WATTA WELLA RENEWABLE ENERGY PROJECT

EMI Assessment

Umwelt (Australia) Pty Ltd

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Image provided by the Proponent. Image credit: Murra Warra Wind Farm Project Co Pty Ltd.

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Objective: Watta Wella Renewable Energy Project EMI Assessment

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EXECUTIVE SUMMARY

DNV has been commissioned by Umwelt (Australia) Pty Ltd ("Umwelt" or "the Customer") on behalf of RES Australia Pty Ltd ("RES" or "the Proponent") to assess potential electromagnetic interference (EMI) impacts associated with the wind farm component of the proposed Watta Wella Renewable Energy Project ("the Project") in western Victoria. The Project is located approximately 16 km northeast of Stawell and 30 km north of Ararat on land with an area of approximately 4,850 hectares (the "Project Area"). The results of the EMI assessment are described in this document and summarised in the table at the end of this section.

Background and methodology

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

A Project layout consisting of 45 wind turbines with a rotor diameter of 178 m and tip height of 255 m has been considered. These dimensions represent the maximum overall tip height within the maximum rotor and tower hub height dimensions.

There are 76 dwellings that have been identified within 5 km of the Project Area, 9 of which are involved dwellings belonging to wind farm host landowners.

Outcomes of the assessment

There is one radiocommunication tower located within 2 km of the turbines that hosts point-to-area style licences used for mobile radio communications. Given the proximity of the proposed wind turbine locations to the identified tower, there is a potential for the Project to interfere with the associated point-to-area style communications through reflection or scattering of the signals. Consultation with the operator of the tower is recommended in order to understand the potential for interference.

Based on the assessment undertaken by DNV, dwellings located within and adjacent to the Project Area and to the west and northwest of the Project Area have increased potential to experience interference to digital television signals from the Ballarat tower, particularly in areas to the west where the signal is already marginal. Digital television signals from the Horsham broadcast tower may also be impacted, although the coverage maps suggest that the potentially affected dwellings are unlikely to be receiving signals from this tower. However, previous feedback received from BAI Communications, who are responsible for broadcasting of national public television services in Australia, suggests that impacts to digital television signals are unlikely.

Interference to signals from geostationary satellites that transmit programs intended for international audiences is possible at one nearby dwelling, although it is considered unlikely that residents will be receiving signals from these satellites. If interference is experienced, mitigation options could include realigning or upgrading the user's satellite dish or seeking an alternative source of the same programming or service. DNV recommends that the Proponent engages with the residents or owners of potentially affected dwellings to determine if any are currently receiving these satellite signals, and to establish an understanding of how any impacts may be mitigated.

There are no turbines located within the diffraction exclusion zones calculated by DNV for the fixed point-to-point links passing over the Project Area, operated by NBN Co, Optus and Northern

Grampians Shire Council. No concerns have been raised to date regarding the current proposed turbine locations, and no turbines are placed within the clearance zones requested by the operators or inferred by DNV from the advice received. Therefore, interference with point-to-point links is considered unlikely.

Consultation has been conducted with the operators of point-to-multipoint links, emergency services, and meteorological radar to help determine the potential EMI impacts on their assets. The Bureau of Meteorology has advised that impacts to their radars are expected to be manageable, and the responses received to date from the operators of point-to-multipoint links and emergency services indicate that the Project is unlikely to have any impact on these services.

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

The Project is located in an area of high wind farm development activity, with several operational wind farms located nearby. Based on the relative locations of these wind farms, there is a risk of cumulative EMI-related impacts to broadcast digital television signals received at nearby dwellings. There is also potential for increased interference to mobile phone and FM radio signals in areas where there may be multiple wind turbines between the user and the transmission tower. Based on the current assessment, cumulative impacts to other services, including point-to-point links and NBN fixed wireless internet signals, are not expected.

1 INTRODUCTION

Umwelt (Australia) Pty Ltd ("the Customer") on behalf of RES Australia Pty Ltd ("RES" or "the Proponent") has commissioned DNV to independently assess the potential electromagnetic interference (EMI) related impacts associated with the wind farm component of the proposed Watta Wella Renewable Energy Project ("the Project") in western Victoria. The results of this work are reported here.

In accordance with the Planning Guidelines for Development of Wind Energy Facilities in Victoria (Victorian Guidelines) prepared by the Victorian Government Department of Transport and Planning in September 2023 [1] and the National Wind Farm Development Guidelines – Draft (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [2], this assessment investigates the potential EMI impact of the Project on:

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

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

2 DESCRIPTION OF THE SITE AND PROJECT AREA

2.1 The site

The proposed Project Area is located in the Northern Grampians Shire Council local government area in western Victoria, approximately 16 km northeast of Stawell and 30 km north of Ararat. The site is characterised by open farmland on gently undulating terrain, interspersed with wind breaks and some areas of trees. The Joel Joel Nature Conservation Reserve lies in the centre of the site and the Wimmera River lies to the east.

2.2 The Project

2.2.1 Proposed wind farm layout

The Project is proposed to consist of 45 wind turbines [3]. A map of the site with the proposed turbine layout is shown in Figure 1, and the coordinates of the proposed turbine locations are presented in Table 7.

2.2.2 Dwelling locations

The locations of dwellings in the vicinity of the Project Area have been provided by the Customer [4, 5, 6]. For the purposes of this assessment, DNV has considered all identified dwellings within 5 km of the Project Area boundaries. There are 76 dwellings located within 5 km of the Project Area boundaries, 9 of which are involved dwellings. Involved dwellings are defined as belonging to wind farm host landowners. The coordinates of these dwellings are presented in Table 8, and the dwellings and site boundaries considered in this assessment are shown in Figure 1.

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

3 REGULATORY REQUIREMENTS

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

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

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

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

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

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

Based on DNV's experience supporting planning applications for wind farms in Victoria, and more broadly across Australia, the Draft National Guidelines have been used to inform the preparation of EMI assessments for multiple wind farm applications. Where the outcome of the modelling conducted by DNV did not raise critical concerns with the relevant planning authorities, these applications have then subsequently been granted approval to proceed.

4 METHODOLOGY AND RESULTS

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

The Customer has asked DNV to complete this assessment based upon a layout provided for the Project consisting of 45 wind turbines, as outlined in Table 7.

For the purpose of the EMI assessment, a hypothetical turbine with a rotor diameter of 178 m and a tip height of 255 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 178 m or less
- an upper tip height of 255 m or less.

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

To conduct the EMI assessment, information regarding radiocommunications licences in the vicinity of the Project Area were obtained from an image of the Australian Communication and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database dated 28 November 2024 [7].

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

The Draft National Guidelines recommend that consultation with the relevant operator be undertaken if a turbine is located within 2 km of a radiocommunication site, within the second Fresnel zone of a point-to-point link (which is calculated as described in section 4.2.1.1), or within 250 nautical miles of an aeronautical or meteorological radar site. DNV 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. Consultation with these operators has been undertaken in three stages:

1. Consultation was conducted in July 2021 as part of a previous EMI assessment with all identified organisations based on a turbine layout consisting of 45 turbines with a rotor diameter of 178 m and an upper tip height of 255 m (“the previous turbine layout”).

2. Further consultation was conducted in December 2023 and February 2024 with those organisations that had expressed concerns or had not previously responded to the consultation undertaken in July 2021, based on a turbine layout consisting of 47 turbines with a rotor diameter of 178 m and an upper tip height of 255 m ("the interim turbine layout"). It was not considered necessary to re-engage with operators who had indicated that they did not expect impacts based on the previous turbine layout and where the potential for interference was not expected to be sensitive to changes in the layout.

3. The turbine layout was subsequently modified, and further consultation was conducted in December 2024 with those organisations that had expressed concerns or had not responded to the consultation undertaken previously, based on the turbine layout and dimensions considered in this assessment ("the current turbine layout", consisting of 45 turbines with a rotor diameter of 178 m and an upper tip height of 255 m). It was not considered necessary to re-engage with operators who had indicated that they did not expect impacts based on the previous or interim turbine layouts and where the potential for interference was not expected to be sensitive to changes in the layout.

The organisations that have been contacted and all responses received to date are summarised in Table 17.

The radiocommunication licences and services with potential to experience EMI-related impacts from the proposed Project are considered in the following sections. Each section contains a brief overview of the relevant technology, followed by an assessment of the identified licences and services in the area around the Project Area and the expected potential for interference. Details of any feedback obtained from the service operators and potential mitigation options are also included where appropriate.

4.1 Radiocommunication towers

The Draft National Guidelines [2] recommend that a radial distance of 50 km to 60 km from the centre of a wind farm would normally capture all of the potentially affected services in the area. However, the methodology for assessing the potential radiocommunications interference used in this assessment is to locate all of the radiocommunication towers within approximately 75 km of the proposed Project Area, and then assess the radiocommunication licences attached to these towers.

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

4.1.1 Locations of radiocommunication towers and potential for interference

From the ACMA RRL database, there are 449 radiocommunication towers within a nominal 75 km of the Project Area. The locations of these radiocommunication towers relative to the Project Area are shown in Figure 2.

There is one radiocommunication tower located within 2 km of the proposed turbine locations. Based on the results of previous EMI assessments conducted for the Project, DNV understands that this tower and licences were registered with the ACMA some time after December 2023 [8]. The tower and the consultation zones recommended by the Draft National Guidelines [2] are shown in Figure 3 based on information obtained from the ACMA RRL database. Each consultation zone includes the rotor radius for turbines with a 178 m rotor diameter, and an additional buffer of 25 m to account for potential inaccuracies in the tower locations given in the ACMA RRL database.

Details of the licences associated with the radiocommunication tower are given in Table 1**.** The licences and services are point-to-area style communications, comprising land mobile licences used for private mobile telephony (mobile radio systems).

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

Site ID	Operator	Licence/service types	Distance to nearest turbine [m]
10039892	Siemens Gamesa Renewable Energy Pty Ltd	Point-to-area (land mobile)	981

Point-to-area style radiocommunications such as mobile radio systems are typically designed to operate in a range of environments and 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. However, interference caused by reflection or scattering of signals or near-field effects can be a problem if the turbines are located close to the transmission tower. Reference [9] provides general guidance regarding the potential for interference with mobile radio systems, and suggests that a clearance of 500 m from the tower is sufficient to avoid significant impacts due to reflection or scattering of signals. Other references recommend that turbines be kept outside of clearance zones ranging from a distance of 200 m to 1200 m from the tower for these types of services [10].

Given the proximity of the proposed wind turbine locations to the tower shown in Table 1, there is a potential for the Project to interfere with the associated point-to-area style communications through reflection or scattering of the signals. Near-field zones for these types of systems are typically only a few metres in radius, and so it is considered unlikely that the Project will cause interference to the services associated with this tower through near-field effects.

4.1.2 Stakeholder consultation

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

4.1.3 Mitigation options

Mitigation measures to avoid potential for impacts to the point-to-area style communications operated by Siemens Gamesa Renewable Energy Pty Ltd from the tower at site ID 10039892 would need to be determined in consultation with operator but may include increasing the signal strength from the affected tower or alternative towers, or installing additional towers in the vicinity of the Project Area.

4.2 Fixed licences of point-to-point type

Point-to-point links are often used for line-of-sight connections for data, voice, and video. Such links often exist on mobile phone and television broadcast towers. The frequency of common microwave signals varies from approximately 1 GHz to 30 GHz.

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

4.2.1 Locations of point-to-point links and potential for interference

DNV has analysed the registered licences for each radiocommunication tower according to the ACMA RRL database to determine the transmission paths of the licenced links. For this analysis, DNV has used a wider and more conservative frequency range of 0 GHz to 50 GHz.

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

The links paths associated with the analysed towers are shown in Figure 4. It can be seen that not all of the identified transmission towers have a fixed licence of point-to-point type transmission vector. Some towers have no active licences associated with them, and some towers are used solely for point-to-area style transmissions, such as some emergency services towers.

There are three point-to-point links recorded in the ACMA RRL database that pass over the proposed Project Area (operated by Northern Grampians Shire Council, Optus Mobile and NBN Co). The details of the links are provided in Table 9, and the link paths are shown in greater detail in Figure 5 based on information obtained from the ACMA RRL database, provided by the link operators, and extracted from aerial or satellite imagery.

The potential interference mechanisms and interference zones established by DNV for these links are described in Sections 4.2.1.1, 4.2.1.2, and 4.2.1.3. Feedback obtained from the operators of the links, including their recommended clearance zones to reduce the potential for interference, is summarised in Section 4.2.2.

4.2.1.1 Interference caused by diffraction

The potential for interference to a fixed point-to-point link through diffraction or obstruction of the signal can usually be avoided by keeping clear of an exclusion zone of circular cross-section around the link path from the transmitter to the receiver [2] [11] [12], typically defined in terms of the Fresnel zones for the link. The *n*th Fresnel zone is comprised of all points for which, if the signal

travelled in a straight line from the transmitter to the point and then to the receiver, the additional length compared to the straight transmitter-receiver path equals $\frac{n-\lambda}{2}$, where λ = wavelength.

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

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

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

To avoid interference to point-to-point links caused by signal diffraction, wind turbines, including the blades, should be kept outside of an exclusion zone based on either the second Fresnel zone as recommended in [11], or potentially 60% of the first Fresnel zone for links below 1,000 MHz with a clear line of sight as suggested in [9] (although DNV understands that this zone is under review by the authors of that document). For each of the links crossing the proposed Project Area, DNV has established a diffraction exclusion zone based on the second Fresnel zone for that link.

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

The potential diffraction exclusion zones in the horizontal plane are shown in Figure 5. Each exclusion zone includes the rotor radius for turbines with a 178 m rotor diameter, and an additional buffer on either side to account for potential inaccuracies in the tower locations. The size of the uncertainty buffer for each link is based on the deviations between the tower locations recorded in the ACMA RRL database, the locations provided by the link operators, and the apparent locations determined from aerial or satellite imagery.

DNV has also assessed the potential for the turbine blades to intersect with the diffraction exclusion zone for each point-to-point link in the vertical plane. This was achieved by examining the elevation and antenna heights at the end of each link, as well as the approximate elevation of areas within the Project Area over which the link crosses. As shown in Figure 5, there are no turbines located within the diffraction exclusion zones for the point-to-point links passing over proposed Project Area. Therefore, it is not expected that the Project will cause interference to the point-to-point links through diffraction of the signals.

4.2.1.2 Interference caused by reflection or scattering

Interference due to reflection or scattering of a fixed point-to-point link can occur when the signal produced by the transmitting antenna is reflected, scattered, or re-radiated by an intervening object into the corresponding receiver antenna. If the reflected or scattered signal is sufficiently strong that the ratio of the direct signal to the indirect signal is lower than the required carrier-to-interference (C/I) ratio, or protection ratio, for the link, the link performance can be degraded. The extent to which an object such as a wind turbine will reflect or scatter electromagnetic waves is characterised by its radar cross section (RCS) [11].

Reference [11] describes a methodology for calculating the C/I ratio that might be expected at a receiver in the presence of a reflected or scattered signal from a wind turbine at a specified location. By evaluating the C/I ratio for incremental changes in the distances between the

transmitter, receiver, and wind turbine, and comparing this to the required C/I ratio, a potential interference zone can be defined.

Reflection or scattering effects can pose a risk when wind turbines are situated close to either the transmitting or receiving towers of a point-to-point link. The nearest turbine is located more than 2 km from the transmission towers. DNV considers that the transmission towers for the point-to-point links crossing the Project Area are sufficiently far from the proposed turbine locations to avoid reflection or scattering effects. Therefore, it is not expected that the Project will cause interference to the point-to-point links through this mechanism.

4.2.1.3 Interference caused by near-field effects

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

Reference [11] presents an equation for estimating the radius of the near-field zone for a point-to-point link from the properties of the transmitting or receiving antenna.

Near-field effects are typically only experienced if wind turbines are located within several hundred metres of a transmission tower. DNV considers that the transmission towers for the point-to-point links crossing the Project Area are sufficiently far from the proposed turbine locations to avoid near-field effects. Therefore, it is not expected that the Project will cause interference to the point-to-point links through this mechanism.

4.2.2 Stakeholder consultation and responses

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

The response received from Optus confirmed that they do not have concerns surrounding the current turbine layout.

Responses have been received from NBN Co and Northern Grampians Shire Council based on the interim turbine layout, as summarised in Table 17.

Feedback received from NBN Co based on the interim layout suggests that they do not expect the Project to cause any impact. To avoid the potential for interference to their services, NBN Co have requested a clearance of 149.42 m either side of the link path based on the current turbine dimensions. As shown in Figure 6 and Table 2, there are no turbines within the clearance zone requested by NBN Co for their point-to-point links.

Feedback received from the Northern Grampians Shire Council indicates that the council are transitioning away from using the point-to-point link crossing the site and they expect that the link will not need to be a consideration for the Project.

Table 2 Details of turbines located within the clearance zones requested by the operators for point-to-point links crossing the proposed Project Area

Link no.	Operator	Requested or inferred clearance zone	Turbines within requested or inferred clearance zone
1	NBN Co	149.42 m from point-to-point link path	None

4.2.3 Mitigation options

While the Project is unlikely to adversely impact any point-to-point links, in the event this was to occur after the Project is operational, mitigation options in the event that interference to point-to-point links is experienced after the Project is operational, mitigation options would need to be confirmed through consultation with the relevant operators but may include upgrading the equipment for the affected links, re-routing links via an existing or new tower, or replacing links with alternative communication technologies.

4.3 Fixed licences of point-to-multipoint type

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

Administratively, the ACMA RRL database details the location of the static station for a fixed licence of the point-to-multipoint type but does not include the remote stations that communicate with the static station. Hence, the paths of the transmission vectors are not readily identifiable.

4.3.1 Locations of point-to-multipoint licences and potential for interference

From the ACMA RRL database, DNV has identified 36 point-to-multipoint Assignment IDs within approximately 75 km of the proposed Project Area. These licences are shown in Figure 7. The details of the licence holders as given in the ACMA database are provided in Table 10.

There are two point-to-multipoint base stations within 20 km of the Project Area. These stations are operated by Central Highlands Water (Site ID 9012292) and Stawell Gold Mines (Site ID 305839). There are also several point-to-multipoint base stations located more than 20 km from the site.

Wind turbines can cause interference to point-to-multipoint links through the same mechanisms as described for point-to-point links in Section 4.2.1. However, as it is not possible to know the link paths in a point-to-multipoint network without obtaining further information about the locations of each station in the network, consultation with the relevant operators is needed to determine the potential for interference.

4.3.2 Stakeholder consultation and responses

DNV has contacted the operators of all potentially affected base stations within 60 km of the Project Area to determine the likelihood that the proposed Project will cause interference to their services. Responses have been received from all operators contacted, as summarised in Table 17, and no concerns have been raised.

4.4 Other licence types

Besides fixed point-to-point and point-to-multipoint licences, other licence types recorded in the ACMA RRL database include spectrum licences that permit a range of radiocommunications in a specific geographic area and frequency band, private mobile radio and public telecommunications service (PTS) licences, television and radio broadcasting licences, amateur apparatus licences, and aeronautical licences for ground to aircraft communications.

4.4.1 Locations of other licences and potential for interference

DNV has identified a number of other licences in the ACMA RRL database within 75 km of the proposed Project Area. The locations of these licences and number of associated Assignment IDs for each licence type are shown in Figure 8 and Table 11.

Most of the licences identified can be broadly described as base to mobile station or point-to-area style communications, including commercial and private mobile telephony and radio and television broadcasting. 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.

The potential for interference to emergency services signals and commercial mobile telephony signals is discussed further in Sections 4.5 and 4.10 respectively, while the potential for interference to radio and television broadcasting services is considered in Sections 4.13 and 4.14.

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

4.5 Emergency services

Licence types operated by emergency services such as state ambulance, police, fire, and rescue services typically comprise fixed point-to-point link and mobile radio communications.

4.5.1 Locations of emergency services licences and potential for interference

DNV has reviewed the ACMA RRL database to identify emergency services with licences for radiocommunication assets operating in the vicinity of the Project Area. The groups identified are listed in Table 12 along with their contact details. The nearest licence is associated with a tower located approximately 5 km from the site boundary.

There are no emergency services point-to-point links crossing the proposed Project Area, and so there is no potential for interference with point-to-point licences operated by emergency services.

All other licences operated by emergency services in the vicinity of the Project Area are mobile telephony licences used for mobile radio and paging systems. As discussed in Section 4.4, mobile telephony systems are generally not affected by the presence of wind turbines any more than other forms of signal obstruction. Reference [9] provides general guidance regarding the potential for interference with mobile radio systems, and suggests that a clearance of 500 m from the tower is sufficient to avoid significant impacts to these systems. Other references recommend that turbines be kept outside of clearance zones ranging from a distance of 200 m to 1200 m from the tower for point-to-area style services [10].

Given the distance of the emergency services mobile telephony licences from the Project Area. DNV considers it unlikely that the Project will cause interference to mobile radio and paging systems operated by emergency services.

4.5.2 Stakeholder consultation and responses

DNV has contacted the operators of all potentially affected stations within approximately 60 km of the Project Area to seek feedback regarding any potential impact that the Project could have on their operations and services.

A response has been received from Ventia (formerly VisionStream) based on the interim turbine layout, stating that there is potential for localised interference within the site boundary within approximately 450 meters of the turbines. Ventia stated that no turbines should be placed within 450 meters of a building where people may live or work due to localised scattering of radio signals. DNV notes that there are no dwellings within 450 meters of the proposed turbines. Ventia indicated that beyond the localised scattering they do not expect there to be any significant impacts to coverage.

Responses have also been received from Ambulance Victoria, Country Fire Authority, Victoria State Emergency Service and Regional Mobile Radio, as summarised in Table 17, and no concerns have been raised. No response has been received from Corrections Victoria or St John Ambulance to date.

4.5.3 Mitigation options

As noted above, there is no potential for impacts to point-to-point links operated by emergency services, and interference with mobile telephony services is considered unlikely. If localised interference to mobile radio or paging system signals is experienced, this can often be mitigated by the user moving a short distance to a new or higher location to receive a clearer signal or by using an external antenna to improve the signal reception. Other mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing a signal repeater or additional tower on the opposite side of the Project Area.

4.6 Aircraft navigation systems and radar

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

4.7 Meteorological radar

The Bureau of Meteorology (the Bureau) operates a network of weather radars across Australia consisting of high-resolution Doppler radars and standard weather watch or weather surveillance radars. Operation of the Bureau's part-time wind finding radar installations ceased in August 2019 [13].

Standard weather watch radars emit pulsed microwave radiation and use reflections or "echoes" of that radiation from water particles in the atmosphere to detect rain and storm activity. Doppler radar installations operate in the same way but are also able to measure the speed of the moving water particles, and therefore can provide information about wind speed and direction [14, 15].

