DNV·GL

TWIN CREEK WIND FARM

EMI Assessment

Twin Creek Energy Pty Ltd

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Table of contents

EXECUTIVE SUMMARY

DNV GL Australia Pty Ltd ("DNV GL") has been commissioned by Twin Creek Energy Pty Ltd ("TCE" or "the Customer") to independently assess potential electromagnetic interference (EMI) impacts associated with the development and operation of the proposed Twin Creek Wind Farm ("the Project") in the mid north area of South Australia.

This report summarises the results of an EMI assessment conducted for the site.

Regulatory requirements

This document assesses the potential risks regarding interference with radiocommunication services operating in the vicinity of the Project in accordance with the Draft South Australian Planning Bulletin [1], Central South Australian Guidelines [2], and Draft National Wind Farm Development Guidelines [3]. In relation to EMI, these 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.

Methodology

The Customer has asked DNV GL to assess the potential EMI impacts of the Project based upon a layout consisting of 51 wind turbines, as outlined in Table 5 and Figure 1.

The Vestas V136-3.45MW turbine with a rotor diameter of 136 m and tip height of 180 m has been considered for the EMI assessment. These dimensions represent the maximum overall tip height within the maximum blade/rotor and tower hub height dimensions. Two hundred and eighty-nine dwellings have been identified in the vicinity of the Project [4], as outlined in Table 6, eight of which belong to associated landholders.

Information relating to telecommunication licences in the vicinity of the Project has been obtained from the Australian Communications and Media Authority [5], with other relevant information obtained from publicly-available sources as required. Services considered include fixed point-to-point links, fixed point-to-multipoint links, emergency services radiocommunications, meteorological radars, trigonometrical stations, Citizen's band radio and mobile phones, wireless internet, satellite television and internet, and broadcast radio and television.

The assessment methodology employed throughout this study has been informed by the methodology outlined in the relevant planning guidelines and various standard industry practices. For point-to-point microwave links, typically used for line-of-sight transmissions between two sites, an exclusion zone has been established around each signal path based on the operating frequency, distance along the link, and turbine blade length. Turbines located within the calculated exclusion zone have the potential to interfere with that signal. Similarly, turbines that intersect the line-of-sight for satellite television and internet signals at dwellings in the vicinity of the Project may interfere with those services. For terrestrial television broadcasts, dwellings that have increased potential to experience interference to broadcast signals have been identified based on the regions around each turbine in which forward scattering and back scattering of signals is likely to occur.

In many cases, however, assessment of the potential EMI impacts on radiocommunication services requires additional information from the service operators. DNV GL has contacted the operators of

services in the vicinity of the Project to inform them of the proposed wind farm development and seek feedback regarding the potential for interference to their operations and services.

Results and findings

The results of this assessment, including the expected EMI impacts for the Project and feedback obtained from stakeholders, are summarised in the table on the following page.

Interference to fixed point-to-point links passing over the Project boundaries is considered unlikely as there are no turbines located within the calculated exclusion zones for those links.

Although base to mobile station style communications such as television and radio broadcasting and commercial and private mobile telephony services are generally unlikely to be affected by wind farms, interference may be experienced in areas of poor or marginal reception. If interference to television and radio reception is increased as a result of the Project, a range of options are available to rectify difficulties.

Conclusions

This EMI assessment has found that the Project has the potential to impact on a number of radiocommunication services in vicinity of the Project. Specifically, the turbines at the Project may interfere with digital television broadcast signals received from the Adelaide broadcast towers at houses surrounding the Project, particularly in areas where the residents currently experience poor or marginal reception. Interference to the FM radio signal broadcast by the nearby Flow FM transmission tower may also be experienced near the edges of the signal coverage area to the west and northwest of the Project.

DNV GL has assessed potential EMI impacts on point-to-multipoint links, emergency services, and wireless internet services through consultation with service operators. DNV GL has also consulted with other organisations operating services that may be affected by the development and operation of the Project to seek feedback regarding any potential EMI-related impact the Project could have on their operations and services. While DNV GL considers that interference to fixed point-to-point links passing over the Project boundaries is unlikely, it is noted that one operator, SA Water, has expressed concerns regarding potential impacts on their link. All other responses received to date indicate that the Project is unlikely to have any impact on the relevant services.

Summary of EMI assessment results for the proposed Project

Licence or service type	Assessment findings	Stakeholder feedback (to date)
Fixed point-to-point links	Three links crossing Project boundary: *SA Water* No turbines in exclusion zone	Potential for interference
	W & L Phillips Pty Limited (Flow FM) No turbines in exclusion zone	No concerns raised
	NBN Co No turbines in exclusion zone	No concerns raised
Fixed point-to-multipoint links	Seven base stations within 20 km of Project boundary: Aussie Broadband (one site) Barossa Valley Golf Club (one site) SA Water (two sites) SA Power Networks / Telstra (one site – shared) The Barossa Council (one site) Treasury Wine Estates Vintners (one site)	Potential for interference to SA Power Networks point-to-multipoint link; resolved with proposed exclusion zone
Emergency services	Point-to-point links: No links crossing boundary Mobile telephony systems: unlikely to be affected	No concerns raised
Meteorological radar	Unlikely to be affected	Potential for interference to Buckland Park radar; satisfied with proposed turbine locations
Trigonometrical stations	Unlikely to be affected	No concerns raised
Citizen's band radio	Unlikely to be affected	-
Mobile phones	Unlikely to be affected, may experience interference in areas with marginal coverage	No concerns raised
Wireless internet	Available services: Agile Communications, Aussie Broadband, NBN May experience interference in areas with marginal coverage	No concerns raised
Satellite television and internet	No signals intercepted	-
Radio broadcasting	AM signals: unlikely to be affected FM signals: may experience interference in close proximity to turbines FM signals from nearby Flow FM transmission tower: may experience interference in areas with marginal reception to the east and northeast of the Project Digital radio signals: unlikely to be affected	AM and digital radio signals: no consultation required FM signals: potential for interference to Flow FM signal
Television broadcasting	May experience interference in areas with poor or marginal reception *Adelaide tower: 'variable' to 'good' coverage across site* Ten dwellings in potential interference zone	-
	Eudunda, Renmark/Loxton, and Waikerie towers: 'variable' coverage to north and east of site No dwellings with coverage in potential interference zone	-

1 PROJECT DESCRIPTION

Twin Creek Energy Pty Ltd ("TCE" or "the Customer") proposes to develop the Twin Creek Wind Farm within the mid-north area of South Australia. The site of the proposed wind farm is approximately 90 km northeast of Adelaide, and northeast of Kapunda.

1.1 Project overview

TCE has advised that the proposed wind farm will consist of the following components:

- up to 51 wind turbines generators (WTG)
  - each WTG has a capacity up to 3.6 megawatts (MW), with a total installed wind capacity up to 183 MW
  - overall height of turbines would be up to 180 m at the blade tip
- associated hard standing areas and access roads
- operations and maintenance building and compound with associated car parking
- two electrical substations
- 50 MW battery energy storage facility
- overhead and underground electrical cable reticulation
- overhead transmission line for approximately 15 km from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro
- meteorological masts for measuring wind speed and other climatic conditions
- temporary construction facilities including a borrow pit and concrete batching plant facilities.

2 PROJECT SITING/LOCALITY DESCRIPTION

TCE proposes to develop the Twin Creek Wind Farm within the mid north area of South Australia. The site of the proposed wind farm is approximately 90 km northeast of Adelaide and 11 km northeast of Kapunda. The proposed development is located between the townships of Kapunda, Eudunda, and Truro.

The site is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges.

Landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands, and isolated topographic features.

Surrounding the site of the proposed development, the landscape is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lings and creek lines. The land use that occurs in the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing.

3 INTRODUCTION

Twin Creek Energy Pty Ltd ("TCE" or "the Customer") has commissioned DNV GL Australia Pty Ltd (DNV GL) to carry out an independent assessment of electromagnetic interference (EMI) related impacts associated with the proposed Twin Creek Wind Farm ("the Project"). The results of this work are reported here. This document has been prepared pursuant to DNV GL proposal L2C-124853-AUME-P-001 Issue C, dated 4 March 2016, and a consultancy agreement between TCE and DNV GL, dated 27 June 2016, and is subject to the terms and conditions therein.

In accordance with the Planning Bulletin: Wind Farms – Draft for Consultation (Draft SA Planning Bulletin) prepared by Planning SA in August 2002 [1], the Wind Farm Development Guidelines for Developers and Local Government Planners (Central SA Guidelines) prepared by the Central Local Government Region of South Australia in June 2014 [2], and the National Wind Farm Development Guidelines – Draft (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [3], this assessment investigates the potential EMI impact of the Project on:

- fixed point-to-point links
- fixed point-to-multipoint links
- radiocommunications 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.

4 REGULATORY REQUIREMENTS

There are three sets of guidelines that are potentially relevant to the assessment of electromagnetic interference impacts for wind farms in South Australia.

The Draft SA Planning Bulletin [1] states that wind farms *"should be sited, designed and operated in a manner that… minimises the potential for nuisance or hazard to nearby property owners/occupiers, road users and wildlife by way of… interference to television and radio signals"*.

Similarly, the Central SA Guidelines [2] currently state:

> *"The effect of wind turbines on electromagnetic waves will usually be relatively limited. Potential electromagnetic interference effects can be calculated from information about affected telecommunications transmitting or receiving stations, local conditions, turbine design and location. The 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. The siting of wind turbines in the 'line of site [sic]' between transmitters and receivers should be avoided."*

Although both the Draft SA Planning Bulletin and Central SA Guidelines describe the importance of assessing EMI related impacts, 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) [3]. The Draft National Guidelines cover a range of issues across the different stages of wind farm development.

The main purpose of the Draft National Guidelines is to provide detailed methodologies to assess issues related to wind farms including community consultations, shadow flicker, noise monitoring, EMI, impacts on landscapes, and flora and fauna. Other issues that are covered to a lesser extent in the guidelines include aircraft safety, blade glint, risk of fire and indigenous heritage.

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 Draft SA Planning Bulletin and Central SA Guidelines, and therefore the Draft National Guidelines have been used to inform the methodology adopted for this assessment.

5 METHODOLOGY AND RESULTS

If not properly designed, wind farms have the potential to interfere with radiocommunications services. Two services that are most likely to be affected include television broadcast signals and fixed point-to-point microwave signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while microwave links are used for line-of-sight connections for data, voice and video. The interference mechanisms are different for each of these and, hence, there are different ways to avoid interference.

The Customer has asked DNV GL to complete this assessment based upon a layout provided for the Project consisting of 51 wind turbines [6]. 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 5.

Two hundred and eighty-nine houses have been identified in the vicinity of the Project, eight of which belong to associated landholders [4]. The coordinates of these houses are presented in Table 6, and the dwellings and site boundaries considered in this assessment are also shown in Figure 1. DNV GL has assumed that all listed houses are potential inhabited residential locations. It should be noted that DNV GL has not carried out a detailed and comprehensive survey of house locations in the area and is relying on information provided by the Customer.

For the purpose of the EMI study, the Vestas V136-3.45MW turbine with a rotor diameter of 136 m and a tip height of 180 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 136 m or less
- an upper tip height of 180 m or less
- a lower tip height of 44 m or greater.

The Draft National Guidelines recommend that a radial distance of 50–60 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 telecommunication towers within approximately 75 km of the proposed Project site, and then assess the telecommunication licences attached to these towers. This is to reduce the likelihood that telecommunications links crossing the site are inadvertently excluded from the assessment.

In order to conduct the EMI assessment, information regarding radiocommunications licences in the vicinity of the Project has been obtained from the Australian Communication and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database [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 telecommunication 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 organisations operating services that may be impacted by the development and operation of the Project, to disseminate basic information on the Project and request responses from the organisations regarding whether they foresee any potential EMI-related impacts on their operations and services. The organisations that have been contacted and all responses received to date are summarised in Table 14.

It is noted that the responses summarised in Table 14 and discussed throughout this report were based on a previous turbine layout for the Project, as described in DNV GL report 170894-AUME-R-02 Issue A, dated 7 October 2016. Subject to confirmation from the Customer, DNV GL is intending to contact the organisations listed in Table 14 to advise them of the changes to the turbine layout and seek further feedback regarding the potential for interference to their operations and services. However, the revised turbine layout described in this report is not expected to substantially alter the results of the consultation process.

5.1 Telecommunication towers

An image of the ACMA database dated 15 July 2016 was used for this assessment [5]. From the database, there are 1351 telecommunication towers within a nominal 75 km of the Project site boundary. The locations of these telecommunication towers relative to the Project are shown in Figure 2.

5.2 Fixed licences of point-to-point (microwave) type

5.2.1 Diffraction

Wind turbines can potentially cause interference, or diffraction, of point-to-point microwave signals and in some cases, point-to-point UHF signals. It is possible to design around this issue as the path and interference zone of these signals are well known. 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. 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 criteria used for avoiding diffraction effects of point-to-point signals are normally based on an exclusion zone of circular cross-section around the direct path from the transmitter to the receiver (often called boresight) [3] [7] [8]. This exclusion zone is defined in terms of Fresnel zones. The nth Fresnel zone is comprised of all points for which, if the radio 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.

To avoid interference to point-to-point signals, wind turbines, including the blades, should be kept outside the second Fresnel zone. The radius of the second Fresnel zone varies along the length of the signal, and is given by:

$$R_{F2} = \sqrt{\frac{2\lambda d_1 d_2}{D}}$$

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 $d_1+d_2 = D$

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

Each individual link is given a unique identifier or "Assignment ID" so that it can be readily distinguished. This Assignment ID is 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 paths resulting from the towers analysed are shown in Figure 3. 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.

A review of the ACMA database shows that there are three links passing over the proposed Project site (operated by SA Water, W & L Phillips Pty Limited (Flow FM), and NBN Co Limited). The links are shown in greater detail in Figure 4.

References [3] [7] [8] state that turbines should be located outside of either the first or second Fresnel zone in order to avoid interference to that link. For each of the identified links around the site, an exclusion zone has been established based on their operating frequencies, the second Fresnel zone, plus the blade length for turbines with a 136 m rotor diameter. The potential exclusion zones are also shown in Figure 4.

It is common practice to have multiple Assignment IDs for the same physical link to cover practicalities such as licensing for sending and/or receiving signals. Accordingly, the Fresnel zone setback has been calculated on the Assignment ID with the lowest frequency. Details of the links are provided in Table 7.

The turbines located within or near the second Fresnel zone for each point-to-point link crossing the proposed Project site are summarised in Table 1 below. There are no turbines located within the exclusion zones for any of the point-to-point links passing over the proposed Project site.

Table 1 Details of turbines located within or near the second Fresnel zones for point-to-point links crossing the proposed Project

Link no.	Assignment ID's for minimum frequency	Operator	Turbines within exclusion zone[1]
1	752339, 752340	SA Water	None (T24 within 44 m)
2	790526, 790527	W & L Phillips Pty Limited (Flow FM)	None (T1 within 60 m)
3	1401120, 1401121	NBN Co Limited	None

1. Distances between turbine locations and the edges of the calculated exclusion zones have been measured perpendicular to the signal path using a geographic information system (GIS) application.

DNV GL has contacted the operators of these links to determine the likelihood that the proposed Project will cause interference to their operations and services. Responses have been received from all three operators. Both Flow FM and NBN Co have indicated that they do not expect their point-to-point links to be impacted by turbines at the Project.

SA Water have expressed concerns regarding the potential for turbines at the Project to interfere with their point-to-point link crossing the Project site, but have declined to comment on the proposed turbine locations or propose a suitable exclusion zone to avoid interference. SA Water have advised that the Customer proceed at their own risk, and that "any impact on the SA Water point-to-point link post construction will be the responsibility of the wind farm developer/owner to remedy". DNV GL recommends that turbines at the Project be kept outside the second Fresnel zone for the SA Water point-to-point link in order to minimise the potential for interference.

A preliminary assessment was also carried out to determine if the links pass over the Project at a height that is well above the highest point of the turbines (maximum tip height of 180 m). This was achieved by examining the elevation and tower heights at each end of the link, as well as the approximate elevation of the areas within the Project boundaries over which the link crosses. It was determined that the links do cross the site at a height which has the potential to intersect with turbine blades.

5.2.2 Near field effects and scattering

The Draft National Guidelines [3] mention the possibility of interference to point-to-point links from two additional mechanisms, near field effects and scattering.

According to the Draft National Guidelines, near field effects are usually limited to approximately 720 m from a communication tower and it is recommended that consultation is required if a turbine is within 1 km of a telecommunication site. The Draft National Guidelines also state that scattering is best avoided by placing wind turbines more than 2 km from a communication tower.

All telecommunication towers are greater than 2 km from the Project, with the closest communication towers (Site IDs 24226 and 24226) located approximately 2.7 km from the proposed site boundary or 3.5 km east of the nearest wind turbine (turbine T25). It is not expected that these towers will experience interference due to near field effects or scattering.

5.3 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 database details the location of the static station for a fixed licence of the point-to-multipoint type. Hence, the location of the transmission vectors is not readily identifiable. A review of fixed licences of point-to-multipoint types was undertaken and 222 Assignment ID's were identified within approximately 75 km of the proposed site. These licences are shown in Figure 5. The details of the licence holders as per the ACMA database are provided in Table 8.

There are seven point-to-multipoint base stations listed in the ACMA database within 20 km of the Project boundary. These stations are operated by Aussie Broadband Pty Ltd (Site ID 9012660), Barossa Valley Golf Club Inc (Site ID 501154), SA Water (Site ID 24263 and 9007183), SA Power Networks (Site ID 24227), Telstra (Site ID 24227), The Barossa Council (Site ID 9011554), and Treasury Wine Estates Vintners Limited (Site ID 138906). It is assumed that the two point-to-

multipoint base stations operated by Barossa Valley Golf Club and Treasury Wine Estates Vintners are associated with communication or irrigation system networks that are confined to the property around the station, and so interference with these services is unlikely. Since it is not possible to determine if there are any potential impacts on the services provided by the other five point-to-multipoint base stations without knowing the locations of each station in the network, DNV GL has contacted the operators of these stations as part of the consultation process to seek feedback on whether their services are likely to be affected by the Project. Responses have been received from several operators, as summarised in Table 14.

As a result of the consultation process, SA Power Networks has advised that they operate a fixed link between their point-to-multipoint base station at Mt Rufus (Site ID 24227) and an electrical substation at Kapunda which crosses the Project site. The link details are given in Table 2, and the path of this link is shown in Figure 6. DNV GL has established an exclusion zone for the link based on the minimum operating frequency, the second Fresnel zone, plus the blade length for turbines with a 136 m rotor diameter, as described in Section 5.2.1. The potential exclusion zone is also shown in Figure 6, and it can be seen that there are no turbines located within the exclusion zone for the SA Power Networks link passing over the proposed Project site. SA Power Networks have confirmed that they are satisfied with an exclusion zone based on the second Fresnel zone, and that they do not expect their link to be impacted by turbines located outside this zone.

Table 2 Details of point-to-multipoint link crossing the proposed Project

	Transmitter		Receiver		
Operator	Latitude [GDA94]	Longitude [GDA94]	Latitude [GDA94]	Longitude [GDA94]	Minimum frequency [MHz}
SA Power Networks	-34.315312	139.127007	-34.335294	138.886801	452.344

There are a number of point-to-multipoint stations at a distance of greater than 20 km from the site. Although it is unlikely that stations at this distance will be servicing customers in the vicinity of the site, DNV GL has also contacted the operators of all potentially affected stations within 60 km of the centre of the Project to seek feedback on any potential impact that the Project could have on their services. Responses have been received from several operators, as summarised in Table 14, and no concerns have been raised to date.

5.4 Other licence types

A review of the ACMA database for other licences was conducted. These licences are shown in Table 9 and Figure 7.

Many of the licences identified can be broadly described as base to mobile station 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, the amelioration method consists of the user simply moving to receive a clearer signal.

A number of broadcasting licences have been identified. These are likely to consist of radio and television broadcasting services, and are considered in Sections 5.13 and 5.14.

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.

5.5 Emergency services

A review of the ACMA database was conducted to identify emergency services with licences for radiocommunications assets operating in the vicinity of the Project. The groups identified are listed in Table 10 along with their contact details. DNV GL has contacted the operators of all stations within approximately 60 km of the centre of the Project to seek feedback regarding any potential impact that the Project could have on their operations and services. Responses have been received from several operators, as summarised in Table 14, and no concerns have been raised to date.

5.6 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.

5.7 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, and kept free from any physical obstruction. The antenna is used to direct a thin beam of radio energy upward into the atmosphere which is then reflected back by a cloud mass. 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 as 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 [9]. 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 [10].

Wind farms located at distances greater than 5 km from a BoM weather station are unlikely to affect wind finding operations [3]. Generally, the optimal coverage area for "weather watch" radar extends approximately 200 km from the radar installation at a height of approximately 3000 m [11] [12], and approximately 100 km at a height of 1000 m [12]. 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 [3]. It has been identified that the BoM operates five weather stations within that range with the closest station, "Buckland Park" (Adelaide), located approximately 58 km southwest of the Project site, or 63 km from the nearest turbine location. The locations of these stations are shown in Figure 8 and the details of each station can be found in Table 11.

Given that the distances between the BoM radar installations and the turbine locations are more than twice the distance at which the WMO and EUMETMET recommend that an impact study be undertaken, it is expected that impact on the radar signals will be minimal.

DNV GL has contacted 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. The response received from the BoM indicates that the WMO guidelines are currently under review and that the recommended impact study distances are expected to be doubled. The BoM has therefore expressed concerns regarding the potential for turbines at the Project to interfere with their Buckland Park radar, resulting in clutter and false artefacts. However, noting that all of the turbines at the Project are more than 60 km from the Buckland Park radar site, the BoM has advised that they are satisfied with the proposed turbine locations.

5.8 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 to 5 km while microwave systems can measure distances up to 150 km. However, such systems are not limited by the line of sight or affected by visibility [13].

