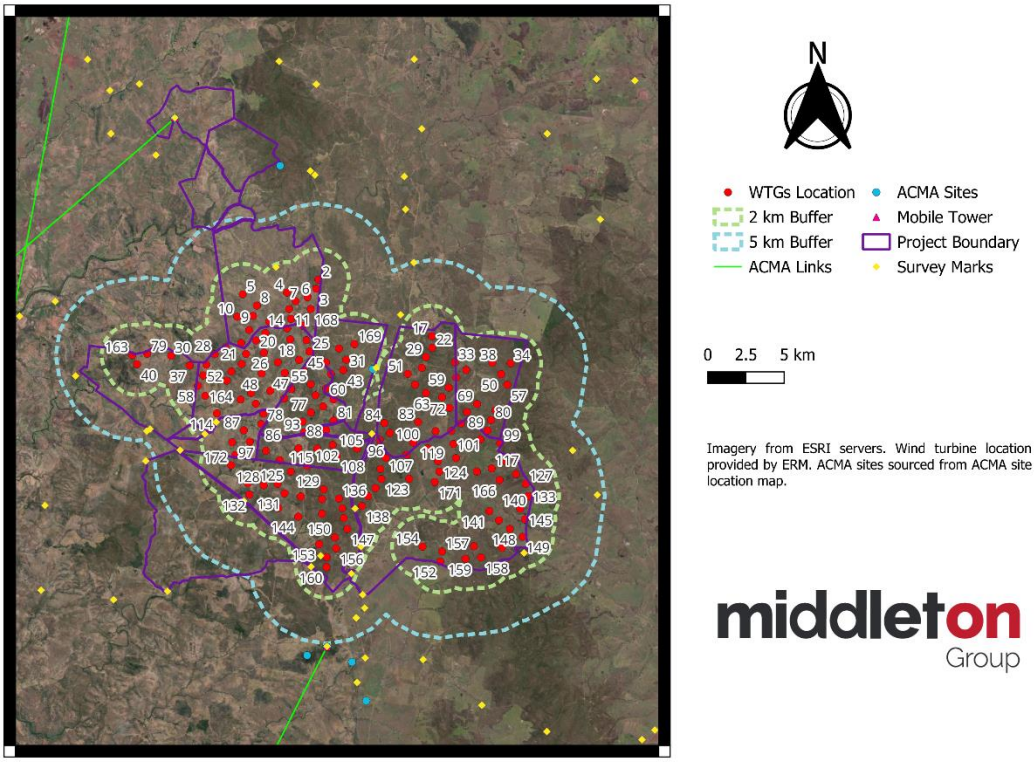


**Figure 1: Site Overview and Relevant Telecommunications Services**

## 5.3 Point-to-point Links

WTGs have the potential to impact on point-to-point ACMA communication links through three mechanisms [1].

1. Near field effects (Section 5.3.1).
2. Diffraction (Section 5.3.2); and
3. Reflection or scattering effects (Section 5.3.3).

As seen in Figure 2, there are two (2) active communication sites found within the Project boundary, and one (1) communication link registered with ACMA is detected.

It is not expected that the Project area will have significant impact on the services of Link 1 and Site 2 as no WTGs have been identified nearby. Future site works will need to be designed to avoid impacting services of Link 1 and Site 2. In-depth analysis for Site 1 will be presented in the following subsections.


**Figure 2: ACMA Point-to-point Links within Project Boundary**

### 5.3.1 Near-field effects

Near-field effects occur in the vicinity of the transmitter and receiver, typically being impacted by objects with inductive fields up to several hundred metres from the transmitter/receiver – though the precise impact is difficult to calculate.

Bacon [1] said that the near-field clearance distance, $D_{nf}$ (m) can be calculated as follows:

For a dish or horn type of antenna:

$$D_{nf} = 10 \times \eta \times D_a^2 \times f$$

For any other type of antenna:

$$D_{nf} = 0.1 \times 10^{0.1G} / f$$

Where:

$\eta$ = antenna efficiency

$D_a$ = diameter of antenna physical aperture (m)

$f$ = frequency (GHz)

$G$ = maximum (boresight) antenna gain (dBi)

There is currently one (1) transmitter/receiver within two (2) kilometres of the Project boundary, with all proposed WTGs are beyond a distance that could result in near-field effects. The in-depth analysis is as below.

**Site 1**

One (1) active ACMA site was found within the indicative Project boundary. This site can be identified in Figure 2. A buffer around the site is required to mitigate against near-field effects. The buffer size varies as a function of antenna radiation pattern and frequency.

The site details are:

- ID: 10002982
- Name: APLNG MLSS Crowsdale Camboon Rd
- Location: Camboon QLD
- Assignments: 2

The near-field effects of the site are summarised in Table 4 below:

**Table 4: Near Field Effects Calculation**

| Licence | Antenna Type | Frequency (MHz) | Gain (dB) | Near-field Clearance (m) |
|---|---|---|---|---|
| **10192520/1** | Horizontal | 463.02 | 5.2 | 0.72 |
| **10192520/1** | Horizontal | 453.02 | 5.2 | 0.73 |

It is advised to place WTGs beyond the near-field clearance distance of a point-to-point transmitter/receiver. The maximum near-field clearance for this ACMA site is 0.73 meters. As shown in Table 5, the nearest WTGs are well clear considerably distant of from this boundary, with the nearest WTG, 31, being 1.8 km from the ACMA site. As such, no near-field effects are expected.

Australia Pacific LNG Pty Limited have been contacted with respect to the impact on their services and have advised that there will be no impact on their services.

**Table 5: Proximity of Site 1 and WTGs**

| WTG No. | Distance (m) |
|---|---|
| **169** | 2016 |
| **31** | 1842 |
| **43** | 1938 |

### 5.3.2 Reflection/scattering effects

Reflection and scattering relate to the interference by an object that reflects the signal from the transmitter to the receiver. This process creates a longer path between the transmitter and receiver, which can cause undesirable temporal modulation. However, where the carrier to interference ratio, that is the ratio of the strength of the intended signal to the interference signal is sufficiently high, the performance will be unaffected. This threshold varies from site to site. Generally, impacts on signal will be negligible beyond two (2) kilometres from a transmitter/receiver.

There is currently one (1) transmitter/receiver within two (2) kilometres of the Project boundary.

### 5.3.3 Diffraction effects

Diffraction is where an object modifies a wave, by obstructing its path of travel. Fresnel zones define an envelope of influence along the length of the ray line, whereby a rotating WTG could adversely impact the signal.

The radius of the n-th Fresnel Zone, Fn, of a point-to-point link of length D, at a distance d1 from the transmitter (or receiver) is given by the following equation:

$$\mathrm{F}_n = \sqrt{\frac{n\lambda d_1(D - d_1)}{D}}$$

The wavelength of the transmittal signal, λ, is calculated as c/f, where c is the speed of light in air and f is the frequency of the transmittal signal.

