



**ASSESSMENT OF ELECTROMAGNETIC
INTERFERENCE ISSUES
FOR THE PROPOSED
LAL LAL WIND FARM**

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Document No	2635/PR/001
Issue No	B
Status	Final
Classification	Client's Discretion
Date	13 July 2007

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Published	:	Available to the general public

Revision History

Issue	Issue Date:	Summary
A	07 June 2007	Draft Issue
B	13 July 2007	Final issue

Circulation:	Copy No:
Westwind	Electronic
GH Pacific	Electronic

Copy No: Electronic

CONTENTS

	Page
1 EXECUTIVE SUMMARY	1
2 DESCRIPTION OF THE WIND FARM SITE	2
3 PROXIMATE RADIOCOMMUNICATIONS	3
3.1 Communication towers	3
3.2 Broadcast licences around the proposed Wind Farm Site	3
3.3 Fixed licences of Point to Point type around the proposed Wind Farm Site	3
3.3 Fixed licences of Point to Multipoint type around the wind farm site	5
3.4 Other licence types around the wind farm site	5
4 CONCLUSIONS AND RECOMMENDATIONS	6
REFERENCES	7
LIST OF TABLES	8
LIST OF FIGURES	9

1 EXECUTIVE SUMMARY

Westwind Energy Pty Ltd. (WW) is developing the Lal Lal wind farm near Ballarat, Victoria. Garrad Hassan Pacific Pty Ltd (GH) have been requested to carry out an independent assessment of any potential electromagnetic interference (EMI) issues associated with the site. Information relating to nearby radio communications licences has been obtained from the Australian Communications and Media Authority (ACMA) and analysed.

In general VHF and UHF frequency band radio signals, and digital voice based technologies such as GSM and CDMA mobile, are essentially unaffected by a wind farm development. This includes land mobile repeaters, radio, the audio component of analogue television, and mobile phones.

If not properly designed for, wind farms can however interfere with both analogue television broadcast signals and microwave signals. Analogue broadcast signals (generally described as point to area) are still commonly used to transmit domestic television, while microwave links (generally described as point to point) are often 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.

For broadcast signals (point to area) large scale interference can generally be avoided by placing the wind turbines distant from the broadcast tower. A clearance of at least 1 km is recommended. No broadcast or communications towers have been identified within 1 km of the Lal Lal wind farm site. Potential interference with the reception of broadcast signals at residences nearby to the proposed Lal Lal wind farm has not been assessed here.

Wind turbines can cause interference, or diffraction, of point to point signals. However it is possible to design around this issue, as the path and interference zone of point to point signals is generally well known. No Fixed licences of Point to Point type transmission towers have been identified within 2 km of the proposed turbine locations however 10 point to point links have been identified which cross the site, five of which are too high to be of concern for the proposed wind farm. Given due consideration, GH considers it is possible to design the wind farm layout such that it does not affect the remaining five point to point links.

2 DESCRIPTION OF THE WIND FARM SITE

The proposed Lal Lal wind farm is located to the southeast of Ballarat, Victoria. The wind farm is comprised of two sections, these being the Yendon section which is approximately 13 km to the east southeast of Ballarat and the Elaine Section which is approximately 23 km to the southeast of Ballarat. The location of the two sections are shown in Figure 1.

The Lal Lal wind farm is located in the southern edges of the Great Dividing Range, and the general topography of the region is largely hilly, although the wind farm sections are located in relatively flat to undulating terrain. The elevation of the immediate surrounding area spans from approximately 480 m to 520 m for the Yendon section and 400 m to 440 m for the Elaine section. At this stage, no turbines locations have been selected and the results of this analysis are to feed into the development of a wind farm layout.

From supplied information [1], turbine dimensions are going to have a total height of up to 150 m agl.

3 PROXIMATE RADIOCOMMUNICATIONS

3.1 Communication towers

An image of the ACMA database was obtained from ACMA on 14 June 2006. The currency of the image was 1 May 2007. From the database there are 267 radiocommunication towers within a nominal 50 km of the Lal Lal wind farm. 50 km has been selected as a reasonable distance to ensure that all transmission vectors are captured in the licence survey. These telecommunication towers locations are shown in Figure 2 relative to the proposed Lal Lal wind farm.

Wind turbines, if not properly sited or designed, can interfere with both television broadcast signals and microwave signals. The interference mechanisms are different for each of these, and hence, there are different ways to avoid interference.

3.2 Broadcast licences around the proposed Wind Farm Site

For broadcast signals, which are usually omni-directional or point to area, large scale interference can generally be avoided by placing the wind turbines distant from the broadcast tower. A clearance of at least 1 km is recommended.

No communications tower, broadcast or otherwise, has been identified within 1 km of the proposed Lal Lal wind farm.

Potential interference with the reception of broadcast signals at residences nearby to the proposed Lal Lal wind farm has not been analysed as part of this work. This issue can be further assessed when the location of wind turbines, and nearby residences, is known.

3.3 Fixed licences of Point to Point type around the proposed Wind Farm Site

Wind turbines can also cause interference, or diffraction, of point to point signals. However it is possible to design around this issue as the path and interference zone of microwave signals are generally well known.

The criteria used for avoiding diffraction effects of point to point signals are normally based on an exclusion zone of circular cross-section around the direct path from the transmitter to the receiver (often called boresight). This exclusion zone is defined in terms of Fresnel zones. The n^{th} Fresnel zone is comprised of all points for which, if the radio signal travelled in a straight line from the transmitter to the point and then to the receiver, the additional path length compared to the straight transmitter-receiver path equals $\frac{n \cdot \lambda}{2}$, where λ = wavelength.

The usual requirement is that 60% of the 1st Fresnel zone should be unobstructed by large, static objects, such as buildings. However, for the varying geometry of a wind turbine, a more conservative approach is taken and the exclusion zone around a signal should at least include the entire 1st Fresnel zone. The radius of the 1st Fresnel zone varies along the length of the signal, and is given by:

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

Where d_1 is the distance from the transmitter
 d_2 is the distance from the receiver
 D is the distance from transmitter to receiver, i.e. $d_1+d_2 = D$

The registered communications licences for each tower according to the ACMA database were analysed to determine the transmission paths of licences that may potentially experience interference from wind turbines (i.e. for frequencies greater than UHF). The paths resulting from the towers analysed are shown graphically in Figure 3. It can be seen that not all of the identified transmission towers have a Fixed licence of Point to Point type transmission vector. Some towers have no active licences associated with them, and some towers are used solely for point to area style transmissions (e.g. some Country Fire Authority (CFA) towers).

A review of the ACMA database shows there are 10 links passing over the proposed wind farm site. These licences are shown in Figure 3.

These links have been further analysed with respect to their operating frequency to determine exclusion zones about each licence vector. The calculations have been conducted based on 1st Fresnel zone setback with turbines of 100 m rotor diameters. These potential exclusion zones are shown in Figure 4 and Figure 5 for the Yendon and Elaine sections respectively. It is common practice to have multiple Assignment IDs for the same physical link to cover practicalities such as licensing for sending and/or receiving signals. Accordingly, the Fresnel zone setbacks have been calculated on the licence with the lowest frequency. Details of all licences are provided in Table 1.

In addition to plan view assessment of Fixed licences of Point to Point type and their associated potential interference zones, a review of each licence was done in conjunction with topographic data [2]. The purpose of the more detailed 3-Dimensional review is to identify those links that pass well over the top of each wind farm site, and therefore will not suffer any potential interference from wind turbines. The links that pass sufficiently close to the ground are of more interest as the wind turbines may potentially cause interference and should therefore be placed to avoid them. The links identified in Figure 4 and Figure 5 have been analysed in conjunction with topographic data and the results for each link are provided in Figure 6 to Figure 15.

From the 3D analysis of the 10 links, 5 of the links pass sufficiently above the site enabling placement of the turbines below the links. The remaining links along with the Fresnel zone exclusions are shown in Figure 16 and Figure 17. These links should be considered as exclusion zones when developing wind farm layouts.

The topographic data used in this analysis is publicly available satellite generated DEM data [2] with a horizontal spatial resolution of 90 m. The elevation accuracy of this data is not known, although checks of the dataset were made using paper map comparison at communication tower locations. From these checks, the DEM elevation data varied by no more than 10 m from the paper map elevations. A further sensitivity check of the 3-Dimensional slice analysis was undertaken using a hub height of 110 m to assess the effects of any such error in the DEM data.

From this analysis, a further 1 link vector (comprising 24 licences) has been identified. Details of the licences are provided in Table 1, and this link is shown in Figure 16.

4 CONCLUSIONS AND RECOMMENDATIONS

Broadcast towers and transmission paths around the proposed Lal Lal wind farm sites were investigated to see if EMI would be an issue for the current proposals. Ten Point to Point style link vectors (involving 68 Fixed licences in total but with many originating and terminating at the same locations) were identified to cross the site. Further analysis shows that of these, only five link vectors (24 licences) passed close enough to the ground over the proposed wind farm site that turbines could potentially interfere with the signal.

One further link was identified that, when considering the likely error in the topographic model, passed close enough to the ground over the proposed wind farm site that turbines could potentially interfere with the signal.

Several Point to Multipoint type Fixed licences were identified proximate to the proposed site. The nearest licence is approximately 4.8 km from the Yendon section of the proposed wind farm.

The details of the licensees of radio communication licences in the region have been provided. It is recommended that these licensees be contacted. Additionally, it is recommended that essential and emergency service organisations be contacted to minimise risks of conflict with radio communications.

REFERENCES

- 1 “Lal Lal Wind Farm Project Update 1”, Westwind energy publication, April 2007.
- 2 3 second digital elevation data obtained from the SRTM data set
(<http://www2.jpl.nasa.gov/srtm/>)

LIST OF TABLES

Table 1	Details of Point to Point licences identified crossing site boundaries.	10
Table 2	Details of Point to Multipoint licences within 50 km of the proposed Lal Lal wind farm.....	17
Table 2	Details of other licences identified within 50 km of the proposed Lal Lal wind farm for frequencies greater than 500 MHz.....	18

LIST OF FIGURES

Figure 1.	Location of proposed Lal Lal Wind Farm.	19
Figure 2.	Location of identified communication sites proximate to the Lal Lal wind farm sections.	20
Figure 3.	Identified transmission vectors for Fixed licences of Point to Point type proximate to the Lal Lal wind farm sites.	21
Figure 4.	Identified radio communications vectors (with Assignment Numbers) and 1 st Fresnel zones for the Yendon section of the proposed Lal Lal wind farm.	22
Figure 5.	Identified radio communications vectors (with Assignment Numbers) and 1 st Fresnel zones for the Elaine section of the proposed Lal Lal wind farm.	23
Figure 6.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	24
Figure 7.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	25
Figure 8.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	26
Figure 9.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	27
Figure 10.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	28
Figure 11.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	29
Figure 12.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	30
Figure 13.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	31
Figure 14.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	32
Figure 15.	Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.	33
Figure 16.	Identified radio communications vectors with Plot ID (see Table 1) with the first Fresnel zone passing below 150 m and 160 m agl over the site area for the Yendon.	34
Figure 17.	Identified radio communications vectors with Plot ID (see Table 1) with the first Fresnel zone passing below 150 m and 160 m agl over the site area for the Elaine.	35
Figure 18.	Identified base stations for Fixed licences of Point to Multipoint type proximate to the Lal Lal wind farm.	36
Figure 19.	Location of general point to area style licences for frequencies greater than 500 MHz within 50 km of proposed Lal Lal site boundaries.	37