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 [14]. 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) [15], 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. Several Australian states also operate GNSS CORS networks, although DNV GL understands that such a network is not currently available in South Australia. 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, and/or satellite communications.

The closest ARGN or AuScope GNSS station is located approximately 55 km southwest of the Project, at Adelaide [16]. Due to the significant distance between the Project and the GNSS station, it is considered unlikely that the Project will cause interference to the GNSS network.

DNV GL has also undertaken a review of the primary geodetic network of Australia [17] and it has been observed that the Project is located within the first-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 [16], there are 56 trig points within 20 km of the Project site boundary. Two trig points, Bald Hill and 6729/1004, are located inside the site boundary approximately 2.4 km southwest of the nearest proposed turbine location (turbine T1). The details of all 56 trig points are provided in Table 12 and illustrated in Figure 9.

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 has contacted Geoscience Australia and the South Australian Land Services Group to inform them of the Project, and seek feedback regarding whether interference to their systems is possible. Responses have been received from both Geoscience Australia and the South Australian Land Services Group, and no concerns have been raised.

5.9 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 communications activities, telemetry, and telecommand applications. The radio service operates on two frequency bands, namely the high frequency (HF) band at between 26.965 MHz and 27.405 MHz, and the ultra-high frequency (UHF) band at between 476.425 MHz and 477.400 MHz.

The 27 MHz CB radio service was legalised in Australia in the 1970s as a temporary move to switch to UHF CB over the following five years, 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 27 MHz 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 "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.

5.10 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.

A review of mobile phone towers in the vicinity of the proposed Project has been carried out. The locations of these towers are shown in Figure 10. The nearest mobile phone tower is located approximately 5 km to the north of the Project boundary.

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

Figure 11 shows the Optus Mobile network coverage for the Project area [18]. The map shows outdoor 3G coverage at most locations in the vicinity of the Project, with some areas immediately to the east requiring an external antenna to receive 3G coverage. Some locations, particularly to the north, southwest, and southeast of the Project, may receive outdoor 4G coverage.

Figure 12 shows the Telstra network coverage for the Project area [19]. This map also shows 3G coverage in the vicinity of the Project, although an external antenna is required to receive coverage in some areas, and some areas appear to have no coverage. Areas around the Project site may also receive 4G coverage, particularly in the north, west, and southwest, but 4GX coverage is limited in the vicinity of the Project.

Figure 13 shows the Vodafone network coverage for the Project area [20]. Most locations in the vicinity of the Project have only outdoor coverage, although some locations have both outdoor and limited indoor coverage. Areas to the southwest of the Project receive good outdoor and indoor coverage.

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, 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. Responses have been received from all three operators, and no concerns have been raised.

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.

5.11 Wireless internet

Agile Communications and Aussie Broadband Pty Ltd hold point-to-multipoint licences in the vicinity of the Project, with base stations located 41 km east of the Project site and 6 km north of the Project site respectively. As the locations of Agile Communications and Aussie Broadband customers are not known, it is not possible to determine whether there is the potential for interference to these services, however it is possible that stations at these distances may be servicing customers in the vicinity of the proposed Project. Agile Communications and Aussie Broadband have been contacted by DNV GL to seek feedback regarding the potential for interference to their services. Responses have been received from both Agile Communications and Aussie Broadband, and no concerns have been raised.

Additionally, residents in the vicinity of the Project are likely to utilise Telstra wireless broadband services. Telstra's wireless broadband service utilises the same network as Telstra's mobile phone service, and therefore the comments made in Section 5.10 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 5.10 may be applicable.

The National Broadband Network (NBN) website [21] indicates that the network is currently available as a fixed wireless service and satellite internet service using the NBN SkyMuster satellite 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. NBN Co has been contacted as part of the consultation process to seek feedback on whether there is potential for the Project to cause interference to their services. No formal response has been received to date.

The potential for signals from the NBN SkyMuster satellite to be intercepted by wind turbines at the Project has been considered as part of the analysis described in Section 5.12 below.

Feedback received from the Customer suggests that residents in the vicinity of the Project currently experience poor wireless internet coverage [22], however it is not clear what service these residents are currently using. Residents who have marginal wireless internet coverage may be more susceptible to interference from the wind farm, depending on the technology type, and the

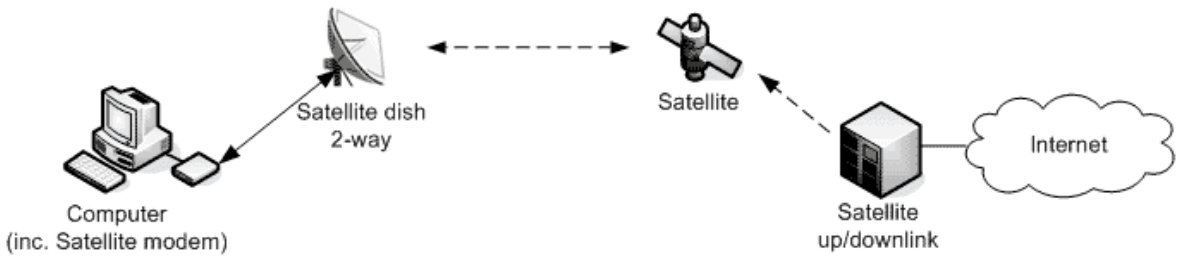
relative positions of the infrastructure of the internet service provider, the wind farm, and the residents.

The Customer has also indicated that some residents may be utilising wireless internet services provided by local company Beam Barossa [22]. DNV GL is intending to contact Beam Barossa to seek further information regarding their services and customers in the vicinity of the Project, and feedback on the potential for interference to their services.

5.12 Satellite television and internet

In some rural or remote areas, television and internet access can be provided through satellite only. Satellite television is delivered via a communication satellite to a satellite dish connected to a set-top box. The satellite transmits television signals to the user's antenna at two frequency bands; the C band at between 4 GHz and 8 GHz, and the Ku band at between 12 GHz and 18 GHz. Signals in the C band are susceptible to interference due to radio relay links, radar systems and other devices operating at a similar frequency while signals in the 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 [23].

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/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.



Two-way connection to the internet via satellite [24]

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

A number of satellites transmit television 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 services to eastern Australia. Although only a small number of satellites are likely to be providing television services intended for Australia (e.g., Optus C1, D1, and D2), all viewable satellites have been considered.

The analysis has shown that no satellite signals to houses in the vicinity of the Project are expected to be intercepted by turbines.

The main satellites for providing satellite internet in Australia are the IPSTAR and Optus D2 satellites, and the NBN SkyMuster satellite. From the Project site, the IPSTAR, Optus D2, and

SkyMuster satellites have elevations of approximately 45.0°, 47.8°, and 50.1° respectively [25]. Therefore it is unlikely that the Project will impact upon the line-of-sight from these satellites to any house.

5.13 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 [26], and are shown in Figure 14.

5.13.1 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 [27]. Any interference problems are likely to be easily resolved through the installation of a high quality antenna and/or amplifier.

5.13.2 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 an FM signal 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 [28]. 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 [27] [29]. 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 [28]. 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 [30].

The closest FM broadcast transmission tower is located approximately 2.7 km from the proposed site boundary or 3.5 km east of the nearest wind turbine (turbine T25). 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 15 and Figure 16. Since the transmission tower is located to the southeast of the proposed turbine locations, the potential interference sector extends to the west and northwest of the Project site. DNV GL has contacted the operator of this tower, Flow FM, to seek feedback on whether interference to their broadcasting services is likely.

The response received from Flow FM indicates that the turbines at the Project have the potential to cause interference to the FM radio signals broadcast from their Kapunda transmission tower, located to the east of the Project site. However, Flow FM has advised that the areas to the west and northwest of the Project site may also receive signals broadcast by their Maitland and Hallett transmission towers. Coverage maps for the radio signals from the Kapunda, Maitland, and Hallett towers have been provided by Flow FM, and have been used to identify the areas with the greatest potential to experience interference to the signal from the Kapunda tower.

The extents of the coverage areas for rural mono reception, assuming a fixed antenna height of 1.5 m, and car radio reception from the Flow FM broadcast towers at Kapunda, Maitland, and Hallett are shown in Figure 15 and Figure 16 respectively. The regions with the highest potential to experience interference to the signal from the Kapunda tower lie at the edges of the signal coverage area to the west and northwest of the Project site, at distances of approximately 35-40 km from the site for fixed antennas and approximately 40-50 km for car radios. Some residents at the edges of the Kapunda rural mono coverage area to the west of the Project are also within the coverage area for the Maitland broadcast tower, which may mitigate any interference experienced in these regions. However, there is no alternative signal available for residents to the northwest of the Project site, around the towns of Saddleworth and Auburn, and so there is increased potential for interference to cause problems in these areas.

Due to the considerable overlap between the car radio coverage areas for the Kapunda, Maitland, and Hallett broadcast towers, it is unlikely that interference arising from the Project will be a problem for car radio reception.

If interference to FM radio signals is experienced, mitigation options include installing high-quality antennas and/or amplifiers at affected residences, increasing the broadcast signal strength from the Kapunda transmitting tower or the nearby Maitland or Hallett towers, moving the Kapunda tower to a new location more than 4 km from any turbine, or installing a signal repeater on the opposite side of the Project. It is understood that the Customer is undertaking further engagement with Flow FM, to establish an understanding of how any impact to the FM radio signal from the Kapunda tower may be mitigated.

5.13.3 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 [31]. 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 [32], digital radio is currently available in areas to the southwest of the Project.

The UK telecommunications regulator Ofcom [28] states:

> *"In contrast [to FM signals], the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections. FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold"*.

DNV GL has therefore concluded that DAB signals are not affected by reflection or scattering from physical structures in the same way as FM signals, and so digital radio broadcasts are generally not susceptible to interference from wind farm developments. However, interference may be experienced if the line-of-sight between a DAB transmitter and a radio receiver is blocked by a wind turbine.

The locations of the DAB transmitters in the vicinity of the Project have been determined from the Broadcast Transmitter Database [26], and are shown in Figure 14. The nearest DAB transmitter is located at Adelaide, approximately 76 km to the south southwest of the Project site.

Due to the significant distance between the transmitter and the Project, it is considered unlikely that listeners in the vicinity of the Project are receiving digital radio broadcasts. The impact of the Project on digital radio services is therefore expected to be minimal. If interference to DAB signals is encountered, it is likely to be resolved through the installation of a high quality antenna and/or amplifier or by moving the existing antenna to receive a stronger signal.

5.14 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 [26]. 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 [28] 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 [26] was examined to identify broadcasters nearby to the proposed Project, with those found shown in Figure 14. The main television transmitter used by residents in the vicinity of the Project is the Adelaide transmitter at Crafers. However, it is also possible that residents to the northeast of the site receive television signals from the Eudunda transmitter, while residents to the east of the site may receive television signals from the Renmark/Loxton and Waikerie 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.

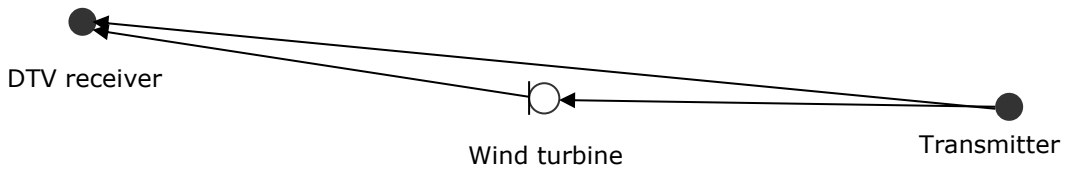
5.14.1 Large scale interference

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 [8]. The closest digital television transmitter to the Project is the Eudunda transmitter, which is approximately 6 km away from the site boundary and 11 km away from the nearest turbine, and so the Project is not expected to cause large scale interference.

5.14.2 Forward and back scatter

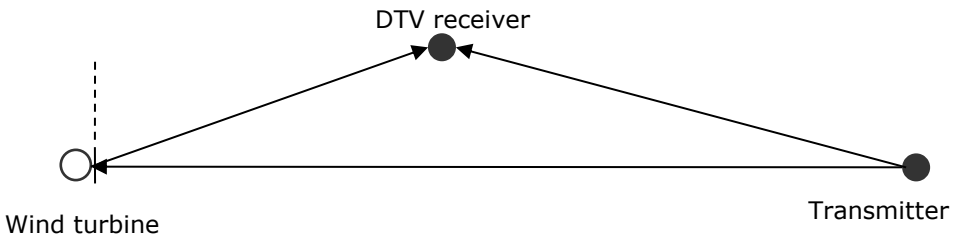
Wind turbines cause interference to television signals by introducing reflections that may be received by the antenna at a dwelling, in addition to the signal received directly from the transmitter, which causes multipath errors. A wind turbine has the potential to scatter electromagnetic waves carrying 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 [33]. 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

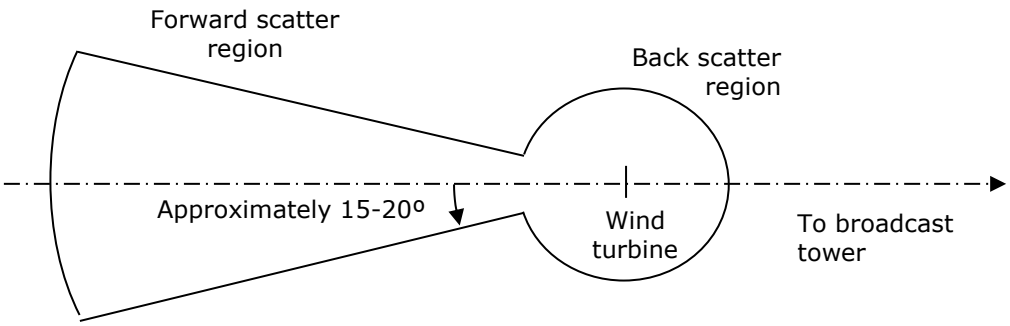
Interference of DTV signals from wind turbine developments can potentially occur in both the forward and backward scatter region. The effect of a wind turbine on a DTV signal can be different depending on the scattering region where the receiver is located [33].

According to Ofcom [28], the forward scatter region does not typically extend further than 5 km for the worst combination of factors [8] [34]. 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 [28]. 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 [8] [35], 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 [36] 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 [37] 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 [37].

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 5.14.4.

5.14.3 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 [38]. 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 [36], 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 [28]. 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 5.14.4.

5.14.4 Potential impacts for dwellings

According to the Australian Government mySwitch website [35], the area around the Project is able to receive DTV signals from the Adelaide, Eudunda, Renmark/Loxton, and Waikerie broadcast towers. The coverage map reproduced in Figure 17 suggests that coverage from the Adelaide tower is 'variable' to 'good' across the site. Coverage maps reproduced in Figure 18 to Figure 20 suggest that coverage from Eudunda, Renmark/Loxton, and Waikerie towers is 'poor' to 'variable' and only available in the areas to the north and east of 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 Table 13 and Figure 17 to Figure 20. The dwellings that are most likely to be susceptible to interference include those within the possible interference zones, as summarised in Table 3 below. Dwellings located in the potential interference zones for the Eudunda, Renmark/Loxton, and Waikerie broadcast towers are not expected to be able to receive signals from these towers, based on the coverage maps in Figure 18 to Figure 20, and are not included in Table 3 and Table 13. 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.

Table 3 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 within potential interference zone
Adelaide (Crafers)	10 (3 dwellings belonging to associated landholders)

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 5.14.5.

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.

5.14.5 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 and/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 [33] DVB-T reception quality may not be substantially affected in the forward scatter region.

The ITU [37] 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 [39].

6 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 51 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 136 m or less and an upper tip height of 180 m or less.

The results of this assessment, including feedback obtained from relevant stakeholders, are summarised in Table 4 on the following pages. It is noted that the Project has the potential to cause interference to digital television signals received at dwellings in the vicinity of the Project, and FM radio broadcasts to the west and northwest of the Project.

DNV GL has assessed potential EMI impacts on point-to-multipoint links, emergency services, and wireless internet services through consultation with service operators. While DNV GL considers that interference to fixed point-to-point links passing over the Project boundaries is unlikely, it is noted that one operator, SA Water, has expressed concerns regarding potential impacts on their link. All other responses received to date indicate that the Project is unlikely to have any impact on the relevant services.

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

Table 4 Summary of EMI assessment results for the proposed Project

Licence/service type	Assessment findings	Stakeholder feedback (to date)
Fixed point-to-point microwave links	Three links crossing Project boundary: *SA Water* No turbines in exclusion zone *W & L Phillips Pty Limited (Flow FM)* No turbines in exclusion zone *NBN Co* No turbines in exclusion zone	Potential for interference No concerns raised No concerns raised
Fixed point-to-multipoint microwave links	222 assignments within 75 km of Project boundary Seven base stations within 20 km of Project boundary: Aussie Broadband (Site ID 9012660) Barossa Valley Golf Club (Site ID 501154) SA Water (Site ID 24263 and 9007183) SA Power Networks / Telstra (Site ID 24227) The Barossa Council (Site ID 9011554) Treasury Wine Estates Vintners (Site ID 138906)	Potential for interference to SA Power Networks point-to-multipoint link; resolved with proposed exclusion zone
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	-
Emergency services	Point-to-point microwave links: No links crossing boundary Base to mobile station style communications: unlikely to be affected	No concerns raised
Aircraft navigation systems and radar	To be considered as part of an aviation impact assessment	-
Meteorological radar	Nearest station: 'Buckland Park' (Adelaide), 63 km from nearest turbine Unlikely to be affected	Potential for interference to Buckland Park radar; satisfied with proposed turbine locations

Table 4 Summary of EMI assessment results for the proposed Project (continued)

Licence/service type	Assessment findings	Stakeholder feedback (to date)
Trigonometrical stations	56 stations within 20 km of Project boundary Electronic equipment: unlikely to be affected Sight lines to other stations: may be blocked by turbines	No concerns raised
Citizen's band radio	Unlikely to be affected	-
Mobile phones	Fair to good coverage across site Unlikely to be affected, may experience interference in areas with marginal coverage	No concerns raised
Wireless internet	Likely service providers: Agile Communications, Aussie Broadband NBN: currently available in areas surrounding Project May experience interference in areas with marginal coverage	No concerns raised
Satellite television and internet	Services intended for Australia: unlikely to be affected Other services: no signals intercepted	-
Radio broadcasting	AM signals: unlikely to be affected FM signals: may experience interference (low level hiss or distortion) in close proximity to turbines FM signals from nearby Flow FM transmission tower: may experience interference in areas with poor or marginal reception to the north and northeast of the Project Digital radio signals: unlikely to be affected	AM and digital radio signals: no consultation required FM signals: potential for interference to Flow FM signal
Television broadcasting	Digital signals: may experience interference in areas with poor or marginal reception *Adelaide tower: 'variable' to 'good' coverage across site* Ten dwellings (three belonging to associated landholders) in potential interference zone	-
	Eudunda, Renmark/Loxton, and Waikerie towers: 'variable' coverage to north and east of site No dwellings with coverage in potential interference zone	-

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LIST OF TABLES

Table 5 Proposed turbine layout for the Project site [6]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]	Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]
T1	321026	6200205	388	T27	323772	6203076	437
T2	321360	6200955	376	T28	322719	6203537	442
T3	322403	6200826	438	T29	322046	6203820	423
T4	321993	6201019	435	T30	321713	6204052	406
T5	321620	6201367	412	T31	321308	6204303	421
T6	320952	6201223	374	T32	321201	6204679	384
T7	319882	6201452	349	T33	324338	6203141	454
T8	320250	6201090	329	T34	323586	6203550	425
T9	322950	6201222	432	T35	322782	6204095	455
T10	322538	6201521	436	T36	322249	6204368	453
T11	322022	6201882	412	T37	321973	6204642	418
T12	322572	6201943	406	T38	324342	6203539	480
T13	322322	6202456	380	T40	324060	6203843	446
T14	320971	6202391	349	T42	323325	6204676	427
T15	320036	6202498	341	T43	322719	6204664	453
T16	320224	6203111	350	T44	323646	6204246	425
T17	321816	6202690	392	T45	323837	6204811	439
T18	323643	6202084	428	T46	323611	6205227	447
T19	323292	6202686	425	T47	323205	6205593	470
T20	322886	6202903	407	T48	323115	6205082	462
T21	322371	6203086	426	T49	322641	6205411	423
T22	321826	6203111	392	T50	321133	6203686	364
T23	321590	6203414	404	T51	321050	6202928	347
T24	320666	6204049	353	T52	321374	6201812	356
T25	324225	6202148	432	T53	323112	6202183	415
T26	323887	6202670	451				

1. Coordinate system: MGA zone 54, GDA94 datum

Table 6 Dwellings in the vicinity of the proposed Project [4]