Obstacles within the 1st Fresnel Zone will adversely impact the signal, whereas, beyond the 1st Fresnel Zone the impact is reduced. More specifically, for odd values of n the Fresnel Zone is a region of constructive interference, whereas for even values of n the Fresnel Zone is a region of destructive interference [2].

In calculating the paths of the links and the relative impact of obstacles, it is important to account for the curvature of the earth and the height of any antennae, as available.

Australian Broadcasting Authority [3] recommends that a clearance threshold of 60% of the 1st Fresnel Zone Radius should be provided; this advice typically relates to 400 MHz links. However, a more conservative approach for WTGs is often preferred – that is, maintaining a clearance of the full 1st Fresnel Zone, or, as recommended by Bacon [1], clearance of the full 2nd Fresnel Zone. The latter is typically required for GHz (higher frequency) links. In particular, for sub-GHz links, the impact of a WTG on the link will be a function of the carrier to interference ratio, C/I. In some instances, the presence of a WTG penetrating the 1st Fresnel Zone will have no material impact on the link; in other instances, the presence of the WTG may have an impact, and mitigation strategies may be required.

There are currently no registered ACMA links transversing the Project area. Therefore, the proposed site is unlikely to have any impact on point-to-point links.

## 5.4 Meteorological Radar

Meteorological radars detect rain and thunderstorm events, as well as other phenomena such as flocks of birds, smoke, or ash, which cause echoes to be visible. The Bureau of Meteorology's (BoM's) radars typically detect rain between 2.5 km to 3.5 km above the ground within a radius of 250 km, and in some instances, beyond. Some wind farms are visible to meteorological radars, registering as static echoes.

Details of specific radars and corresponding coverage maps are available online from http://www.bom.gov.au/australia/radar/index.shtml.

The World Meteorological Organisation (WMO) recommends that WTGs are sited, at a minimum, beyond five (5) kilometres from meteorological radars, and preferably beyond twenty (20) kilometres [4]. Furthermore, the Operational Programme for the Exchange of Weather Radar Information (OPERA), and the radar programme of European Meteorological Services Network (EUMETNET), state that no WTG should be deployed within five-kilometre radius of C-band radars and ten- kilometre radius of S-band radars. An impact study should be submitted if the WTGs are sited within twenty-kilometre radius of C-band radars and thirty- kilometre radius of S-band radars [5].

Figure 3 demonstrates the location of the meteorological radars in relation to the Project area. The details of the closest three (3) weather radars (within 250 km of the Project buffer) are also outlined in Table 6.

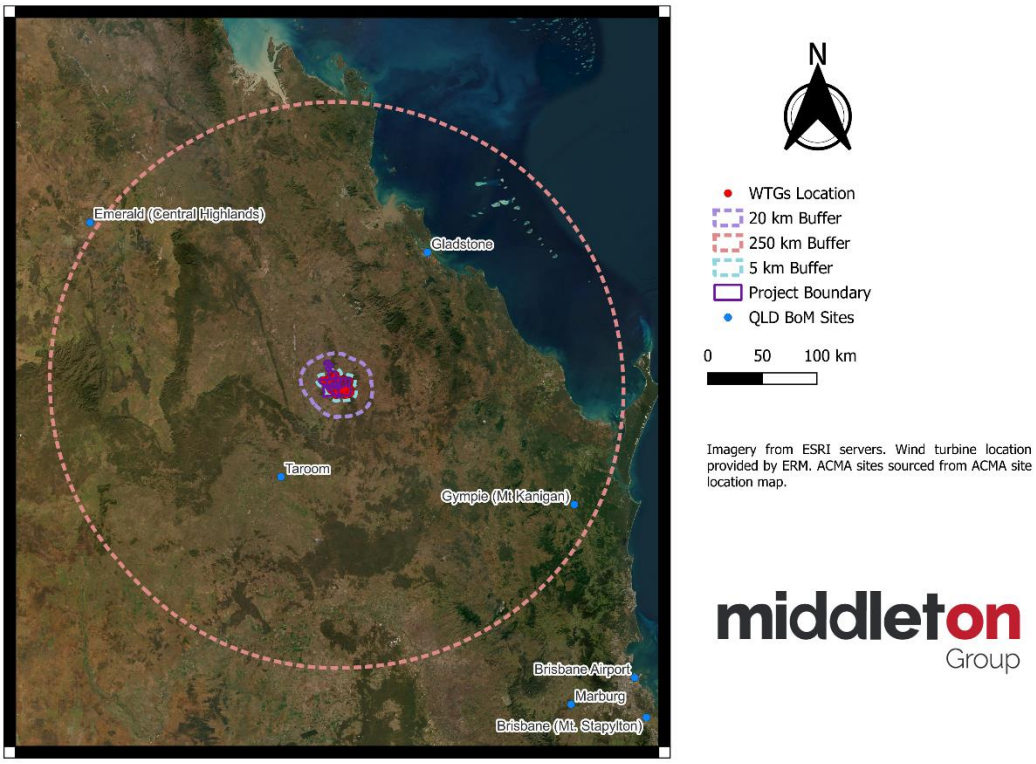


**Figure 3: Meteorological Radars Map**

**Table 6: Meteorological Radar Information**

| Weather Radar Name | Coordinate | Radar type | Distance to the Project Area |
|---|---|---|---|
| **Taroom** | -25.70° N, 149.90° E | Meteor 1700 S-band, Doppler | 90.17 km |
| **Gladstone** | -23.86° N, 151.26° E | WSR74 S-Band | 138.04 km |
| **Gympie (Mt Kanigan)** | -25.96° N, 152.58° E | DWSR 8502S 2° S-band | 227.49 km |

The Project area complies with WMO standards based on distance setbacks from the various meteorological radars in the region. Further, there is excellent coverage from the three radars within 250 km of the wind farm, giving good visibility of weather events in that region. As such, the presence of the Project area is unlikely to cause adverse performance of the radars during extreme weather events.

Based on the stakeholder engagement, the proposed Theodore Wind Farm may impact multiple scans of the Taroom radar and is hence categorized as High Risk. The Bureau of Meteorology will need to conduct the risk assessment and will discuss with the Proponent on possible mitigation options.

The correspondence will be found in Appendix B.2.

## 5.5 Mobile Voice-based Communications

### 5.5.1 Mobile Coverage – Nearby Towers

The closest Telstra Mobile Tower (Site ID: 4719004) is 5.2 km away from the nearest WTG. The next closest Telstra Mobile Towers are 12.3 km (Site ID: 4630003) and 12.4 km (Site ID: 4719002) away from the nearest WTGs, respectively, as can be seen in Figure 4. Typically, the signal will not be significantly impacted where the towers are located more than 1 km from WTGs. Therefore, it is unlikely that the Project area will cause any significant impact on the operation of mobile phone base stations. Future site works will need to be designed to avoid impacting services of mobile towers.