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
1	1809836-2226655	1183042	928.3875	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
1	1809836-2226656	1183042	928.3875	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
1	1809837-2226655	1183042	852.3875	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
1	1809837-2226656	1183042	852.3875	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
2	1104847-1104560	1106463	7821.825	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104847-1104561	1106463	7821.825	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104848-1104560	1106463	8133.145	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104848-1104561	1106463	8133.145	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104849-1104562	1106468	7881.125	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104849-1104563	1106468	7881.125	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
2	1104850-1104562	1106468	8192.445	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353

**Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)**

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
2	1104850-1104563	1106468	8192.445	University of Ballarat c/o David Edwards PO Box 663 BALLARAT VIC 3353
3	1315778-1312866	1318174	19695	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
3	1315778-1312867	1318174	19695	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
3	1315779-1312866	1318174	18685	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
3	1315779-1312867	1318174	18685	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
4	1322556-1318132	1324601	932.5	Mobile Communication Systems Pty Ltd 80-82 Bell Street HEIDELBERG HEIGHTS VIC 3081
4	1322556-1318133	1324601	932.5	Mobile Communication Systems Pty Ltd 80-82 Bell Street HEIDELBERG HEIGHTS VIC 3081
4	1322557-1318132	1324601	856.5	Mobile Communication Systems Pty Ltd 80-82 Bell Street HEIDELBERG HEIGHTS VIC 3081
4	1322557-1318133	1324601	856.5	Mobile Communication Systems Pty Ltd 80-82 Bell Street HEIDELBERG HEIGHTS VIC 3081

**Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)**

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
5	8156085-8147627	1430660	7690.5	Lake Imaging Pty Ltd PO Box 42W BALLARAT VIC 3350
5	8156085-8147628	1430660	7690.5	Lake Imaging Pty Ltd PO Box 42W BALLARAT VIC 3350
5	8156086-8147629	1430660	7529.5	Lake Imaging Pty Ltd PO Box 42W BALLARAT VIC 3350
5	8156086-8147630	1430660	7529.5	Lake Imaging Pty Ltd PO Box 42W BALLARAT VIC 3350
6	1510952-1508799	1511950	5945.2	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510952-1508800	1511950	5945.2	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510954-1508799	1511950	6197.24	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510954-1508800	1511950	6197.24	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510955-1508801	1511951	5974.85	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510955-1508802	1511951	5974.85	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510956-1508801	1511951	6226.89	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510956-1508802	1511951	6226.89	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113

**Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)**

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
6	1510957-1508803	1511952	6004.5	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510957-1508804	1511952	6004.5	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510958-1508803	1511952	6256.54	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510958-1508804	1511952	6256.54	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510959-1508805	1511953	6034.15	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510959-1508806	1511953	6034.15	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510960-1508805	1511953	6286.19	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510960-1508806	1511953	6286.19	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510961-1508807	1511954	6063.8	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510961-1508808	1511954	6063.8	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510962-1508807	1511954	6315.84	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113

**Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)**

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
6	1510962-1508808	1511954	6315.84	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510963-1508809	1511955	6093.45	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510963-1508810	1511955	6093.45	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510964-1508809	1511955	6345.49	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
6	1510964-1508810	1511955	6345.49	Digital Distribution Australia Pty Ltd PO Box 1966 Macquarie Centre North Ryde NSW 2113
7	339129-98439	81199	1499	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
7	339129-98440	81199	1499	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
7	38215-98439	81199	1438.5	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
7	38215-98440	81199	1438.5	Telstra Corporation Ltd Atten R Curtis Wireless Technologies 15/242-282 Exhibition St MELBOURNE VIC 3000
7	8166756-8161750	1146114	7463	Telstra Corporation Ltd/Vic SMR Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001

Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
7	8166756-8161751	1146114	7463	Telstra Corporation Ltd/Vic SMR Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
7	8166757-8161752	1146114	7624	Telstra Corporation Ltd/Vic SMR Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
7	8166757-8161753	1146114	7624	Telstra Corporation Ltd/Vic SMR Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
8	1326408-1321246	1327473	928.2375	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
8	1326408-1321247	1327473	928.2375	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
8	1326409-1321246	1327473	852.2375	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
8	1326409-1321247	1327473	852.2375	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149
9	1317338-1314189	1320609	18655	Optus Mobile Pty Limited. Attn Trong Ho & J. Wickramasinghe Singtel Optus Pty Ltd Level 11, 12 Help Street CHATSWOOD NSW 2067
9	1317338-1314190	1320609	18655	Optus Mobile Pty Limited. Attn Trong Ho & J. Wickramasinghe Singtel Optus Pty Ltd Level 11, 12 Help Street CHATSWOOD NSW 2067
9	1317339-1314189	1320609	19665	Optus Mobile Pty Limited. Attn Trong Ho & J. Wickramasinghe Singtel Optus Pty Ltd Level 11, 12 Help Street CHATSWOOD NSW 2067

Table 1 Details of Point to Point licences identified crossing site boundaries.
(Cont.)

Plot ID	Assignment_ID	Licence Number	Frequency [MHz]	Postal Address
9	1317339-1314190	1320609	19665	Optus Mobile Pty Limited. Attn Trong Ho & J. Wickramasinghe Singtel Optus Pty Ltd Level 11, 12 Help Street CHATSWOOD NSW 2067
10	1514203-1512018	1514027	10637	Vodafone Network Pty Ltd Att: Mr Ganesh Ganeswaran PO Box 1066 CHATSWOOD NSW 2057
10	1514203-1512019	1514027	10637	Vodafone Network Pty Ltd Att: Mr Ganesh Ganeswaran PO Box 1066 CHATSWOOD NSW 2057
10	1514204-1512018	1514027	10572	Vodafone Network Pty Ltd Att: Mr Ganesh Ganeswaran PO Box 1066 CHATSWOOD NSW 2057
10	1514204-1512019	1514027	10572	Vodafone Network Pty Ltd Att: Mr Ganesh Ganeswaran PO Box 1066 CHATSWOOD NSW 2057

**Table 1 Details of Point to Point licences identified crossing site boundaries.
(Concl.)**

ACMA Assignment No.	ACMA Licence No.	Site ID	AMG Location	Contact Details
87263-21539	204996	55528	54 752085 5838490	K B Consultancy Pty Ltd PO Box 354 BALLARAT VIC 3353
1146836-2220192	1140420	36275	54 752011 5838451	Regional Internet Australia Pty Ltd PO Box 1982 TOWNSVILLE QLD 4810
1305688-1304661	1308885	301164	54 749900 5837190	Harness Racing Board PO Box 184 MOONEE PONDS VIC 3039
1305689-1304661	1308885	301164	54 749900 5837190	Harness Racing Board PO Box 184 MOONEE PONDS VIC 3039
1309356-1307365	1310561	11681	55 264585 5773225	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1309357-1307365	1310561	11681	55 264585 5773225	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1309263-1307289	1311442	11706	55 266700 5839845	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1309264-1307289	1311442	11706	55 266700 5839845	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1309497-1307479	1311720	11726	54 761145 5836865	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1309498-1307479	1311720	11726	54 761145 5836865	Telstra Corporation Ltd/Gasnet Australia Telstra MR&WS GPO Box 1825 ADELAIDE SA 5001
1326211-1321088	1327337	305779	55 270058 5782309	Shell Refining (Australia) Ltd Refinery Road CORIO VIC 3214
1326212-1321088	1327337	305779	55 270058 5782309	Shell Refining (Australia) Ltd Refinery Road CORIO VIC 3214

Table 2 Details of Point to Multipoint licences within 50 km of the proposed Lal Lal wind farm.

Licence Type	Licence Category	Number of Instances
ACA	ACA Assigned	44
Amateur	Amateur Beacon	5
Amateur	Amateur Repeater	23
Broadcasting	Broadcast Service	227
Earth	Fixed Earth	7
Earth Receive	Earth Receive	10
Fixed	Point to Multipoint	68
Fixed	Point to Point (900MHz STL)	2
Fixed	Sound Outside Broadcast	16
Fixed Receive	Fixed Receive	5
Land Mobile	Ambulatory System	54
Land Mobile	Land Mobile System - > 30MHz	973
Land Mobile	PABX Cordless Telephone Service	11
PTS	PMTS Class B	3318
Radiodetermination	Radiodetermination	41
Scientific	Scientific Assigned	6
Spectrum	1.8 GHz 2000 Lower Band	49
Spectrum	1.8 GHz 2000 Upper Band	49
Spectrum	1.8 GHz Lower Band	98
Spectrum	1.8 GHz Upper Band	1567
Spectrum	2 GHz Lower Band	32
Spectrum	2 GHz Upper Band A	944
Spectrum	2 GHz Upper Band B	3183
Spectrum	2.3 GHz MDS B Band	56
Spectrum	27 GHz Band	2
Spectrum	28 GHz Band	67
Spectrum	3.4 GHz Lower Band	19
Spectrum	3.4 GHz Upper Band A	10
Spectrum	3.4 GHz Upper Band B	4
Spectrum	31 GHz Band	102
Spectrum	500 MHz Lower Band	393
Spectrum	500 MHz Upper Band	381
Spectrum	800 MHz Lower Band	1682
Spectrum	800 MHz Upper Band	2302

Table 3 Details of other licences identified within 50 km of the proposed Lal Lal wind farm for frequencies greater than 500 MHz.

