DNV·GL

DELBURN WIND FARM

EMI Assessment

OSMI Australia Pty Ltd

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EXECUTIVE SUMMARY

DNV GL has been commissioned by OSMI Australia Pty Ltd ("OSMI" or "the Customer") to independently assess potential electromagnetic interference (EMI) impacts associated with the development and operation of the proposed Delburn Wind Farm ("the Project") in southeastern Victoria. The results of the EMI assessment are described in this document and summarised in the table on the following page.

Background and methodology

DNV GL has assessed the potential EMI impacts for the Project in accordance with the Victorian Planning Guidelines [1] and Draft National Wind Farm Development Guidelines [2]. The methodology used in this study has been informed by these guidelines and various standard industry practices.

A Project layout consisting of 35 wind turbines with a rotor diameter of 180 m and tip height of 250 m has been considered. These dimensions represent the maximum overall tip height within the maximum rotor and tower hub height dimensions. Approximately 2000 dwellings have been identified within 5 km of the Project.

Outcomes of the assessment

The Project has potential to interfere with several point-to-multipoint links operated by Gippsland Water. However, DNV GL understands that the turbines located within the exclusion zones for these links will be micro-sited to avoid interference in a future revision to the turbine layout.

Interference to other point-to-multipoint links and to point-to-point links crossing the Project site is considered unlikely.

Interference to FM radio signals from the Kids FM broadcast tower to the north of the Project boundaries may be experienced in areas surrounding the Project. DNV GL recommends consulting with the operator of this tower to seek feedback on whether interference to their services is likely.

There is also potential for interference to wireless internet signals received from the Boolarra NBN tower at several dwellings in the vicinity of the Project. If interference to the NBN wireless internet service is experienced, mitigation options could include installing a new NBN tower to service the affected houses or relocating the antennas at those houses to achieve a clearer signal, although NBN Co has not confirmed the viability of these mitigation options.

Turbines at the Project may interfere with digital television broadcast signals received from nearby towers at a number of houses surrounding the Project. Coverage maps suggest that, for most of these towers, many of the potentially-affected houses are located in areas with limited to no signal coverage and therefore may not be receiving signals from that tower. However, interference to the signals from Latrobe Valley tower, which appears to be the primary transmitter for the area, could have a significant impact on local residents. Interference to mobile phone signals is also possible,

particularly in areas that already experience marginal coverage. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference is also possible for satellite television and internet signals, but the signals that are likely to be intercepted by turbines in the Project are from satellites that do not provide services designed for Australian audiences.

Potential EMI impacts on other services considered in this assessment are expected to be minor or can be assessed through consultation with the service operators. DNV GL recommends consulting with all organisations operating services that may be affected by the Project to seek feedback regarding any potential for EMI-related impact.

Summary of EMI assessment results for the proposed Project

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Radiocommunication towers	One tower within 2 km of proposed turbine locations, operated by Southern Cross Austereo Group (Kids FM)	Potential for interference –see findings for FM radio broadcasting	Consultation recommended but not yet undertaken
Fixed point-to-point links	Seven links crossing Project boundary, operated by: AusNet Services (one link) Aussie Broadband (one link) Gippsland Water (one link) Digital Distribution Australia (one link) Optus Mobile (two links) VerTel (one link) Diffraction effects: no turbines in DNV GL exclusion zones, no turbines in requested clearance zones Reflection/scattering and near-field effects: turbines are sufficiently far from towers to avoid impacts	Unlikely to cause interference	No concerns raised by Aussie Broadband and Digital Distribution Australia Potential for interference noted by other operators Clearance zones requested by AusNet Services, Digital Distribution Australia, Optus Mobile, and VerTel
Fixed point-to-multipoint links	23 base stations within 20 km of Project boundary, operated by: AusNet Services (two sites) Aussie Broadband (two sites) Hazelwood Power Station (two sites) Gippsland Water (eight sites) Connectivity I.T. (two sites) Yallourn Power Station (one site) Speedweb Wireless Internet (four sites)	Potential for interference to links operated by Gippsland Water	No concerns raised by AusNet Services, Aussie Broadband, Connectivity I.T., Speedweb Wireless Internet, and Latrobe City Council Potential for interference noted by Gippsland Water, and details of links provided

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
	Latrobe City Council (one site) Loy Yang Power Station (one site) Diffraction effects: turbines in exclusion zones for four Gippsland Water links, information not available for other links Reflection/scattering and near-field effects: turbines are sufficiently far from towers to avoid impacts		Consultation with Hazelwood, Yallourn, and Loy Yang Power Stations unlikely to be necessary Consultation with operators of other base stations up to 60 km from the Project recommended but not yet undertaken
Emergency services	Point-to-point links: no links crossing boundary Mobile telephony systems: unlikely to be affected	Unlikely to cause interference	Consultation recommended but not yet undertaken

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Meteorological radar	Unlikely to be affected	Unlikely to cause interference	Consultation recommended but not yet undertaken
Trigonometrical stations	Unlikely to be affected	Unlikely to cause interference	Consultation recommended but not yet undertaken
Citizen's band radio	Unlikely to be affected	Unlikely to cause interference	-
Mobile phones	Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	Potential for interference	No concerns raised by Optus Mobile Consultation with Telstra and Vodafone recommended but not yet undertaken
Wireless internet	Likely service providers: Aussie Broadband, Connectivity I.T, Speedweb Wireless Internet, mobile phone networks NBN: currently available as a fixed wireless and satellite service, potential for interference to fixed wireless internet signals from the Boolarra NBN tower to several dwellings	Potential for interference to NBN fixed wireless internet signals	No concerns raised by Aussie Broadband, Connectivity I.T., Speedweb Wireless Internet, and Optus Mobile Consultation with Telstra, Vodafone, and NBN Co recommended but not yet undertaken
Satellite television and internet	Services intended for Australia: unlikely to be affected Other services: signals from four satellites intercepted at nearby dwellings	Unlikely to cause interference	-
Radio broadcasting	AM signals: unlikely to be affected FM signals: may experience interference in close proximity to turbines FM signals from nearby Kids FM transmission tower: may experience interference in areas with marginal reception Digital radio signals: not available in vicinity of Project	Potential for interference to Kids FM radio broadcasts through obstruction of signals	Consultation with Southern Cross Austereo Group (operator of Kids FM broadcasting) recommended but not yet undertaken

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Television broadcasting	May experience interference in areas with poor or marginal reception *Boolarra tower: 'good' coverage in southeast, 'variable' to 'poor' coverage elsewhere* 271 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	Consultation with RBA Holdings (operator of Boolarra broadcasting tower) recommended due to proximity but not yet undertaken
	Churchill tower: 'variable' to 'poor' coverage across site 244 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Jeeralang/Yinnar South tower: 'good' coverage in east, 'variable' to 'poor' coverage elsewhere 275 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Latrobe Valley tower: 'variable' to 'good' coverage across the site 200 dwellings in potential interference zone	Potential for interference	-
	Melbourne tower: 'variable' to 'good' coverage in northwest, 'variable' to 'poor' coverage elsewhere 846 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Newborough tower: 'good' coverage in north, 'variable' to 'poor' coverage elsewhere 258 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Trafalgar/Yarragon tower: 'variable' to 'good' coverage in northwest, 'poor' coverage elsewhere 863 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-

1 INTRODUCTION

OSMI Australia Pty Ltd ("OSMI" or "the Customer") has commissioned DNV GL to independently assess the potential electromagnetic interference (EMI) related impacts associated with the proposed Delburn Wind Farm ("the Project") in southeastern Victoria. The results of this work are reported here. This document has been prepared in accordance with DNV GL proposal L2C-178219-AUME-P-01 Issue A, dated 1 February 2019, and is subject to the terms and conditions in that agreement.

In accordance with the Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (Victorian Guidelines) prepared by the Department of Environment, Land, Water and Planning (DELWP) in October 2018 [1] and the National Wind Farm Development Guidelines – Draft (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [2], this assessment investigates the potential EMI impact of the Project on:

- fixed point-to-point links
- fixed point-to-multipoint links
- radiocommunication assets belonging to emergency services
- meteorological radars
- trigonometrical stations
- Citizen's band (CB) radio and mobile phones
- wireless internet
- satellite television and internet
- broadcast radio and television.

"Radiocommunications" is used as a broad term in this report to encompass all services that rely on microwave or radio frequency electromagnetic waves to transfer information, including those listed above.

2 DESCRIPTION OF THE SITE AND PROJECT

2.1 The site

The proposed Project site is located in southeast Victoria, approximately 8 km south of Moe and 125 km southeast of Melbourne. The site is located within a radiata pine plantation situated on rolling hills either side of the Strzelecki Highway.

2.2 The project

2.2.1 Proposed wind farm layout

The Project is proposed to consist of 35 wind turbines [3]. A map of the site with the proposed turbine layout is shown in Figure 1, and the coordinates of the proposed turbine locations are presented in Table 9.

2.2.2 House locations

There are approximately 2000 houses within 5 km of the Project [4]. The dwellings and site boundaries considered in this assessment are shown in Figure 1.

DNV GL has not carried out a detailed and comprehensive survey of building locations in the area and is relying on information provided by the Customer. For the purposes of this assessment, DNV GL has assumed that all identified houses are potential inhabited residential locations.

3 REGULATORY REQUIREMENTS

There are two sets of guidelines that are potentially relevant to the assessment of EMI impacts for wind farms in Victoria.

The Victorian Guidelines [1] state that "*a wind energy facility can affect the amenity of the surrounding area due to … electromagnetic interference*" and that "*[t]he potential for electromagnetic interference from the generation of electricity from a wind energy facility should be minimised, if not eliminated, through appropriate turbine design and siting*".

Although the Victorian Guidelines state that *"potential electromagnetic interference effects can be calculated from information about affected telecommunications transmitting or receiving stations, local conditions, [and] turbine design and location"* they do not provide detailed methodologies for these assessments.

The EPHC, in conjunction with Local Governments and the Planning Ministers' Council released a draft version of the National Wind Farm Development Guidelines in July 2010 (Draft National Guidelines) [2]. The Draft National Guidelines cover a range of issues across the different stages of wind farm development.

In relation to EMI, the Draft National Guidelines provide advice and methodologies to identify likely affected parties, assess EMI impacts, consult with affected parties and develop mitigation steps to address the likely EMI impacts.

DNV GL considers that the recommendations of the Draft National Guidelines meet, if not exceed, the recommendations of the Victorian Guidelines. Therefore the Draft National Guidelines have been used to inform the methodology adopted for this assessment.

4 METHODOLOGY AND RESULTS

If not properly designed, wind farms have the potential to interfere with radiocommunication services. Two services that are most likely to be affected are television broadcast signals and fixed point-to-point signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while point-to-point 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.

The Customer has asked DNV GL to complete this assessment based upon a layout provided for the Project consisting of 35 wind turbines, as outlined in Table 9.

For the purpose of the EMI assessment, a hypothetical turbine with a rotor diameter of 180 m and a tip height of 250 m has been considered. These dimensions represent the maximum tip height and rotor diameter under consideration for the Project. The results generated based on this turbine configuration will be conservative for all turbine configurations with dimensions that remain inside the turbine envelope by satisfying all of the following criteria:

- a rotor diameter of 180 m or less
- an upper tip height of 250 m or less.

The Draft National Guidelines recommend that a radial distance of 50 km to 60 km from the centre of a wind farm would normally capture all of the potentially affected services in the area. However, the methodology for assessing the potential radiocommunications interference used in this assessment is to locate all of the radiocommunication towers within approximately 75 km of the proposed Project site, and then assess the radiocommunication licences attached to these towers. This reduces the likelihood that radiocommunication links crossing the site are inadvertently excluded from the assessment.

To conduct the EMI assessment, information regarding radiocommunications licences in the vicinity of the Project was obtained from an image of the Australian Communication and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database dated 12 February 2019 [5].

Other services with the potential to experience interference from the Project have also been identified, and the potential for interference to those services discussed, including meteorological radars, trigonometrical stations, CB radio and mobile phones, wireless internet, broadcast radio, satellite television and internet, and broadcast television.

The Draft National Guidelines recommend that consultation with the relevant operator be undertaken if a turbine is located within 2 km of a radiocommunication site, within the second Fresnel zone of a point-to-point link, or within 250 nautical miles of an aeronautical or meteorological radar site. DNV GL has consulted with a number of organisations operating services that may be impacted by the development and operation of the Project, to disseminate basic information on the Project and request feedback regarding whether they foresee any potential EMI-related impacts on their operations and services. Consultation with other organisations operating services in the vicinity of the Project is also recommended. The organisations that have been contacted and all responses received to date are summarised in Table 17.

4.1 Radiocommunication towers

From the ACMA RRL database, there are 1025 radiocommunication towers within a nominal 75 km of the Project site boundary. The locations of these radiocommunication towers relative to the Project are shown in Figure 2.

Wind turbines located close to radiocommunication sites have the potential to cause interference through near-field effects or reflection or scattering of the signals. According to the Draft National Guidelines [2], the near-field zone for a transmission tower can vary from several metres to approximately 720 m depending on the service type. The Draft National Guidelines therefore recommend that any radiocommunication site within 1 km of a proposed turbine location be considered as a having the potential to be impacted by near-field effects. The potential for a turbine to cause reflection or scattering of signals also depends on a number of factors, including the service type, the required signal-to-noise ratio for the service, and the distances between the user, transmission tower, and turbine. Since there is no single criterion for potential impact on radiocommunication services due to near-field effects and reflection or scattering, the Draft National Guidelines recommend consulting with the service operator if any turbine is to be located within 2 km of a radiocommunication site.

There is one radiocommunication tower located within 2 km of the proposed turbine locations (site ID 47336). This tower is a commercial FM radio broadcasting tower operated by Southern Cross Austereo Group, as shown in Table 1. The location of the tower and the consultation zones recommended by the Draft National Guidelines [2] are shown in Figure 3. The potential for interference to FM radio broadcasting services is discussed further in Section 4.13.2.

Table 1 Details of radiocommunication towers located within 2 km of turbines at the proposed Project

Site ID	Associated licence types	Operator	Distance to nearest turbine [m]
47336	Broadcasting (narrowcasting)	Town & Coastal Broadcasters Australia Pty Ltd (Kids FM, Latrobe Valley 91.9 HMz, Southern Cross Austereo Group)	1936

There is another radiocommunication tower located 2001 m from the nearest proposed turbine location (site ID 9023463). This tower is an NBN fixed wireless internet tower operated by NBN Co. Although this tower is nominally outside the 2 km consultation zone recommended by the Draft National Guidelines [2], its location and the corresponding consultation zones are also shown in Figure 3. The potential for interference to NBN wireless internet signals is discussed further in Section 4.11.

4.1.1 Stakeholder consultation

DNV GL recommends contacting the operator of the services associated with the tower shown in Table 1, RBA Holdings, to determine the likelihood that the proposed Project will cause interference to their services through near-field effects or reflection or scattering of signals.

4.2 Fixed licences of point-to-point type

Wind turbines can potentially cause interference to point-to-point microwave links and, in some cases, point-to-point ultra high frequency (UHF) links through three mechanisms: diffraction of the signal, reflection or scattering of the signal, and near-field effects. It is generally possible to design around these issues as the link paths and potential interference zones for these signals can be determined.

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 frequency of common microwave signals varies from approximately 1 GHz to 30 GHz. For this analysis, DNV GL has used a wider and more conservative frequency range of 0 GHz to 50 GHz.

The registered radiocommunication licences for each tower according to the ACMA RRL database were analysed to determine the transmission paths of licenced links that may experience interference from wind turbines.

Each individual link was given a unique identifier or "Assignment ID" so that it could be readily distinguished. This Assignment ID was taken as either the Device Registration ID (for spectrum licences associated with the use of certain frequency band within a particular geographic area) or the EFL ID (for apparatus licences associated with the use of a particular device).

The links paths associated with the analysed towers are shown in Figure 4. It can be seen that 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 emergency services towers.

There are seven point-to-point links recorded in the ACMA RRL database that pass over the proposed Project site. The details of the links and operators are provided in Table 10, and the link paths are shown in greater detail in Figure 5 based on information obtained from the ACMA RRL database, provided by the link operators, and extracted from satellite imagery. The potential interference mechanisms and interference zones established by DNV GL for these links are described in Sections 4.2.1, 4.2.2, and 4.2.3, and summarised in Section 4.2.4. Feedback obtained from the operators of the links, including their recommended clearance zones to reduce the risk of interference, is summarised in Section 4.2.5 and Table 17.

4.2.1 Interference caused by diffraction

The potential for interference to a fixed point-to-point link through diffraction or obstruction of the signal can usually avoided by keeping clear of an exclusion zone of circular cross-section around the link path from the transmitter to the receiver [2] [6] [7], typically defined in terms of the Fresnel zones for the link. The *n*th Fresnel zone is comprised of all points for which, if the signal travelled in a straight line from the transmitter to the point and then to the receiver, the additional length compared to the straight transmitter-receiver path equals $\frac{n-\lambda}{2}$, where λ = wavelength.

The radius of the *n*th Fresnel zone varies along the length of the signal, and is given by:

$$R_{Fn} = \sqrt{\frac{n\lambda d_1 d_2}{D}}$$

where d_1 is the distance from the transmitter
d_2 is the distance from the receiver
D is the distance from the transmitter to receiver, such that $d_1+d_2 = D$

To avoid interference to point-to-point links caused by signal diffraction, wind turbines, including the blades, should be kept outside of an exclusion zone based on either the second Fresnel zone as recommended in [6], or potentially 60% of the first Fresnel zone for links below 1,000 MHz with a clear line of sight as suggested in [8] (although DNV GL understands that this zone is under review by the authors of that document). For each of the links crossing the proposed Project site, DNV GL has established a diffraction exclusion zone based on the second Fresnel zone for that link.

It is common practice to have multiple Assignment IDs for the same physical link to cover practicalities such as licensing for sending or receiving signals. Accordingly, the second Fresnel zone for each link has been calculated based on the Assignment ID with the lowest frequency.

The potential diffraction exclusion zones in the horizontal plane are shown in Figure 5. Each exclusion zone includes the rotor radius for turbines with a 180 m rotor diameter, and an additional buffer on either side to account for potential inaccuracies in the tower locations. The size of the uncertainty buffer for each link is based on the deviations between the tower locations provided by the link operators and the apparent locations determined from satellite imagery.

DNV GL has also assessed the potential for the turbine blades to intersect with the diffraction exclusion zone for each point-to-point link in the vertical plane. This was achieved by examining the elevation and antenna heights at the end of each link, as well as the approximate elevation of areas within the Project boundaries over which the link crosses.

The turbines located within the diffraction exclusion zone in the horizontal and vertical plane for each point-to-point link crossing the proposed Project site are summarised in Table 2.

There are two turbines located within the exclusion zone in the horizontal plane for the point-to-point link operated by Digital Distribution Australia. However, this link passes over the Project at a height that is well above the maximum proposed turbine tip height of 250 m. Consequently, the diffraction exclusion zone established by DNV GL for this link is clear of the turbine blades in the vertical plane. As discussed in Section 4.2.5, Digital Distribution Australia have confirmed that the link is clear of the turbines in the vertical plane and that they do not expect the Project to cause any interference to their link. There are no turbines located within the diffraction exclusion zones in either the horizontal or vertical plane for any other point-to-point links.

4.2.2 Interference caused by reflection or scattering

Interference due to reflection or scattering of a fixed point-to-point link can occur when the signal produced by the transmitting antenna is reflected, scattered, or re-radiated by an intervening object into the corresponding receiver antenna. If the reflected or scattered signal is sufficiently strong that the ratio of the direct signal to the indirect signal is lower than the required carrier-to-interference (C/I) ratio, or protection ratio, for the link, the link performance can be degraded. The extent to which an object such as a wind turbine will reflect or scatter electromagnetic waves is characterised by its radar cross section (RCS) [6].

Reference [6] describes a methodology for calculating the C/I ratio that might be expected at a receiver in the presence of a reflected or scattered signal from a wind turbine at a specified location. By evaluating the C/I ratio for incremental changes in the distances between the transmitter, receiver, and wind turbine, and comparing this to the required C/I ratio, a potential interference zone can be defined.

DNV GL has assessed that the transmission towers for all of the point-to-point links crossing the Project boundary are sufficiently far from the proposed turbine locations to avoid reflection or scattering effects and so it is not expected that the Project will cause interference to the point-to-point links through this mechanism.

4.2.3 Interference caused by near-field effects

The potential for interference to fixed point-to-point links caused by near-field effects can generally be avoided by keeping clear of the near-field zone for the transmitting or receiving antenna. Within the near-field zone, local inductive and capacitive effects are significant and it is difficult to predict the potential impacts of other objects on the transmitted or received signal. Although the near-field distance typically varies with direction relative to the link path, for most practical purposes the near-field zone can be approximated as a sphere centred on the transmitting or receiving antenna.

Reference [6] presents an equation for estimating the radius of the near-field zone for a point-to-point link from the properties of the transmitting or receiving antenna.

DNV GL has assessed that the transmission towers for all of the point-to-point links crossing the Project boundary are sufficiently far from the proposed turbine locations to avoid near-field effects and so it is not expected that the Project will cause interference to the point-to-point links through this mechanism.

4.2.4 Summary of point-to-point interference effects

Table 2 summarises the turbines located within the calculated diffraction, reflection/scattering, and near-field interference zones for each of the point-to-point links crossing the Project site.

Table 2 Details of turbines located within the interference zones established by DNV GL for point-to-point links crossing the proposed Project site

Link no.	Operator	Turbines within potential interference zone			
		Diffraction		Reflection/ scattering	Near-field
		Horizontal plane	Vertical plane		
1	AusNet Transmission Group Pty Ltd (AusNet Services)	None	None	Not assessed[1]	Not assessed[1]
2	Aussie Broadband Pty Ltd	None	None	Not assessed[1]	Not assessed[1]
3	Central Gippsland Region Water Corporation (Gippsland Water)	None	None	Not assessed[1]	Not assessed[1]
4	Digital Distribution Australia Pty Limited	T37, T38	None, interference zone passes over turbines	Not assessed[1]	Not assessed[1]
5	Optus Mobile Pty Limited	None	None	Not assessed[1]	Not assessed[1]
6	Optus Mobile Pty Limited	None	None	Not assessed[1]	Not assessed[1]
7	Vertical Telecoms Pty Limited (VerTel)	None	None	Not assessed[1]	Not assessed[1]

1. Transmission towers are located more than 5 km from the proposed turbine locations. Interference caused by reflection or scattering of signals or near-field effects is not expected for this link.

4.2.5 Stakeholder consultation and responses

DNV GL has contacted the operators of the point-to-point links crossing the proposed Project site to determine the likelihood that the proposed Project will cause interference to their operations and services through diffraction, reflection or scattering, or near-field effects.

No concerns were raised by Aussie Broadband Pty Ltd or Digital Distribution Australia. The potential for turbines at the Project to interfere with their point-to-point links was noted by AusNet Services, Gippsland Water, Optus, and VerTel. However, DNV GL believes that the turbine layout considered in this assessment fully addresses those concerns and is unlikely to impact these links.

To avoid the risk of interference to their point-to-point links, AusNet Services, Digital Distribution Australia, Optus Mobile, and VerTel asked that specific clearances be maintained with respect to those links. While Gippsland Water did not request a specific clearance distance for their point-to-point links, they acknowledged the second Fresnel zone exclusion zones established by DNV GL. No specific clearance distances were requested by Aussie Broadband. The requested clearances are summarised in Table 3.

The clearance requested by AusNet Services is the same as the diffraction exclusion zone applied by DNV GL, and is shown in Figure 5 and discussed in Section 4.2.1.

The clearances requested by Digital Distribution Australia, Optus, and VerTel in the horizontal plane are shown in Figure 6. In each case the clearance zones shown in Figure 6 include the rotor radius for turbines with a 180 m rotor diameter, and an additional buffer on either side to account for

potential inaccuracies in the tower locations, as described in Section 4.2.1. DNV GL has also assessed the potential for the turbine blades to intersect with the point-to-point link clearances requested by Digital Distribution and VerTel in the vertical plane.

Table 3 Details of turbines located within the clearance zones requested by the operators for point-to-point links crossing the proposed Project site

Link no.	Operator	Requested clearance zone	Turbines within requested clearance zone	
			Horizontal plane	Vertical plane
1	AusNet Transmission Group Pty Ltd (AusNet Services)	Second Fresnel zone, or reduce turbine tip height to 180m	None	None
2	Aussie Broadband Pty Ltd	None requested	-	-
3	Central Gippsland Region Water Corporation (Gippsland Water)	None requested	-	-
4	Digital Distribution Australia Pty Limited	Third Fresnel zone	T37, T38	None, clearance zone passes over turbines
5	Optus Mobile Pty Limited	30 m from link path in horizontal plane	None	-
6	Optus Mobile Pty Limited	30 m from link path in horizontal plane	None	-
7	Vertical Telecoms Pty Limited (VerTel)	First Fresnel zone plus 15 m buffer	None	None

The turbines located within the requested clearances in the horizontal and vertical plane for the point-to-point links operated by AusNet Services, Digital Distribution Australia, Optus Mobile, and VerTel are also summarised in Table 3.

There are two turbines located within the requested clearance zone in the horizontal plane for the point-to-point link operated by Digital Distribution Australia. However, as discussed in Section 4.2.1, this link passes over the Project at a height that is well above the maximum proposed turbine tip height and so the requested clearance zone established by DNV GL is clear of the turbine blades in the vertical plane. As summarised in Table 17, Digital Distribution Australia have conducted their own assessment of the potential for turbines T37 and T38 to cause interference to their point-to-point link and have confirmed that the link is clear of the turbines in the vertical plane. Therefore, it is not expected that the Project will cause any interference to the link operated by Digital Distribution Australia. There are no turbines located within the requested clearance zones in either the horizontal or vertical plane for any other point-to-point links.

Through the consultation process, Latrobe City Council advised that they are planning to install a new radiocommunication tower at Jeeralang, which will host two additional point-to-point links that are expected to cross the Project boundary in the north of the site. DNV GL is currently engaging with Latrobe City Council to obtain further information about the proposed radiocommunication tower and point-to-point links, and the potential for the Project to interfere with those links.

4.3 Fixed licences of point-to-multipoint type

Fixed licences of the point-to-multipoint type are a variation of the point-to-point type. The difference between them is administrative. A point-to-point licence permits communication between two static sites, where the locations of the sites are detailed in the licence register. 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.

Administratively, the ACMA RRL database details the location of the static station for a fixed licence of the point-to-multipoint type. Hence, the paths of the transmission vectors are not readily identifiable. A review of fixed point-to-multipoint licences was undertaken and 258 Assignment IDs were identified within approximately 75 km of the proposed site. These licences are shown in Figure 7. The details of the licence holders as per the ACMA database are provided in Table 11.

