APPENDIX 17

Bango Wind Farm Electromagnetic and Communication Assessment

Lawrence Derrick & Associates

UPDATES TO THE ENVIRONMENTAL IMPACT STATEMENT

During the preparation of this Environmental Impact Statement, a number of changes occurred.

Please consider these changes while reviewing this Appendix.

- The Assessment Type of the Bango Wind Farm has transitioned from Part 3A, after its repeal, and is now being assessed as a State Significant Development under Part 4 of the EP&A Act. Any reference to a Part 3A assessment in attached technical assessments may be disregarded, and considered as State Significant Development;

- Rugby Wind Farm, a wind farm that was proposed to the north of the Project has been withdrawn. Where references are made to cumulative impacts with the Rugby Wind Farm, please disregard these;

- Slight changes have occurred to the Rye Park Wind Farm layout, a wind farm under development to the east of the Project. The changes made to the layout are not significant and therefore sit within the cumulative impact assessment undertaken for this EIS. The revised layout has been considered in the Environmental Noise Assessment and Landscape Visual Impact Assessment. Where further references are made to the Rye Park Wind Farm layout, these will be incorporated into future documentation where required;

- Four turbines at the south east extent of the Project, situated in the Mt Buffalo cluster have been removed through consultation with landowners. This change has been highlighted in maps and a review of all technical assessments has deemed that the removal of the four turbines has resulted in a reduced. This change will be incorporated into future documentation. These wind turbines are identified as “removed wind turbines” in the Project maps in Volume 2; and

- A number of changes were made to the residence information for the Project, as a result of construction of houses and change in occupancy status of existing buildings. These changes have been incorporated into the EIS.

LAWRENCE DERRICK & ASSOCIATES

Bango Wind Farm

Electromagnetic and Communication System Assessment

Lawrence Derrick B. E. (Elec.)

19/04/2013

Final

This report examines the possible impacts of the proposed wind farm on existing radiocommunications and broadcasting services in the area and proposes interference mitigation strategies where necessary.

REV	DATE	DESCRIPION	AUTHOR	REVIEWED
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	8 Apr 2013	Draft 2, incl. WPCWP markups, index added	LJD	WPCWP
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DISCLAIMER

This Report has been prepared on the basis of ACMA radiocommunications licensing data and broadcasting information and other reference material available in the public domain at the date of production of the report. The Report does not imply that any conclusions are not subject to change

EXECUTIVE SUMMARY

Wind Prospect CWP is developing a proposal for the construction of the Bango Wind Farm situated 20 km north of Yass, 7 km south-east of Boorowa and 80 km west of Goulburn, New South Wales (NSW).

A number of existing Australian Communications and Media Authority (ACMA) registered radiocommunication services are located in the general area and two point-to-point radio services cross the wind farm nominal site boundaries. To ensure that the locations of turbines will not degrade the performance of radio systems minimum separation distances and exclusion zones have been established for the turbine structures.

Residences in the area surrounding the wind farm are possibly provided with TV, FM Sound and other services from high power transmitters located on Black Mountain (Canberra), Mt Canobolas (Central Tablelands) or Mt Ulandra (SW Slopes/E. Riverina). Low power tranmitters near Harden and Gunning exist although they may not cover the area near the wind farm. Based on ABC and DCBDE prediction maps the wind farm is just outside the predicted tertiary service area of all three main stations some dwellings in the area may currently have unsatisfactory TV coverage from the terrestrial services and would need to rely on the VAST or pay TV satellite services. The TV/Sound broadcasting Licensees providing terrestrial services to the area have been identified and correspondence with the organisations involved to request an impact assessment on these services has been initiated.

This Assessment provides an analysis of each of the radio facilities registered near the wind farm. It also establishes recommended clearances based on accepted industry criteria for radio links crossing the wind farm and any required buffer zones for other radiocommunications sites. A study of the signal paths from the main TV stations to the low power TV repeaters has been made to identify any potential interference to their input signals by wind turbines.

Comments are also provided on the radio interference and human exposure impacts from electric and magnetic fields from powerlines and power transmission infrastructure associated with the wind farm.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii
1 INTRODUCTION 1
1.1 Objective of this Assessment 1
1.2 Scope 1
1.3 Assumptions 1
2 WIND TURBINE IMPACTS ON RADIO COMMUNICATIONS 1
2.1 Near-field Effects 2
2.2 Diffraction 2
2.3 Reflection 2
2.4 Omnidirectional Services 2
3 RADIO SERVICES LOCATED NEAR BANGO WF 2
3.1 Point-to-point Systems 3
3.2 Off-Air Links to TV and FM Broadcasting Stations at Harden, and Gunning. 3
3.3 Air Services Facilities 4
3.4 Point to Multipoint (PMP) Services 4
3.5 Radio Sites in Close Proximity to Wind Turbines 4
4 TV COVERAGE IN THE AREA 4
5 CUMULATIVE IMPACTS WITH PROPOSED WIND FARMS 5
6 POWER TRANSMISSION INFRASTRUCTURE ELECTRIC AND MAGNETIC FIELDS 5
7 MONITORING MASTS AND CONSTRUCTION ACTIVITY 6
8 DISCUSSION 6
8.1 Point-to-Point Links 7
8.2 TV and FM Broadcasting Services 7
8.3 Mobile Radio Base Stations 7
9 RECOMMENDATIONS 7
9.1 Point-to-point Links 7
9.2 General Buffer Zones 8
9.3 Interference to Television reception 8
9.4 Interference to Radio Reception 9
10 CONCLUSIONS 9
11 REFERENCES 10
ATTACHMENT 1 11
WIND TURBINE GRID COORDINATES BANGO WIND FARM LAYOUT OPTION 1 11
ATTACHMENT 2 13
WIND TURBINE GRID COORDINATES BANGO WIND FARM LAYOUT OPTION 2 13
ATTACHMENT 3 - TELEVISION STATIONS and CHANNELS - BANGO WIND FARM AREA. 15
ATTACHMENT 4 16
MAP OF RADIO LINKS and SITES OPERATING BELOW 1000 MHz 16
ATTACHMENT 5 17
MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 1 DETAIL 1 17
ATTACHMENT 6 18

MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 1 DETAIL 2 18
ATTACHMENT 7 19
MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 2 DETAIL 1 19
ATTACHMENT 8 20
MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 2 DETAIL 2 20
ATTACHMENT 9 21
MAP OF RADIO LINKS and SITES OPERATING ABOVE 1000 MHz 21
ATTACHMENT 10 22
MAP OF RADIO LINKS OPERATING ABOVE 1000 MHz – OPTION 1 DETAIL 22
ATTACHMENT 11 23
MAP OF RADIO LINKS OPERATING ABOVE 1000 MHz – OPTION 2 DETAIL 23
ATTACHMENT 12 24
SAMPLE CALCULATIONS OF CLEARANCE ZONES 24
ATTACHMENT 13 – ENVIRONMENT and HERITAGE LINK PATH PROFILE SITE 9519 to 9534 26
ATTACHMENT 14 – ENVIRONMENT and HERITAGE LINK PATH PROFILE SITE 201826 to SITE 9534 27
ATTACHMENT 15 28
WIND FARM SITE LAYOUT INCLUDING POWER LINE ROUTES 28
LAYOUT OPTION 1 28
ATTACHMENT 16 29
WIND FARM SITE LAYOUT INCLUDING POWER LINE ROUTES 29
LAYOUT OPTION 2 29
ATTACHMENT 17 30
MAP OF WIND FARMS IN NSW INCLUDING THOSE ADJACENT TO BANGO WIND FARM 30
ATTACHMENT 18 – ABC PREDICTED TV COVERAGE FOR MAIN STATIONS 31

LIST OF TABLES

TABLE 1 - UHF LINK CLEARANCES 3
TABLE 2 – LOCAL TV AND SOUND BROADCAST STATIONS 3
TABLE 3 - POINT TO MULTIPONT SYSTEMS IN THE AREA 4
TABLE 4 - TV STATION TRANSMITTER SITES 4
TABLE 5 - WIND FARMS ADJACENT TO BANGO WIND FARM 5
TABLE 6 - OVERHEAD TRANSMISSION LINE DIMENSIONS 6
TABLE 7 – RECOMMENDED CLEARANCES FOR RADIO POINT TO POINT LINK 7
TABLE 8 - RADIO LINK CLEARANCE COMPLIANCE 8

1 INTRODUCTION

The Project currently comprises a wind farm with two potential wind turbine layouts; one consisting of 122 wind turbines (Layout Option 1) and the other up to 96 wind turbines (Layout Option 2), together with ancillary structures spread over 15 different properties. A maximum blade tip height of 192 m for the turbines has been assumed for this assessment. This results from a maximum tower height of 120 m and a blade length maximum of 72 m. The coordinates of the wind turbines provided by Wind Prospect CWP are shown in Attachments1 and 2 for both layouts.

1.1 Objective of this Assessment

The objective of this Assessment is to determine the clearance requirements for the radio services in the area to allow a turbine layout to be planned so that there will be no detrimental effects on the performance of the existing services. The object also is to derive a minimum required buffer zone for the omnidirectional services including mobile radio base stations and any nearby TV/ FM Broadcasting transmitting station, ensuring an acceptable grade of protection to the coverage required in the service areas of each service. A check that the both proposed turbine layouts meet the required clearance criteria for the various radio links and radio sites has also been undertaken.

1.2 Scope

Criteria for clearance of obstructions from point-to-point link ray lines have been well established in the literature, including the specific case of rotating turbine blades. For omnidirectional mobile and other services, however, any need for a buffer zone is usually dismissed on the basis of the accepted variability of coverage to/from the mobile or hand held terminals in the normal operational environment. The known exception to this are the South Australian Department of Transport Energy and Infrastructure (SA DTEI) guidelines prepared by Telstra for the derived exclusion zone for the SA – GRN 400 MHz mobile radio base stations.. This Assessment considers the factors involved in the specific services in the locality of the Project site and proposes what are considered to be acceptable clearance zones.