Consultation and engagement with Telstra and Optus with respect to the impact on their services has been collated and advised no impact on their services. The correspondences will be found in Appendix B.4 and B.5, respectively.

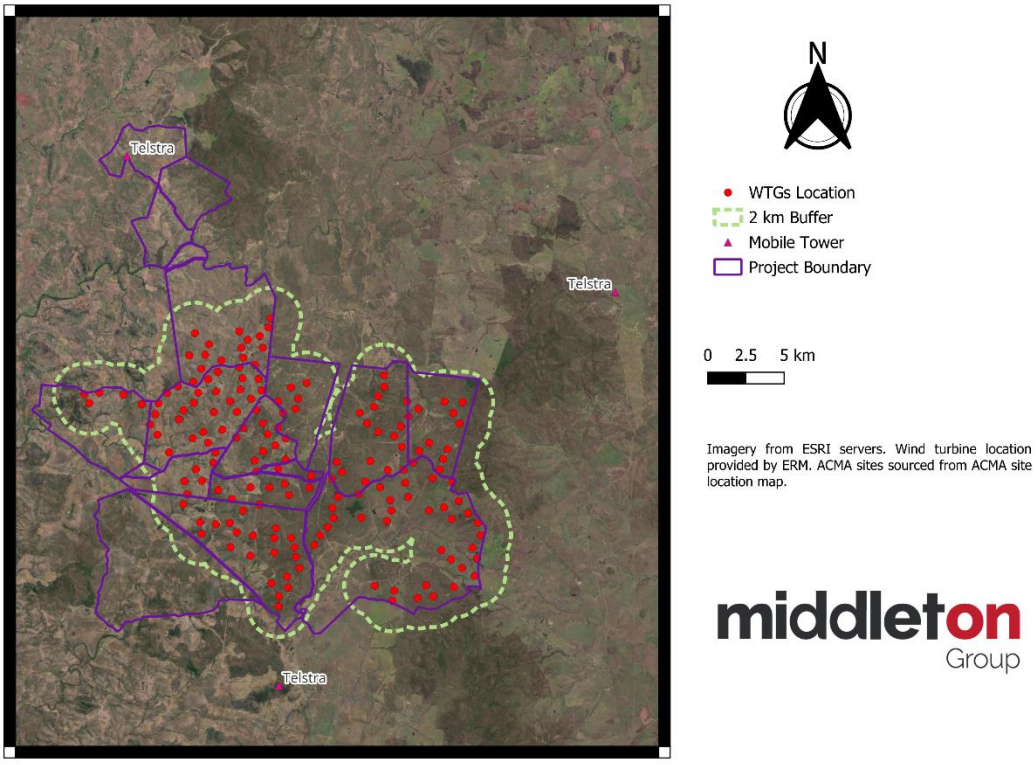


**Figure 4: Proximity of the Project Area to Mobile Phone Base Stations**

### 5.5.2 Mobile Coverage – General

The mobile network coverage maps of Telstra and Optus within the region are shown in Figure 5 and Figure 6, respectively.

In the immediate vicinity of the WTGs, the prevalent available networks are 3G and 4G, some reduction in signal may occur. However, this can be mitigated by relocating the mobile phone receiver in the order of tens of metres. Beyond the Project area, there will not be any significant impact on the signal.

Consultation and engagement with Telstra and Optus with respect to the impact on their services has been collated and advised no impact on their services. The correspondences can be found in Appendix B.4 and B.5, respectively.