There are 23 point-to-multipoint base stations listed in the ACMA RRL database within 20 km of the Project boundary. The operators of these stations, and the potential for interference to the corresponding point-to-multipoint links, are summarised in Table 4. There are also several point-to-multipoint base stations located more than 20 km from the site.

Table 4 Operators of point-to-multipoint base stations within 20 km of the proposed Project site and potential for interference to point-to-multipoint links

Operator	Number of sites within 20 km of Project boundary	Distance from nearest site to Project boundary [km]	Expected impact
AusNet Electricity Services Pty Ltd (AusNet Services)	2	15	Potential for interference if link paths cross the Project site
Aussie Broadband Pty Ltd	2	9	Potential for interference if link paths cross the Project site
Australian Power Partners B V & Others (Hazelwood Power Station)	2	6	Unlikely to cause interference – link paths are expected to be restricted to coal mine and power station site
Central Gippsland Region Water Corporation (Gippsland Water)	8	2	Potential for interference if link paths cross the Project site
Connectivity I.T. Pty Ltd	2	14	Potential for interference if link paths cross the Project site
Energy Australia Yallourn Pty Ltd (Yallourn Power Station)	1	6	Unlikely to cause interference – link paths are expected to be restricted to coal mine and power station site
Kallistrate Pty Ltd (Speedweb Wireless Internet)	4	10	Potential for interference if link paths cross the Project site
Latrobe City Council	1	12	Potential for interference if link paths cross the Project site
Loy Yang Power Management Pty Ltd (Loy Yang Power Station)	1	9	Unlikely to cause interference – link paths are expected to be restricted to coal mine and power station site

4.3.1 Stakeholder consultation

Since it is not possible to determine if there are any potential impacts to a point-to-multipoint network without knowing the locations of each station in the network, DNV GL has contacted the operators of all potentially-affected base stations within 20 km of the Project identified in Table 4 to determine the likelihood that the proposed Project will cause interference to their services. Given the locations of their operations relative to the proposed Project, the risk of interference with point-to-multipoint links operated by Hazelwood Power Station, Yallourn Power Station, and Loy Yang Power Station was considered extremely low.

Responses have been received from all of the operators contacted, and no concerns have been raised by AusNet Services, Aussie Broadband, Connectivity I.T., Speedweb Wireless Internet, or Latrobe City Council in relation to their point-to-multipoint networks.

Gippsland Water has noted the potential for turbines at the Project to interfere with their point-to-multipoint links and has provided DNV GL with details of the station locations and link paths for their point-to-multipoint network in the area around the Project. Based on this information, DNV GL has identified 18 point-to-multipoint links operated by Gippsland Water that pass over the proposed Project site.

For each of the Gippsland Water point-to-multipoint links crossing the Project boundary, DNV GL established a diffraction exclusion zone based on the second Fresnel zone for the lowest frequency of that link as described in Section 4.2.1 for fixed point-to-point links. The potential for the turbine blades to intersect with the diffraction exclusion zones in both the horizontal and vertical planes was then assessed. Each interference zone included an additional buffer to account for potential inaccuracies in the station locations in the horizontal plane.

Based on this analysis, there are turbines located within the diffraction exclusion zones established by DNV GL for three of the 18 Gippsland Water point-to-multipoint links passing over the proposed Project site. Therefore, there is potential for turbines in the current Project layout to cause interference to these links. DNV GL understands that these turbines will be micro-sited to avoid incursions into the diffraction exclusion zones for the Gippsland Water links in a future revision to the turbine layout.

DNV GL has assessed that the stations for all of the point-to-multipoint links crossing the Project boundary are sufficiently far from the proposed turbine locations to avoid reflection, scattering, or near-field effects and so it is not expected that the Project will cause interference to the point-to-point links through these mechanisms.

Although it is less likely that point-to-multipoint base stations located more than 20 km from the Project site will be affected, DNV GL recommends contacting the operators of all stations within approximately 60 km of the Project to seek feedback regarding any potential impact that the Project could have on their operations and services.

4.4 Other licence types

Other licences in the ACMA database were reviewed. These licences and associated Assignment IDs are shown in Table 12 and Figure 8.

Many of the licences identified can be broadly described as base to mobile station or point-to-area style communications, including radio broadcasting and commercial and private mobile telephony. 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, mitigation consists of the user simply moving to receive a clearer signal. Reference [8] provides general guidance regarding the potential for interference with mobile radio systems, and suggests that a clearance of 500 m from the tower is sufficient to avoid significant impacts to these systems. Other references recommend that turbines be kept outside of clearance zones ranging from a distance of 200 m to 1200 m from the tower for point-to-area style services [9].

Potential impacts to emergency services signals and commercial mobile telephony signals are considered in Sections 4.5 and 4.10 respectively.

A number of broadcasting licences have been identified. These are likely to consist of radio and television broadcasting services and are considered in Sections 4.13 and 4.14.

A number of aeronautical licences, and radiodetermination licences which may be used for aircraft navigation, have been identified. DNV GL understands that potential impacts to these services will be considered as part of an aviation impact study.

4.5 Emergency services

A review of the ACMA RRL database was conducted to identify emergency services with licences for radiocommunication assets operating in the vicinity of the Project. The groups identified are listed in Table 13 along with their contact details. It is noted that the nearest license is associated with a tower located approximately 2 km from the site boundary. DNV GL recommends contacting the operators of all stations within approximately 60 km of the Project to seek feedback regarding any potential impact that the Project could have on their operations and services.

4.6 Aircraft navigation systems and radar

DNV GL understands that a separate aviation impact study will be undertaken to assess the impact of the Project on nearby aviation navigation systems and radar.

4.7 Meteorological radar

The Bureau of Meteorology (BoM) operates a network of weather stations across Australia and uses radar instruments for measuring wind speeds in the upper atmosphere (known as "wind finding" radar), and determining rain and storm activity (known as "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. The "weather watch" radar, or "weather surveillance" radar, consists of a rotating antenna located on a building 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. The location of the cloud is then determined by the direction and travel time of the reflected beam.

Wind profile measurements are used to ensure the safe and economical operation of aircraft and provide an important source of data for the BoM's general weather forecasting system. "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. Hence, 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.

The World Meteorological Organisation (WMO) currently states that wind turbines should not be located within 5 km of a meteorological radar site, due to the high risk of interference to the radar signal and subsequent loss of weather data [10]. For wind farms located within 20 km of a radar, the WMO recommends consultation and analysis be undertaken to assess the likelihood of turbines interfering with the radar signals or Doppler velocity measurements. Similarly, the Network of European Meteorological Services (EUMETNET) recommends that, to avoid potential for interference, wind turbines should not be located within 5-10 km of a meteorological radar, depending on the antenna frequency band, and that an impact study should be undertaken for wind turbines located within 20-30 km of a radar site [11].

Wind farms located at distances greater than 5 km from a BoM weather station are unlikely to affect wind finding operations [2]. Generally, the optimal coverage area for "weather watch" radar extends approximately 200 km from the radar installation at a height of approximately 3000 m [12] [13], and approximately 100 km at a height of 1000 m [13]. Theoretically, wind farms can impact upon weather watch radar when located within several hundred kilometres of a radar station, however, due to the curvature of the earth, and intervening terrain, the range at or near ground level is generally less.

According to the Draft National Guidelines, consultations with operators of weather stations within 250 nautical miles (463 km) of the proposed Project should be undertaken [2]. DNV GL has identified that the BoM operates six weather stations within that range with the closest station, "Bairnsdale", located approximately 116 km northeast of the Project site or 119 km from the nearest wind turbine. The locations of these stations are shown in Figure 9 and the details of each station can be found in Table 14.

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

DNV GL recommends contacting the BoM regarding the Project, in accordance with the recommendations of the Draft National Guidelines, to seek feedback on whether interference to their operations and services is likely.

4.8 Trigonometrical stations

A trigonometrical station, also known as a trig point or a trig beacon, is an observation mark used for surveying or distance measuring purposes.

Some trig points may host surveying equipment such as Global Positioning System (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. Most EDM devices require the target object to be highly reflective and, accordingly, a reflective prism is placed on the target object being surveyed.

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, and could be intercepted or obstructed by the presence of turbines. However, the risk of impact is considered low as it is likely to be possible to relocate the target to obtain an unobstructed view of the trig point. Microwave systems can measure distances up to 150 km, but such systems are not limited by the line of sight or affected by visibility [14].

Global navigation satellite system (GNSS) technology is also commonly used for surveying and distance measurements, as it enables users to accurately determine their geographic location using positioning and timing information received from satellite signals. Geoscience Australia currently operates several GNSS networks across Australia, including the Australian Regional GNSS Network (ARGN) and the AuScope GNSS network [15]. The ARGN is comprised of 20 permanent GNSS Continuously Operating Reference Stations (CORS) which provide the geodetic framework for the spatial data infrastructure in Australia and its territories. Eight stations from the ARGN form the Australian Fiducial Network (AFN) [16], through which the Geocentric Datum of Australia (GDA) is defined. The ARGN also provides information for the measurement of geological processes and contributes data to the International GNSS Service. Additional geospatial information aimed at enhancing the accuracy and resolution of the National Geospatial Reference System is provided by the AuScope GNSS network of around 100 CORS strategically distributed across the country. In Victoria, the DELWP also operates a state-wide GNSS CORS network, known as GPSnet, which is used to provide geospatial data for mapping, surveying, agriculture, and industry [17]. GNSS stations are typically equipped with EDM devices and GPS receivers, and transmit data to Geoscience Australia or the relevant state authority via phone lines, internet, or satellite communications.

The closest ARGN or AuScope GNSS station is located approximately 7 km northeast of the Project, at Yallourn [18]. Due to the distance between the Project and the GNSS station, it is considered unlikely that the Project will cause interference to the GNSS network. The closest GPSnet GNSS station is also located approximately 7 km northeast of the Project at Yallourn [19].

DNV GL has also undertaken a review of the primary geodetic network of Australia [20] and has observed that the Project is located within the third-order triangulation region. 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 are then used for the second-order triangulation network and so forth, with the degree of accuracy decreasing for subsequent networks.

According to Geoscience Australia [18], there are 35 trig points within 20 km of the Project site boundary. The details of all 35 trig points are provided in Table 15 and illustrated in Figure 10.

Although it is unlikely that the trig points in close proximity to the Project host EDM devices or other equipment that may be subject to EMI, DNV GL recommends contacting Geoscience Australia and the DELWP to inform them of the Project, and seek feedback regarding whether interference to their systems is possible.

4.9 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. It is commonly used in rural areas for emergency communications, road safety information, communication between recreational travellers, and general conversation. 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.

The CB radio service can be used for voice communication activities, telemetry, and telecommand applications. The radio service operates on two frequency bands, namely the high frequency (HF)

band between 26.965 MHz and 27.405 MHz and the ultra-high frequency (UHF) band between 476.425 MHz and 477.400 MHz.

The HF CB radio service was legalised in Australia in the 1970s as a temporary move to switch to UHF CB over the following five years, and transmits signals in either AM (amplitude modulation) or SSB (single side band) transmission mode. The actual range over which the signal is transmitted depends on the antenna used, the terrain, and the interference levels. Over the last decade, the use of the HF CB radio service has declined and has been replaced by UHF CB radio service.

The UHF CB radio service is unique in Australia and uses the FM (frequency modulation) transmission mode. It provides clear communication over 5–20 km and is less susceptible to power line noise. However, the UHF CB radio service requires a clear 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 will be allocated to emergency, telemetry, or repeater inputs.

Since users of CB radio services 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 services 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.

4.10 Mobile phones

Mobile phone networks typically operate at frequencies of either between 700 and 900 MHz, or between 1800 and 2600 MHz, however some new services may operate at up to 3500 MHz. At such frequencies, signals are likely to be affected by physical obstructions such as buildings and wind turbines. However, mobile phone networks are designed to operate in such conditions and in most cases, if there is sufficient mobile network coverage and signal strength, the presence of wind turbines is unlikely to cause any interference.

In rural areas, the mobile network coverage may be more susceptible to physical obstructions due to the large distance between the phone towers and the mobile phone user. In that case, it is theoretically possible that wind turbines could cause some interference to the signal, although there is little evidence of this in the literature.

DNV GL has reviewed the locations of mobile phone towers in the vicinity of the proposed Project. The locations of these towers are shown in Figure 11. The nearest mobile phone tower is located approximately 1.2 km southeast of the Project boundary.

Mobile phone network coverage maps have been obtained for Optus, Telstra, and Vodafone.

Figure 12 shows the Optus Mobile network coverage for the Project area [21]. Outdoor 4G Plus coverage is available in many areas around the Project site, but the network is either not available or limited to outdoor 3G coverage in areas across the west, south, and southeast.

Figure 13 shows the Telstra network coverage for the Project area [22]. Either 3G or 4G coverage is available across most of the Project site and surrounding area, although coverage is marginal or

unavailable in some locations within the Project boundaries and to the south, southwest, and southeast of the site.

Figure 14 shows the Vodafone network coverage for the Project area [23]. Outdoor 4G coverage is available across most of the Project site and areas to the north and east, with several regions able to receive good indoor 4G coverage. However, coverage is limited to the 3G network in many locations to the west, south, and southeast, and there is marginal or no coverage in the southwest.

In general, for areas with good coverage, interference to mobile phone signals is unlikely. However, for areas where the reception is likely to be marginal, such as those where an external antenna is required, the possibility for interference exists if a wind turbine intercepts the signal between a mobile phone and the tower.

DNV GL has contacted Optus Mobile to seek their feedback on the potential for the Project to interfere with their mobile phone network. The response received from Optus indicates that they do not have any concerns regarding potential impacts on their mobile phone services.

DNV GL also recommends contacting Telstra and Vodafone to inform them of the proposed Project and to seek feedback on any potential impact that the Project could have on their services. However, previous advice received from Telstra suggests that interference is unlikely provided that turbines are located more than 500 m from the nearest mobile phone tower.

In cases of marginal network coverage, simple procedures are available to mitigate interference, such as moving a short distance to a new or higher location until the signal improves, or using an external antenna to improve the signal.

4.11 Wireless internet

Aussie Broadband, Connectivity I.T., and Speedweb Wireless Internet hold point-to-multipoint licences in the vicinity of the Project, with the nearest base stations located 9 km northeast, 14 km west, and 10 km north of the Project site respectively. As the locations of Aussie Broadband, Connectivity I.T., and Speedweb Wireless Internet customers are not known, it is not possible to determine whether there is the potential for interference to this service, however it is possible that stations at these distances may be servicing customers in the vicinity of the proposed Project. DNV GL has contacted Aussie Broadband, Connectivity I.T., and Speedweb Wireless Internet to seek feedback regarding the potential for interference to their services. Responses have been received from all three operators, and no concerns have been raised.

Additionally, residents in the vicinity of the Project are likely to use wireless broadband services provided by Optus, Telstra, and Vodafone. These wireless broadband services use the same networks as mobile phone services for those providers, and therefore the comments made in Section 4.10 are applicable here. Specifically, the presence of wind turbines is unlikely to cause any interference. However, should interference occur, the simple mitigation options given in Section 4.10 may be applicable.

The National Broadband Network (NBN) website [24] indicates that the network is currently available as a fixed wireless service and satellite internet service using the NBN Sky Muster I and II satellites in the areas surrounding the Project site. It is therefore likely that some residents are currently accessing the internet via the NBN and that the network will also be available to other residents in the vicinity of the Project in the near future. The locations of NBN fixed wireless towers within 75 km of the Project site are shown in Figure 11, and a map of NBN service coverage in the

vicinity of the Project is shown in Figure 15. According to the NBN website [24], residents located outside the fixed wireless coverage areas shown in Figure 15 are being offered the NBN Sky Muster satellite service.

NBN fixed wireless signals operate by line of sight between the NBN tower and the user's antenna, with a maximum range of 14 km [25]. Consequently, the signals may be affected by physical obstructions such as terrain, vegetation, and wind turbines [26]. NBN towers servicing the Project area are located at Moe South in the north, Narracan in the northwest, Thorpdale in the west, Boolarra in the southeast, and Yinnar in the east. Given the relative positions of the NBN towers and nearby dwellings, and the fixed wireless coverage areas shown in Figure 15, there is potential for the Project to impact residents who are currently receiving NBN fixed wireless internet signals.

DNV GL has assumed that all residential dwellings located within both (i) 100 m of the fixed wireless coverage areas shown in Figure 15 and (ii) 14 km of any NBN tower have the potential to receive wireless internet signals from that tower. The locations of these houses are shown in Figure 15. DNV GL notes that this part of the EMI assessment was conducted using an incomplete list of dwellings in the vicinity of the Project, which was provided by the Customer in the early stages of this work. Therefore, there may be additional houses with potential to experience interference to NBN fixed wireless internet signals that have not been identified here. The assessment will be updated to consider all dwelling locations in the vicinity of the Project in a future revision.

If the signal path between an NBN tower and a dwelling is obstructed by a turbine, interference to that signal may occur. Given the maximum range of the NBN fixed wireless signals, the intervening terrain, and the locations of the NBN towers and dwellings, only signals from the Boolarra and Narracan NBN towers are likely to be affected. DNV GL has identified 30 dwellings to the west and southwest of the Project site that may be receiving wireless internet signals from the Boolarra or Narracan NBN towers and have potential to experience interference to those signals, based on their location relative to the Project. The coordinates of these houses are presented in Table 16.

For each of the signal paths between a potentially-affected dwelling and the corresponding NBN tower, DNV GL has established a potential interference zone based on the second Fresnel zone for the lowest frequency signal transmitted by the tower as described in Section 4.2.1 for fixed point-to-point links. Each interference zone includes the rotor radius for turbines with a 180 m rotor diameter, and an additional buffer of 25 m on either side to account for potential inaccuracies in the tower or dwelling locations. The potential interference zones are shown in Figure 15.

The turbines located within the potential interference zone for each signal path to a potentially-affected dwelling are summarised in Table 5 and Table 6 for the Boolarra and Narracan towers respectively. There are three turbines (T42, T46, T47) located within the potential interference zones for NBN fixed wireless signal paths from the Boolarra NBN tower to seven dwellings. There are no turbines in the potential interference zones for NBN fixed wireless signal paths from the Narracan NBN tower.

DNV GL has also carried out an assessment to determine whether each of the potentially-affected fixed wireless signal paths is clear of terrain obstructions and passes over the Project at a height that has potential to intersect with the turbine blades. This was achieved by examining the elevation and antenna heights at the NBN tower and the dwelling, as well as the approximate elevation of the areas over which the signal path crosses. The results of this assessment are also summarised in Table 5.

It was determined that the signal paths are clear of terrain for four of the seven potentially-affected dwellings, which suggests that these houses are likely to be receiving signals from the Boolarra NBN tower. The signal paths for these four houses also pass over the Project at a height that may intersect the rotor swept area for the turbines, which increases the potential for interference. For two of the three dwellings for which the signal path is obstructed or potentially obstructed by terrain, however, the second Fresnel zone for the signal from the Boolarra NBN tower passes below the rotor swept area for the turbines and therefore is unlikely to be affected.

Based on this assessment, there are four houses in the vicinity of the Project that may experience interference to fixed wireless internet signals from the Boolarra NBN tower as a result of the Project (dwellings 45, 1220, 1221, 1222). Interference to fixed wireless internet signals from the Boolarra NBN tower is possible for one additional house (dwelling 44), although analysis of the signal path from the NBN tower to this dwelling suggests that the signals may already be obstructed by terrain.

DNV GL recommends contacting NBN Co to seek feedback on whether there is potential for the Project to cause interference to their services, and to allow them to take the presence of the Project into account in their coverage planning maps.

DNV GL understands that, if interference to NBN fixed wireless signals is experienced at dwellings in the vicinity of the Project, several mitigation options may be available to improve the signal reception. These could include installing a new NBN tower to service the affected houses or moving the outdoor antennas at the affected houses a short distance from the dwelling, to a location where the signal is not impacted by the turbines, and connecting that antenna to the dwelling via a cable (described by NBN Co as a "non-standard install process" [27]). However, these mitigation options have not been confirmed by NBN Co. It may also be possible to avoid impact by micro-siting the turbines in some cases. Although the NBN Sky Muster satellite internet service is a potential alternative to the fixed wireless internet service, NBN Co have previously advised that the Sky Muster service cannot be considered as a mitigation option for dwellings affected by interference from wind turbines.

The potential for signals from the NBN SkyMuster I and II satellites to be intercepted by wind turbines at the Project has been considered as part of the analysis described in Section 4.12.

Table 5 Potential for impact to fixed wireless internet signals from the Boolarra NBN tower to dwellings in the vicinity of the Project

House ID[1]	Turbines within interference zone	Line of sight of signal path[2]		Expected impact
		Relative to terrain	Relative to turbines	
44	T47	Potentially obstructed	Intersects rotor swept area	Potential for interference, but dwelling may not be receiving coverage
45	T47	Clear	Intersects rotor swept area	Potential for interference
46	None	-	-	Unlikely
62	None	-	-	Unlikely
63	None	-	-	Unlikely
64	None	-	-	Unlikely
67	None	-	-	Unlikely
68	None	-	-	Unlikely
93	None	-	-	Unlikely
94	None	-	-	Unlikely
95	None	-	-	Unlikely
764	None	-	-	Unlikely
765	None	-	-	Unlikely
766	None	-	-	Unlikely
795	None	-	-	Unlikely
796	None	-	-	Unlikely
811	None	-	-	Unlikely
826	T46	Obstructed	Passes below rotor swept area	Unlikely
827	None	-	-	Unlikely
828	None	-	-	Unlikely
829	None	-	-	Unlikely
830	None	-	-	Unlikely
831	None	-	-	Unlikely
832	T42	Potentially obstructed	Passes below rotor swept area	Unlikely
1202	None	-	-	Unlikely
1203	None	-	-	Unlikely
1211	None	-	-	Unlikely
1220	T47	Clear	Intersects rotor swept area	Potential for interference
1221	T47	Clear	Intersects rotor swept area	Potential for interference
1222	T47	Clear	Intersects rotor swept area	Potential for interference

1. This part of the EMI assessment was conducted in the early stages of this work using an incomplete list of dwellings in the vicinity of the Project, and so there may be additional houses with potential to experience interference to NBN fixed wireless internet signals that have not been identified here. The assessment will be updated to consider all dwelling locations in the vicinity of the Project in a future revision.
2. Not assessed for signal paths with no turbines located within the potential interference zone.

Table 6 Potential for impact to fixed wireless internet signals from the Narracan NBN tower to dwellings in the vicinity of the Project

House ID[1]	Turbines within interference zone	Line of sight of signal path[2]		Expected impact
		Relative to terrain	Relative to turbines	
826	None	-	-	Unlikely
827	None	-	-	Unlikely
828	None	-	-	Unlikely
829	None	-	-	Unlikely
830	None	-	-	Unlikely
831	None	-	-	Unlikely
832	None	-	-	Unlikely

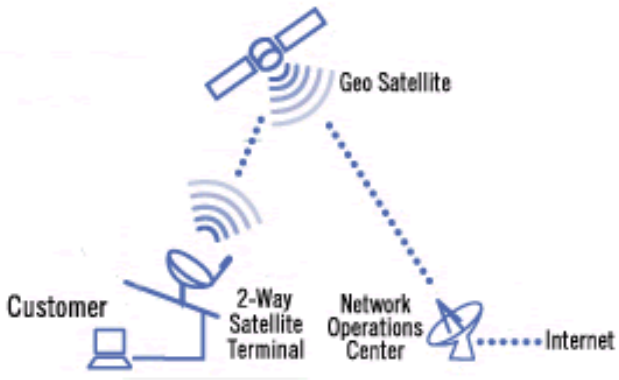
1. This part of the EMI assessment was conducted in the early stages of this work using an incomplete list of dwellings in the vicinity of the Project, and so there may be additional houses with potential to experience interference to NBN fixed wireless internet signals that have not been identified here. The assessment will be updated to consider all dwelling locations in the vicinity of the Project in a future revision.
2. Not assessed for signal paths with no turbines located within the potential interference zone.

4.12 Satellite television and internet

In some rural or remote areas, television and internet access can only be provided through satellite signals.

Satellite television is delivered via a communication satellite to a satellite dish connected to a set-top box. Satellite television signals are typically transmitted to the user's antenna in one of two frequency bands: the C-band between 4 GHz and 8 GHz, or the Ku-band 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. Signals in the Ku-band are most likely to be affected by rain which acts as an excellent absorber of microwave signals at this frequency. DNV GL understands that there are currently 20 satellites that can provide television to the east coast of Australia [28]. The main satellites that transmit Australian free-to-air or subscription television channels are the Optus C1, D1, and D3 satellites and the Intelsat 19 satellite [29] [30].

In the case of satellite internet, the user's computer is connected to a satellite modem which is in turn linked to a satellite dish or antenna mounted on the building roof. When the user accesses the internet, a request is sent to the operation centre of the satellite internet provider via the satellite antenna. Data is then sent back to the user's computer via the same path as shown in the figure below. Satellite internet signals are typically transmitted in the Ku-band, as for satellite television, or the Ka-band, with frequencies ranging from 26.5 GHz to 40 GHz. Like signals in the Ku-band, signals in the Ka-band are susceptible to deterioration caused by moisture in the air, but newer satellites contain technologies that help to minimise the loss of signal quality associated with rain and other weather conditions. The main satellites for providing satellite internet in Australia are the IPSTAR (THAICOM-4) and Optus D2 satellites, and the NBN SkyMuster I and II satellites.



Two-way connection to the internet via satellite [31]

Due to marginal coverage of some communication services, some residents in the vicinity of the Project may use satellite television and internet.

A number of satellites transmit television and internet signals that can be received in Australia. DNV GL has analysed the line-of-sight to dwellings in the vicinity of the Project for satellites which provide any television or internet services to eastern Australia. Although only a small number of satellites are likely to be providing services intended for Australia, all viewable satellites have been considered.

The analysis has shown that signals from the Eutelsat 70B, Intelsat 22, Apstar 7 and Thaicom-5 satellites to a number of nearby dwellings may be intercepted by turbines. However, DNV GL understands that these satellites do not transmit signals designed for Australian audiences [30], and as such it is unlikely that residents in the vicinity of the Project will be receiving signals from these satellites.

4.13 Radio broadcasting

Radio stations typically broadcast using one of two forms of transmission: either amplitude modulation (AM) or frequency modulation (FM). In Australia, AM radio operates in the medium wave (MW) band at frequencies between 520 kHz and 1610 kHz, while FM radio operates in the very high frequency (VHF) band between 87.5 MHz and 108 MHz. The locations of AM and FM broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [32], and are shown in Figure 16.