The possible impact on Free-to Air TV and Radio Broadcasting services to residents near the wind farm is also discussed.

1.3 Assumptions

Data for the existing services was sourced from the Australian Communications and Media Authority (ACMA) database for licensed radiocommunication services both from a recently issued CD ROM and the ACMA public website. The accuracy of the location of towers specified in the database, is shown in some cases to be within 10 metres and in the others within 100 metres. No check survey has been carried out.

It is also assumed that modern wind generators are well electromagnetically shielded to international standards and are not the source of any significant generated electromagnetic interference in the frequency bands used by radio services in the area. This report considers the reflection, scattering or obstruction of signals to the radio services, potentially caused by close spacing of the turbines to the radio link ray lines between transmitting and receiving site pairs.

2 WIND TURBINE IMPACTS ON RADIO COMMUNICATIONS

The paper by D. F. Bacon in 2002 (Reference 1), issued by Ofcom, the regulator for the UK communications industries, has become the most used reference by the industry for the calculation of clearance zones from turbines to the ray line and antennas for point to point links. The Paper identifies three principal mechanisms which are relevant to a wind turbine in proximity to a microwave link. These are near-field effects, diffraction and reflection, and are discussed in detail below.

2.1 Near-field Effects

A transmitting or receiving antenna has a near-field zone where local inductive fields are significant, and within which it is not simple to predict the effect of other objects. Bacon's paper (Reference 1) provides the well known formulae for calculation of the near-field distance depending on the gain or physical aperture of antenna. The near field distance is a function of frequency and the physical dimensions or gain of the antenna.

2.2 Diffraction

An object detrimentally modifies an advancing wavefront when it obstructs the wave's path of travel. Here the formula applied is for the classical Fresnel zone distance where diffraction will be insignificant if obstructions are kept outside a specified volume of revolution around a radio path.

2.3 Reflection

The physical structure of the turbine and in particular the rotating turbine blades reflect interfering signals into the receiving antenna of a fixed link. A formula is given in Bacon's paper (Reference 1) to derive a distance from the radio path where any reflected/scattered signal will be of an amplitude sufficiently smaller than the direct signal arriving at the receiver. The acceptable Carrier/Interference (C/I) ratio will depend on the modulation and coding schemes of the link. Bacon's paper (Reference 1) provides formulas to calculate the distance from the link path where the C/I will be below a desirable level depending on the link parameters.

The calculation of the scattering level of RF signals from turbines is complex and varies with RF frequency, physical dimensions of the turbine blades and their twist, tilt and orientation. Radar Cross-Section (RCS) values are used in Bacon's paper (Reference 1) and elsewhere to account for the scattering characteristics of individual turbines. A wide spread of values appear in the literature for typical modern turbines which makes the estimation of the scattered signal levels uncertain. It is noted that Bacon's paper (Reference 1) uses an RCS value of 30 m² whereas the SA DTEI guidelines use a value of 480 m² which is the total area of the 3 blades based on an assumed width of 4 metres each and lengths of 40 metres. In another British study (Reference 3), the RCS of turbines were modelled and validated with actual field measurements. This study focused on the aviation radar signatures of wind farms and measurements were carried out with radar in the 1 to 3 GHz range. Peak RCS values can significantly exceed the physical area of the turbine but they will occur over narrow arcs. The wind generator nacelle and the general shape of the tower itself can make significant contributions. Reference 3 stated that a 100 metre tall tower with 45 metre turbine blades was estimated to have a maximum peak RCS of 25000 m². According to Reference 3, this high peak was probably associated with a particular style of nacelle and tower. For the purposes of this study a peak of 1000 m² associated with the blades is considered appropriate. The RCS will, of course, vary with wind direction, blade pitch and other design factors including rotor tilt and coning angle. Multiple turbine interference from a wind farm will also be additive on a power basis due to the uncoordinated sources.

2.4 Omnidirectional Services

Bacon's paper (Reference 1) was written for the point-to point-radio link situation and no omnidirectional system (e.g. mobile radio base station) was considered. The SA DTEI guidelines have been developed for omnidirectional mobile services from Bacon's paper (Reference 1) by applying the formula for the point-to-point link reflection/scattering case to an omnidirectional service. It further derives another criterion for the case where the remote mobile/portable unit is located at points where a turbine is in line with the transmission path to the base station. A criterion of no more than 10% of the Fresnel zone width being blocked by a blade width of 4 metres appears to have been employed to derive an exclusion zone. This purports to limit signal variations as a result of the turbine to 0.5 dB.

3 RADIO SERVICES LOCATED NEAR BANGO WF

From the latest ACMA database, maps have been prepared showing registered radio sites and point-to-point links in the locality of the Project site. Attachment 4 shows the situation for systems with frequencies below 1000 MHz with zoomed views in Attachments 5, 6, 7 and 8 for both layout options. Attachment 9 shows the links and sites for systems operating on frequencies above 1000 MHz with zoomed views in Attachments 10 and 11. These include separate maps for Layout Options 1 and 2. Typical calculations of required clearances are shown in Attachment 12 using the formulas in Bacon's

paper (Reference 1). It should be noted that site numbers displayed in Attachments 4 and 9 may not be the actual ones associated with a particular point to point links due to label overlap of close spaced site labels.

3.1 Point-to-point Systems

The radio link maps have been examined and the links crossing the wind farm site and near radio sites have been identified from the ACMA data. There are two point-to-point links in the UHF bands operated by one operator over the two paths which nominally cross the site. A third microwave link crossing near the wind farm boundary is show in the link mapping, how it is no longer shown in the ACMA public database. One radio site located inside the wind farm boundaries requires consideration from a buffer zone point of view. A summary of the calculated 0.6x 1st Fresnel zone clearances at mid-path and at 1 km are shown in Table 1. The locations of the turbines for both layouts have been shown in the link maps generated in MapInfo and were used to confirm that distances from radio link ray lines and the turbine tower centrelines meet the clearance criteria.

TABLE 1 - UHF LINK CLEARANCES

PATH ACMA Site ID's	Total Path Dist. km	Frequency Band MHz	Operator	Mid Path* 0.6x 1st Fresnel Zone Distance m	**1 Km Fresnel Zone Distance m**
9519-9534	86.69	400	Environment and Heritage	76.5	16.3
201821-9534	86.71	900	Environment and Heritage	51.0	10.9

*or where path passes wind turbines

The calculation of the reflection/scattering zone using the Bacon formula (Reference 1) requires iteration with increasing values of the distance from the path bore sight at each distance from the terminal until the required C/I value is reached. As the recommended clearance distances above are calculated for the mid path for each link (where the clearances are at a maximum) scattering from turbines near a radio site will be low.

3.2 Off-Air Links to TV and FM Broadcasting Stations at Harden, and Gunning.

Nearby low power TV and FM Broadcasting stations for Harden, Gunning, Boorowa and Mount Manton are located at sites as shown in Table 2 below:

TABLE 2 – LOCAL TV AND SOUND BROADCAST STATIONS

Town	Site ID	Type	Distance to nearest WT Km
Harden	140020	TV	34.85
Gunning	9504	TV	39.4
Mount Manton	151009	FM	24.75
Boorowa	9547	FM	7

The nearest of these broadcasting sites is about 7 km from the nearest turbines. All of these sites are separated from the wind farm by sufficient distances to not have their TV or FM coverage impacted by wind turbines. From some past special purpose ACMA data it appears that the Gunning station receives TV signals off-air from the Canberra main TV station. The Harden station also is likely to receive TV signal off air from Canberra. Examination of the signal paths between the Canberra main stations and these repeaters indicates that the paths are well clear of turbines.

3.3 Air Services Facilities

There are two registered Air Services Radar sites, 9001816 and 9010120, located approximately 18 km from the nearest turbine, that are possibly within line of site of the turbines. . Non Directional Beacons (NDBs) and /or other VHF services are also located at site 9010120. It is recommended that an Aviation Specialist considers the issue of any impact of the turbines on the performance of the radar facilities. It is considered that there will be no impact on the VHF services due to separation distance.

3.4 Point to Multipoint (PMP) Services

Table 3 lists sites within the Study area which are specified as point to multipoint services. Usually only the base stations are ACMA registered for PMP systems, so the remote (subscriber or device) end is not known. It is therefore not possible to determine if there could be any turbine obstruction in the paths between the base and the fixed remote end.

TABLE 3 - POINT TO MULTIPONT SYSTEMS IN THE AREA

Site/Service	Frequency Band MHz	Operator	Comment
34853/Boorowa	450	Boorowa Council	UHF
9551/Harden	450	Goldenfields Water	UHF
9529/Mt Manton	450	Yass Valley Council	UHF
101225/Harden	450	Harden Council	UHF
202399/Gunning	900	Aust. Rail Track	UHF
198028/ Beremangera	900	Goldenfields Water	UHF

Given that most base station locations are remote from the wind farm site there is a low probability that any path to the remote (subscriber or device) would cross the wind farm. It would be prudent to advise the operators of the PMP Services of the wind farm proposal.

3.5 Radio Sites in Close Proximity to Wind Turbines

There are no radio sites within the Project site or Study area. One site, 304511, appears to exist on the project site as shown on the link mapping in Attachment 5 however this is incorrect. Investigations showed that a site coordinate error exists in the ACMA database which placed this site incorrectly.

4 TV COVERAGE IN THE AREA

An investigation was undertaken to identify TV stations potentially available for residents in the locality of the Project site. Using ACMA lists of broadcasting stations and the ABC and DBCDE internet prediction service of available coverage (based on post codes or town names) a number of services are potentially available, although availability will vary depending on actual locations around the wind farm site. From the ABC predictions, coverage from the TV transmitting stations shown in Table 4 may be possible depending on site elevation and low terrain obstructions towards the TV stations. From the ABC prediction maps in Attachment 18 the area surrounding the wind farm is just outside the tertiary coverage areas at the extremities of the three main station service areas. The TV channels now available from stations in the area are shown in Attachment 3.