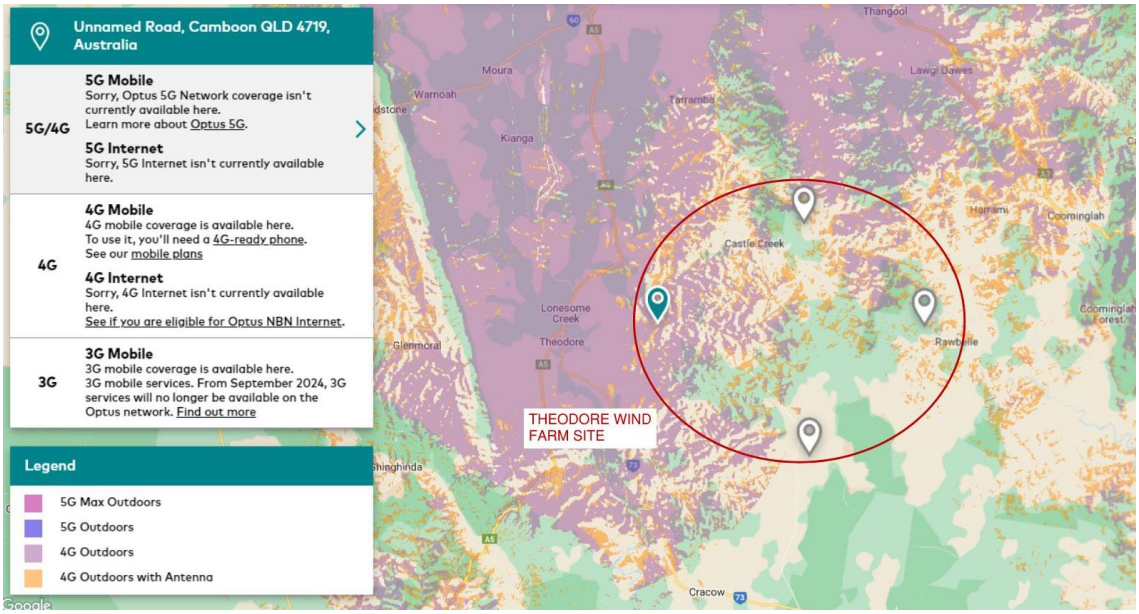


**Figure 5: Optus Network Coverage Map of the Project Area**

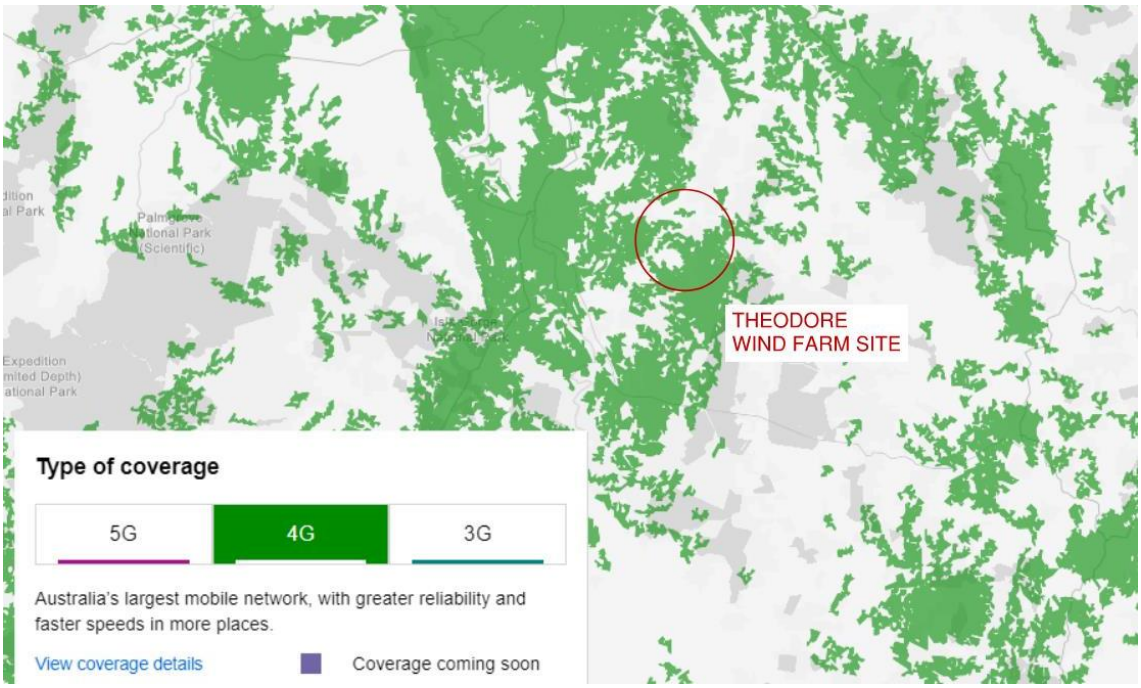


**Figure 6: Telstra Network Coverage Map of the Project Area**

## 5.6 Wireless and Satellite Services

Satellite services will only be impacted where receivers are sited in extremely close proximity to WTGs, impeding their view of the sky. These satellites typically provide pay-tv, wireless internet, and satellite phone coverage, as well as TV coverage where there is no terrestrial service available.

There are 4 dwellings within 2 km of the WTGs as seen in Figure 7. The closest dwelling (H05) is a host dwelling within 1.52 km of the WTG 81. There are no neighbour (non-associated) dwellings within 2 km of the WTG.

The host dwellings may experience some signal degradation. These dwellings have entered a private agreement with the proponent and have accepted this risk. The neighbour (non-associated) dwellings are situated more than 2 kms away from WTGs and are not expected to experience any degraded signal.

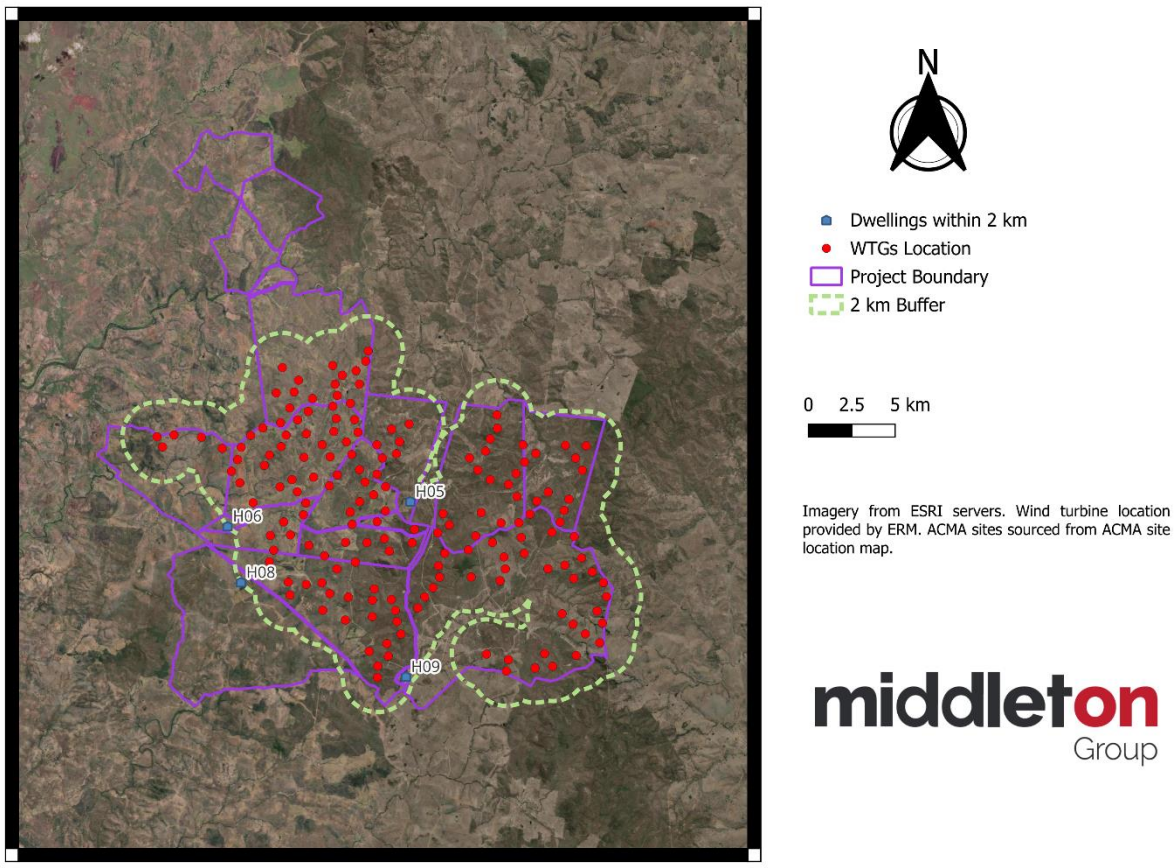


**Figure 7: Dwellings located near the project**

**Table 7: Dwellings summary**

| Dwelling ID | WTG ID | Distance (km) |
|---|---|---|
| **H05** | 81 | 1.52 |
| **H09** | 160 | 1.67 |
| **H08** | 172 | 2.01 |
| **H06** | 114 | 2.09 |

## 5.7 Trigonometrical Stations and GPS

Trigonometrical stations and survey marks are observation marks used for surveying or distance measuring purposes. GPS antennas and Electronic Distance Measuring (EDM) devices may be installed at some trigonometrical stations.

The performance of the EDM devices depends on the type of wavelength bands used. The current EDM devices operate by using three different wavelength bands: microwave systems, infrared systems, and light wave systems. Microwave systems have a measurement range of up to 150 km and are not limited to line of sight or visibility. The infrared systems and light wave systems can measure a range 3 – 5 km, but accuracy may be limited by the line of sight or visibility [6]. If a line-of-sight blockage occurs, moving laterally one (1) to two (2) metres will typically alleviate the line-of-sight blockage. In addition, the presence of WTGs will typically assist with sight navigation, providing fixed reference points.