4.13.1 AM radio

AM radio signals are diffracted by the ground as they propagate, such that they follow the curvature of the earth, and are also reflected or refracted by the ionosphere at night. This means that AM radio waves are able to travel significant distances under the right conditions. Due to their long wavelength, they can readily propagate around physical obstructions on the surface of the earth (such as wind turbines), however they do not propagate easily through some dense building materials such as brick, concrete, and aluminium.

The distance over which AM radio signals 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.

As AM radio signals are able to propagate around obstructions such as turbines, it is expected that the Project will 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 [33]. Any interference problems are likely to be easily resolved through the installation of a high quality antenna or amplifier.

4.13.2 FM radio

FM radio signals are better suited to short range broadcasting. Unlike lower frequency signals (such as AM signals), they are not reflected or refracted off the ionosphere. The waves are slightly refracted by the atmosphere and curve back towards the earth, meaning they can propagate slightly beyond the visual horizon, however they may be blocked by significant terrain features. FM radio stations therefore tend to have only local coverage, which means that signals are less susceptible to interference from distant FM broadcasters. FM signals are also less susceptible to interference from changes in atmospheric conditions and electrical equipment than AM signals.

FM radio signals are susceptible to interference from buildings and other structures, although they are less vulnerable than higher frequency signals. Interference to FM signals can occur by two mechanisms: reflection or scattering of the radio waves, or physical obstruction and attenuation of the broadcast signal.

Reflection or scattering of radio waves by physical structures such as wind turbines can reduce the 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 result in hissing, fluttering, or distortion being heard by the listener [34]. However, this type of interference is typically only experienced in the immediate vicinity (within several tens of metres) of a wind turbine, where the signal-to-noise ratio is low [33] [35]. It is unlikely that any permanent FM radio receivers will be located sufficiently close to the Project to be affected.

Wind turbines located close to an FM transmission tower may also present a physical obstruction to the radio signal. If the line-of-sight between the tower and a radio receiver is blocked by a turbine, this can cause a noticeable decrease in signal quality or may lower the signal strength below the threshold of the receiver's sensitivity [34]. In these situations, the attenuation of the signal may be as great as 2.5 dB in the direction of the obstructing wind turbine. However, this type of interference is generally only a problem near the edges of the FM signal coverage area, where the broadcast signal is already weak. For commercial FM broadcast signals, physical obstruction of the signal may occur if the turbines are located within approximately 4 km of the transmission tower [36].

The closest FM broadcast transmission tower is a Kids FM broadcast tower located adjacent to the proposed Project boundary, 1.9 km northeast of the nearest wind turbine (turbine T03) and within 4 km of six turbines (turbine T03, T04, T05, T06, T07, T08). Given the relatively small distance between the broadcast tower and the site, it is possible that the FM radio signals from this tower could be influenced by the Project. The location of the broadcast tower in relation to the Project and the sector in which physical obstruction of the signal may occur is shown in Figure 17. Since the transmission tower is located to the northeast of the proposed turbine locations, the potential interference sector extends to the southwest of the Project site. Residents within this zone, which includes the townships of Delburn, Boolarra, Mirboo, and Mirboo North and may extend as far as

Koonwarra, Meeniyan, and Foster, may experience interference to Kids FM radio signals broadcast from this tower. DNV GL recommends contacting the operator of this tower, Southern Cross Austereo Group, to seek feedback on whether interference to their broadcasting services is likely.

If interference to FM radio signals is experienced, mitigation options include installing high-quality antennas or amplifiers at affected residences, increasing the broadcast signal strength from the transmission tower, moving the tower to a new location further away from the turbines, or installing a signal repeater on the opposite side of the Project.

4.13.3 Digital radio

Digital radio services were introduced in metropolitan licence areas in Australia in 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 [37]. Digital radio broadcasts in Australia operate in the VHF band at frequencies between 174 MHz and 230 MHz, and therefore tend to have only local coverage within the visual horizon. According to the digital radio coverage map available on the ABC website [38], digital radio is not yet available in the Project region. Hence, while there are no digital radio broadcasts in the vicinity of the Project, no interference to digital radio signals is possible.

4.14 Terrestrial television broadcasting

Terrestrial television is broadcast in Australia by a number of networks, both public and commercial. As of December 2013, all television broadcasts in Australia are now digital broadcasts [32]. Digital television (DTV) signals are typically more robust in the presence of interference than analogue television signals, and are generally unaffected by interference from wind turbines. DNV GL has experience in situations where houses were able to receive adequate DTV reception in an area of adequate signal strength where the DTV signal was passing through a wind farm.

The United Kingdom telecommunications regulator Ofcom [34] states the following with regard to interference to DTV reception:

> *"Digital television signals are much better at coping with signal reflections, and digital television pictures do not suffer from ghosting. However a digital receiver that has to deal with reflections needs a somewhat higher signal level than one that has to deal with the direct path only. This can mean that viewers in areas where digital signals are fairly weak can experience interruptions to their reception should new reflections appear… reflections may still affect digital television reception in some areas, although the extent of the problem should be far less than for analogue television."*

DNV GL has drawn two conclusions from this report:

- Firstly, that DTV is very robust and does not suffer from ghosting. In most cases DTV signals are not susceptible to interference from wind farm developments.
- Secondly, that areas of weak DTV signal can experience interruptions to their reception should new reflections appear, such as those from nearby wind turbines.

The ACMA Broadcast Transmitter Database [32] was examined to identify broadcasters nearby to the proposed Project, with those found shown in Figure 16. The main television transmitter used by residents in the vicinity of the Project is the Latrobe Valley transmitter at Mt Tassie. However, it is

also possible that nearby residents receive television signals from the Boolarra, Churchill, Jeeralang/Yinnar South, Melbourne, Newborough, and Trafalgar/Yarragon transmitters.

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

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

4.14.1 Large scale interference

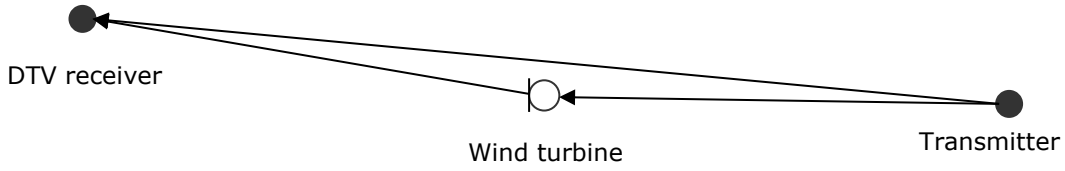
For broadcast signals, large scale interference can generally be avoided by placing the wind turbines distant from the broadcast tower. Broadcast towers may be either relay or primary transmitters. Relay television transmitters are more commonly found in rural areas. Primary television transmitter towers are higher power and are more commonly located near large urban areas. A clearance of at least 1 km is recommended for relay television transmitters, while a clearance of at least 6 km is recommended for primary television transmitters [7].

The closest digital television transmitter to the Project is the Boolarra relay transmitter, which is approximately 1.2 km from the Project boundary and 3.1 km from the nearest turbine, and there are no primary transmitters located within 6 km of the Project. While the Project is not expected to cause large scale interference to television broadcast signals, DNV GL recommends contacting the operator of the Boolarra relay transmitter, RBA Holdings Pty Ltd, to seek feedback on the potential for the Project to cause interference to their operations and services through other mechanisms.

4.14.2 Forward and back scatter

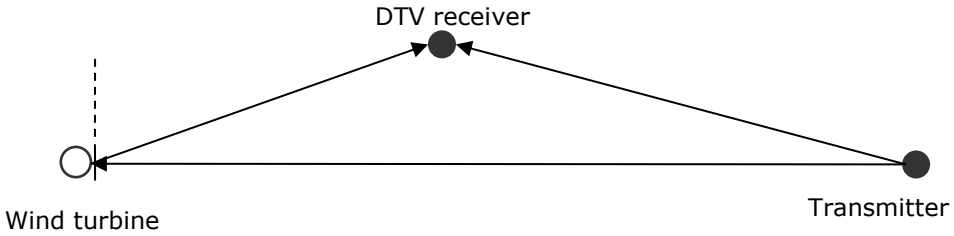
Wind turbines cause interference to television signals by introducing reflections that may be received by the antenna at a dwelling, in addition to the signal received directly from the transmitter, which causes multipath errors. A wind turbine has the potential to scatter electromagnetic waves carrying television signals both forward and back.

Forward scatter can occur when the transmitter, one or more wind turbines, and receiver are almost aligned as shown below. The forward scatter region in this case is characterised by a shadow zone of reduced signal strength behind the turbine, where direct and scattered signals can be received, with the blade rotation introducing a rapid variation in the scattered signal [39]. Both of these effects can potentially degrade the DTV signal quality.



Forward scatter signal path

Back scatter from wind turbines occurs when DTV signals are reflected from turbine towers and turbine blades onto a DTV receiver as shown below. The reflected signals are attenuated, time-delayed and phase-shifted (due to a longer path from transmitter to receiver) compared to the original signal. The reflected signals are also time-varying due to the rotation of the blades and vary with wind direction. The resultant signal at the receiver includes the original signal (transmitter to receiver) and a series of time-varying multipath signals (transmitter-turbine-receiver).



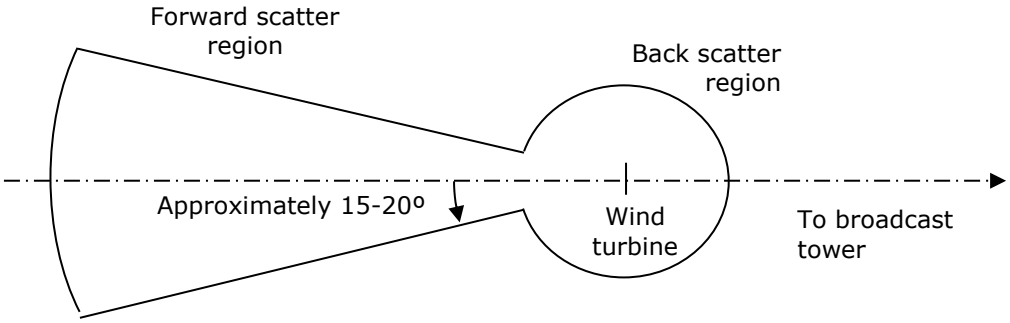
Back scatter signal path

Interference of DTV signals from wind turbine developments can potentially occur in both the forward and backward scatter region. The effect of a wind turbine on a DTV signal can be different depending on the scattering region where the receiver is located [39].

According to Ofcom [34], the forward scatter region does not typically extend further than 5 km for the worst combination of factors [7] [40]. Interference may extend beyond 5 km if the houses are screened from the broadcast tower, but do have line-of-sight to the wind turbines [34]. The shape of this region, assuming a relatively high gain, directional antenna, can be represented by a circular segment with an azimuthal range of approximately ±15° to ±20°, corresponding to the beam width of the antenna. If a lower gain or omni-directional antenna is being used, this region is likely to be larger.

Back scattered signals arrive at the house delayed relative to the source signal from the broadcast tower. The back scatter region generally does not extend further than 500 m [7] [41], 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.

The combination of the forward and back scatter regions, as shown in the following figure, resembles a keyhole.



Potential television interference zones around a wind turbine

Television interference mechanisms rely on many factors (as previously mentioned) and are complex to calculate. Previous experience has shown that even after great effort has been put into performing such calculations, they tend to have limited accuracy, and would require field validation after the wind farm is operational.

In Australia, digital television signals are transmitted using the DVB-T (Digital Video Broadcasting – Terrestrial) standard. The International Telecommunication Union (ITU) Recommendation BT.1893 [42] states the following in regards to the forward scatter region for DVB-T signals:

> *"In most of the situations where the impact of a wind farm to DVB-T reception quality was analyzed, the threshold C/N [carrier-to-noise] ratios obtained were similar to those expected in environments with the absence of wind farms. More precisely, in the forward scattering region of the wind turbines, where the transmit antenna, one or more turbines and the receive antenna are lined-up (±60° behind the wind turbine), the DVB-T reception quality may not be affected though further work of analysis is needed in order to confirm this point, especially in the vicinity of 0°."*

In other words, wind turbines are not generally expected to affect DVB-T DTV signals in the forward scatter region. However, the ITU [43] also highlight that in the case where there is significant blockage of the direct signal, but clear line-of-sight to one or more wind turbines, interference to the reception of the DTV signal is possible. Results of studies reported by the ITU also suggest that interference may be more likely in areas where the existing DTV signal is already weak or degraded [43].

With regards to back scattering, the ITU states:

> *"In the case of the backscattering region, in those situations where the scattered signals from wind turbines are significant in amplitude and variability, the threshold C/N ratio necessary for quasi error free (QEF) condition is higher."*

In other words, the C/N ratio needs to be higher in the presence of significant back scatter to achieve the same QEF condition as is the case without the presence of wind turbines, which effectively means that interference is more likely to occur as coverage quality decreases. The implications of this conclusion for dwellings in the vicinity of the Project are discussed in Section 4.14.4.

4.14.3 Theoretical models for wind turbine scattering estimation

Various theoretical scatter models to predict scatter of terrestrial television signals have been proposed, some dating back to the late 1970s. A review of these models, as well as a comparison against empirical data has been reported in [44]. This comparison with empirical data found:

> *"…none of the analyzed methods seems to be accurate enough to provide realistic estimations of the signal scattered by the wind turbines. In conclusion, a more complete scattering model is needed in order to provide more practical estimations of the scattered signals and evaluate their potential impact on the broadcasting services."*

Notably, the scattering model proposed by the ITU to specifically address DTV signals [42], was found to be the most inaccurate, and does not provide signal estimations in the forward scattering zone of the blades. Additionally, DNV GL notes that it only applies to a single wind turbine rather than a wind farm as a whole. Due to the lack of an accurate scattering model, DNV GL has not performed detailed scatter calculations to predict DTV interference.

As an alternative, it is common practice to identify those dwellings or areas that are most likely to experience potential television interference based on likely forward and back scatter regions. As introduced above, this is often referred to as the 'keyhole' approach, and is an established technique for predicting where terrestrial television interference is most likely, based on a number of assumptions regarding receiving antenna characteristics. The approach involves combining multiple keyhole shaped areas that are placed over each turbine location [34]. The combination of these areas forms a region where there is an increased likelihood of interference to television signals occurring. The results of using this approach to identify the dwellings that have increased potential to receive scattered signals from a turbine in the Project, and hence have an increased likelihood of experiencing interference to television signals, are described in Section 4.14.4.

4.14.4 Potential impacts for dwellings

According to the Australian Government mySwitch website [41], the area around the Project is able to receive DTV signals from the Boolarra, Churchill, Jeeralang/Yinnar South, Latrobe Valley, Melbourne, Newborough, and Trafalgar/Yarragon broadcast towers. The coverage maps (reproduced in Figure 18 to Figure 24) suggest that the primary transmitter for the area is the Latrobe Valley tower, which offers 'good' to 'variable' coverage across the site. Coverage from the nearby Boolarra, Jeeralang/Yinnar South, Newborough, and Trafalgar/Yarragon towers, which are understood to be relay transmitters, is 'good' in the immediate vicinity of the tower and generally 'variable' to 'poor' elsewhere. Coverage from the Melbourne tower is 'variable' to 'good' in the northwest but 'variable' to 'poor' elsewhere, while coverage from the Churchill tower is 'variable' to 'poor' across the site.

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

The results of the analysis can be seen in Figure 18 to Figure 24. The dwellings that are most likely to be susceptible to interference include those within the possible interference zones, as summarised in Table 7 below. Note that 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), interference may still occur outside of the identified interference zones.

Houses to the west of the Project have increased potential to experience interference to DTV signals from the Latrobe Valley broadcast tower, particularly in areas where the signal is already marginal. The potential interference zones for the Latrobe Valley tower include the townships of Narracan and Delburn, and may extend to Thorpdale or beyond. Given that the Latrobe Valley tower appears to be the primary transmitter for the area, interference to the signals from this tower could have a significant impact on local residents. Consequently, it may be necessary to install a relay transmitter to service those dwellings on the western side of the Project that are currently receiving signals from the Latrobe Valley broadcast tower.

A number of dwellings have also been identified in the potential interference zones for the Boolarra, Churchill, Jeeralang/Yinnar South, Melbourne, Newborough, and Trafalgar/Yarragon broadcast towers, but the coverage maps suggest that there is little to no signal coverage from those towers in most of the potentially-affected areas.

Table 7 Number of dwellings located within potential interference zones for digital television broadcast towers in the vicinity of the Project site

Digital television broadcast tower	Number of dwellings in potential interference zone	Signal coverage in potential interference zone
Boolarra	271	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower
Churchill	244	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower
Jeeralang/Yinnar South (Silcocks)	275	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower
Latrobe Valley (Mt Tassie)	200	Variable to good
Melbourne (Mt Dandenong)	846	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower
Newborough (Moe)	258	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower
Trafalgar/Yarragon (Yarragon South)	863	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower

Although DTV signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate coverage, interference could be encountered in areas where coverage is marginal and antennas at dwellings may receive a reflected signal from a turbine that is of sufficient power to interfere with the signal received directly from the transmitter. Based on the coverage maps for the area around the Project, it is possible that some areas could be deemed to have marginal reception, and interference could be encountered. If reception difficulties are encountered, there are a number of mitigation options available, and these are discussed in further detail in Section 4.14.5.

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. This simplified analysis is deemed appropriate as the implications of potential television interference are reasonably low given the large range of mitigation options available.

4.14.5 Mitigation options

In the event that television interference is an issue during construction or after commissioning of the Project, there are several amelioration options available:

1. Realigning the householder's television antenna more directly towards their existing transmitter.
2. Tuning the householder's antenna into alternative sources of the same television signal or a substitute signal.
3. Installing a more directional or higher gain antenna at the affected house.
4. Relocating the antenna to a less affected position.
5. Installing cable or satellite television at the affected house.
6. Installing a television relay station.

In the event of significant interference in the backscatter region, a more directional antenna should ensure a stronger signal from the transmitter since the backscattered signal will originate from a different direction. In the case of forward scatter, the antenna will be pointed towards both the original and scattered signal and hence a more directional antenna may not alleviate a forward scatter issue however, as noted in [39], DVB-T reception quality may not be substantially affected in the forward scatter region.

The ITU [43] identified that the receiver height can also affect interference. In areas that are relatively flat and free of vegetation, reflections can enhance or decrease the received signal strength relative to the free path signal strength. The ITU found that the received signal strength may not increase monotonically with receiver height. In other words, lowering the receiver height can improve reception in some cases.

In the event that terrestrial DTV reception cannot be improved, satellite television represents another potential amelioration option. Satellite based television comprises of both free to air and subscription based broadcasts. Residents in areas which are unable to receive DTV through their normal television antenna due to local interference, terrain, or distance from the transmitter in their area may be eligible to access the Australian Government funded Viewer Access Satellite Television (VAST) service [45].

In addition to the mitigation options outlined above, the Victorian Guidelines [1] include example permit conditions stating that, prior to commencing development, a survey must be undertaken to determine the average television and radio reception strength within 5 km of the wind farm site. If a complaint is later received regarding the effect of the wind farm on television or radio reception at a pre-existing dwelling within 5 km of the site, the operator must investigate that complaint. If the investigation finds that the wind farm has had a detrimental impact on the quality of television or radio reception, the operator must then restore reception at the affected dwelling to at least the quality determined in the pre-development survey to the satisfaction of the responsible authority.

4.15 Latrobe Valley flood warning system

Through the consultation process, Latrobe City Council advised that they also operate a flood warning system in the region around the proposed Project. DNV GL understands that this system consists of a network of approximately 20 stations that measure rainfall and river height data, then transmit that data in real time to the Latrobe City Council, Victorian State Emergency Service, and BoM Flood Warning Service [46] [47]. The Latrobe Valley flood warning system currently uses VHF radiocommunication signals at a frequency of around 151 MHz to transmit the recorded data. However, DNV GL understands that other systems in the BoM flood warning network, particularly those located in remote areas, have been configured to transmit data using mobile internet or satellite communication technologies.

DNV GL is currently engaging with Latrobe City Council to obtain further information about the Latrobe Valley flood warning system, and the potential for the Project to interfere with the operation of that system.

5 CONCLUSIONS

Broadcast towers and transmission paths around the Project were investigated to determine if EMI would be experienced as a result of the development and operation of the Project. The Project will involve the installation of 35 wind turbine generators. DNV GL has considered a turbine geometry that will be conservative for turbine configurations with dimensions satisfying all of the following criteria: a rotor diameter of 180 m or less and an upper tip height of 250 m or less.

The results of this assessment, including feedback obtained from relevant stakeholders, are summarised in Table 8.

The Project has potential to interfere with several point-to-multipoint links operated by Gippsland Water. However, DNV GL understands that the turbines located within the exclusion zones for these links will be micro-sited to avoid interference in a future revision to the turbine layout.

Interference to other point-to-multipoint links and to point-to-point links crossing the Project site is considered unlikely.

Interference to FM radio signals from the Kids FM broadcast tower to the north of the Project boundaries may be experienced in areas surrounding the Project. DNV GL recommends consulting with the operator of this tower to seek feedback on whether interference to their services is likely.

There is also potential for interference to wireless internet signals received from the Boolarra NBN tower at several dwellings in the vicinity of the Project. If interference to the NBN wireless internet service is experienced, mitigation options could include installing a new NBN tower to service the affected houses or relocating the antennas at those houses to achieve a clearer signal, although NBN Co has not confirmed the viability of these mitigation options.

Turbines at the Project may interfere with digital television broadcast signals received from nearby towers at a number of houses surrounding the Project. Coverage maps suggest that, for most of these towers, the potentially-affected houses are located in areas with limited to no signal coverage and therefore may not be receiving signals from that tower. However, interference to the signals from Latrobe Valley tower, which appears to be the primary transmitter for the area, could have a significant impact on local residents. Interference to mobile phone signals is also possible, particularly in areas that already experience marginal coverage. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference is also possible for satellite television and internet signals, but the signals that are likely to be intercepted by turbines in the Project are from satellites that do not provide services designed for Australian audiences.

Potential EMI impacts on other services considered in this assessment, including emergency services, meteorological radar, trigonometrical stations, CB radio, and mobile phones, are expected to be minor or can be assessed through consultation with the service operators.

Table 8 Summary of EMI assessment results for the proposed Project

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Radiocommunication towers	One tower within 2 km of proposed turbine locations, operated by Southern Cross Austereo Group (Kids FM) Nearest tower: 1936 m from turbines	Potential for interference –see findings for FM radio broadcasting	Consultation recommended but not yet undertaken
Fixed point-to-point links	Seven links crossing Project boundary, operated by: AusNet Services (one link) Aussie Broadband (one link) Gippsland Water (one link) Digital Distribution Australia (one link) Optus Mobile (two links) VerTel (one link) Diffraction effects: no turbines in DNV GL exclusion zones, no turbines in requested clearance zones Reflection/scattering and near-field effects: turbines are sufficiently far from towers to avoid impacts	Unlikely to cause interference	No concerns raised by Aussie Broadband and Digital Distribution Australia Potential for interference noted by other operators Clearance zones requested by AusNet Services, Digital Distribution Australia, Optus Mobile, and VerTel
Fixed point-to-multipoint links	258 assignments within 75 km of Project boundary 23 base stations within 20 km of Project boundary, operated by: AusNet Services (two sites) Aussie Broadband (two sites) Hazelwood Power Station (two sites) Gippsland Water (eight sites) Connectivity I.T. (two sites) Yallourn Power Station (one site) Speedweb Wireless Internet (four sites) Latrobe City Council (one site) Loy Yang Power Station (one site) Diffraction effects: turbines in exclusion zones for four Gippsland Water links, information not available for other links Reflection/scattering and near-field effects: turbines are sufficiently far from towers to avoid impacts	Potential for interference to links operated by Gippsland Water	No concerns raised by AusNet Services, Aussie Broadband, Connectivity I.T., Speedweb Wireless Internet, and Latrobe City Council Potential for interference noted by Gippsland Water, and details of links provided Consultation with Hazelwood, Yallourn, and Loy Yang Power Stations unlikely to be necessary Consultation with operators of other base stations up to 60 km from the Project recommended but not yet undertaken
Other licence types	Base to mobile station style communications: unlikely to be affected (see "Emergency services", "Mobile phones", "Radio broadcasting", "Television broadcasting") Aeronautical and radiodetermination: to be considered as part of an aviation impact assessment	-	-

Table 8 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Emergency services	Point-to-point links: no links crossing boundary Base to mobile station style communications: unlikely to be affected	Unlikely to cause interference	Consultation recommended but not yet undertaken
Meteorological radar	Nearest station: "Bairnsdale", 116 km from Project Unlikely to be affected	Unlikely to cause interference	Consultation recommended but not yet undertaken
Trigonometrical stations	35 stations within 20 km of Project boundary Electronic equipment: unlikely to be affected Sight lines to other stations: may be blocked by turbines	Unlikely to cause interference	Consultation recommended but not yet undertaken
Citizen's band radio	Unlikely to be affected	Unlikely to cause interference	-
Mobile phones	Fair to good coverage across most of the site, with limited coverage in some areas to the west, southwest, south, and southeast Unlikely to be affected, may experience interference in areas with marginal coverage	Potential for interference	No concerns raised by Optus Mobile Consultation with Telstra and Vodafone recommended but not yet undertaken
Wireless internet	Likely service providers: Aussie Broadband, Connectivity I.T, Speedweb Wireless Internet, mobile phone networks NBN: currently available as a fixed wireless and satellite service in areas surrounding the Project, potential for interference to fixed wireless internet signals from the Boolarra NBN tower to several dwellings	Potential for interference to NBN fixed wireless internet signals	No concerns raised by Aussie Broadband, Connectivity I.T., Speedweb Wireless Internet, and Optus Mobile Consultation with Telstra, Vodafone, and NBN Co recommended but not yet undertaken
Satellite television and internet	Services intended for Australia: unlikely to be affected Other services: signals from four satellites intercepted at nearby dwellings	Unlikely to cause interference	-
Radio broadcasting	AM signals: unlikely to be affected FM signals: may experience interference in close proximity to turbines FM signals from nearby Kids FM transmission tower: may experience interference in areas with marginal reception Digital radio signals: not available in vicinity of Project	Potential for interference to Kids FM radio broadcasts through obstruction of signals	Consultation with Southern Cross Austereo Group (operator of Kids FM broadcasting) recommended but not yet undertaken

Table 8 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)
Television broadcasting	Digital signals: may experience interference in areas with poor or marginal reception *Boolarra tower: 'good' coverage in southeast, 'variable' to 'poor' coverage elsewhere* 271 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	Consultation with RBA Holdings (operator of Boolarra broadcasting tower) recommended due to proximity but not yet undertaken
	Churchill tower: 'variable' to 'poor' coverage across site 244 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Jeeralang/Yinnar South tower: 'good' coverage in east, 'variable' to 'poor' coverage elsewhere 275 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Latrobe Valley tower: 'variable' to 'good' coverage across the site 200 dwellings in potential interference zone	Potential for interference	-
	Melbourne tower: 'variable' to 'good' coverage in northwest, 'variable' to 'poor' coverage elsewhere 846 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Newborough tower: 'good' coverage in north, 'variable' to 'poor' coverage elsewhere 258 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-
	Trafalgar/Yarragon tower: 'variable' to 'good' coverage in northwest, 'poor' coverage elsewhere 863 dwellings in potential interference zone, but signal coverage is limited in that area	Potential for interference	-

6 REFERENCES

[1] Department of Environment, Land, Water and Planning, "Policy and planning guidelines for development of wind energy facilities in Victoria," State of Victoria, October 2018.