While 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. Because radar installations monitor the current weather situation over a wide

area, the information they provide can be used to indicate the possibility and approach of severe storms, tropical cyclones, and flooding events. Wind profile measurements are also used to ensure the safe and economical operation of aircraft and provide an important source of data for the Bureau's general weather forecasting system.

The optimal coverage area for a weather radar generally extends approximately 200 km from the radar installation at a height of around 3000 m [16, 17], and approximately 100 km at a height of 1000 m [17]. Therefore, wind farms can theoretically impact on weather radar operations when located within several hundred kilometres of an installation. However, due to the curvature of the earth and intervening terrain, the range at or near ground level is generally less.

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 complete or partial blockage of the radar signal and subsequent loss of weather data [18, 19]. For wind farms located between 5 km and 20 km of a radar, the WMO recommends consultation and analysis to assess the likelihood of turbines causing reflection or scattering of the radar signals or interfering with Doppler velocity measurements. At distances of between 20 km and 45 km, the presence of a wind farm may produce radar echoes or signal clutter that can cause loss of data or be mistaken for rain. Significant impacts are generally not expected for wind farms located more than 45 km from a meteorological radar, since in most cases the turbine will below the radar scan line of sight. However, the WMO notes that these guidelines are only applicable to typical radar installations in flat terrain and may need to be modified for higher-powered radars or specific situations.

Recent advice received from the Bureau also suggests that there may be potential for interference to meteorological radar operations from wind farms over much greater distances than indicated by the WMO guidelines, depending on the relative elevations of the radar and the wind farm and the intervening terrain.

According to the Draft National Guidelines, operators of weather radars within 250 nautical miles (463 km) of the proposed Project Area should be consulted [2].

4.7.1 Locations of meteorological radars and potential for interference

DNV has identified that the Bureau operates 16 weather radars within 250 nautical miles of the proposed Project Area, with the closest radar, "Rainbow (Wimmera)", located approximately 133 km northwest of the Project Area. The locations of these radars are shown in Figure 9 and the details of each radar are given in Table 13.

Although the distance between the Project Area and the nearest Bureau radar is considerably greater than the distances at which the WMO suggests impacts may occur, consultation with the Bureau is needed to determine the potential for interference.

4.7.2 Stakeholder consultation and response

DNV previously contacted the Bureau regarding the Project, as recommended by the Draft National Guidelines, to seek feedback on whether interference to their operations and services is likely, based on the previous turbine layout. The response received from the Bureau indicated that the potential impact would be manageable, and no objections would be raised provided that the Bureau is:

1. informed of any changes to the proposed turbine locations of more than 100 m, or changes to the proposed turbine height

2. given at least two weeks' notice prior to any planned shutdown of the Project after construction, which will allow the Bureau to calibrate their radar systems while the turbines are not operating and hence account for the presence of the Project in their signal processing and interpretation.

DNV understands that the Proponent has agreed in writing to the conditions specified by the Bureau based on the previous turbine layout.

DNV has contacted the Bureau regarding the Project's current turbine layout and the Bureau have confirmed that the expected impact will still be manageable and that the previous agreement between the Proponent and the Bureau is still valid.

4.7.3 Mitigation options

Considering that the Bureau expects the impact of the Project on their radars to be manageable, compliance with the conditions specified by the Bureau and outlined in Section 4.7.2 are recommended to help to mitigate any interference with meteorological radar operations once the Project is operational. Alternative mitigation options would need to be confirmed through consultation with the Bureau.

According to the WMO, there are currently no automated signal processing techniques available that can be used to effectively filter radar data to remove interference caused by wind farms [19], However, if analysis indicates there is a potential for the wind farm to cause reflection or scattering of radar signals, the WMO suggests it may be possible to reduce the potential impact through the relocation of individual turbines prior to construction. In situations where the expected interference is limited to signal clutter, the radar operator may also be able to mask these effects in the data or train the users to take the locations of the wind farms into account.

4.8 Trigonometrical stations

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

Some trig points may host surveying equipment such as Global Positioning System (GPS) antennas and electronic distance measuring (EDM) devices. EDM devices measure the distance from the trig point to the target object by means of a beam of known velocity which is reflected back to the unit from the target object. Most EDM devices require the target object to be highly reflective and, accordingly, a reflective prism is placed on the target object being surveyed.

The effective range of EDM devices depends on the wavelength bands used. Light wave and infrared systems have an effective range of 3 km to 5 km, and could be intercepted or obstructed by the presence of turbines. However, the potential for impact is considered low as it is likely to be possible to relocate the target to obtain an unobstructed view of the trig point. Microwave systems can measure distances up to 150 km, but such systems are not limited by the line of sight or affected by visibility [20].

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 [21]. 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) [22], 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 In Victoria, the Department of Transport and Planning (DTP, formerly the Department of Energy, Land, Water and Planning, DELWP) also operates a state-wide GNSS CORS network, known as GPSnet, which is used to provide geospatial data for mapping, surveying, agriculture, and industry [23]. The AuScope GNSS network of around 100 CORS strategically distributed across the country. GNSS stations are typically equipped with EDM devices and GPS receivers, and transmit data to Geoscience Australia or the relevant state authority via phone lines, internet, or satellite communications.

4.8.1 Locations of trigonometrical stations and potential for interference

According to Geoscience Australia [24], there are seven trig points within 20 km of the Project Area boundary. The details of these trig points are provided in Table 14 and their locations are illustrated in Figure 10. There are also 77 permanent survey marks within 2 km of the Project Area boundary [25] as shown in Figure 11. The closest survey mark is located 95 m southeast of turbine T41.

DNV has reviewed the primary geodetic network of Australia [26] and observed that the Project Area 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.

The closest GNSS station is located approximately 22 km northwest of the Project Area, at Glenorchy [24]. 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.

4.8.2 Stakeholder consultation and responses

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 has contacted Geoscience Australia and the DTP (formerly DELWP) to inform them of the Project, and seek feedback regarding whether interference to their systems is possible.

The response received from the DTP based on the previous turbine layout states that they do not expect the Project to have any impact on their positioning infrastructure, but that the survey marks located within the site boundary should not be disturbed during wind farm construction and operation. The DTP have requested that they be notified if there is a need to disturb any of the survey marks.

The response received from Geoscience Australia based on the interim turbine layout stated that Geoscience Australia do not foresee any potential for interference to their infrastructure from the proposed Project.

4.9 Citizen's band radio

Citizen's band radio, also known as CB radio, is a class-licensed two-way, short distance communication service that can be used by any person in Australia for private or work purposes. It is commonly used in rural areas for emergency communications, road safety information, communication between recreational travellers, and general conversation. The class licence implies that all users of the CB radio operate within the same frequency range on a shared basis and no individual licence is required.

The CB radio service can be used for voice communication activities, telemetry, and telecommand applications. The radio service operates on two frequency bands, namely the high frequency (HF) band between 26.965 MHz and 27.405 MHz and the ultra-high frequency (UHF) band between 476.425 MHz and 477.400 MHz.

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

The UHF CB radio service is unique in Australia and uses the FM (frequency modulation) transmission mode. It provides clear communication over 5–20 km and is less susceptible to power line noise. However, the UHF CB radio equipment requires a clear line of sight for a strong signal and is easily hindered by hilly terrain and forested areas. Even in the absence of physical obstructions, UHF CB radio signals generally cannot travel beyond the effective radio horizon, which depends on elevation, antenna height, weather, and atmospheric conditions. If located on a hilltop, CB radio signals can be transmitted over at least 50 km. However, under normal conditions on flat ground, signal range is typically limited to around 5 km. CB repeater stations are often 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.

4.9.1 Locations of CB radio devices and potential for interference

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. Given the limitations of UHF radio signals, CB radio services are typically only intended for local or short-range communications. CB radio signals passing through the Project Area are likely to be intercepted by existing obstructions such as terrain and vegetation, and there is little evidence in the literature to suggest that wind turbines pose a particular risk of interference to these systems. Therefore, the impact of the Project on CB radio services is expected to be minimal.

4.9.2 Mitigation options

If interference to CB radio signals is experienced, simple steps such as moving a short distance to a new or higher location until the signal strength improves may help to mitigate the impact. CB radio users can also increase their signal range and improve reception by switching their equipment to a higher power setting, using a longer antenna, or increasing the antenna mounting height.

4.10 Mobile phones

Mobile phone networks typically operate at frequencies of either between 700 and 900 MHz, or between 1800 MHz and 2600 MHz, however some new services may operate at up to 3500 MHz. At such frequencies, signals may 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. However, there is little evidence in the literature of wind turbines interfering with mobile phone signals, and DNV notes that previous advice received from mobile phone network operators in Australia has generally indicated that they do not expect wind farm developments to interfere with their services.

4.10.1 Availability of mobile phone services and potential for interference

DNV has reviewed the locations of mobile phone towers in the vicinity of the proposed Project Area. The locations of these towers are shown in Figure 12. The nearest mobile phone tower is located approximately 9 km east of the Project Area.

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

Figure 13 shows the Optus Mobile 4G network coverage for the Project Area [27]. Signal coverage is generally good across the site, with some areas to the west and south where coverage is only available with an external antenna.

Figure 14 shows the Telstra 4G network coverage for the Project Area [28]. The extent of coverage shows signals available across most of the site. However, there are small areas within the site boundary and to the northeast, west and south where coverage is not available.

Figure 15 shows the Vodafone network coverage for the Project Area [29]. Vodafone 4G coverage is available across most of the site and surrounding area. Although Figure 15 also shows areas where Vodafone 3G coverage is available, this service was turned off in January 2024.

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.

4.10.2 Stakeholder consultation and responses

DNV has contacted Optus, 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.

Vodafone and Telstra have confirmed that the proposed turbine locations do not present any significant impact to their mobile phone coverage.

No detailed response regarding impacts to Optus mobile phone services has been received to date.

4.10.3 Mitigation options

As noted above, interference with mobile phone signals is considered unlikely in most cases. If localised interference is experienced by mobile phone users, this can often be rectified by the user moving a short distance to a new or higher location until the signal improves, or using an external

antenna to improve the signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing an additional tower on the opposite side of the Project Area.

4.11 Wireless internet

Wireless internet services in Australia include wireless broadband provided by mobile phone network operators and other internet service providers, and fixed wireless or satellite internet services through the National Broadband Network (NBN).

4.11.1 Wireless broadband services

Wireless broadband services allow the user to connect to the internet without the need for a phone line or cable connection. The wireless signals may operate by line of sight between a base station and the user's antenna as part of a point-to-multipoint network, or may use point-to-area style transmissions such as mobile phone networks.

4.11.1.1 Availability of wireless broadband services and potential for interference

Residents in the vicinity of the Project Area are likely to use wireless broadband services provided by Optus, Telstra, and Vodafone where network coverage is available. These wireless broadband services use the same networks as mobile phone services for those providers, and therefore the comments made in Section 4.10.1 are applicable here. Specifically, there is a low theoretical potential for interference in areas with marginal reception if a wind turbine intercepts the signal between a receiver and the tower.

Challenge Networks Resources Pty Ltd has been identified as a potential internet service provider, registered 55 km from the site boundary. Given this distance, it is unlikely that the residents surrounding the site will be using their services.

4.11.1.2 Stakeholder consultation and responses

DNV has contacted the operators of wireless internet services surrounding the Project Area. Vodafone and Telstra have confirmed that the proposed turbine locations do not present any significant impact to their wireless broadband services.

DNV has also contacted Optus to seek feedback regarding the potential for interference to their services. No detailed responses regarding impacts to wireless broadband or mobile phone services have been received to date.

DNV has contacted Challenge Networks Resources Pty Ltd to seek feedback regarding their services surrounding the Project and the potential for interference. No response has been received to date.

4.11.1.3 Mitigation options

As noted above, interference with wireless broadband services is considered unlikely. If interference to the wireless broadband services provided by mobile phone networks occurs, the mitigation options given in Section 4.10.3 may be applicable. Specifically, localised interference can often be rectified by the user moving a short distance or using an external antenna to improve signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing a signal repeater or additional tower on the opposite side of the Project Area.

4.11.2 National Broadband Network

The NBN is a national wholesale broadband access network, which consists of fixed line, fixed wireless, and satellite internet services.

NBN fixed line services use wired connections to provide internet signals directly to the user. This technology is typically only available in urban areas and is not expected to be affected by wind farm developments.

NBN fixed wireless services are available in many rural and regional areas. The signals operate by line of sight between an NBN tower and the user's antenna, with a maximum range of 14 km [30]. Consequently, the signals may be affected by physical obstructions such as terrain, vegetation, and wind turbines [31].

NBN satellite internet signals are available to rural and remote users in areas that are not able to receive fixed line or fixed wireless services. The potential for interference to satellite internet signals from the NBN Sky Muster I and II satellites is considered in Section 4.12.

4.11.2.1 Availability of NBN services and potential for interference

The National Broadband Network (NBN) website [32] indicates that the network is currently available as a satellite internet service using the NBN SkyMuster I and II satellites in the areas surrounding the Project Area. 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 Area in the near future. However, given that the network is only available as a satellite internet service service, it is unlikely that the Project will impact on residents who are currently using the NBN. The network is currently available as a fixed wireless service in areas to the west and southwest of the Project Area, however given the relative locations of the dwellings and NBN towers, it is unlikely that the Project Area will have an impact on this service.

4.11.2.2 Stakeholder consultation and responses

DNV has contacted NBN Co to seek feedback on whether there is potential for the Project to cause interference to their services, and to allow them to take the presence of the Project into account in their coverage planning maps. The response received from NBN Co indicates that they do not expect the Project to have any impact on their fixed wireless internet service.

4.12 Satellite television and internet

In some rural or remote areas, television and internet access can only be provided through satellite signals. There are two types of satellite that are typically used to provide commercial telecommunication services: geostationary satellites and low Earth orbit (LEO) satellites.

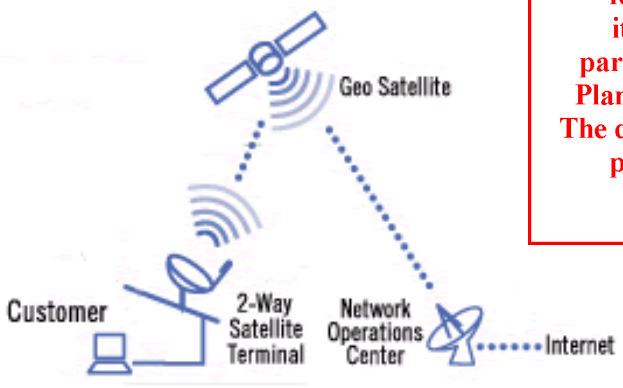
4.12.1 Geostationary satellite communication services

Geostationary satellites orbit the earth directly above the equator, at a height of 35,786 km above the Earth's surface [33]. At this altitude, the satellites travel at the same rate as the Earth's rotational speed and therefore appear to remain stationary at the same point in the sky relative to an observer at a fixed location. Additionally, due to their high altitude, each satellite can view (and therefore provide coverage to) a large portion of the Earth's surface. Geostationary orbits are typically used for weather monitoring satellites that continually observe a specific area of the Earth and for satellites that provide telecommunication services, since the satellite dish or antenna used on Earth to receive and transmit signals can be permanently pointed to the correct location in the

sky. Both satellite television and satellite internet services are currently available in Australia via geostationary satellites.

Satellite television signals are delivered via a geostationary communication satellite to a satellite dish connected to a set-top box. Satellite television signals are typically transmitted to the user's antenna in one of two frequency bands: the C-band between 4 GHz and 8 GHz, or the Ku-band between 12 GHz and 18 GHz. Signals in the C-band are susceptible to interference due to radio relay links, radar systems, and other devices operating at a similar frequency. Signals in the Ku-band are most likely to be affected by rain which acts as an excellent absorber of microwave signals at this frequency. The main geostationary satellites that transmit Australian free-to-air or subscription television channels are the Optus C1, D1, and D3 satellites and the Intelsat 19 satellite [34, 35].

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



Two-way connection to the internet via satellite [36]

4.12.1.1 Locations of geostationary satellite vectors and potential for interference

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

A number of satellites transmit television and internet signals that can be received in Australia. Although only a small number of satellites are likely to be providing services specifically intended for Australian audiences, DNV has considered the line of sight to dwellings in the vicinity of the Project Area from all theoretically viewable satellites.

The results of this analysis are summarised in Table 15. Based on these results, turbines at the Project Area may intercept signals from six satellites at one nearby dwelling.

DNV understands that all potentially affected satellites provide television signals intended for international audiences, and considers it unlikely that residents in the vicinity of the Project Area will currently be receiving signals from these satellites. Many of these satellites have a low angle of elevation above the horizon at the wind farm site location, and so degradation caused by atmospheric effects or interference from terrain or other obstacles may already prevent the signals from being received at the affected dwellings. For some of these satellites, the programs transmitted on the beam footprints that cover Australia may also be available through other satellite services which have a higher angle of elevation above the horizon and are not expected to be intercepted by turbines at the Project Area. If residents are not currently receiving signals from these satellites, either by choice or because those signals are not available due to existing degradation or interference, there will be no potential for the Project to impact on those services.

4.12.1.2 Stakeholder consultation

As discussed in Section 4.12.1.1, it is unlikely that nearby residents are currently receiving signals from satellites that may be affected by interference from turbines in the Project Area. If desired by the Proponent, the potential for impact could be confirmed by engaging with the residents of the dwellings identified in Table 15 prior to construction of the Project to determine if any are currently receiving signals from the potentially affected satellites and to establish an understanding of how any impact to these services may be mitigated.

4.12.1.3 Mitigation options

If nearby residents that are currently using television services provided via geostationary satellites experience interference to those services caused by the Project, several mitigation options may be available. If an alternative source of the same programming is available, the satellite dishes at affected dwellings can simply be re-directed to receive signals from the other satellite. In some cases, residents may also be able to access the affected programs directly over the internet. If an alternative source of programming is not available, it may be possible to rectify interference by installing a larger or higher-quality satellite dish, or by changing the height or location of the dish to obtain a stronger signal.

4.12.2 Low Earth orbit satellite communication services

Satellites in LEO occupy heights between 160 km and 1000 km above the Earth's surface [33]. At these altitudes, the satellites travel significantly faster than the Earth's rotational speed and typically compete a full orbit in approximately 90 minutes. Unlike geostationary satellites, LEO satellites do not have to follow a particular path around the Earth and their orbits are usually tilted with respect to the equator. However, due to their low altitude, each satellite can only observe or communicate with a small portion of the Earth's surface at a time and this, together with their fast movement across the sky, can limit the usefulness of LEO satellites in some situations.

For telecommunication applications, satellites in LEO offer lower latency and better performance than geostationary satellites, due to the reduced distance for the signal to travel. However, using a single LEO satellite to provide telecommunication services is often impractical due to the relatively small coverage area and significant effort required to track the satellite from the ground. To compensate for this, LOE satellites used for telecommunications usually operate as part of a large network or "constellation" of multiple satellites that work together to provide continuous coverage to large areas simultaneously. As satellites within the constellation move through the field of view

of a satellite dish on Earth, the dish detects and connects to the satellite with the strongest signal and then automatically switches over to another satellite as the first moves out of view. Nevertheless, these services may be sensitive to physical obstructions such as terrain, vegetation, buildings, and other structures such as wind turbines, which can unexpectedly interrupt the signal from the connected satellite and cause the service to temporarily drop out until a new satellite can be found.

4.12.2.1 Availability of low Earth orbit services and potential for interference

Starlink is the only LEO satellite internet service currently available to customers in Australia. The current Starlink LEO constellation consists of several thousand satellites orbiting the Earth at a height of approximately 550 km [37], although this may increase to tens of thousands of satellites in the future. Starlink offers two classes of satellite dish to users of their services: a standard dish that is considered suitable for most residential applications, and a high performance dish that has a wider field of view (enabling it to connect to more satellites, even in the presence of obstructions), a higher gain antenna, and improved performance under extreme environmental conditions [38, 39].

In the southern hemisphere, Starlink satellite dishes currently require a relatively clear view of the sky within a field of view of 100° tilted towards the south, with a minimum elevation angle of 25° above the southern horizon [40]. Although some obstructions can be tolerated, the impact of these obstacles will depend on their apparent size, their distance and direction relative to the satellite dish, and the proportion of the sky already obstructed. Obstacles below an elevation angle of 25° in the south, 40° in the east and west, and 40° in the north (allowing for locations where no tilt of the satellite dish is required) will not pose any obstruction to the field of view. However, as more satellites are launched and join the Starlink constellation, it is expected that the required angle of tilt towards the south will reduce until dishes can be pointed directly upwards, with elevation angles above the horizon of 40° in all directions [41], and the service will become less sensitive to obstructions due to the increased number of visible satellites at each location.

DNV has considered the potential for turbines at the Project Area to obstruct Starlink signals received at nearby dwellings, based on the relative locations of the dwellings and the nearby turbines, the elevations of the dwellings and turbines, and a turbine tip height of 255 m.

At all dwellings in the vicinity of the Project Area, the turbines are expected to be below an elevation angle of 25° above the horizon in all directions. Therefore, based on this analysis, it is not expected that turbines in the Project Area will obstruct Starlink signals for any nearby dwellings.

4.13 Radio broadcasting

Radio stations typically broadcast using one of two forms of transmission: either amplitude modulation (AM) or frequency modulation (FM). In Australia, AM radio operates in the medium wave (MW) band at frequencies between 520 kHz and 1610 kHz, while FM radio operates in the very high frequency (VHF) band between 87.5 MHz and 108 MHz.

4.13.1 AM radio

AM radio signals are diffracted by the ground as they propagate, such that they follow the curvature of the earth, and are also reflected or refracted by the ionosphere at night. This means that AM radio waves are able to travel significant distances under the right conditions. Due to their long wavelength, they can readily propagate around physical obstructions on the surface of the

earth (such as wind turbines), however they do not propagate easily through some dense building materials such as brick, concrete, and aluminium.

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

However, as noted above, the presence of physical obstructions such as turbines is unlikely to cause significant interference to AM radio signals. Due to the long wavelength of the signal, interference is only likely in the immediate vicinity of a turbine [42].

4.13.1.1 Locations of AM transmitters and potential for interference

The locations of AM broadcast transmitters in the vicinity of the Project Area were determined from the ACMA Broadcast Transmitter Database [43], and are shown in Figure 17.

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. It is unlikely that any permanent AM radio receivers will be located sufficiently close to the Project Area to be affected by interference to the radio signals from the turbines.

4.13.1.2 Mitigation options

In the event that localised interference to AM radio signals is experienced, this can potentially be rectified by installing a high-quality antenna or amplifier at the affected residence.

4.13.2 FM radio

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

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

Reflection or scattering of radio waves by physical structures such as wind turbines can reduce the signal strength at a receiver or can cause multi-path errors through reception of a reflected signal in addition to the primary signal from the transmitter. This can result in hissing, fluttering, or distortion being heard by the listener [44]. 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 [42, 45].