TABLE 4 - TV STATION TRANSMITTER SITES

SERVICE AREA	TRANSMITTER SITE
Canberra (main station)	Black Mountain
Central Tablelands (main station)	Mt Canobolas
SW Slopes/E. Riverina	Mt Ulandra

A phone or field survey would need to be carried out to determine the actual TV station(s) utilised at individual residences in the area. It may be that TV satellite services are used in a significant number of dwellings in view of the poor predicted cover of terrestrial services. It is expected that reception of

digital signals will be less impacted by turbine interference in reasonable signal level areas than for the now switched off analogue TV transmitters.

Mitigation techniques for TV interference from turbines at residences could include the following:

- Replacement or reposition of TV antenna
- Use of an alternative terrestrial TV station
- Use of the new VAST Satellite TV service

5 CUMULATIVE IMPACTS WITH PROPOSED WIND FARMS

Consideration has been given to the potential cumulative impacts to radiocommunications links and broadcasting reception of the Bango wind farm in conjunction with other proposed or existing adjacent wind farms. A map issued by NSW Planning and Infrastructure and updated on 19 July 2012 and reproduced in Attachment 17 shows the locations of wind farms approved, operating or where an application has been received for them. The adjacent wind farms to Bango are listed in Table 5:

TABLE 5 - WIND FARMS ADJACENT TO BANGO WIND FARM

Wind Farm	Status	Border to Border Distances from Bango Wind Farm km
Rugby	DGR's issued	12
Rye Park	DGR's issued	8
Yass Valley	Under assessment	18
Conroys Gap	Determination	25

Regarding the impacts on point to point radiocommunications each wind farm will be planned to ensure that there is adequate clearance between crossing radio paths and the individual turbines so that any radio path traversing any wind farm will not experience interference. There will therefore be no cumulative interference. Any impact on TV reception at dwellings is unlikely to occur beyond 5 km from any turbine. With the adjacent wind farm minimum wind turbine separations of 8 to 25 km the scattered signal from these adjacent wind farm turbines will be negligible around the Bango wind farm area. No adjacent wind farm are/ will be sited sufficiently close to any TV station to impact on the general TV coverage in the stations' service areas.

6 POWER TRANSMISSION INFRASTRUCTURE ELECTRIC AND MAGNETIC FIELDS

The project will involve the construction of the following power distribution components:

- A collector substation (CS) comprising cable marshalling, switchgear, high voltage transformers and associated protections and communications assets;
- A switching station (SS) comprising switching and protection devices, busbars, circuit breakers, isolators and communications assets;
- Underground transmission lines (up to 132 kilovolt (kV)) and control cables within each of the wind turbine Clusters, and connecting to the CS and SS;
- Overhead transmission lines (up to 132 kV double circuit) and control cables within and between the wind turbines and clusters, in single or multiple lines, connecting to the CS and SS.

Attachments 15 and 16 are maps of the Project site showing the connection to the power grid for Layout Options 1 and 2 respectively. Approximately 61 km of up to 33 kV trenched underground transmission lines and control cables will be required to connect the wind turbines to the CS and the CS to the SS. Approximately 9km of up to 132 kV double circuit overhead transmission lines, some sections running in 2 or 3 parallel line configurations. The overhead transmission lines can be up to 45

m in height comprising two cross arms with insulators with a typical span length for various voltages as show in Table 6 below:

TABLE 6 - OVERHEAD TRANSMISSION LINE DIMENSIONS

Voltage	Easement Width	Height of Pole	Typical Span Distance
330 kV	60 m	50 m	300 – 400 m
132 kV	45 m	35 m	200 – 300 m
66 kV	30 m	30 m	150 – 250 m
33 kV	30 m	20 m	150 m

Power generated by the wind turbines will be exported to the transmission grid via purpose built substations and high voltage transmission lines using conventional designs to meet standards applying to the State network at large. Substations will be designed and sited to reduce the electric and magnetic fields to acceptable levels at the boundary fence. The height of the lines and the easement width shown above are in accordance with TransGrid recommendations to ensure magnetic and electric fields are maintained within acceptable limits for human exposure. Electromagnetic interference levels to TV and radio reception at dwellings in the area and for accessible public access areas will also be low outside the easements specified. Cables buried in trenches will result in very low electric and magnetic fields above the ground. Depending on the number of circuits carried and the voltage used, the lower lines would be suspended from cross arms at 15 or 20 metres above ground level with human exposure limits met at ground level. HV powerlines and substations are required to meet the standards of the Australian Standard AS/NZS 2344: 1997 Amendment 1:2007 which protects broadcasting and radiocommunications reception from unacceptable interference. The overhead power lines are not expected to obstruct the radiocommunications systems which cross the wind farm in view of their relative low height above ground. The distance to the nearest radiocommunications site will also ensure that EMI from the power infrastructure will have no impact on radio system receivers at that site.

7 MONITORING MASTS AND CONSTRUCTION ACTIVITY

There is currently one 60 m temporary wind monitoring masts installed to the south-east of the Project site. Up to six permanent monitoring masts, up to 120 m high, are proposed to be installed. These masts will need to be positioned so that they do not obstruct the ray lines of the two existing radio links crossing the Study area. It is recommended that the clearances derived for the wind turbine locations also be applied to these masts. Of course the masts can be installed closer to the ray lines of links than for wind turbines because the turbine blade length is not involved.

Although it is unlikely to be a problem the use of large cranes on site during the wind farm construction period may need to be considered to avoid the link ray lines. It is understood that the cranes are positioned on the hard standing areas around the wind turbine towers and will be within a blade length from the tower and therefore will be in the safe area for obstruction of links.

8 DISCUSSION

Bacon (Reference 1) suggests second Fresnel zone clearance has been used for clearance criteria calculated for the path midpoint for microwave links. This is reasonably conservative, and as such, protects against any inaccurate coordinates of radio sites in the ACMA database. This is useful for turbines that are close to one end of the links. For VHF/ UHF links a “free space” criteria of 0.6x 1st Fresnel zone has been adopted based on advice from David Bacon (pers. comm. < 24/07/2009>).

The Telstra SA – GRN Guidelines have additional criteria for omnidirectional services which cover the operation of mobile or portable radio units in situations where a turbine is located in the first Fresnel zone of the path to/from the base station. This, of course, applies to both ends of the link, that is, near the base station and near the mobile/ portable unit. A number of reports available on radio system clearances to wind farms have not considered this issue. For example, two reports (References 4 and 5) which considered base station clearances to turbines derived the clearances required using the scattering criteria only. Reference 5 (BCL NZ) stated that a clearance of 600 metres was derived for VHF mobile base stations, while Reference 4 (Kordia NZ) stated a clearance of 320 metres for both

VHF and UHF mobile bases. Differences in assumptions about turbine RCS and safety margins appear to account for the differences in distance in these two reports.

8.1 Point-to-Point Links

As shown in Table 1 above, link paths require Fresnel zone clearance of between 51 and 76.5 metres at the mid path of the link or near wind turbine positions depending on path length and operating frequency. The Fresnel zone clearance is tapered, increasing from 0 at both ends of the links with the maximum at the mid path points. It is generally accepted that a second Fresnel turbine clearance should be applied to the higher frequency microwave links of multi-channel capacity, and is desirable for lower frequency links. It could be argued, however, that it is not essential to apply it to the VHF or UHF links, considering the low impact on these links. There are no microwave links crossing or near any wind turbines where the full 2nd Fresnel zone clearance would have needed to be maintained.

8.2 TV and FM Broadcasting Services

These are omnidirectional services and have similar requirements to mobile base stations with regard to clearance zones for scattering. Estimates based on scattering criteria, suggest that with a clearance of 300 metres, negligible impact on the service coverage would occur. When turbines or towers are closely placed to transmitters, there is also the possibility of impacts on TV reception, such as ghosting and other effects. These impacts may occur over a large area. However, as there is a considerable distance to the nearest turbine, a negligible impact is expected upon local low power TV and FM stations mentioned in section 3.2 above. There is still the potential, though, that TV reception from the main and local station(s) may be impaired at some residences close to the turbines. References 6, 7, 8 and 9 provide details of the mechanism and estimation of TV signal scattering from wind turbines. References 8 and 9 are recent ITU documents which specifically address the issue of the impact of wind turbines on digital television.

8.3 Mobile Radio Base Stations

Once again, the relevant criterion is the Scattering mechanism. Calculations for the Mobile and Paging base stations suggest a 200 metre clearance. The SA - GRN Guidelines (Reference 2), however, recommend buffer zones of 1200 metres for emergency services radio base stations and Paging Services.

9 RECOMMENDATIONS

9.1 Point-to-point Links

As there are two link paths which cross or are close to the site, horizontal corridor or vertical clearances are required,. Details of these are summarised in Table 7 below. Path profiles of links where wind turbines close to the link ray lines are shown in Attachments 13 and 14. These horizontal clearances are specified because sufficient vertical clearance may not be achieved when turbine blade tip clearances are considered. As mentioned in section 8.1, the Fresnel zone clearance requirement is tapered, increasing from a minimum distance near the link ends to a maximum distance at the mid path. However, it is proposed that for most links that a simple fixed width corridor be defined, and that the width is based on the maximum clearance, at the mid path, to cover all scattering clearances. The corridor clearances shown in Table 7 should be maintained for the two crossing links.