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LIST OF TABLES

Table 9 Proposed turbine layout for the Project site [3]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]	Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]
T03	436525	5765561	293	T29	435389	5759043	251
T04	435750	5765156	317	T30	437040	5758715	211
T05	435296	5764592	317	T32	435954	5758492	226
T06	437495	5764699	209	T33	434976	5758338	248
T07	436473	5764438	253	T34	434051	5758153	217
T08	435544	5763978	256	T35	437056	5758069	199
T09	435470	5762948	230	T36	436134	5757873	223
T12	436508	5761045	196	T37	434704	5757718	250
T14	437789	5761008	191	T38	435544	5757416	225
T15	433800	5760517	254	T39	436935	5757281	206
T16	437282	5760457	194	T41	434750	5757067	262
T17	434760	5760476	217	T42	434253	5756519	258
T20	436493	5760073	223	T43	435616	5756655	189
T21	434216	5759907	224	T45	435767	5755772	187
T24	435787	5759639	234	T46	433871	5755768	243
T25	437408	5759641	198	T47	433005	5755169	229
T28	436532	5759218	227	T48	433276	5754264	192

1. Coordinate system: MGA zone 55, GDA94 datum.

Table 10 Details of point-to-point links crossing the proposed Project site

Link no.	Assignment ID	Licence number	Frequency [MHz]	Licence owner
1	3076691, 3076692	10329969/1	7792.175	AusNet Transmission Group Pty Ltd (AusNet Services) SPI Powernet Pty Limited Locked Bag 1405 Licensing-ICT Business Office MELBOURNE CITY MAIL CENTRE VIC 8001
	3076690, 3076689	10329969/1	8103.495	
	3076695, 3076696	10329970/1	7851.475	
	3076694, 3076693	10329970/1	8162.795	
2	758436, 758437	1188347/1	7821.825	Aussie Broadband Pty Ltd PO Box 3351 GIPPSLAND MC VIC 3841
	758435, 758434	1188347/1	8133.145	
3	896369, 896370	1925030/1	14564.000	Central Gippsland Region Water Corporation (Gippsland Water) PO Box 348 TRARALGON VIC 3844
	896368, 896367	1925030/1	15208.000	
4	773899, 773898	1222580/1	5974.850	Digital Distribution Australia Pty Limited PO Box 1966 Macquarie Centre NORTH RYDE NSW 2113
	773896, 773897	1222580/1	6226.890	
	773907, 773906	1222581/1	6034.150	
	773904, 773905	1222581/1	6286.190	
	773915, 773914	1222582/1	6093.450	
	773912, 773913	1222582/1	6345.490	
5	1189185, 1189186	1990120/1	10815.000	Optus Mobile Pty Limited Singtel Optus Pty Ltd PO Box 888 NORTH RYDE NSW 1670
	1189184, 1189183	1990120/1	11305.000	
6	3859133, 3859132	10467326/1	6019.325	
	3859130, 3859131	10467326/1	6271.365	
7	2615336, 2615337	10234394/1	6640.000	Vertical Telecoms Pty Limited (VerTel) PO Box 126 ROSEBERY NSW 2018
	2615335, 2615334	10234394/1	6980.000	

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
1245541	47952	1565029/1	-38.346	146.475	15	Ausnet Electricity Services Pty Ltd Locked Bag 1405 Licensing-ICT Business Office MELBOURNE CITY MAIL CENTRE VIC 8001
1245544	47952	1565029/1	-38.346	146.475	15	
1245616	53019	1900011/1	-38.279	146.050	16	
1245613	53019	1900011/1	-38.279	146.050	16	
1245528	53019	1565024/1	-38.279	146.050	16	
1245525	53019	1565024/1	-38.279	146.050	16	
1245497	51143	1564676/1	-38.570	146.307	22	
1245500	51143	1564676/1	-38.570	146.307	22	
1245493	302113	1564674/1	-38.406	146.639	31	
1245496	302113	1564674/1	-38.406	146.639	31	
1247655	53018	1966701/1	-37.955	145.493	75	
1247659	53018	1966702/1	-37.955	145.493	75	
1247656	53018	1966702/1	-37.955	145.493	75	
1247652	53018	1966701/1	-37.955	145.493	75	
831174	305993	1564598/1	-38.224	146.417	9	Aussie Broadband Pty Ltd PO Box 3351 GIPPSLAND MC VIC 3841
831171	305993	1564598/1	-38.224	146.417	9	
892089	54736	1922866/1	-38.130	146.484	19	
892086	54736	1922866/1	-38.130	146.484	19	
1174973	9001659	1930055/1	-38.619	146.174	27	
1174976	9001659	1930055/1	-38.619	146.174	27	
831179	305992	1564601/1	-38.372	146.611	28	
831182	305992	1564601/1	-38.372	146.611	28	
892130	50549	1922869/1	-38.655	146.346	32	
892133	50549	1922869/1	-38.655	146.346	32	
892134	306018	1922870/1	-37.935	146.642	45	
892137	306018	1922870/1	-37.935	146.642	45	
831187	305885	1564602/1	-37.955	146.828	55	
831190	305885	1564602/1	-37.955	146.828	55	
980565	305493	1975738/1	-38.242	146.375	6	Australian Power Partners B V & Others Attn: Accounts Payable PO Box 195 IT Manager MORWELL VIC 3840
1372239	305493	9872738/1	-38.242	146.375	6	
1372236	305493	9872738/1	-38.242	146.375	6	
980562	305493	1975738/1	-38.242	146.375	6	
757252	9002874	1187260/1	-38.274	146.389	7	
757249	9002874	1187260/1	-38.274	146.389	7	
1306492	42152	1323748/1	-37.695	146.505	63	Bureau of Meteorology GPO Box 1289 MELBOURNE VIC 3001
1306495	42152	1323748/1	-37.695	146.505	63	
920285	9014501	1942092/1	-38.388	146.269	2	Central Gippsland Region Water Corporation (Gippsland Water) PO Box 348 TRARALGON VIC 3844
920288	9014501	1942092/1	-38.388	146.269	2	
908556	9011755	1934760/1	-38.218	146.248	4	
813991	9011755	1433619/1	-38.218	146.248	4	
908553	9011755	1934760/1	-38.218	146.248	4	
913037	9011755	1937848/1	-38.218	146.248	4	
913034	9011755	1937848/1	-38.218	146.248	4	
4278667	9011755	1300996/2	-38.218	146.248	4	
4278666	9011755	1300996/2	-38.218	146.248	4	
715460	9011755	197132/1	-38.218	146.248	4	
813994	9011755	1433619/1	-38.218	146.248	4	
715463	9011755	197132/1	-38.218	146.248	4	
792396	42768	1325578/1	-38.201	146.260	5	
792393	42768	1325578/1	-38.201	146.260	5	
908187	42764	1934415/1	-38.159	146.347	9	
908190	42764	1934415/1	-38.159	146.347	9	
744385	42764	1143457/1	-38.159	146.347	9	
744388	42764	1143457/1	-38.159	146.347	9	
1400404	42764	9896649/1	-38.159	146.347	9	
1400405	42764	9896649/1	-38.159	146.347	9	
715471	42764	197133/1	-38.159	146.347	9	

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
715468	42764	197133/1	-38.159	146.347	9	
1005198	9023520	1987417/1	-38.234	146.424	10	
1005201	9023520	1987417/1	-38.234	146.424	10	
874504	9009530	1911224/1	-38.194	146.446	13	
874507	9009530	1911224/1	-38.194	146.446	13	
2871045	10005987	1934759/2	-38.213	146.526	19	
2871042	10005987	1934759/2	-38.213	146.526	19	
4322392	42773	10543600/1	-38.210	146.526	19	
1399783	42773	9896646/1	-38.210	146.526	19	
1399786	42773	9896646/1	-38.210	146.526	19	
4322391	42773	10543600/1	-38.210	146.526	19	
2871049	9003508	1934759/2	-38.137	146.499	20	
2871046	9003508	1934759/2	-38.137	146.499	20	
908182	9011756	1934414/1	-38.185	145.930	29	
908179	9011756	1934414/1	-38.185	145.930	29	
786335	100232	1312078/1	-38.185	145.929	29	
786338	100232	1312078/1	-38.185	145.929	29	
813995	305763	1433620/1	-38.374	146.677	33	
832504	305763	1565581/1	-38.374	146.677	33	
813998	305763	1433620/1	-38.374	146.677	33	
832507	305763	1565581/1	-38.374	146.677	33	
2527175	305763	10220583/1	-38.374	146.677	33	
2600596	305763	10231253/1	-38.374	146.677	33	Central Gippsland Region Water Corporation (Gippsland Water) PO Box 348 TRARALGON VIC 3844
2600595	305763	10231253/1	-38.374	146.677	33	
2527176	305763	10220583/1	-38.374	146.677	33	
2527172	305763	10220582/1	-38.374	146.677	33	
2527171	305763	10220582/1	-38.374	146.677	33	
1399788	305763	9896648/1	-38.374	146.677	33	
1399789	305763	9896648/1	-38.374	146.677	33	
715459	305763	197131/1	-38.374	146.677	33	
715456	305763	197131/1	-38.374	146.677	33	
893079	141953	1923318/1	-38.150	145.840	38	
893082	141953	1923318/1	-38.150	145.840	38	
740962	133457	1140150/1	-38.001	145.951	39	
740967	133457	1140150/1	-38.001	145.951	39	
792380	305228	1325576/1	-37.960	146.793	52	
792377	305228	1325576/1	-37.960	146.793	52	
792385	305229	1325577/1	-37.882	146.780	57	
792388	305229	1325577/1	-37.882	146.780	57	
2527167	305229	10220581/1	-37.882	146.780	57	
2527168	305229	10220581/1	-37.882	146.780	57	
792412	305232	1325580/1	-37.961	146.972	66	
792409	305232	1325580/1	-37.961	146.972	66	
2527184	301089	10220585/1	-38.108	147.052	66	
2527183	301089	10220585/1	-38.108	147.052	66	
2527160	301089	10220579/1	-38.108	147.052	66	
2527159	301089	10220579/1	-38.108	147.052	66	
715435	301089	197125/1	-38.108	147.052	66	
715438	301089	197125/1	-38.108	147.052	66	
975443	301089	1973297/1	-38.108	147.052	66	
975446	301089	1973297/1	-38.108	147.052	66	
981764	301089	1976255/1	-38.108	147.052	66	
981767	301089	1976255/1	-38.108	147.052	66	
792401	305231	1325579/1	-38.107	147.054	67	
792404	305231	1325579/1	-38.107	147.054	67	
2527188	305231	10220586/1	-38.107	147.054	67	
2527187	305231	10220586/1	-38.107	147.054	67	
832523	461630	1565583/1	-38.112	147.061	67	
832520	461630	1565583/1	-38.112	147.061	67	
908198	9008444	1934416/1	-37.941	146.985	68	
908195	9008444	1934416/1	-37.941	146.985	68	
2527164	9008444	10220580/1	-37.941	146.985	68	
2527163	9008444	10220580/1	-37.941	146.985	68	
715446	9008444	197127/1	-37.941	146.985	68	

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
715443	9008444	197127/1	-37.941	146.985	68	
715479	42743	197134/1	-38.189	147.084	68	
715476	42743	197134/1	-38.189	147.084	68	
2018460	9026704	9862650/2	-38.238	146.094	14	
2018459	9026704	9862650/2	-38.238	146.094	14	
2018387	134106	1929770/2	-38.244	146.048	17	
2018388	134106	1929770/2	-38.244	146.048	17	
2018383	134106	1929769/2	-38.244	146.048	17	
1900686	134106	10091673/1	-38.244	146.048	17	
1900689	134106	10091673/1	-38.244	146.048	17	
2018384	134106	1929769/2	-38.244	146.048	17	
2018404	43871	1933278/2	-38.269	145.984	22	
2018403	43871	1933278/2	-38.269	145.984	22	
2018367	134576	1929765/2	-38.057	146.032	30	
2018364	134576	1929764/2	-38.057	146.032	30	
2018363	134576	1929764/2	-38.057	146.032	30	
2018368	134576	1929765/2	-38.057	146.032	30	
2018428	134576	1961068/2	-38.057	146.032	30	
2018427	134576	1961068/2	-38.057	146.032	30	
1900685	9003364	10091672/1	-38.112	145.900	35	
2018375	9003364	1929767/2	-38.112	145.900	35	
2018379	9003364	1929768/2	-38.112	145.900	35	
2018380	9003364	1929768/2	-38.112	145.900	35	Connectivity I.T. Pty Ltd Level 1 5/15 Phoenix St WARRAGUL VIC 3820
2018376	9003364	1929767/2	-38.112	145.900	35	
1900682	9003364	10091672/1	-38.112	145.900	35	
2018391	100231	1929771/2	-38.117	145.819	41	
2018396	100231	1929772/2	-38.117	145.819	41	
1900693	100231	10091674/1	-38.117	145.819	41	
1900690	100231	10091674/1	-38.117	145.819	41	
2018392	100231	1929771/2	-38.117	145.819	41	
2018395	100231	1929772/2	-38.117	145.819	41	
2018456	9012604	9856950/2	-38.187	145.777	42	
2018455	9012604	9856950/2	-38.187	145.777	42	
2018371	9012604	1929766/2	-38.187	145.777	42	
2018372	9012604	1929766/2	-38.187	145.777	42	
2018416	9012604	1935291/2	-38.187	145.777	42	
2018415	9012604	1935291/2	-38.187	145.777	42	
2018411	9012604	1935290/2	-38.187	145.777	42	
2018412	9012604	1935290/2	-38.187	145.777	42	
2018399	50118	1930067/2	-38.223	145.745	44	
2018400	50118	1930067/2	-38.223	145.745	44	
2018451	53563	9844676/2	-38.073	145.653	56	
2018452	53563	9844676/2	-38.073	145.653	56	
2018424	53563	1935293/2	-38.073	145.653	56	
2018423	53563	1935293/2	-38.073	145.653	56	
2018419	53563	1935292/2	-38.073	145.653	56	
2018420	53563	1935292/2	-38.073	145.653	56	
727427	52632	491772/1	-38.208	146.366	6	EnergyAustralia Yallourn Pty Ltd TruEnergy Yallourn Pty Ltd Attn: Neil Firmin PO Box 444 MOE VIC 3825
727424	52632	491772/1	-38.208	146.366	6	

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
757180	12029	1187159/1	-38.406	146.638	31	
757177	12029	1187159/1	-38.406	146.638	31	ESSO Australia Pty Ltd
715320	12041	191259/1	-38.372	146.677	33	GPO Box 400C
715323	12041	191259/1	-38.372	146.677	33	Level 4
868048	42394	1905840/1	-38.221	147.156	74	EMIT Invoice
989329	42394	1980218/1	-38.221	147.156	74	Management
989326	42394	1980218/1	-38.221	147.156	74	MELBOURNE VIC
868045	42394	1905840/1	-38.221	147.156	74	3001
789685	42394	1322428/1	-38.221	147.156	74	
789688	42394	1322428/1	-38.221	147.156	74	
785895	301406	1309544/1	-38.175	146.007	24	Fonterra Australia Pty Ltd
785892	301406	1309544/1	-38.175	146.007	24	150 Darnum Park Road DARNUM VIC 3822
1289448	50840	1308564/1	-38.699	146.458	40	Gippsland Ports Committee of Management Inc (Gippsland Ports)
1289451	50840	1308564/1	-38.699	146.458	40	PO Box 388 BAIRNSDALE VIC 3875
1220124	403605	1425351/1	-38.000	146.658	40	
1220127	403605	1425351/1	-38.000	146.658	40	Gippsland Southern Rural Water Corporation (Southern Rural Water)
1220079	305868	1327584/1	-37.899	146.809	58	
1220076	305868	1327584/1	-37.899	146.809	58	
1220069	306301	1326457/1	-37.943	147.009	69	Accounts Payable PO Box 153 MAFFRA VIC 3860
1220066	306301	1326457/1	-37.943	147.009	69	
1219876	306301	1141792/1	-37.943	147.009	69	
1219879	306301	1141792/1	-37.943	147.009	69	
1220083	305869	1327585/1	-37.848	146.944	70	
1220080	305869	1327585/1	-37.848	146.944	70	
788997	303837	1320997/1	-38.071	145.476	71	Itron Australasia Pty Limited Actaris Pty Ltd 8 Rosberg Road WINGFIELD SA 5013
788996	303837	1320997/1	-38.071	145.476	71	
922635	9014872	1944112/1	-38.156	146.352	10	
922638	9014872	1944112/1	-38.156	146.352	10	
1448112	9027494	9938336/1	-38.137	146.281	11	Kallistrate Pty Ltd (Speedweb Wireless Internet) PO Box 356 MORWELL VIC 3840
1448115	9027494	9938336/1	-38.137	146.281	11	
926185	9015290	1946547/1	-38.354	146.437	12	
926182	9015290	1946547/1	-38.354	146.437	12	
922619	9014871	1944110/1	-38.138	146.485	19	
922622	9014871	1944110/1	-38.138	146.485	19	
922611	9014865	1944109/1	-38.030	146.625	36	
922614	9014865	1944109/1	-38.030	146.625	36	
4052206	10011059	10502978/1	-38.355	146.438	12	Latrobe City Council (Latrobe Shire Council) PO Box 264 MORWELL VIC 3840
4052209	10011059	10502978/1	-38.355	146.438	12	
787803	302912	1317096/1	-38.397	146.562	24	
787806	302912	1317096/1	-38.397	146.562	24	

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
787359	302666	1316032/1	-38.252	146.410	9	Loy Yang Power Management Pty Ltd PO Box 1799 TRARALGON VIC 3844
787362	302666	1316032/1	-38.252	146.410	9	
2399897	9003020	10182410/1	-38.241	146.560	22	
2399900	9003020	10182410/1	-38.241	146.560	22	
4047026	52625	10501450/1	-38.238	146.561	22	
4047023	52625	10501450/1	-38.238	146.561	22	
1235455	305291	1919623/1	-38.321	145.607	54	Multinet Gas DB No1 Pty Ltd Multinet Gas DB No2 Pty Ltd Multinet Gas Distribution Partnership PO Box 449 MOUNT WAVERLEY VIC 3149
1235452	305291	1919623/1	-38.321	145.607	54	
750367	42778	1149019/1	-38.440	145.934	27	South Gippsland Region Water Corporation (South Gippsland Water) PO Box 102 FOSTER VIC 3960
750370	42778	1149019/1	-38.440	145.934	27	
1009809	9024061	1989850/1	-38.645	146.210	30	
1009812	9024061	1989850/1	-38.645	146.210	30	
882125	9010281	1916656/1	-38.586	146.011	31	
882128	9010281	1916656/1	-38.586	146.011	31	
742953	9000510	1142258/1	-38.658	146.372	33	
742950	9000510	1142258/1	-38.658	146.372	33	
748213	9001159	1147200/1	-38.442	145.836	35	
748210	9001159	1147200/1	-38.442	145.836	35	
811174	9000509	1430555/1	-38.666	146.431	36	
811171	9000509	1430555/1	-38.666	146.431	36	
806660	403440	1424576/1	-38.398	145.815	36	
806657	403440	1424576/1	-38.398	145.815	36	
761978	9003574	1192052/1	-38.630	145.955	37	
761981	9003574	1192052/1	-38.630	145.955	37	
806732	403442	1424646/1	-38.716	146.121	39	
806729	403442	1424646/1	-38.716	146.121	39	
748935	9001277	1148024/1	-38.374	145.705	45	
748938	9001277	1148024/1	-38.374	145.705	45	
833223	46457	1566525/1	-38.673	146.694	51	
833226	46457	1566525/1	-38.673	146.694	51	
758980	9003022	1188768/1	-38.812	146.041	51	
758983	9003022	1188768/1	-38.812	146.041	51	
762436	9003596	1192427/1	-38.663	145.671	58	
762439	9003596	1192427/1	-38.663	145.671	58	
3112625	44091	10335279/1	-38.608	145.597	61	
997347	44091	1984167/1	-38.608	145.597	61	
997350	44091	1984167/1	-38.608	145.597	61	
3112624	44091	10335279/1	-38.608	145.597	61	
762440	44091	1192428/1	-38.608	145.597	61	
762443	44091	1192428/1	-38.608	145.597	61	
704828	38559	86886/1	-37.575	146.190	74	Telstra Corporation Limited Attn: Tom Fairbrother (Radio Engineering) Radio, Transport Engineering Locked Bag 810 ADELAIDE SA 5000
704825	38559	86886/1	-37.575	146.190	74	
1395520	9027170	9891130/1	-38.015	146.815	51	W C and T L Warren

Table 11 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
1395523	9027170	9891130/1	-38.015	146.815	51	2057 Sale-Heyfield Road DENISON VIC 3858
788803	303670	1320365/1	-38.149	145.923	32	Warragul Country Club Inc PO Box 2 WARRAGUL VIC 3820
788800	303670	1320365/1	-38.149	145.923	32	
866905	9008521	1904647/1	-38.531	145.411	73	Westernport Region Water Corporation 2 Boys Home Road NEWHAVEN VIC 3925
866908	9008521	1904647/1	-38.531	145.411	73	

Table 12 Details of other licences identified within 75 km of the proposed Project

Licence category	Licence type	Number of assignment IDs
1800 MHz Band	Spectrum	968
2 GHz Band	Spectrum	1006
2.3 GHz Band	Spectrum	2232
2.5 GHz Band	Spectrum	410
3.4 GHz Band	Spectrum	242
700 MHz Band	Spectrum	1294
800 MHz Band	Spectrum	909
Aeronautical Assigned System	Aeronautical	77
Amateur Repeater	Amateur	95
Ambulatory - Initial	Land Mobile	14
Ambulatory System	Land Mobile	174
CBRS Repeater	Land Mobile	12
Commercial Radio	Broadcasting	6
Commercial Television	Broadcasting	9
Community Broadcasting	Broadcasting	7
Earth Receive	Earth Receive	1
Fixed Earth	Earth	1
Fixed Receive	Fixed Receive	3
Land Mobile System - > 30MHz	Land Mobile	2205
Land Mobile System 0-30MHz	Land Mobile	264
Limited Coast Assigned System	Maritime Coast	28
Narrowband Area Service station(s)	Broadcasting	2
Narrowcasting Service (Fixed Tax)	Broadcasting	4
Narrowcasting Service (LPON)	Broadcasting	25
National Broadcasting	Broadcasting	12
Paging System - Exterior	Land Mobile	50
Paging System - Interior	Land Mobile	22
PMTS Class B	PTS	1010
PMTS Class B (935-960 MHz)	PTS 900 MHz	270
Radiodetermination	Radiodetermination	11
Retransmission	Broadcasting	26

Table 13 Emergency services with radiocommunication assets in the vicinity of the proposed Project

Emergency service	Contact details	Distance from closest site to Project boundary [km]
Ambulance Victoria	Ambulance Victoria Attn: Tim McCallum 303 Gillies Street North WENDOUREE VIC 3355	24
Australian Maritime Safety Authority	Australian Maritime Safety Authority GPO Box 2181 Attn: Response Division Administration Canberra ACT 2601	64
Australian Radio Rescue Service Inc	Australian Radio Rescue Service Inc VMR Westernport PO Box 353 (Attn: Ian Cuthbertson) FRANKSTON VIC 3199	69
Country Fire Authority	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149	2
Department of Justice and Regulation – Corrections Victoria S&ES Group	Department of Justice and Regulation Corrections Victoria S&ES Group Radiocommunications Coordinator Locked Bag 7 LARA VIC 3212	59
Department of Justice and Regulation – ESTA Emergency Services Telecommunications Authority	Department of Justice and Regulation ESTA Emergency Services Telecommunications Authority c/-10 Wesley Court - Motorola MMR Project Tally Ho Bus Park EAST BURWOOD VIC 3151	35
Department of Justice and Regulation – RMR Regional Mobile Radio	Department of Justice and Regulation RMR Regional Mobile Radio c/- Level 2 Building M5 30 Henderson Road CLAYTON VIC 3168	7
Department of Justice and Regulation – Visionstream Australia	Department of Justice and Regulation Visionstream Australia Locked Bag 4001 Attn: Rosario Holden HEATHERTON VIC 3202	5
Life Saving Victoria Limited	Life Saving Victoria Limited PO Box 353 (Paul Kildea) SOUTH MELBOURNE VIC 3205	33
St. John Ambulance Australia Incorporated	St. John Ambulance Australia Incorporated Attn: Paul Stein 170 Forster Road MOUNT WAVERLEY VIC 3149	7
The Australian Volunteer Coast Guard Association Inc	The Australian Volunteer Coast Guard Association Inc PO Box 64 SANDRINGHAM VIC 3191	22
Victoria State Emergency Service	Victoria State Emergency Service 168 Sturt Street SOUTHBANK VIC 3006	7

Table 14 BoM radar sites in the vicinity of the proposed Project

BoM radar site	Latitude[1]	Longitude[1]	Distance to Project [km]
Bairnsdale	-37.890	147.560	116
Melbourne	-37.860	144.760	138
Yarrawonga	-36.030	146.030	246
NW Tasmania	-41.181	145.579	317
Wagga Wagga	-35.170	147.470	357
Canberra	-35.660	149.510	404