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
1	333402	6212941	Non-associated landholder	12.5
2	332889	6208870	Non-associated landholder	9.9
3	317966	6209162	Non-associated landholder	5.5
4	328759	6208684	Non-associated landholder	6.2
5	318425	6204359	Non-associated landholder	2.2
6	317441	6204023	Non-associated landholder	2.9
7	314690	6200064	Non-associated landholder	5.4
8	317532	6197178	Non-associated landholder	4.6
9	324339	6199469	Non-associated landholder	2.2
10	332956	6200681	Non-associated landholder	8.8
11	315260	6200442	Non-associated landholder	4.7
12	332692	6205239	Non-associated landholder	8.5
13	333156	6212589	Non-associated landholder	12.0
14	323507	6197563	Non-associated landholder	3.5
15	321443	6211068	Non-associated landholder	5.8
16	332053	6213021	Non-associated landholder	11.5
17	316653	6209849	Non-associated landholder	6.9
18	326591	6204222	Non-associated landholder	2.3
19	319693	6211627	Non-associated landholder	6.9
20	330489	6211539	Non-associated landholder	9.3
21	321390	6210185	*Associated landholder*	4.9
22	316087	6197701	Non-associated landholder	5.3
23	319090	6211336	Non-associated landholder	6.9
24	331055	6202837	Non-associated landholder	6.7
25	317428	6198149	Non-associated landholder	4.1
26	330378	6205007	Non-associated landholder	6.2
27	316856	6202618	Non-associated landholder	3.2
28	316348	6204184	Non-associated landholder	4.0
29	317896	6207851	Non-associated landholder	4.6
30	316038	6210298	Non-associated landholder	7.6
31	319234	6211695	Non-associated landholder	7.2
32	314980	6201698	Non-associated landholder	4.9
33	318887	6210081	Non-associated landholder	5.9
34	316892	6212587	Non-associated landholder	9.0
35	318683	6213276	Non-associated landholder	8.8
36	320026	6212872	Non-associated landholder	7.9
37	320360	6213355	Non-associated landholder	8.3
38	321846	6212649	Non-associated landholder	7.2
39	323271	6212624	Non-associated landholder	7.0
40	326660	6213122	Non-associated landholder	8.3
41	327250	6212452	Non-associated landholder	8.0
42	331257	6213255	Non-associated landholder	11.1
43	331793	6210204	Non-associated landholder	9.6
44	331902	6209525	Non-associated landholder	9.3
45	330253	6209655	Non-associated landholder	8.0
46	330760	6210910	Non-associated landholder	9.1
47	329548	6210857	Non-associated landholder	8.2
48	328334	6211145	Non-associated landholder	7.6
49	327768	6211498	Non-associated landholder	7.5
50	320263	6212613	Non-associated landholder	7.6
51	320282	6212500	Non-associated landholder	7.5
52	319846	6212278	Non-associated landholder	7.4
53	319737	6212327	Non-associated landholder	7.5
54	314685	6206976	Non-associated landholder	6.7
55	314798	6206455	Non-associated landholder	6.3

Table 6 Dwellings in the vicinity of the proposed Project [4] (continued)

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
56	314913	6206182	Non-associated landholder	6.1
57	315169	6206334	Non-associated landholder	5.9
58	314945	6203986	Non-associated landholder	5.3
59	316285	6203701	Non-associated landholder	3.9
60	316133	6202968	Non-associated landholder	3.9
61	315845	6202465	Non-associated landholder	4.2
62	314649	6201555	Non-associated landholder	5.2
63	321440	6211313	Non-associated landholder	6.0
64	329377	6208084	Non-associated landholder	6.4
65	329672	6207896	Non-associated landholder	6.6
66	328249	6207469	Non-associated landholder	5.1
67	329079	6205727	Non-associated landholder	5.2
68	330079	6207149	Non-associated landholder	6.7
69	328912	6206433	Non-associated landholder	5.3
70	327001	6207829	Non-associated landholder	4.3
71	317366	6208478	Non-associated landholder	5.4
72	319006	6208941	Non-associated landholder	4.8
73	319843	6205696	*Associated landholder*	1.7
74	320270	6205615	Non-associated landholder	1.3
75	321830	6206405	*Associated landholder*	1.3
76	324379	6207966	Non-associated landholder	2.7
77	324320	6207653	Non-associated landholder	2.3
78	323818	6210616	Non-associated landholder	5.1
79	323873	6210441	Non-associated landholder	4.9
80	324097	6210418	Non-associated landholder	4.9
81	333163	6204041	Non-associated landholder	8.8
82	332114	6199930	Non-associated landholder	8.2
83	331318	6199253	Non-associated landholder	7.7
84	330876	6199742	Non-associated landholder	7.1
85	330199	6199883	Non-associated landholder	6.4
86	330014	6199830	Non-associated landholder	6.2
87	328452	6199011	Non-associated landholder	5.3
88	330707	6195869	Non-associated landholder	9.0
89	329182	6196326	Non-associated landholder	7.7
90	329251	6196299	Non-associated landholder	7.7
91	329366	6196323	Non-associated landholder	7.8
92	329477	6196741	Non-associated landholder	7.5
93	329375	6196658	Non-associated landholder	7.5
94	329394	6196597	Non-associated landholder	7.6
95	329439	6196657	Non-associated landholder	7.6
96	329316	6196623	Non-associated landholder	7.5
97	329248	6196582	Non-associated landholder	7.5
98	329163	6196530	Non-associated landholder	7.5
99	329163	6196557	Non-associated landholder	7.5
100	329174	6196594	Non-associated landholder	7.4
101	329184	6196620	Non-associated landholder	7.4
102	329214	6196373	Non-associated landholder	7.6
103	328993	6196382	Non-associated landholder	7.5
104	328943	6196320	Non-associated landholder	7.5
105	329118	6196714	Non-associated landholder	7.3
106	329158	6196489	Non-associated landholder	7.5
107	329020	6196732	Non-associated landholder	7.2
108	328227	6196021	Non-associated landholder	7.3
109	328868	6196628	Non-associated landholder	7.2
110	328765	6196749	Non-associated landholder	7.1

Table 6 Dwellings in the vicinity of the proposed Project [4] (continued)

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
111	327910	6197263	Non-associated landholder	6.1
112	325928	6196512	Non-associated landholder	5.6
113	323876	6195866	Non-associated landholder	5.2
114	316390	6196126	Non-associated landholder	6.2
115	323124	6196480	Non-associated landholder	4.3
116	323256	6196546	Non-associated landholder	4.3
117	321750	6197065	Non-associated landholder	3.2
118	318374	6200027	*Associated landholder*	2.1
119	318462	6200062	*Associated landholder*	2.0
120	318362	6200119	*Associated landholder*	2.0
121	316698	6201396	Non-associated landholder	3.2
122	322874	6198829	Non-associated landholder	2.1
123	324465	6199580	Non-associated landholder	2.2
124	324921	6199805	Non-associated landholder	2.4
125	324704	6200152	Non-associated landholder	2.1
126	331687	6202536	Non-associated landholder	7.4
127	330979	6201508	Non-associated landholder	6.8
128	330871	6203287	Non-associated landholder	6.5
129	330007	6201895	Non-associated landholder	5.8
130	329866	6203188	Non-associated landholder	5.5
131	324533	6197985	Non-associated landholder	3.6
132	324698	6197761	Non-associated landholder	3.8
133	319433	6210179	Non-associated landholder	5.8
134	319393	6209917	Non-associated landholder	5.6
135	319245	6209852	Non-associated landholder	5.5
136	329263	6197269	Non-associated landholder	7.0
137	329442	6197354	Non-associated landholder	7.1
138	329172	6197743	Non-associated landholder	6.6
139	333146	6199476	Non-associated landholder	9.3
140	330772	6211625	Non-associated landholder	9.6
141	331628	6212480	Non-associated landholder	10.8
142	333080	6209399	Non-associated landholder	10.3
143	331996	6204819	Non-associated landholder	7.7
144	326589	6210431	Non-associated landholder	5.9
145	331473	6207476	Non-associated landholder	8.1
146	331945	6207310	Non-associated landholder	8.5
147	319969	6205165	*Associated landholder*	1.3
148	319669	6207310	Non-associated landholder	3.0
149	314445	6202336	Non-associated landholder	5.5
150	316224	6203117	Non-associated landholder	3.9
151	320252	6205722	*Associated landholder*	1.4
152	329320	6196662	Non-associated landholder	7.5
153	329222	6196619	Non-associated landholder	7.5
154	329050	6196585	Non-associated landholder	7.4
155	329084	6196649	Non-associated landholder	7.3
156	329037	6196731	Non-associated landholder	7.2
157	329091	6196837	Non-associated landholder	7.2
158	328914	6196750	Non-associated landholder	7.2
159	328900	6196737	Non-associated landholder	7.2
160	328983	6197055	Non-associated landholder	7.0
161	329223	6197127	Non-associated landholder	7.1
162	329189	6197081	Non-associated landholder	7.1
163	329315	6197629	Non-associated landholder	6.8
164	329376	6197622	Non-associated landholder	6.9
165	329283	6197521	Non-associated landholder	6.9

Table 6 Dwellings in the vicinity of the proposed Project [4] (continued)

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
166	329427	6197811	Non-associated landholder	6.8
167	331881	6199249	Non-associated landholder	8.2
168	325069	6195084	Non-associated landholder	6.3
169	324942	6195205	Non-associated landholder	6.2
170	324876	6195388	Non-associated landholder	6.0
171	324384	6194580	Non-associated landholder	6.6
172	322403	6193774	Non-associated landholder	6.6
173	322166	6193978	Non-associated landholder	6.3
174	322377	6195495	Non-associated landholder	4.9
175	321305	6214520	Non-associated landholder	9.1
176	322134	6214224	Non-associated landholder	8.7
177	316423	6203609	Non-associated landholder	3.8
178	319884	6195267	Non-associated landholder	5.1
179	320076	6195303	Non-associated landholder	5.0
180	325159	6199502	Non-associated landholder	2.8
181	323623	6197004	Non-associated landholder	4.0
182	323772	6197057	Non-associated landholder	4.0
183	323773	6196905	Non-associated landholder	4.2
184	322571	6195278	Non-associated landholder	5.2
185	322560	6194278	Non-associated landholder	6.1
186	323539	6196728	Non-associated landholder	4.3
187	326433	6207948	Non-associated landholder	3.9
188	328156	6194319	Non-associated landholder	8.7
189	328827	6193956	Non-associated landholder	9.4
190	327849	6193219	Non-associated landholder	9.4
191	329897	6193600	Non-associated landholder	10.3
192	330243	6194049	Non-associated landholder	10.1
193	329437	6191717	Non-associated landholder	11.5
194	329439	6191654	Non-associated landholder	11.6
195	329883	6191224	Non-associated landholder	12.2
196	329942	6191210	Non-associated landholder	12.2
197	329987	6191376	Non-associated landholder	12.1
198	330371	6191129	Non-associated landholder	12.5
199	330424	6191076	Non-associated landholder	12.6
200	330575	6191066	Non-associated landholder	12.7
201	330532	6191090	Non-associated landholder	12.7
202	330214	6190939	Non-associated landholder	12.6
203	330462	6190513	Non-associated landholder	13.1
204	330420	6190543	Non-associated landholder	13.0
205	330236	6190480	Non-associated landholder	13.0
206	330272	6190519	Non-associated landholder	13.0
207	330182	6190514	Non-associated landholder	12.9
208	330115	6190492	Non-associated landholder	12.9
209	330290	6190746	Non-associated landholder	12.8
210	330599	6193136	Non-associated landholder	11.0
211	328296	6196025	Non-associated landholder	7.4
212	325385	6194799	Non-associated landholder	6.7
213	325861	6194403	Non-associated landholder	7.3
214	325870	6194335	Non-associated landholder	7.4
215	329570	6194498	Non-associated landholder	9.3
216	329530	6194510	Non-associated landholder	9.3
217	329469	6194508	Non-associated landholder	9.3
218	327658	6193293	Non-associated landholder	9.2
219	327302	6192599	Non-associated landholder	9.6
220	327546	6191204	Non-associated landholder	10.9
221	327813	6191195	Non-associated landholder	11.1
222	327884	6191280	Non-associated landholder	11.0
223	327845	6191144	Non-associated landholder	11.1
224	327814	6191146	Non-associated landholder	11.1
225	327926	6191067	Non-associated landholder	11.2
226	327891	6191081	Non-associated landholder	11.2

Table 6 Dwellings in the vicinity of the proposed Project [4] (continued)

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
227	328051	6191084	Non-associated landholder	11.3
228	328176	6191074	Non-associated landholder	11.3
229	328105	6191058	Non-associated landholder	11.3
230	328221	6191050	Non-associated landholder	11.4
231	328227	6191071	Non-associated landholder	11.4
232	328289	6191043	Non-associated landholder	11.4
233	328285	6191021	Non-associated landholder	11.4
234	328259	6190995	Non-associated landholder	11.5
235	328202	6191014	Non-associated landholder	11.4
236	328378	6191064	Non-associated landholder	11.5
237	327895	6191019	Non-associated landholder	11.3
238	327736	6191073	Non-associated landholder	11.1
239	327771	6191057	Non-associated landholder	11.2
240	327724	6190994	Non-associated landholder	11.2
241	327772	6190979	Non-associated landholder	11.2
242	327781	6190978	Non-associated landholder	11.2
243	327794	6190972	Non-associated landholder	11.2
244	327806	6190972	Non-associated landholder	11.3
245	327823	6190964	Non-associated landholder	11.3
246	327863	6190961	Non-associated landholder	11.3
247	327800	6191000	Non-associated landholder	11.2
248	327778	6191009	Non-associated landholder	11.2
249	327827	6190995	Non-associated landholder	11.2
250	327751	6191015	Non-associated landholder	11.2
251	327880	6190979	Non-associated landholder	11.3
252	327917	6190967	Non-associated landholder	11.3
253	327918	6190931	Non-associated landholder	11.3
254	327932	6190959	Non-associated landholder	11.3
255	328046	6190889	Non-associated landholder	11.4
256	328050	6190919	Non-associated landholder	11.4
257	328084	6190905	Non-associated landholder	11.4
258	328113	6190894	Non-associated landholder	11.5
259	328141	6190886	Non-associated landholder	11.5
260	328136	6190860	Non-associated landholder	11.5
261	328044	6190850	Non-associated landholder	11.5
262	328057	6190809	Non-associated landholder	11.5
263	328086	6190833	Non-associated landholder	11.5
264	328100	6190829	Non-associated landholder	11.5
265	327999	6190852	Non-associated landholder	11.5
266	327962	6190865	Non-associated landholder	11.4
267	327909	6190891	Non-associated landholder	11.4
268	327878	6190901	Non-associated landholder	11.4
269	327935	6190882	Non-associated landholder	11.4
270	327824	6190926	Non-associated landholder	11.3
271	328179	6190855	Non-associated landholder	11.5
272	328198	6190850	Non-associated landholder	11.6
273	328216	6190866	Non-associated landholder	11.5
274	328416	6190927	Non-associated landholder	11.6
275	328439	6190984	Non-associated landholder	11.6
276	328206	6190972	Non-associated landholder	11.5
277	327791	6191184	Non-associated landholder	11.1
278	329216	6191476	Non-associated landholder	11.6
279	331991	6192334	Non-associated landholder	12.5
280	328154	6190849	Non-associated landholder	11.5
281	329412	6190930	Non-associated landholder	12.1
282	331957	6190500	Non-associated landholder	14.0
283	332111	6190531	Non-associated landholder	14.1
284	332360	6190441	Non-associated landholder	14.3
285	332404	6190454	Non-associated landholder	14.3
286	333877	6192644	Non-associated landholder	13.5
287	332679	6193278	Non-associated landholder	12.3

Table 6 Dwellings in the vicinity of the proposed Project [4] (continued)

House ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
288	332708	6193251	Non-associated landholder	12.3
289	332743	6193332	Non-associated landholder	12.3

1. Coordinate system: MGA zone 54, GDA94 datum

Dwellings belonging to associated landholders are indicated by *underlined italic text*

Table 7 Details of point-to-point links crossing the proposed Project site

Link no.	Assignment ID	Licence number	Frequency [MHz]	Postal address
1	752337, 752338	1181233/1	414.150	South Australian Water Corporation SA Water Adelaide GPO Box 1751 (C/- Chris Atkinson) ADELAIDE SA 5001
	752339, 752340	1181233/1	404.700	
2	790526, 790527	1323526/1	849.400	W & L Phillips Pty Limited Flow FM PO Box 407 KAPUNDA SA 5373
3	1401118, 1401119	9900523/1	8044.195	NBN Co Limited Level 11, 100 Arthur Street NORTH SYDNEY NSW 2060
	1401120, 1401121	9900523/1	7732.875	

Table 8 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
825047	501670	1509414/1	-34.859032	138.612163	68	Adelaide Cemeteries Authority PO Box 294 ENFIELD PLAZA SA 5085
825044	501670	1509414/1	-34.859032	138.612163	68	
887641	9010114	1920362/1	-34.669	139.455032	51	Agile Pty Ltd Agile Communications Adelaide Accts Payable Locked Bag 16 CLOISTERS SQUARE WA 6850
887644	9010114	1920362/1	-34.669	139.455032	51	
887652	9010892	1920363/1	-34.353795	139.540136	41	
887649	9010892	1920363/1	-34.353795	139.540136	41	
1175109	9013850	1937806/1	-33.590507	138.948662	71	Aussie Broadband Pty Ltd PO Box 3351 GIPPSLAND MC VIC 3841
1175112	9013850	1937806/1	-33.590507	138.948662	71	
1174839	403816	1926122/1	-34.913975	139.303291	67	
1174842	403816	1926122/1	-34.913975	139.303291	67	
1174835	403816	1926121/1	-34.913975	139.303291	67	
1174838	403816	1926121/1	-34.913975	139.303291	67	
1175001	500947	1930218/1	-33.871023	138.651993	55	
1175004	500947	1930218/1	-33.871023	138.651993	55	
1175008	9012665	1930220/1	-33.931071	138.677158	48	
1175005	9012665	1930220/1	-33.931071	138.677158	48	
1174903	501046	1927157/1	-34.435721	138.509917	47	
1174906	501046	1927157/1	-34.435721	138.509917	47	
1175000	9012663	1930217/1	-34.197677	138.660263	35	
1174997	9012663	1930217/1	-34.197677	138.660263	35	
1174935	9012518	1929261/1	-34.53602	138.750656	32	
1174938	9012518	1929261/1	-34.53602	138.750656	32	
1174993	9012662	1930216/1	-33.990368	138.916622	29	
1174996	9012662	1930216/1	-33.990368	138.916622	29	
1174989	9012661	1930215/1	-34.179009	138.832201	21	
1174992	9012661	1930215/1	-34.179009	138.832201	21	
1174985	9012660	1930214/1	-34.167868	139.067008	6	
1174988	9012660	1930214/1	-34.167868	139.067008	6	
1289159	501781	1142622/1	-34.104047	139.867285	73	Australian Vintage Ltd RMB 3375 PIANGIL VIC 3597
1289162	501781	1142622/1	-34.104047	139.867285	73	
824019	501154	1506275/1	-34.431931	138.968331	10	Barossa Valley Golf Club Inc PO Box 322 NURIOOTPA SA 5355
824016	501154	1506275/1	-34.431931	138.968331	10	
792875	305318	1325983/1	-34.569823	138.64902	42	Barry Farmer Virginia Farm Produce PO Box 38 VIRGINIA SA 5120
792872	305318	1325983/1	-34.569823	138.64902	42	

Table 8 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
1305745	22712	433978/1	-34.921223	138.622149	73	Bureau of Meteorology Network Services Operations Manager GPO Box 1289 MELBOURNE VIC 3001
1305748	22712	433978/1	-34.921223	138.622149	73	
1306043	134199	1148674/1	-34.922189	138.680288	71	
1306040	134199	1148674/1	-34.922189	138.680288	71	
1306484	304390	1322463/1	-34.883287	138.759151	64	
1306481	304390	1322463/1	-34.883287	138.759151	64	
1306874	23452	1505641/1	-34.882778	138.87125	61	
1306871	23452	1505641/1	-34.882778	138.87125	61	
1305749	24472	433980/1	-33.90131	138.61134	55	
1305752	24472	433980/1	-33.90131	138.61134	55	
1305790	23428	434009/1	-34.72427	138.9279	43	
1305787	23428	434009/1	-34.72427	138.9279	43	
1306021	405152	1145023/1	-34.201488	138.596999	40	
1306018	405152	1145023/1	-34.201488	138.596999	40	
1306053	135941	1180111/1	-34.544387	139.192999	26	
1306050	135941	1180111/1	-34.544387	139.192999	26	
824038	501183	1506307/1	-33.820107	138.613472	61	Clare Golf Club Inc PO Box 86 CLARE SA 5453
824041	501183	1506307/1	-33.820107	138.613472	61	
824996	501643	1509217/1	-34.582717	139.610856	56	Condo & Son Pty Ltd & Trustee for Condo Family Trust Swan Produce PO Box 334 BROOKLYN PARK SA 5032
824999	501643	1509217/1	-34.582717	139.610856	56	
1465844	22202	1143151/2	-34.919999	138.60893	74	Department for Health and Ageing eHealth Systems (ICT) Infrastructure GPO Box 11027 c/- Shared Services ADELAIDE SA 5001
1465843	22202	1143151/2	-34.919999	138.60893	74	

Table 8 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
1267625	22971	493558/1	-34.716039	138.534509	60	Department of Defence Director Defence Spectrum Office D DSO APW-GF-173 Anzac Park West PO Box 7953 CANBERRA BC
1267622	22971	493558/1	-34.716039	138.534509	60	
1265221	22971	99850/1	-34.716039	138.534509	60	
1265218	22971	99850/1	-34.716039	138.534509	60	
1267629	52733	493559/1	-34.734195	138.634893	55	
1267626	52733	493559/1	-34.734195	138.634893	55	
1265637	22977	100379/1	-34.732426	138.647818	55	
1267633	22977	493573/1	-34.732426	138.647818	55	
1265644	22977	100389/1	-34.732426	138.647818	55	
1265641	22977	100389/1	-34.732426	138.647818	55	
1265640	22977	100379/1	-34.732426	138.647818	55	
1265653	22977	100394/1	-34.732426	138.647818	55	
1265656	22977	100394/1	-34.732426	138.647818	55	
1267630	22977	493573/1	-34.732426	138.647818	55	
1265636	22977	100378/1	-34.732426	138.647818	55	
1252145	22977	100384/1	-34.732426	138.647818	55	
1265214	22977	99849/1	-34.732426	138.647818	55	
1265217	22977	99849/1	-34.732426	138.647818	55	
1265652	22977	100392/1	-34.732426	138.647818	55	
1265648	22977	100391/1	-34.732426	138.647818	55	
1265645	22977	100391/1	-34.732426	138.647818	55	
1252148	22977	100384/1	-34.732426	138.647818	55	
1265632	22977	100374/1	-34.732426	138.647818	55	
1265649	22977	100392/1	-34.732426	138.647818	55	
1265629	22977	100374/1	-34.732426	138.647818	55	
1265633	22977	100378/1	-34.732426	138.647818	55	
1270336	100206	1136256/1	-34.710839	138.625296	54	
1270333	100206	1136256/1	-34.710839	138.625296	54	
832235	23109	1565401/1	-34.949392	138.715901	72	Direct-Mix Concrete Pty Ltd PO Box 232 TORRENSVILLE PLAZA SA 5031
832232	23109	1565401/1	-34.949392	138.715901	72	
979286	23109	1974920/1	-34.949392	138.715901	72	
979283	23109	1974920/1	-34.949392	138.715901	72	
822822	500354	1501292/1	-34.779834	138.480671	69	Flinders Ports Pty Ltd St Vincent St PORT ADELAIDE SA 5015
822825	500354	1501292/1	-34.779834	138.480671	69	
795677	501003	1329006/1	-34.611677	138.837313	34	Gawler Golf Club PO Box 278 GAWLER SA 5118
795681	501003	1329006/1	-34.611677	138.837313	34	
761640	304555	1191804/1	-34.093624	139.861635	73	GD & AR Bald Pty Ltd ATF Bald Family Trust PO Box 78 WAIKERIE SA 5330
761637	304555	1191804/1	-34.093624	139.861635	73	
824090	501221	1506533/1	-33.8187	138.5972	62	Jim Barry Wines Pty Ltd PO Box 321 CLARE SA 5453
824087	501221	1506533/1	-33.8187	138.5972	62	
791294	304672	1324071/1	-34.052643	138.718536	37	Koonowla Pty Ltd Koonowla Wines PO Box 45 AUBURN SA 5451
791291	304672	1324071/1	-34.052643	138.718536	37	