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 [44]. 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 [46].

4.13.2.1 Locations of FM transmitters and potential for interference

The locations of FM broadcast transmitters in the vicinity of the Project Area were determined from the ACMA Broadcast Transmitter Database [43], and are shown in Figure 17.

The closest FM broadcast transmission tower is located approximately 10 km west of the proposed site boundary. Due to the considerable distance between the transmission tower and the Project Area, it is not expected that the Project will cause interference to the FM radio signals from this tower.

It is unlikely that any permanent FM radio receivers will be located sufficiently close to the Project Area to be affected by reflection or scattering of the radio signals from the turbines.

4.13.2.2 Mitigation options

In the event that localised interference to FM radio signals is experienced, this can potentially be rectified by installing a high-quality antenna or amplifier at the affected residence.

4.13.3 Digital radio

Digital radio services were introduced in metropolitan licence areas in Australia in July 2009. The digital radio services offered use an updated version of the digital audio broadcasting (DAB) digital radio standard, DAB+, to broadcast digital radio to Adelaide, Brisbane, Perth, Melbourne, and Sydney [47]. 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.

4.13.3.1 Availability of digital radio services and potential for interference

According to the digital radio coverage search functions available on the ABC website [48] and Digital Radio Plus website [49], digital radio is not yet available in the Project Area region. Hence, while there are no digital radio broadcasts in the vicinity of the Project Area no interference to digital radio signals is possible.

4.14 Terrestrial television broadcasting

Terrestrial television is broadcast in Australia by a number of networks, both public and commercial. As of December 2013, all television broadcasts in Australia are now digital broadcasts [50]. 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 has experience in situations where dwellings 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 [44] 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 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.

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

4.14.1 Availability of DTV broadcasting and potential for interference

The locations of DTV broadcast transmitters in the vicinity of the Project Area were determined from the ACMA Broadcast Transmitter Database [50], and are shown in Figure 17. The main DTV transmitter used by residents in the vicinity of the Project Area is the Ballarat transmitter at Lookout Hill. However, according to the Australian Government mySwitch website [51], it is also possible that residents to the north and northwest of the site may be able to receive DTV signals from the Horsham transmitter at Arapiles, although coverage from this transmitter is marginal. Coverage maps for these broadcast transmitters are reproduced in Figure 18 and Figure 19.

4.14.1.1 Interference caused by large scale effects

For broadcast signals, large scale interference can generally be avoided by placing the wind turbines distant from the broadcast tower. Broadcast transmitters may be either relay or primary transmitters. Relay transmitters are more commonly found in rural areas. Primary 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 transmitters, while a clearance of at least 6 km is recommended for primary transmitters [12].

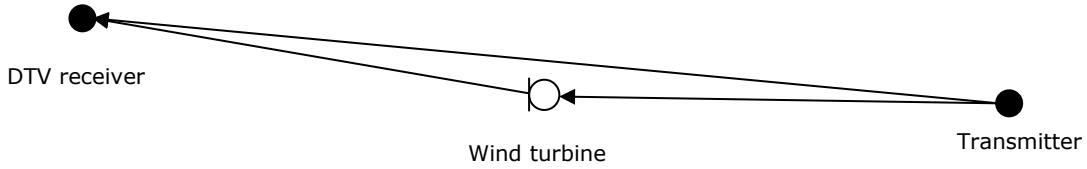
The closest DTV transmitter to the Project Area is the Ballarat transmitter at Lookout Hill, which is approximately 35 km southwest of the Project Area. Therefore, it is considered unlikely that the Project will cause large scale interference to DTV signals.

4.14.1.2 Interference caused by forward and back scatter

Wind turbines can cause interference to DTV 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 DTV 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 [52]. 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 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

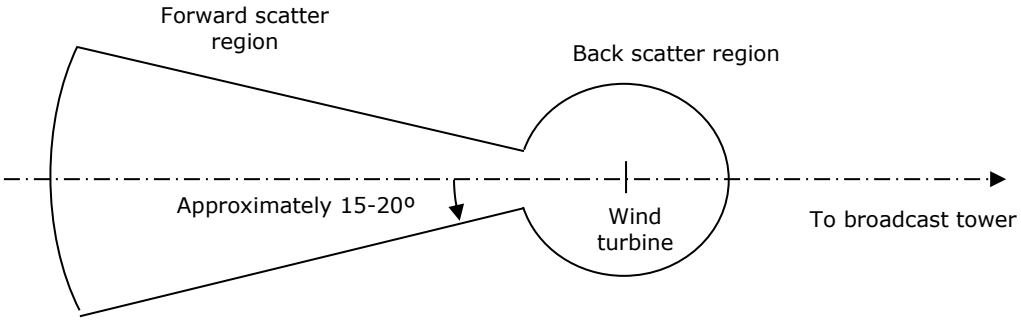
Interference of DTV signals from wind turbine developments can potentially occur in both the forward and backward scatter region. The effect of a wind turbine on a DTV signal can be different depending on the scattering region where the receiver is located [52].

According to Ofcom [44], the forward scatter region does not typically extend further than 5 km for the worst combination of factors [12, 53]. Interference may extend beyond 5 km if the dwellings are screened from the broadcast transmitter, but do have line-of-sight to the wind turbines [44]. 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 dwelling delayed relative to the source signal from the broadcast transmitter. The back scatter region generally does not extend further than 500 m [12, 44], 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, DTV signals are transmitted using the DVB-T (Digital Video Broadcasting – Terrestrial) standard. The International Telecommunication Union (ITU) Recommendation BT.1893 [54] 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 [55] 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 [55].

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 Area are discussed in Section 4.14.1.4.

4.14.1.3 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 [56]. 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 [54], was found to be the most inaccurate, and does not provide signal estimations in the forward scattering zone of the blades. Additionally, DNV 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 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 [44]. 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 Area and hence have an increased likelihood of experiencing interference to television signals, are described in Section 4.14.1.4.

4.14.1.4 Potential impacts for nearby dwellings

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 Area, it is possible that some areas could be deemed to have marginal reception and interference could be encountered.

The coverage maps shown in Figure 18 and Figure 19 suggest that the primary transmitter for the area is the Ballarat tower, which offers 'good' coverage across most of the Project Area, with some areas of 'variable' coverage to the west and south of the site boundary.

Coverage from the Horsham tower is 'poor' to non-existent across most of the site and surrounding area, and so it is likely that most residents will not be receiving signals from this tower.

Dwellings that have increased potential to receive back-scattered or forward-scattered signals from a turbine in the Project Area (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 16, Figure 18 and Figure 19. The dwellings most likely to be susceptible to interference include those within the possible interference zones, as summarised in Table 3. 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.

Dwellings located within and adjacent to the Project Area boundaries and to the west and northwest of the Project Area have increased potential to experience interference to DTV signals from the Ballarat tower, particularly in areas to the west where the signal is already marginal. Dwellings in these areas of marginal coverage have the potential to receive a scattered signal from the wind turbines that is stronger than the signal received directly from the Ballarat transmitter.

Dwellings adjacent to the Project Area boundaries and to the east and southeast of the Project Area have been identified within the calculated interference zone for the Horsham tower. However, there is little to no signal coverage from this tower in most of the potentially-affected areas and so it is unlikely that the identified dwellings will be receiving signals from the Horsham tower.

Table 3 Number of dwellings located within potential interference zones for digital television broadcast transmitters in the vicinity of the Project Area

Digital television broadcast tower	Number of dwellings in potential interference zone	Signal coverage in potential interference zone
Ballarat (Lookout Hill)	32 (4 stakeholder dwellings)	Variable to good across most of the site, marginal in some areas to the west of the site
Horsham (Arapiles)	12 (2 stakeholder dwellings)	Limited – dwellings in the potential interference zone are unlikely to be receiving signals from this tower

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 in most cases as the implications of potential television interference are typically low. If reception difficulties are encountered, there are a number of mitigation options available as discussed in further detail in Section 4.14.3.

4.14.2 Stakeholder consultation and responses

DNV has contacted BAI Communications, who are responsible for broadcasting of national public television services in Australia, to inform them of the proposed Project and seek feedback on any potential impact that the Project could have on DTV signals in the surrounding area.

BAI Communications has conducted an assessment of the potential for turbines at the Project Area, based on the previous turbine layout, to interfere with DTV signals from the Ballarat (Lookout Hill), Halls Gap (Mt William), and Western Victoria (Mt Dundas) transmitters [57]. The Horsham (Arapiles) transmitter was not identified by BAI Communications as providing DTV coverage in the area around the Project Area. The method used by BAI Communications involved modelling the reflection or scattering of DTV signals from the wind turbines, and identifying locations within 10 km of the Project Area where the resulting C/I ratio for a directional antenna oriented towards the transmitter of interest would be less than required for adequate signal reception.

From the results of their modelling, BAI Communications have advised that they do not expect the Project to cause interference to DTV signals from the Halls Gap and Western Victoria transmitters, and only minor impacts are expected for signals from the Ballarat transmitter. Based on population density data for the areas identified as potentially affected by interference to DTV signals from the Ballarat transmitter, BAI Communications concluded that no viewers are expected to be impacted.

DNV has reviewed the results provided by BAI Communications for DTV signals from the Ballarat transmitter in relation to the dwelling locations provided by the Customer and considered in this assessment. There are no identified dwellings located within the interference areas predicted by BAI Communications for the Ballarat transmitter. Therefore, the results of the BAI Communications modelling suggest that impacts on DTV broadcasting are unlikely.

DNV have provided BAI Communications with the current turbine layout, but no further response has been received to date.

4.14.3 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 user's television antenna more directly towards their existing transmitter.
2. Tuning the user's antenna into alternative sources of the same television signal or a substitute signal.
3. Installing a more directional or higher gain antenna at the affected dwelling.
4. Relocating the antenna to a less affected position.
5. Installing cable or satellite television at the affected dwelling.
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. However, the effectiveness of this mitigation may be reduced if there is no clear line of sight from the antenna to the transmitter. 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 [52], DVB-T reception quality may not be substantially affected in the forward scatter region.

The ITU [55] 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 [58].

In addition to the mitigation options outlined above, the Victorian Guidelines [1] include example permit conditions stating that, prior to commencing development, a survey must be undertaken to determine the average television and radio reception strength within 5 km of the wind farm site. If

a complaint is later received regarding the effect of the wind farm on television or radio reception at a pre-existing dwelling within 5 km of the site, the operator must investigate that complaint. If the investigation finds that the wind farm has had a detrimental impact on the quality of television or radio reception, the operator of the Project must then restore reception at the affected dwelling to at least the quality determined in the pre-development survey to the satisfaction of the responsible authority.

4.15 Cumulative impacts

DNV notes that the Project is located in an area of high wind farm development activity, with multiple operational wind farms nearby. Consequently, it is possible that some radiocommunication services could experience cumulative impacts from the proposed Project.

The nearest wind farm developments are summarised in Table 4 and shown in Figure 20, based on information provided by the Customer [59] and obtained from publicly available sources [60] [61] [62].

Table 4 Other wind farm developments located in the vicinity of the Project Area

Wind farm	Status	Location
Bulgana Wind Farm	Operating	Adjacent to Project Area southern boundaries (nearest turbine less than 1 km from Project turbines)
Crowlands Wind Farm	Operating	12 km southeast of the Project Area boundaries
Ararat Wind Farm	Operating	14 km south of the Project Area boundaries

Table 5 summarises the anticipated EMI-related impact of the Project in isolation, and the potential for cumulative impacts from the Project in conjunction with the neighbouring wind farms. For services where impact from the Project itself is considered either unlikely or non-existent, it is generally expected that there will be no cumulative impact.

Table 5 Potential for cumulative EMI-related impacts from the Project and neighbouring wind farms

Licence or service type	Anticipated impact from the Project in isolation	Potential for cumulative impact from the Project and neighbouring wind farms
Radiocommunication towers	Potential for interference (see Section 4.1)	No potential for cumulative impact, as the neighbouring turbines are outside of the recommended consultation zones
Fixed point-to-point links	Unlikely to cause interference (see Section 4.2) Feedback received from operators to date suggests they do not expect any impact	No potential for cumulative impact, as the link paths do not cross neighbouring wind farms
Fixed point-to-multipoint links	Potential for interference if link paths cross the site near turbines (see Section 4.3) DNV has consulted with the operators to establish link paths and potential for impact Based on the responses received, there are no links crossing the Project Area	No potential for cumulative impact, based on consultation responses
Other licence types	Point-to-area style communications: see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting	
Emergency services	Unlikely to cause interference (see Section 4.5)	Very low potential for cumulative impact
Meteorological radar	Interference is expected to be manageable (see Section 4.7)	Low potential for cumulative impact, based on response from consultation with the Bureau
Trigonometrical stations	Unlikely to cause interference (see Section 4.8)	Very low potential for cumulative impact
Citizen's band radio	Unlikely to cause interference (see Section 4.9)	Very low risk of cumulative impact
Mobile phones	Low potential for interference in areas with marginal coverage (see Section 4.10)	Potential for cumulative impact where there are multiple turbines between the tower and the user
Wireless internet	Low potential for interference to services provided by mobile phone networks (see Section 4.11.1) Unlikely to cause interference to NBN fixed wireless internet service (see Section 4.11.2)	Potential for cumulative impact to services provided by mobile phone networks where there are multiple turbines between the tower and the user No potential for cumulative impact to NBN fixed wireless signals as turbines are outside or on the periphery of service area
Satellite television and internet	Geostationary satellites: no potential for interference to services intended for Australian audiences, low potential for interference to services intended for international audiences (see Section 4.12) LEO satellites: unlikely to cause interference	No potential for cumulative impact
Radio broadcasting	Low potential for interference to AM and FM signals received in close proximity to turbines (see Section 4.13)	Potential for cumulative impact where there are multiple turbines between the tower and the user
Television broadcasting	Potential for interference to signals from the Ballarat tower (see Section 4.14)	Potential for cumulative impact to signals from the Ballarat tower received at dwellings located to the west and southwest of the Project Area

The greatest potential for cumulative EMI-related impact is to broadcast DTV signals received at nearby dwellings. Given the close proximity of the Bulgana Wind Farm and the relative locations of the broadcast towers servicing the area, there is potential for increased interference to signals received from the Ballarat tower at dwellings located to the west and southwest of the proposed Project Area, as shown in Figure 21.

As discussed in Section 4.14.3, the planning permit conditions for the Project are expected to include a requirement to determine the average television and radio reception strength in the vicinity of the Project Area prior to construction. This pre-development survey may help to better understand the DTV signal coverage in the surrounding area and the potential for cumulative impacts at the dwellings located between the Project Area and the Bulgana Wind Farm. If interference is found to be a problem at these dwellings after construction of the Project, the mitigation options given in Section 4.14.3 may be applicable.

There is also some potential for increased interference to other point-to-area style services, such as mobile phone and AM and FM radio signals, in areas with marginal coverage or where there may be multiple wind turbines between the user and the transmission tower. Based on the coverage maps reproduced in Figure 13 to Figure 15, cumulative impacts are more likely to be an issue for the Telstra and Vodafone mobile networks, as the signal coverage for these services is limited in some areas in the southern part of the Project Area near the neighbouring Bulgana Wind Farm. If interference to these services is experienced, the mitigation options given in Sections 4.10.3, 4.13.1.2, and 4.13.2.2 may be applicable.

Cumulative impacts to the point-to-point links crossing the Project Area are not expected, as these links do not cross any of the neighbouring wind farm sites.

Cumulative impacts to the NBN fixed wireless internet service are not expected, as both the Project Area and the neighbouring Bulgana Wind Farm turbines are located outside or on the periphery of the service area.

5 CONCLUSIONS

Broadcast towers and transmission paths around the Project Area 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 45 wind turbine generators. DNV has considered a turbine geometry that will be conservative for turbine configurations with dimensions satisfying all of the following criteria: a rotor diameter of 178 m or less and an upper tip height of 255 m or less.

The results of this assessment, including feedback obtained to date from relevant stakeholders and potential mitigation options, are summarised in Table 6. If the Project causes interference to nearby radiocommunication licences and services, it is expected that appropriate mitigation measures would be determined through consultation with the affected operator or user. The Proponent or operator of the Project is expected to be responsible for implementing any mitigation measures that are required.

There is one radiocommunication tower located within 2 km of the turbines that hosts point-to-area style licences used for mobile radio communications. Given the proximity of the proposed wind turbine locations to the identified tower, there is a potential for the Project to interfere with the associated point-to-area style communications through reflection or scattering of the signals. Consultation with the operator of the tower is recommended in order to understand the potential for interference.

Based on the assessment undertaken by DNV, dwellings located within and adjacent to the Project Area and to the west and northwest of the Project Area have increased potential to experience interference to DTV signals from the Ballarat tower, particularly in areas to the west where the signal is already marginal. Digital television signals from the Horsham broadcast tower may also be impacted, although the coverage maps suggest that the potentially affected dwellings are unlikely to be receiving signals from this tower. However, feedback received from BAI Communications, based on the previous turbine layout, who are responsible for broadcasting of national public television services in Australia, suggests that impacts to digital television signals are unlikely.

Interference to signals from geostationary satellites that transmit programs intended for international audiences is possible at one nearby dwelling, although it is considered unlikely that residents will be receiving signals from these satellites. If interference is experienced, mitigation options could include realigning or upgrading the user's satellite dish or seeking an alternative source of the same programming or service. DNV recommends that the Proponent engages with the residents or owners of potentially affected dwellings to determine if any are currently receiving these satellite signals, and to establish an understanding of how any impacts may be mitigated.

There are no turbines located within the diffraction exclusion zone calculated by DNV for the fixed point-to-point links passing over the Project Area, operated by NBN Co, Optus and Northern Grampians Shire Council. No concerns have been raised to date regarding the current proposed turbine locations, and no turbines are placed within the clearance zones requested by the operators or inferred by DNV from the advice received. Therefore, interference with point-to-point links is considered unlikely.

Consultation has been conducted with the operators of point-to-multipoint links, emergency services, and meteorological radar to help determine the potential EMI impacts on their assets. The Bureau of Meteorology has advised that impacts to their radars are expected to be manageable, and the responses received to date from the operators of point-to-multipoint links and emergency services indicate that the Project is unlikely to have any impact on these services.

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

The Project is located in an area of high wind farm development activity, with several operational wind farms located nearby. Based on the relative locations of these wind farms, there is a potential for cumulative EMI-related impacts to broadcast DTV signals received at nearby dwellings. There is also potential for increased interference to mobile phone and FM radio signals in areas where there may be multiple wind turbines between the user and the transmission tower. Based on the current assessment, cumulative impacts to other services, including point-to-point links and NBN fixed wireless internet signals, are not expected.

Table 6 Summary of EMI assessment results for the proposed Project

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)	Potential mitigation options
Radiocommunication towers	One tower within 2 km of proposed turbine locations operated by: Siemens Gamesa Renewable Energy Pty Ltd	Potential for interference	Consultation recommended but not undertaken	If required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower
Fixed point-to-point links	Three links crossing Project Area, operated by: Northern Grampians Shire Council Optus Mobile NBN Co Diffraction effects: No turbines within exclusion zones established by DNV for the links operated by Northern Grampians Shire Council, Optus Mobile and NBN Co Reflection/scattering and near-field effects: turbines are sufficiently far from towers to avoid impacts	Unlikely to cause interference	NBN Co: requested 149.42 m clearance around the link path. No turbines in the requested clearance zone. Optus and Northern Grampians Shire Council: no concerns raised	If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Fixed point-to-multipoint links	36 assignments within 75 km of Project Area boundary Two base stations within 20 km of Project Area boundary, operated by: Central Highlands Water Stawell Gold Mines	Potential for interference if link paths cross the Project Area near turbines	No concerns raised	None required
Other licence types	Point-to-area style communications: see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting	-	-	-

Table 6 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)	Potential mitigation options
Emergency services	Point-to-point links: No links crossing boundary Mobile telephony systems: unlikely to be affected	Unlikely to cause interference	Ventia (formerly VisionStream): potential for localised interference, no significant concerns raised No concerns raised by Ambulance Victoria, Country Fire Authority, and Regional Mobile Radio No response received from Corrections Victoria and St John Ambulance	Point-to-point links: none required Mobile radio systems: if required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower
Meteorological radar	Nearest radar: "Rainbow (Wimmera)", 133 km from Project Area	Potential for interference if turbines at the Project Area are visible to radars	Interference is expected to be manageable	Notify the Bureau of Meteorology prior to planned wind farm shutdown to allow calibration of radar systems
Trigonometrical stations	Seven stations within 20 km of Project Area boundary Electronic equipment: unlikely to be affected Survey marks: unlikely to be affected Sight lines to other stations: may be blocked by turbines	Unlikely to cause interference	No concerns raised by DTP regarding interference, but potential for physical disturbance to survey marks noted No concerns raised by Geoscience Australia	None required for electronic equipment Potential physical disturbance of survey marks to be mitigated through Proponent engagement with DTP during construction if required
Citizen's band radio	Unlikely to be affected	Unlikely to cause interference	Consultation not considered necessary	None required

Table 6 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)	Potential mitigation options
Mobile phones	Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	Low potential for interference	No concerns raised by Vodafone and Telstra No response received from Optus Mobile	If required – increase signal strength from affected tower or alternative towers, install additional tower
Wireless internet	Likely service providers: mobile phone networks NBN: available as a satellite service only	Unlikely to cause interference	No concerns raised by NBN Co, Vodafone and Telstra No response received from Optus Mobile and Challenge Networks Resources Pty Ltd	Mobile phone networks: as for mobile phones NBN: none required
Satellite television and internet	Geostationary satellites: signals from satellites providing services intended for Australian audiences unlikely to be affected; signals from six satellites providing services intended for international audiences intercepted at one dwelling Low earth orbit (LEO) satellites: unlikely to be affected	Geostationary satellites: low potential for interference to services intended for international audiences LEO satellites: unlikely to cause interference	Consultation with operators not considered necessary DNV recommends engaging with residents of potentially affected dwellings	Geostationary satellites: if required – redirect satellite dish to alternative satellite, install larger or higher-quality satellite dish, change location or height of satellite dish at affected location LEO satellites: none required
Radio broadcasting	AM and FM signals: may experience interference in close proximity to turbines Digital radio signals: not available in vicinity of Project Area	Low potential for interference to AM and FM signals	Consultation not considered necessary	AM signals and FM signals: if required – install higher-quality antenna at affected location, Digital radio signals: none required