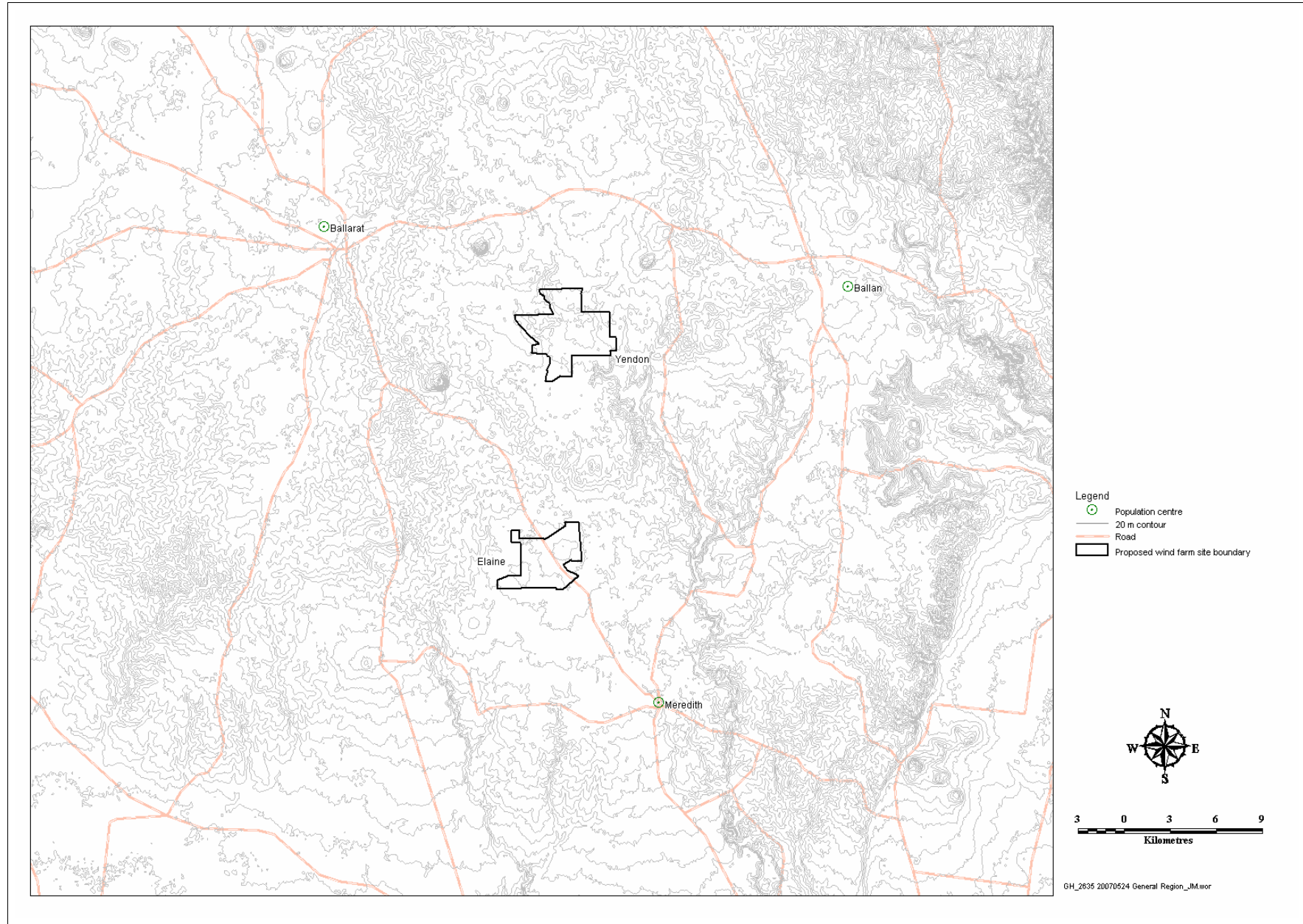


Figure 1. Location of proposed Lal Lal Wind Farm.

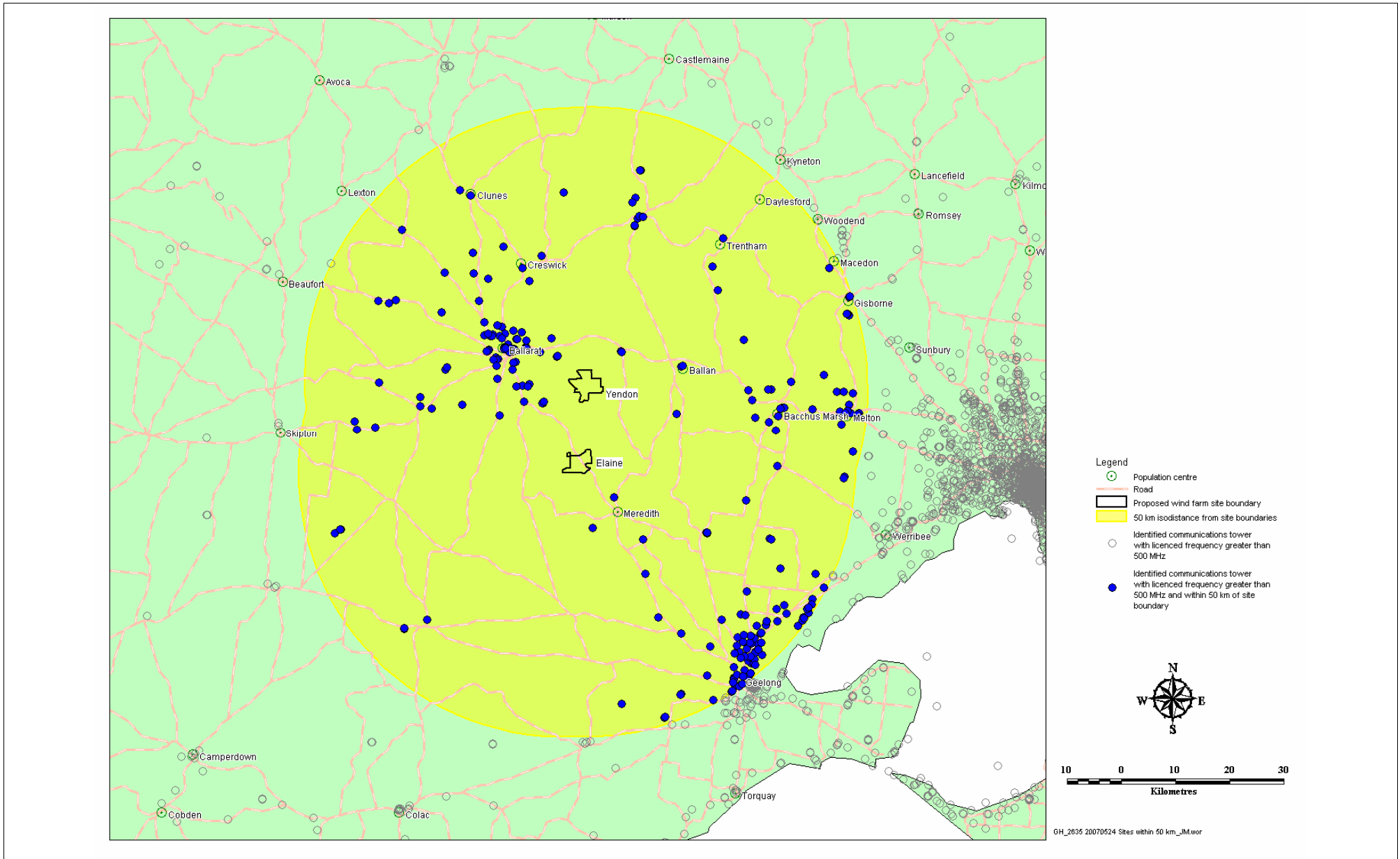


Figure 2. Location of identified communication sites proximate to the Lal Lal wind farm sections.

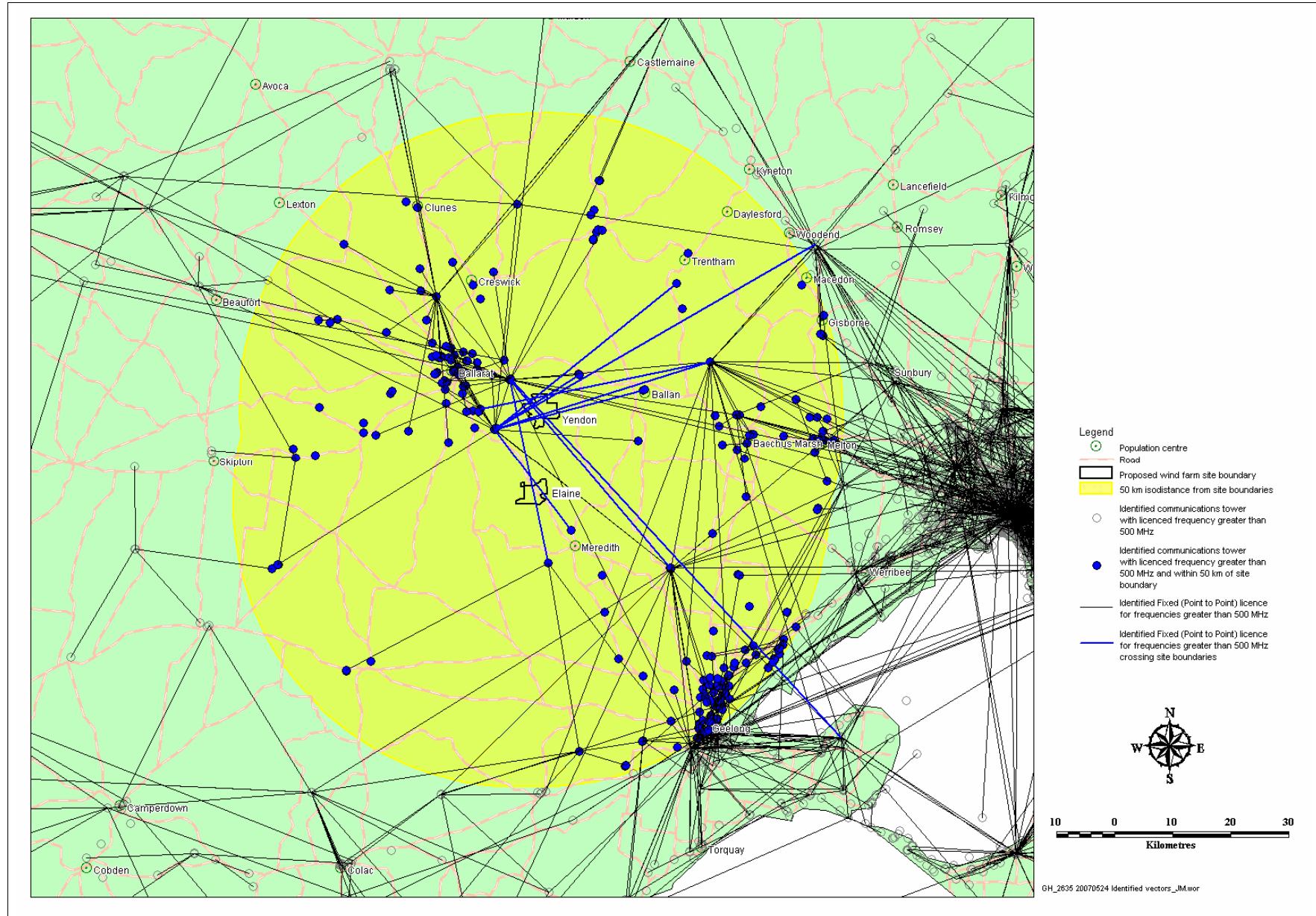


Figure 3. Identified transmission vectors for Fixed licences of Point to Point type proximate to the Lal Lal wind farm sites.