Table 8 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
1256417	502448	1322427/1	-34.694378	139.657867	66	Oakville Potatoes Pty Ltd PO Box 42 NILDOTTIE SA 5238
1256420	502448	1322427/1	-34.694378	139.657867	66	
827419	502100	1512188/1	-34.694822	139.657315	66	
827422	502100	1512188/1	-34.694822	139.657315	66	
1000005	9023070	1985221/1	-34.098875	139.853532	72	Samuel Smith and Son Pty Ltd Yalumba Winery Oxford Landing Estate PMB 31 WAIKERIE SA 5330
1000002	9023070	1985221/1	-34.098875	139.853532	72	
1311943	54110	9847156/1	-34.940285	138.633422	75	South Australian Water Corporation SA Water Adelaide GPO Box 1751 (C/- Chris Atkinson) ADELAIDE SA 5001
1311940	54110	9847156/1	-34.940285	138.633422	75	
917364	54110	1940402/1	-34.940285	138.633422	75	
917367	54110	1940402/1	-34.940285	138.633422	75	
1311938	22346	9847157/1	-34.865257	138.501625	74	
1311935	22346	9847157/1	-34.865257	138.501625	74	
1706232	22346	10058433/1	-34.865257	138.501625	74	
1706231	22346	10058433/1	-34.865257	138.501625	74	
1311965	500963	9847151/1	-34.994554	138.910898	72	
1311964	500963	9847151/1	-34.994554	138.910898	72	
932093	23114	1950797/1	-34.946926	138.714206	72	
1696541	23114	10054183/1	-34.946926	138.714206	72	
932096	23114	1950797/1	-34.946926	138.714206	72	
1696540	23114	10054183/1	-34.946926	138.714206	72	
971881	305774	1971357/1	-34.874449	138.771582	63	
971878	305774	1971357/1	-34.874449	138.771582	63	
825223	501743	1509915/1	-34.865003	138.774852	62	
825227	501743	1509915/1	-34.865003	138.774852	62	
1400555	134025	9898303/1	-34.769796	138.582586	61	
917380	134025	1940404/1	-34.769796	138.582586	61	
917383	134025	1940404/1	-34.769796	138.582586	61	
917372	134025	1940403/1	-34.769796	138.582586	61	
917375	134025	1940403/1	-34.769796	138.582586	61	
1400554	134025	9898303/1	-34.769796	138.582586	61	
1696533	23452	10054185/1	-34.882778	138.87125	61	
1696532	23452	10054185/1	-34.882778	138.87125	61	
1740362	23452	10065205/1	-34.882778	138.87125	61	
1740361	23452	10065205/1	-34.882778	138.87125	61	
823252	500680	1503652/1	-34.021737	139.684262	60	
823255	500680	1503652/1	-34.021737	139.684262	60	
831194	500680	1564623/1	-34.021737	139.684262	60	
831191	500680	1564623/1	-34.021737	139.684262	60	
749226	502494	1148259/1	-34.83582	138.746881	60	
749223	502494	1148259/1	-34.83582	138.746881	60	
779525	205783	1232338/1	-33.818628	138.646676	59	
779528	205783	1232338/1	-33.818628	138.646676	59	
830888	9004223	1564380/1	-34.832581	138.806886	57	
830891	9004223	1564380/1	-34.832581	138.806886	57	
908994	23437	1935045/1	-34.849854	139.133642	57	
908991	23437	1935045/1	-34.849854	139.133642	57	
825535	501838	1510884/1	-34.761131	138.710789	54	
825532	501838	1510884/1	-34.761131	138.710789	54	
886607	9010753	1919707/1	-34.814866	138.873895	54	
886610	9010753	1919707/1	-34.814866	138.873895	54	
868770	9008662	1906921/1	-34.756795	138.71602	53	
868767	9008662	1906921/1	-34.756795	138.71602	53	
825221	501742	1509914/1	-34.753714	138.719076	53	
825218	501742	1509914/1	-34.753714	138.719076	53	

Table 8 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
779517	24293	1232337/1	-33.932219	138.676867	48	
779520	24293	1232337/1	-33.932219	138.676867	48	
824704	501499	1508463/1	-34.052467	138.600476	46	
824701	501499	1508463/1	-34.052467	138.600476	46	
864043	137591	1901960/1	-34.733186	139.080779	43	
864046	137591	1901960/1	-34.733186	139.080779	43	
970858	23422	1970916/1	-34.726063	138.927309	43	
970852	23422	1970916/1	-34.726063	138.927309	43	
781543	23422	1235783/1	-34.726063	138.927309	43	
781546	23422	1235783/1	-34.726063	138.927309	43	
825410	501790	1510402/1	-34.602938	138.760769	37	
825413	501790	1510402/1	-34.602938	138.760769	37	
957733	501790	1964490/1	-34.602938	138.760769	37	
957730	501790	1964490/1	-34.602938	138.760769	37	
911061	9002222	1936788/1	-34.27461	138.686434	30	
911058	9002222	1936788/1	-34.27461	138.686434	30	
752368	24275	1181237/1	-33.964823	139.06284	29	
752365	24275	1181237/1	-33.964823	139.06284	29	
1311959	9002223	9847152/1	-34.392418	138.71854	27	
1311962	9002223	9847152/1	-34.392418	138.71854	27	
752356	24182	1181235/1	-34.571804	139.00583	25	
752353	24182	1181235/1	-34.571804	139.00583	25	
1311921	9007183	9847149/1	-34.489054	139.18397	20	
1311924	9007183	9847149/1	-34.489054	139.18397	20	
752362	24263	1181236/1	-34.184752	139.071928	4	
752357	24263	1181236/1	-34.184752	139.071928	4	
806149	304331	1423692/1	-33.995414	139.732308	65	Spark Infrastructure SA (No2) Pty Limited SA Power Networks GPO Box 77 (C/- Geof Axon) ADELAIDE SA 5001
806152	304331	1423692/1	-33.995414	139.732308	65	
1725438	23530	10062782/1	-34.929104	139.034726	65	
1725435	23530	10062782/1	-34.929104	139.034726	65	
829201	23530	1515470/1	-34.929104	139.034726	65	
829198	23530	1515470/1	-34.929104	139.034726	65	
810662	23530	1430093/1	-34.929104	139.034726	65	
810665	23530	1430093/1	-34.929104	139.034726	65	
829177	35742	1515225/1	-34.735937	138.71334	51	
904908	35742	1931977/1	-34.735937	138.71334	51	
904905	35742	1931977/1	-34.735937	138.71334	51	
955379	35742	1963427/1	-34.735937	138.71334	51	
955376	35742	1963427/1	-34.735937	138.71334	51	
829174	35742	1515225/1	-34.735937	138.71334	51	
806488	35742	1424275/1	-34.735937	138.71334	51	
806485	35742	1424275/1	-34.735937	138.71334	51	
914766	24293	1938723/1	-33.932219	138.676867	48	
914763	24293	1938723/1	-33.932219	138.676867	48	
993465	24293	1982086/1	-33.932219	138.676867	48	
993462	24293	1982086/1	-33.932219	138.676867	48	
1004794	24227	1987208/1	-34.315311	139.127007	3	
1004797	24227	1987208/1	-34.315311	139.127007	3	

Table 8 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
823364	500752	1503777/1	-33.660182	139.441125	72	Telstra Corporation Limited Radio Transport Engineering Locked Bag 810 (Attn Tom Fairbrother) ADELAIDE
823367	500752	1503777/1	-33.660182	139.441125	72	
823359	24468	1503775/1	-33.849035	138.595627	60	
823356	24468	1503775/1	-33.849035	138.595627	60	
707371	24205	90628/1	-34.669208	139.454395	51	
707374	24205	90628/1	-34.669208	139.454395	51	
790742	24205	1323924/1	-34.669208	139.454395	51	
790745	24205	1323924/1	-34.669208	139.454395	51	
707365	24227	90627/1	-34.315311	139.127007	3	
707368	24227	90627/1	-34.315311	139.127007	3	
895132	9011554	1924213/1	-34.476202	138.985256	15	The Barossa Council PO Box 867 NURIOOTPA SA 5355
895129	9011554	1924213/1	-34.476202	138.985256	15	
764733	136864	1194316/1	-34.912209	138.588613	74	The Corporation Of The City Of Adelaide City of Adelaide GPO Box 2252 ADELAIDE SA 5001
764730	136864	1194316/1	-34.912209	138.588613	74	
793880	305748	1327131/1	-33.954162	138.653486	48	Treasury Wine Estates Vintners Limited Annies Lane at Qelltaler PO Box 10 WATERVALE SA 5452
793883	305748	1327131/1	-33.954162	138.653486	48	
889272	138906	1921484/1	-34.497473	138.991953	17	
889269	138906	1921484/1	-34.497473	138.991953	17	
828764	502346	1513794/1	-34.155936	139.89588	74	Waikerie Golf Club Inc PO Box 643 WAIKERIE SA 5330
828767	502346	1513794/1	-34.155936	139.89588	74	
823703	500886	1504946/1	-34.870885	138.50047	75	West Lakes Golf Club Incorporated 26 Lochside Drive WEST LAKES SA 5021
823706	500886	1504946/1	-34.870885	138.50047	75	

Table 9 Details of other licences identified within 75 km of the proposed Project

Licence type	Licence category	Number of instances
1800 MHz Band	Spectrum	6583
2 GHz Band	Spectrum	9818
2.3 GHz Band	Spectrum	1050
2.5 GHz Band	Spectrum	352
2.5 GHz Mid Band Gap	Spectrum	112
27 GHz Band	Spectrum	2
700 MHz Band	Spectrum	2294
800 MHz Band	Spectrum	3481
Aeronautical Assigned System	Aeronautical	55
Amateur Beacon	Amateur	8
Amateur Repeater	Amateur	72
Ambulatory - Initial	Land Mobile	28
Ambulatory System	Land Mobile	348
CBRS Repeater	Land Mobile	2
Commercial Radio	Broadcasting	8
Commercial Television	Broadcasting	18
Community Broadcasting	Broadcasting	4
Earth Receive	Earth Receive	17
Fixed Earth	Earth	6
Fixed Receive	Fixed Receive	4
HF Domestic Service	Broadcasting	1
Land Mobile System - > 30MHz	Land Mobile	1988
Land Mobile System 0-30MHz	Land Mobile	146
Limited Coast Assigned System	Maritime Coast	24
Limited Coast Marine Rescue	Maritime Coast	15
Narrowband Area Service station(s)	Broadcasting	10
Narrowcasting Service (Fixed Tax)	Broadcasting	3
Narrowcasting Service (LPON)	Broadcasting	40
Narrowcasting Service Station(s)	Broadcasting	1
National Broadcasting	Broadcasting	12
PABX Cordless Telephone Service	Land Mobile	4
Paging System - Exterior	Land Mobile	39
Paging System - Interior	Land Mobile	15
PMTS Class B	PTS	300
Point to Multipoint	Fixed	208
Point to Multipoint - Land Mobile Spec	Fixed	12
Radiodetermination	Radiodetermination	36
Retransmission	Broadcasting	33
Sound Outside Broadcast	Fixed	4
Television Outside Broadcast	Fixed	1

Table 10 Emergency services with radiocommunication assets in the vicinity of the proposed Project

Emergency service	Contact details	Distance from closest site to Project boundary [km]
Australian Federal Police	Australian Federal Police Attn: T&I Eileen Ferber PO Box 401 CANBERRA ACT 2601	55
South Australia Police	South Australia Police GPO Box 1539 ADELAIDE SA 5001	72
South Australian Country Fire Service	South Australian Country Fire Service GPO Box 2468 ADELAIDE SA 5001	42
South Australian State Emergency Service	South Australian State Emergency Service GPO Box 2706 ADELAIDE SA 5001	69
St John Ambulance Australia (N.S.W.)	St John Ambulance Australia (N.S.W.) 9 Deane Street BURWOOD NSW 2134	75
St John Ambulance Australia Incorporated	St John Ambulance Australia Incorporated Attn: Paul Stein 170 Forster Road MOUNT WAVERLEY VIC 3149	18
Surf Life Saving South Australia Inc	Surf Life Saving South Australia Inc PO Box 117 WEST BEACH SA 5024	86
The Australian Volunteer Coast Guard Association Inc	The Australian Volunteer Coast Guard Association Inc SA Squadron PO Box 60 SEMAPHORE SA 5019	69
The South Australian Sea Rescue Squadron Inc	The South Australian Sea Rescue Squadron Inc PO Box 267 GLENELG SA 5045	73
Visionstream Australia Pty Limited	Visionstream Australia Pty Limited 962 South Road EDWARDSTOWN SA 5039	75

Table 11 BoM radar sites in the vicinity of the proposed Project

BoM Radar site	Location[1]		Distance to Project [km]
Buckland Park (Adelaide)	S34.65°	E138.47°	58
Sellicks Hill	S35.33°	E138.50°	119
Mildura	S34.23°	E142.08°	274
Woomera	S31.16°	E136.80°	401
Mt Gambier	S37.75°	E140.77°	409

1. Coordinate system: Lat/Long WGS84 datum

Table 12 Trigonometrical stations in the vicinity of the proposed Project

Station name	Datum	Latitude	Longitude	Distance to Project [km]
Bald Hill	AGD66	S34°20' 21.71"	E139°2' 2.83"	0
Belvidere	GDA94	S34°25' 40.47"	E138°54' 14.18"	14
	AGD84	S34°25' 45.75"	E138°54' 9.30"	
	AGD66	S34°25' 45.76"	E138°54' 9.35"	
Brownlow	AGD84	S34°12' 35.44"	E139°14' 37.43"	15
	GDA94	S34°12' 30.14"	E139°14' 42.28"	
Julia	GDA94	S34°50' 52.46"	E139°1' 23.28"	15
	AGD84	S34°5' 57.754"	E139°1' 18.43"	
Light	AGD66	S34°18' 7.38"	E138°50' 8.31"	16
	GDA94	S34°18' 2.09"	E138°50' 13.14"	
	AGD84	S34°18' 7.37"	E138°50' 8.27"	
Penrice	AGD84	S34°29' 26.42"	E139°2' 28.39"	16
	GDA94	S34°29' 21.13"	E139°2' 33.26"	
	AGD66	S34°29' 26.43"	E139°2' 28.44"	
Rufus	AGD84	S34°18' 59.84"	E139°7' 33.73"	3
	GDA94	S34°18' 54.55"	E139°7' 38.59"	
	AGD66	S34°18' 59.84"	E139°7' 33.78"	
Smith Hill	AGD84	S34°40' 30.54"	E138°57' 27.36"	19
	GDA94	S34°40' 25.25"	E138°57' 32.21"	
Waterloo	AGD66	S34°12' 12.11"	E138°57' 52.22"	9
	GDA94	S34°12' 6.82"	E138°57' 57.03"	
	AGD84	S34°12' 12.11"	E138°57' 52.17"	
6628/23502	GDA94	S34°29' 56.76"	E138°57' 3.69"	18
6628/47819	GDA94	S34°30' 28.54"	E138°58' 50.24"	18
6629/ 1083	GDA94	S34°14' 53.93"	E138°50' 51.70"	17
6629/ 1085	GDA94	S34°15' 2.98"	E138°57' 1.68"	9
6629/ 1086	GDA94	S34°14' 44.95"	E138°59' 54.27"	5
6629/ 1088	GDA94	S34°14' 56.43"	E139°00' 4.47"	4
6629/ 1111	GDA94	S34°29' 49.00"	E138°59' 55.63"	17
6629/ 1112	GDA94	S34°29' 51.71"	E138°56' 34.55"	18
6629/ 1113	GDA94	S34°29' 51.04"	E138°56' 42.35"	18
6629/ 1114	GDA94	S34°29' 48.64"	E138°54' 18.22"	20
6629/ 1139	GDA94	S34°15' 10.07"	E138°52' 59.62"	14
6629/ 1357	GDA94	S34°17' 21.60"	E138°59' 59.60"	3
6629/ 1358	GDA94	S34°17' 24.49"	E138°59' 58.45"	3
6629/ 1359	GDA94	S34°16' 39.78"	E138°58' 9.91"	6
6629/ 1360	GDA94	S34°16' 46.19"	E138°58' 2.66"	6
6629/ 1361	GDA94	S34°15' 42.49"	E138°57' 51.65"	7
6629/ 1362	GDA94	S34°14' 52.00"	E138°53' 54.99"	13

Table 12 Trigonometrical stations in the vicinity of the proposed Project (continued)

Station name	Datum	Latitude	Longitude	Distance to Project [km]
6629/ 1363	GDA94	S34°15' 9.49"	E138°53' 1.41"	14
6629/ 1364	GDA94	S34°14' 53.74"	E138°51' 0.03"	17
6629/ 1381	AGD66	S34°21' 17.85"	E138°52' 18.60"	13
	GDA94	S34°21' 12.56"	E138°52' 23.43"	
	AGD84	S34°21' 17.84"	E138°52' 18.55"	
6629/ 1382	GDA94	S34°21' 12.44"	E138°52' 24.60"	13
6629/ 1383	GDA94	S34°26' 14.04"	E138°55' 31.67"	13
6629/ 1384	GDA94	S34°26' 12.66"	E138°55' 31.43"	13
6629/ 1385	GDA94	S34°28' 46.63"	E138°58' 21.01"	15
6629/ 1386	GDA94	S34°28' 46.54"	E138°58' 20.31"	15
6629/ 1387	GDA94	S34°15' 0.89"	E138°57' 2.70"	9
6629/ 1389	GDA94	S34°29' 51.76"	E138°56' 33.94"	18
6629/ 1391	GDA94	S34°29' 51.00"	E138°56' 42.87"	18
6629/ 1392	GDA94	S34°29' 38.79"	E138°53' 43.46"	20
6629/ 1660	GDA94	S34°28' 59.35"	E138°59' 27.59"	15
6629/ 3418	GDA94	S34°29' 51.23"	E138°57' 30.29"	17
6629/ 3462	GDA94	S34°27' 40.42"	E138°58' 52.83"	13
6728/ 1817	GDA94	S34°30' 24.75"	E139°10' 43.04"	18
6728/ 3365	GDA94	S34°30' 50.98"	E139°20' 38.76"	19
6728/ 3416	GDA94	S34°30' 36.53"	E139°30' 30.40"	18
6729/ 1003	AGD66	S34°13' 35.95"	E139°50' 17.49"	2
	GDA94	S34°13' 30.65"	E139°50' 22.30"	
	AGD84	S34°13' 35.95"	E139°50' 17.45"	
6729/ 1004	AGD66	S34°20' 21.66"	E139°20' 2.63"	0
	AGD84	S34°20' 21.68"	E139°20' 2.58"	
	GDA94	S34°20' 16.37"	E139°20' 7.45"	
6729/ 1005	GDA94	S34°23' 8.10"	E139°50' 53.95"	6
	AGD84	S34°23' 13.39"	E139°50' 49.09"	
	AGD66	S34°23' 13.39"	E139°50' 49.14"	
6729/ 1104	GDA94	S34°28' 31.93"	E139°10' 17.27"	14
6729/ 1191	GDA94	S34°22' 23.72"	E139°00' 15.96"	3
6729/ 1192	GDA94	S34°22' 19.54"	E139°00' 10.44"	3
6729/ 1193	GDA94	S34°19' 56.02"	E139°00' 7.54"	1
6729/ 1196	GDA94	S34°27' 24.58"	E139°00' 7.35"	12
6729/ 1197	GDA94	S34°27' 28.16"	E139°00' 7.84"	12
6729/ 1532	GDA94	S34°27' 56.58"	E139°10' 33.33"	13
6729/ 1951	GDA94	S34°29' 9.49"	E139°10' 49.47"	15
6729/ 1970	GDA94	S34°29' 21.62"	E139°30' 19.90"	16

Table 13 Houses with increased potential to experience EMI to DTV from television broadcast towers

House ID	Easting[1] [m]	Northing[1] [m]	Located in potential interference zone Adelaide
70	327001	6207829	X
74	320270	6205615	X
75	*321830*	*6206405*	*X*
76	324379	6207966	X
77	324320	6207653	X
79	323873	6210441	X
80	324097	6210418	X
147	*319969*	*6205165*	*X*
151	*320252*	*6205722*	*X*
187	326433	6207948	X

1. Coordinate system: MGA zone 54, GDA94 datum
Dwellings belonging to associated landholders are indicated by *underlined italic text*

Table 14 Summary of service operators contacted by DNV GL and responses received to date