TABLE 7 – RECOMMENDED CLEARANCES FOR RADIO POINT TO POINT LINK

LINK A – B (ACMA Link ID's)	TOTAL CORRIDOR WIDTH Metres Note 1	SITE A COORDS GDA 94 Z55	SITE B COORDS GDA 94 Z55
9519-9534	76.5	E658091 N6145718	E706322 N6217759
201821-9534	51.0	E658133 N6145672	E706322 N6217759

Note 1 No part of a turbine should protrude into the corridors. With a turbine rotor diameter of, for example, 144 metres, the centre line of the turbine towers should be at least 107.4 metres (i.e.: 70.8/2 + 144/2) from the 1st listed radio link ray line.

The radio link paths and the turbine layouts superimposed on the MapInfo maps indicate that the required horizontal clearances are met for all of the radio links which traverse the wind farm site for a 144 metre diameter rotor. In general if any micro-siting of turbines is required, the specified buffer zones must be maintained as the link paths do not have vertical turbine blade tip clearance. The results of checking the clearance from the nearer turbines to the radio link ray lines and the required clearance is presented in Table 8 below:

TABLE 8 - RADIO LINK CLEARANCE COMPLIANCE

Wind Turbine No	Scaled Distance from MapInfo		Calculated Required Clearance
Layout Option 1	**Link A**	**Link B**	
T43	238 m	282 m	123 or 148.5m
T105	193 m	238 m	123 or 148.5m
T70	195 m	242 m	123 or 148.5m
T10	237 m	283 m	123 or 148.5m
T32	248 m	290 m	123 or 148.5m
Layout Option 2	**Link A**	**Link B**	
T91	236 m	281 m	123 or 148.5m
T36	197 m	240 m	123 or 148.5m
T14	197 m	238 m	123 or 148.5m
T46	240 m	286 m	123 or 148.5m
T28	525 m	569 m	123 or 148.5m

9.2 General Buffer Zones

Taking into account the scattering zone requirements of all omnidirectional services, and the near field clearances required for the longer distance links, a clearance circle of 1200 metres radius (centred on the radio towers) is the worst case zone requirement. This is based on the SA - GRN guidelines for emergency services omnidirectional services which include paging services. As indicates in section 3.5 Site 304511 which appears on the link mapping in Attachment 5 does not in fact exist on the project site due to a coordinate error in the ACMA database. All other radio sites are in excess of 1200 metres from the nearest turbine and therefore there will be no impact on radio systems performance.

9.3 Interference to Television reception

The Study area is potentially served by three main TV stations, Canberra, Central Tablelands and SW Slopes/E Riverina with transmitters at Black Mountain, Mt Canobolas and Mt Ulandra respectively. The predicted coverage is very marginal and some residents may use satellite TV services. The prediction of TV interference at individual dwellings as a result of turbine interference has been shown to be generally unreliable. As indicated in section 8.2 above, there is a possibility that interference to TV reception at some residences that are particularly close to turbines may occur (if they are located in the forward scatter zone, in the received direction of the TV stations). It is expected that reception of digital signals will be less impacted by turbine interference in reasonable signal level areas. A number of possible mitigation methods are available to restore interference free television to dwellings as listed in section 4.

Television operators in the area are:

- Broadcast Australia – ABC and SBS
- Australian Capital Television Pty Ltd
- Prime Television (Southern) Pty Ltd
- WIN Television NSW Pty Ltd

It is recommended that these organisations and Broadcast Australia, who own and operate the ABC, SBS and shared commercial transmission facilities, be advised of the wind farm proposal and be requested to comment on any issues they have from a TV coverage impact point of view.

9.4 Interference to Radio Reception

Interference to AM radio reception is highly unlikely due to the propagation mechanism involved. Furthermore there is no indication in the literature that wind farms cause interference to AM radio reception. FM radio reception interference, while theoretically possible, also has not been observed except in laboratory set-ups. It is therefore concluded that impairment of AM and FM radio reception around the proposed Bango wind farm is highly unlikely.

10 CONCLUSIONS

For both current alternative layouts of wind turbines no adverse impacts on point to point or omnidirectional radio systems in the area are expected

TV and radio broadcasting transmitting sites are sufficiently distant from turbines to not have any general service area coverage degradation.

Some individual dwellings close to turbines and in the forward scatter areas of TV transmissions may experience some reception impairment. However mitigation methods are available to return reception to at least preconstruction conditions.

Interconnecting power lines and substations will be constructed and located according to industry standards to ensure that magnetic and electric fields are well below the human exposure limits for public spaces and at private dwellings. EMI levels at power line easement boundaries will be required to meet the appropriate Australian Standard levels which will ensure that radio and TV reception and other radiocommunication services will not be impaired.

11 REFERENCES

[1] Fixed-Link wind-turbine exclusion zone method, Version 1.1, 28 October 2002, D.F. Bacon, UK Radio Communications Agency,

[2] Guidelines for Minimizing the Impact of Wind Farms on the SA - GRN, Issue 1, 22 October 2003, Rohan Fernandez, Telstra SA, Document TR049-SA

[3] Wind Farms Impact on Radar Aviation Interests-Final Report, September 2003, FES W/14/00614/00/REP, Contractor QinetiQ Prepared by Gavin J Poupart.

[4] Mahinerangi Wind Farm, Compatibility with Radio Services, 3 April 2007, Anton Pereira and Richard Brown, Kordia NZ

[5] Project Hayes, Compatibility with Radio Services, 7 July 2006, Duncan Chisholm, BCL NZ

[6] Electromagnetic Interference from Wind Turbines, Sengupta and Senior, Chapter 9, Wind Turbine Technology Ed. David E. Spera ASME Press 1994

[7] ITU, ITU-R Recommendation BT805 Assessment of Impairment Caused to Television Reception by a Wind Turbine 1992

[8] ITU, ITU-R, Recommendation BT.1893 Assessment of Impairment Caused to Digital Television Reception by a Wind Turbine May 2011

[9] ITU, ITU-R, Report BT.2142-1 The Effect of the Scattering of Digital Television Signals from a Wind Turbine

ATTACHMENT 1

WIND TURBINE GRID COORDINATES BANGO WIND FARM LAYOUT OPTION 1

ZONE 55 MGA94, 122 WTG
(Note PL1_WTG_ID has unique, non-consecutive numbering)

PL1_WTG_ID	EASTING	NORTHING	PL1_WTG_ID	EASTING	NORTHING
1	671618.5	6174752	68	662976.1	6171569
2	672550.6	6169350	69	669424.3	6173513
3	671219.7	6172725	70	671231	6164855
4	661435.7	6181108	71	669565	6173814
5	672506	6168805	72	663856	6171405
6	661265.9	6181406	73	665139.8	6172054
7	671261.1	6169917	74	660806	6177880
8	661037.9	6179320	75	661106	6180380
9	661656	6178780	76	665306	6176655
10	671081	6164555	77	662230	6180655
11	664943.8	6171739	78	661382.9	6181745
12	672634.6	6169745	79	663431	6171805
13	671656	6173805	80	671402.5	6173443
14	664721.1	6172733	81	669706	6171830
16	661716.8	6180555	83	669931	6172005
17	672376.6	6168142	85	670956	6171280
18	663601	6172799	86	665621.3	6171497
19	664006	6171605	87	663831	6172255
20	660318.6	6178696	88	663806	6174730
21	662281	6173305	89	663681	6173030
22	670581	6170580	91	669715.2	6174088
24	671306	6169580	92	671306	6166980
25	671131.4	6168379	93	671981	6176330
26	669891.6	6171233	94	664806	6174530
27	664756	6172455	95	670350.9	6173243
28	670262.5	6173541	96	664131	6173380
29	662856	6171305	97	664781	6175530
30	660342.1	6178460	98	665231	6176430
31	660339	6178953	99	671631	6175455
32	672716.4	6167943	100	670756	6171080
33	672070.4	6170045	101	672131	6176005
34	672357	6170336	102	672300.7	6167831
35	663756	6172505	103	671281	6175230
36	672237.6	6168456	104	664806	6173505
37	660889.3	6178505	105	671431	6165155
38	663206	6171055	107	672458	6168591

PL1_WTG_ID	EASTING	NORTHING	PL1_WTG_ID	EASTING	NORTHING
41	664931	6176230	**108**	661531	6179905
43	671063.2	6165463	**109**	660931	6179955
44	664806	6174230	**110**	671327.7	6172413
45	671006.3	6168951	**111**	671558.2	6167971
46	671465	6170340	**112**	671931	6175805
47	671216.9	6169267	**113**	661456	6182005
48	669615	6171540	**114**	663956	6173205
49	664831	6175855	**115**	664704.5	6175039
50	671015	6173890	**116**	661173.9	6179613
51	661500	6180824	**117**	662631	6178280
52	661572.3	6177598	**118**	664806	6173805
53	670056	6172655	**119**	662440	6173814
54	671370.2	6174593	**120**	671606	6167380
55	669956	6172305	**121**	665471.2	6177230
56	665381	6176955	**122**	672507.6	6169040
57	670581	6170855	**123**	671431	6167205
58	671286.8	6174189	**124**	661881	6180255
59	670190	6172964	**125**	662139.1	6178525
60	671481	6173130	**126**	661100	6177474
61	672625.4	6168300	**127**	660984.9	6177199
62	671667.7	6167651	**128**	661000	6176924
63	663056	6174030	**129**	661775.1	6176851
64	661781	6178105	**130**	661728.8	6177247
65	663781	6172005	**131**	662136.2	6176984
67	672227.5	6170535	**132**	662335.9	6177256

ATTACHMENT 2

WIND TURBINE GRID COORDINATES BANGO WIND FARM LAYOUT OPTION 2

ZONE 55 MGA94, 96 WTG
(Note PL2_WTG_ID has unique, non-consecutive numbering)