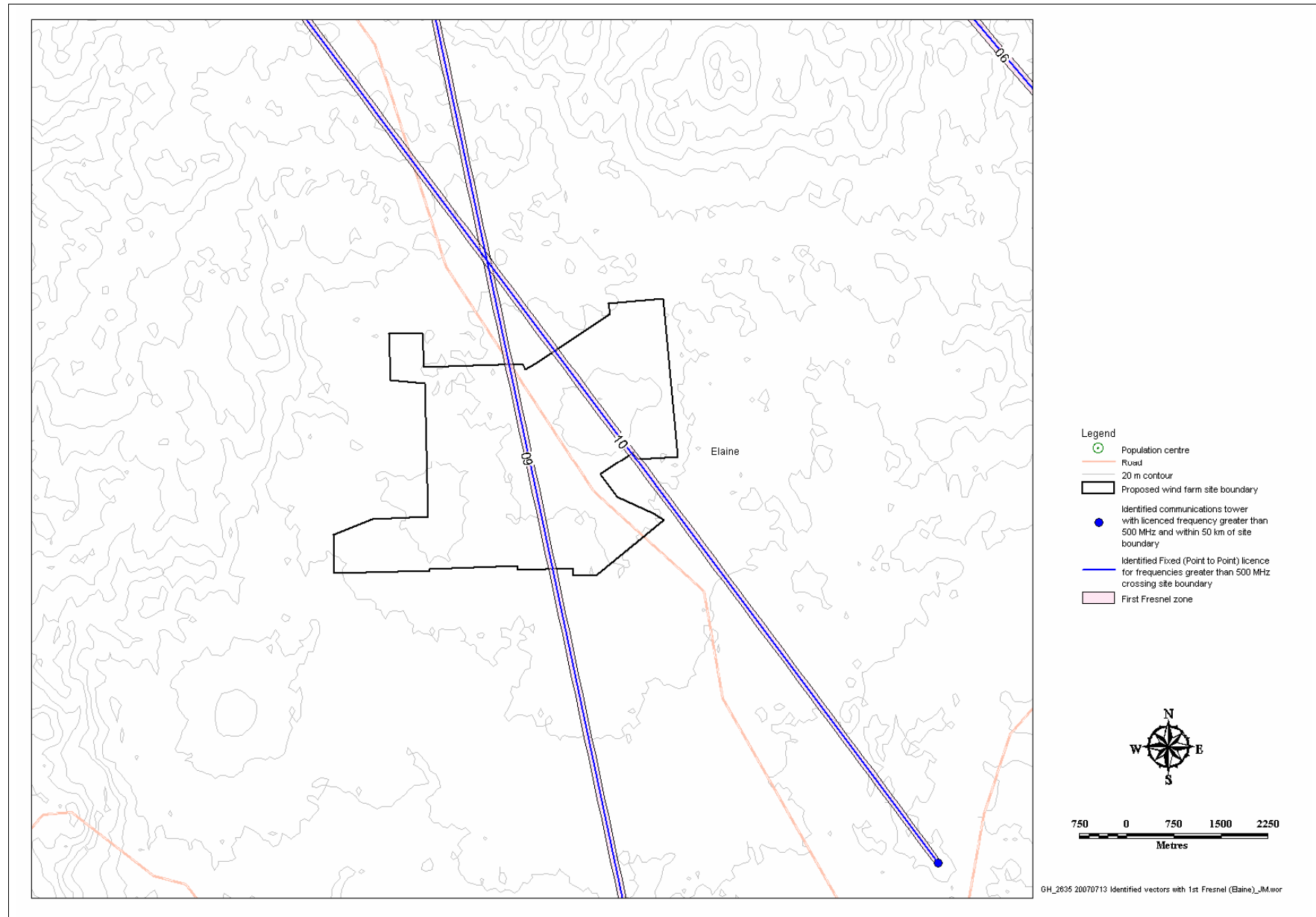


Figure 5. Identified radio communications vectors (with Assignment Numbers) and 1st Fresnel zones for the Elaine section of the proposed Lal Lal wind farm.