### 5.7.1 Survey Marks

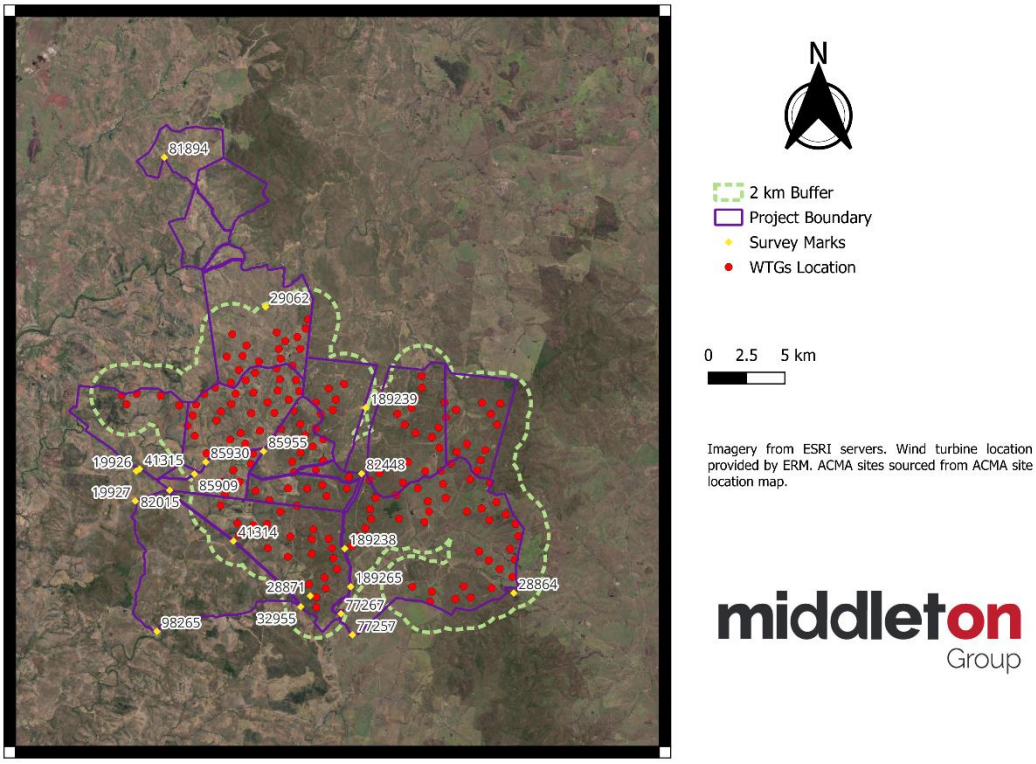


**Figure 8: Survey Marks within the Project Area**

A review on the location of all active survey marks has been completed, and the findings are summarised as the below:

- There is no proposed WTG location that shares the same location as a survey mark.
- There are twelve (12) survey marks within the proposed Project boundary (see Figure 8).
- The closest distance between survey marks to the nearest WTGs is as shown in Table 8. Site works will need to be designed to avoid the survey mark, or, alternatively, seek assistance from a registered surveyor to move or remove the survey marks.

**Table 8: Proximity of Nearby Survey Marks and the Project Area**

| Survey Mark ID | WTG No. | Distance (m) |
|---|---|---|
| **28864** | 149 | 1067 |
| **28871** | 165 | 408 |
| **29062** | 4 | 1818 |
| **32955** | 160 | 1009 |
| **41314** | 132 | 549 |
| **189265** | 147 | 1454 |
| **189238** | 138 | 478 |
| **77267** | 160 | 1681 |
| **82448** | 96 | 656 |
| **85909** | 114 | 1553 |
| **85955** | 78 | 704 |
| **85930** | 114 | 578 |

The wind farm construction may physically impact these survey marks. If this is likely to occur, the Project Proponent should consult with the Queensland Government via the following website: https://www.dnrme.qld.gov.au/?contact=surveying. As stated above, assistance from a registered surveyor may be required.

### 5.7.2 Global Navigation Satellite System (GNSS) Station

Global Navigation Satellite System (GNSS) networks are operated and maintained across the Australian region and the South Pacific. This includes the Australian Regional GNSS Network (ARGN), the South Pacific Regional GNSS Network (SPRGN) and the AuScope Network. GNSS networks provide the geodetic framework for the spatial data infrastructure in Australia and its territories. Data from the GNSS Network also contributes to the International GNSS Service (IGS).

Based on the GNSS network map provided by Geoscience Australia [7], the electromagnetic interference impact of the Project area to the GNSS stations has been analysed. Figure 9 demonstrates that there is no GNSS stations within the Project's two-kilometre boundary. The closest GNSS station, TNGL00AUS0 is 44.02 km away from the nearest WTG. The next closest GNSS stations, MNTO00AUS0 and EDS100AUS0 are 59 km and 70 km away from the nearest WTGs respectively.

Although it is highly unlikely that the Project area will impact the GNSS services, stakeholder engagement has been conducted to understand if any impact is expected on the GNSS infrastructure and confirm that there will be no impact on their services.