PL2_WTG_ID	EASTING	NORTHING	PL2_WTG_ID	EASTING	NORTHING
1	670056	6172655	**50**	671054.2	6173944
2	671370.2	6174593	**51**	671465	6170340
3	669956	6172305	**52**	672309.5	6168689
4	665381	6176955	**53**	662230	6180655
5	671286.8	6174189	**54**	671216.9	6169267
6	670581	6170855	**55**	663656	6172955
7	671618.5	6174752	**56**	665621.3	6171497
8	671402.5	6173443	**57**	663806	6174730
9	672550.6	6169350	**58**	660806	6177880
10	669706	6171830	**59**	663756	6172505
11	671219.7	6172725	**61**	663056	6174030
12	671606	6167380	**62**	660318.6	6178696
13	669456	6173580	**63**	669634.1	6173944
14	671231	6164855	**64**	669615	6171540
15	662281	6173305	**65**	661031	6179755
16	672506	6168980	**66**	672634.6	6169745
17	665484.3	6177302	**68**	663431	6171805
18	661435.7	6181108	**70**	661106	6180380
19	672625.4	6168300	**71**	662631	6178280
20	671370.1	6167089	**72**	669756	6174180
21	661881	6180255	**73**	662976.1	6171569
22	665289.4	6176593	**74**	671031	6171355
23	671631	6175455	**75**	661781	6178105
24	671481	6173130	**76**	663956	6173205
25	664806	6173805	**77**	661537.2	6180733
26	671281	6175230	**78**	664021.1	6173610
27	664806	6174230	**79**	662139.1	6178525
28	672300.7	6167831	**80**	670331	6173405
29	664931	6176230	**81**	671327.7	6172413
30	672131	6176005	**82**	672227.5	6170535
31	671261.1	6169917	**83**	664781	6175530
32	670858.7	6171115	**85**	661572.3	6177598
33	671656	6173805	**86**	661437	6181941
34	670190	6172964	**87**	664704.5	6175039
35	661037.9	6179320	**89**	663206	6171055

PL2_WTG_ID	EASTING	NORTHING	PL2_WTG_ID	EASTING	NORTHING
36	671431	6165155	**91**	671063.2	6165463
37	661341.2	6181554	**92**	669891.6	6171233
38	661656	6178780	**93**	671295.4	6169503
39	664943.8	6171739	**94**	664131	6173380
41	671006.3	6168951	**95**	660889.3	6178505
42	663781	6172005	**96**	661100	6177474
43	664756	6173455	**97**	661000	6176924
44	671506	6167805	**98**	661845.4	6177173
45	664721.1	6172733	**99**	662335.9	6177256
46	671081	6164555	**100**	664803.1	6174672
47	661531	6179905	**101**	663965.4	6174234
48	664831	6175855	**102**	662537.8	6173952
49	663856	6171405	**103**	671131.4	6168379

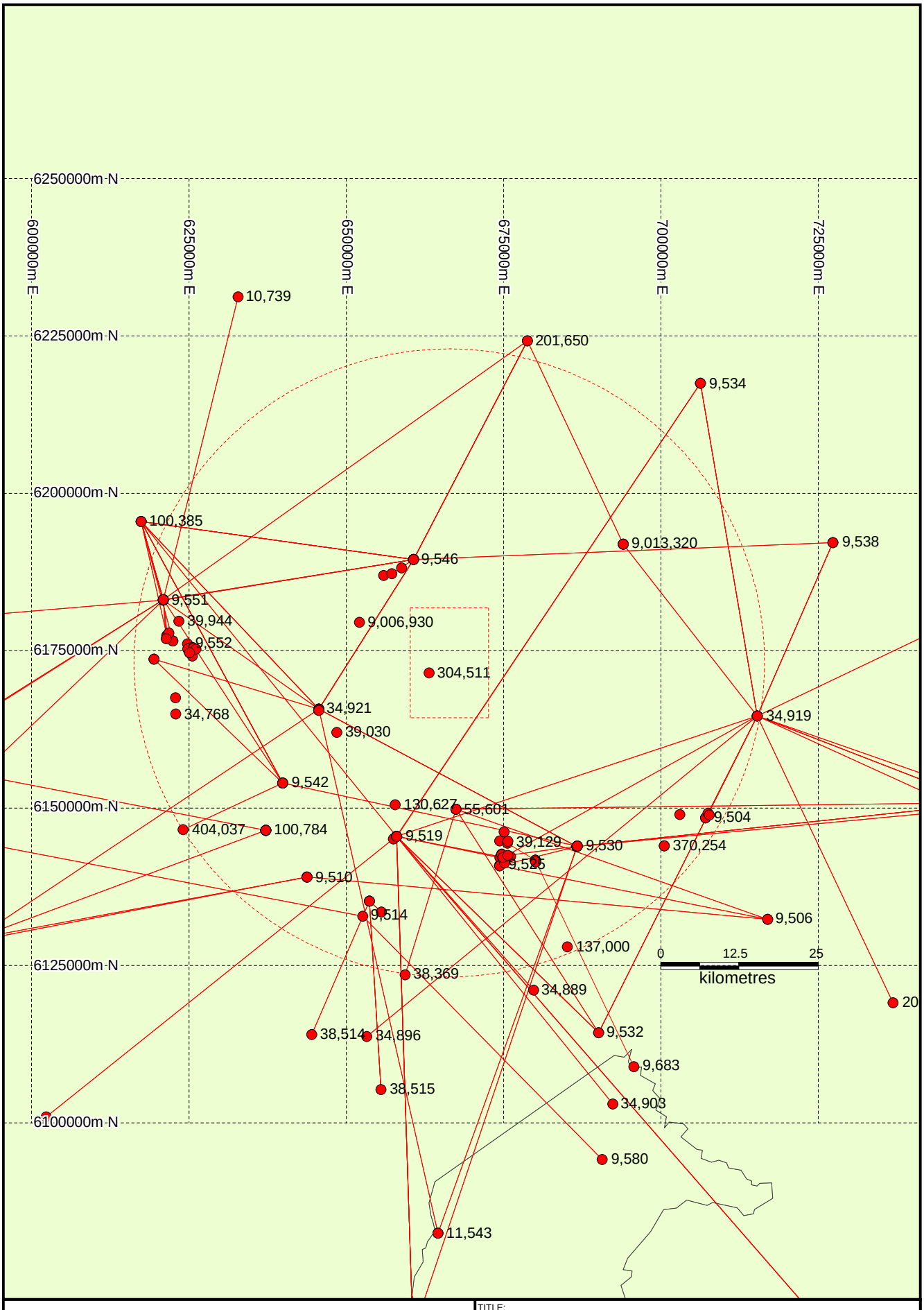
ATTACHMENT 3 - TELEVISION STATIONS and CHANNELS - BANGO WIND FARM AREA

Transmitter Location/service	Operator	Analog Channels	Digital Channels	Comment
Canberra	SBS		30H	UHF
	ABC		9A V	VHF
	CBN		12V	VHF
	CTC		6V	VHF
	WIN		11V	VHF
Central Tablelands	SBS		42H	UHF
	ABC		36H	UHF
	CBN		37H	UHF
	CTC		43H	UHF
	WIN		40H	UHF
SW Slopes/E Riverina	SBS		48H	UHF
	ABC		46V	VHF
	CBN		47H	UHF
	CTC		51H	UHF
	WIN		50H	UHF

ATTACHMENT 4

MAP OF RADIO LINKS and SITES OPERATING BELOW 1000 MHz

Map shown on following page



SPECTRUM ENGINEERING
SPECTRUM ENGINEERING AUSTRALIA PTY LIMITED
A.C.N. 008 642 028
Radiocommunications Planning and Design

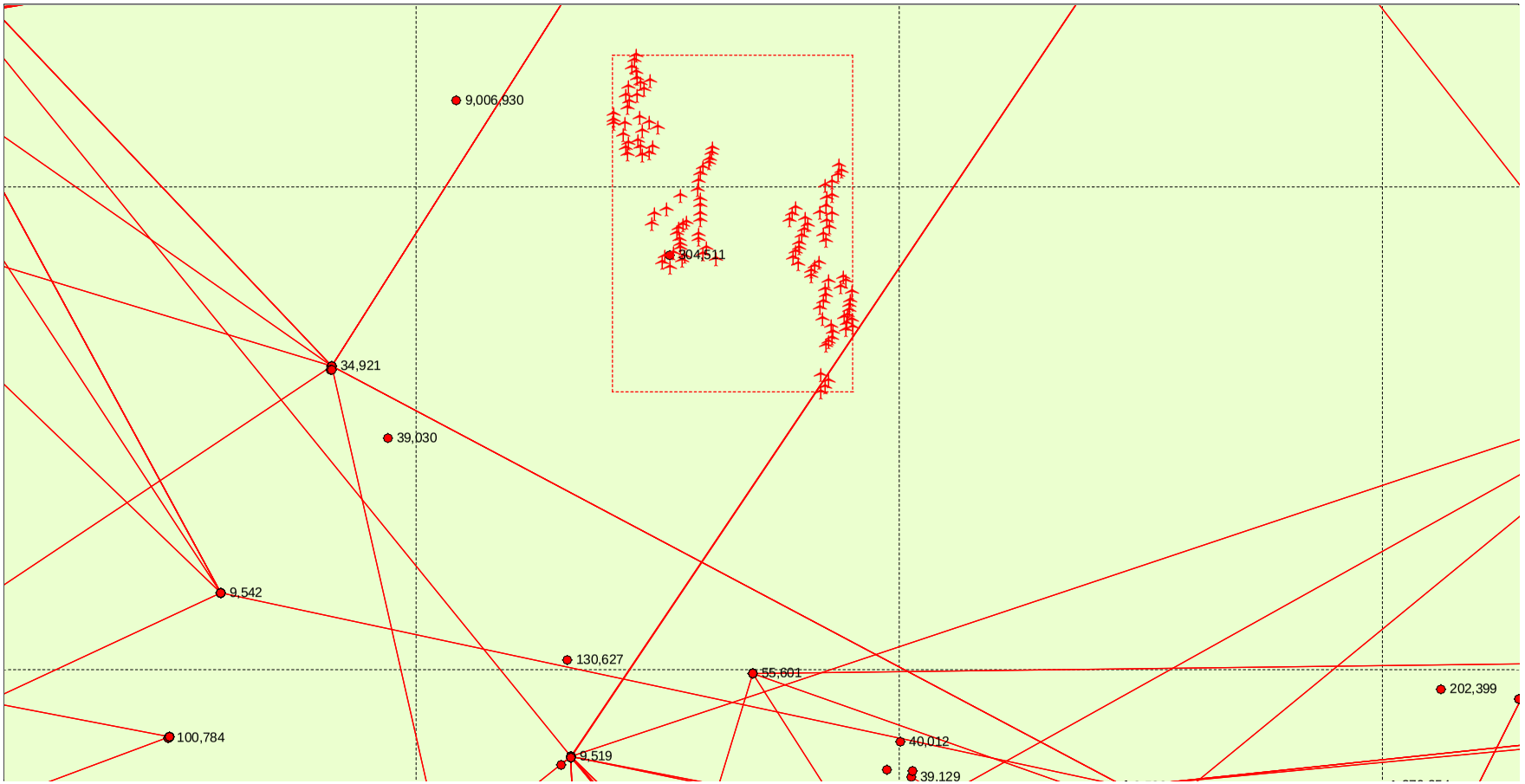
Postal: P.O. Box 3213, BELCONNEN ACT 2617
Telephone: 02 6253 2555
Facsimile: 02 6253 2800