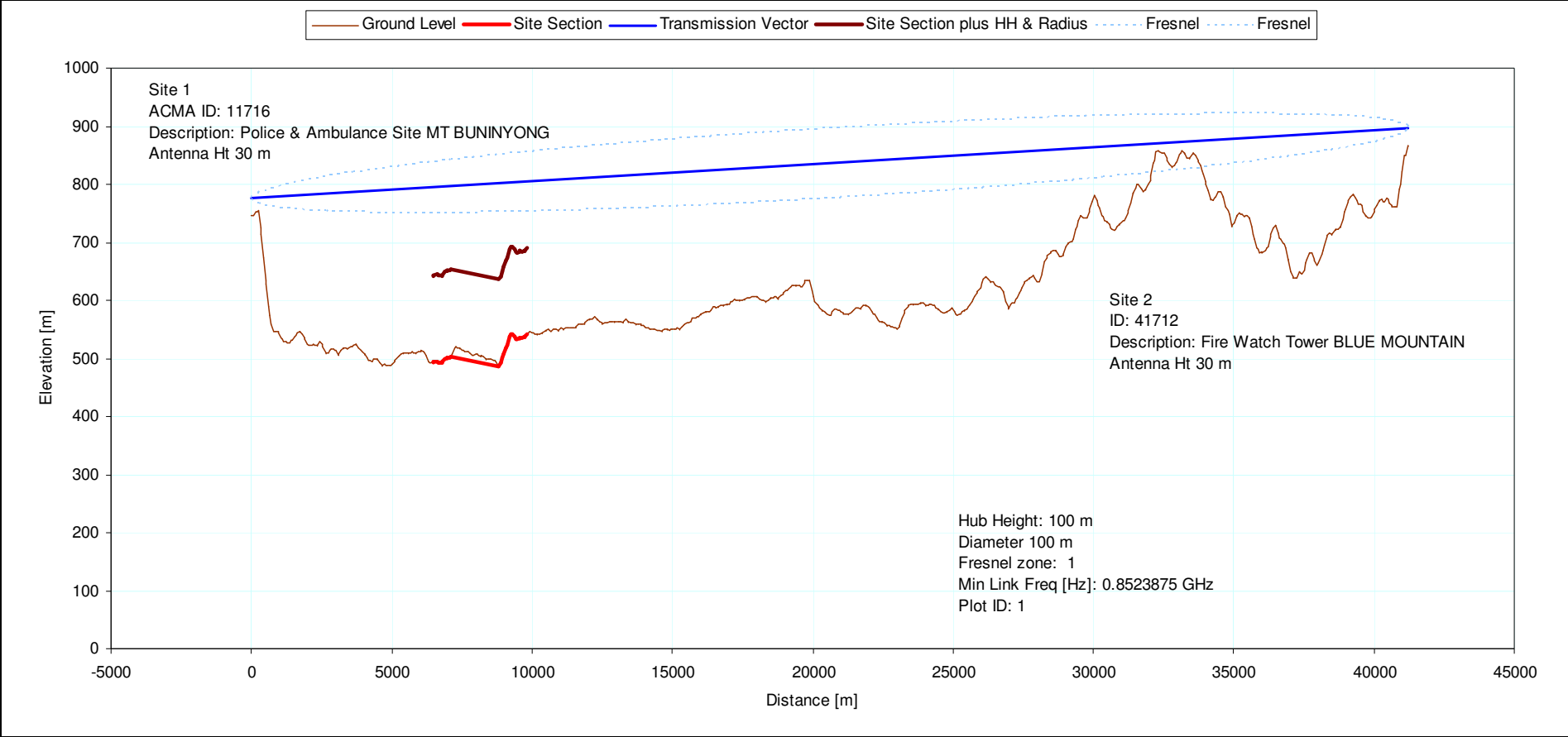


Figure 6. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

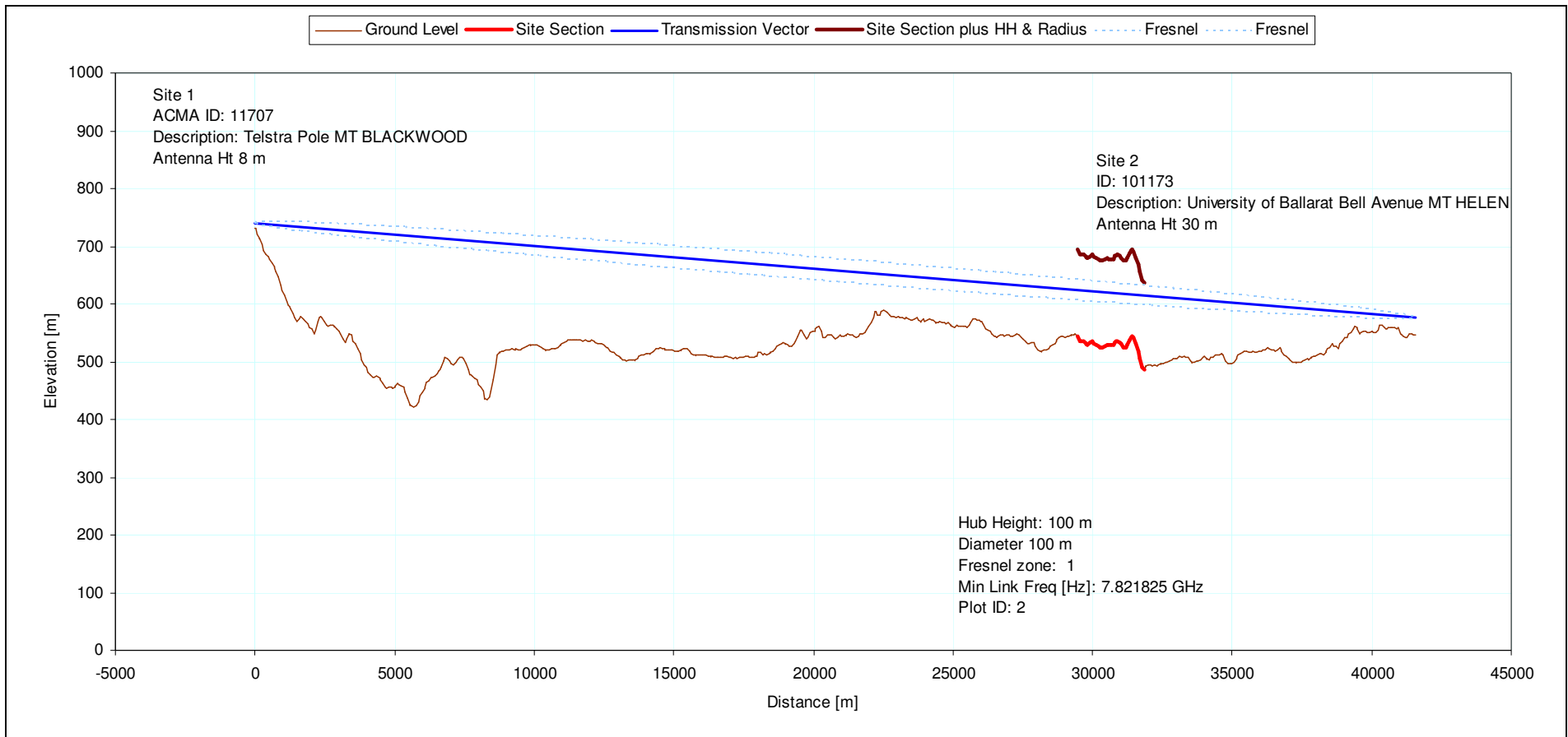


Figure 7. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

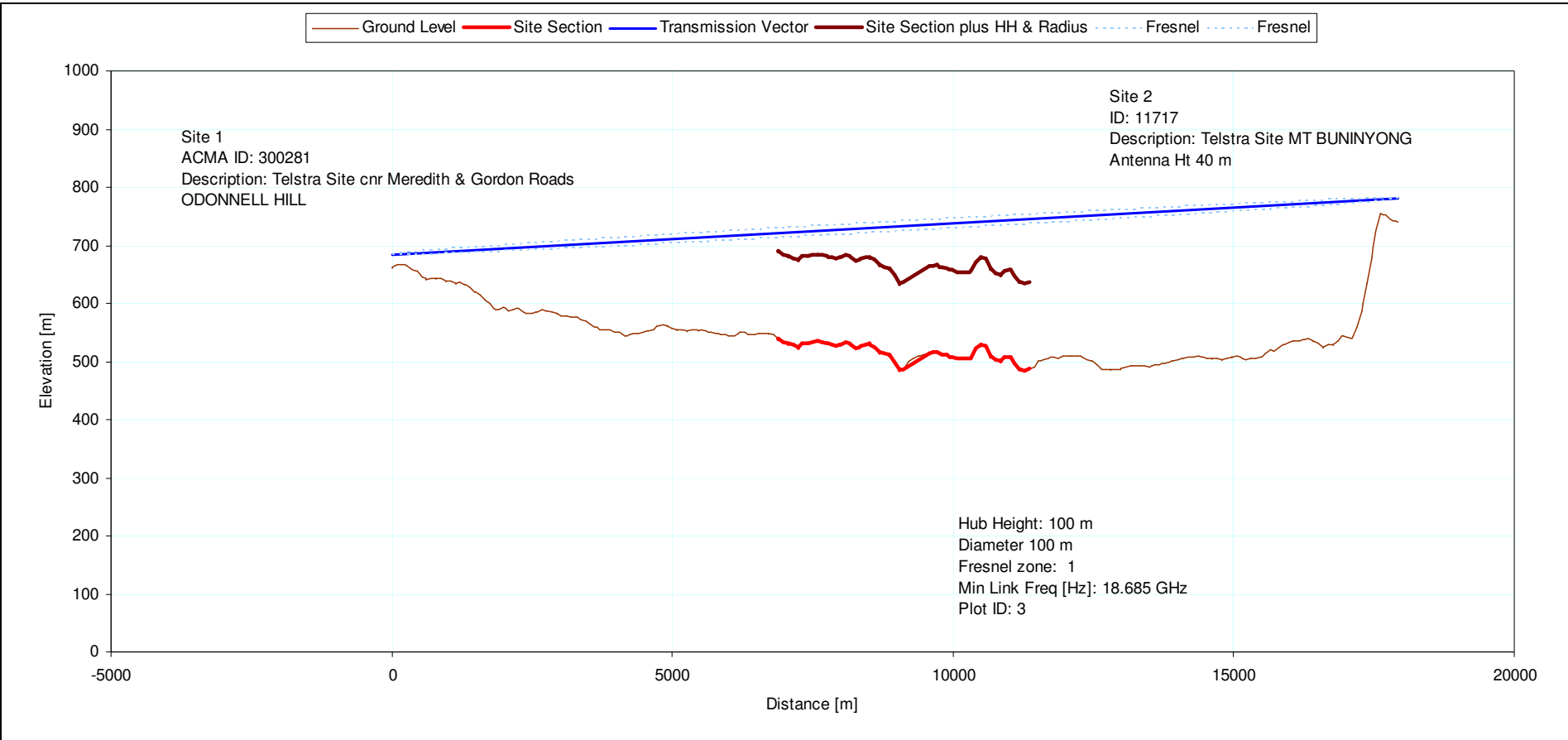


Figure 8. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

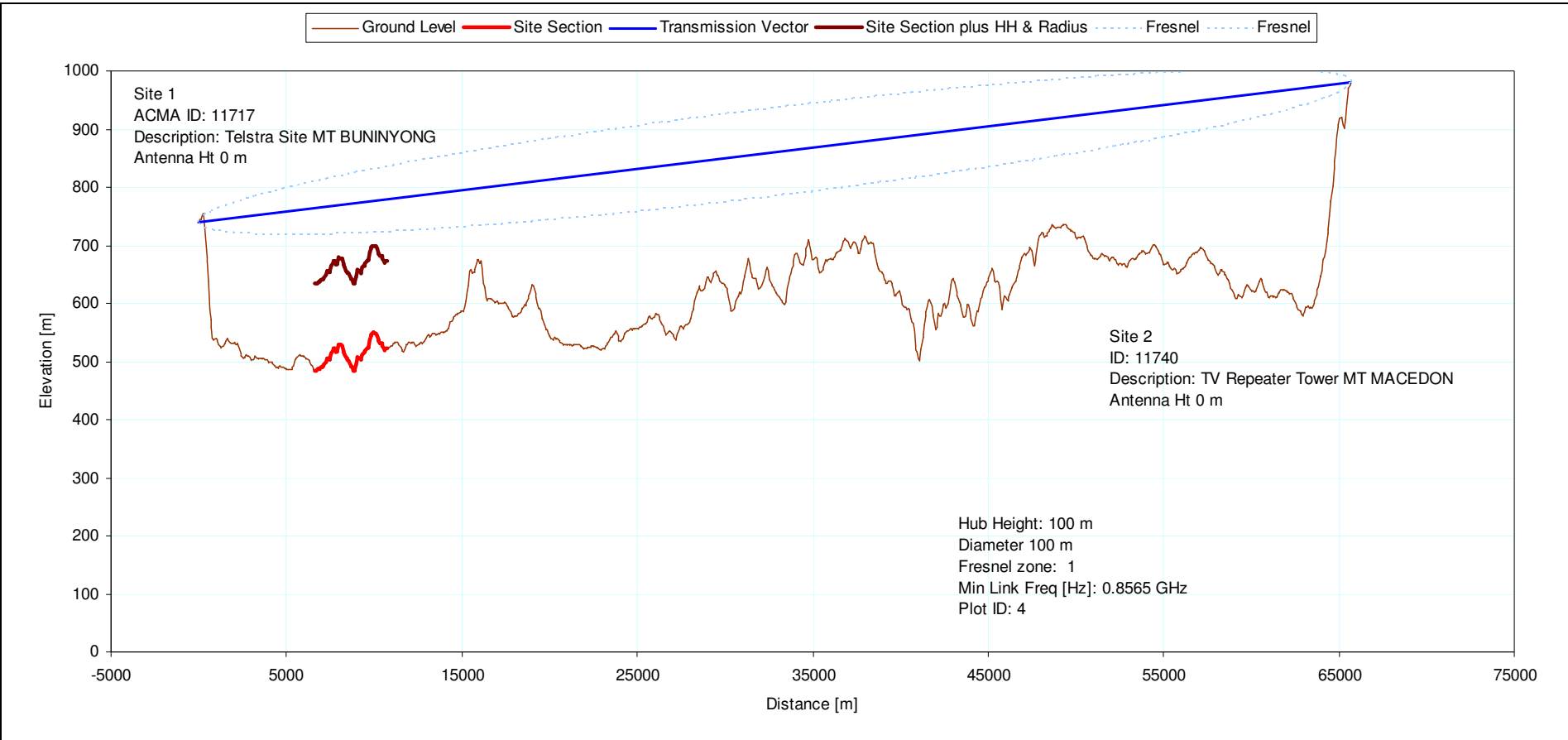


Figure 9. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

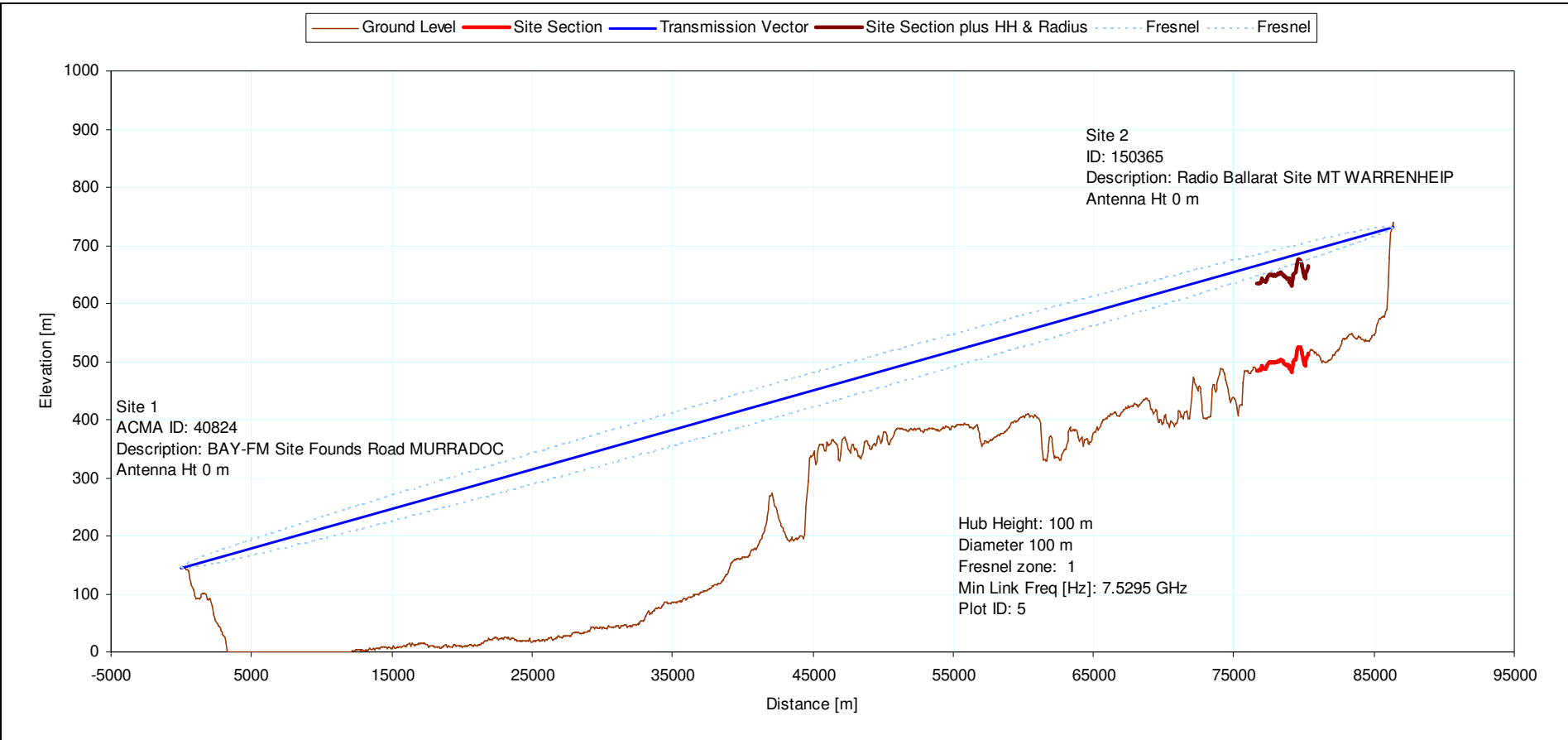