1. Coordinate system: Lat/Lon WGS84 datum.

Table 15 Trigonometrical stations in the vicinity of the proposed Project

Station name	Datum	Latitude	Longitude	Distance to Project [km]
Allambee	AGD66	S38°15' 47.48"	E146°2' 42.34"	17
	AGD84	S38°15' 47.50"	E146°2' 42.26"	
	GDA94	S38°15' 42.03"	E146°2' 47.01"	
Andersons	AGD66	S38°9' 20.04"	E146°19' 50.02"	10
Austins Hill	AGD66	S38°28' 45.71"	E146°17' 2.41"	11
	AGD84	S38°28' 45.73"	E146°17' 2.32"	
	GDA94	S38°28' 40.25"	E146°17' 7.07"	
Austins Hill RM1	AGD66	S38°28' 45.68"	E146°17' 2.21"	11
Boola	AGD66	S38°8' 8.33"	E146°28' 1.31"	18
Budgeree	AGD66	S38°25' 24.71"	E146°21' 42.09"	11
	AGD84	S38°25' 24.73"	E146°21' 42.00"	
	GDA94	S38°25' 19.24"	E146°21' 46.74"	
Davey	AGD66	S38°15' 31.49"	E146°21' 50.25"	5
	AGD66	S38°15' 31.49"	E146°21' 50.25"	
	AGD66	S38°15' 31.49"	E146°21' 50.25"	
Dobbins	AGD66	S38°21' 22.54"	E146°26' 12.39"	13
Gooding	AGD66	S38°8' 14.14"	E146°17' 7.89"	11
Haunted Hills	AGD66	S38°11' 11.78"	E146°19' 17.85"	6
	AGD66	S38°11' 11.78"	E146°19' 17.85"	
Hazelwood	AGD66	S38°16' 44.49"	E146°22' 49.37"	7
	AGD66	S38°16' 44.49"	E146°22' 49.37"	
	AGD66	S38°16' 44.49"	E146°22' 49.37"	
Hernes Oak	AGD66	S38°13' 4.52"	E146°18' 16.84"	2
Hooghly	AGD66	S38°23' 18.33"	E146°27' 53.14"	16
	AGD84	S38°23' 18.35"	E146°27' 53.06"	
	GDA94	S38°23' 12.86"	E146°27' 57.79"	
Howletts	AGD66	S38°10' 13.49"	E146°20' 36.25"	8
Kayes	AGD66	S38°8' 1.37"	E146°22' 58.76"	13
Kerrie Brae	AGD66	S38°14' 47.43"	E146°2' 50.70"	17
	AGD84	S38°14' 47.45"	E146°2' 50.61"	
	GDA94	S38°14' 41.97"	E146°2' 55.36"	
Mardan	AGD66	S38°26' 40.15"	E146°6' 27.39"	13
	AGD84	S38°26' 40.18"	E146°6' 27.30"	
	GDA94	S38°26' 34.70"	E146°6' 32.06"	
Medews	AGD66	S38°19' 0.69"	E146°24' 50.04"	10
Mills	AGD66	S38°18' 15.42"	E146°27' 35.28"	14
Moe	AGD66	S38°13' 19.57"	E146°13' 33.06"	5
	AGD84	S38°13' 19.60"	E146°13' 32.97"	
	GDA94	S38°13' 14.11"	E146°13' 37.71"	
Morwell North Base	AGD66	S38°15' 14.90"	E146°27' 12.83"	13
Morwell South Base	AGD66	S38°16' 26.33"	E146°26' 6.74"	11
Morwell WT	AGD66	S38°13' 33.71"	E146°24' 51.25"	9
	AGD66	S38°13' 33.71"	E146°24' 51.26"	
	AGD66	S38°13' 33.71"	E146°24' 51.26"	
Ronalds	AGD66	S38°15' 36.74"	E146°23' 34.83"	8
	AGD66	S38°15' 36.70"	E146°23' 34.81"	
Sayers	AGD66	S38°14' 4.50"	E146°18' 4.42"	1
Shaws	AGD66	S38°19' 35.36"	E146°18' 23.76"	1
Silcocks	AGD66	S38°18' 19.81"	E146°20' 50.13"	4
Tanjil East	AGD66	S38°9' 12.70"	E146°24' 12.16"	13

Table 15 Trigonometrical stations in the vicinity of the proposed Project (continued)

Station name	Datum	Latitude	Longitude	Distance to Project [km]
Thorpdale	AGD66	S38°18' 21.25"	E146°12' 50.26"	2
	AGD84	S38°18' 21.28"	E146°12' 50.17"	
	GDA94	S38°18' 15.79"	E146°12' 54.91"	
Traralgon South	AGD66	S38°15' 47.71"	E146°30' 28.54"	18
Tyers	AGD66	S38°7' 52.52"	E146°28' 54.37"	19
	AGD84	S38°7' 52.55"	E146°28' 54.29"	
	GDA94	S38°7' 47.05"	E146°28' 59.00"	
Tyers North	AGD66	S38°7' 15.22"	E146°28' 31.49"	20
	AGD84	S38°7' 15.25"	E146°28' 31.41"	
	GDA94	S38°7' 9.75"	E146°28' 36.13"	
Tyers North Trav Point A	AGD66	S38°7' 22.83"	E146°28' 36.83"	20
	AGD84	S38°7' 22.86"	E146°28' 36.74"	
	GDA94	S38°7' 17.36"	E146°28' 41.46"	
Tyers West	AGD66	S38°9' 6.65"	E146°25' 34.52"	14
Walkers Hill	AGD66	S38°21' 14.64"	E146°29' 3.90"	17

Table 16 Houses with potential to experience interference to NBN fixed wireless internet signals from NBN towers in the vicinity of the Project

House ID[1]	Easting[2] [m]	Northing[2] [m]	May be receiving signals from the Boolarra NBN tower	May be receiving signals from the Narracan NBN tower
44	429015	5759172	X	
45	429096	5759045	X	
46	428824	5759012	X	
62	425839	5752479	X	
63	426048	5752406	X	
64	426102	5752181	X	
67	426039	5751200	X	
68	426312	5751217	X	
93	429940	5752608	X	
94	430195	5752601	X	
95	429915	5752846	X	
764	431206	5752889	X	
765	431155	5752966	X	
766	431253	5752942	X	
795	432088	5752531	X	
796	431377	5752829	X	
811	431033	5753784	X	
826	432624	5758517	X	X
827	432809	5758713	X	X
828	432992	5758778	X	X
829	432961	5758727	X	X
830	432914	5758908	X	X
831	433149	5758915	X	X
832	433210	5759227	X	X
1202	427286	5752312	X	
1203	425759	5752387	X	
1211	426923	5754892	X	
1220	429920	5758731	X	
1221	429853	5758891	X	
1222	429343	5759113	X	

1. This part of the EMI assessment was conducted in the early stages of this work using an incomplete list of dwellings in the vicinity of the Project, and so there may be additional houses with potential to experience interference to NBN fixed wireless internet signals that have not been identified here. The assessment will be updated to consider all dwelling locations in the vicinity of the Project in a future revision.
2. Coordinate system: MGA zone 55, GDA94 datum.

Table 17 Summary of service operators contacted by DNV GL and responses received to date

	Licence/service type and distance of closest site	Operator name and DNV GL reference	Response received to date
1	Fixed point-to-point: one link crossing the Project site, no turbines in diffraction exclusion zone set by DNV GL Fixed point-to-multipoint: 15 km from Project boundary	AusNet Transmission Group Pty Ltd (AusNet Services) PP227556-AUME-L-01-A	Response received by email on 10 April 2019: *"From our desktop analysis, the maximum height allowed to the top of the turbine blade is 180m if they are in between our direct LOS.* *In our analysis we have allowed for the desktop error margin and our future requirements.* *The height could be increased if the turbine structures are moved to the side to avoid direct LOS on our link. Our clearance criteria is 2x Fresnel radii (8GHz frequencies)."* Coordinates of towers provided on 11 April 2019
2	Fixed point-to-point: one link crossing the Project site, no turbines in diffraction exclusion zone set by DNV GL Fixed point-to-multipoint: 9 km from Project boundary	Aussie Broadband Pty Ltd PP227556-AUME-L-02-A	Response received by email on 15 April 2019: *"We don't have any concerns about the proposed wind farm."*
3	Fixed point-to-point: one link crossing the Project site, no turbines in diffraction exclusion zone set by DNV GL Fixed point-to-multipoint: 2 km from Project boundary Mobile radio: 4 km from Project boundary	Central Gippsland Water Corporation (Gippsland Water) PP227556-AUME-L-03-A	Response received by email on 22 May 2019: *"We have analysed the coordinate location data provided by DNV GL – Energy and have identified that radio communication paths traverse the proposed wind farm site and associated turbines.* *Gippsland Water have radio communications assets at Moe South, these assets communicate to numerous other sites in the areas of Boolarra, Yinnar, Churchill, Jeeralang Junction and Hazelwood. Gippsland Water also have a digital mobile radio (DMR) base located at the Moe South site.* *Due to the number of communications pathways traversing the site, Gippsland Water's assets, services and DMR coverage will be impacted by the proposed wind farm.* *In regards to the clearances required, we acknowledge your diffraction exclusion zone calculations and are seeking your assurance that our radio communications will not be impacted."* Coordinates of towers and details of point-to-multipoint link paths provided on 24 May 2019

Table 17 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV GL reference	Response received to date
4	Fixed point-to-point: one link crossing the Project site, no turbines in diffraction exclusion zone set by DNV GL	Digital Distribution Australia Pty Ltd PP227556-AUME-L-04-A	Response received by email on 17 April 2019: *"Digital Distribution Australia (DDA) has reviewed the information presented in relation to the proposed Delburn Wind Farm and its potential impacts on DDA's existing telecommunications infrastructure and services…* *DDA's network that is traversing over this proposed windfarm carries on-air commercial television as well as carrier grade Ethernet backhaul services. It is imperative that there are no adverse impacts to the performance of the network during and post installation of this windfarm.* *…At this stage, we don't believe that the turbines T37 and T38 will have any negative impacts on the performance of the current point to point microwave radio link.* *…DDA have conducted clearance checks to ensure that the first 3 Fresnel zones remain unobstructed… none of the proposed turbines are within the exclusion zone.* *…DDA don't believe… that the proposed turbines would have an impact on our existing microwave radio links. This is however only based on desk top study, and DDA would request to be kept up to date in relation to the schedule and installation of this project…* *In summary, the proposed windfarm and turbine locations do not appear to have any impacts on the existing DDA infrastructure and point to point links currently in operation."* Coordinates of towers provided on 8 May 2019
5	Fixed point-to-point: two links crossing the Project site, no turbines in diffraction exclusion zones set by DNV GL PMTS/spectrum (mobile phone): 4 km from Project boundary	Optus Mobile Pty Limited PP227556-AUME-L-05-A	Response received by email on 29 March 2019: *"There are two Optus owned Microwave radio links that cross the proposed wind farm."* Follow-up response received by email on 7 May 2019: *"At least a minimum of 30m of clearance is required."* Coordinates of one tower for link 5 obtained from Telstra on 7 May 2019, other tower for link 5 is shared with AusNet Services. No tower locations obtained for link 6.

Table 17 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV GL reference	Response received to date
6	Fixed point-to-point: one link crossing the Project site, no turbines in diffraction exclusion zone set by DNV GL	Vertical Telecoms Pty Ltd (VerTel) PP227556-AUME-L-06-A	Response received by email on 15 April 2019: *"Based on the calculations, we have first Fresnel zone F1 =24.4m for the point to point link…* *We would like to have a minimum buffer distance of 15m between the [turbine] rotor's edge and first Fresnel zone F1."* Coordinates of towers provided on 16 April 2019 Follow-up response received by email on 3 May 2019, after receiving advice from DNV GL that the link crosses the Project site well above the maximum turbine tip height *"We are good as long as terrain elevation height plus turbine height is less than 610 m."*
7	Fixed point-to-multipoint: 14 km from Project boundary	Connectivity I.T. Pty Ltd PP227556-AUME-L-07-A	Response received by telephone on 3 June 2019: No concerns regarding potential for interference
8	Fixed point-to-multipoint: 10 km from Project boundary	Kallistrate Pty Ltd (Speedweb Wireless Internet) PP227556-AUME-L-08-A	Response received by email on 2 April 2019: *"I see no problem with your windfarm development.* *As far as any problems with interference we are happy to work around them for the greater good so to speak."*

Table 17 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV GL reference	Response received to date
9	Fixed point-to-point: two proposed links crossing the Project site – details yet to be confirmed Fixed point-to-multipoint: 7 km from Project boundary Flood warning system	Latrobe City Council PP227556-AUME-L-09-A	<u>Response received by email on 21 May 2019:</u> *"I have overlayed your kmz files with a copy of our network. As you can see, [we have] a proposed link [in the north of the site] that will not show up on ACMA at this point in time. These licences will go up later this year once our tower is built in Jeeralang…* *…we don't have any impact in any other areas of our Microwave Comms network.* *In regards to our TV network. The licences are listed as RBA but the towers are owned by LSS. It might be best to contact them for exact details.* *For our flood monitoring network, this has licences in 151.5 mhz. The repeater stations are located in Jerralang [sic] and MT Tassie, however the local transmitter are located throughout the council area… I will have to wait until the system manager… comes back to do a drive around and map to kmz to see if they are in the way. I don't think they will be but would rather be 100% sure."* <u>Response received by email on 16 June 2019:</u> *"At this point in time we hope [the Jeeralang tower is] within 100 meters of the existing Ausnet Services in Jeeralang, but could be moved within a 1km…* *Our existing microwave links are 18GHz, however due to the distance and equipment availability we are likely to move to 11GHz. The antennas are not likely to exceed 30 meters on both ends. The DB gain is not known yet…* *…we do not have the exact locations [of the flood warning system stations] seeing they have been installed for over 20 years… I will try and get as much as possible for you. I think we have around 20 locations by memory, all around the 151Mhz and all are configured like a mesh so they all transmit and receive to each other. It's a network we provide to the BOM and State Govt for Flood monitoring purposes."* <u>Consultation ongoing to confirm location of Jeeralang tower, details of proposed point-to-point links, and locations of stations for the flood warning system</u>

LIST OF FIGURES

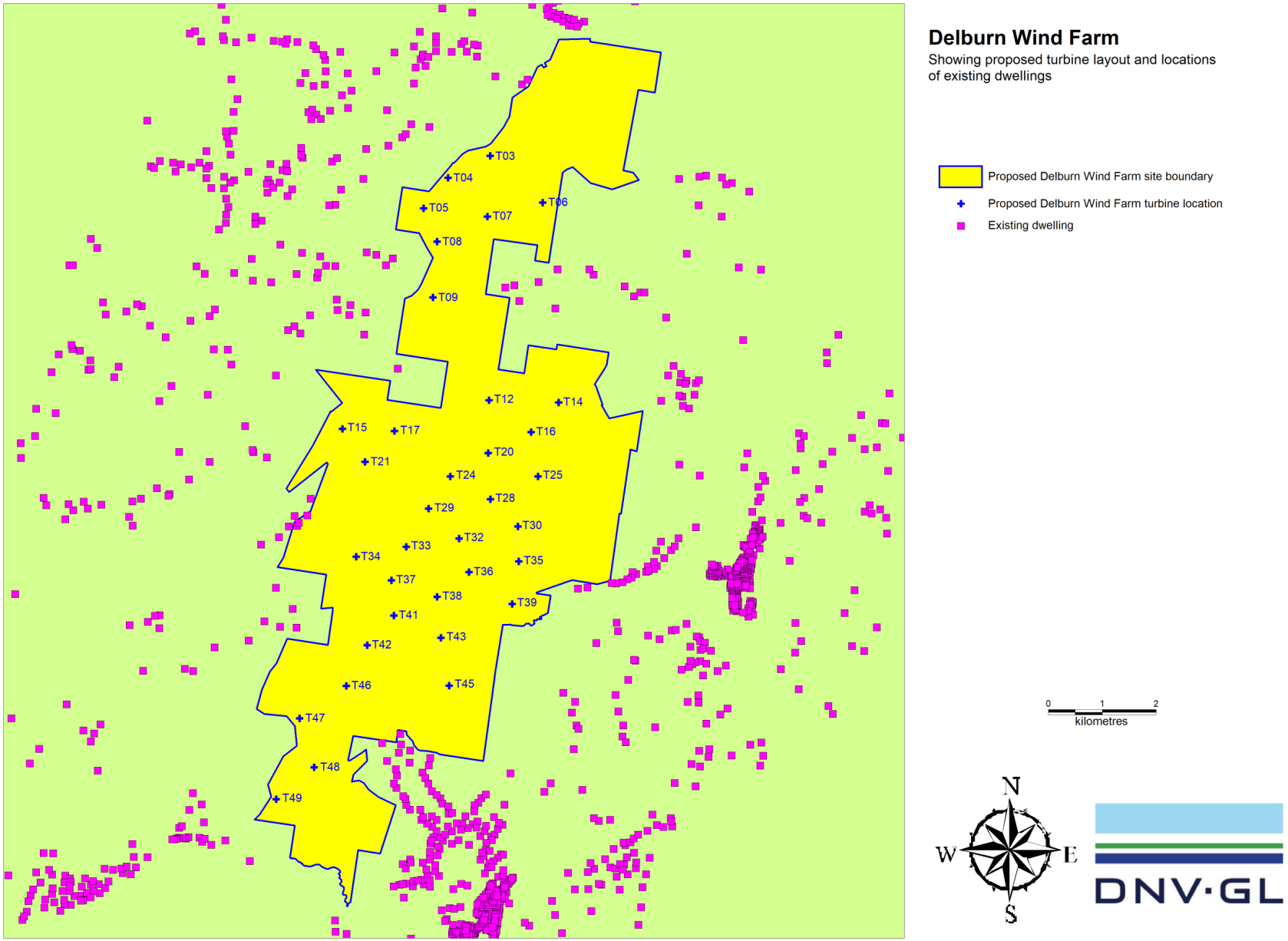

Figure 1 Map of the proposed Project, showing site boundaries, turbine locations, and locations of nearby dwellings

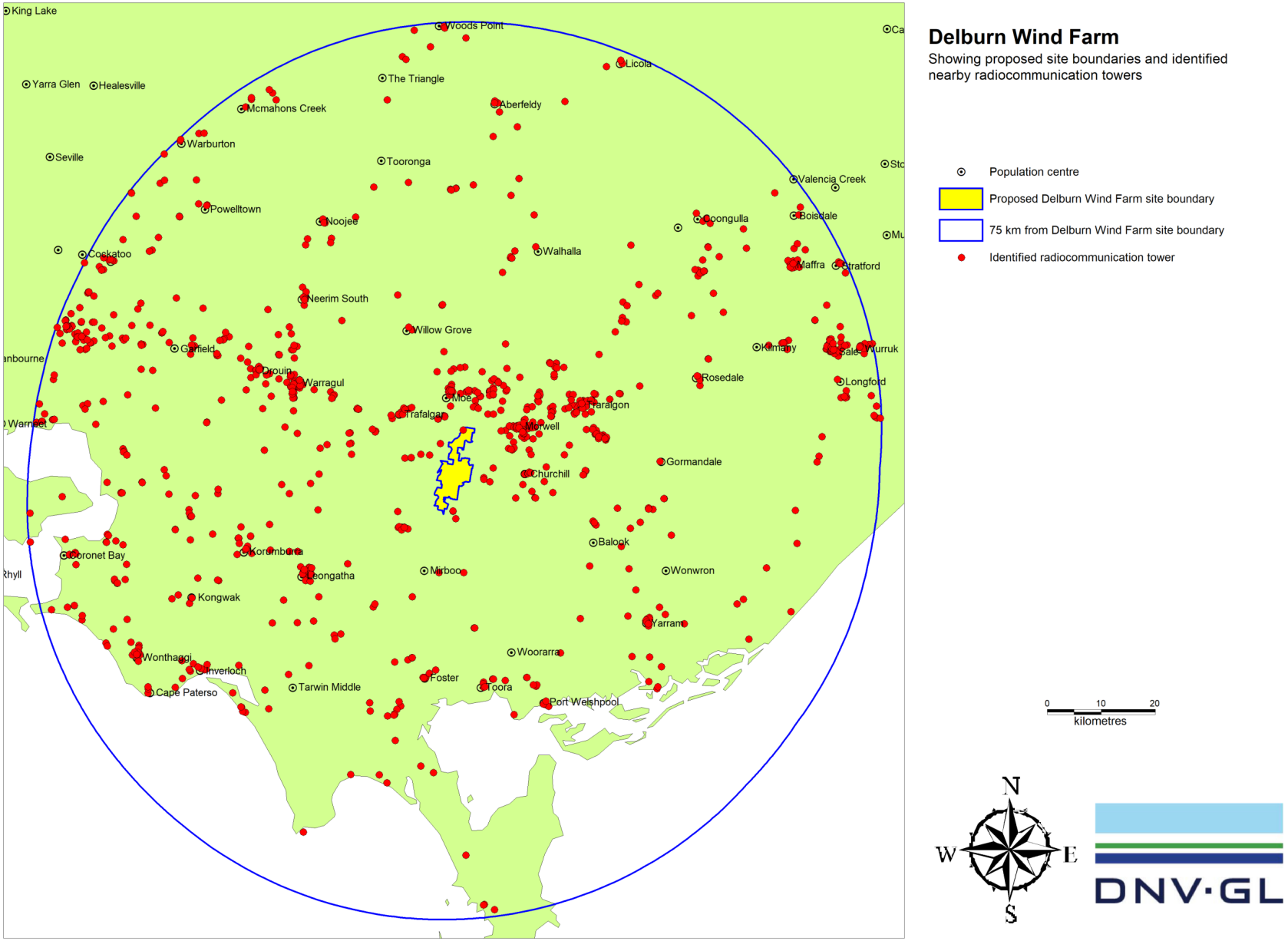

Figure 2 Location of the proposed Project and identified proximate radiocommunication sites

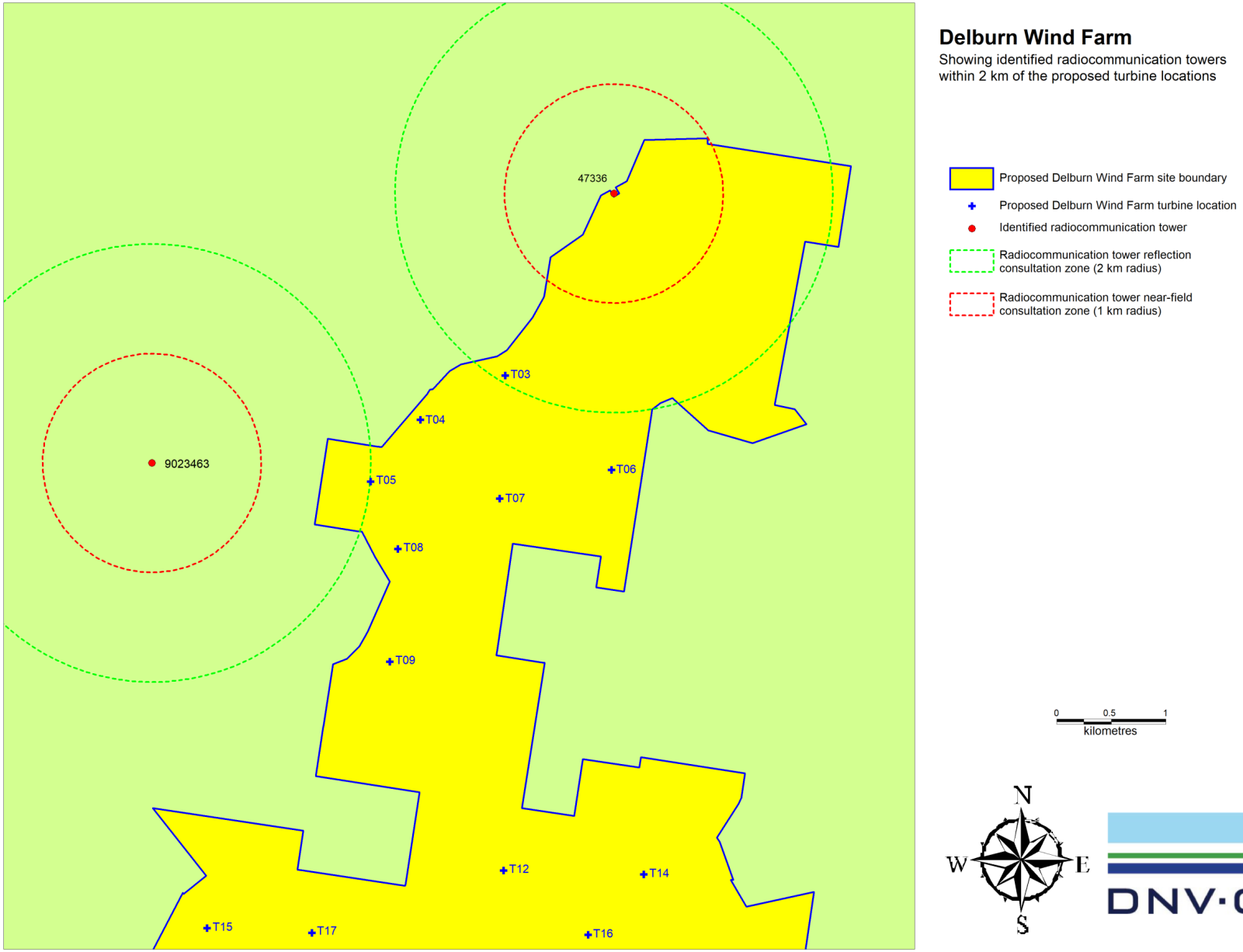

Figure 3 Identified radiocommunication sites within 2 km of the turbine locations for the proposed Project