TITLE:
40-999 MHz Assignments
As Extracted from RRL Database

FILENAME: 40-999 MHz Bango Windfarm	DATE: 14/11/2012
PROJECT: Bango Windfarm	SCALE: N/A
DRWG NO: 1	BY: SEA

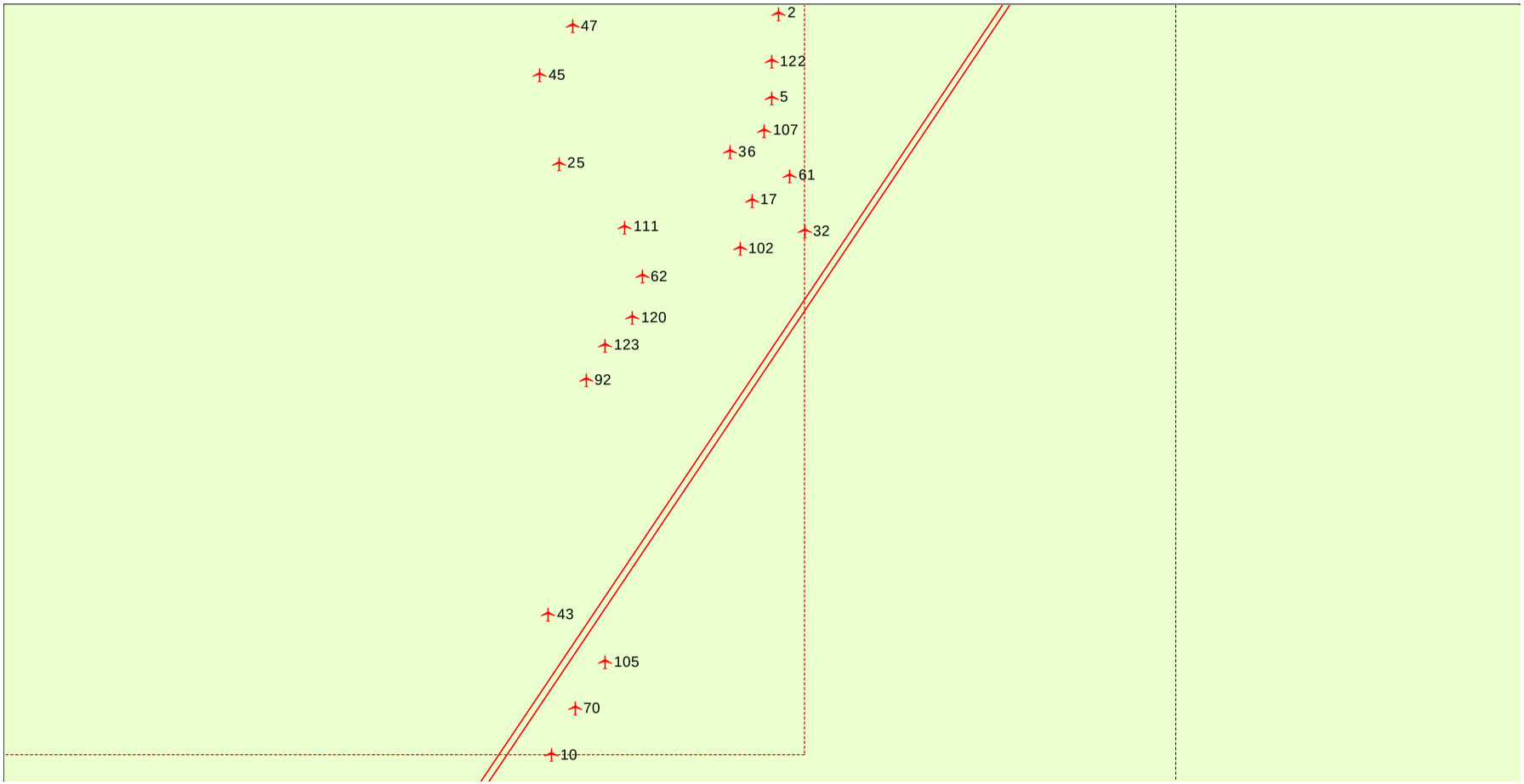
ATTACHMENT 5

MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 1 DETAIL 1



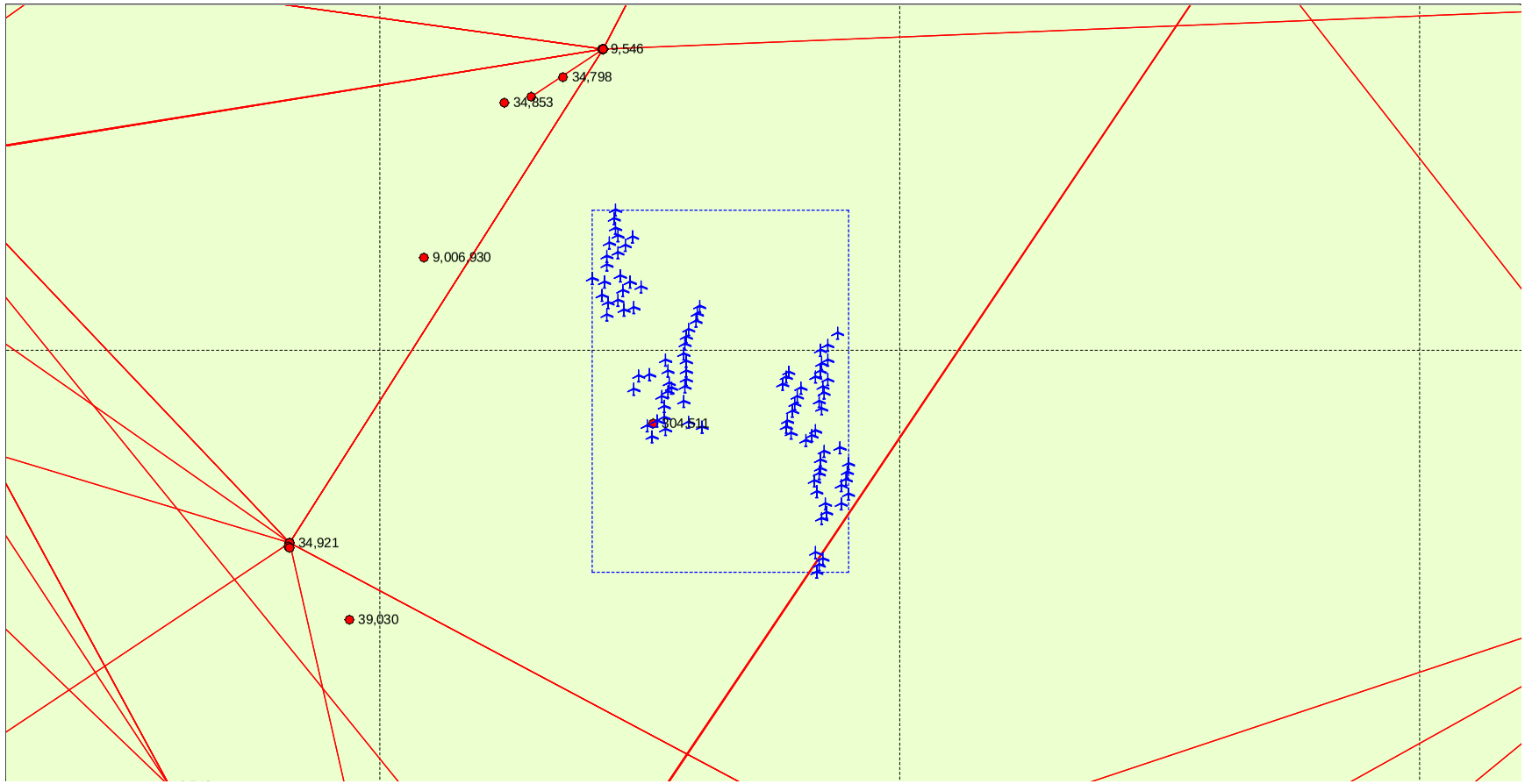
ATTACHMENT 6

MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 1 DETAIL 2



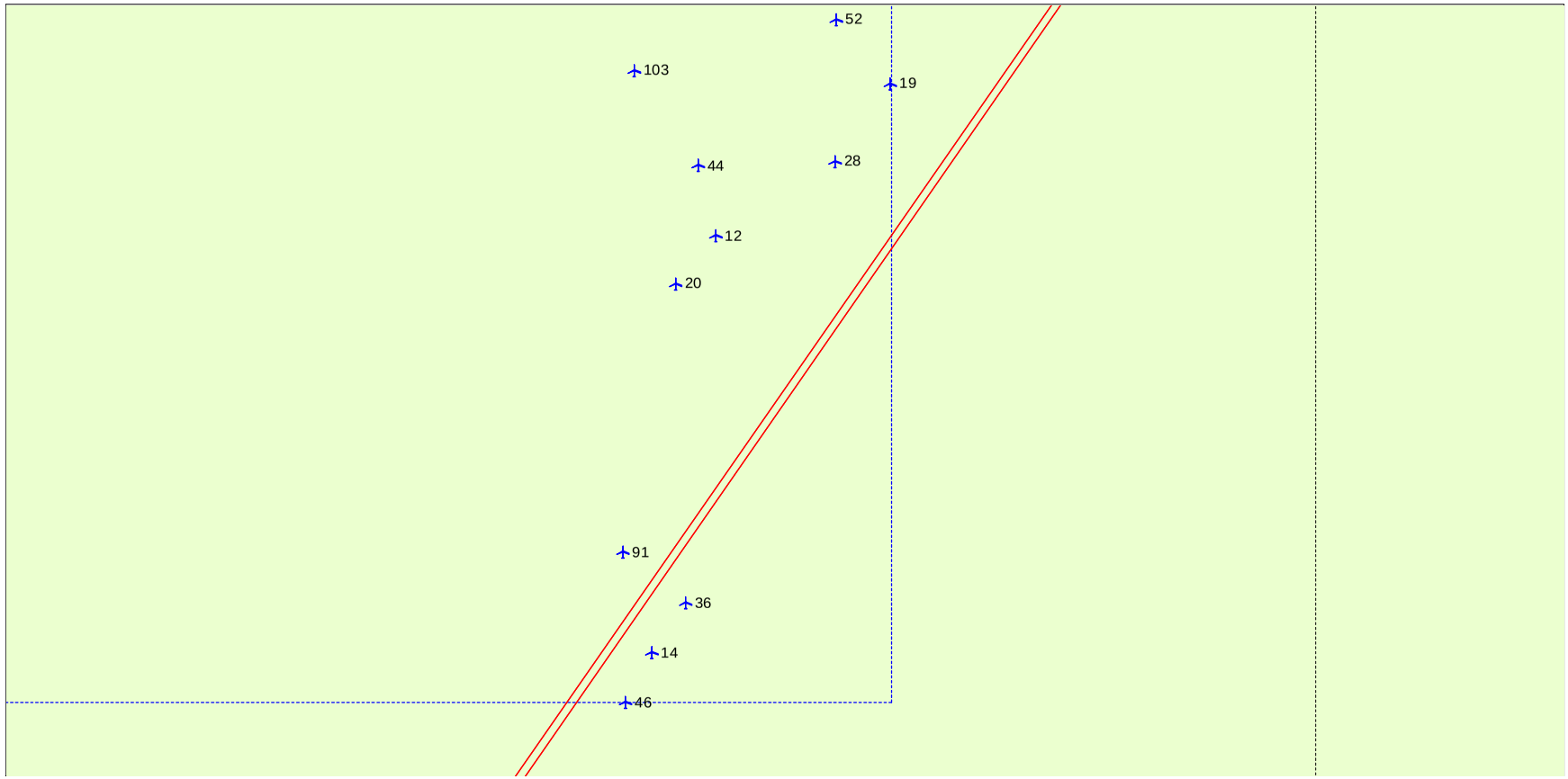
ATTACHMENT 7

MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 2 DETAIL 1



ATTACHMENT 8

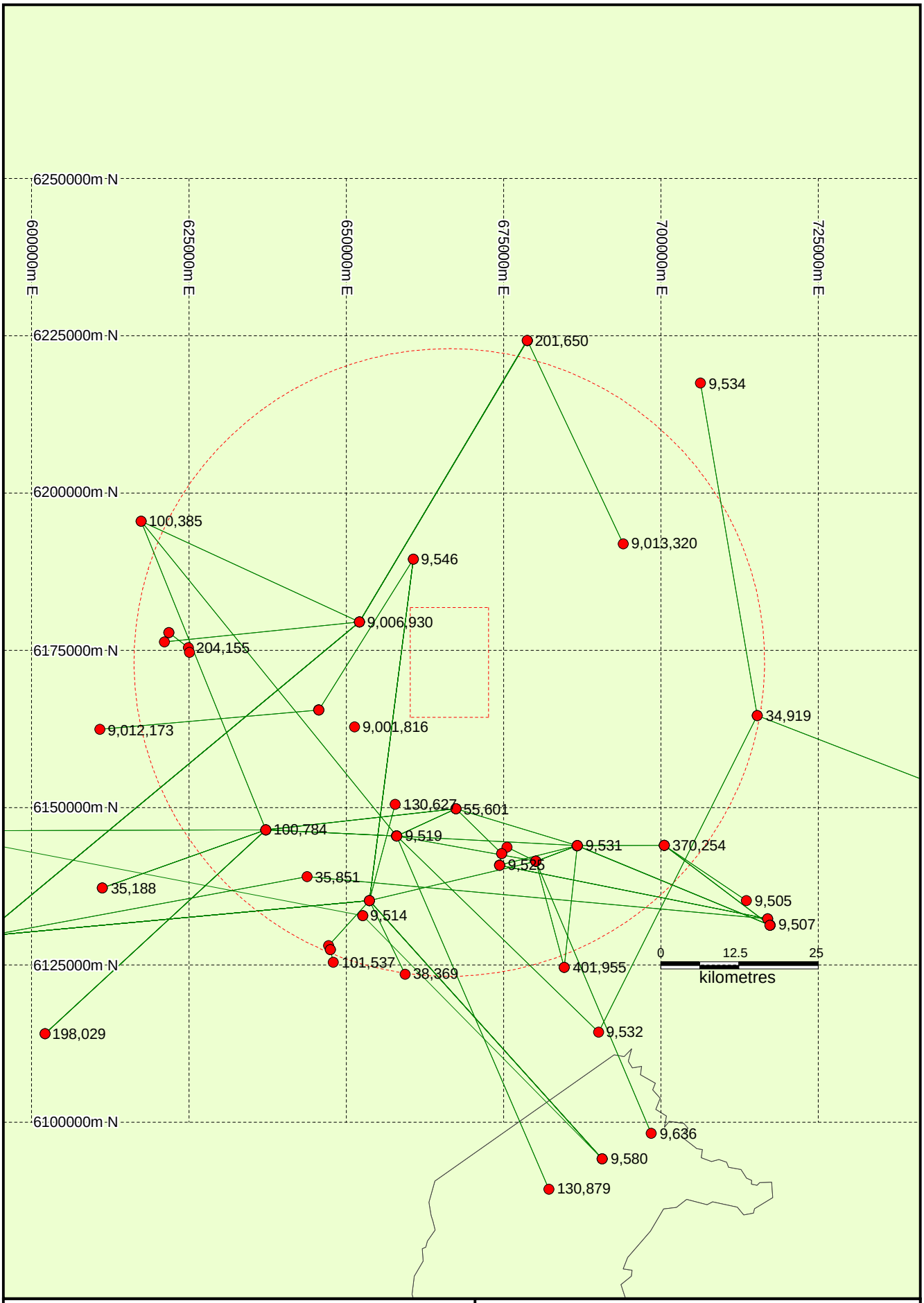
MAP OF RADIO LINKS OPERATING BELOW 1000 MHz – OPTION 2 DETAIL 2



ATTACHMENT 9

MAP OF RADIO LINKS and SITES OPERATING ABOVE 1000 MHz

Map shown on following page



SPECTRUM ENGINEERING

SPECTRUM ENGINEERING AUSTRALIA PTY LIMITED

A.C.N. 008 642 028

Radiocommunications Planning and Design

Postal: P.O. Box 3213, BELCONNEN ACT 2617
Telephone: 02 6253 2555
Facsimile: 02 6253 2800