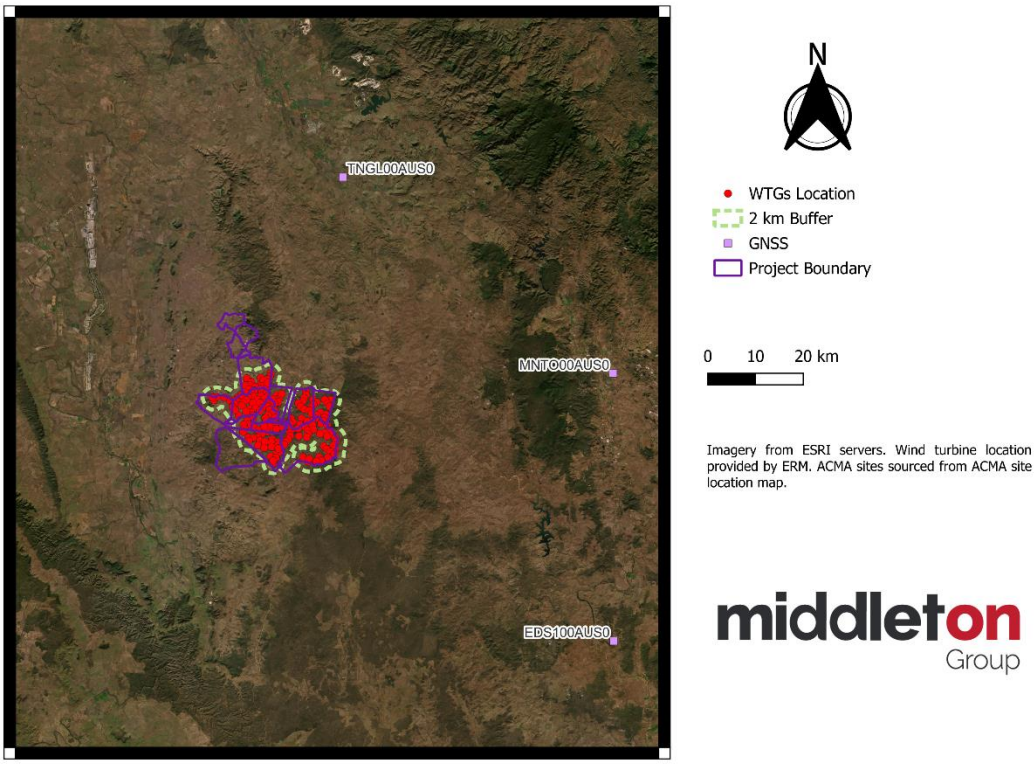


**Figure 9: GNSS Station Locations relative to WTG Layout**

## 5.8 Broadcast, Digital Radio and Television

Amplitude Modulation (AM) signals are long wave signals. Operating WTGs can influence the radiating patterns, with the potential to result in reduced signal quality and strength, as well as causing interference at neighbouring frequencies. A two-kilometre radius consultation zone exists around AM transmitters. The field of influence from the receiver's perspective is in the order of tens of metres.

Frequency modulated (FM) signals tend to be more robust around obstructions such as buildings and wind farms. At the edge of their transmission range, where the signal to noise ratio is already quite low, WTGs can have an adverse influence on the signal. A one-kilometre radius consultation zone exists around FM radio transmitters.

Digital signals tend to be more robust than analogue signals. Therefore, a two-kilometre radius is generally desirable around transmitters – for both digital radio and Digital Television (DTV). Noting that digital signals are more robust against ghosting, though WTG rotor pass can cause signal frequency variation.

As can be seen in Figure 10, no broadcast, radio, and television services transmitters are located within two (2) kilometres of a WTG. The closest FM station, THEODORE is 27 km away from the nearest WTG.

It is highly unlikely that the Project area will impact the any broadcast, radio, and television services transmitters.

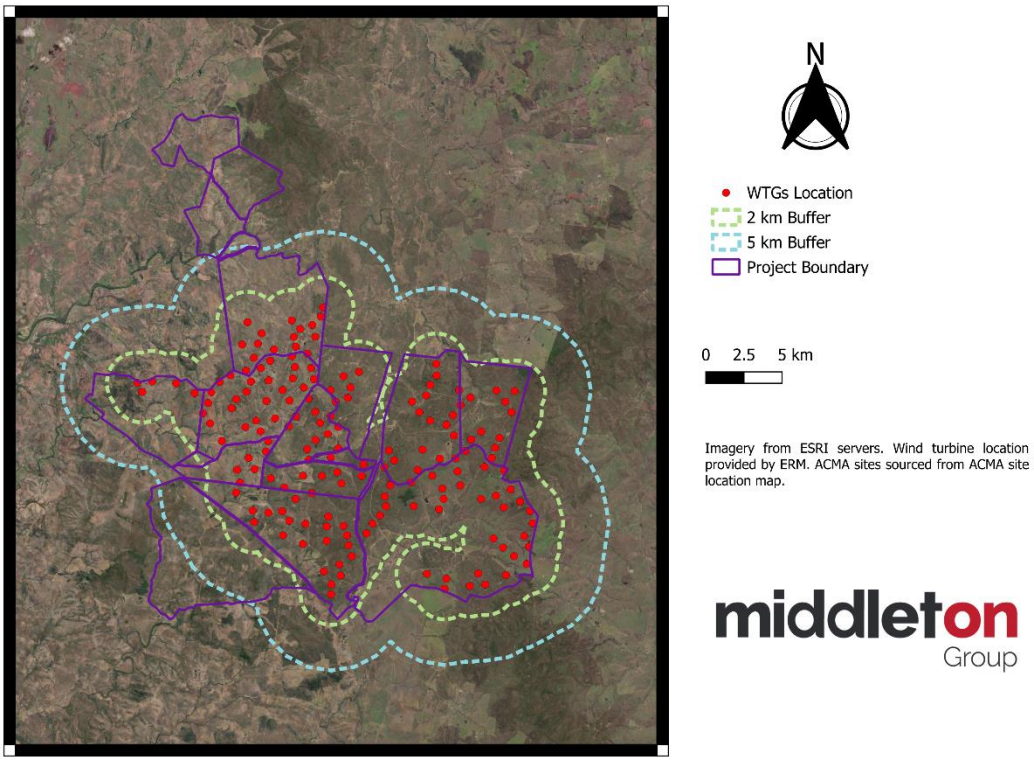


**Figure 10: Location of Broadcast Transmitters Relative to the Project Area**

# 6 Stakeholder Engagement

Consultation and engagement with stakeholders were initiated by MG. A list of key stakeholders is presented in Table 9. Responses from these stakeholders are provided in Appendix B.

A summary of the engagement is listed below:

**Table 9: List of Stakeholder Engagement**

| Stakeholder | Impact | Responses |
|---|---|---|
| **Australia Pacific LNG Pty Limited** | ACMA site | No Impact |
| **Bureau of Meteorology** | Meteorological radar operations | High Risk |
| **Geoscience Australia** | Survey Marks, GNSS Towers and Trigonometrical infrastructure | No Impact |
| **Telstra** | Mobile service operation | No Impact |
| **Optus** | Mobile service operation | No Impact |

# 7 Conclusion

The potential communication impact assessment of the Theodore Wind Farm has been investigated in this report. Based on the analysis, the Project area will have no material impact on:

- Point-to-point microwave links;
- Meteorological radar;
- Mobile voice-based communications;
- Wireless and satellite internet services; Broadcast and digital radio;
- Broadcast, digital and satellite television;
- Trigonometry stations; and
- GPS.

As part of the assessment, MG have worked with the Proponent to engage and consult with key stakeholders to ensure that the Project area has no material impacts on telecommunication services.

Based on MG's assessments, it is expected that Project area has been designed, located and sited to avoid, or minimise and mitigate EMI impact to the pre-existing television, radar and radio transmission. Stakeholder correspondences have been collated regarding impact on their services. The Bureau of Meteorology has expressed a high-risk on multiple scans of their Taroom radar based on a high-level technical assessment. They will be conducting a risk assessment and discuss with the Proponent on potential mitigation options.

# Appendix A References


[1] D. Bacon, "Fixed-link wind-turbine exclusion zone method," Radiocommunications Agency UK, 2002.

[2] G. Durgin, "The Practical Behavior of Various Edge-Diffraction Formulas," *IEEE Antennas and Propagation Magazine,* vol. 51, no. 3, pp. 24-35, 2009.

[3] A. B. Authority, Technical Planning Parameters and Methods for Terrestrial Broadcasting, Canberra: Australian Broadcasting Authority, 2004.

[4] Commission for Instruments and Methods of Observation, "WMO Guidance Paper on Weather Radar/Wind Turbine Siting," World Meteorological Organisation, Helsinki, 2010.