Figure 10. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

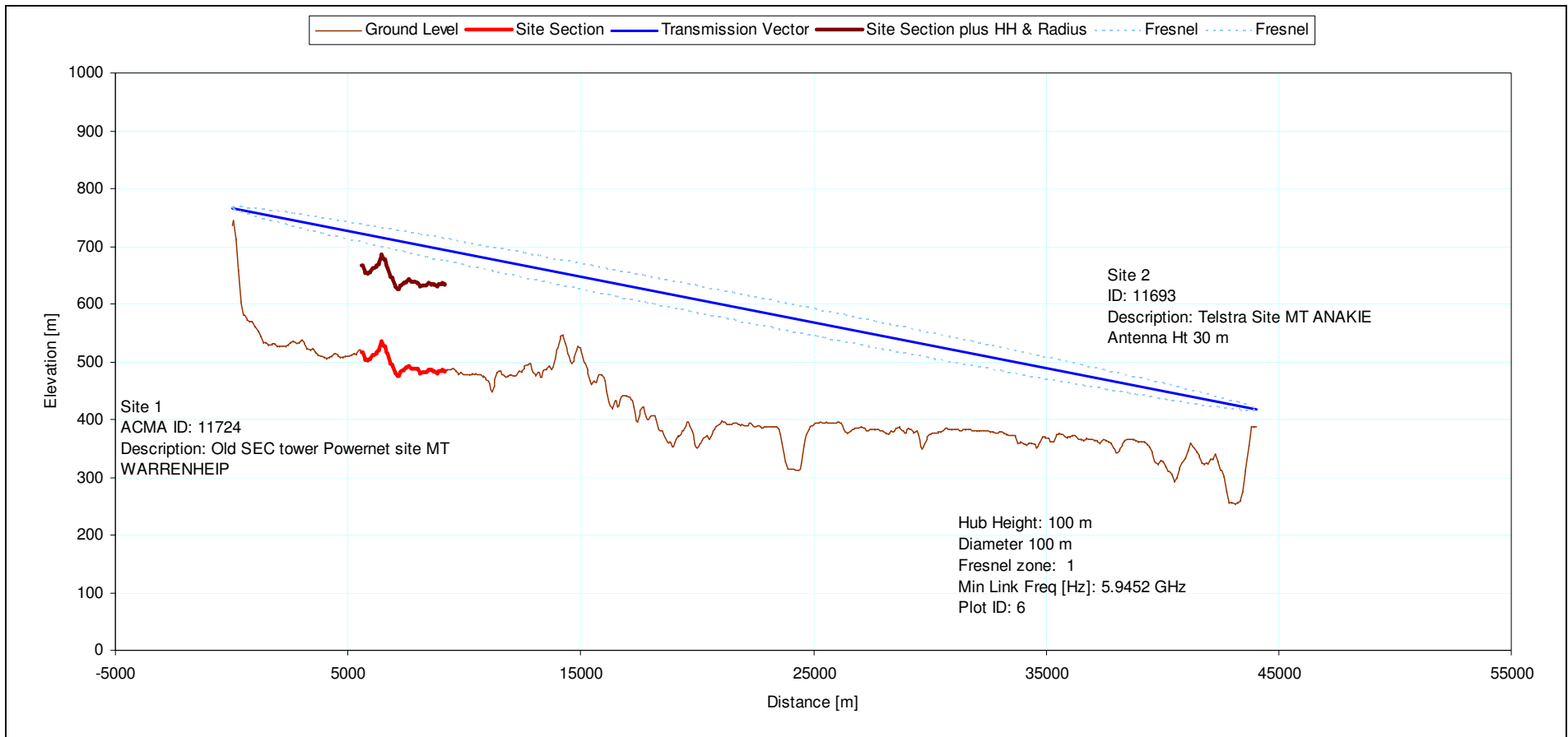


Figure 11. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

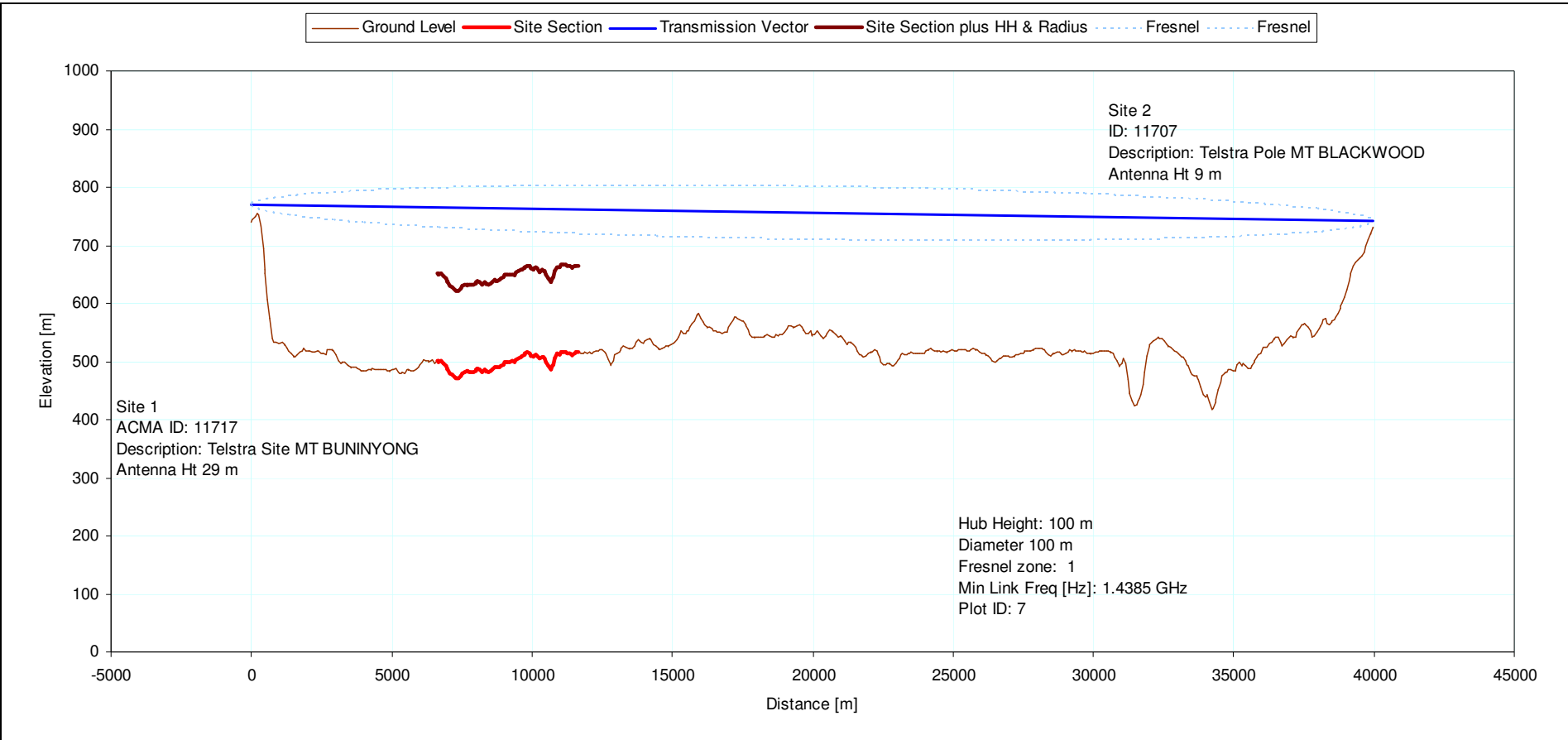


Figure 12. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

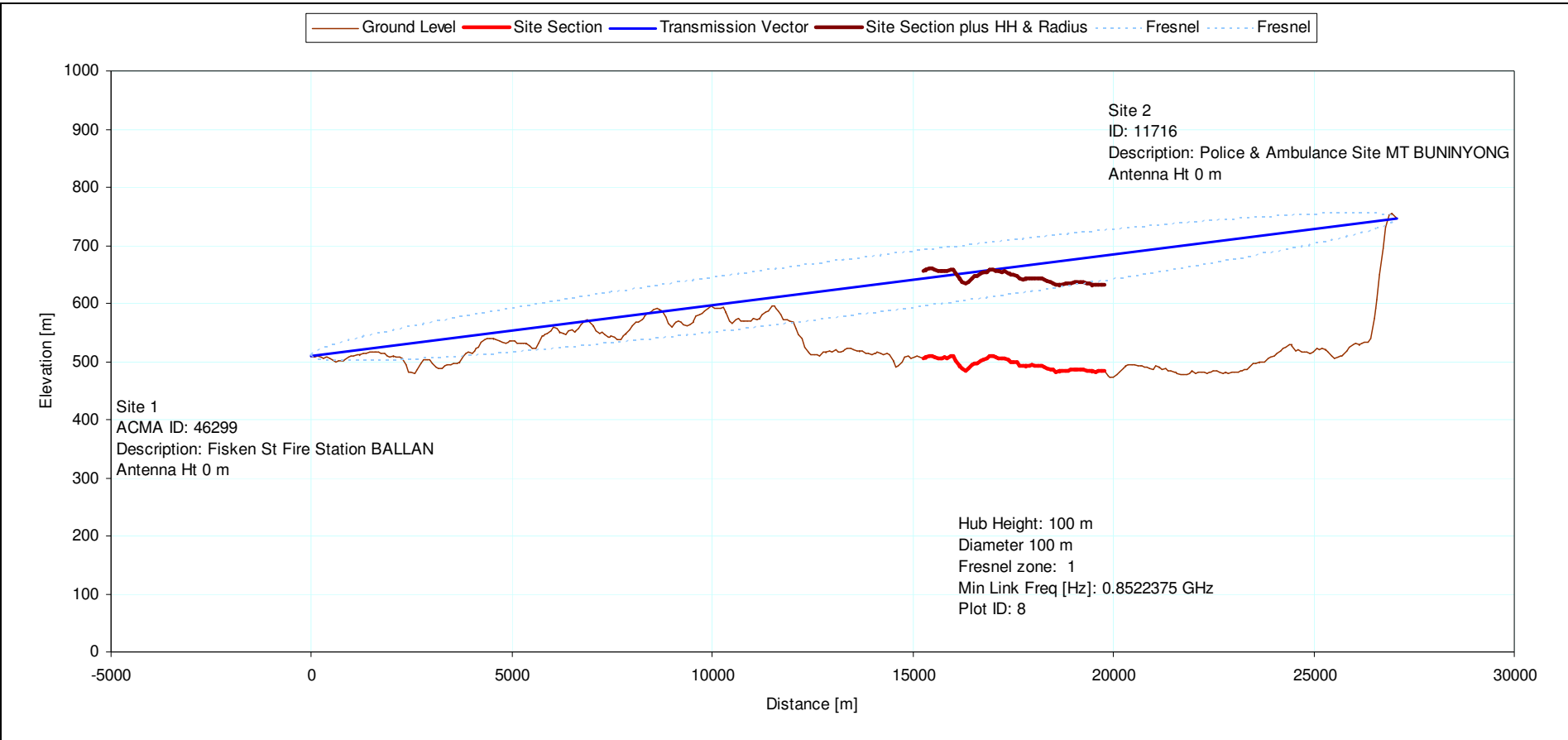


Figure 13. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

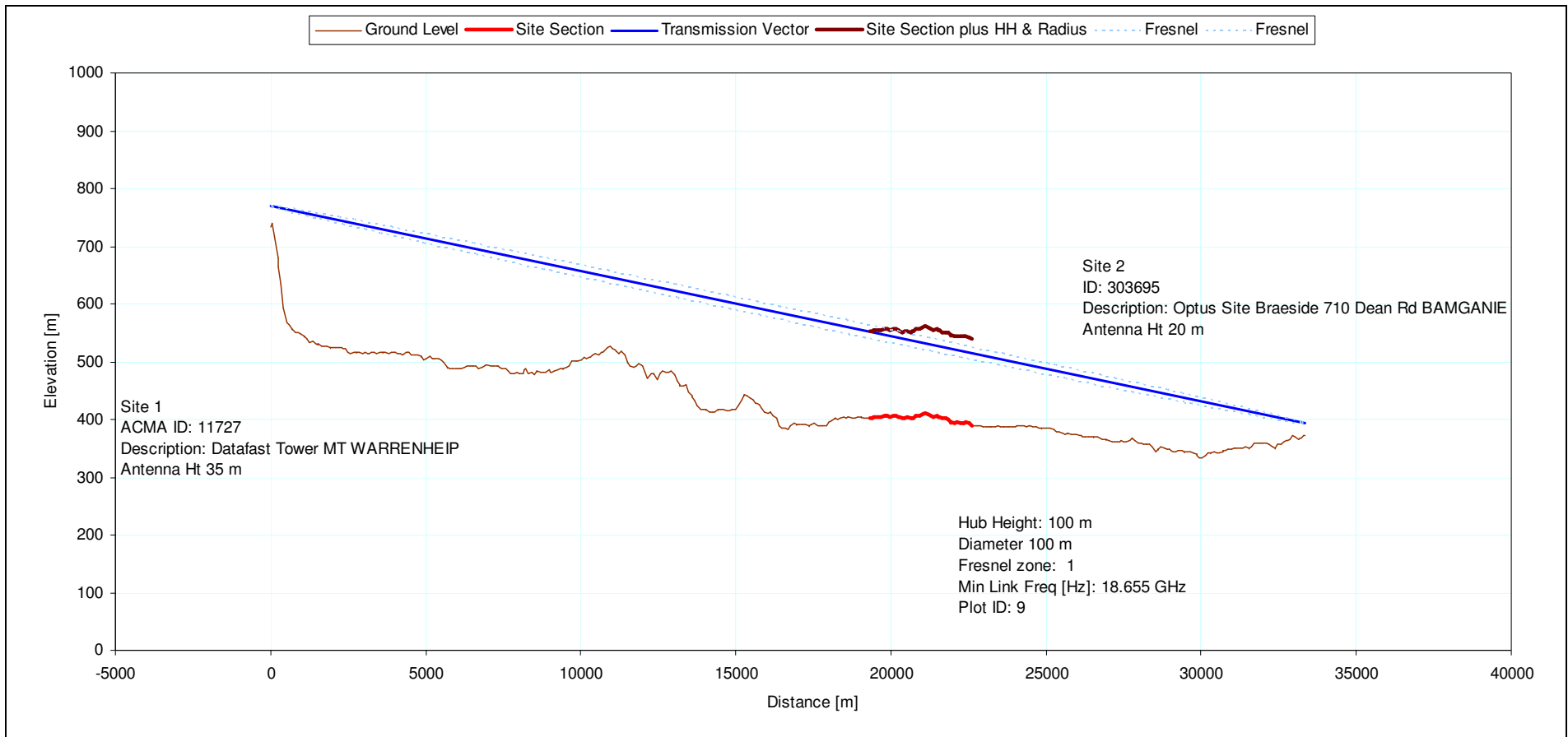