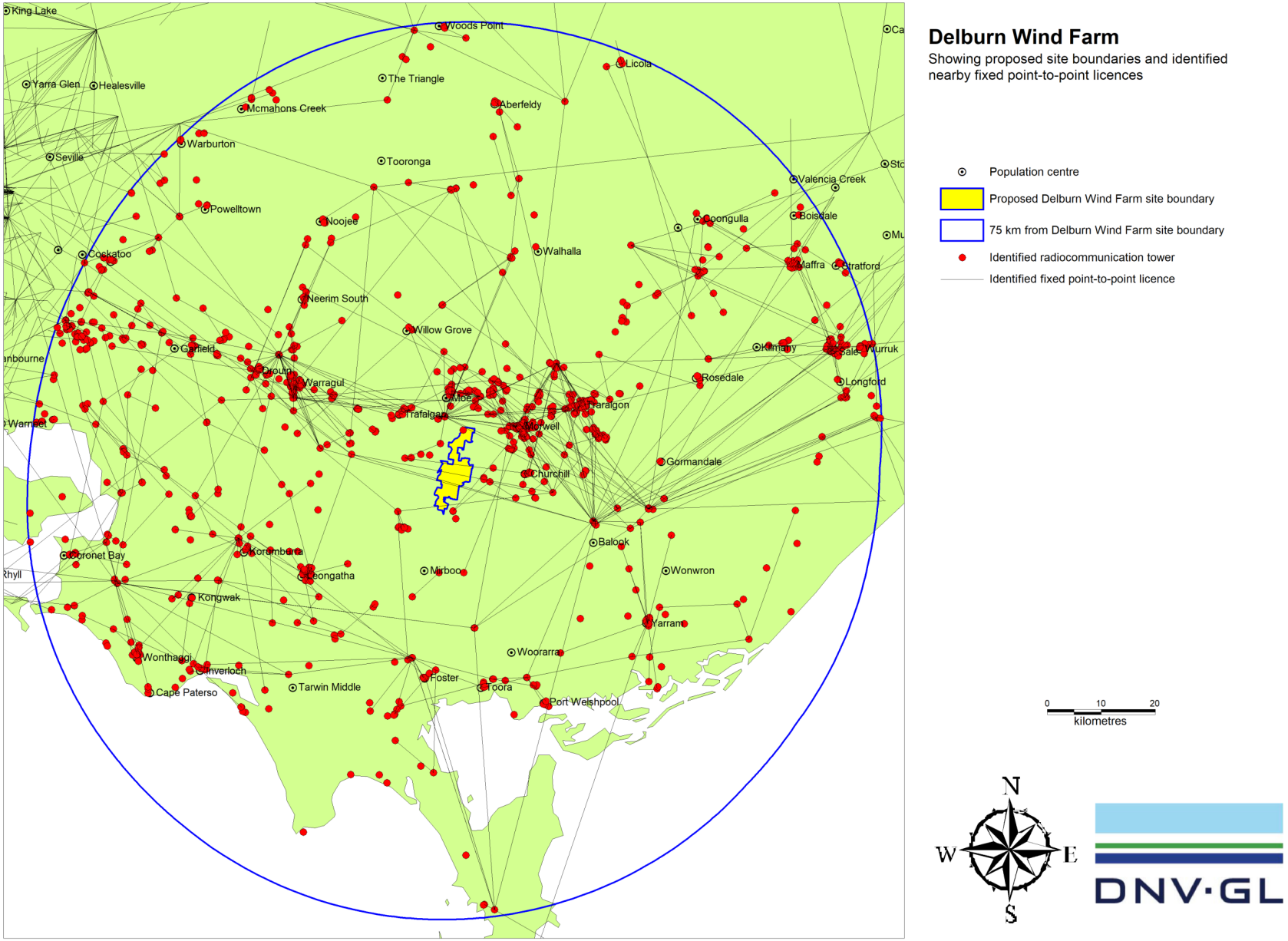

Figure 4 Identified transmission vectors for fixed licences of point-to-point type in the vicinity of the proposed Project

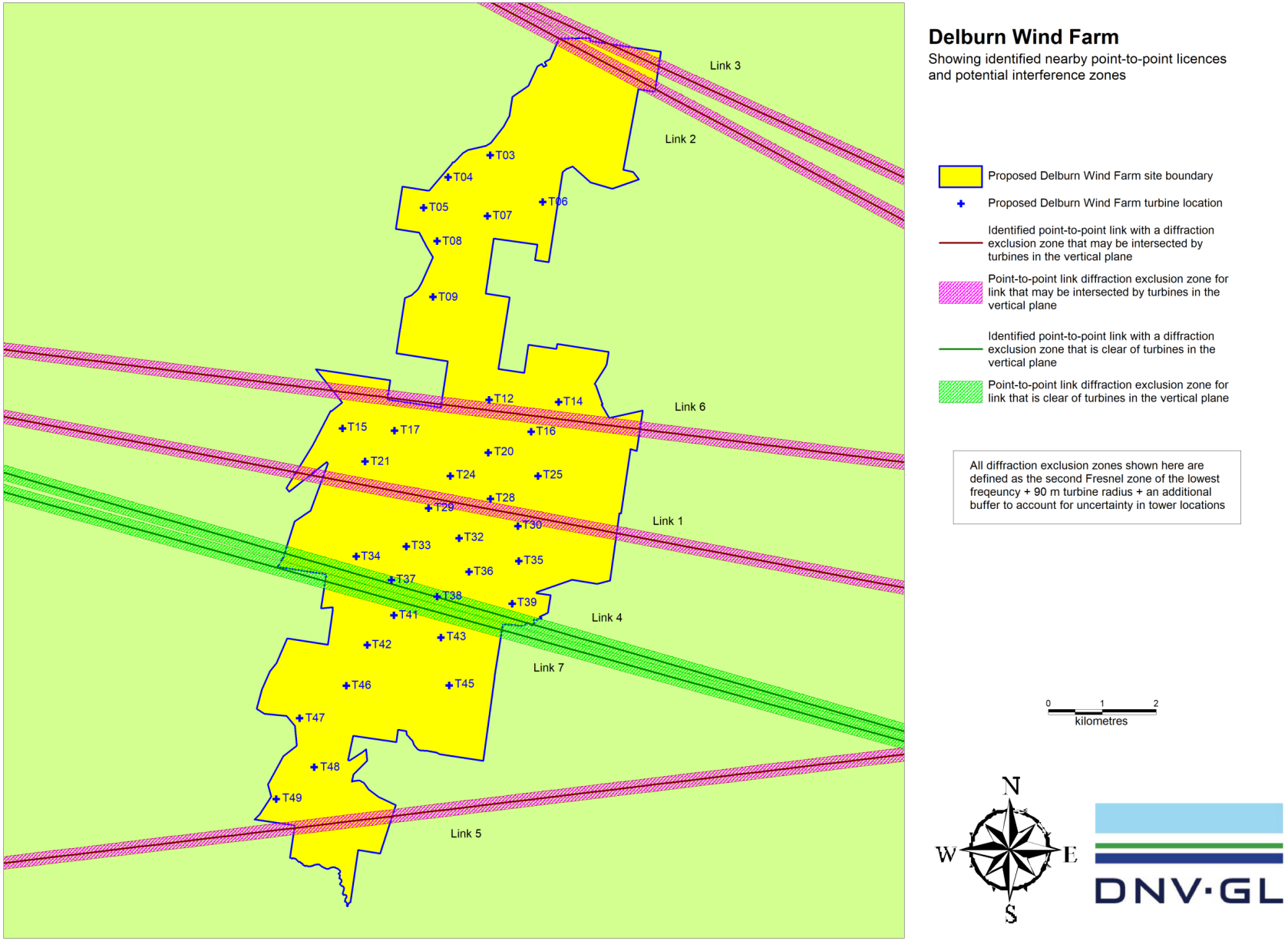

Figure 5 Identified point-to-point radiocommunication vectors and interference zones established by DNV GL for the proposed Project

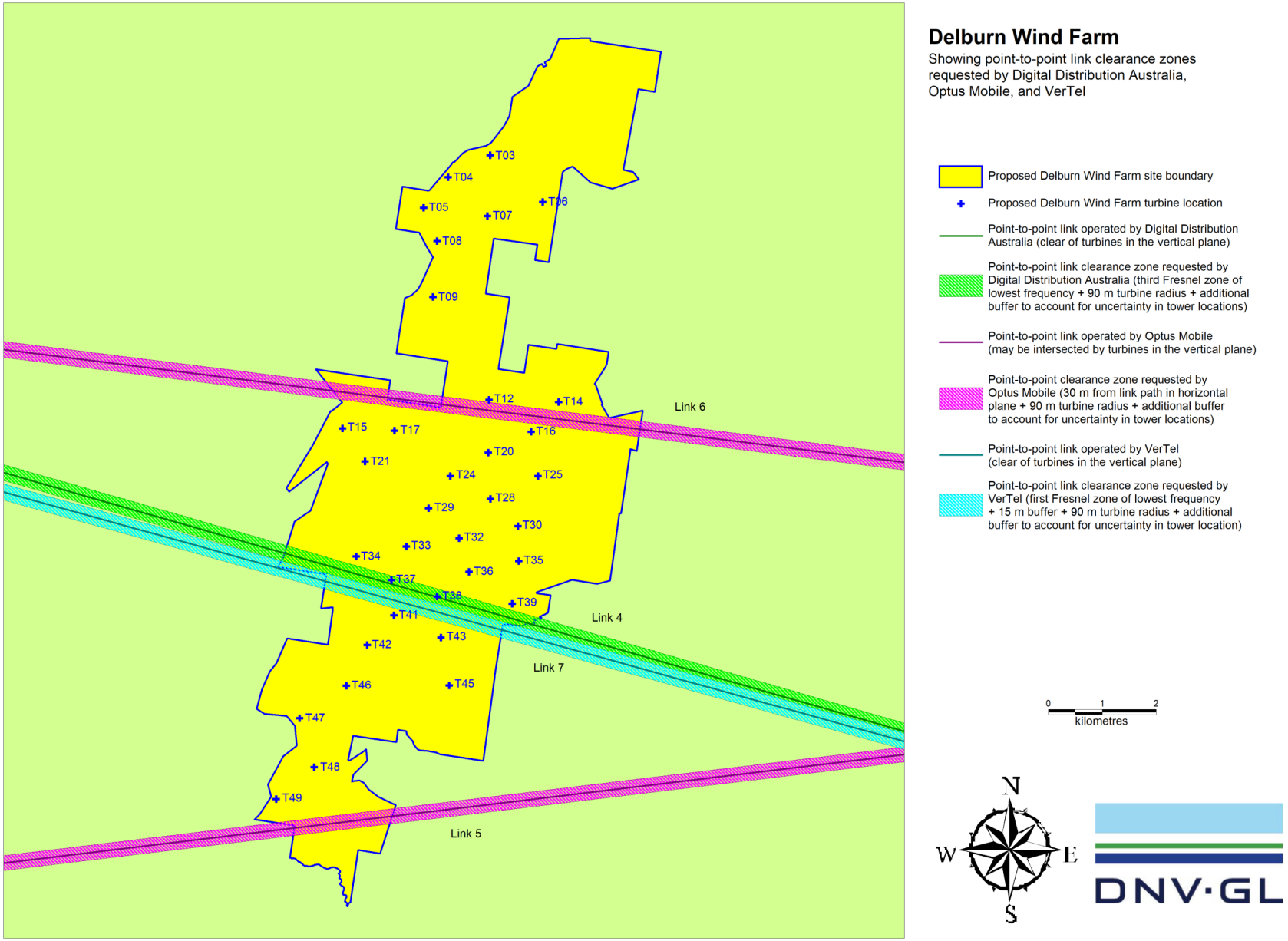

Figure 6 Identified point-to-point radiocommunication vectors operated by Digital Distribution Australia, Optus Mobile, and VerTel and requested clearance zones for the proposed Project

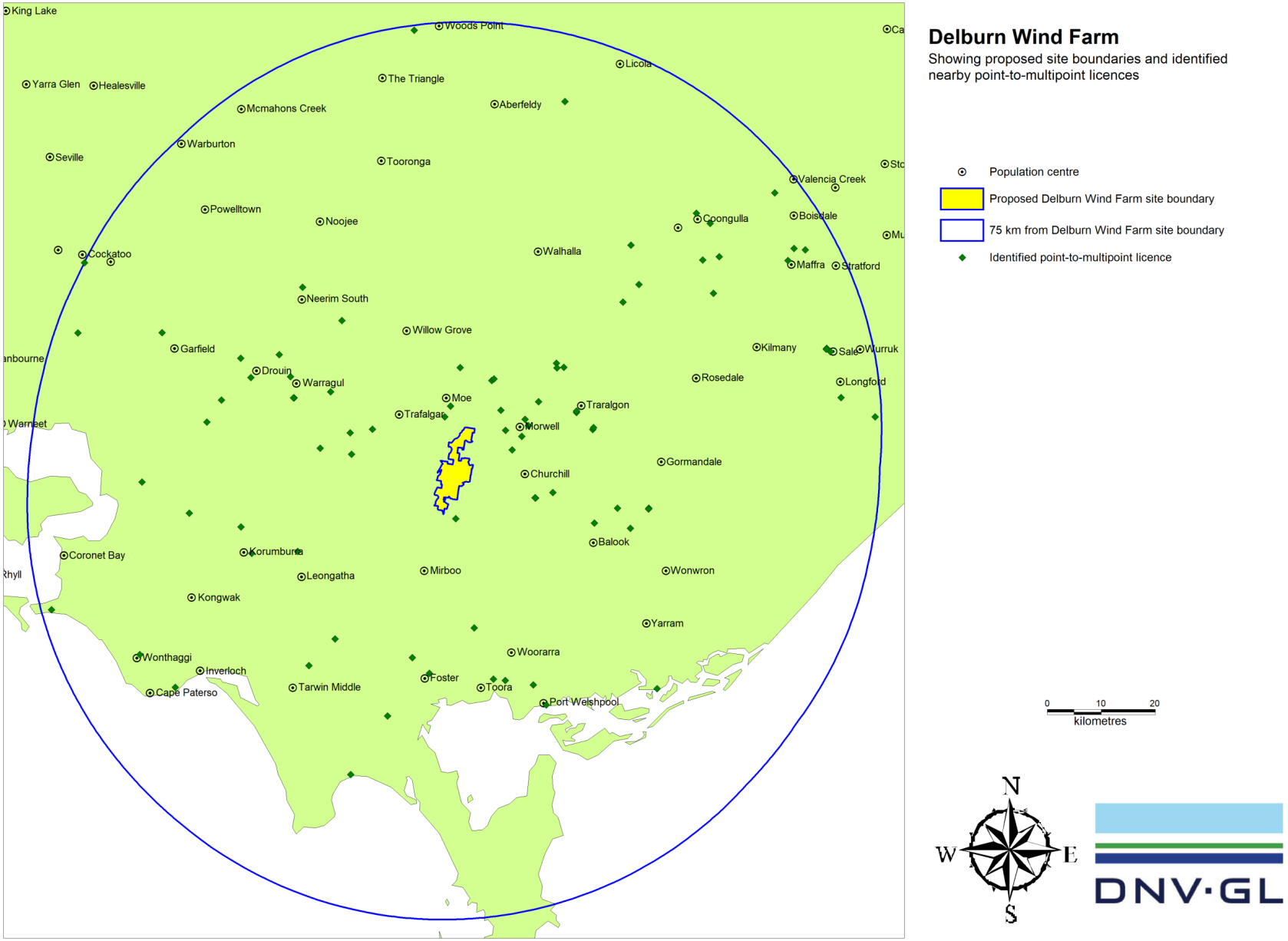

Figure 7 Location of point-to-multipoint licences in the vicinity of the proposed Project

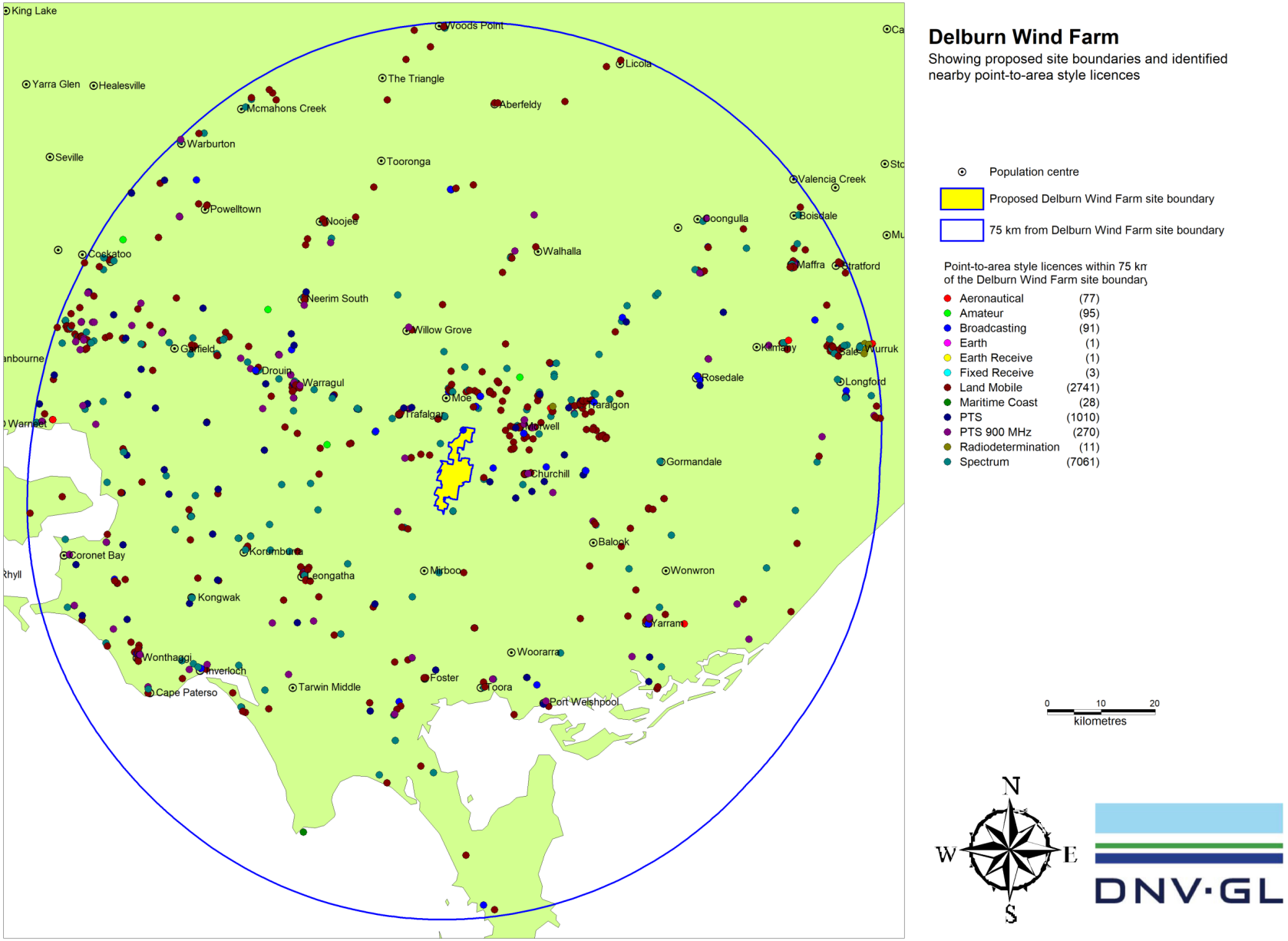

Figure 8 Location of general point-to-area style licences within 75km of the proposed Project

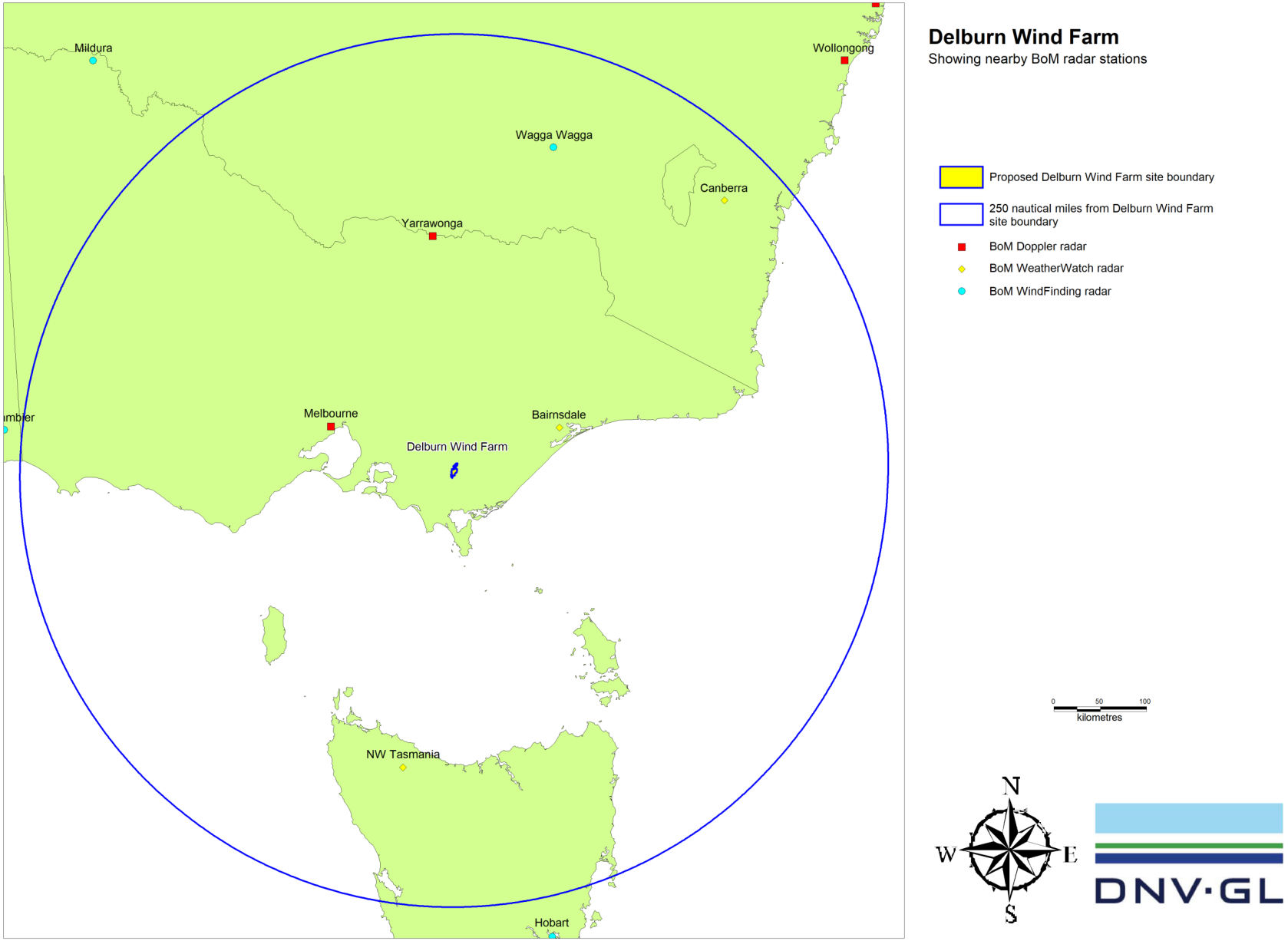

Figure 9 Location of meteorological radar sites within 250 nautical miles of the proposed Project

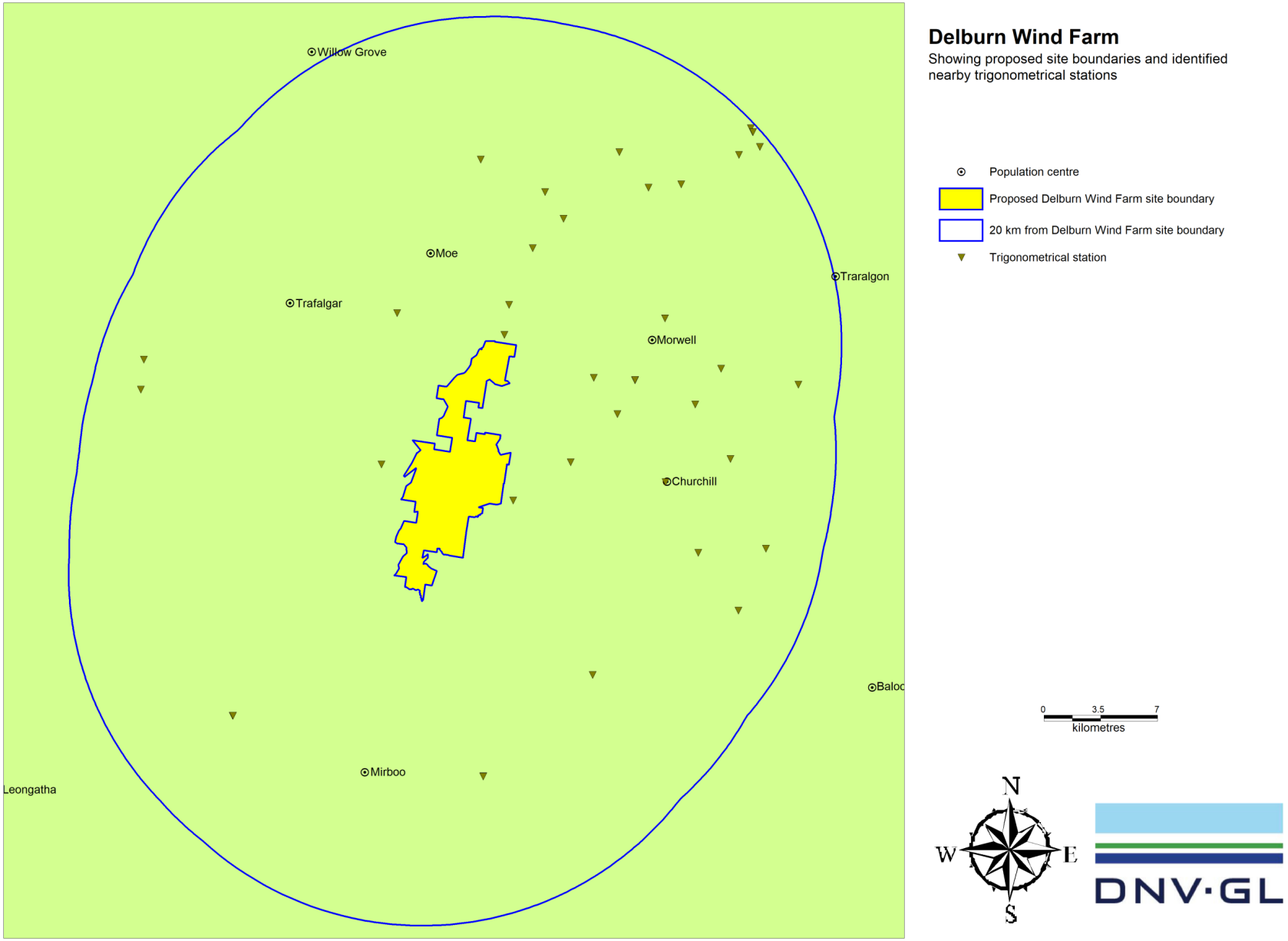

Figure 10 Location of trigonometrical stations within 20 km of the proposed Project