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
1	Fixed point-to-point, fixed point-to-multipoint	Point-to-point: no turbines in exclusion zone set by DNV GL Fixed point-to-multipoint: 4 km	South Australian Water Corporation (SA Water)	170894-AUME-L-01	<u>Response received by email on 10 November 2016:</u> *"It would appear that this could impact our PTP link between Mt Kitchener & Eudunda bases (site ID 24263)* *If we were to have interference, approx 4 critical pump station/tank sites would be impacted."* <u>Response received by email on 17 November 2016:</u> *"…we are concerned that the proposed installation of wind turbines at the proposed location may adversely impact our PTP radio link between our radio facilities at Mt Kitchener and Eudunda. Upon reviewing the Google Earth data originally submitted to us, it would appear that our radio path will be dissected by the turbines.* *As a ACMA radio licence holder, we are entitled to operate on our allocated frequencies unimpeded and without interference. We are not in a position to suggest whether or not the proposed development of the wind farm could or would impact our operations with any degree of certainty. Therefore it is our position that… [the developer] must engage a subject matter expert in the field of RF propagation to provide an expert opinion and report into this. This report should document opinion on the likelihood of interference posed to our allocated frequencies and recommend any mitigating measures that should take place to prevent interference. The completed report should then be submitted to SA Water for further review."* <u>Response received by email on 24 January 2017 (following submission of draft EMI Assessment report):</u> *"…whilst we acknowledge your EMI Assessment draft report and the conclusions you have drawn from the findings, SA Water normally do not provide approvals or acceptance on locations of wind turbines in relation to SA Water infrastructure.* *We advise that you proceed at your own risk, and any impact on the SA Water point to point link post construction will be the responsibility of the wind farm developer/owner to remedy."*

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
2	Fixed point-to-point, FM broadcasting	Point-to-point: no turbines in exclusion zone set by DNV GL FM transmission tower: 3 km	W & L Phillips Pty Limited (Flow FM)	170894-AUME-L-02	<u>Response received by email on 17 November 2016:</u> *"I've had a look at the proposal for the wind farm and agree that there is sufficient Fresnel zone clearance for out (sic) 850MHz studio-to-transmitter link. So this shouldn't be a problem with the our STL link…* *Not sure as to how much the 99.5MHz signal will be affected… but this still may not be a problem as the wind tower may or may not have a sufficient surface area to reflect enough signal to cause a problem at 99.5MHz it may only be minor if any."* <u>Response received by email on 2 December 2016:</u> *"I think as you suggest that coverage in some of the weaker areas from Mt Rufus [Kapunda] will get coverage from one of the other transmitters in most cases."*
3	Fixed point-to-point, wireless internet	Point-to-point: no turbines in exclusion zone set by DNV GL Wireless internet: 9 km	NBN Co Limited	170894-AUME-L-03	<u>Response received by telephone on 11 November 2016:</u> No concerns regarding fixed network No formal response regarding wireless services received to date
4	Fixed point-to-multipoint, wireless internet	41 km	Agile Pty Ltd	170XXX-AUME-L-04	<u>Response received by email on 28 October 2016:</u> *"I have reviewed your brief and found there to be minimal interference risk arising from the wind farm proposal."*
5	Fixed point-to-multipoint, wireless internet	6 km	Aussie Broadband Pty Ltd	170894-AUME-L-05	<u>Response received by email on 14 November 2016:</u> *"We don't have any concerns regarding the proposed wind farm."*

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
6	Fixed point-to-multipoint, meteorological radar	Point-to-multipoint: 6 km Meteorological radar: 58 km	Bureau of Meteorology	170894-AUME-L-06	<u>Response received by email on 14 December 2016:</u> *"Noting that:* *No Bureau radar is within 20 to 30 km of the proposed Twin Creek wind farm. The closest Bureau radars to the proposed wind farm is approximately 58km away at Buckland Park (S-band), at least 2x the range at which the WMO suggests an impact study is required. However a WMO working group is currently revising these guidelines and will recommend that these avoidance distances be doubled.* *Recommendation* *Given that Buckland Park radar is within 2x the range of the proposed WMO guidelines and straight-line propagation puts the wind farm at about 0.2 degrees above the horizon (the effective angle will actually be higher due to atmospheric refraction). Buckland Park radar will observe clutter at higher elevation angles due to the wind farm and radar side-lobe scatter. Buckland Park radar will most likely be affected by the location of the proposed Twin Creek wind farm. The Bureau would prefer if this wind farm is located at a greater distance from Buckland Park radar in order to mitigate interference, namely clutter and Doppler mode false artefacts."* <u>Response received by email on 2 February 2017 (following confirmation that all proposed radar locations are more than 60 km from the Buckland Park radar):</u> *"The Bureau is rather cautious regarding the wind farm's location and the effect it will have on Buckland Park radar's contiguous performance beyond the wind farm, towards the border region. …whilst the proposed site meets WMO recommendations The Bureau strives to provide the best possible performance of our radar network for all stakeholders throughout the country.* *…The Bureau would be happy with the proposed turbine locations as it now stands."*

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
7	Fixed point-to-multipoint	54 km	Department of Defence	170894-AUME-L-07	None received to date
8	Fixed point-to-multipoint	3 km	Spark Infrastructure SA (No2) Pty Limited (SA Power Networks)	170894-AUME-L-08	Response received by email on 18 November 2016: *"Based on our radio designers review they have plotted some of the turbines on a map and have found that they are in the path of our link between Mt Rufus to Kapunda substation. They are located roughly 6 km along the path and they have run a path calculation (attached) showing the effect of the proposed 180m turbines on our path. The obstruction will attenuate the radio considerably and the actual path effect is very hard to predict since the rotational obstruction is impossible to model.* *Bottom line is that we expect this will impact the reliability of the path between Mt Rufus and Kapunda substation. Which is critical to our operation of the Electricity Distribution business."* Response received by email on 9 January 2017 (following suggestion that an exclusion zone based on the second Fresnel zone be applied): *"Thanks for your response to our concerns regarding our path between Mt Rufus and Kapunda.* *I have had a look through your proposal and an exclusion zone of the second Fresnel zone would be adequate to ensure the reliability of our path."*

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
9	Fixed point-to-multipoint, PTMS/spectrum (mobile phone)	Point-to-multipoint: 3 km PTMS/spectrum: 5 km	Telstra Corporation Limited	170894-AUME-L-09	<u>Response received by email on 23 November 2016:</u> *"...a desk top study has been undertaken of the area and nearby telecommunications infrastructure.* *Based on the provided information relating to the proposed wind farm on rural land in the Twin Creek area South of Eudunda, between Kapunda and Frankton, SA, results of Radio rayline analysis investigation reveals that there is no potential for undue interference from the proposed wind farm.* *Also, results of Optic & Copper cable investigation reveals that there is no cable within 1.22Km of any of the proposed location of the Wind Turbines.* *Telstra has no objection to this development in relation to the proposed wind farm subject to [the developer] confirming its agreement to the conditions and matters set out in this letter.* *Telstra requires [the developer] to notify of any additional turbines, or any change to the proposed location of the Wind Turbine, so that impacts on Telstra's Network can be re-assessed.* *Telstra will require the protection of/relocation of its fixed telecommunications infrastructure that may be impacted by activities on this site. To minimise risk of liability due to any damage, the DialBeforeYouDig 1100 Inquiry number should be contacted to obtain location of Telstra plant before commencement of construction work."*
10	Fixed point-to-multipoint	15 km	The Barossa Council	170894-AUME-L-10	None received to date

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
11	Emergency service, fixed point-to-point, land mobile system	Point-to-point: no links crossing the Project Land mobile: 55 km	Australian Federal Police	170894-AUME-L-11	None received to date
12	Emergency service, land mobile system	42 km	South Australian Country Fire Service	170894-AUME-L-12	Response received by email on 28 October 2016: *"I have reviewed the proposal, CFS doesn't see any potential issue pertaining to the HF site, Para Wirra National Park, site ID 23048."*
13	Emergency service, land mobile system	46 km	St John Ambulance Australia Incorporated	170894-AUME-L-13	Response received by email on 10 November 2016: *"…we have reviewed it and could not identify any obvious impact to St John assets."*
14	Trigonometrical stations, Global Navigational Satellite System (GNSS) stations	Within Project boundaries	Geoscience Australia	170894-AUME-L-14	Response received by email on 5 December 2016: *"Geoscience Australia does not see foresee any impact to our trigonometrical stations, Global Navigational Satellite System stations, equipment, facilities or services associated with the proposed Twin Creek Wind Farm."*

Table 14 Summary of service operators contacted by DNV GL and responses received to date (continued)

	Licence/service type	Distance of closest site [km]	Operator	DNV GL reference	Response received to date
15	Trigonometrical stations	Within Project boundaries	South Australia Land Services Group	170894-AUME-L-15	Response received by email on 25 October 2016: *"Departmental Trig Points and Permanent Survey Marks are non-communicative assets and so will not be affected at all by electromagnetic interference...* *The marks you have listed are generally outside of the proposed wind farm boundary and so will be unaffected by potential construction works and the one inside the boundary appears to be sufficiently clear of the proposed turbine localities.* *There are four survey marks along Ben Lomond Rd that runs through the centre portion of the site. The mark numbers are 6729/1606, 6729/1607, 6729/2060 and 6729/2059, although I have estimated that the turbine locations are just south of Ben Lomond Rd so these marks may not be affected either. However, if these marks are to be disturbed in any way by construction of the wind farm turbines, please arrange for my office to be contacted before they are moved or destroyed."*
16	PTMS/spectrum (mobile phone)	5 km	Optus Mobile Pty Ltd	170894-AUME-L-16	Response received by email on 31 November 2016: *"We have reviewed this proposal and conclude it will not impact either our mobile network or microwave link network."*
17	PTMS/spectrum (mobile phone)	8 km	Vodafone Australia Pty Limited	170894-AUME-L-17	Response received by email on 14 November 2016: *"Having spoken with both our radio access and transmission teams Vodafone confirm that we have no plant in the area of interest and as a result would not expect the Twin Creek development to impact our network operation."*

LIST OF FIGURES

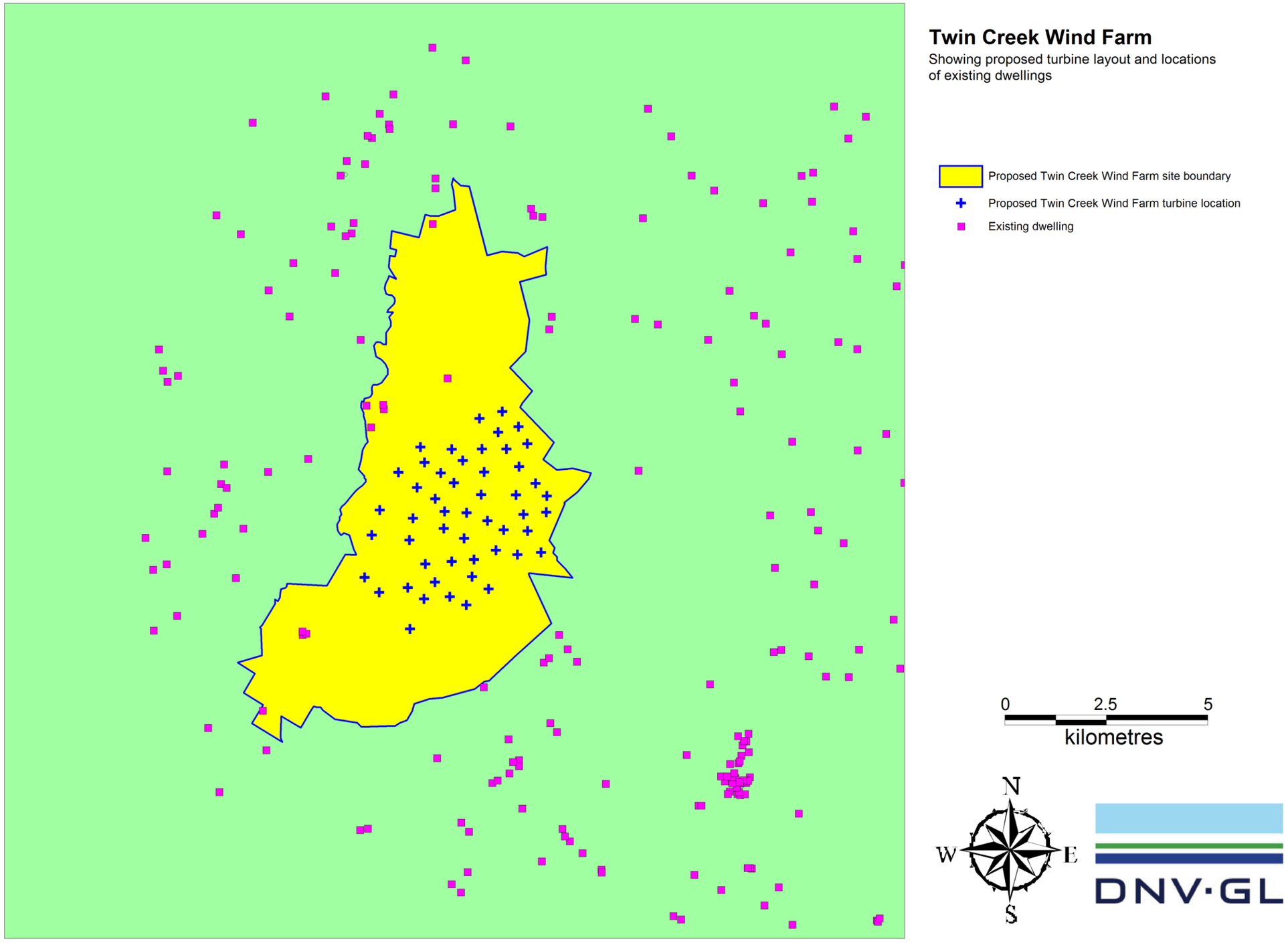

Figure 1 Map of the proposed Project, showing site boundaries, turbine locations, and locations of nearby dwellings

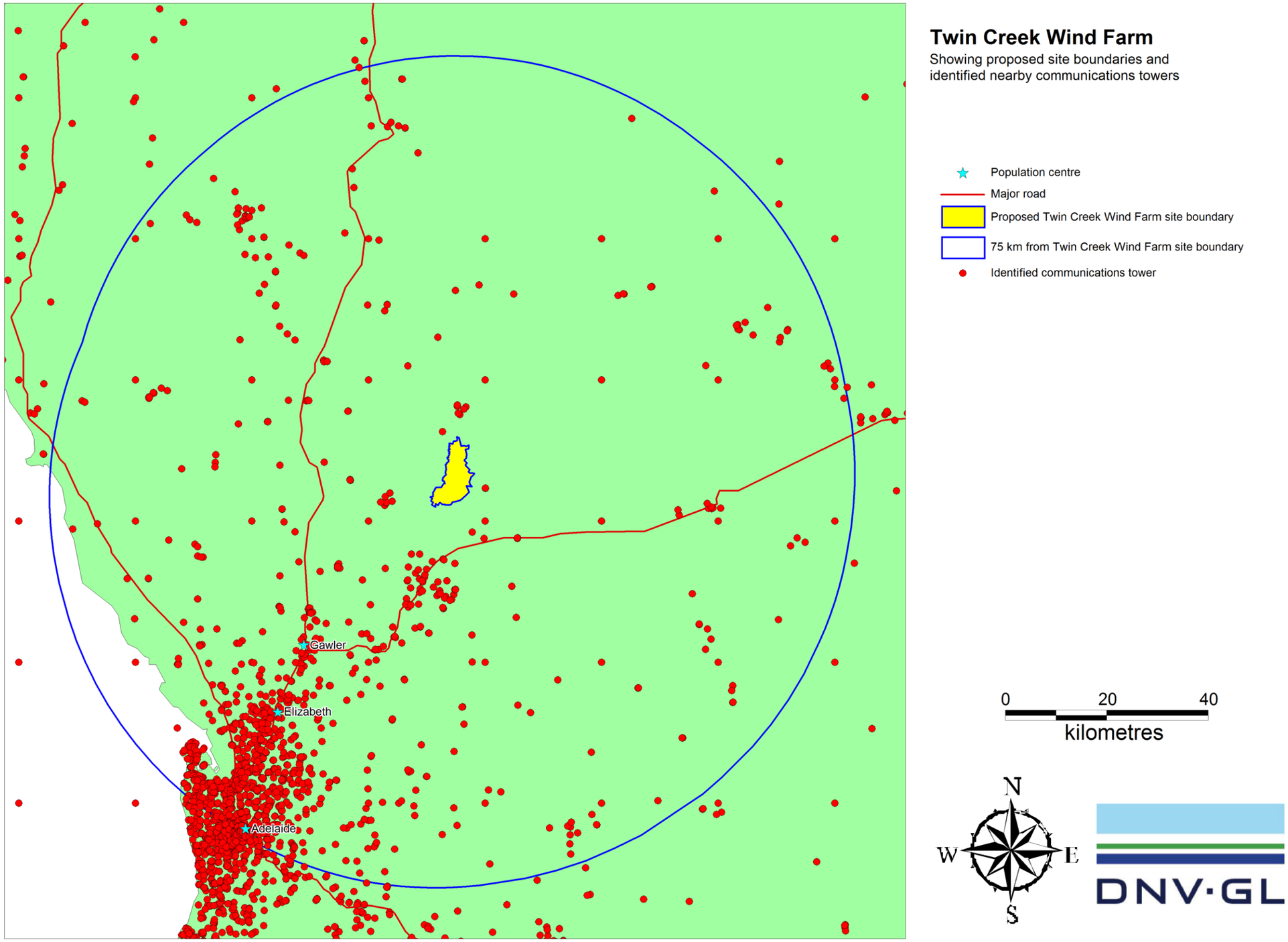

Figure 2 Location of the proposed Project and identified proximate radiocommunication sites

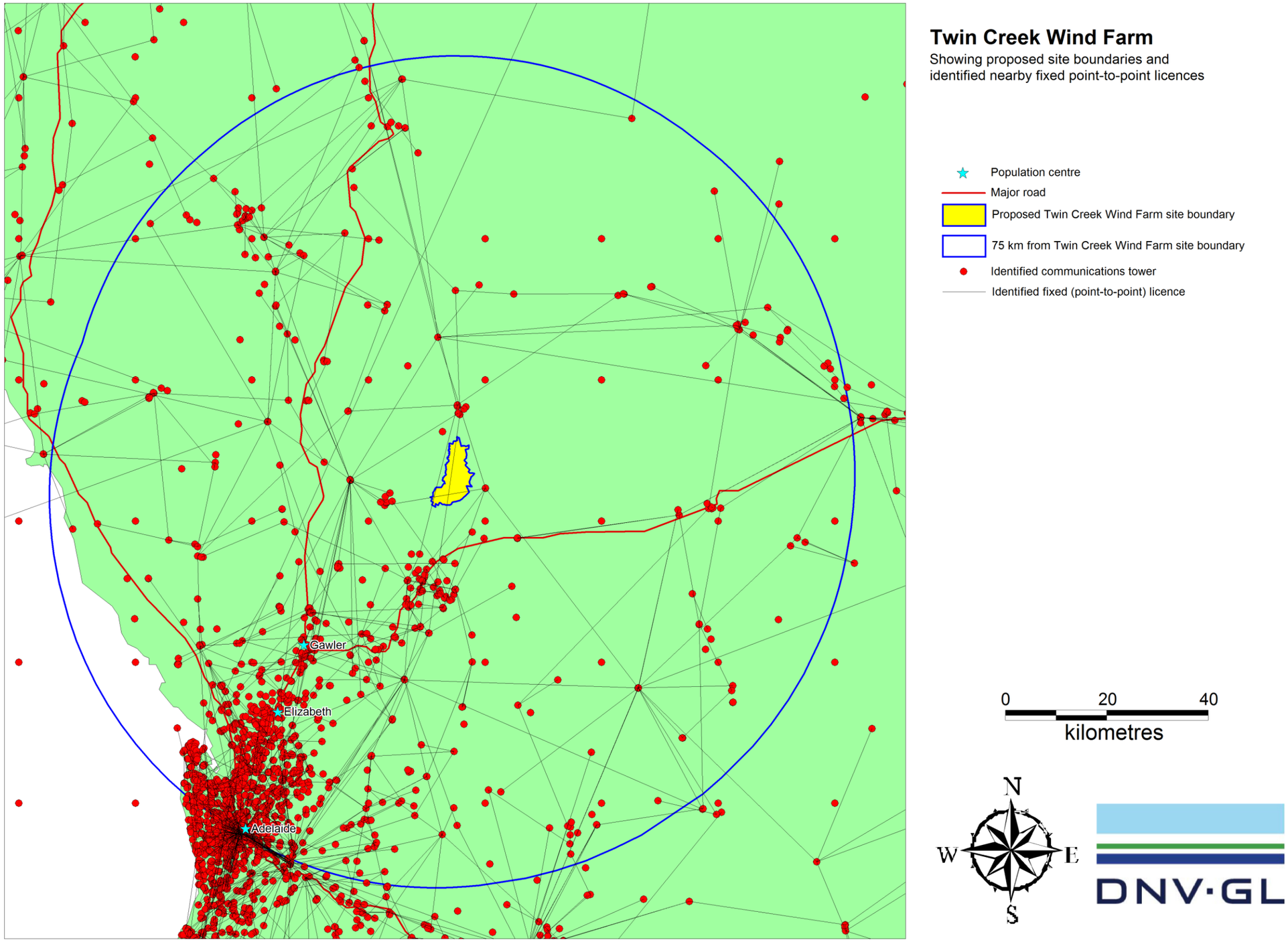

Figure 3 Identified transmission vectors for fixed licences of point-to-point type in the vicinity of the proposed Project