Figure 14. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

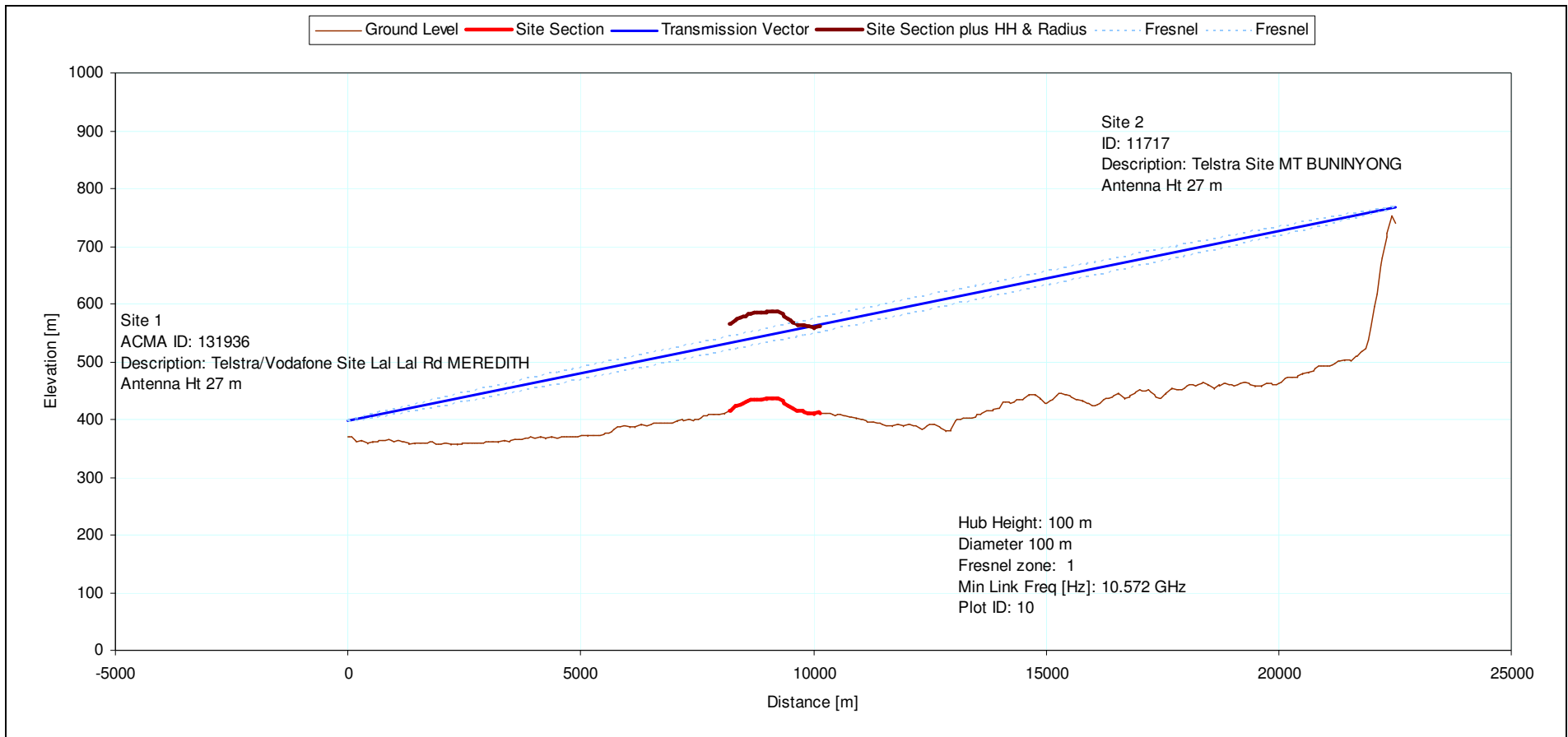


Figure 15. Terrain slice along radio communications vector showing proposed wind farm sections and maximum blade height.

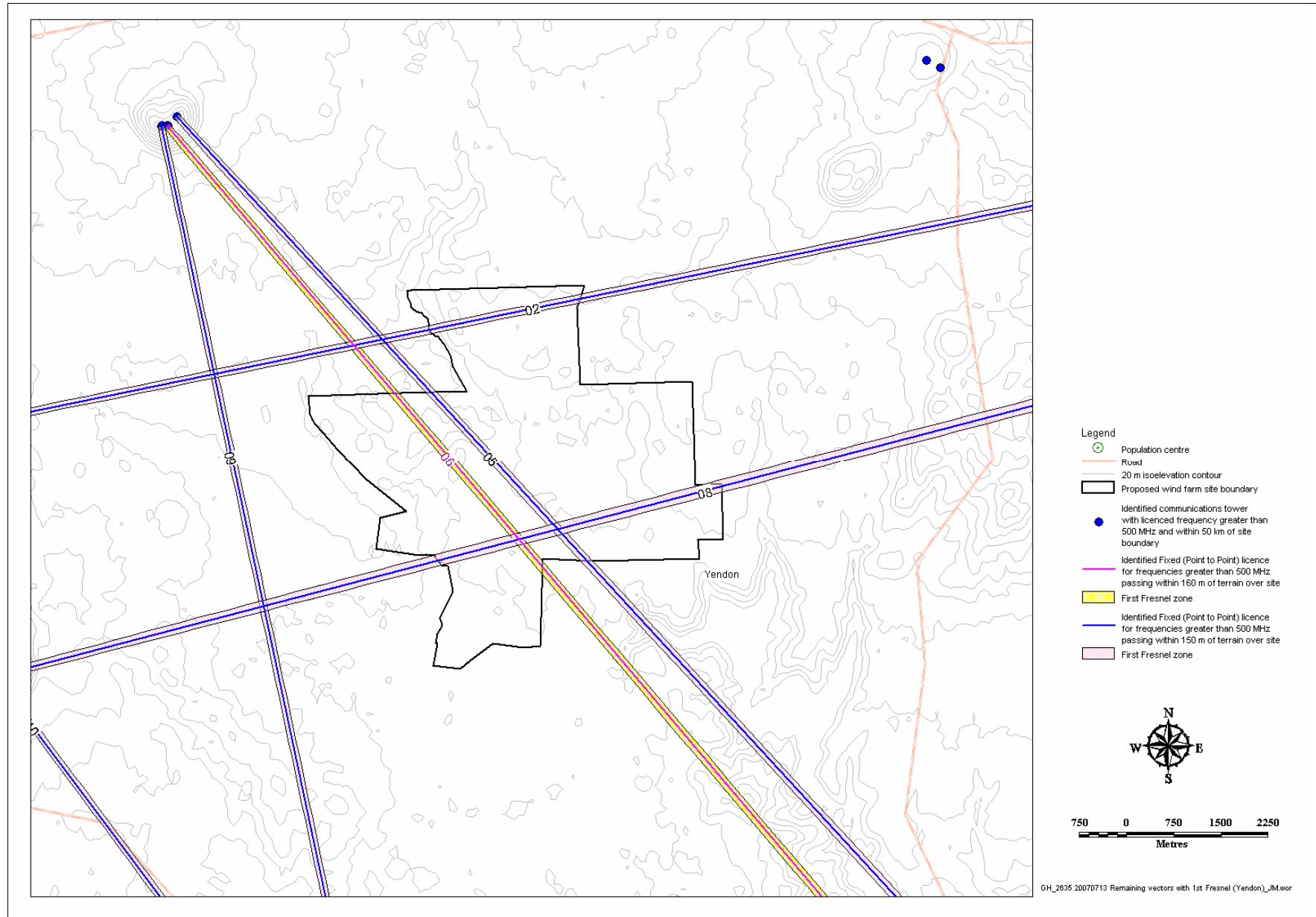


Figure 16. Identified radio communications vectors with Plot ID (see Table 1) with the first Fresnel zone passing below 150 m and 160 m agl over the site area for the Yendon section.