[5] O. Il, "Impact of Wind Turbines on Weather Radars," 2006.

[6] Satheesh Gopi, R. Sathikumar, N. Madhu, "8.3 EDM Instrument Characteristics," in *Advanced Surveying: Total Station, Gis and Remote Sensing*, Pearson, 2006.

[7] G. Australia, "GNSS Network Map," Geoscience Australia, [Online]. Available: https://gnss.ga.gov.au/network. [Accessed 25 05 2021].

# Appendix B Stakeholder Correspondence

## B.1 Australia Pacific LNG Pty Limited - Link Correspondence

# RE: [EXTERNAL]FW: Theodore Wind Farm early-stage consultation

LM

Lyle, Mike <Michael.Lyle@upstream.originenergy.com.au>
To Heshna Uppadoo

OK thanks. They advise me they have looked into it, and have no objections. We don't envisage a negative impact on our communications, which are predominantly via FO buried with the pipe.

This won't be a show-stopper; if anything further arises we will work with RWE on a solution.

Any crossing of our pipeline by HV cables will be included in a crossing deed that is being developed.

Regards,

**Mike Lyle**
Compliance and Interface Coordinator
APLNG Pipeline Operations

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## B.2 Bureau of Meteorology (BoM)

# FW: Theodore Wind Farm – BoM Correspondence [SEC=OFFICIAL]

AJ
Andrew Jones <Andrew.Jones@bom.gov.au>
To Linh Vi
Cc Peter Stone; GM_OSO; windfarmenquiries; Energy; Heshna Uppadoo; sophie.allan@erm.com

Reply | Reply All | Forward

Wed 14/08/2024 1:05 PM

OFFICIAL

Good afternoon Linh

My name is Andrew Jones and I am the acting Group Executive for Business Solutions at the Bureau.

I want to start by first echoing Mohammad's apologies below for the delayed response from the Bureau on this issue which is critical to your business.

Following enquiries this morning, I am able to share with you the high-level result of our Technical Assessment, which shows that the proposed Theodore Wind Farm will impact multiple scans of Taroom radar and as such it is categorized as High Risk. I provide a few lines of additional information below.

Given both the delays and the assessment of the project as High Risk, I would like to propose that we arrange a meeting with you and your clients at our earliest mutual convenience, to give any further details required on the basis for the risk assessment and to discuss potential mitigation options.

I apologise again for the delays and hope that this is an acceptable way forward. Please give me a call on the number below if you would like to discuss further.

Kind regards
AJ

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Beam propagation modelling and power-level simulations indicate that the wind farm will impact lower scans of the Taroom radar (~90 km southwest of the wind farm) under normal propagation conditions. The power-level simulations indicate that majority of the turbines will affect first two scans (0.5 and 0.8 deg) of the radar. Only handful of turbines (12-20) in narrow azimuth angles are expected to affect the third and fourth scans (1.4 and 2.4 deg). The second closest weather radar Gladstone (~138 km Northeast) is not expected to be affected.

Given most turbines in the proposed Theodore wind farm are anticipated to affect the first-two radar scans of Taroom radar under normal propagation conditions, this will have a High impact on the quality of radar services. The wind farm is therefore assessed as a High-risk development due to the impact on the first two radar scans.

***

**Dr Andrew Jones**
General Manager International Development
Business Solutions Group
M: 0467 566 074

## B.3 Geoscience Australia

# RE: Tchelery Wind Farm – GNSS and Survey Marks Correspondence [SEC=OFFICIAL]

GA GNSS Operations <gnss@ga.gov.au>
To Linh Vi
Cc Client Services

Reply | Reply All | Forward | ...

Wed 12/06/2024 3:21 PM

You replied to this message on 12/06/2024 3:23 PM.

Good afternoon,

Geoscience Australia do not foresee any interference to our GNSS infrastructure as a result of the proposed Theodore Wind Farm in QLD.

Kind regards,

**Emma Allen** | Quality and Performance Manager
GNSS Infrastructure and Informatics Section | Positioning Australia Branch
Space Division

**t** +61 2 6249 9750 ga.gov.au



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**From:** Linh Vi <Linh.Vi@middletongroup.com.au>
**Sent:** Thursday, April 4, 2024 4:32 PM
**To:** Client Services <ClientServices@ga.gov.au>
**Subject:** Tchelery Wind Farm – GNSS and Survey Marks Correspondence

To whom it may concern,

We are conducting early-stage consultation for the Theodore Wind Farm in Queensland, focusing on Telecommunications Impact. An environmental impact statement is being prepared by Environmental Resources Management Australia Pty Ltd (ERM) and Middleton Group, and the applicant for the wind farm is Theodore Energy Development Pty LTD (TED) - a wholly owned subsidiary of RWE Renewables Australia Pty Ltd (RWE).

The proposed Theodore Wind Farm (the Project) is planned to be constructed within the Shire of Banana and sits across 47,048 hectares of land. The Project will be located 22 km east of Theodore, in the Shire of Banana, Queensland (QLD). The Project will consist of approximately 170 wind turbines, with a maximum height of 270 metres (to the top of the vertical blade).

We append the wind turbine co-ordinates for turbines in proximity to the link in .csv format and .kml format. Note that the rotor diameter of the turbines will be up to 200 metres, with a tip height of 270 metres.

We note that all installations on the wind farm will comply with the Radiocommunications Act (1992) and associated notices.

If you have any concerns relating to the development and any potential impacts on their communication link or mobile services, please get in contact by return email or by calling us on the phone number listed below prior to **04/05/2024**.

Best regards,

**Linh Vi**
BEng (Elec)(Hons)
**Electrical Engineer**
**M:** +61 431 955 377 | **E:** linh.vi@middletongroup.com.au
Level 4, 59 Goulburn St, Haymarket NSW 2000

## B.4 Telstra Correspondence

6 June 2024

Linh Vi
middleton Group
Sydney NSW 2000

**Re: Proposed Theodore Wind Farm**

Dear Linh,

To provide a better understanding of potential impacts to Telstra infrastructure a desktop assessment was undertaken. Based on this assessment, to minimise potential interference to Telstra's telecommunications network, Telstra requires the developer to confirm its agreement to the conditions and matters set out below:

1) There are no expected impacts to Telstra's Mobile network due to this wind farm based on the turbine locations provided.

2) Based on the turbine locations provided one of our customer radio paths is impacted:

    - Mungungal R/T (-25.0773180 150.4172000) to Mount Kandoonan (-24.9487702 150.3954868), 850 MHz

    Turbine T134 encroaches* on this radio path (please see Figure 1. below). It is requested that this turbine be relocated to at least 150 m from the turbine blade extent to the radio path.

    *The criteria used for encroachment (and therefore clearance): The 1st and 2nd Fresnel zones of the radio path must be free from obstructions.