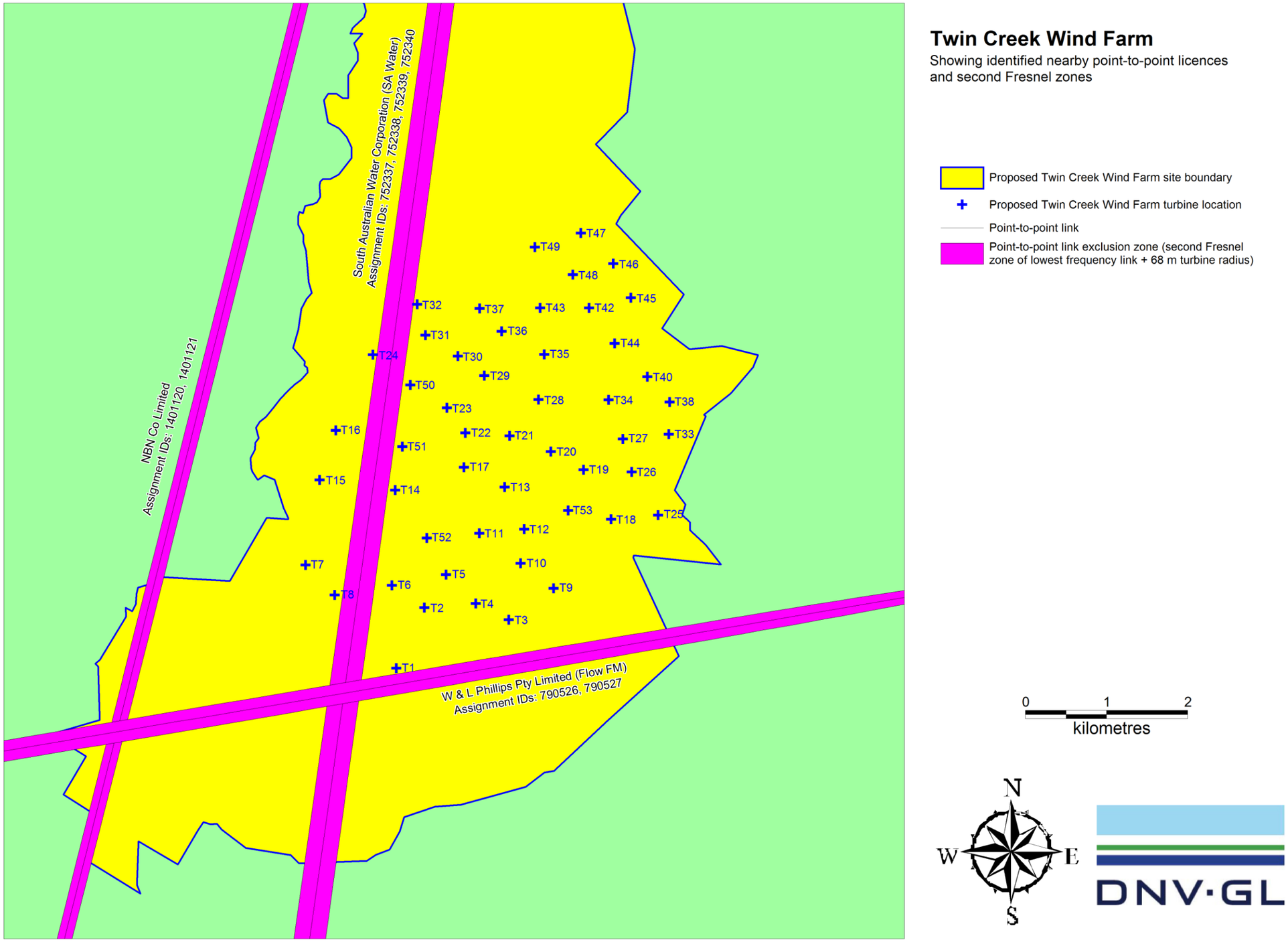

Figure 4 Identified telecommunication vectors and second Fresnel zones plus 68 m buffer for the proposed Project

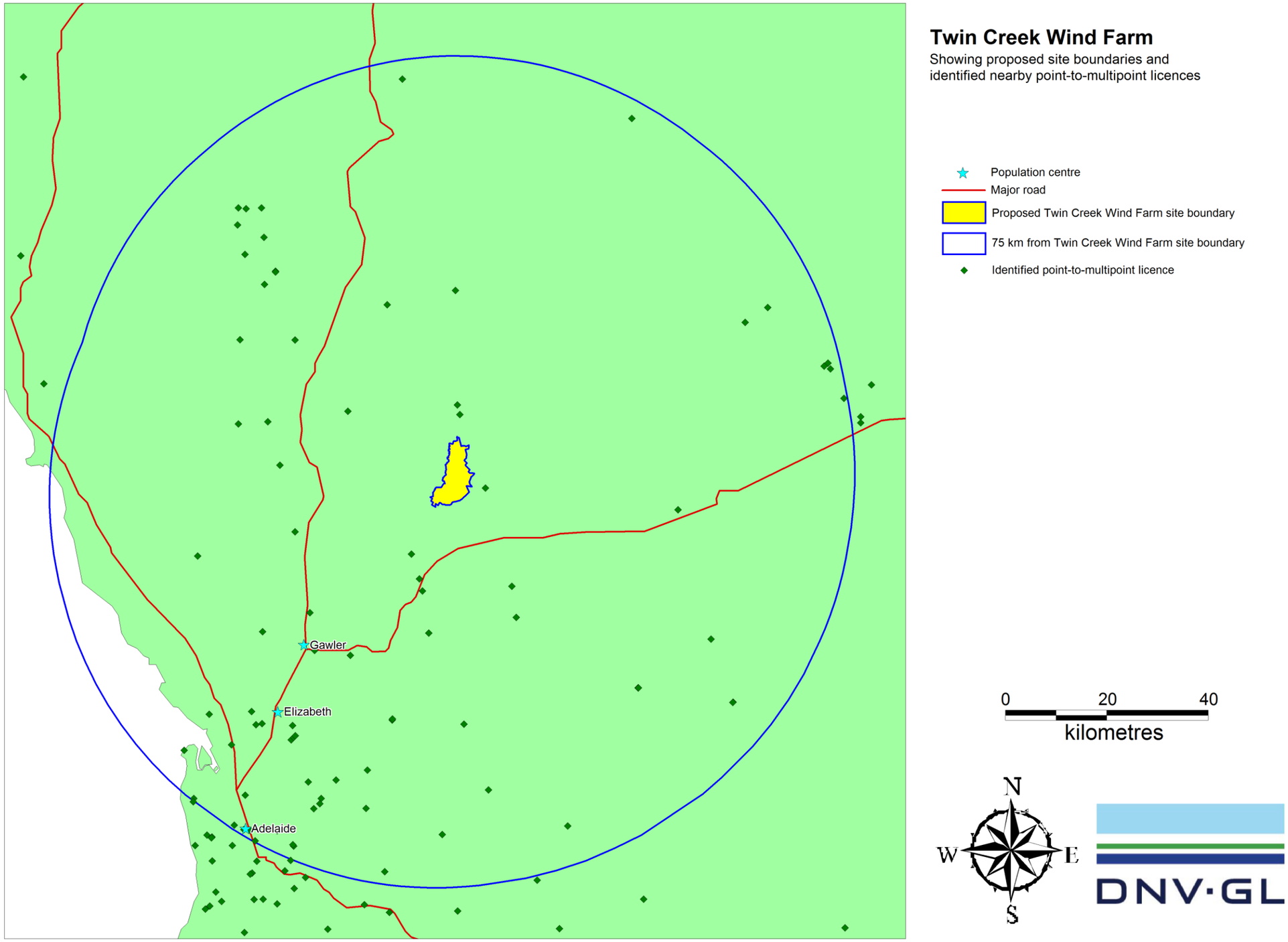

Figure 5 Location of point-to-multipoint licences in the vicinity of the proposed Project

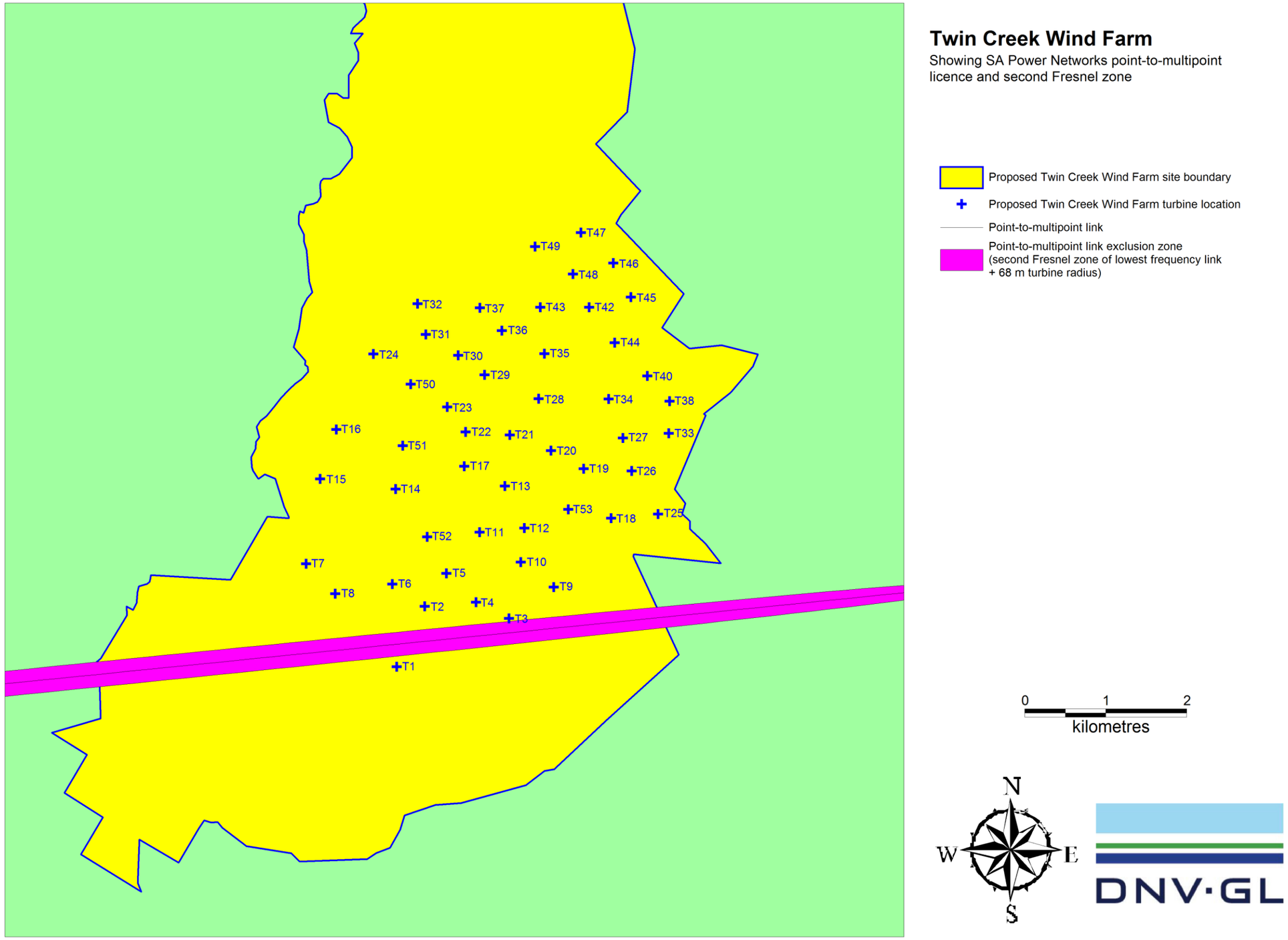

Figure 6 Identified SA Power Networks link and second Fresnel zone plus 68 m buffer

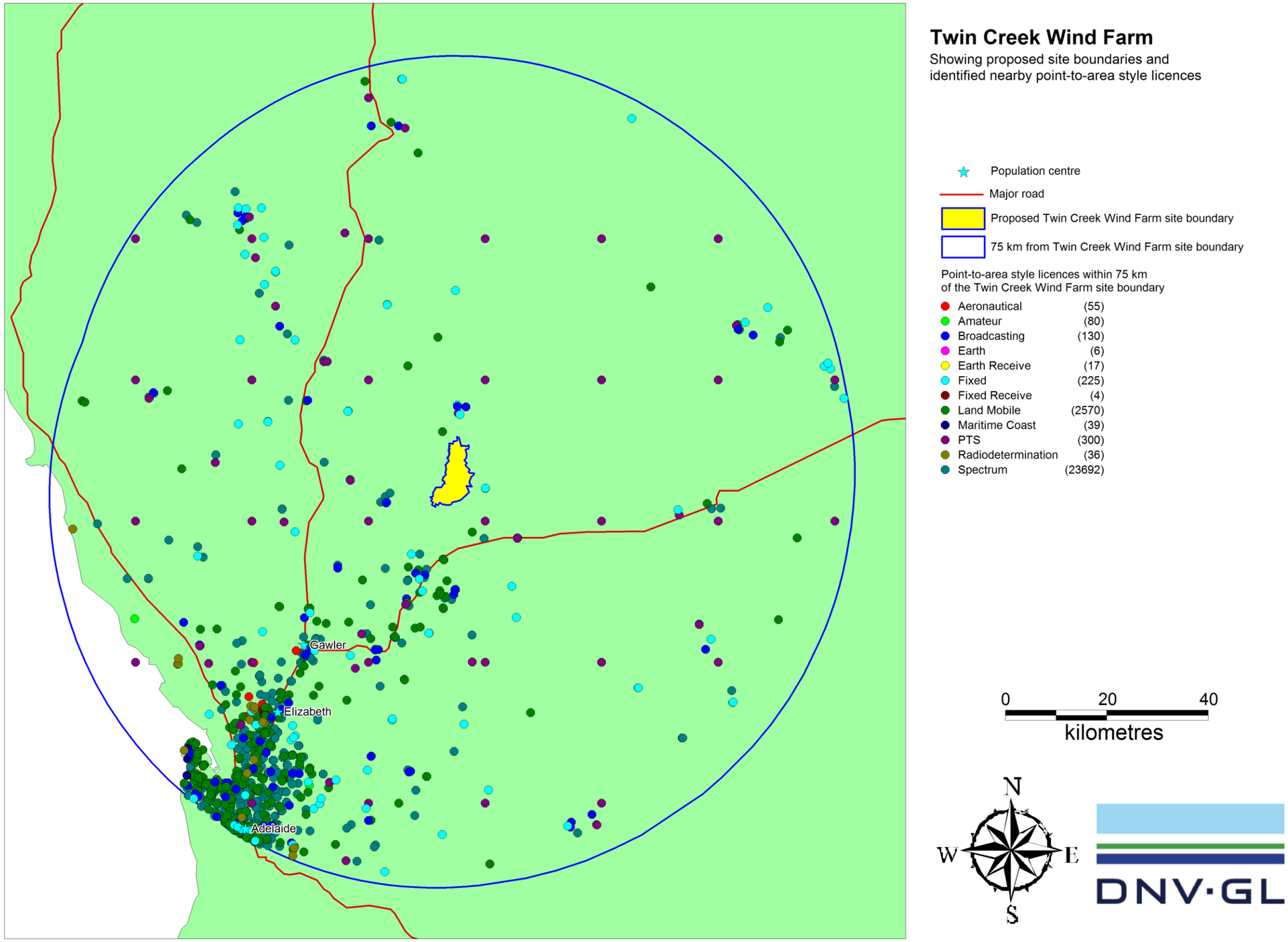

Figure 7 Location of general point-to-area style licences within 75km of the proposed Project

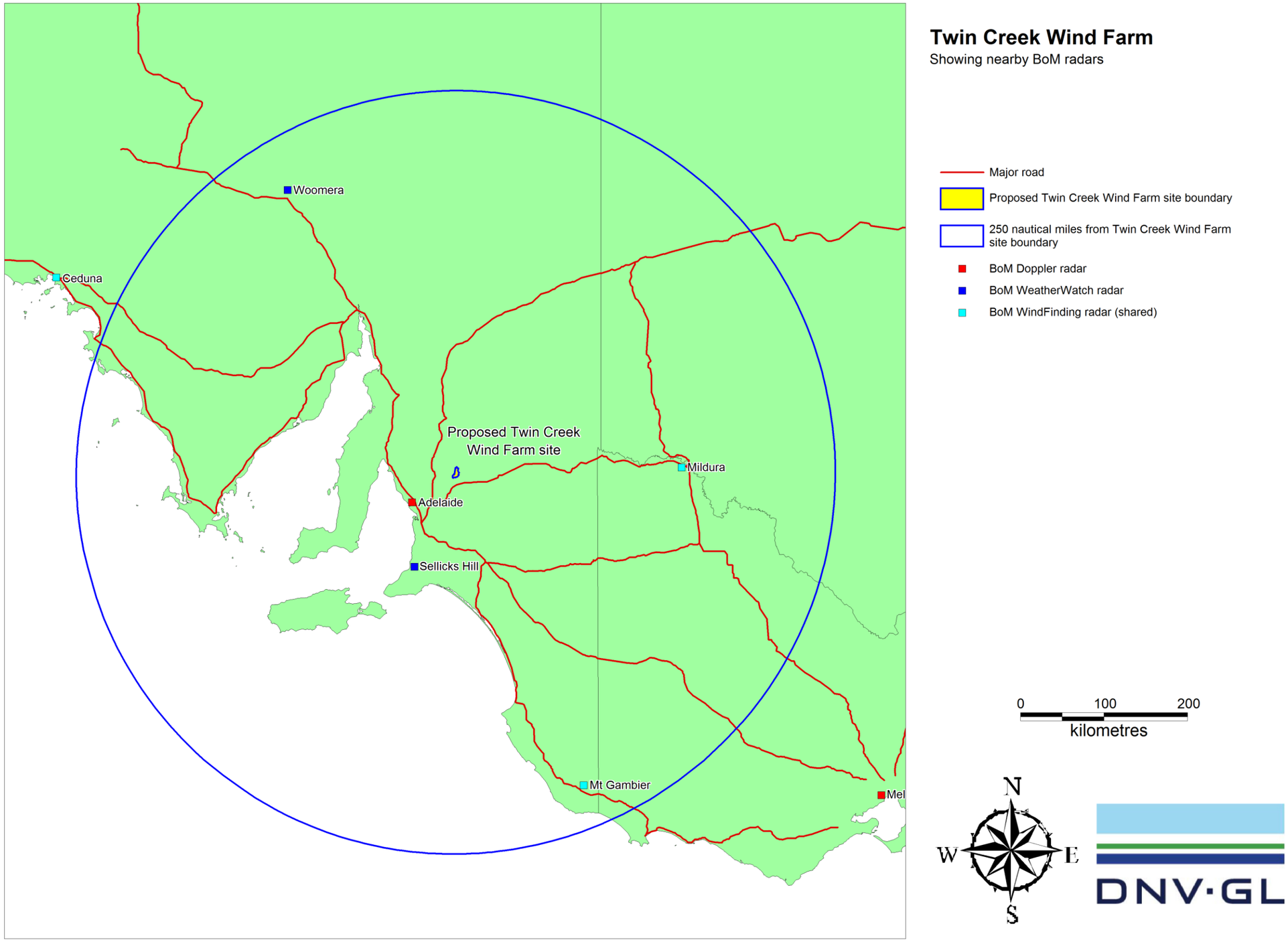

Figure 8 Location of meteorological radar sites within 250 nautical miles of the proposed Project

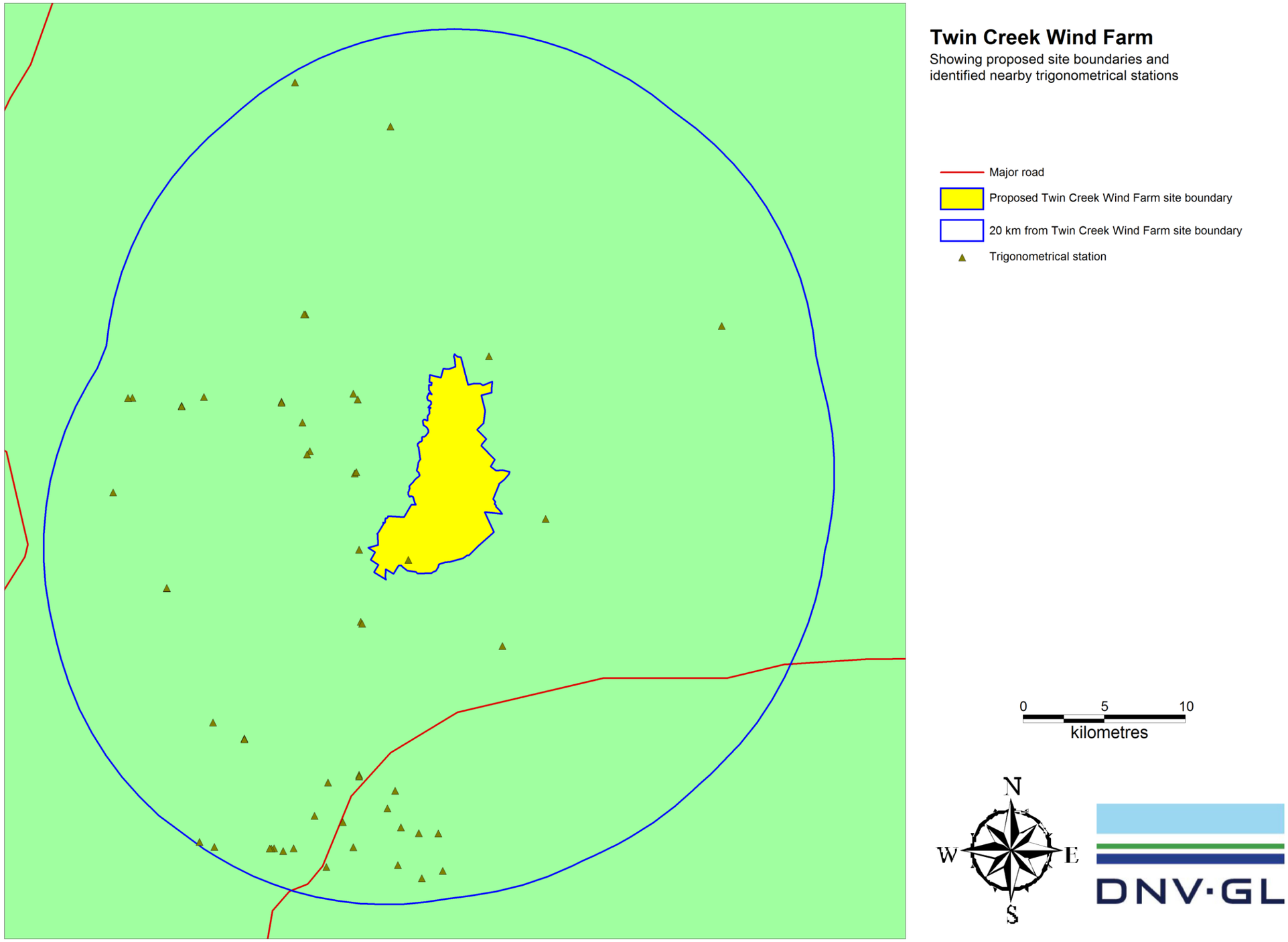

Figure 9 Location of trigonometrical stations within 20 km of the proposed Project