Table 6 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Assessment findings	Expected impact	Stakeholder feedback (to date)	Potential mitigation options
Television broadcasting	May experience interference in areas with poor or marginal reception *Ballarat (Lookout Hill) tower: 'variable' to 'good' coverage across the site* 32 dwellings in potential interference zone	Potential for interference	Low potential for interference and no buildings identified in potential interference areas	If required – re-align antenna at affected dwelling to existing tower, re-direct antenna to alternative tower, install more directional or higher gain antenna, change location of antenna, install cable or satellite television, install relay transmitter
	Horsham (Arapiles) tower: 'poor' to 'variable' coverage across the site 12 dwellings in potential interference zone	Potential for interference; although residents are likely to be able to receive alternative signals from the Ballarat tower	Not considered to be providing coverage in the area around the Project Area	

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Table 7 Proposed turbine layout for the Project site [3]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]	Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation [m]
T1	675123	5897322	250	T24	674611	5902203	225
T2	674306	5898338	264	T25	670723	5902511	233
T3	674628	5898023	248	T26	673784	5902287	228
T4	675250	5898000	247	T27	672082	5902497	215
T5	675746	5898411	229	T28	670731	5900805	238
T6	674199	5902231	219	T29	673268	5903336	230
T7	672769	5899273	245	T30	673656	5902866	223
T8	673127	5899182	245	T31	674027	5903733	214
T9	671555	5899832	222	T32	671571	5902822	217
T10	671291	5906540	210	T33	672550	5903526	228
T11	670789	5899847	249	T36	672086	5904266	227
T12	671331	5900081	236	T37	673305	5904230	218
T13	670358	5899945	259	T38	672940	5904620	220
T14	670946	5903181	220	T39	672571	5905101	216
T15	672980	5900212	243	T40	671711	5905318	211
T16	677150	5900399	224	T41	670229	5905409	203
T17	677588	5900404	230	T42	672181	5905700	212
T18	678125	5900408	214	T43	669407	5905806	213
T19	669672	5900497	267	T44	669814	5905753	204
T20	670041	5900881	258	T45	671321	5905775	215
T21	671283	5901486	239	T46	670848	5906297	212
T22	674135	5902785	223	T47	670475	5906718	207
T23	669462	5900980	257				

1. Coordinate system: MGA zone 54, GDA94 datum.

Table 8 Dwellings in the vicinity of the proposed Project [5, 4, 6]

Dwelling ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
0	678361	5898558	Not involved	1.9
1	666184	5898124	Not involved	4.2
2	*669749*	*5902271*	*Involved*	*1.0*
3	681618	5901553	Not involved	3.7
4	676875	5906830	Not involved	4.2
5	679941	5905121	Not involved	5.1
6	666426	5902143	Not involved	3.3
7	665372	5897764	Not involved	5.1
8	676986	5895734	Not involved	2.4
9	678868	5902527	Not involved	2.2
10	682472	5901814	Not involved	4.6
11	668313	5903395	Not involved	2.6
12	676342	5901674	Not involved	1.5
13	*677642*	*5894108*	*Involved*	*4.1*
14	677842	5895790	Not involved	3.1
15	677143	5902053	Not involved	1.7
16	664834	5910279	Not involved	6.4
17	673669	5908549	Not involved	3.1
18	667059	5902544	Not involved	2.9
20	682743	5901714	Not involved	4.8
21	681512	5900971	Not involved	3.4
22	672982	5911761	Not involved	5.3
23	677004	5903378	Not involved	2.0
24	682968	5901805	Not involved	5.0
25	679220	5898513	Not involved	2.2
26	666817	5897388	Not involved	4.2
27	673477	5910402	Not involved	4.4
28	666754	5903317	Not involved	3.6
29	679862	5903583	Not involved	3.6
30	675006	5900351	Not involved	1.9
31	676188	5903025	Not involved	1.8
32	666554	5902630	Not involved	3.3
33	665690	5897402	Not involved	5.0
34	*667120*	*5897577*	*Involved*	*3.9*
35	679842	5903680	Not involved	3.7
36	682911	5902250	Not involved	5.1
37	679806	5903657	Not involved	3.7
38	*673777*	*5907538*	*Involved*	*2.4*
39	*667167*	*5897580*	*Involved*	*3.8*
40	676972	5908733	Not involved	5.7
41	668258	5902216	Not involved	1.7
42	683063	5902519	Not involved	5.4
43	681840	5897473	Not involved	4.7
44	670957	5897209	Not involved	2.6
45	666210	5898158	Not involved	4.2
46	*672062*	*5908384*	*Involved*	*2.0*
47	*676129*	*5901656*	*Involved*	*1.6*
48	667326	5902957	Not involved	2.9
49	680407	5895208	Not involved	5.7
50	667204	5903136	Not involved	3.1
51	668065	5904350	Not involved	2.0

Table 8 Dwellings in the vicinity of the proposed Project [5, 4, 6] (continued)

Dwelling ID	Easting[1] [m]	Northing[1] [m]	Status	Distance to nearest turbine [km]
52	669093	5895803	Not involved	4.3
53	668890	5910098	Not involved	3.7
54	*669101*	*5907464*	*Involved*	*1.6*
55	666906	5902953	Not involved	3.2
56	666317	5897298	Not involved	4.6
57	679034	5895221	Not involved	4.4
58	665961	5903031	Not involved	4.1
59	682256	5898831	Not involved	4.4
60	665865	5909385	Not involved	5.0
61	667826	5905316	Not involved	1.7
62	667940	5903147	Not involved	2.6
63	672485	5910332	Not involved	4.0
64	668055	5903838	Not involved	2.4
65	668126	5907406	Not involved	2.0
66	668403	5904581	Not involved	1.6
67	668986	5912956	Not involved	6.4
68	668109	5904886	Not involved	1.6
69	668509	5904147	Not involved	1.9
70	667892	5902284	Not involved	2.0
71	681732	5900313	Not involved	3.6
72	668401	5903959	Not involved	2.1
73	666729	5902917	Not involved	3.3
74	667117	5904419	Not involved	2.7
75	667600	5906574	Not involved	2.0
76	*677235*	*5902833*	*Involved*	*2.4*

1. Coordinate system: MGA zone 54, GDA94 datum.
Involved dwellings are indicated by *underlined italic text*.

Table 9 Details of point-to-point links crossing the proposed Project site

Link no.	Licence number	Assignment ID	Frequency [MHz]	Licence owner
1	12181763/1	11131488	6271365000	NBN Co Limited Level 13 100 Arthur Street North Sydney NSW 2060
		11131489	6271365000	
		11131490	6019325000	
		11131491	6019325000	
	12181764/1	11131492	6271365000	
		11131493	6271365000	
		11131494	6019325000	
		11131495	6019325000	
	12181766/1	11131496	6330665000	
		11131497	6330665000	
		11131498	6078625000	
		11131499	6078625000	
	12181767/1	11131500	6330665000	
		11131501	6330665000	
		11131502	6078625000	
		11131503	6078625000	
2	9862001/1	10437899	8118320000	Northern Grampians Shire Council PO Box 580 Stawell VIC 3380
		10437900	8118320000	
		10437901	7807000000	
		10437902	7807000000	
3	12010506/1	10437899	8118320000	Optus Mobile Pty Limited 4G TXN 1 Lyonpark Road Macquarie Park NSW 2113
		10437900	8118320000	
		10437901	7807000000	
		10437902	7807000000	
	12010507/1	10437903	8118320000	
		10437904	8118320000	
		10437905	7807000000	
		10437906	7807000000	

Table 10 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
3331264	10008624	10378122/1	-37.2281	143.2006	27	Bureau of Meteorology GPO Box 1289 Melbourne VIC 3001
3331267	10008624	10378122/1	-37.2281	143.2006	27	
3331259	11733	10378121/1	-37.2950	142.6037	38	
3331262	11733	10378121/1	-37.2950	142.6037	38	
900071	9012292	1928160/1	-36.9634	143.0974	10	Central Highlands Region Water Corporation Central Highlands Water PO Box 152 Ballarat VIC 3353
900074	9012292	1928160/1	-36.9634	143.0974	10	
966600	9019657	1968909/1	-36.9441	143.3184	29	
966603	9019657	1968909/1	-36.9441	143.3184	29	
832748	404211	1565855/1	-37.0876	143.4828	43	
832751	404211	1565855/1	-37.0876	143.4828	43	
1514337	404211	9996009/1	-37.0876	143.4828	43	
1514340	404211	9996009/1	-37.0876	143.4828	43	
832764	9004356	1565857/1	-37.2605	143.5336	54	
832767	9004356	1565857/1	-37.2605	143.5336	54	
750917	9001492	1149775/1	-37.4245	143.3813	54	
750920	9001492	1149775/1	-37.4245	143.3813	54	
750925	306085	1149777/1	-37.0736	143.7380	65	
750928	306085	1149777/1	-37.0736	143.7380	65	
832956	306085	1565998/1	-37.0736	143.7380	65	
832959	306085	1565998/1	-37.0736	143.7380	65	
793546	11753	1326725/1	-36.7222	143.6460	66	Coliban Region Water Corporation Coliban Water 37-45 Bridge Street Bendigo VIC 3550
793549	11753	1326725/1	-36.7222	143.6460	66	
877060	11753	1913356/1	-36.7222	143.6460	66	
877063	11753	1913356/1	-36.7222	143.6460	66	
6309956	11733	10895501/1	-37.2950	142.6037	38	Grampians Wimmera Mallee Water Authority GWM Water PO Box 481 HORSHAM VIC 3400
6309959	11733	10895501/1	-37.2950	142.6037	38	
3799563	11728	10457447/1	-37.2651	142.8902	24	Powercor Australia Ltd Locked Bag 14090 Manager Communications Network Provisioning Melbourne VIC 8001
3799566	11728	10457447/1	-37.2651	142.8902	24	
3799567	11728	10457448/1	-37.2651	142.8902	24	
3799570	11728	10457448/1	-37.2651	142.8902	24	
1294342	305839	1327664/1	-37.0694	142.8087	9	Stawell Gold Mines Pty Ltd Box 265 Stawell VIC 3380
1294345	305839	1327664/1	-37.0694	142.8087	9	
2112529	404211	10127656/1	-37.0876	143.4828	43	Wireless Network (Ballarat) Pty. Ltd 10 Bogart Drive Wendouree VIC 3355
2112532	404211	10127656/1	-37.0876	143.4828	43	

Table 11 Details of other licences identified within 75 km of the proposed Project

Licence category	Licence type	Number of assignment IDs
1800 MHz Band	Spectrum	336
2 GHz Band	Spectrum	306
2.3 GHz Band	Spectrum	5030
2.5 GHz Band	Spectrum	290
2.5 GHz Mid Band Gap	Spectrum	4
3.4 GHz Band	Spectrum	7579
700 MHz Band	Spectrum	995
800 MHz Band	Spectrum	423
850/900 MHz Band	Spectrum	518
AWL - FSS Only	Spectrum	100
AWL - Standard	Spectrum	48
Aeronautical Assigned System	Aeronautical	67
Amateur Repeater	Amateur	53
Ambulatory - Initial	Land Mobile	4
Ambulatory System	Land Mobile	26
CBRS Repeater	Land Mobile	8
Commercial Radio	Broadcasting	5
Commercial Television	Broadcasting	6
Community Broadcasting	Broadcasting	2
Earth Receive	Earth Receive	2
Fixed Receive	Fixed Receive	1
Land Mobile System - > 30MHz	Land Mobile	989
Land Mobile System 0-30MHz	Land Mobile	128
Narrowband Area Service station(s)	Broadcasting	2
Narrowcasting Service (Fixed Tax)	Broadcasting	4
Narrowcasting Service (LPON)	Broadcasting	18
National Broadcasting	Broadcasting	11
PMTS Class B	PTS	246
Paging System - Exterior	Land Mobile	31
Paging System - Interior	Land Mobile	8
Radiodetermination	Radiodetermination	1
Retransmission	Broadcasting	3
Retransmission (Out of Area)	Broadcasting	3

Table 12 Emergency services with radiocommunication assets in the vicinity of the proposed Project

Emergency service	Contact details	Distance from closest site to Project boundary [km]
Airservices Australia	Airservices Australia VIC/TAS Services Locked Bag 747 (Attention Spencer Robinson) EAGLE FARM QLD 4009	27
Ambulance Victoria	Ambulance Victoria Attn: Tim McCallum 303 Gillies Street North WENDOUREE VIC 3355	42
Country Fire Authority	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149	6
DEPARTMENT OF ENVIRONMENT LAND WATER AND PLANNING	DEPARTMENT OF ENVIRONMENT LAND WATER AND PLANNING DEPARTMENT OF ENERGY ENVIRONMENT AND CLIMATE ACTION DELWP Accounts Payable Locked Bag 32017 Collins Street East VIC 8003	15
ESTA Emergency Services Telecommunications Authority	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY ESTA Emergency Services Telecommunications Authority c/-10 Wesley Court - Motorola MMR Project Tally Ho Bus Pk, EAST BURWOOD VIC 3151	42
RMR Regional Mobile Radio	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY RMR Regional Mobile Radio C/- Level 2 Bld M3 30 Henderson Rd CLAYTON VIC 3168	16
Visionstream Australia	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY Visionstream Australia 167-169 Cremorne Street CREMORNE VIC 3121	5
Grampians Wimmera Mallee Water Authority	Grampians Wimmera Mallee Water Authority GWM Water PO Box 481 HORSHAM VIC 3400	26
M & E Thiele Enterprises Pty Ltd	M & E Thiele Enterprises Pty Ltd PO Box 34 AVOCA VIC 3467	42
Radio Rescue Emergency Communications Incorporated	Radio Rescue Emergency Communications Incorporated Radio Rescue Emergency Communications Incorporated PO Box 802 MURRAY BRIDGE SA 5253	47
ST. JOHN AMBULANCE AUSTRALIA INCORPORATED	ST. JOHN AMBULANCE AUSTRALIA INCORPORATED ST JOHN AMBULANCE AUSTRALIA (VICTORIA) INC. PO Box 573 MT WAVERLEY VIC 3149	38
Victoria State Emergency Service	Victoria State Emergency Service Victoria State Emergency Service Authority 168 Sturt St SOUTHBANK VIC 3006	11

Table 13 Bureau radar sites in the vicinity of the proposed Project

Site ID	Site name	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]
10012512	Wimmera Radar Pullut West Road Pullut	-35.9977	142.0134	133
302559	Met Rd Melbourne Airport	-37.6656	144.8320	177
49834	Met Bureau Radar Site RAAF Base Laverton	-37.8552	144.7552	180
49723	Met Bureau Glenlitta Ave Broadmeadows	-37.6902	144.9435	187
49837	Met Bureau BMTC Annex Glenlitta Ave Broadmeadows	-37.6905	144.9470	187
134173	Met Bureau S1 Doppler Radar Training Facility Glenlitta Avenue Broadmeadows	-37.6911	144.9480	187
23944	Meteorology Radar Site Airport MOUNT Gambier	-37.7478	140.7746	204
304566	Met Bureau Site Yarrawonga Airport	-36.0297	146.0227	292
141677	Meteorological Office Mildura Airport Mildura	-34.2353	142.0873	311
502339	Bureau of Meteorology site Mildura Airport	-34.2352	142.0861	311
10019217	Mildura Radar off Sturt Highway Cullulleraine	-34.2871	141.6077	319
136780	Wind Profiler Radar Site RAAF Base East Sale	-38.1156	147.1329	385
136953	Weather Radar Site Bairnsdale Aerodrome Aerodrome Road Bairnsdale	-37.8875	147.5755	416
23280	Met Site Mount Terrible Range Road West Sellicks Hill	-35.3296	138.5025	435
10021356	Hillston Radar off Griffith Road 8 km S of Hillston	-33.5520	145.5286	445
201025	Meteorological Office Wagga Wagga	-35.1582	147.4563	452

Table 14 Trigonometrical stations in the vicinity of the proposed Project

Station name	Datum	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]
Avon Rise	AGD66	-36.840	142.785	17
Concongella	AGD66, AGD84, GDA94	-37.035	142.894	1
Landsborough Hill	AGD66, GDA94	-36.968	143.146	13
Panrock	AGD66	-37.146	142.768	17
Stawell	AGD66	-37.054	142.788	10
Tucker Hill	AGD66	-37.161	142.908	12
Warrawing	AGD66	-36.886	142.983	8

Table 15 Satellite vectors with potential to be intercepted by the proposed Project

Intercepted satellite	Services provided [63]	Affected dwelling
Eutelsat 70B (E70B, W5A, Eutelsat W5A), Intelsat 22 (IS-22), G-Sat 11, G-Sat 14, G-Sat 18, G-Sat 7 (Insat 4F, Rukmini)	Programs intended for international audiences	12

Table 16 Dwellings with increased potential to experience EMI to DTV from television broadcast towers

Dwelling ID	Easting[1] [m]	Northing[1] [m]	Located in potential interference zone	
			Ballarat	Horsham
2	*669749*	*5902271*	*X*	
6	666426	5902143	X	
8	676986	5895734		X
9	678868	5902527		X
11	668313	5903395	X	
12	676342	5901674	X	X
14	677842	5895790		X
15	677143	5902053	X	X
18	667059	5902544	X	
23	677004	5902378	X	X
28	666754	5903317	X	
30	675006	5900351		
31	676188	5903025	X	X
32	666554	5902630	X	
41	668258	5902216	X	
47	*676129*	*5901656*	*X*	*X*
48	667326	5902957	X	
50	667204	5903136	X	
51	668065	5904350	X	
53	668890	5910098	X	
54	*669101*	*5907464*	*X*	
55	666906	5902953	X	
57	679034	5895221		X
58	665961	5903031	X	
59	682256	5898831		X
61	667826	5905316	X	
62	667940	5903147	X	
64	668055	5903838	X	
65	668126	5907406	X	
66	668403	5904581	X	
68	668109	5904886	X	
69	668509	5904147	X	
70	667892	5902284	X	
71	681732	5900313		X
72	668401	5903959	X	
73	666729	5902917	X	
74	667117	5904419	X	
75	667600	5906574	X	
76	*677235*	*5902833*	*X*	*X*

1. Coordinate system: MGA zone 54, GDA94 datum.
Involved dwellings are indicated by *underlined italic text.*

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
1	Fixed point-to-point	No turbines in diffraction exclusion zone established by DNV Potential reflection/scattering and near-field effects not considered	Northern Grampians Shire Council 10271936-AUME-L-01	Response received by email on 11/04/24 based on the interim turbine layout: *"… We are currently having trouble with our radio tower equipment in St Arnaud. Council has decided to move away from using it. I don't have a time frame for our transition away from the radio link but due to the faults occurring, we are required to resolve our issues over the next 6 months and therefore I expect that our radio link will no longer need to be a consideration of the project…"* **Further consultation based on the current turbine layout is not considered necessary**
2	Fixed point-to-point PMTS/spectrum (mobile phone)	No turbines in diffraction exclusion zone established by DNV Potential reflection/scattering and near-field effects not considered Mobile phone: 10 km	Optus Mobile Pty Limited (Optus Mobile) 10271936-AUME-L-02	Response received by email on 08/12/24 based on the current turbine layout: *"No issue as the closest turbine location…will have no impact on the existing link."* No response regarding impacts to mobile phone services received to date.

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
3	Fixed point-to-multipoint Meteorological radar	Point-to-multipoint: 27 km Meteorological radar: 133 km	Bureau of Meteorology 10271936-AUME-L-03	<u>Response received by email on 21/07/21 based on the previous turbine layout:</u> *"Our analysis shows that the proposed wind farm … has manageable impact on our weather radar network on normal weather conditions. Therefore, the Bureau is ready to agree with your proposed wind farm should the farm operator/owner agreed [sic] with the following conditions:* *1- To inform the Bureau of any changes in the wind farm including varying the layout of the farm, changing the location of each turbine more than 100 m or altering the turbine's height.* *2- Notify the Bureau at least two weeks before any planned shut-down of the farm (for maintenance or any other reason) enabling us to calibrate our radar systems without the effect of rotating turbines.* *If the above-mentioned conditions are acceptable, please kindly send us a letter confirming that you agreed with those terms."* <u>Response received by email on 26/07/21 based on the previous turbine layout:</u> *"The two PMP stations are OK and the proposed wind farm… doesn't have any foreseeable effect."* <u>Response received by email on 04/12/24 based on the current turbine layout:</u> *"Given that the turbines' structure haven't been changed and also considering the minimal changes in the turbines layout, so the level of risk [has] remained acceptable and hence the letter submitted by the… developer… is sufficient."*
4	Fixed point-to-multipoint	17 km	Grampians Wimmera Mallee Water Authority (GWMWater) 10271936-AUME-L-04	<u>Response received by email on 13/08/21 based on the previous turbine layout:</u> *"We've looked at the information you've provided and we don't believe the proposal will interfere with our radio equipment located in the Eastern Grampians."* **Further consultation based on the current turbine layout is not considered necessary**

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
5	Fixed point-to-multipoint	23 km	Powercor Australia Pty Ltd (Powercor) 10271936-AUME-L-05	Response received by email on 15/07/21 based on the previous turbine layout: *"I can confirm that the Point to Multipoint links are all clear of the Watta Wella WF boundary.* *The radio links do not intersect the WF boundary or cut across the turbine field."* **Further consultation based on the current turbine layout is not considered necessary**
6	Emergency service	Land mobile: 42 km	Ambulance Victoria 10271936-AUME-L-06	Response received by email on 13/07/21 based on the previous turbine layout: *"Based on the location of the proposed Windfarm and the direction Ambulance Victoria uses the nearby site this will have no impact to our services."* **Further consultation based on the current turbine layout is not considered necessary**
7	Emergency service	Land mobile: 24 km	Ararat Fire Brigade 10271936-AUME-L-07	Response received by email on 13/07/21 based on the previous turbine layout: *"The majority of this proposed Wind farm will [be] located in the Stawell Fire Brigad area of operation with a small block on the Western side in the Joel Joel Brigade area. Both these brigades still fall under the CFA District 16 area of control."* Response received by email from CFA on 13/07/21 based on the previous turbine layout: *"I confirm that the CFA radio services (fixed radio links and land mobile services) are not affected by the proposed wind turbines."* **Further consultation based on the current turbine layout is not considered necessary**
8	Emergency service	Land mobile: 6 km	Country Fire Authority (CFA) 10271936-AUME-L-08	Response received by email on 13/07/21 based on the previous turbine layout: *"I confirm that the CFA radio services (fixed radio links and land mobile services) are not affected by the proposed wind turbines."* **Further consultation based on the current turbine layout is not considered necessary**