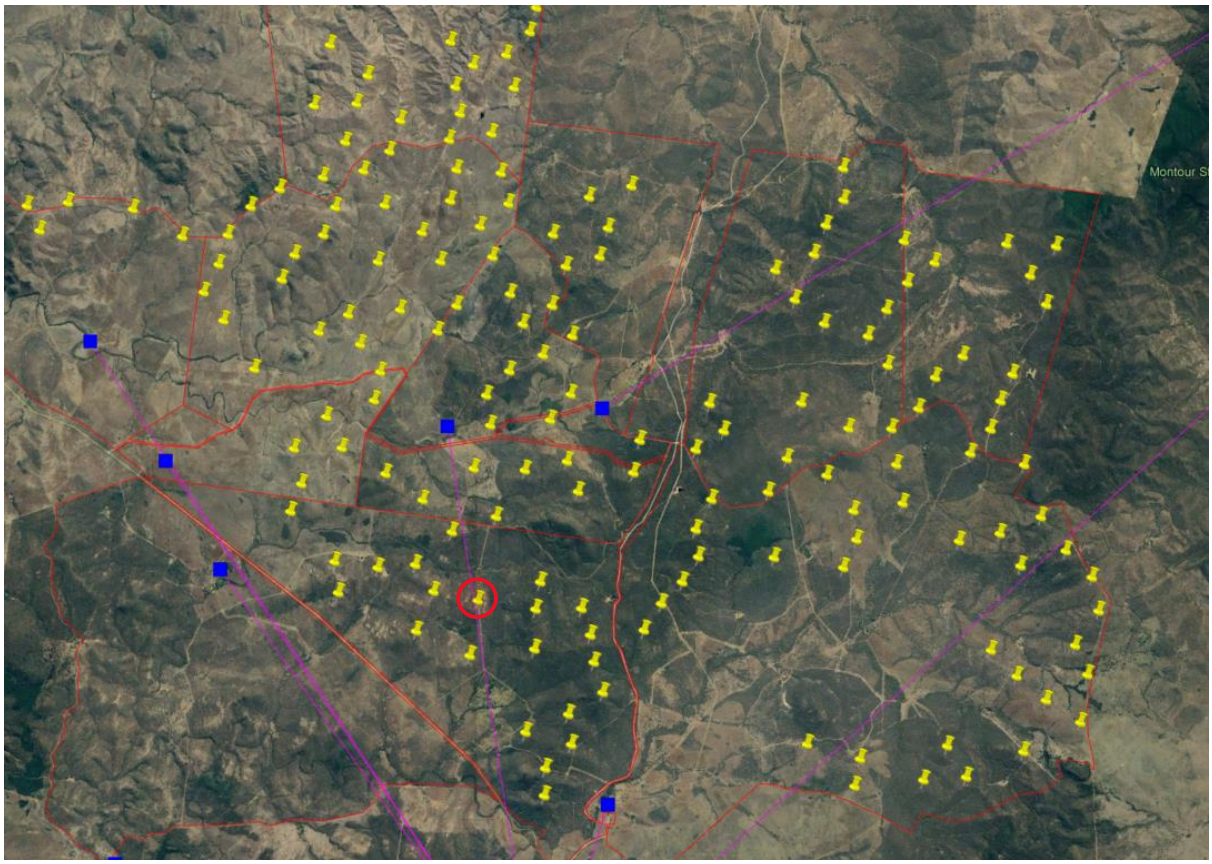


Figure 1. Turbine Impact

3) A detailed analysis of the full power coordination impact (Low Frequency Induction (LFI) and/or Earth Potential Rise (EPR)) of the wind farm development is required. This includes location of the wind farm switch yard, the route and potential of any associated HV transmissions lines and the LFI and EPR impact on any Telstra plant they may affect.

4) It is recommended that you contact Before You Dig Australia, so you are aware of the underground assets in the area. They will provide you with the location of Telstra's as well as any other utilities' underground assets.

The developer also confirms its role as the proponent and ultimate owner of the proposed wind farm and that it has the authority to ensure that the conditions set out above are implemented and complied with. If the agreement of any other person or entity is required to ensure the conditions set out in this letter are complied with, the developer undertakes to obtain that agreement in writing and to provide it to Telstra prior to lodging a development application for the wind farm.

If the proposed plans and specifications of the development are altered or amended, Telstra reserves the right to request further conditions and amendments to the development.

Should you wish to discuss any aspect of this letter please do not hesitate to contact the undersigned. Otherwise, I would appreciate you responding to me confirming the developer's agreement to the conditions and matters set out above.

Yours faithfully,

David Jonas
Senior Access Planner
Fixed Access Planning
david.jonas@team.telstra.com

## B.5 Optus Correspondence

**From:** Yadira Narvaez
**Sent:** Friday, May 31, 2024 1:27 PM
**To:** Linh Vi <Linh.Vi@middletongroup.com.au>
**Subject:** RE: Tchelery Wind Farm – Optus Correspondence

Hi Linh,

Thanks for your email.
Our technical team has reviewed this proposal and advised not interference issues with Optus equipment expected.

Kind regards,

**EME Enquiries | Mobile Deployment | Optus**
emeenquiries@optus.com.au


**OPTUS**

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**From:** Linh Vi <Linh.Vi@middletongroup.com.au>
**Sent:** Thursday, April 4, 2024 4:33 PM
**To:** EME Enquiries <emeenquiries@optus.com.au>
**Subject:** Tchelery Wind Farm – Optus Correspondence

**[External email] Please be cautious when clicking on any links or attachments.**
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To whom it may concern,

We are conducting early-stage consultation for the Theodore Wind Farm in Queensland, focusing on Telecommunications Impact. An environmental impact statement is being prepared by Environmental Resources Management Australia Pty Ltd (ERM) and Middleton Group, and the applicant for the wind farm is Theodore Energy Development Pty LTD (TED) - a wholly owned subsidiary of RWE Renewables Australia Pty Ltd (RWE).

The proposed Theodore Wind Farm (the Project) is planned to be constructed within the Shire of Banana and sits across 47,048 hectares of land. The Project will be located 22 km east of Theodore, in the Shire of Banana, Queensland (QLD). The Project will consist of approximately 170 wind turbines, with a maximum height of 270 metres (to the top of the vertical blade).

We have assessed that there is no Optus mobile phone base station located within the two-kilometre buffer of the Project's wind turbines.

We append the wind turbine co-ordinates for turbines in proximity to the link in .csv format and .kml format. Note that the rotor diameter of the turbines will be up to 200 metres, with a tip height of 270 metres.

We note that all installations on the wind farm will comply with the Radiocommunications Act (1992) and associated notices.

If Optus have any concerns relating to the development and any potential impacts on their communication link or mobile services, please get in contact by return email or by calling us on the phone number listed below prior to **04/05/2024**.

Best regards,
**Linh Vi**