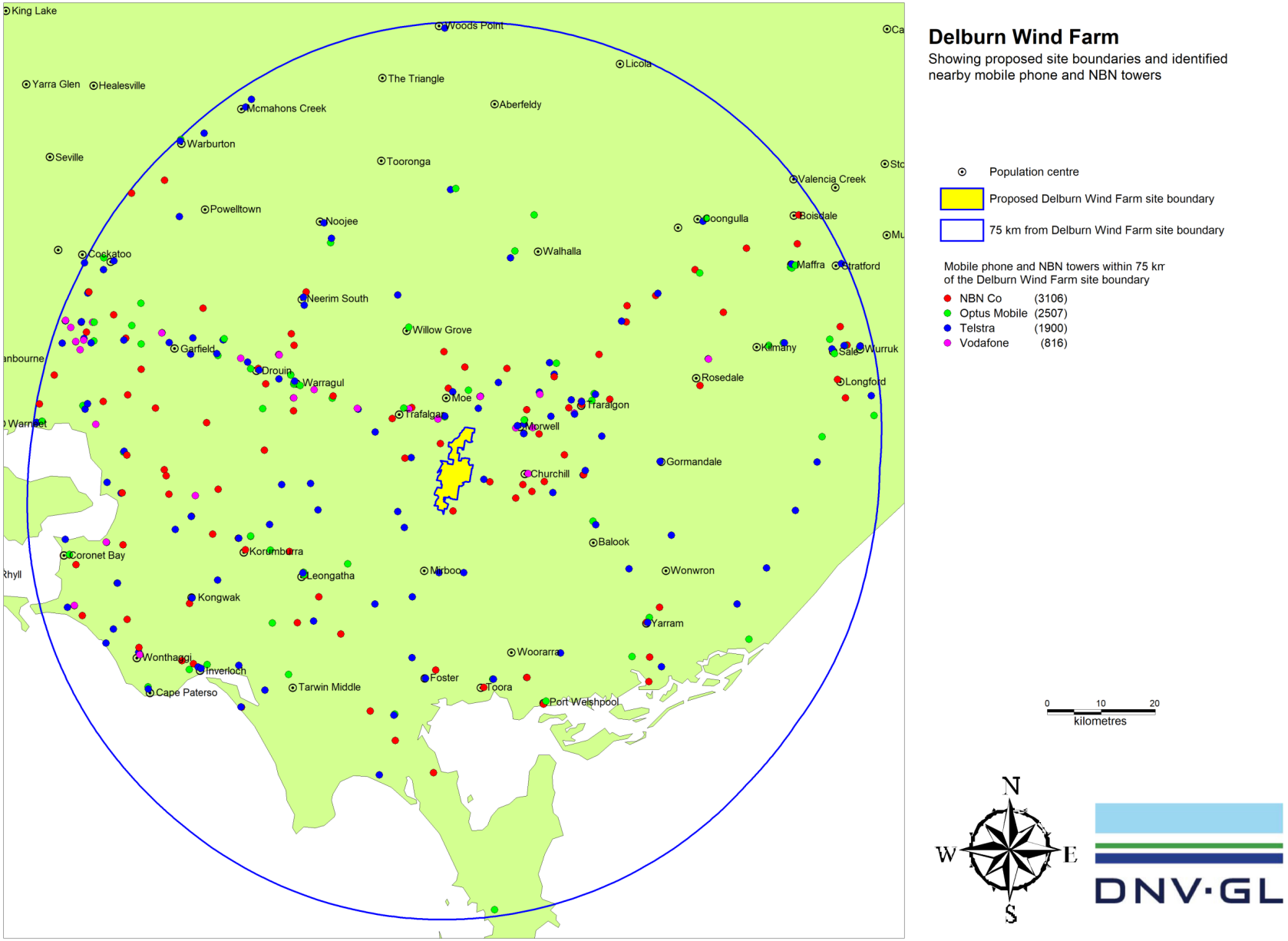

Figure 11 Location of mobile phone and NBN towers within 75 km of the proposed Project

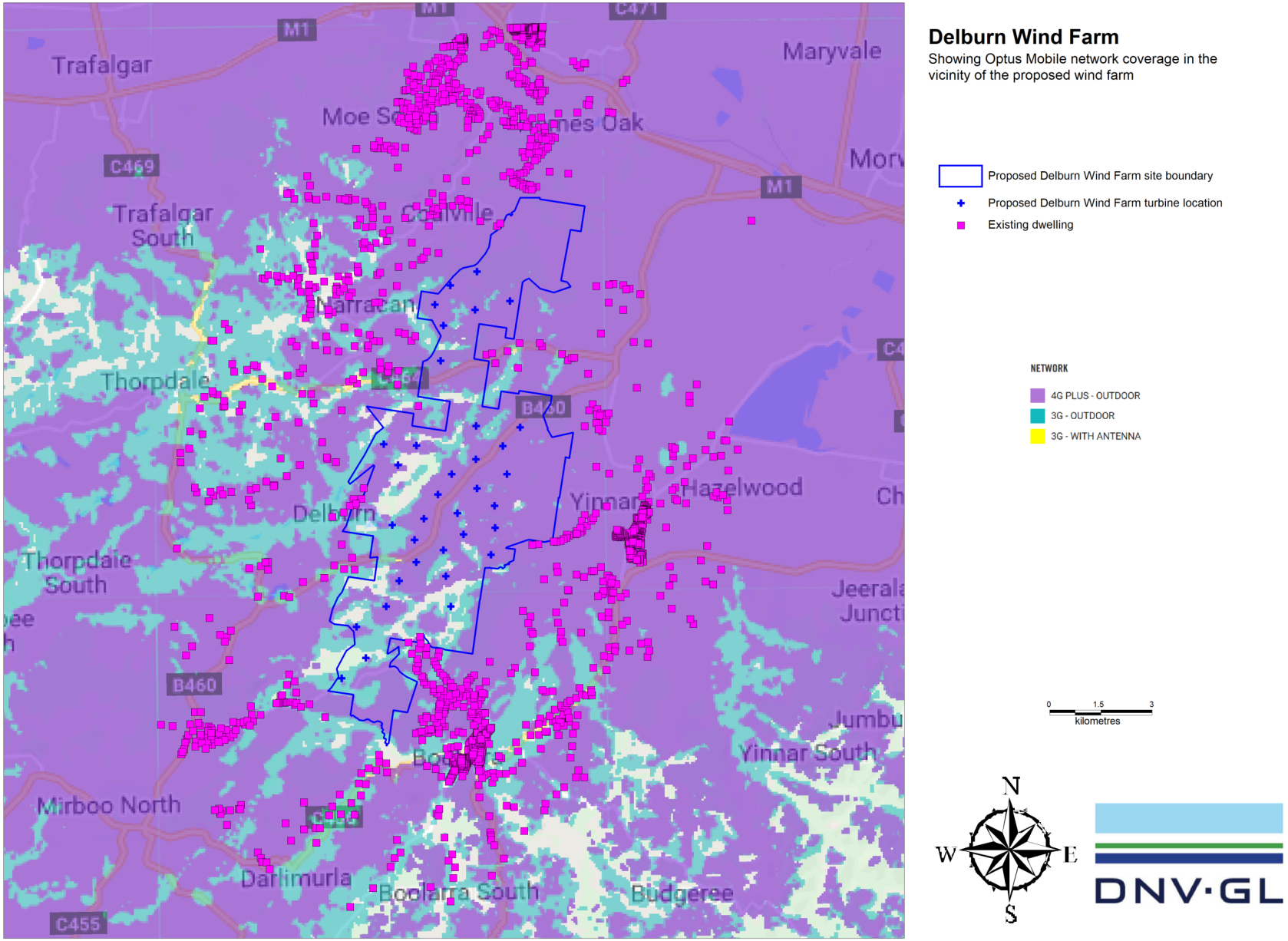

Figure 12 Optus Mobile network coverage (Apple iPhone X handset) for the proposed Project

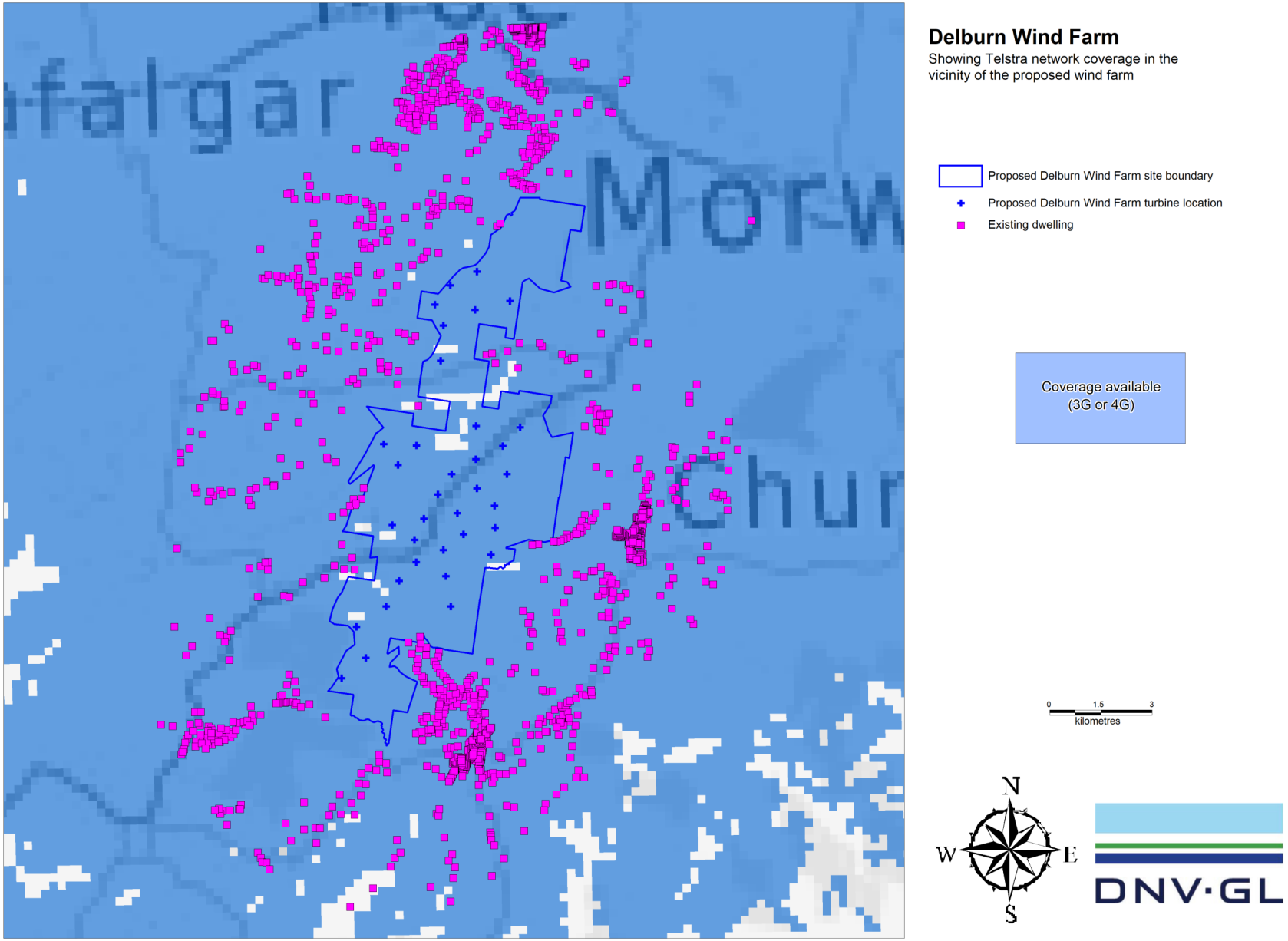

Figure 13 Telstra network coverage for the proposed Project

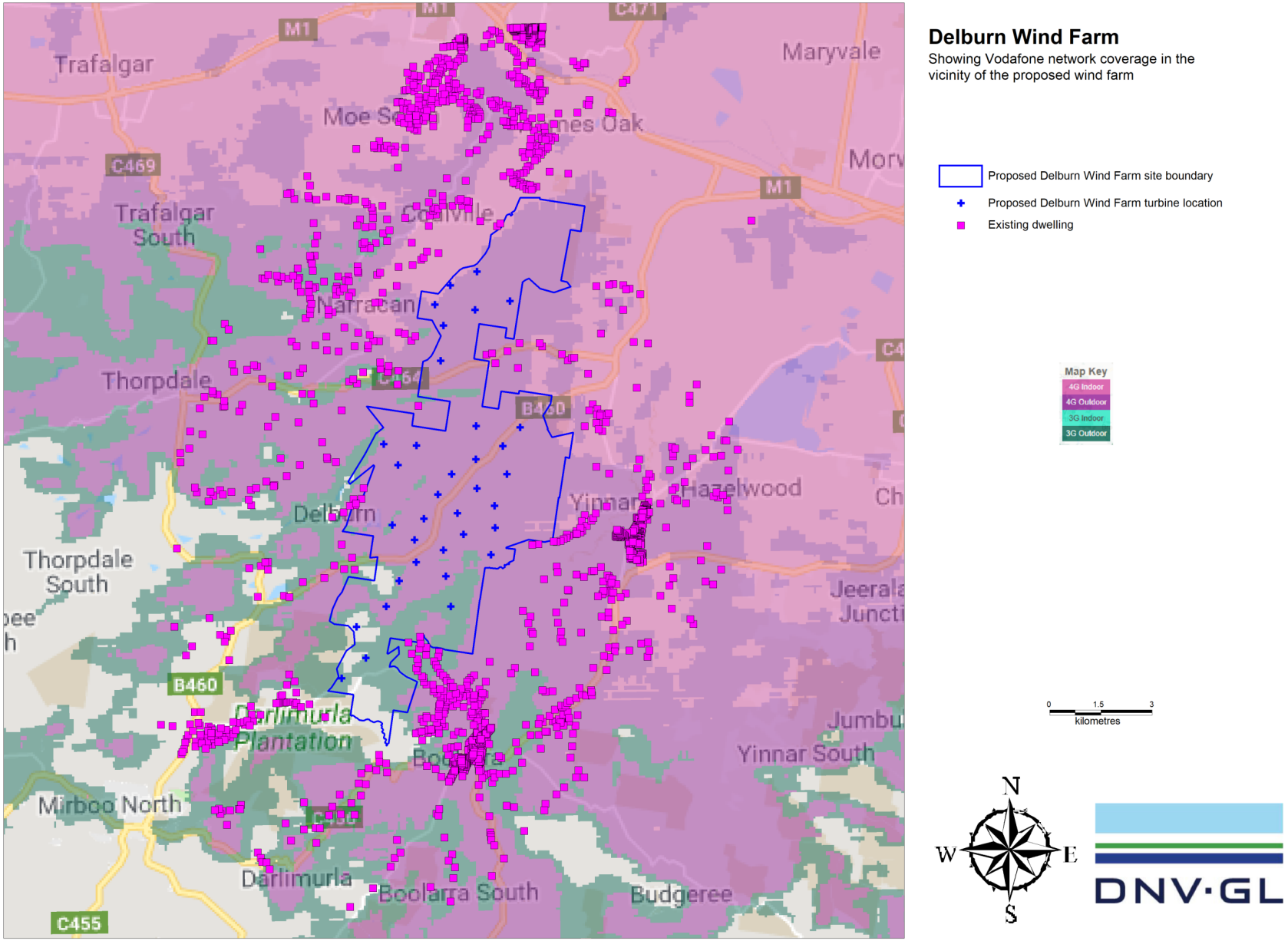

Figure 14 Vodafone network coverage (Apple iPhone X handset) for the proposed Project

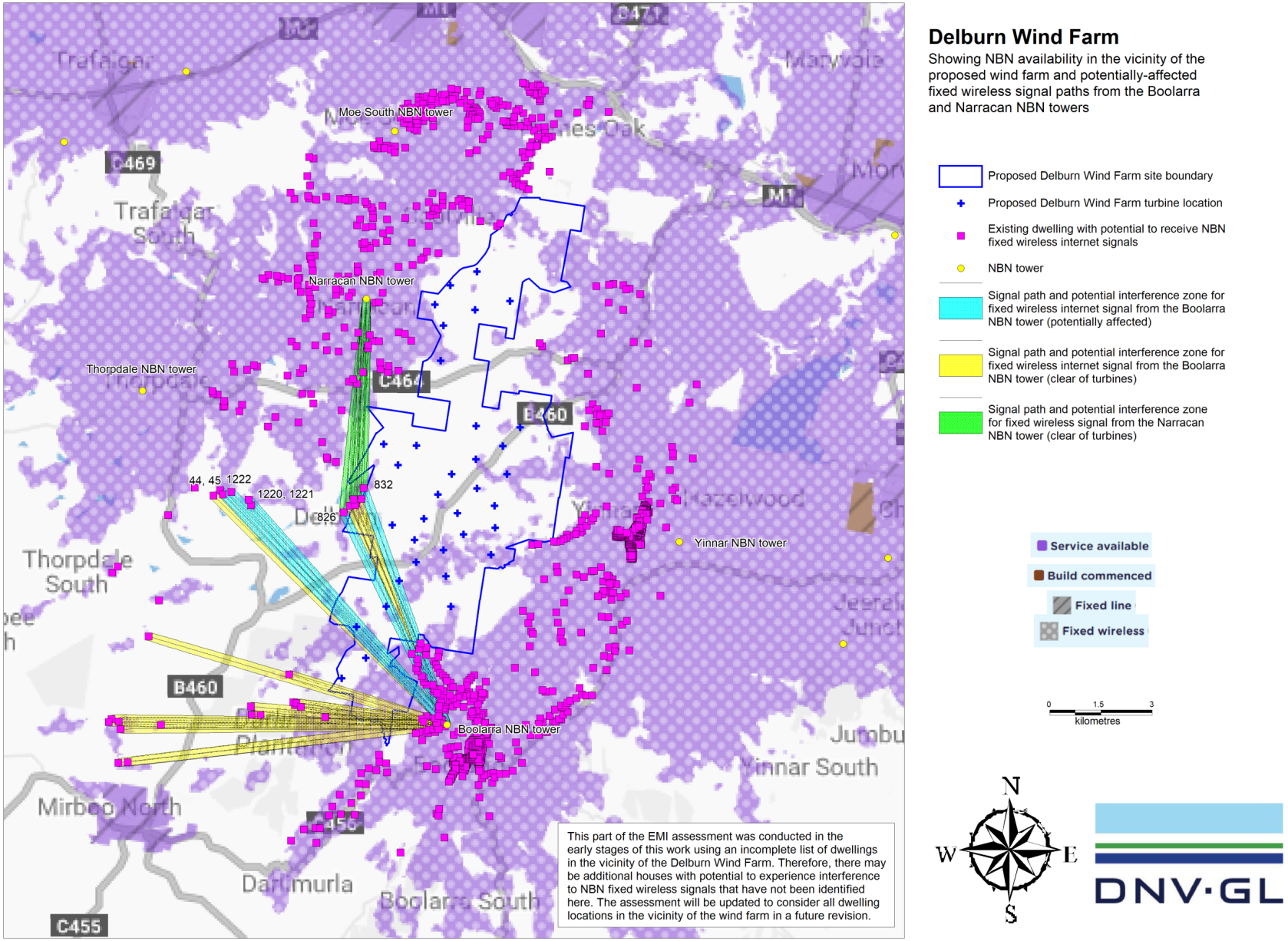

Figure 15 NBN internet coverage in the vicinity of the proposed Project and potentially-affected fixed wireless internet signal paths from the Boolarra and Narracan NBN towers

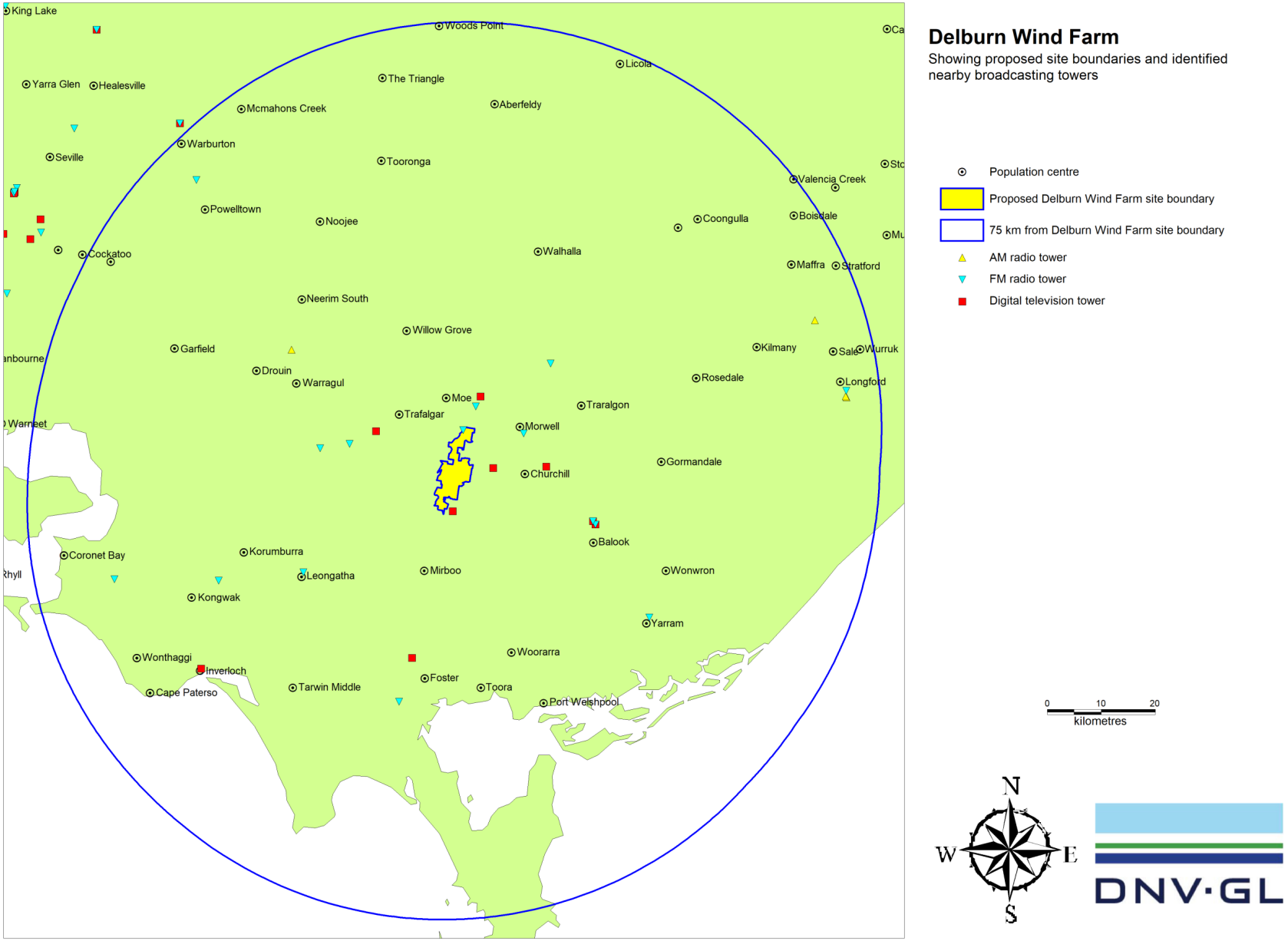

Figure 16 Location of broadcast transmitters in the vicinity of the proposed Project

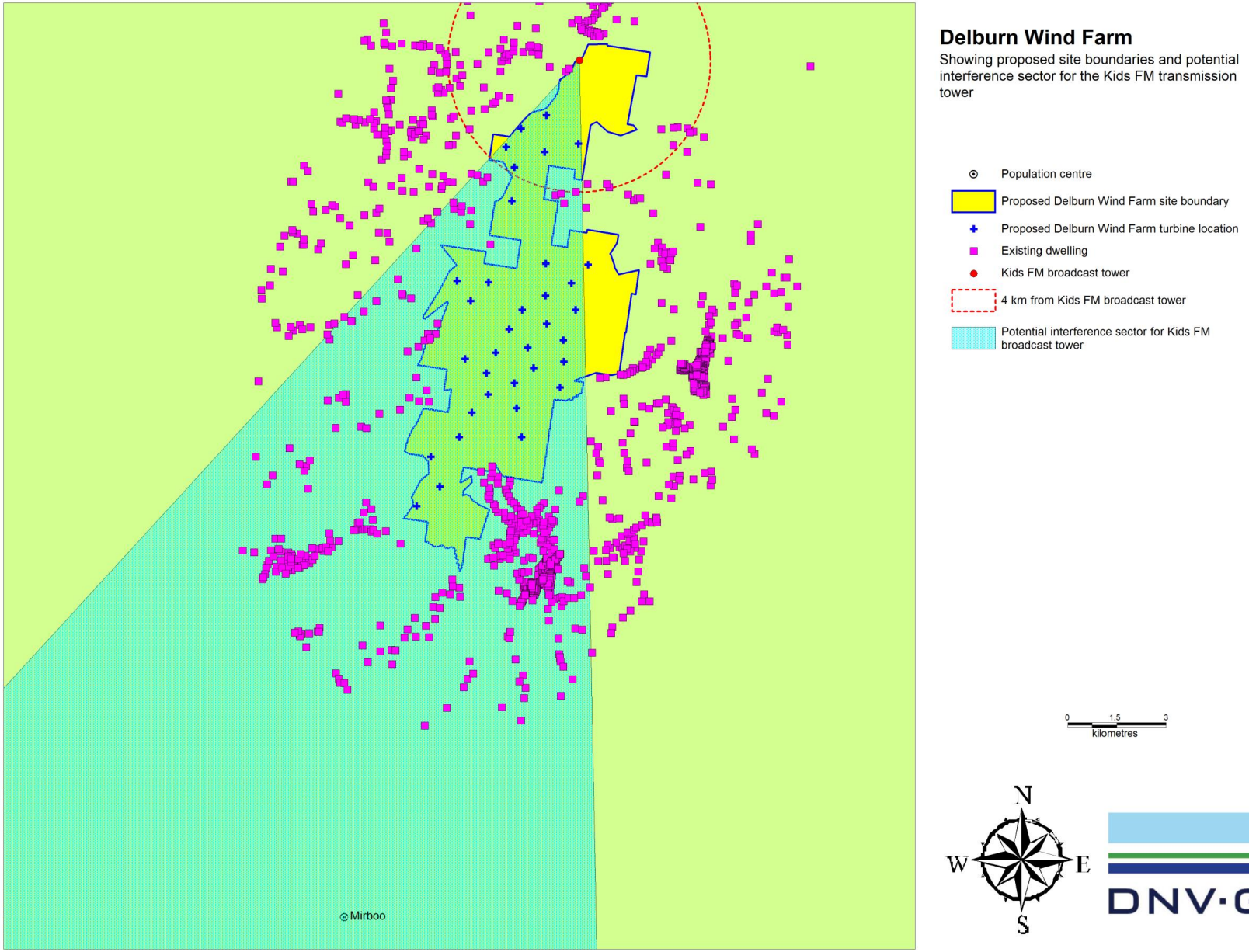

Figure 17 Potential FM radio interference sectors from the Kids FM broadcast tower for the proposed Project