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
10	Emergency service	Land mobile: 16 km	Department of Justice and Community Safety – Regional Mobile Radio (RMR) 10271936-AUME-L-10	Response received by email on 13/07/21 based on the previous turbine layout: *"From the information you have provided, we see no impact to our RMR services."* **Further consultation based on the current turbine layout is not considered necessary**
11	Emergency service	Land mobile: 5 km	Department of Justice and Community Safety – VisionStream (now Ventia) 10271936-AUME-L-11	Response received by email on 16/04/2024 based on the interim turbine layout: *"…In essence, there will be coverage impacts in the vicinity of the wind farm (within a few hundred meters of one or more of the new towers). This will impact dwellings nearby to the wind farm development, should any still be in use. Beyond that we see minimal impact to coverage* *The localized degradation in coverage may also impact the ability of emergency services working on site at the Watta Wella wind farm should that ever be needed, although once on site, paging is not the primary method of communication, so should have minimal operational impact.* *We have also evaluated the potential impact on coverage for the Joel Joel Fire Station, which is very close to the Watta Wella wind farm…* *Given the distance between the wind farm and our Radio Transmitting sites (the closest proposed wind turbine is approximately 7km from our nearest site at Campbells Bridge) there is not expected to be any interference with our transmitting sites. There will be localized scattering of RF signal around the wind turbines such that RF distortion and multi-path reflections will likely cause message reception problems within the Watta Wella Wind Farm area (up to 450 from each wind turbine* • *the required clearance from your Paging System - Interior to avoid or minimise the risk of interference to Visionstream Australia assets and services* *Our coverage will be impacted on and around the wind farm (within approximately 450 meters of any turbine)* • *any mitigation measures that could be implemented to avoid or minimise the risk of interference to Visionstream Australia assets and services* *Ensure that turbines are not placed within 450m of a building where people may live or work…"* **Further consultation based on the current turbine layout is not considered necessary**

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
12	Emergency service	Land mobile: 38 km	St John Ambulance Australia 10271936-AUME-L-12	Response received by email on 08/04/2024 based on the interim turbine layout: *"As you have indicated there are no St John Links paths that are affected by the Wind Farm at Watta Wella"* **Further consultation based on the current turbine layout is not considered necessary**
13	Emergency service	Land mobile: 11 km	Victoria State Emergency Service (VICSES) 10271936-AUME-L-13	Response received by email on 04/12/2024 based on the current turbine layout: *"No concerns from VICSES for this site."*
14	Trigonometrical stations GNSS stations	1 km	Geoscience Australia 10271936-AUME-L-14	Response received by email on 22/02/24 based on the interim turbine layout: *"Geoscience Australia do not foresee any potential for interference to our GNSS Infrastructure from the proposed Watta Wella Wind Farm, near Stawell in western Victoria."* **Further consultation based on the current turbine layout is not considered necessary**
15	Trigonometrical stations Permanent survey marks	Within site boundaries	Department of Environment, Land, Water and Planning (DELWP) 10271936-AUME-L-15	Response received by email on 13/07/21 based on the previous turbine layout: *"I have assessed the positioning infrastructure located around and within the proposed wind farm site. I do not believe the wind farm will cause any interference with the positioning infrastructure in this region. There are survey control marks of varying quality located throughout the area. The survey marks are located within road reserve so should be well clear of the wind turbine infrastructure. The survey marks should not be disturbed as part of any construction or ongoing maintenance works. However, if there is a need to disturb the survey marks then please notify us at smes.support@delwp.vic.gov.au so we can update our online records."* **Further consultation based on the current turbine layout is not considered necessary**

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
16	PMTS/spectrum (mobile phone)	9 km	Telstra Corporation Limited (Telstra) 10271936-AUME-L-16	Response received by email on 12/08/21 based on the previous turbine layout: *"The response from Radio is that the proposed turbine locations will not impact our existing radio system."* Response received by email on 20/03/24 based on the interim turbine layout: *"… Based on this assessment, to minimise potential interference to Telstra's telecommunications network, Telstra requires the developer to confirm its agreement to the conditions and matters set out below…* *1) There are no expected impacts to Telstra's Mobile network due to this wind farm based on the turbine locations provided.* *2) Based on the turbine locations provided and information regarding Telstra's existing point to point radio links obtained from Waypoint and maprad.io, the proposed wind farm should not impact on any of Telstra's existing point to point radio links.* *3) A detailed analysis of the full power coordination impact (Low Frequency Induction (LFI) and/or Earth Potential Rise (EPR)) of the wind farm development is required. This includes location of the wind farm switch yard, the route and potential of any associated HV transmissions lines and the LFI and EPR impact on any Telstra plant they may affect.* *4) It is recommended that you contact Before You Dig Australia, so you are aware of the underground assets in the area. They will provide you with the location of Telstra's as well as any other utilities' underground assets…"* Current turbine layout provided on 06/12/2024 No response received to date

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
17	PMTS/spectrum (mobile phone)	10 km	Vodafone Australia Pty Limited (Vodafone) 10271936-AUME-L-17	Response received by email on 04/12/24 based on the current turbine layout: *"…TPG/Vodafone has assessed this advice in two parts:* *Near Field Impact to existing and near future Public Mobile Telephone Coverage, and Impact to existing or near future microwave point to point links (which may impact connection services to our Public Mobile Telephone Coverage sites).* *Regarding Point A:* *The nearest TPG/Vodafone existing, or near future Public Mobile Telephone Coverage site, is approximately 11km from the proposed locations of the wind farm turbines. As such, there is no prohibitive or significant near field impact to our Public Mobile Telephone coverage.* *Regarding Point B:* *Purna, from our Transmission team has responded below and advised there is no impact to our existing transmission network..."*

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
18	Fixed point-to-point Spectrum (wireless internet)	No turbines in diffraction exclusion zone established by DNV Potential reflection/scattering and near-field effects not considered Spectrum: 10 km	NBN Co 10271936-AUME-L-18	<u>Response received by email on 14/07/21 based on the previous turbine layout:</u> *"While some proposed towers are near existing nbn wireless coverage boundaries these towers do not appear to obstruct existing nbn wireless connections or dwellings.* *The proposed tower locations [do] not pose any risk of introducing a physical obstruction to wireless customer RF Profiles or any boresight paths of existing nbn microwave links.* *A standard nbn response for wind farm applications regarding potential interference impact on the nbn Fixed Wireless network is as follows:* *Referring to an email dated 13th July 2021 regarding the application for the Watta Wella Wind Farm:* *We confirm that NBN Co Spectrum Pty Ltd (nbn Spectrum) has a number of spectrum licenses within 75 km of the proposed … Watta Wella Wind Farm. nbn have strict obligations to provide internet services to the community, and this area has been determined as a FW service area where the footprint of this service is now in place. nbn will be forced to consider its position as part of the planning should there an interference issue.* *If the Application is amended before it is lodged we request that we are sent any amended Application so we can determine whether we have any objections to the amended Application.* *We note that, as you would be aware, under section 197 of the Radiocommunications Act 1992 (Cth) it is an offence to knowingly or recklessly do anything likely to interfere substantially with radiocommunications or otherwise substantially disrupt or disturb radiocommunications."* <u>*Response received by email on 26/02/24 based on the interim turbine layout:*</u> *"I have reviewed the data provided based on the proposed wind farm location; while some proposed towers are near existing nbn wireless coverage boundaries these towers do not appear to obstruct existing nbn wireless connections or dwellings.* *The proposed tower locations do not pose any risk of introducing a physical obstruction to wireless customer RF Profiles or any boresight paths of existing nbn microwave links.* *…Please provide information on any planned RF transmission equipment planned to be installed so a potential interference impact can be assessed. This information should include as a minimum the operating*

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

Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
			transmission frequencies and transmit power, channel bandwidths, antenna types and radiation patterns as well as the exact location with antenna height, boresight azimuth and tilt [mechanical and electrical tilt]. *…We confirm that NBN Co Spectrum Pty Ltd (nbn Spectrum) has a number of spectrum licenses within 75 km of the proposed Hills of Watta Wella Wind Farm.* *nbn have strict obligations to provide internet services to the community, and this area has been determined as a FW service area where the footprint of this service is now in place.* *nbn will be forced to consider its position as part of the planning should there an interference issue.* *If the Application is amended before it is lodged we request that we are sent any amended Application so we can determine whether we have any objections to the amended Application…"* *<u>Response received by email on 25/03/24 based on the interim turbine layout:</u>* *"…Satellite view from above, the WT has to be 149.42m from centre line of the link Line of Sight (LOS)…"* <u>Current turbine layout provided on 06/12/2024</u> No response received to date

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

	Licence/service type	Distance of closest site	Operator and DNV reference	Response received to date
19	Broadcasting	35 km	BAI Communications 10271936-AUME-L-19	Response received by email on 03/07/24 based on the interim turbine layout: *"…BAI Communications has done a study on the proposed wind farm located in Watta Wella, Victoria. The impact on three digital television broadcast facilities were studied. The results show that one of the broadcast facilities is predicted to be impacted (Lookout Hill DTV services) by the proposed wind turbines, but none of the viewers are predicted to be impacted. However, if there is any impact, remediation that is required to rectify DTV degradation to the viewers, is expected to form part of the wind farm project…* *… Interference analysis shows that Mt Dundas and Mt William WIN DTV services are not predicted to be impacted by the presence of wind farms in the current configuration. Furthermore, interference analysis predicts that Lookout Hill DTV services are affected by the proposed wind farm, but none of the viewers are predicted to be impacted.* *In addition, four ACMA fixed links have been identified near the proposed wind farm and no BAI operated off-air links have been identified over the Watta Wella wind farm area. The nearest BAI SPM measurement location is approximately 30 kms away.* *Whilst there are no persons predicted to be impacted by the wind farm, any degradation of DTV services caused by the wind farm development would be expected to be rectified as part of the project."* Current turbine layout provided on 04/12/2024 No response received to date
20	Fixed point-to-multipoint	43 km	Wireless Network (Ballarat) Pty Ltd.	Response received by email on 21/02/24 based on the interim turbine layout: *"I can confirm that Wireless Network Ballarat Pty Ltd do not provide any Wireless Internet Services. Please do not hesitate to contact me if you require any further information in relation to this matter."* **Further consultation based on the current turbine layout is not considered necessary**
21	PTS (wireless internet)	55 km	Challenge Networks Resources Pty Ltd 10271936-AUME-L-21	Current turbine layout provided on 04/12/2024 No response received to date

LIST OF FIGURES

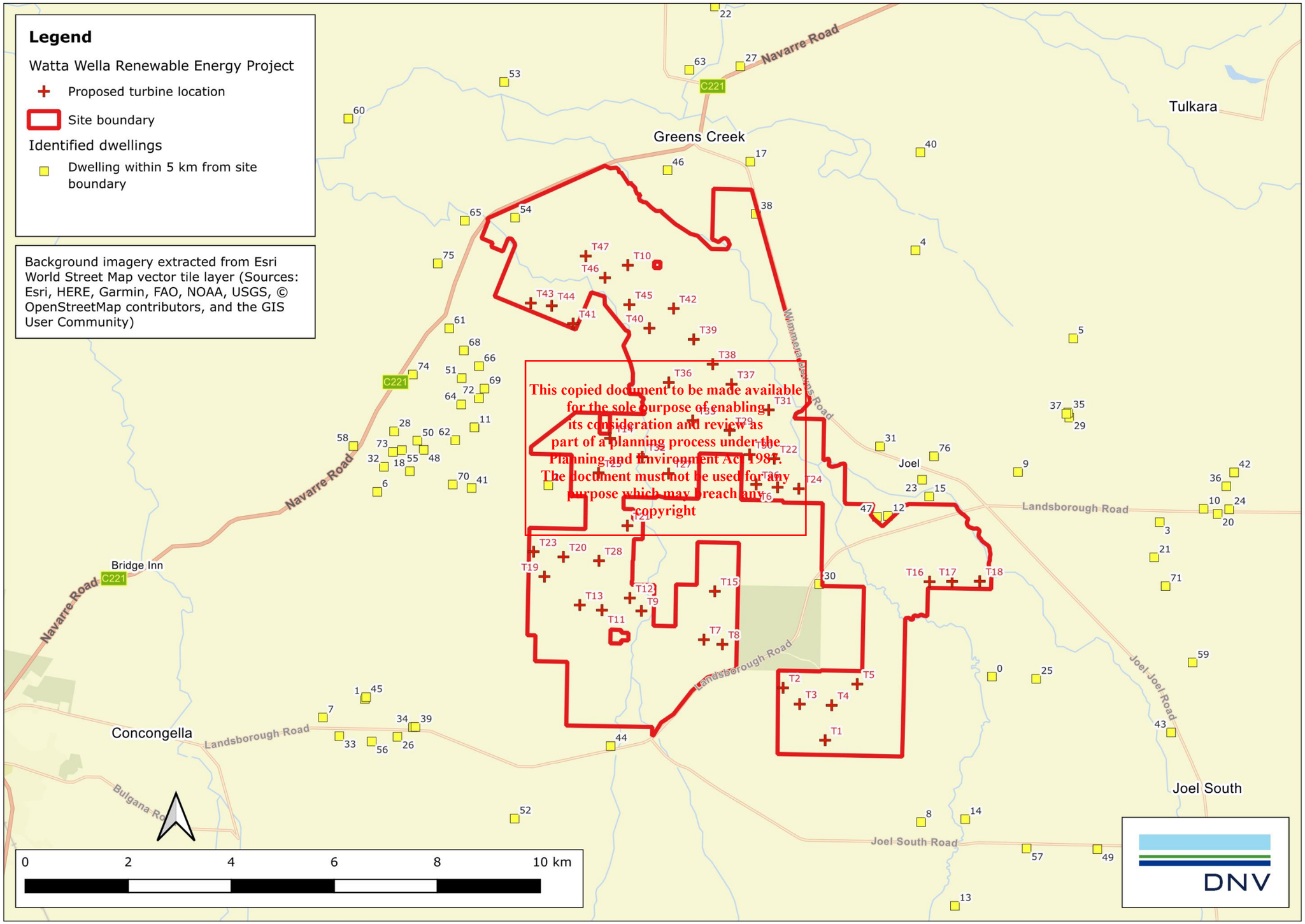

Figure 1 Map of the proposed Project, showing site boundaries, turbine locations, and locations of nearby dwellings

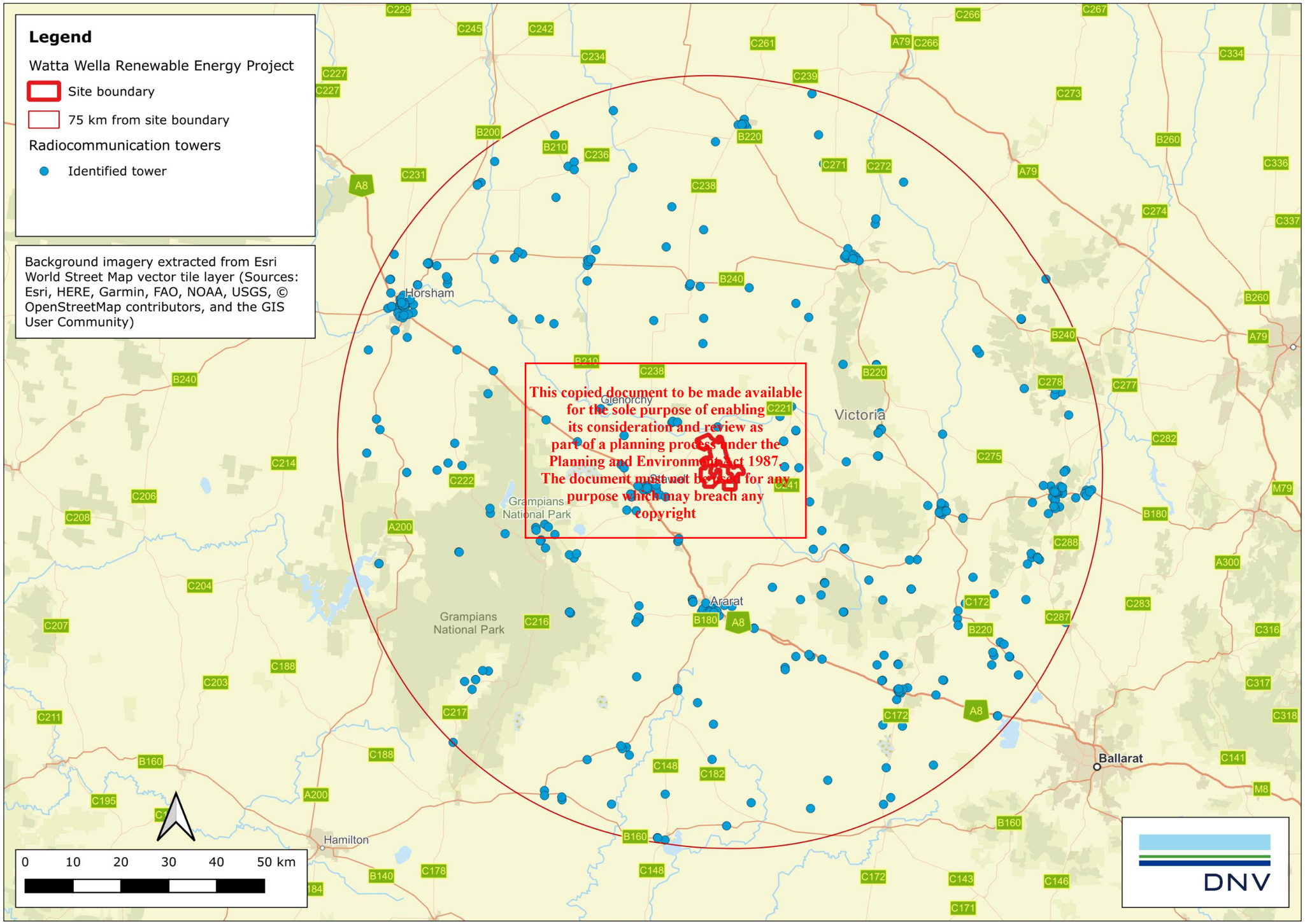

Figure 2 Location of the proposed Project and identified nearby radiocommunication sites

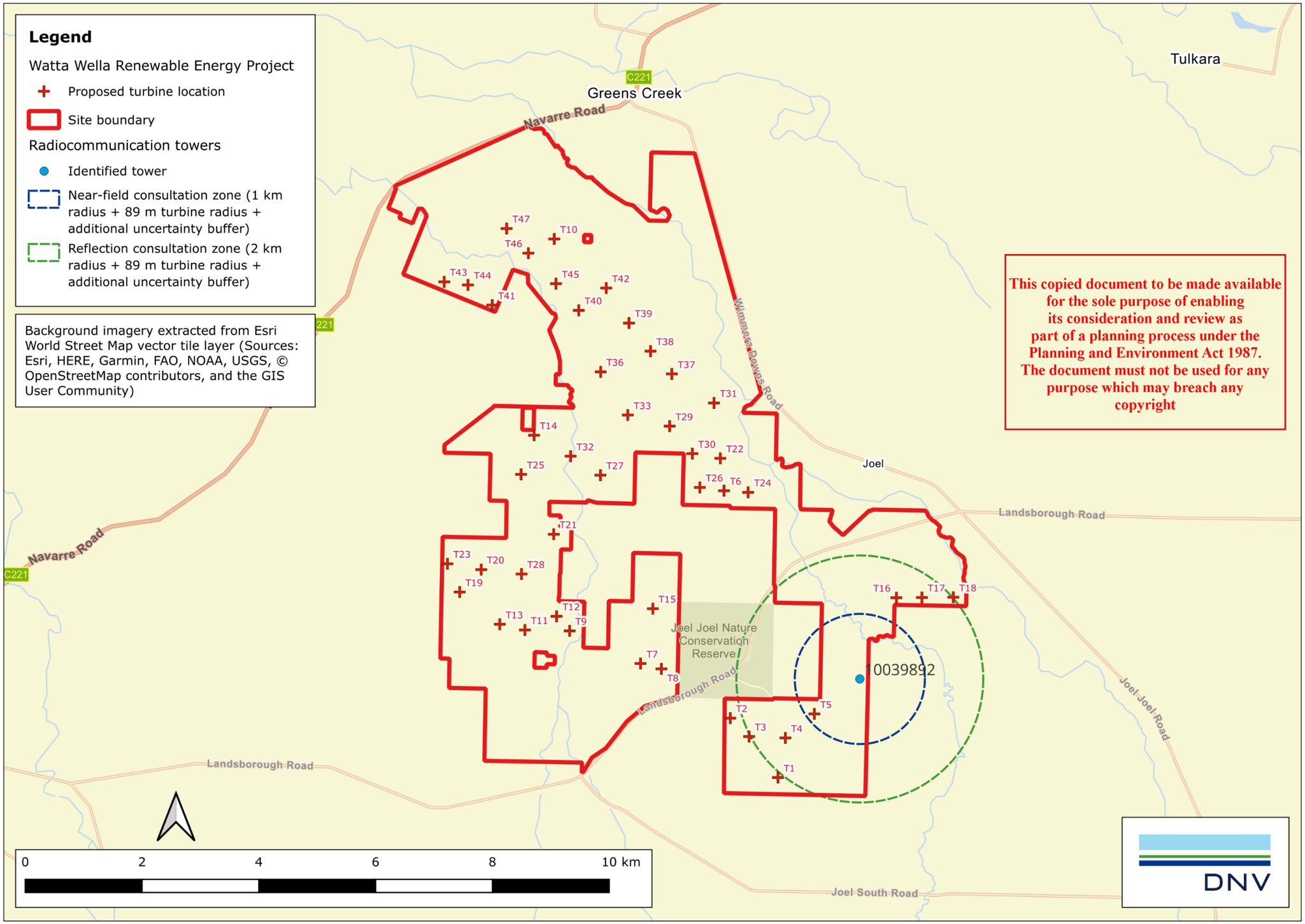

Figure 3 Identified radiocommunication sites within 2 km of the Project Area

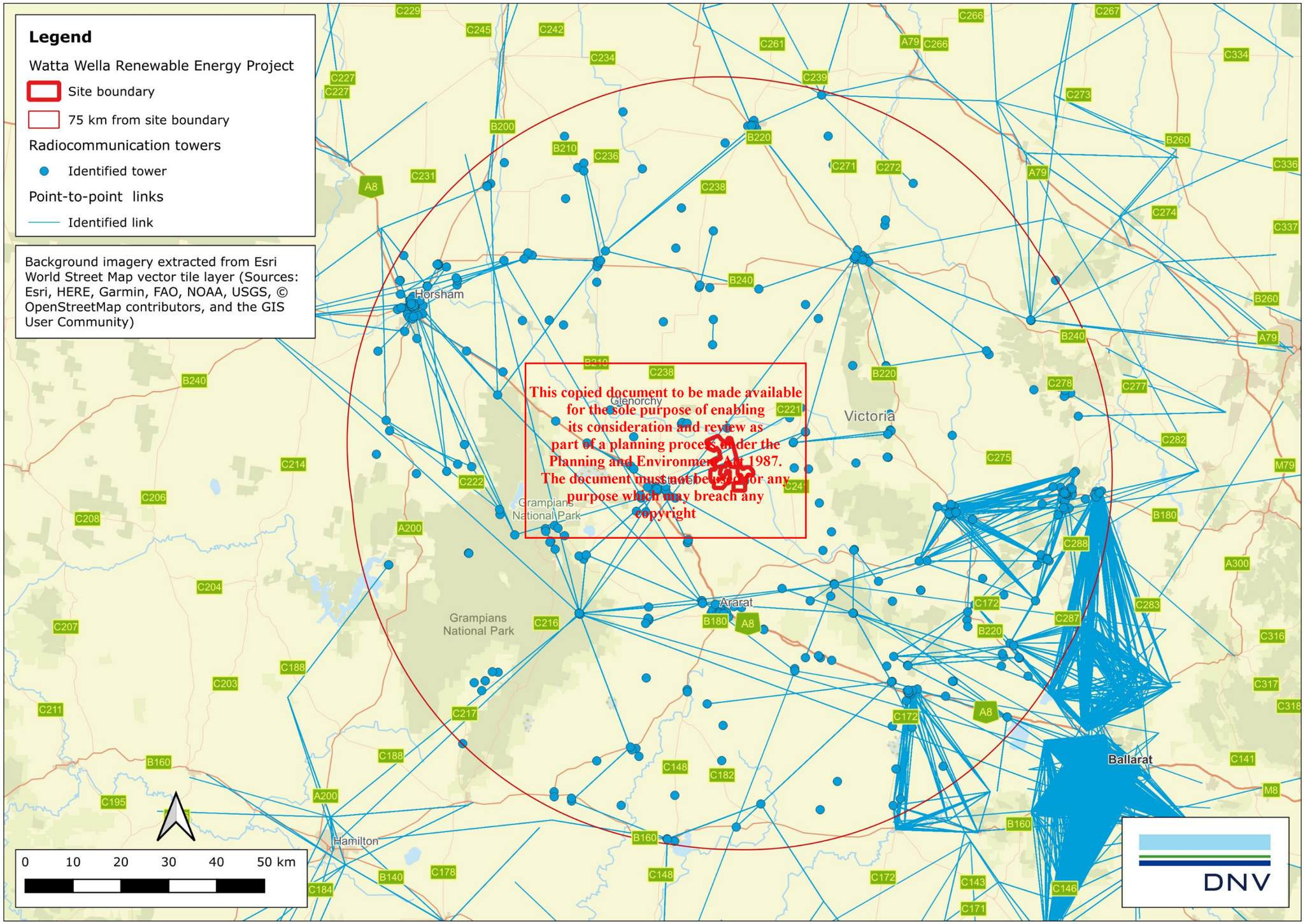

Figure 4 Identified transmission vectors for fixed licences of point-to-point type in the vicinity of the proposed Project