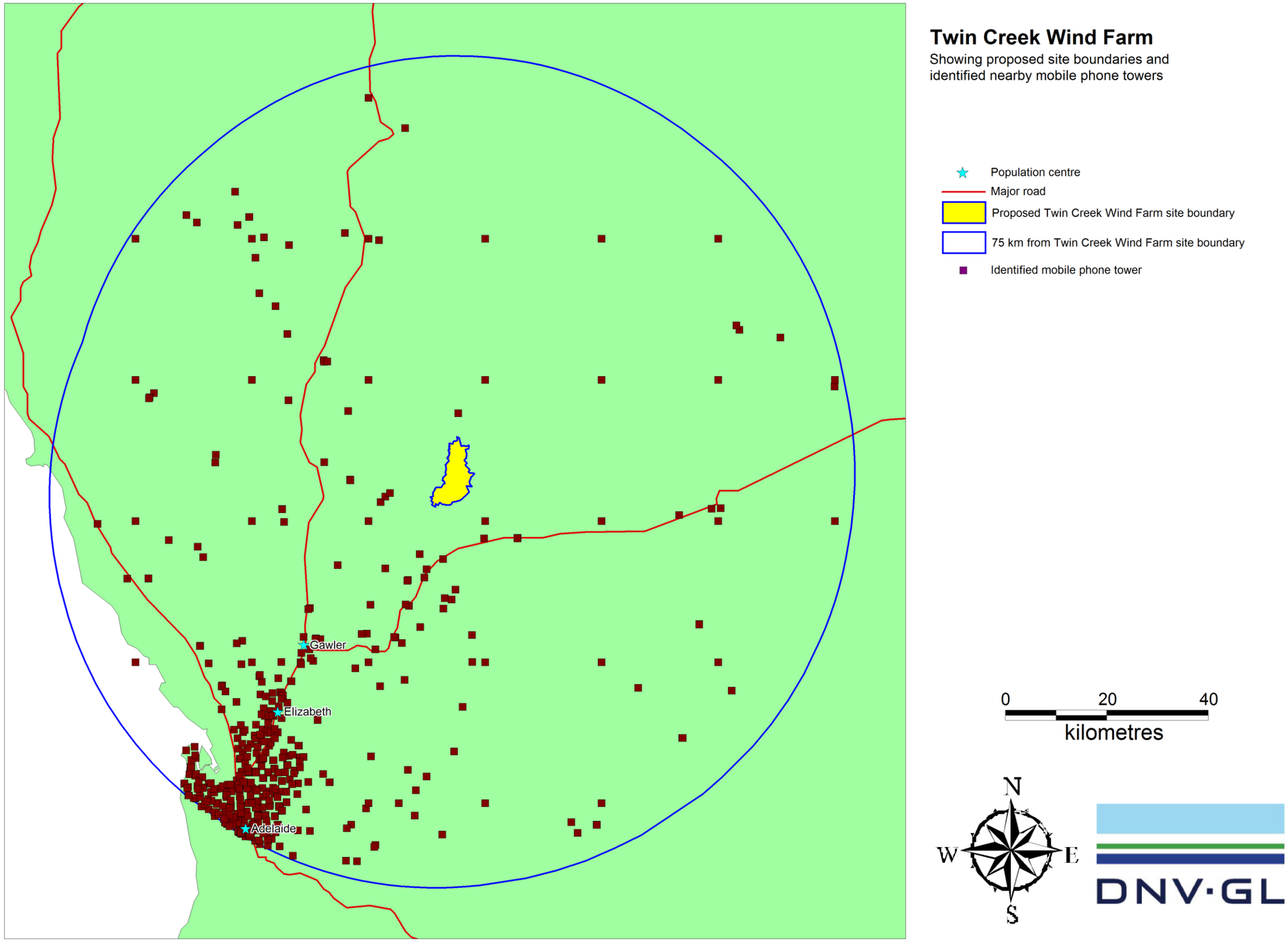

Figure 10 Location of mobile phone towers within 75 km of the proposed Project

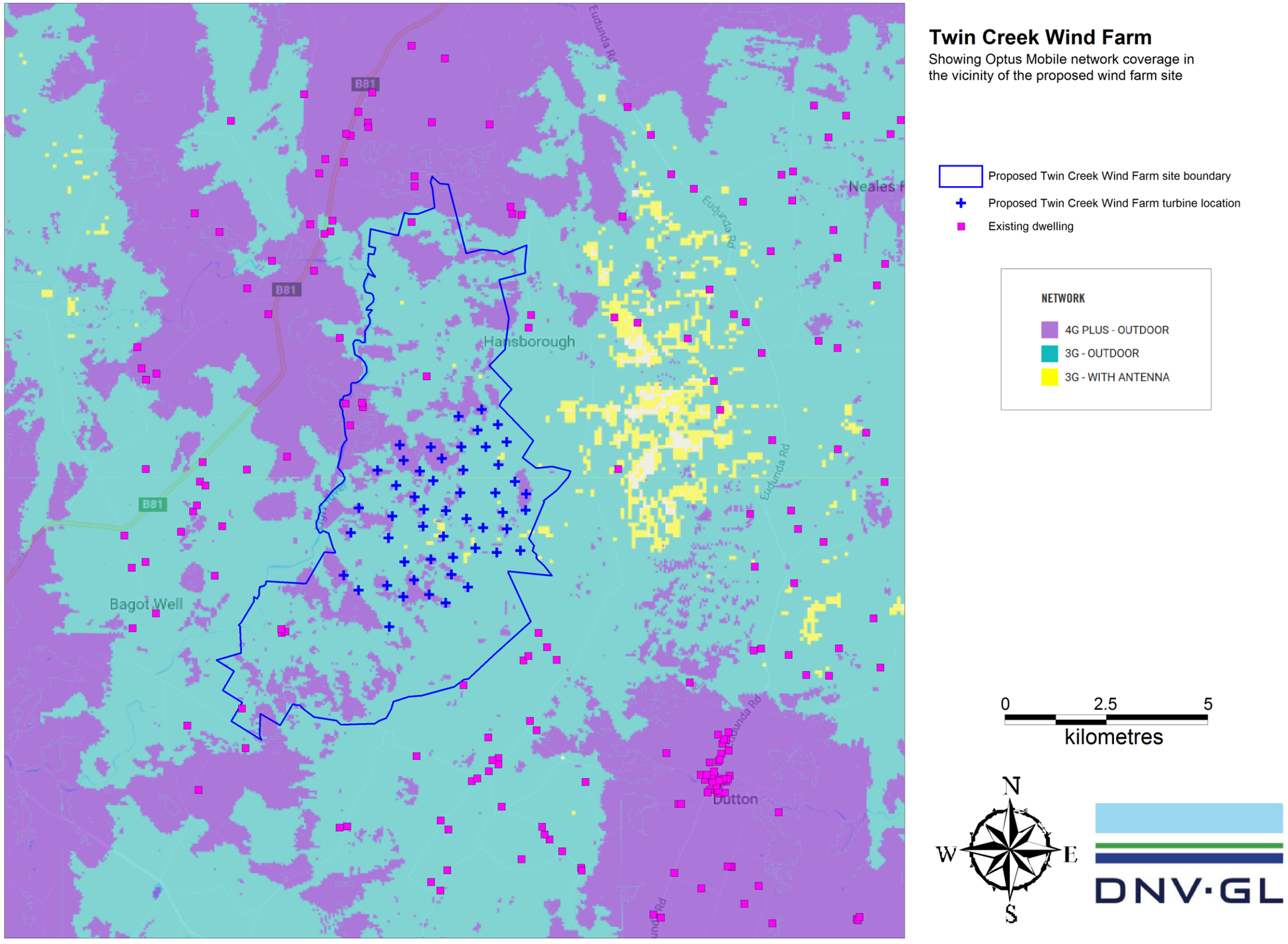

Figure 11 Optus Mobile network coverage (Samsung Galaxy S7 handset) for the proposed Project

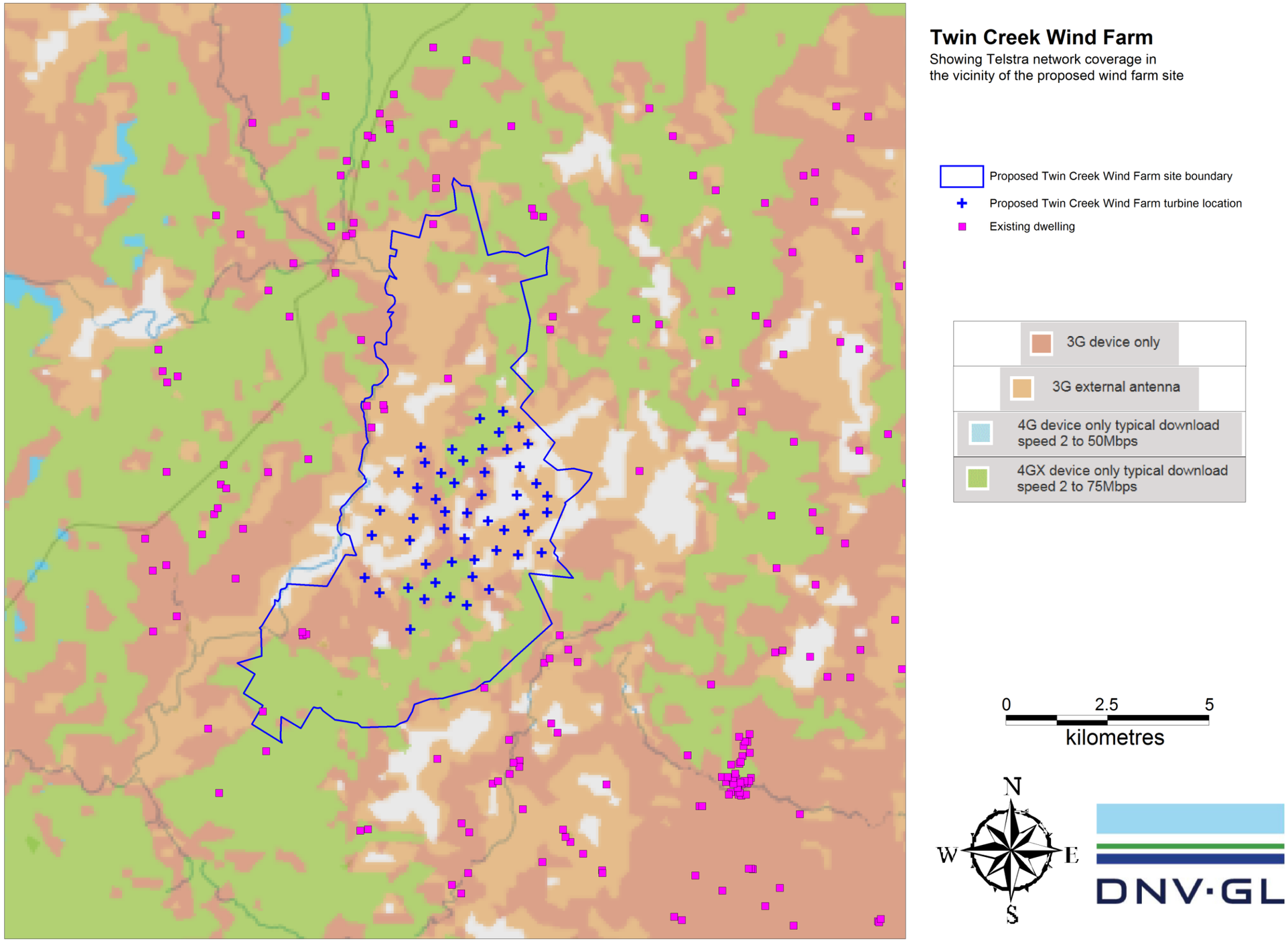

Figure 12 Telstra network coverage for the proposed Project

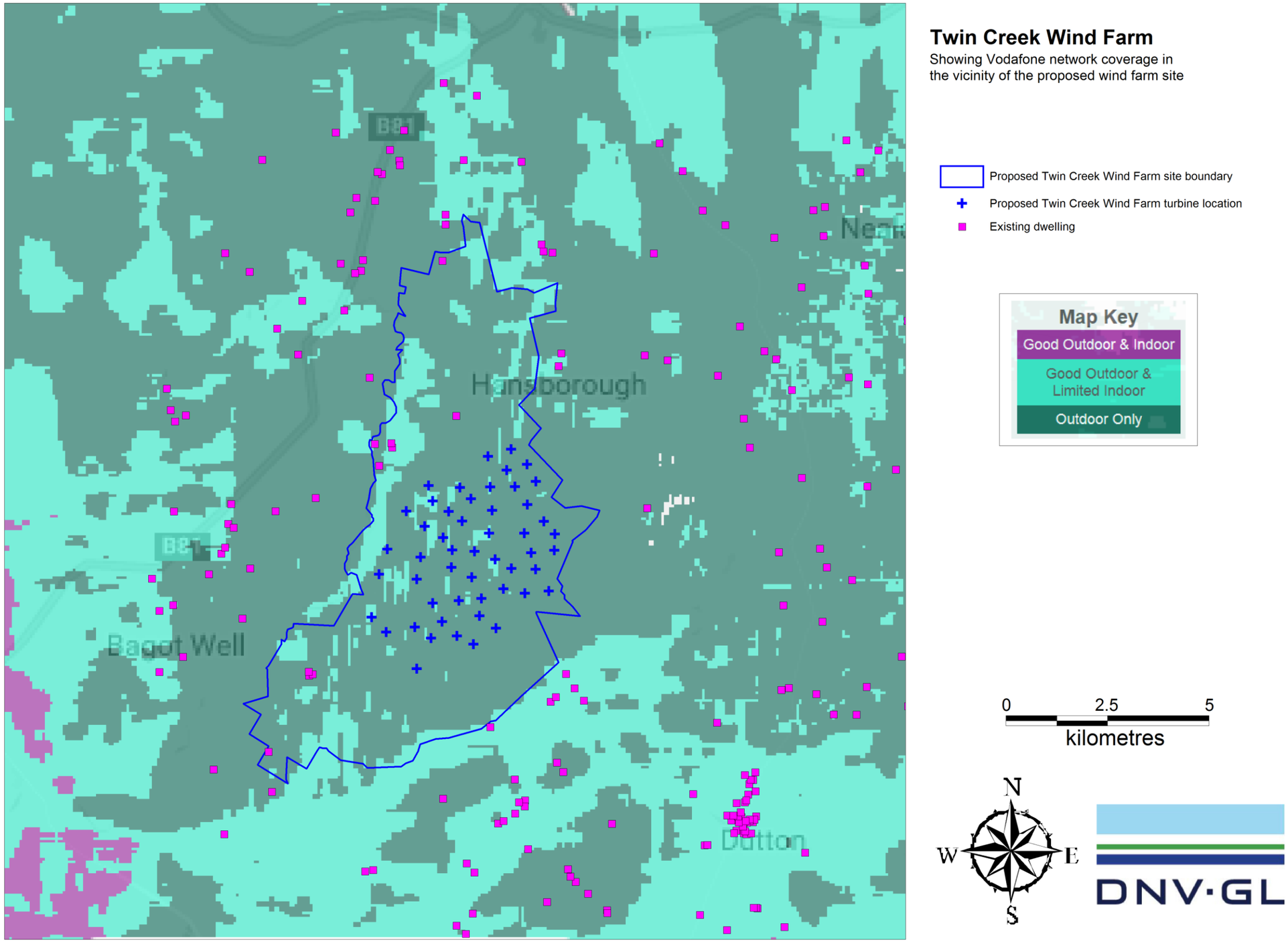

Figure 13 Vodafone network coverage for the proposed Project

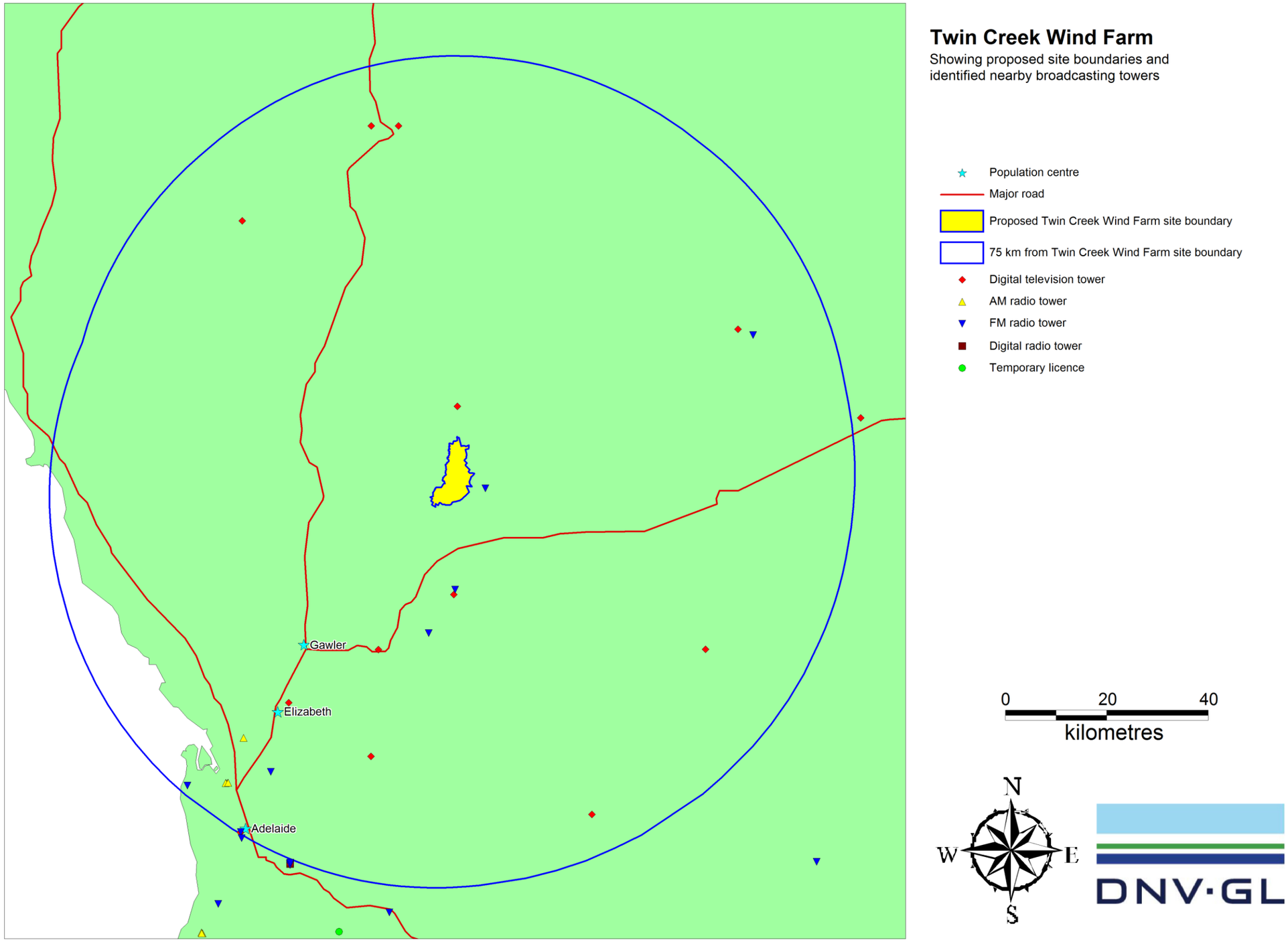

Figure 14 Location of broadcast transmitters in the vicinity of the proposed Project