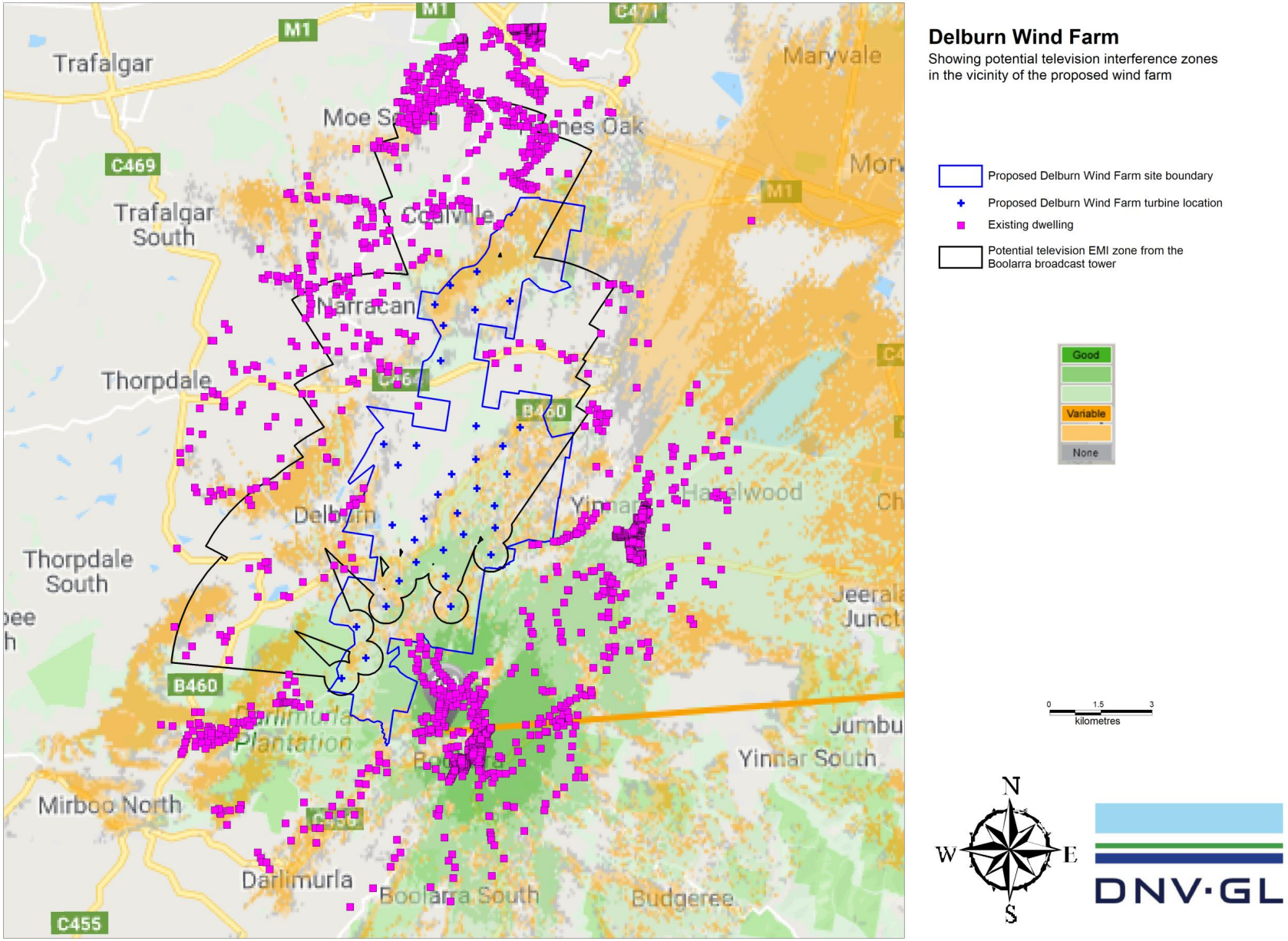

Figure 18 Potential television EMI zones from the Boolarra broadcast tower for the proposed Project

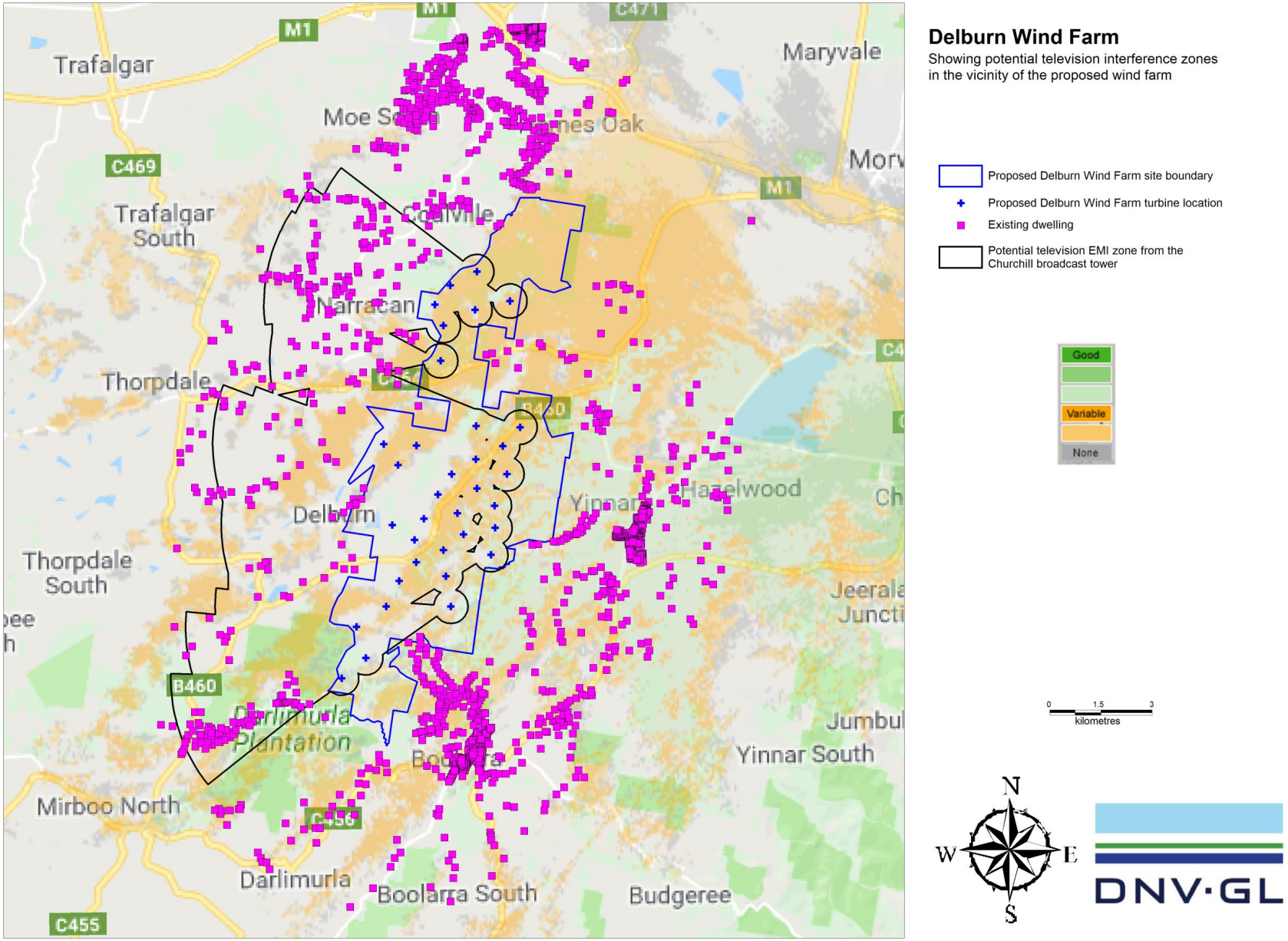

Figure 19 Potential television EMI zones from the Churchill broadcast tower for the proposed Project

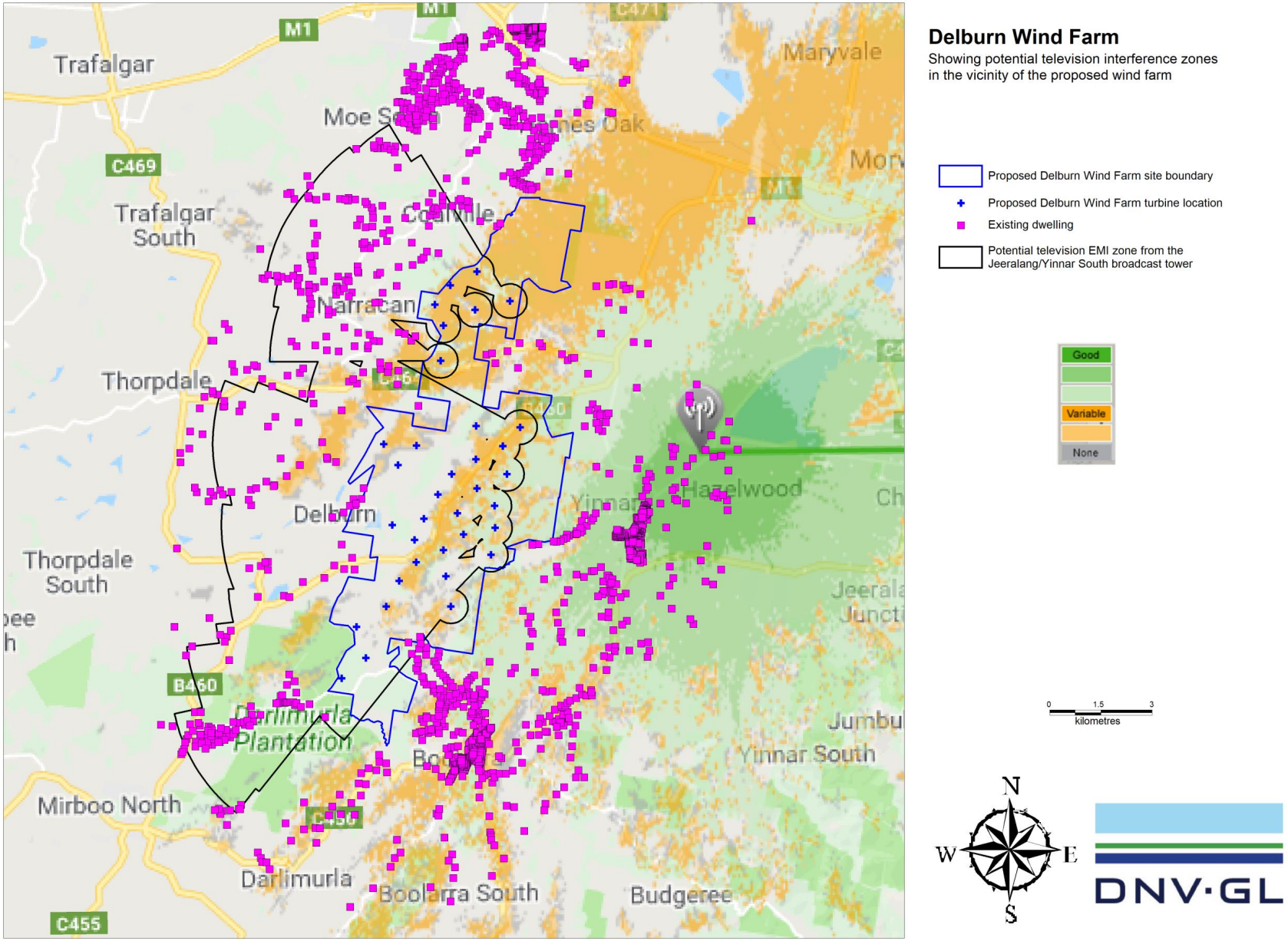

Figure 20 Potential television EMI zones from the Jeeralang/Yinnar South broadcast tower for the proposed Project

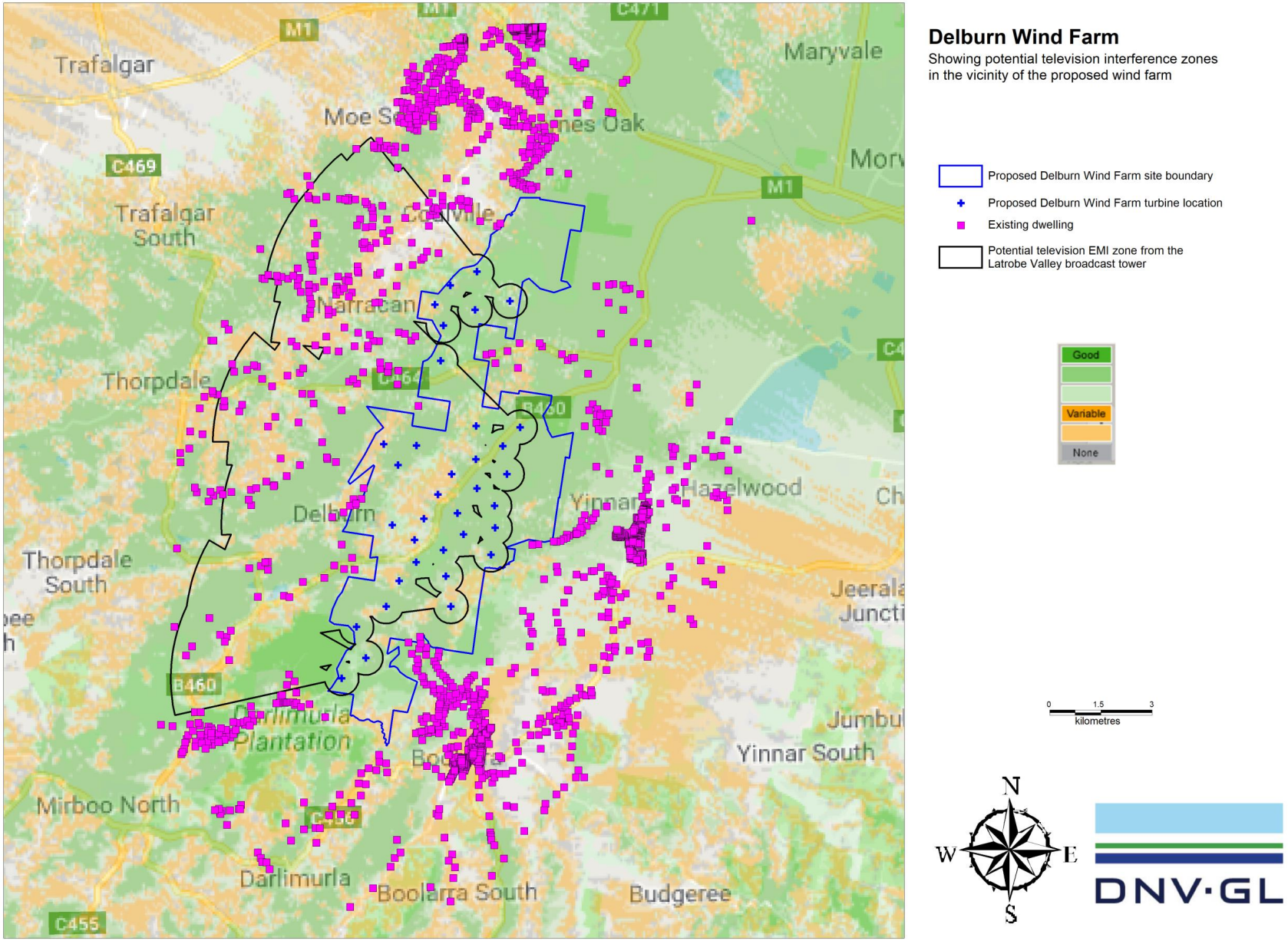

Figure 21 Potential television EMI zones from the Latrobe Valley broadcast tower for the proposed Project

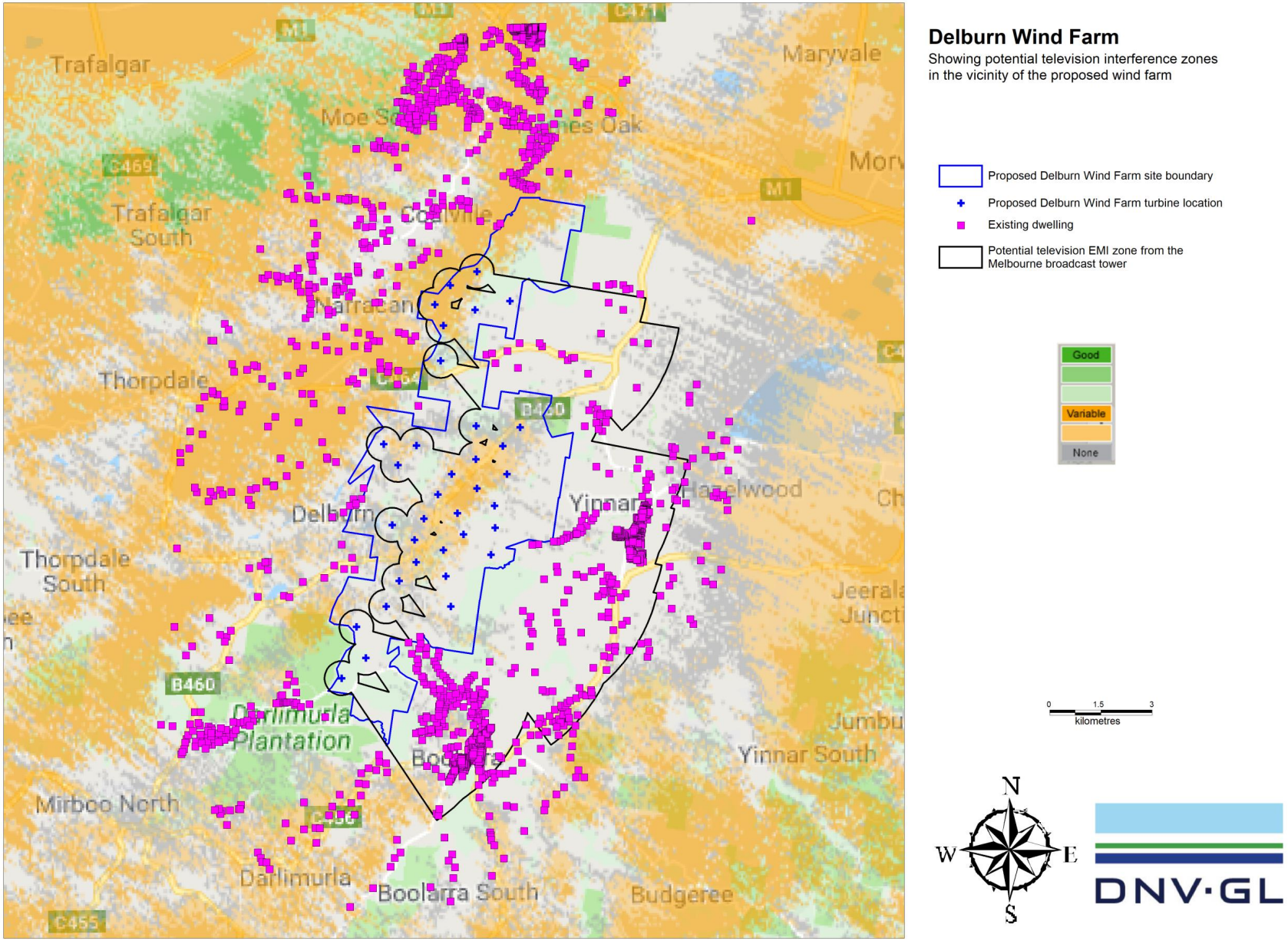

Figure 22 Potential television EMI zones from the Melbourne broadcast tower for the proposed Project

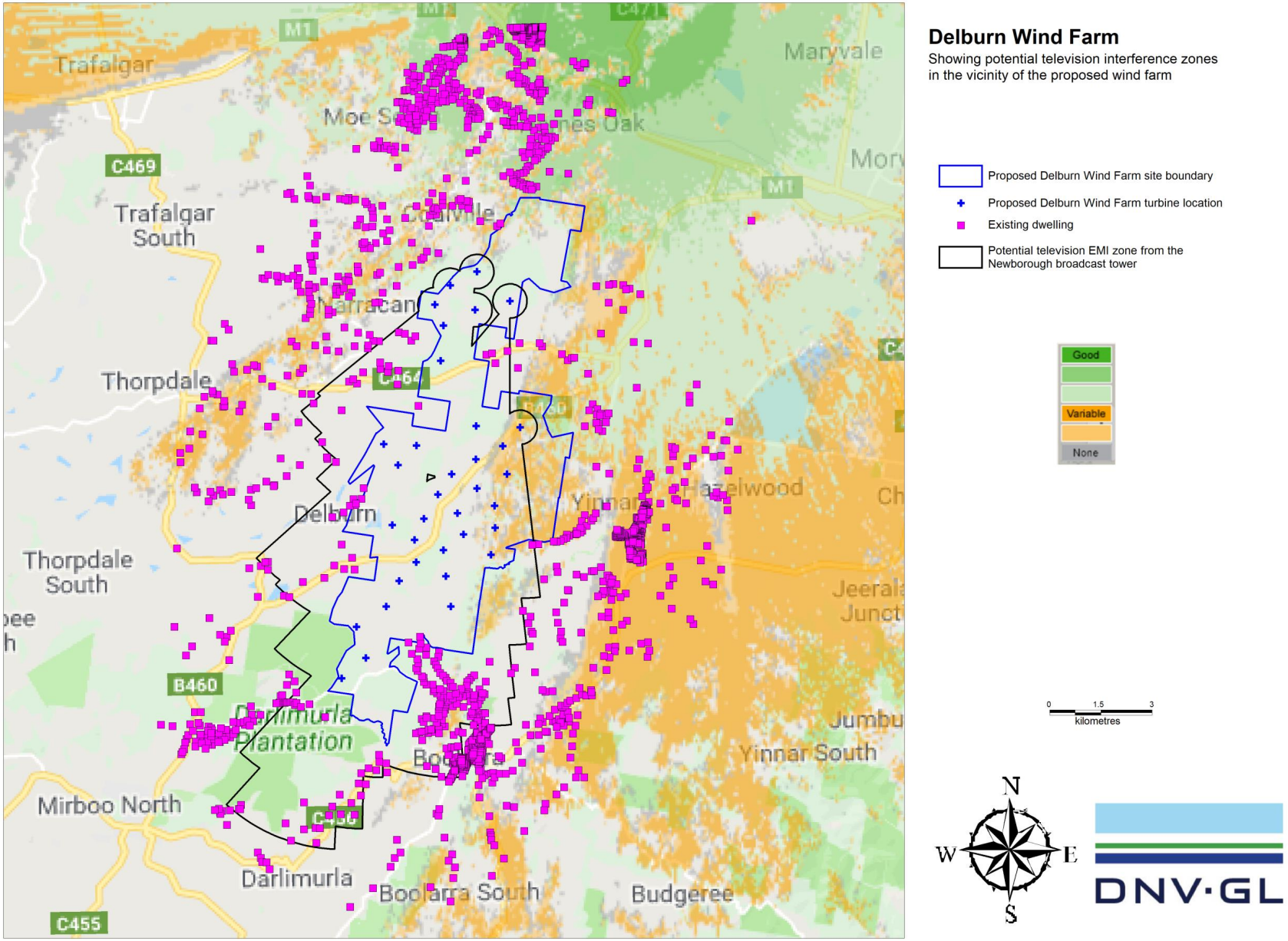

Figure 23 Potential television EMI zones from the Newborough broadcast tower for the proposed Project

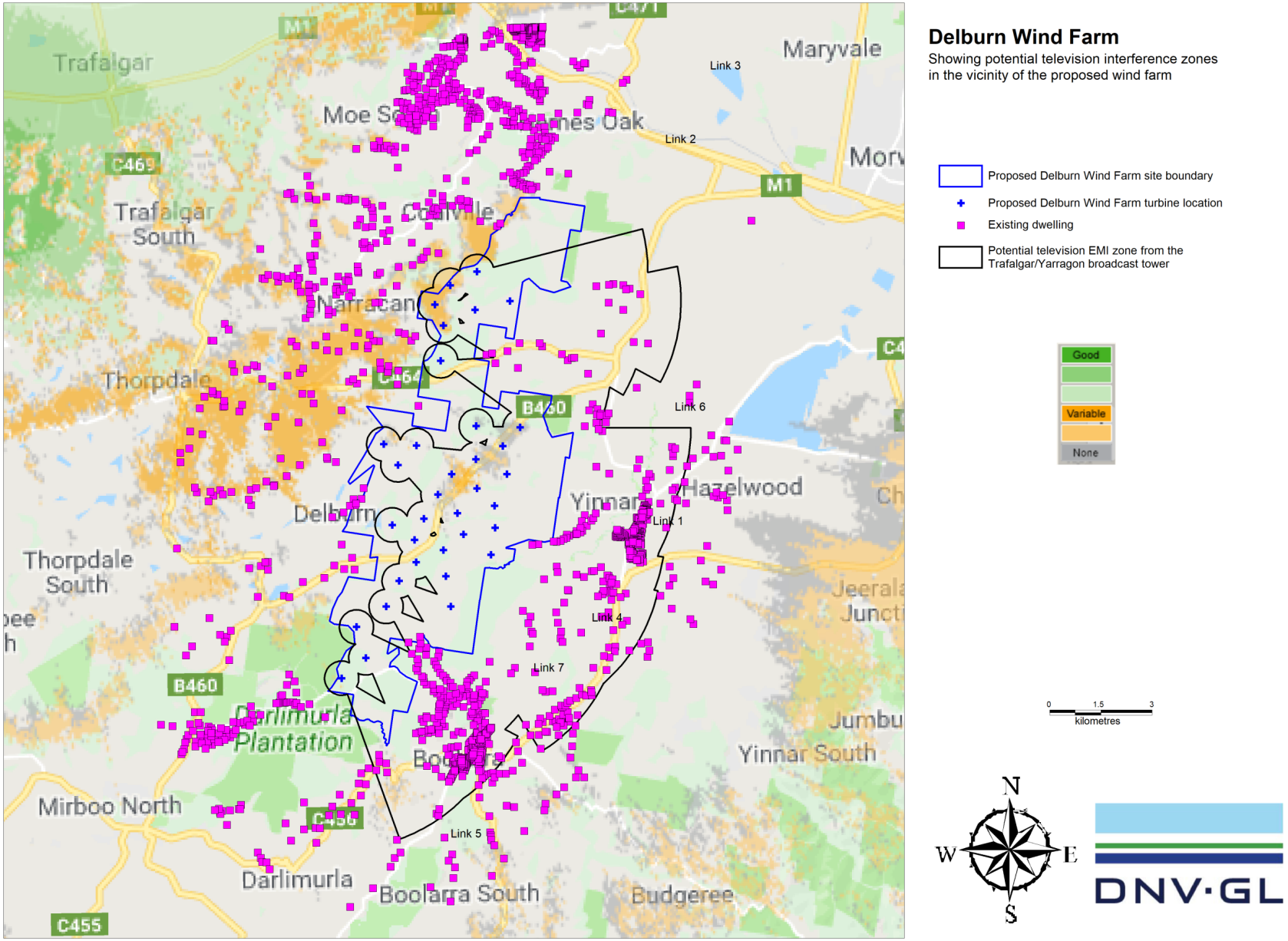

Figure 24 Potential television EMI zones from the Trafalgar/Yarragon broadcast tower for the proposed Project

ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.