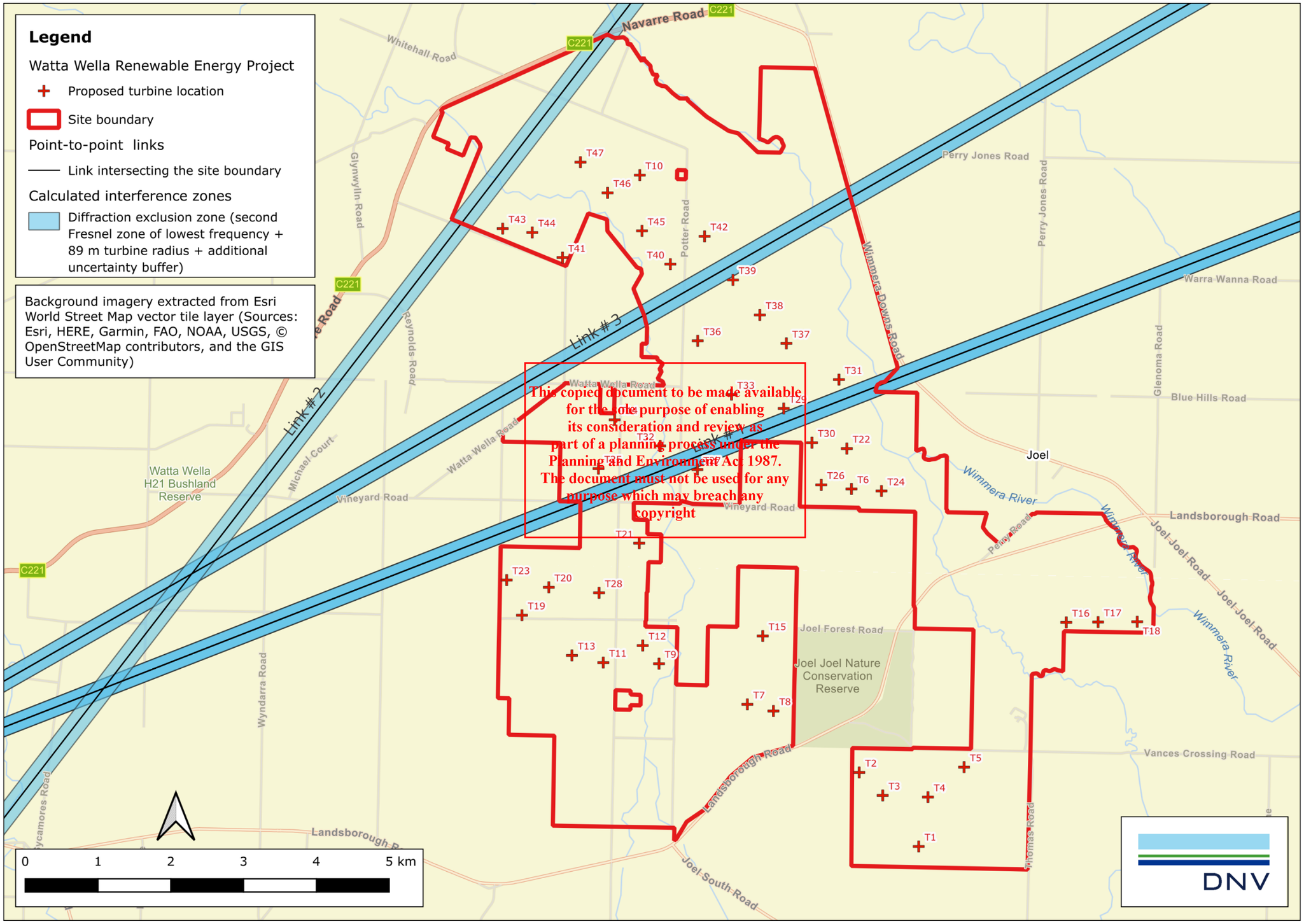

Figure 5 Identified point-to-point radiocommunication vectors crossing the proposed Project and calculated interference zones

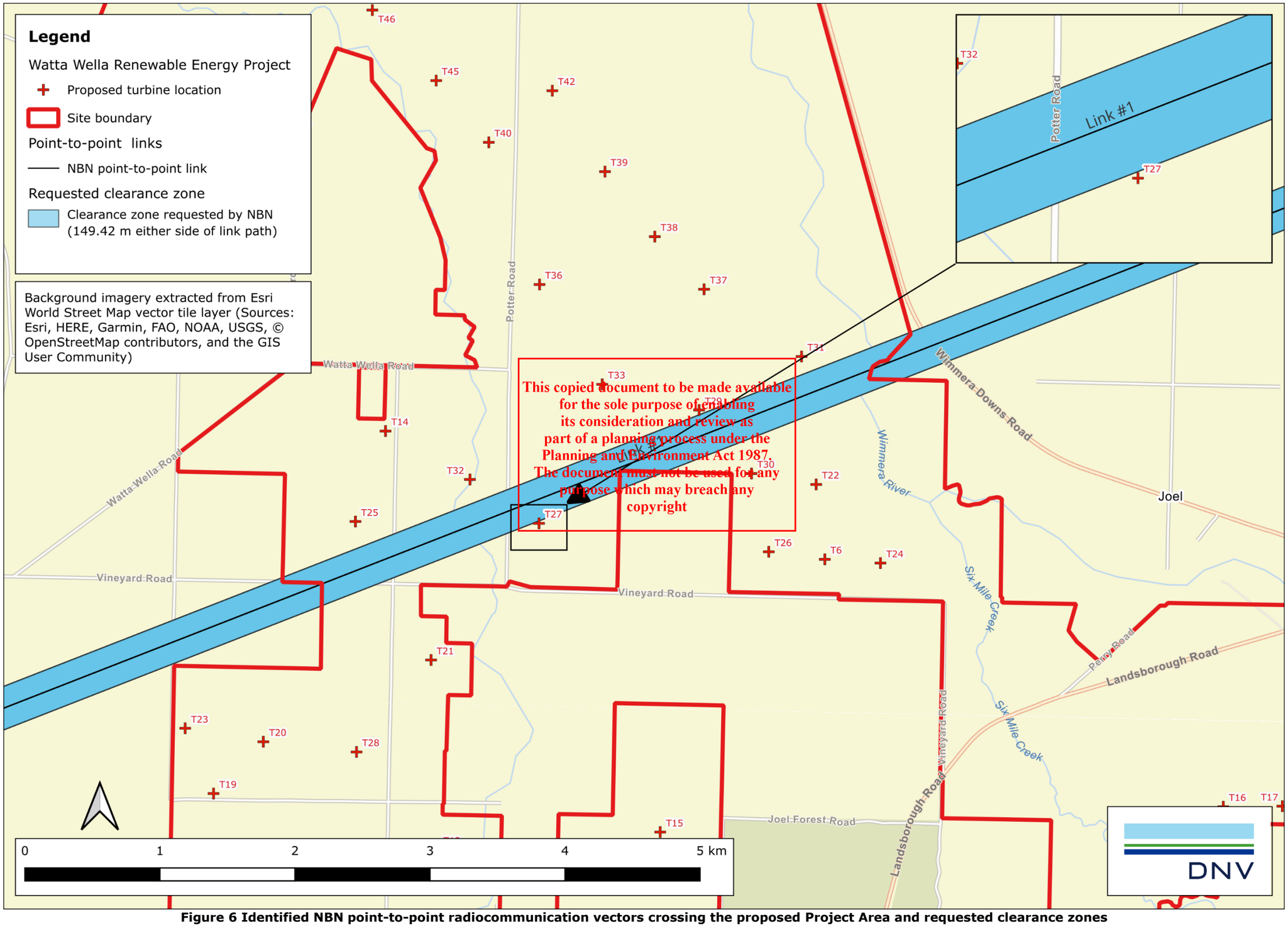

Figure 6 Identified NBN point-to-point radiocommunication vectors crossing the proposed Project Area and requested clearance zones

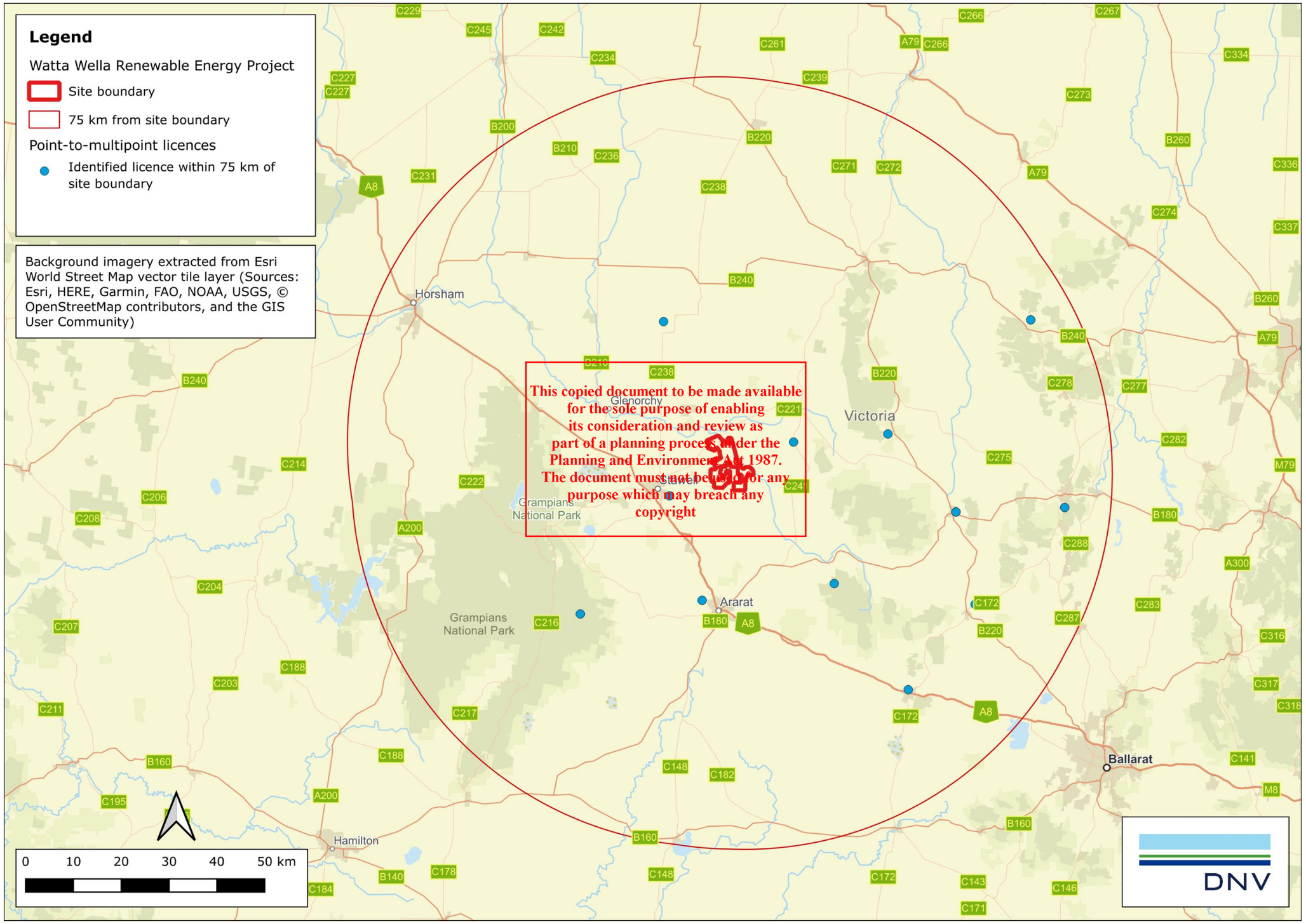

Figure 7 Location of point-to-multipoint licences in the vicinity of the proposed Project

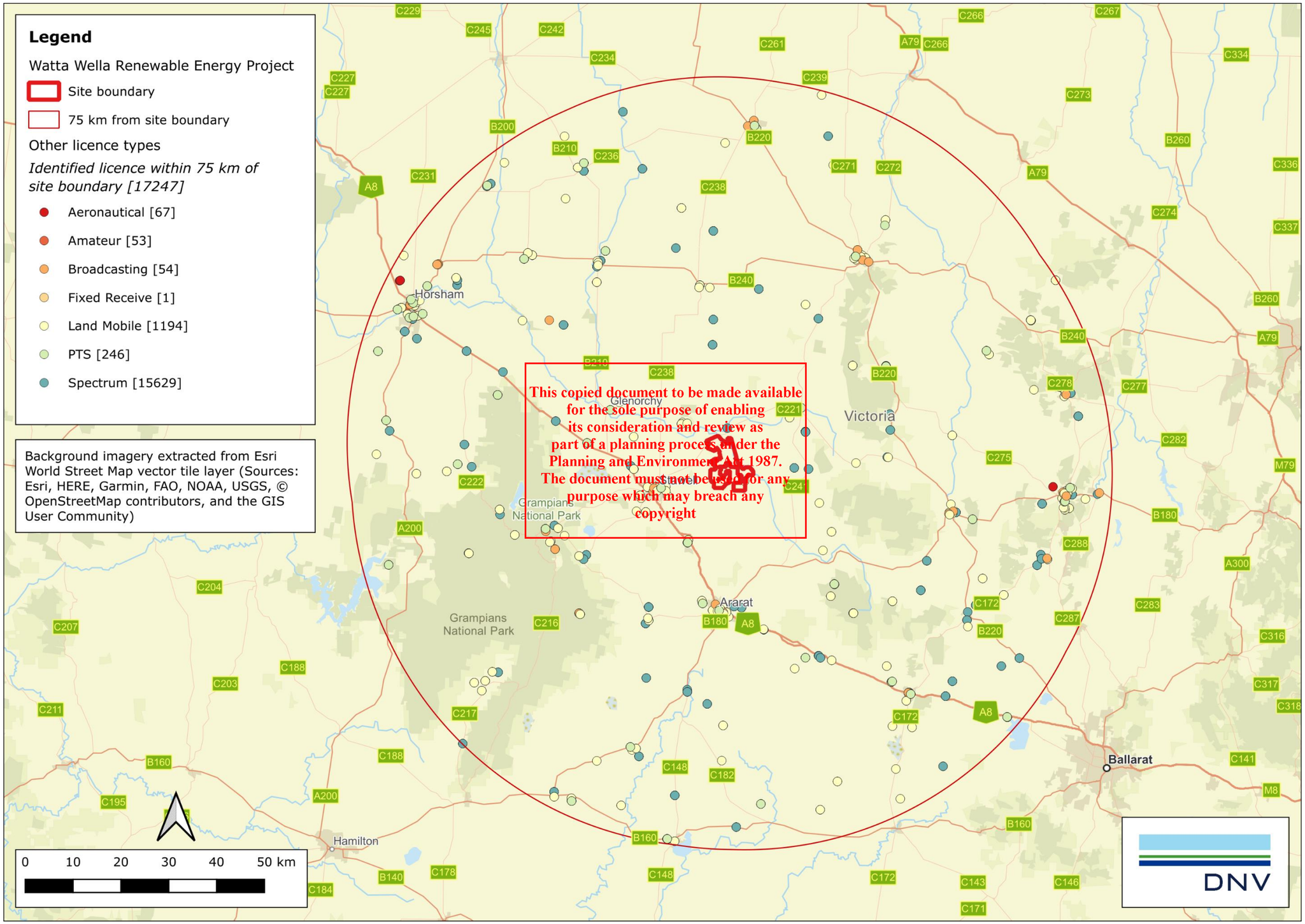

Figure 8 Location of general point-to-area style licences within 75km of the proposed Project

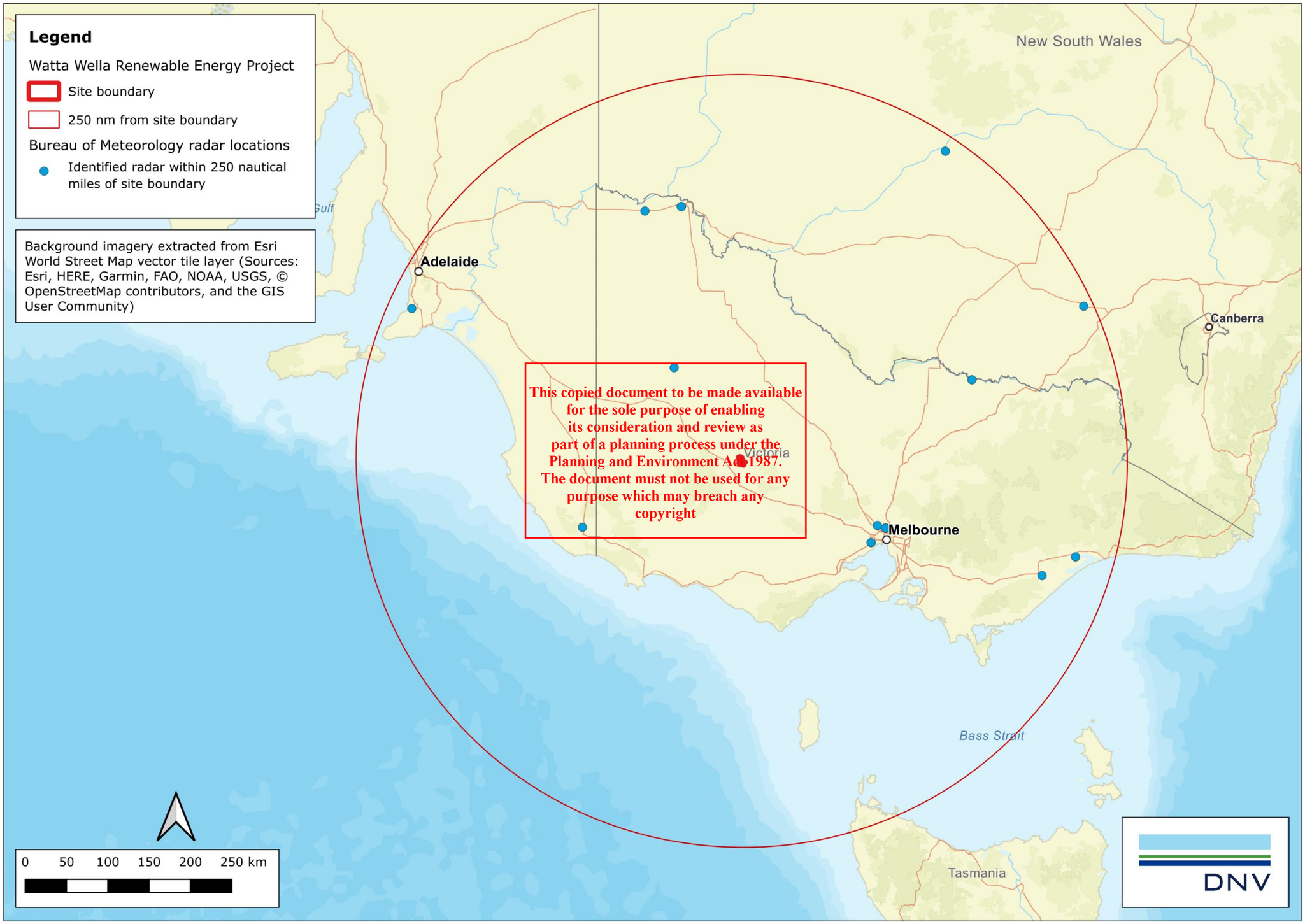

Figure 9 Location of meteorological radar sites within 250 nautical miles of the proposed Project