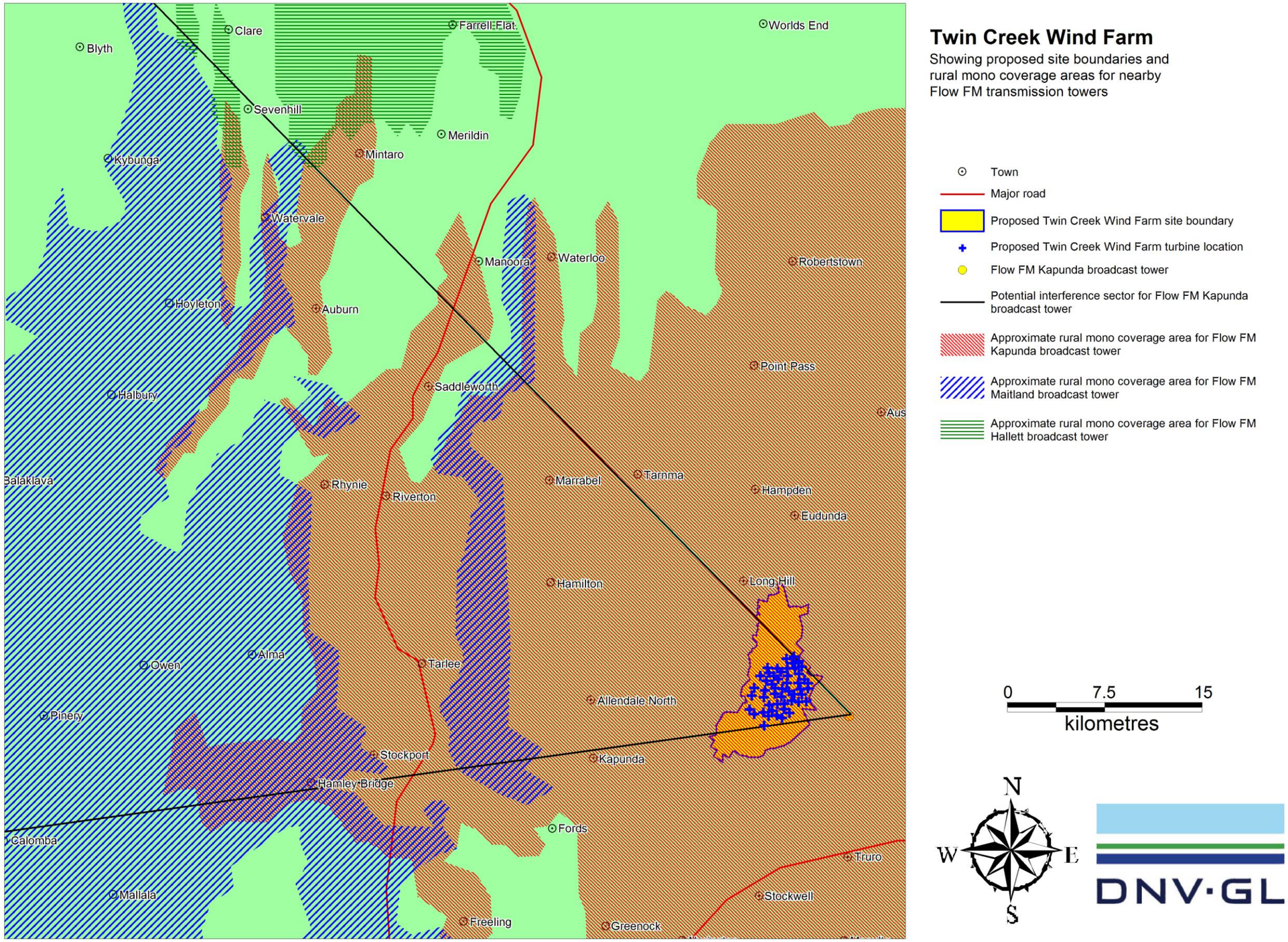

Figure 15 Flow FM signal coverage (rural mono reception) for the proposed Project

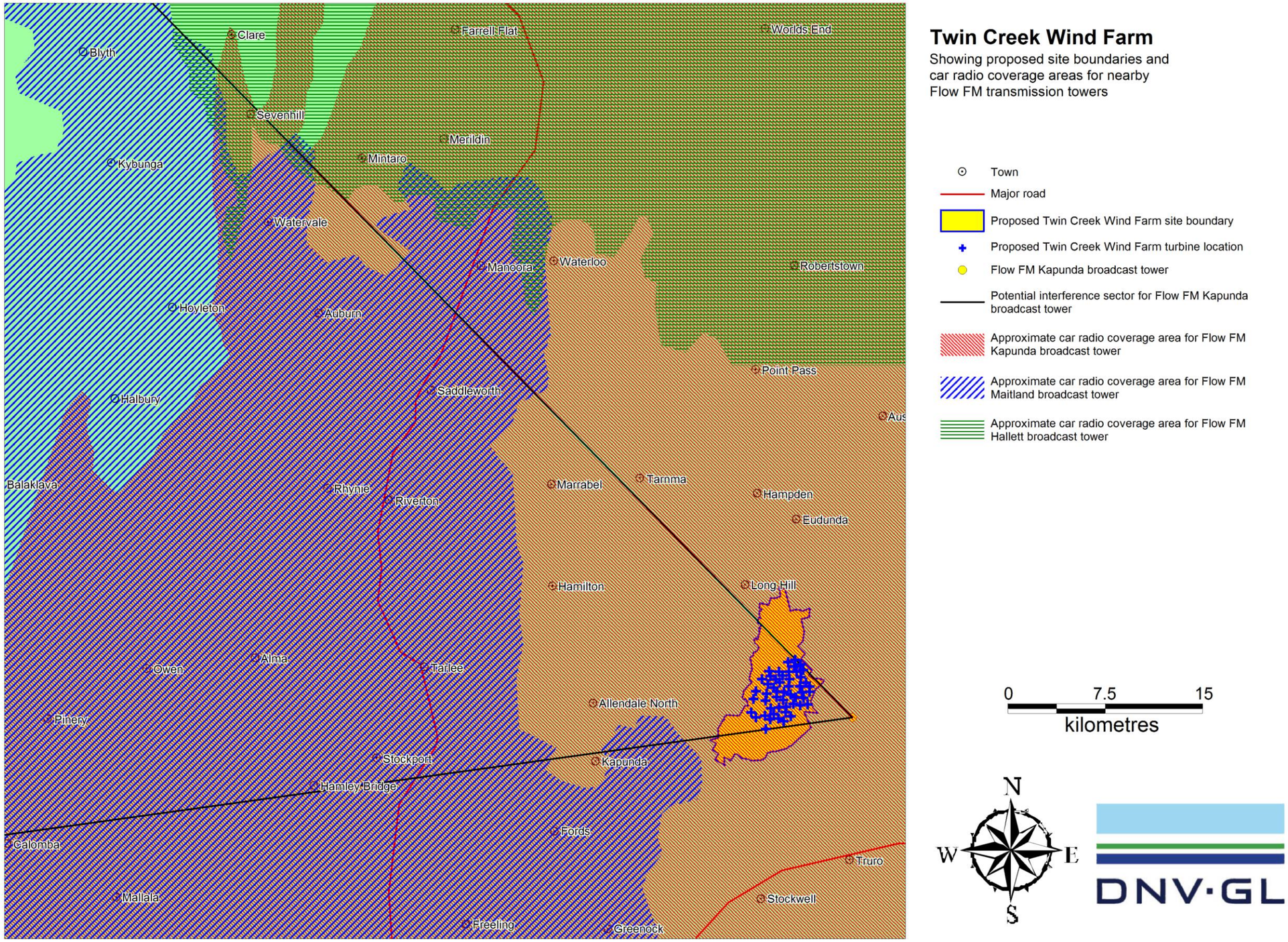

Figure 16 Flow FM signal coverage (car radio reception) for the proposed Project

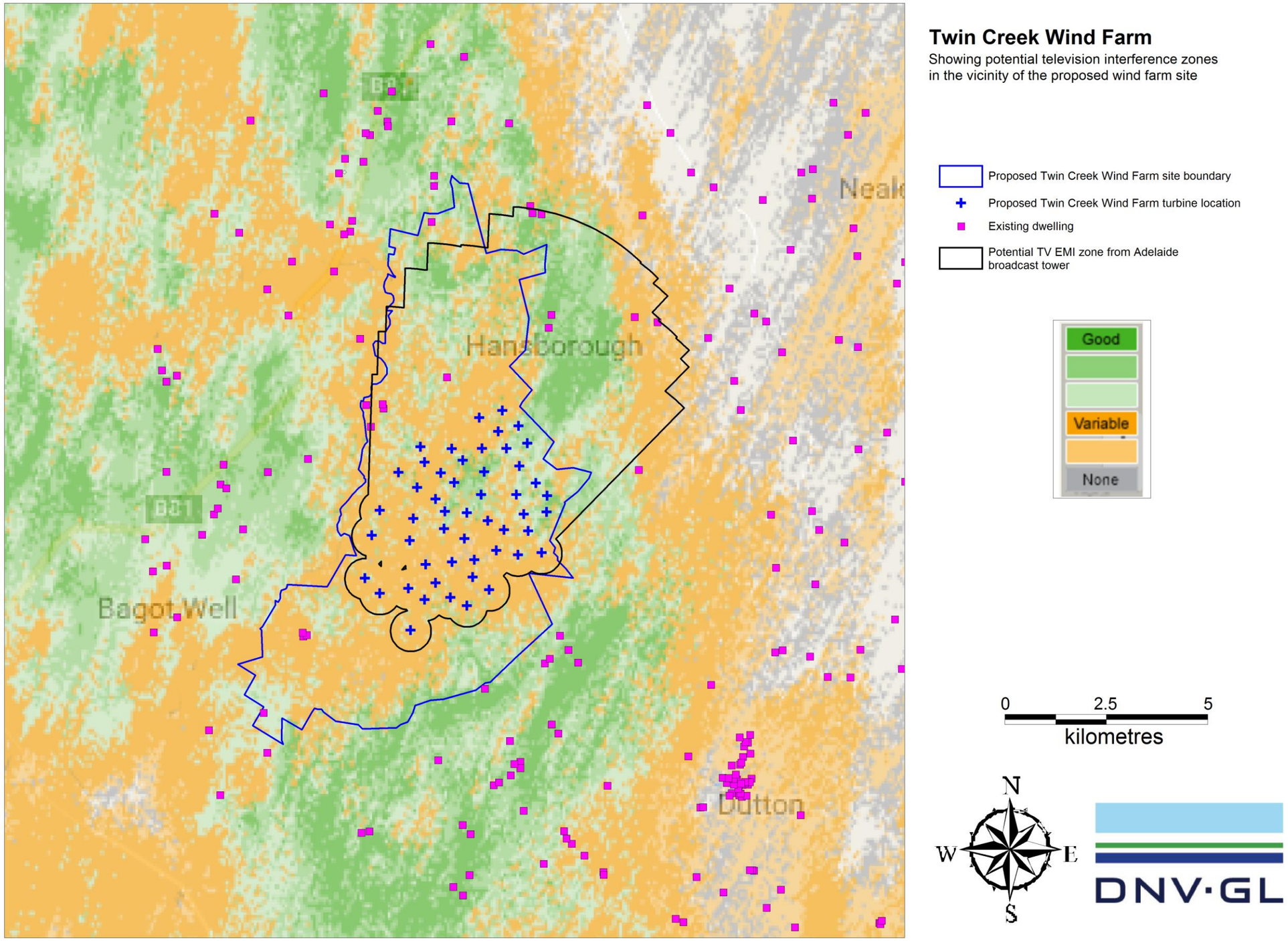

Figure 17 Potential television EMI zones from the Adelaide broadcast tower for the proposed Project

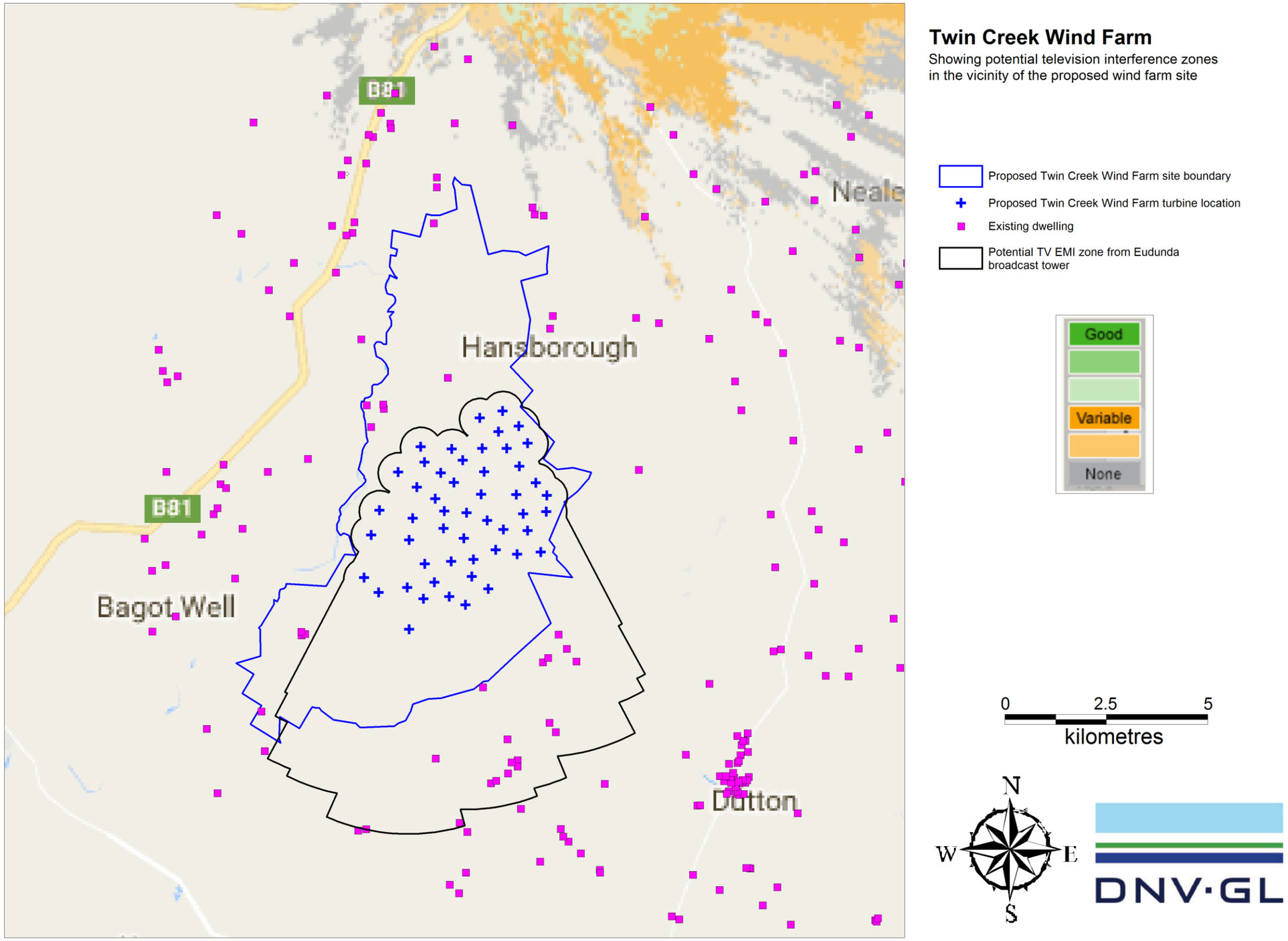

Figure 18 Potential television EMI zones from the Eudunda broadcast tower for the proposed Project

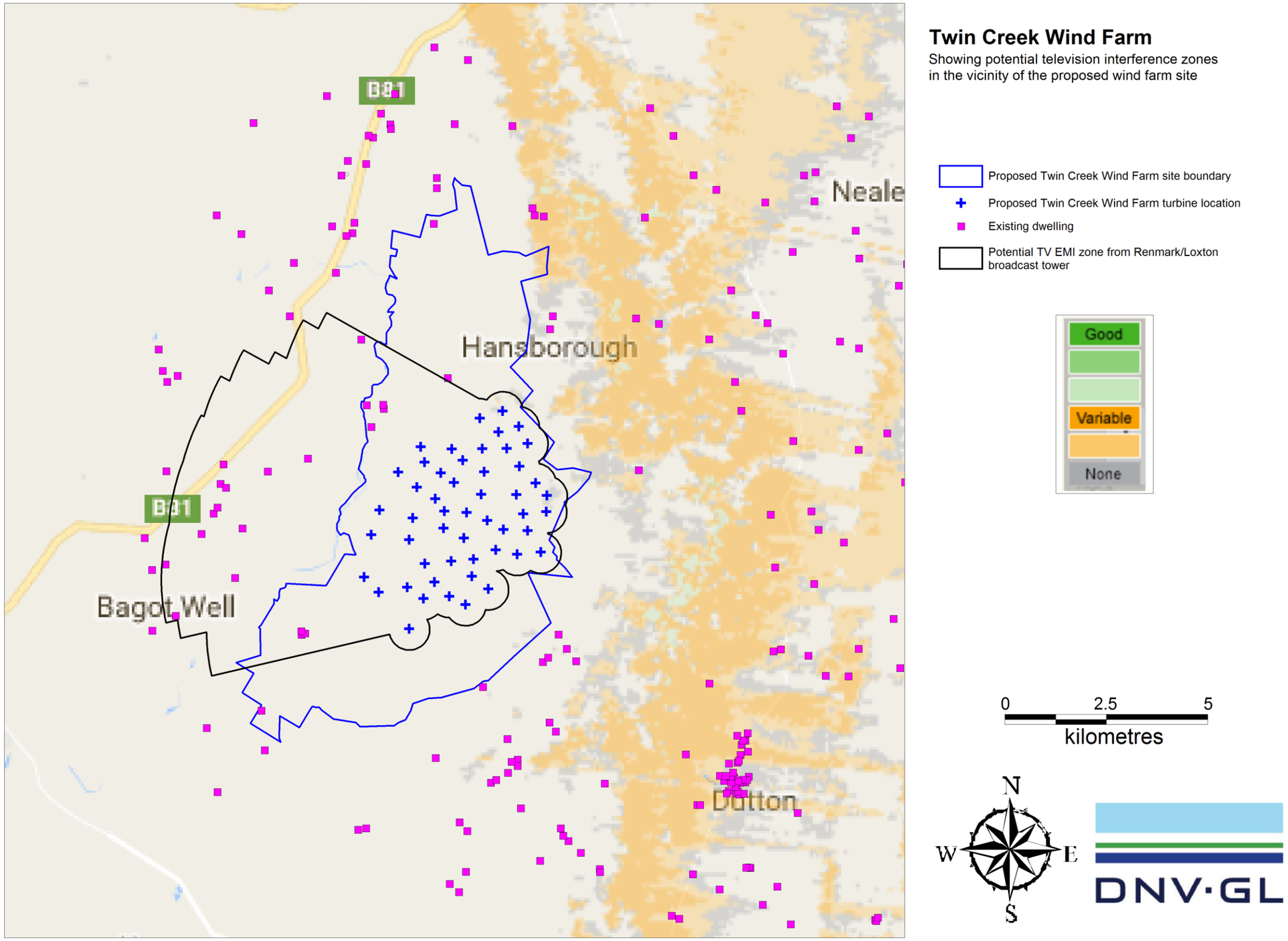

Figure 19 Potential television EMI zones from the Renmark/Loxton broadcast tower for the proposed Project

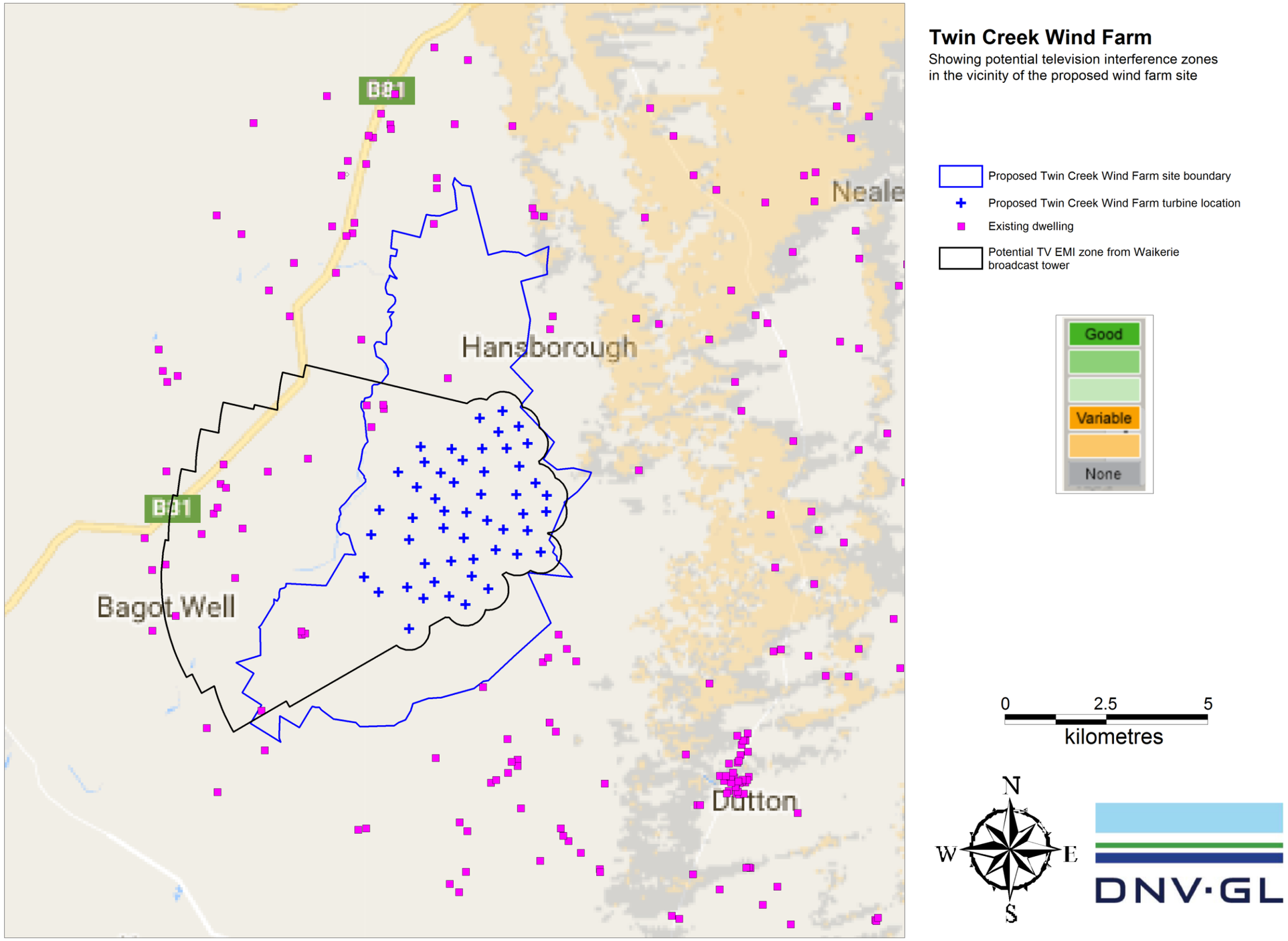

Figure 20 Potential television EMI zones from the Waikerie broadcast tower for the proposed Project

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.