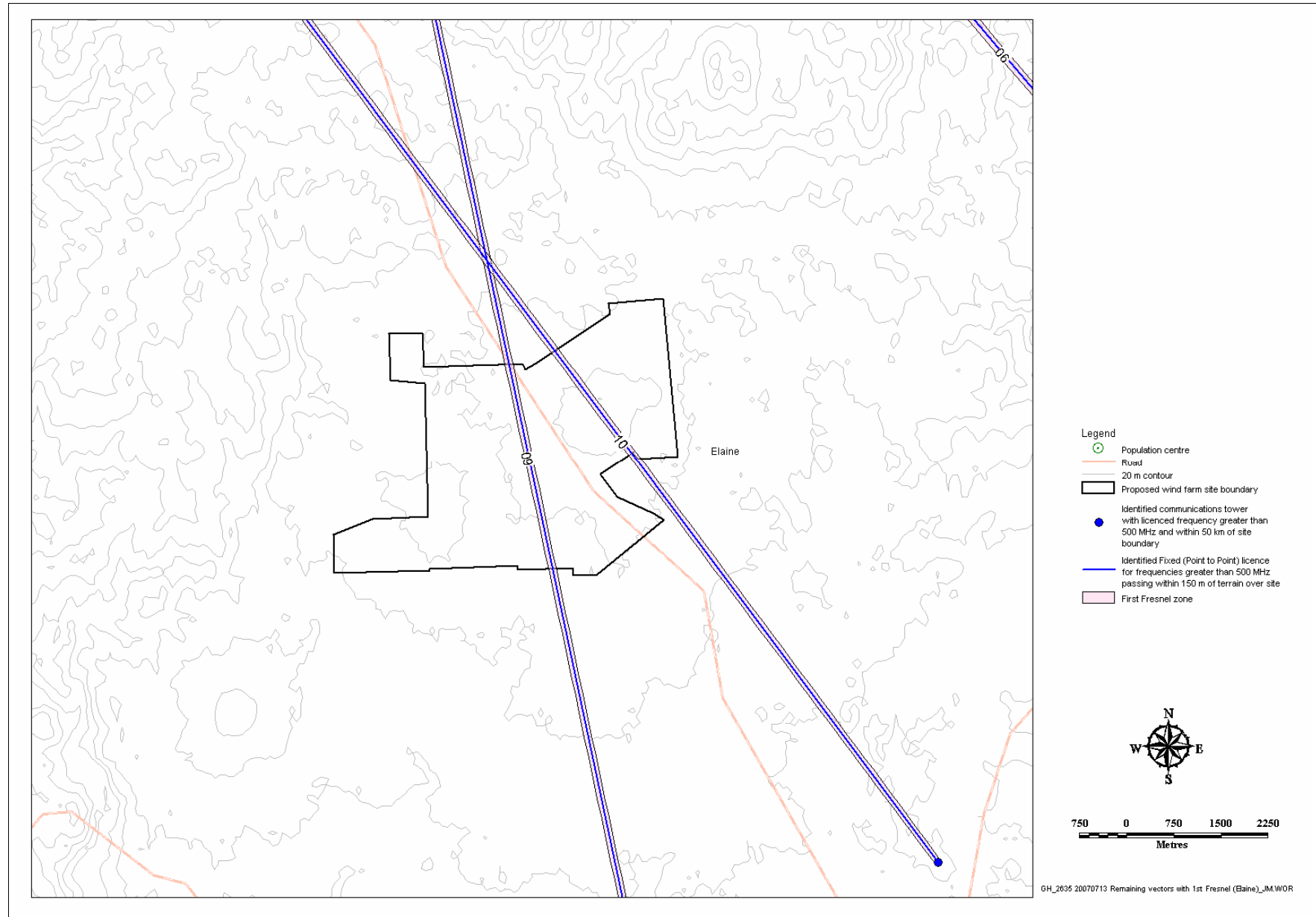


Figure 17. Identified radio communications vectors with Plot ID (see Table 1) with the first Fresnel zone passing below 150 m agl over the site area for the Elaine section.

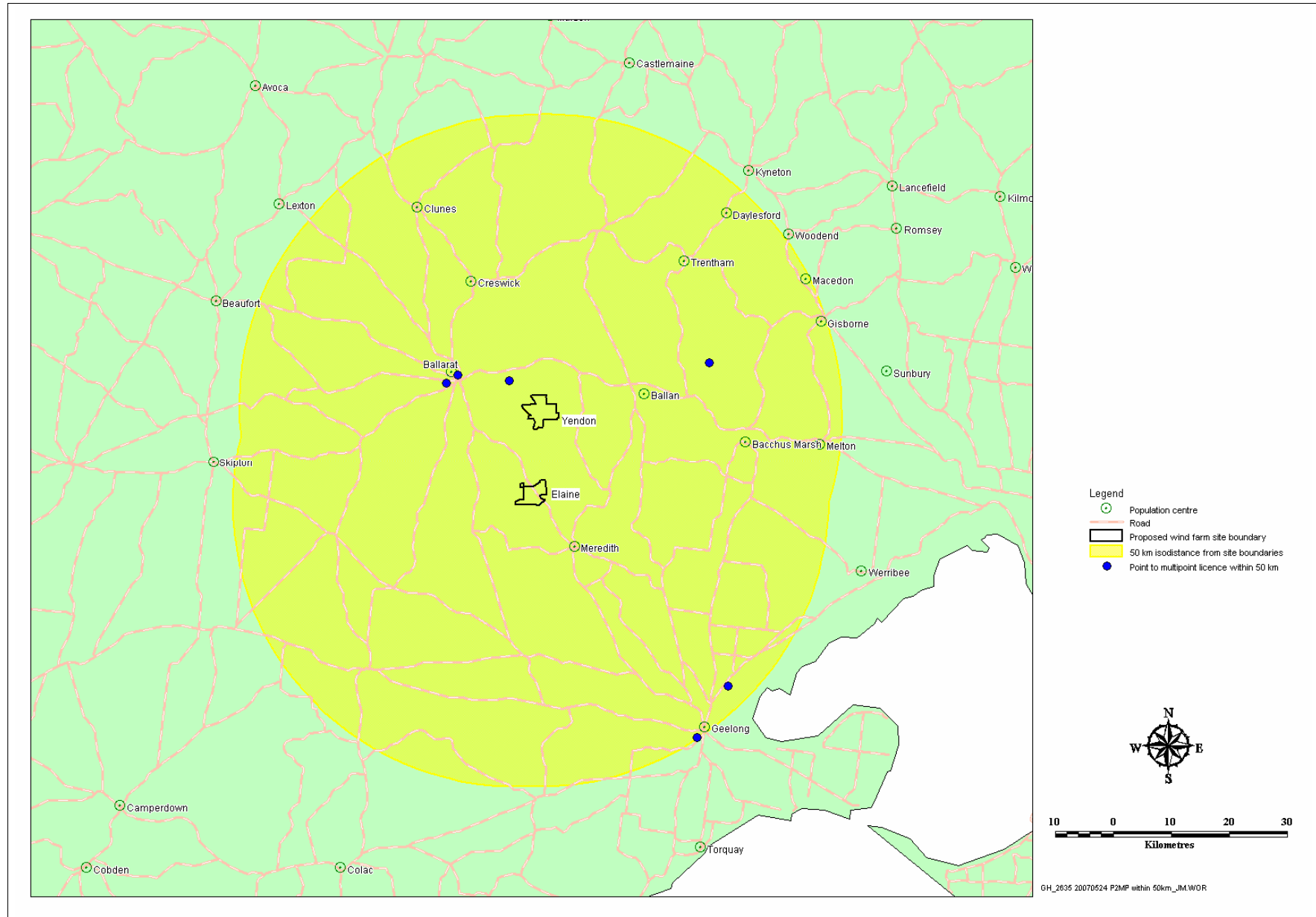


Figure 18. Identified base stations for Fixed licences of Point to Multipoint type proximate to the Lal Lal wind farm.

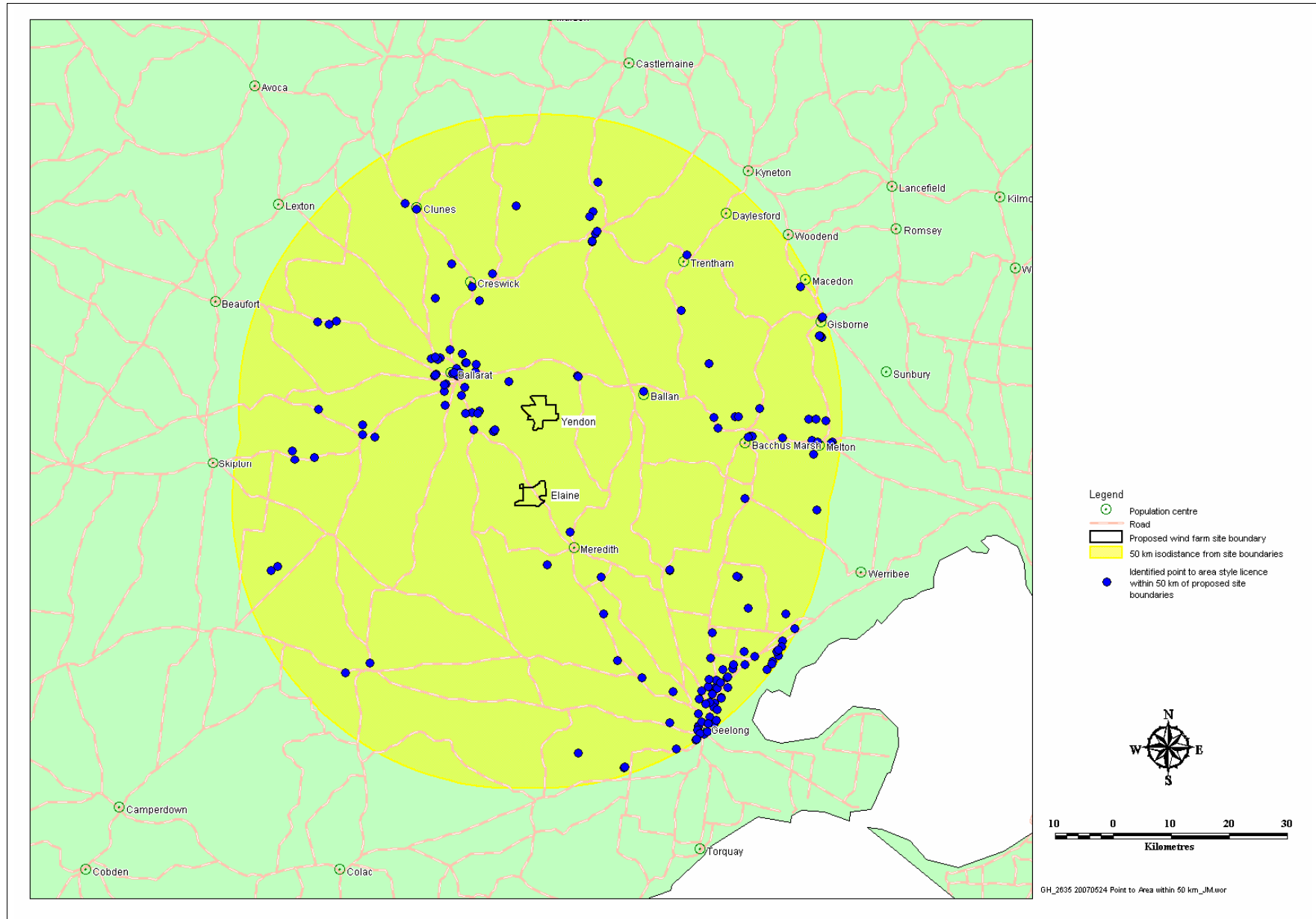


Figure 19. Location of general point to area style licences for frequencies greater than 500 MHz within 50 km of proposed Lal Lal site boundaries.