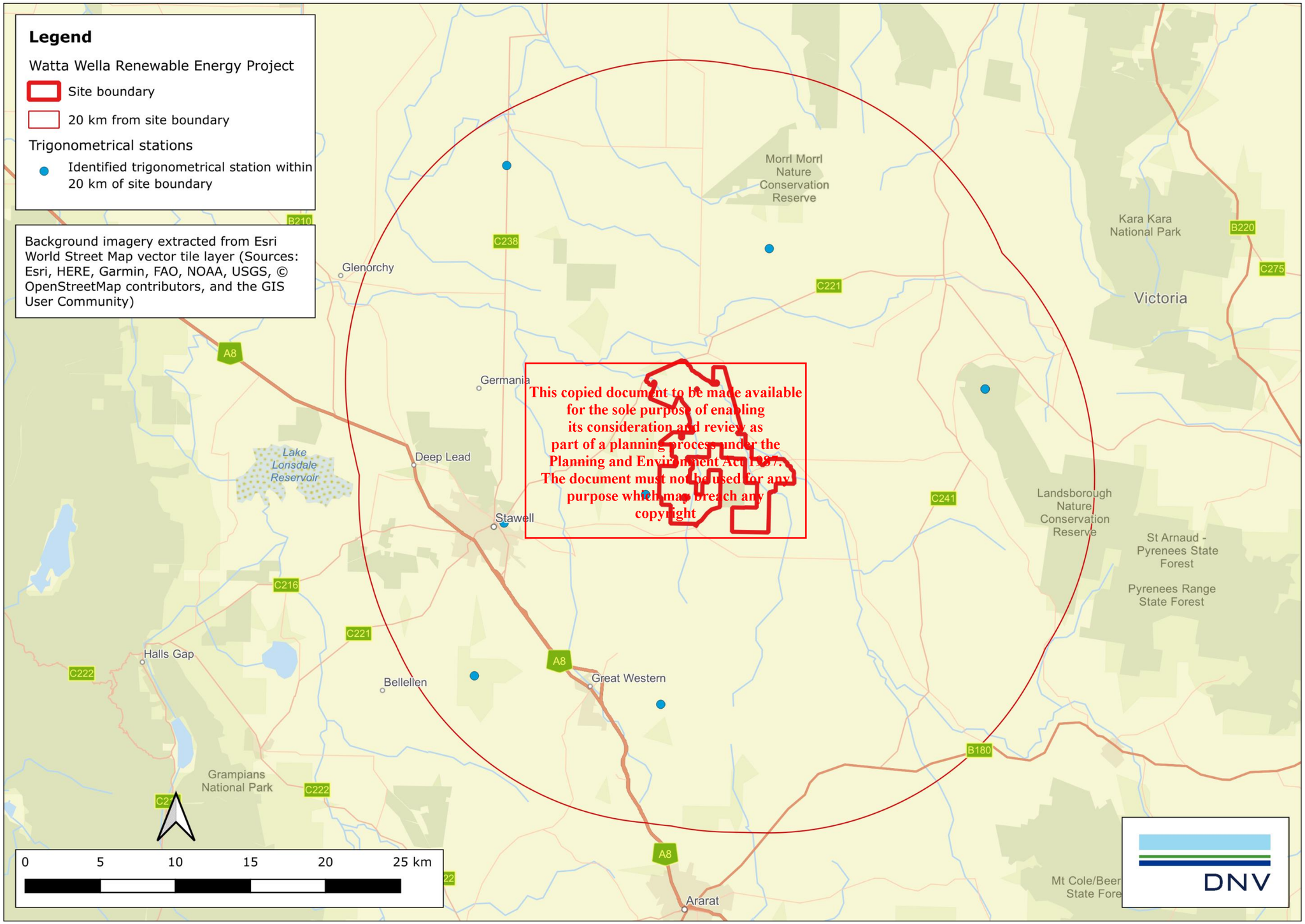

Figure 10 Location of trigonometrical stations within 20 km of the proposed Project

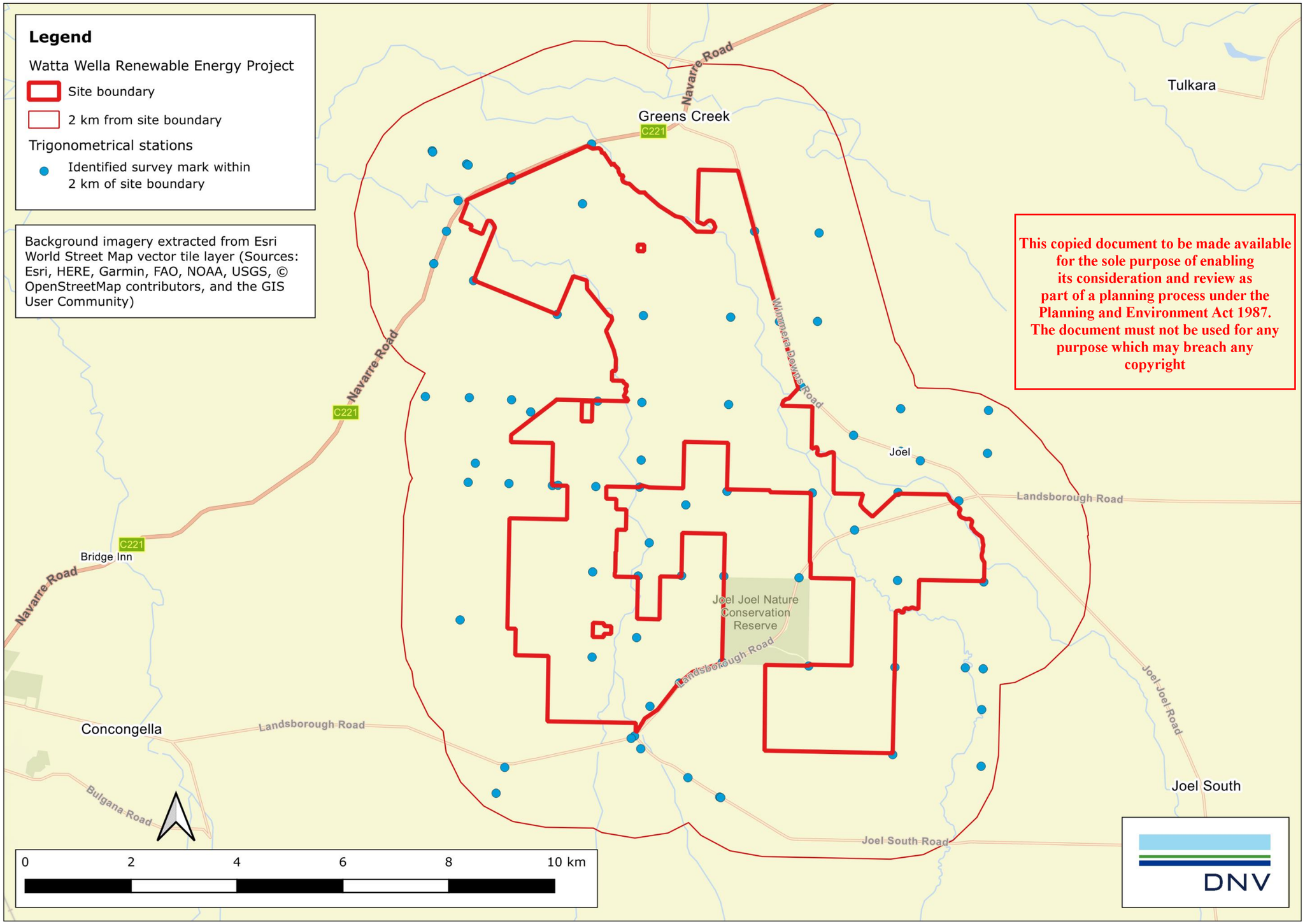

Figure 11 Location of permanent survey marks within 2 km of the proposed Project

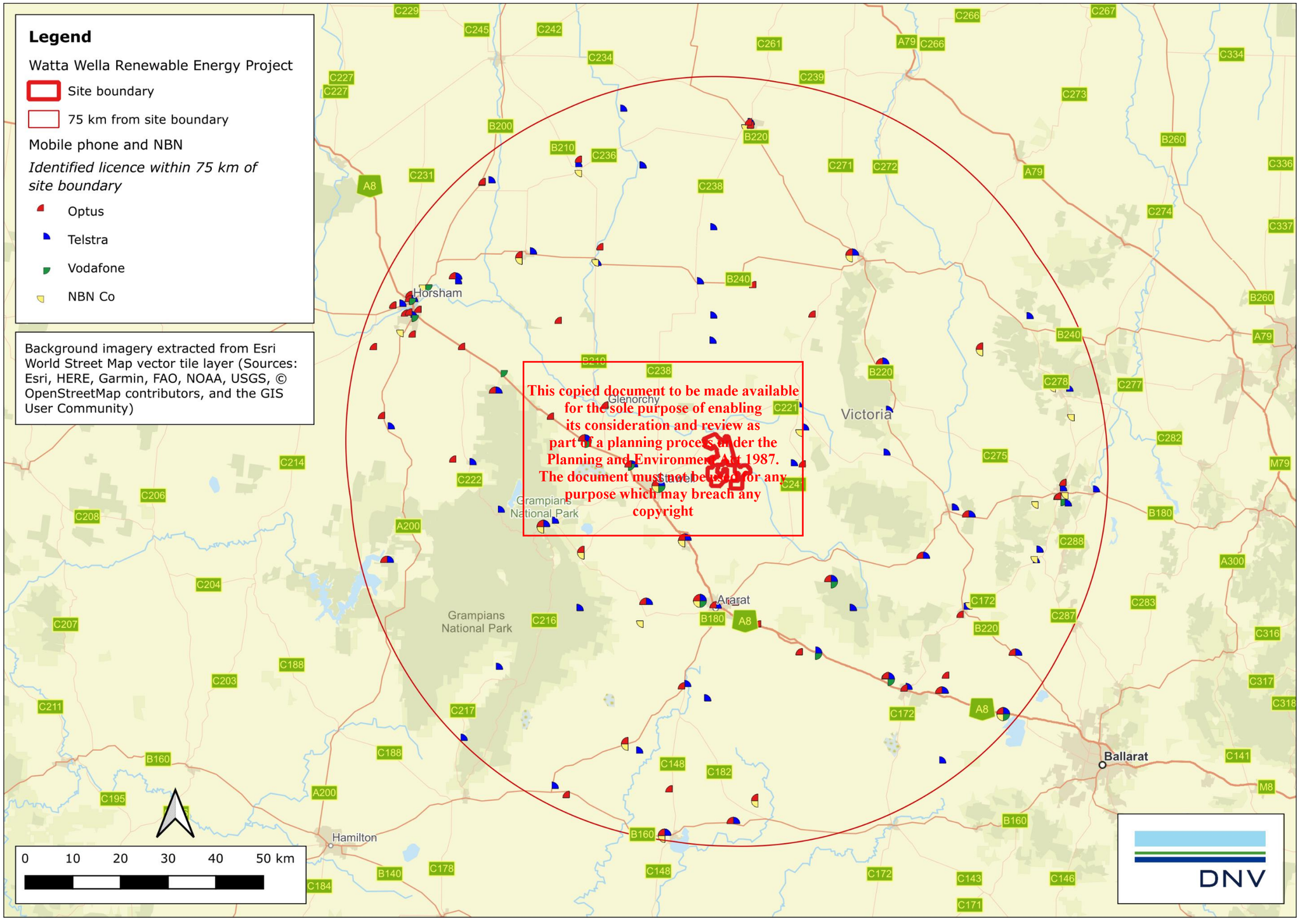

Figure 12 Location of mobile phone and NBN towers within 75 km of the proposed Project

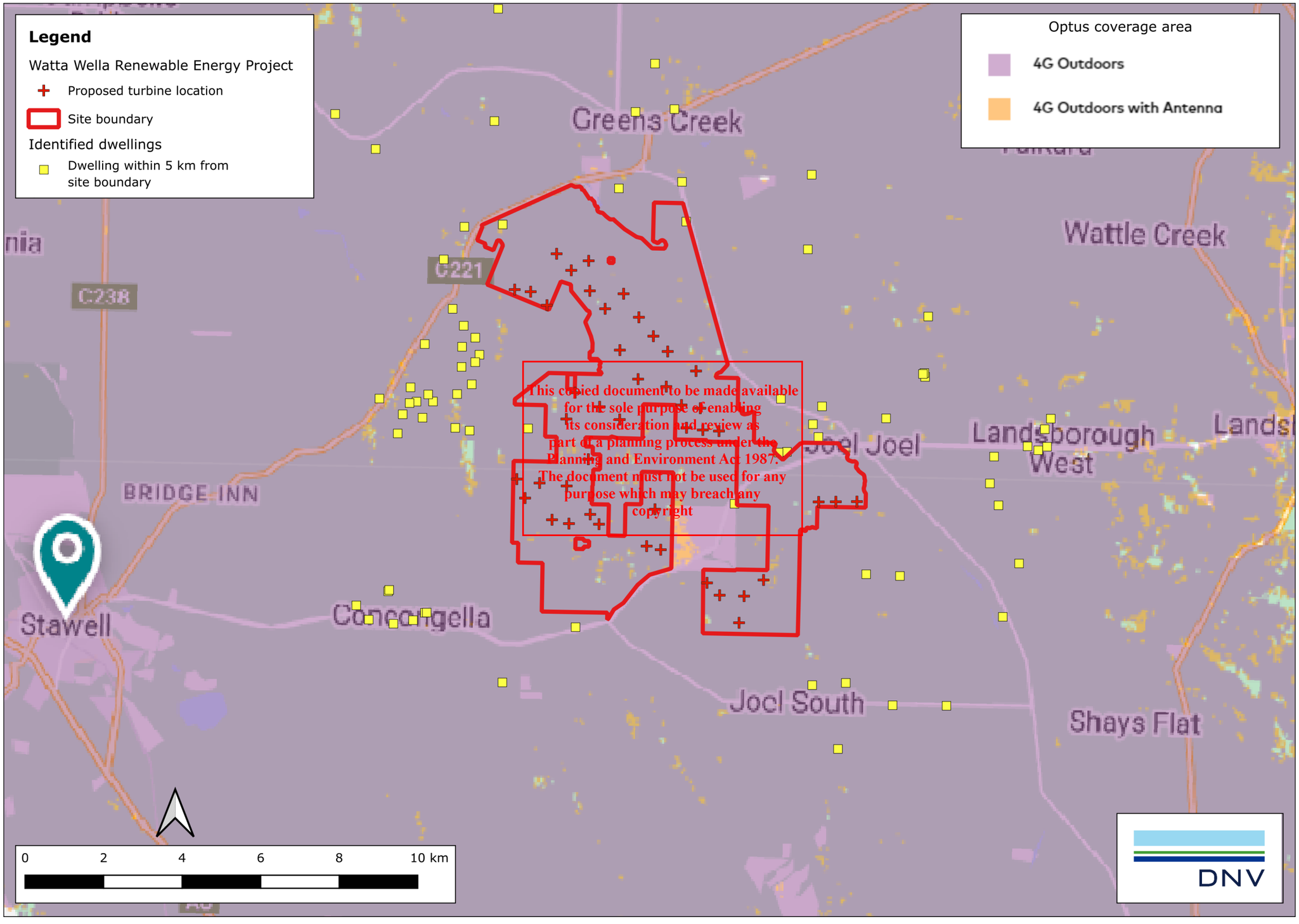

Figure 13 Optus Mobile 4G network coverage for the proposed Project

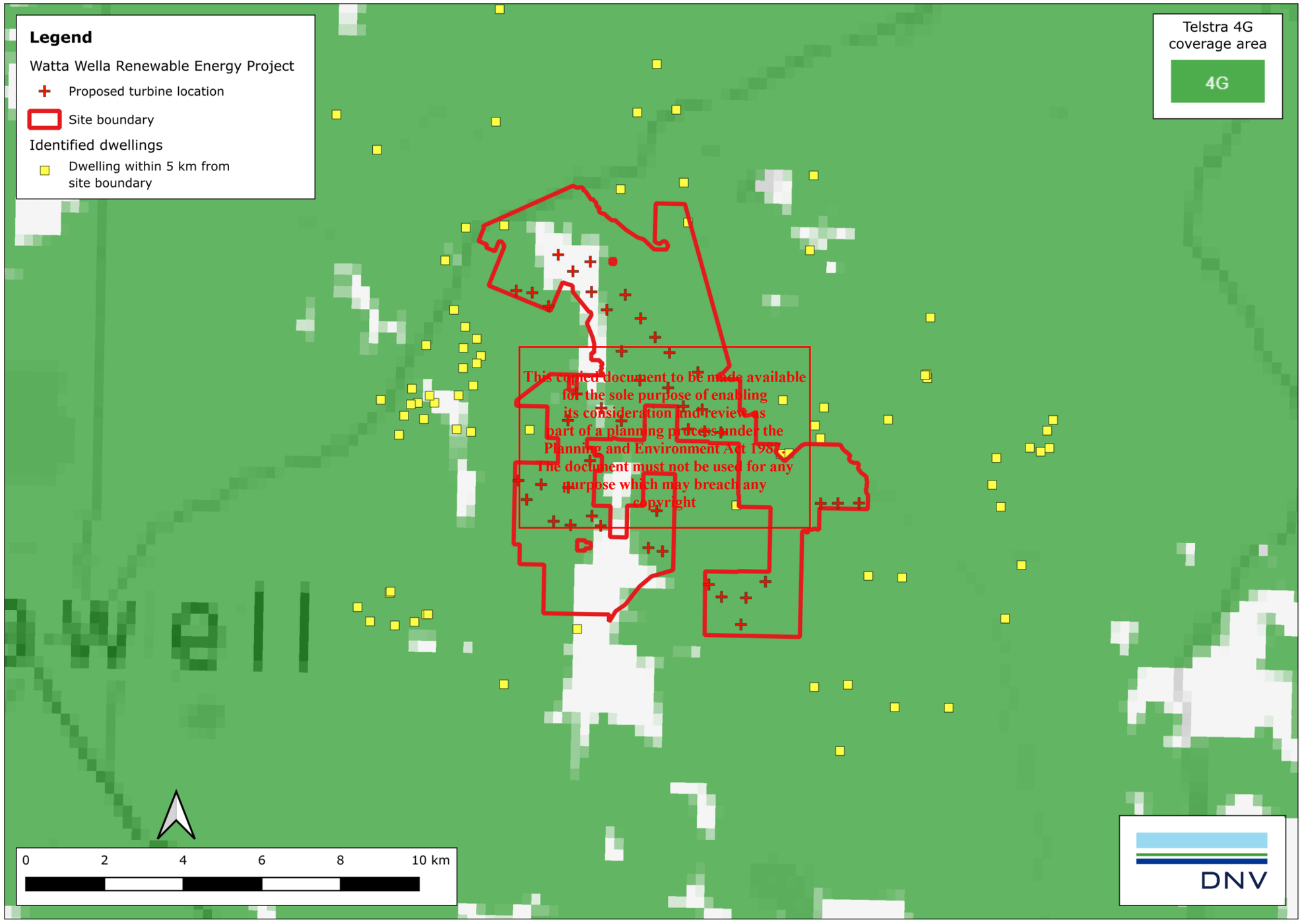

Figure 14 Telstra 4G network coverage for the proposed Project

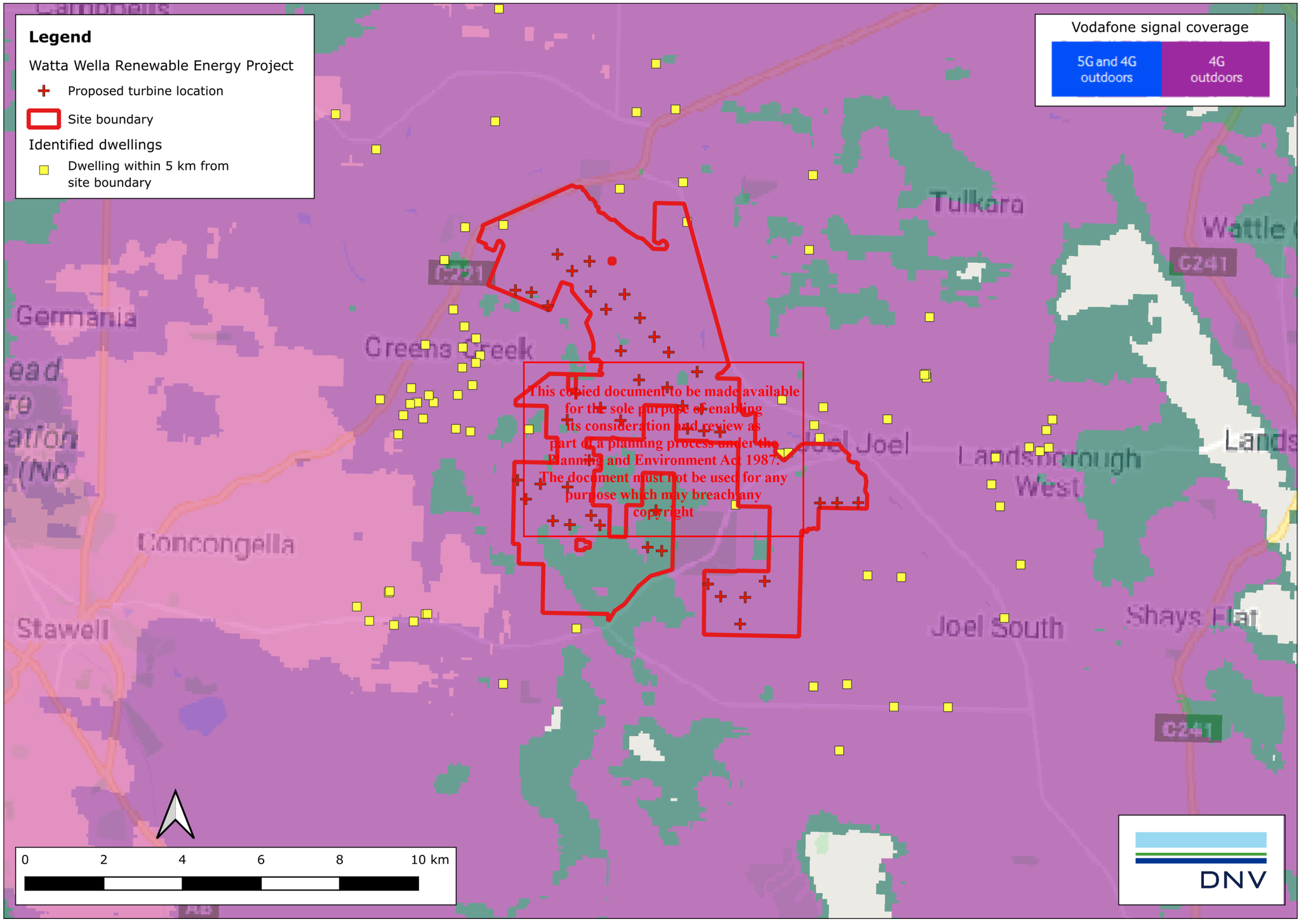

Figure 15 Vodafone network coverage (Apple iPhone 12 handset) for the proposed Project

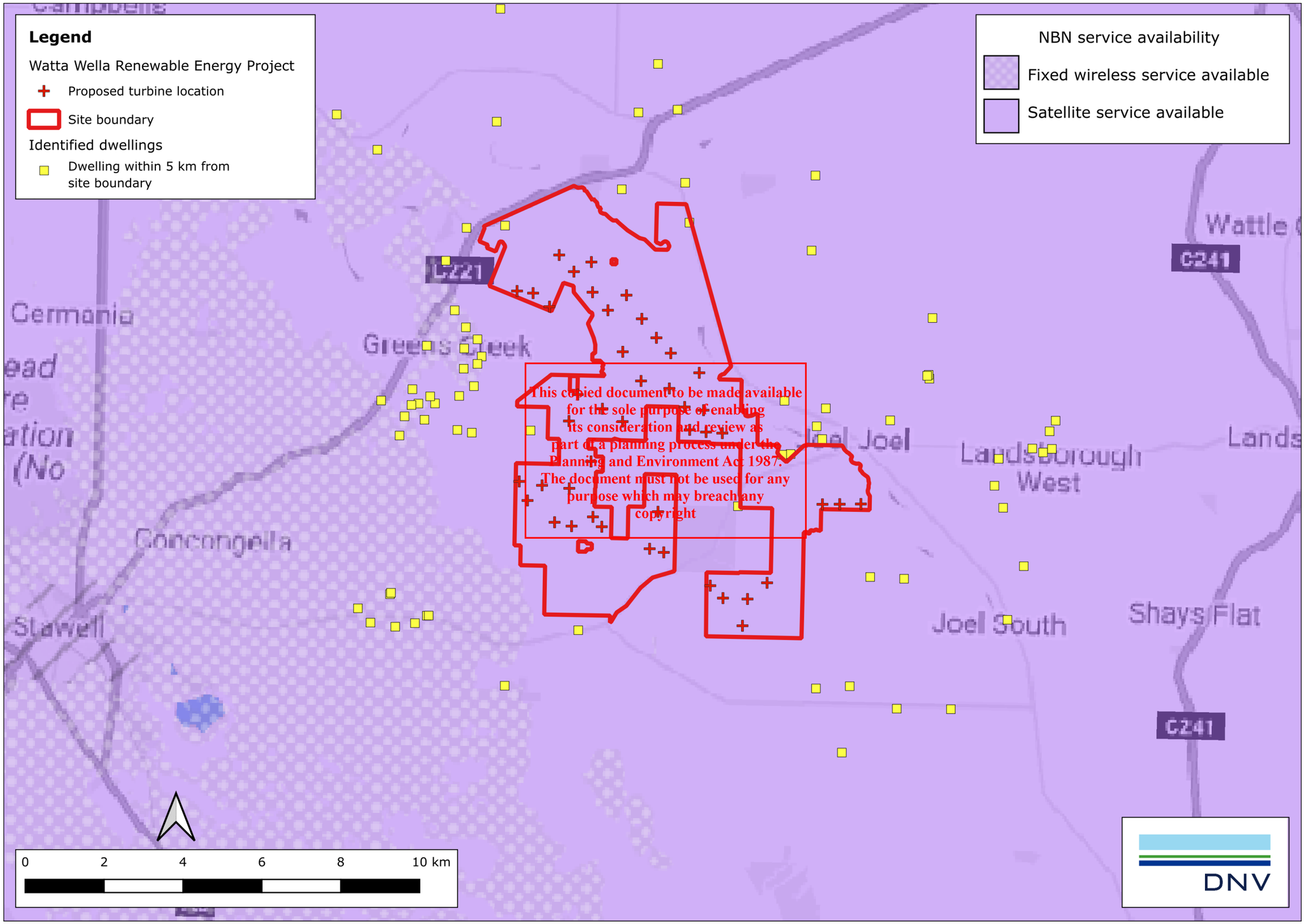

Figure 16 NBN internet coverage in the vicinity of the proposed Project

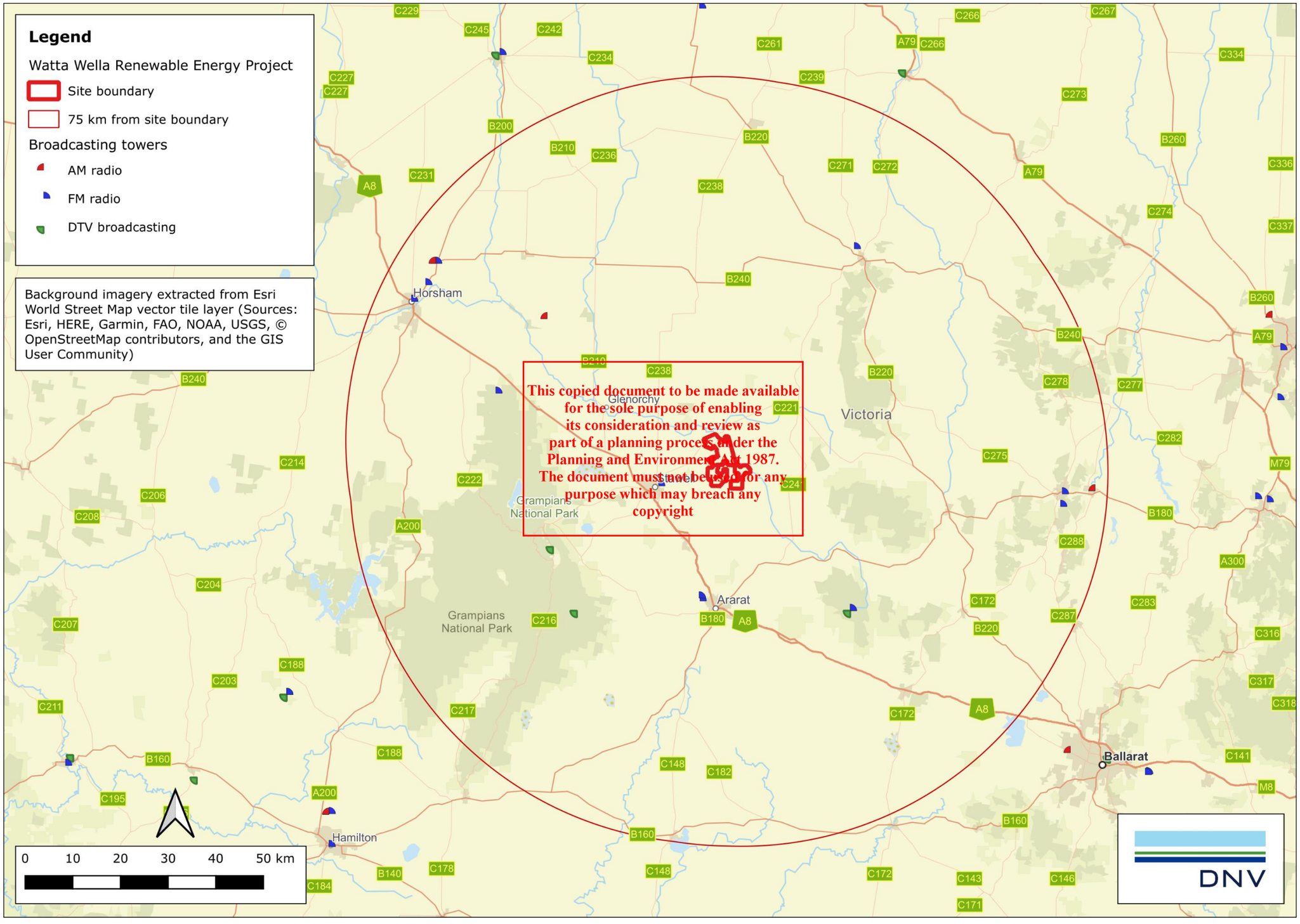

Figure 17 Location of broadcast transmitters in the vicinity of the proposed Project

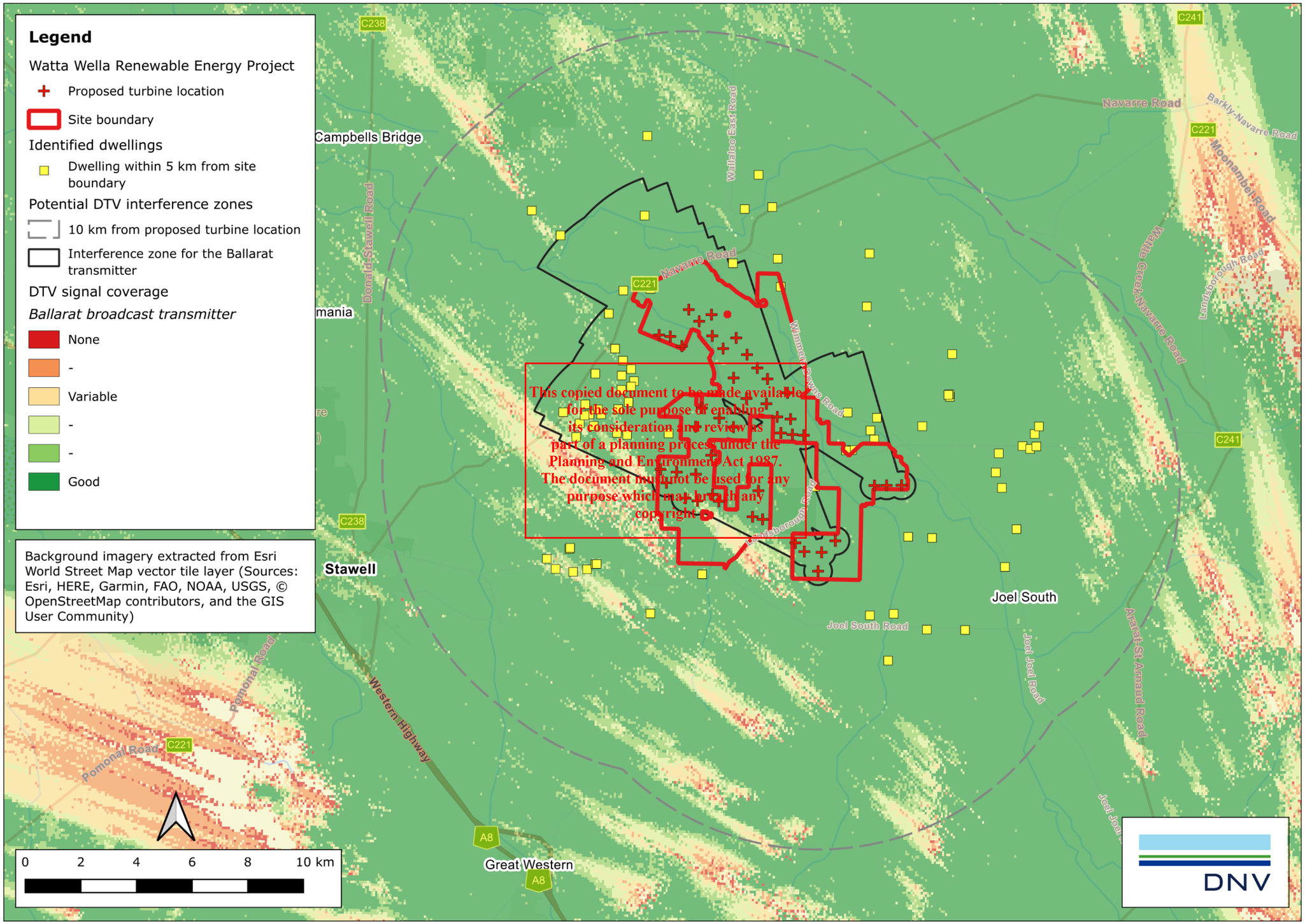

Figure 18 Potential television EMI zones for the Ballarat broadcast tower from the proposed Project

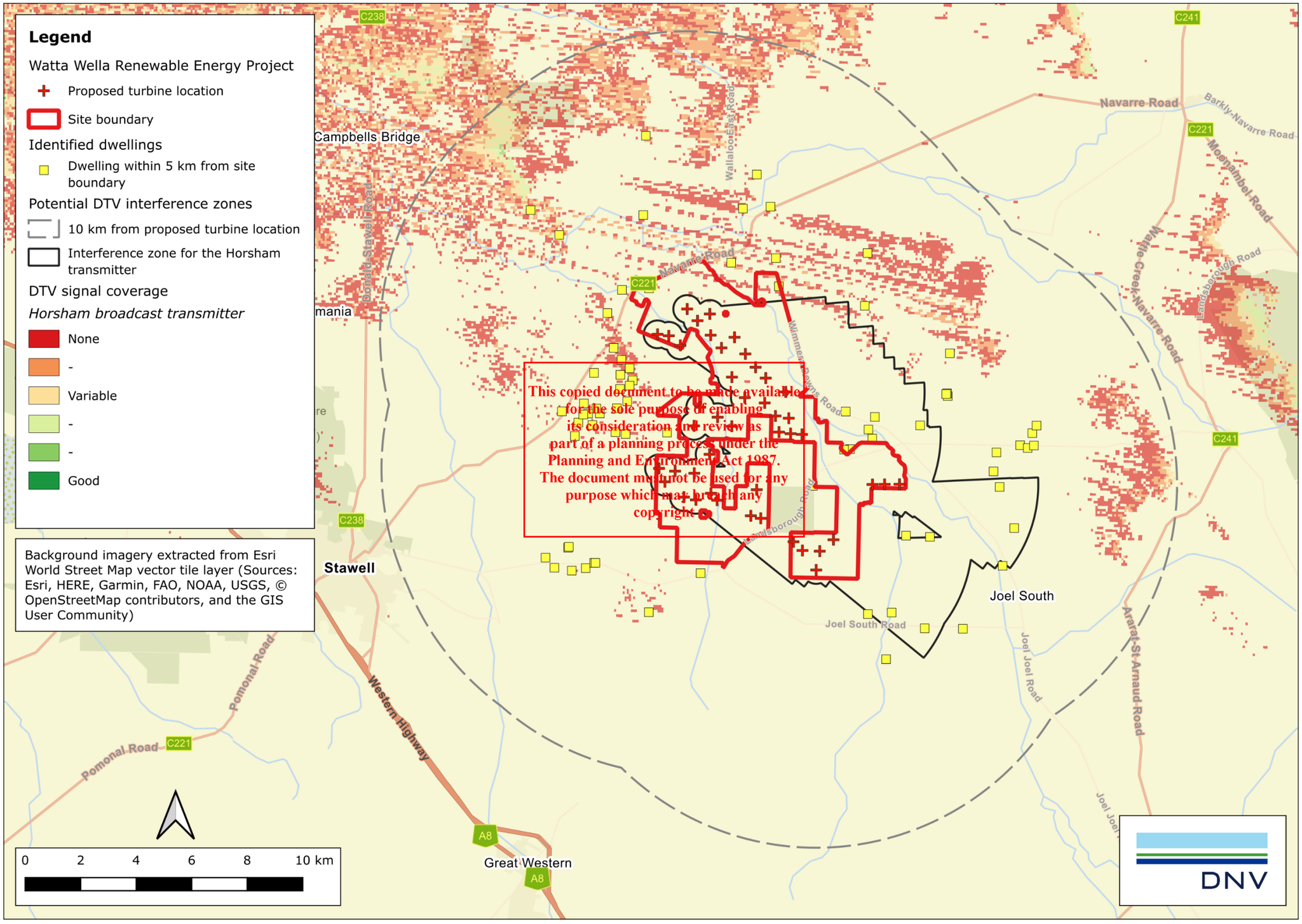

Figure 19 Potential television EMI zones for the Horsham broadcast tower from the proposed Project

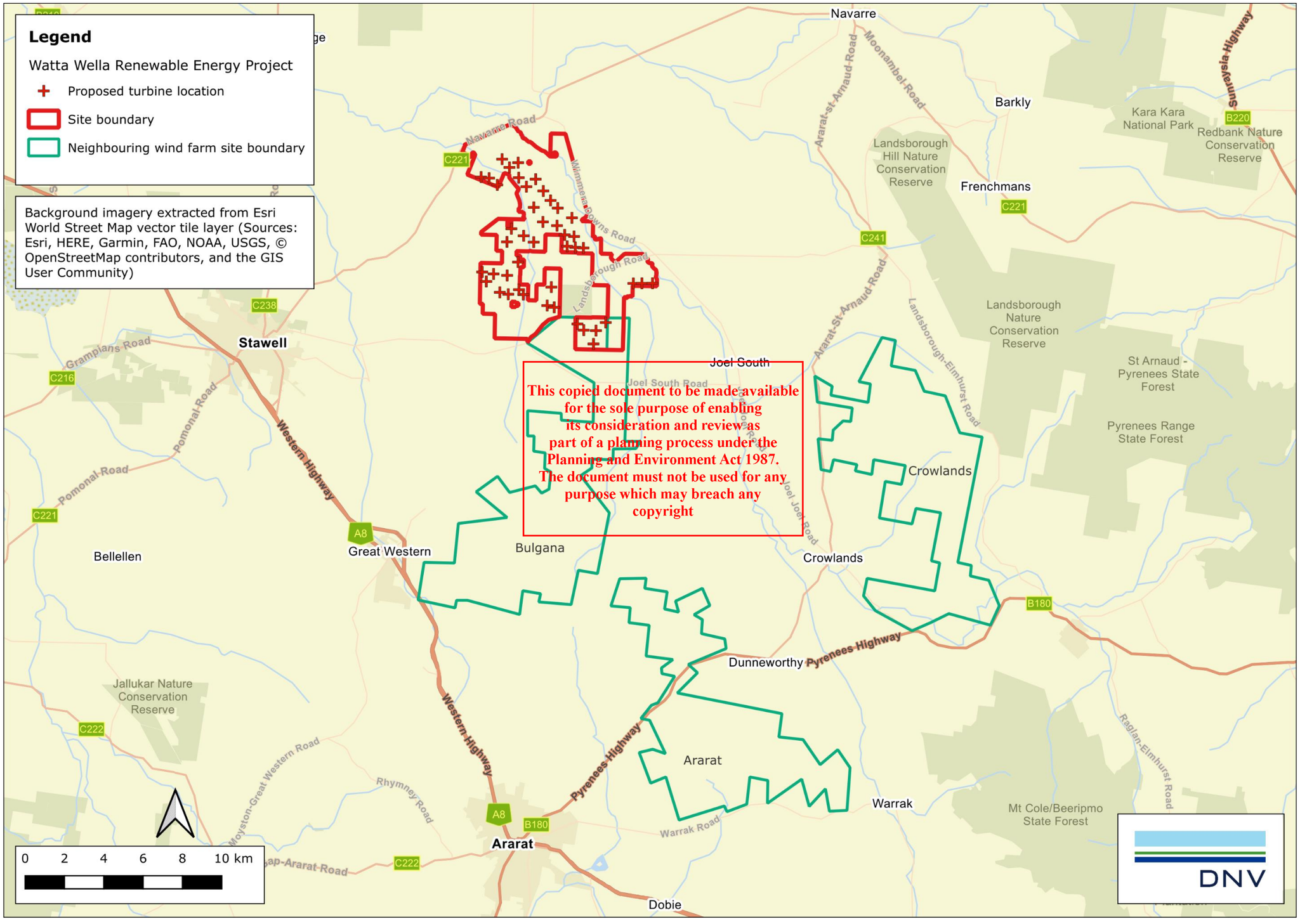

Figure 20 Map of the proposed Project Area, showing neighbouring wind farm developments

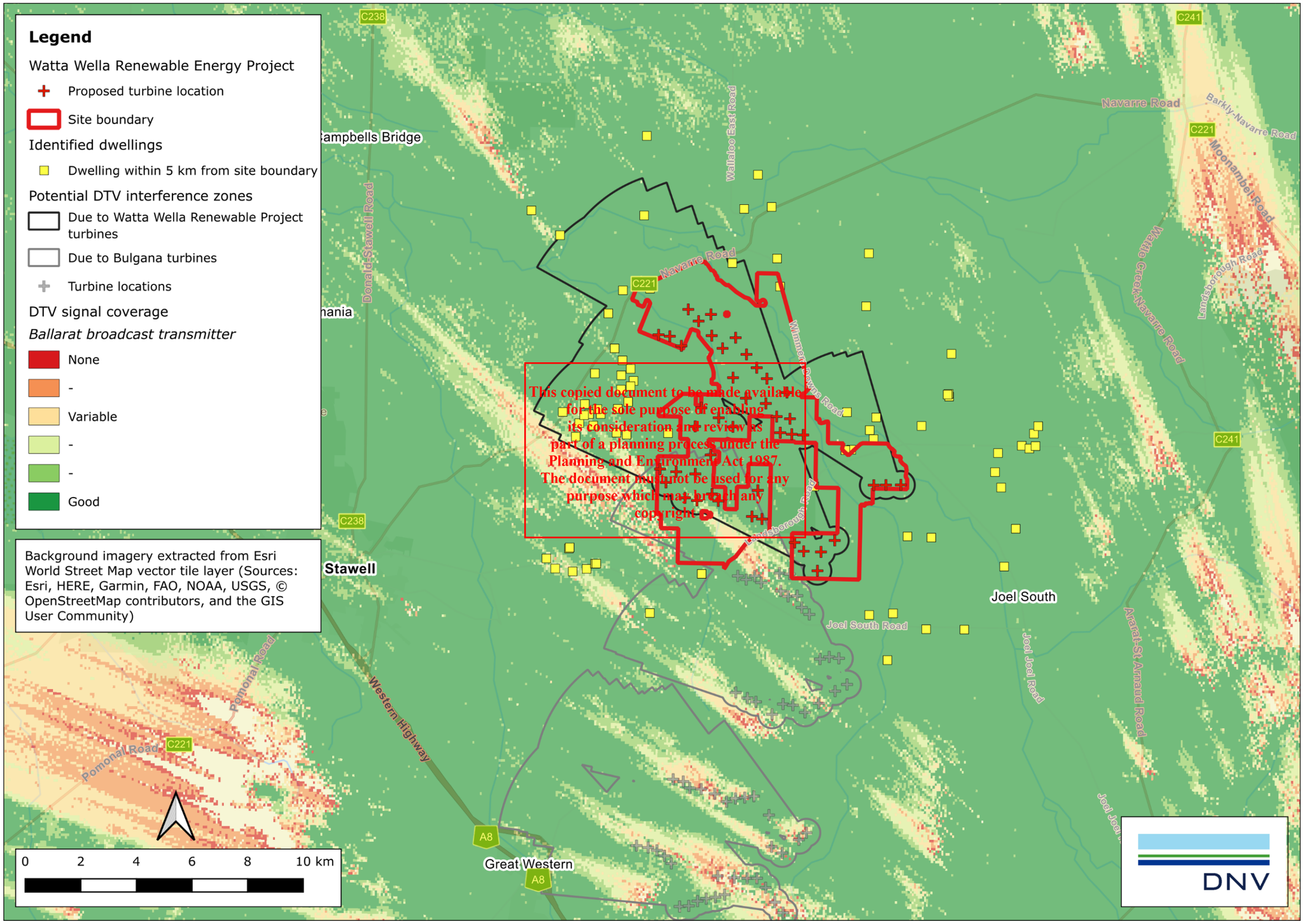

Figure 21 Potential cumulative EMI impacts to television signals from the Ballarat broadcast tower

About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.