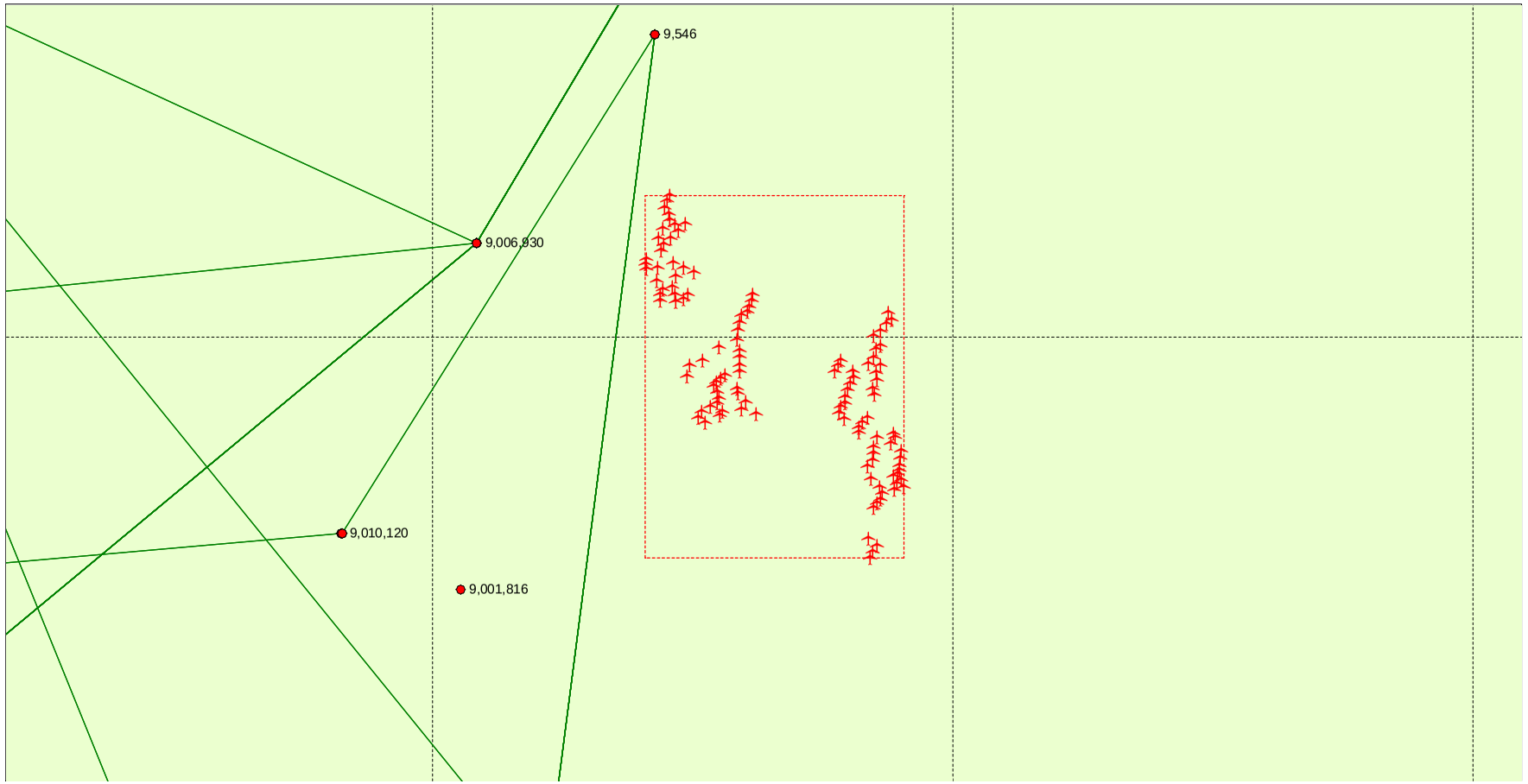
TITLE:

Above 1 GHz Assignments As Extracted from RRL Database

FILENAME: Above 1 GHz Bango Windfarm	DATE: 14/11/2012
PROJECT: Bango Windfarm	SCALE: N/A
DRWG NO: 2	BY: SEA

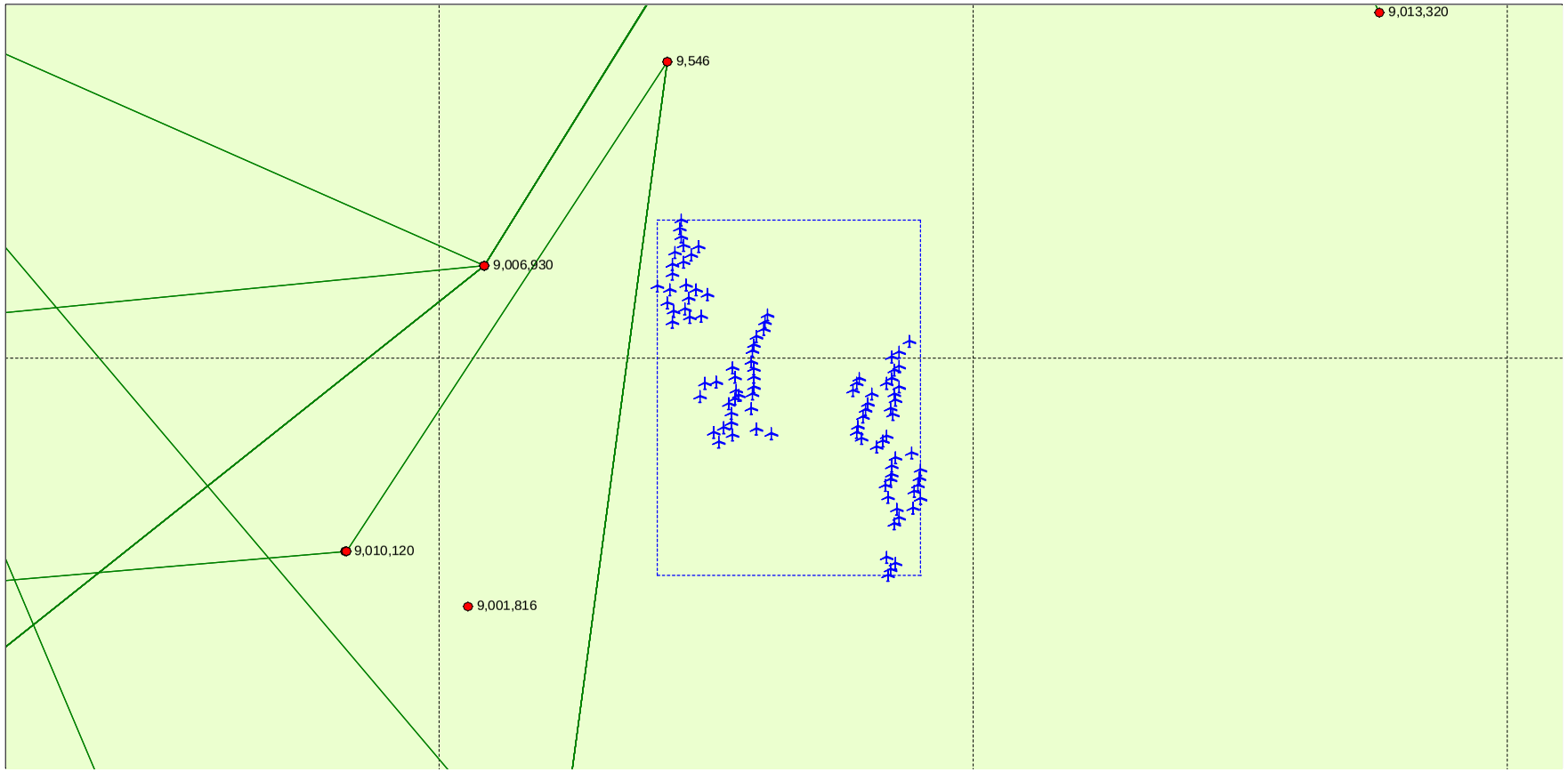
ATTACHMENT 10

MAP OF RADIO LINKS OPERATING ABOVE 1000 MHz – OPTION 1 DETAIL



ATTACHMENT 11

MAP OF RADIO LINKS OPERATING ABOVE 1000 MHz – OPTION 2 DETAIL



ATTACHMENT 12

SAMPLE CALCULATIONS OF CLEARANCE ZONES

The calculations below are examples for near field, second Fresnel zone and scattering clearances for the point-to-point and omnidirectional services. The results of Fresnel Zone calculations are in tables in the body of the Assessment. The formulas used are taken from Reference 1

1. Point-to-point Link 55450 to 6909 TransGrid

(a) Near Field Zone
Frequency 45 MHz
Antenna Gain 8.2 dB

D_{nf} = $0.1\ 10^{0.1G} / f$
= $0.1x\ 10^{0.1 \times 8.2} /0.045$
= 14.7 metres

Second Fresnel Clearance
Path Distance 119km
Mid Path distance 59.5km

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

= $\sqrt{2x(300/45)x59500x59500/119000}$

....=630. metres (mid path)

= $\sqrt{2x(300/45)x1000x118000/119000}$

= 115 metres @ 1km from tower

(b) Reflection/Scattering Clearance Zone

The ratio, expressed in dB, of the wanted signal level received from the direct T-R path divided by the worst-case signal level received from the indirect T-W-R path, is given by:

R_{ci} = $71 + S + 20 \log (s_1 s_2) - 20 \log (D_p) + G_1(0) + G_2(0) - G_1(\theta_1) - G_2(\theta_2)$ (dB)

where:

$s_{1,2}$ = $\sqrt{d_{1,2}^2 + D_s^2}$ (km)

S	=	$10 \log(\sigma)$	(dB)
σ	=	Worst-case radar cross section of turbine	(m^2)
$G_{1,2}(0)$	=	Antenna boresight gains	(dBi)
$G_{1,2}(\theta_{1,2})$	=	Antenna gain at off-boresight angles θ	(dBi)
$\theta_{1,2}$	=	angle (D_s , $d_{1,2}$)	

For each pair of $d_{1,2}$ values, equations above are used to evaluate R_{ci} for D_s incremented from zero (from a non-zero but small distance in the vicinity of the terminals) upwards in suitably small increments until the required value of C/I ratio, given by R_{ci}, is obtained. A guide as to a suitable increment for D_s is that the resulting zone should be defined by a smooth curve.

Antenna Type Scalar Y103 – 203 Vert
Turbine Radar Cross Section (RCS) assumed 1000 metres²

C/I Ratio required >40dB

An Excel spread sheet was set up to with the formulas above implemented to carry out the iteration required for d_1, d_2 values for increasing values of D_s. At 1.0km from the tower a C/I value of 40 dB was achieved at <100 metres off the rayline. Beyond 1 km the C/I value is achieved even on boresight. These indicates that scattering can be ignored 1 km and beyond the end sites. The published Radiation Pattern Envelope (RPE) for the antenna types for the actual link was used in the calculation

2. **Telstra Point to Multipoint Radio Base Stations – Omnidirectional Covera**ge

(a) Near Field Zone
Frequency 3.4 GHz
Antenna Gain 10dB

D_{nf} = $0.1\ 10^{0.1G} / f$
= $0.1x\ 10^{0.1x10}/3.4$
= 0.3 metres

(b) Reflection/Scattering Clearance Zone
Turbine RCS = 1000 m²
Wanted C/I >30dB

The C/I ratio is:

$$r_{ci} = \frac{l_i}{l_d} = \frac{4\pi s_1^{\ 2} s_2^{\ 2} g_1(0)\, g_2(0)}{\sigma D_p^{\ 2} g_1(\theta_1)\, g_2(\theta_2)}$$

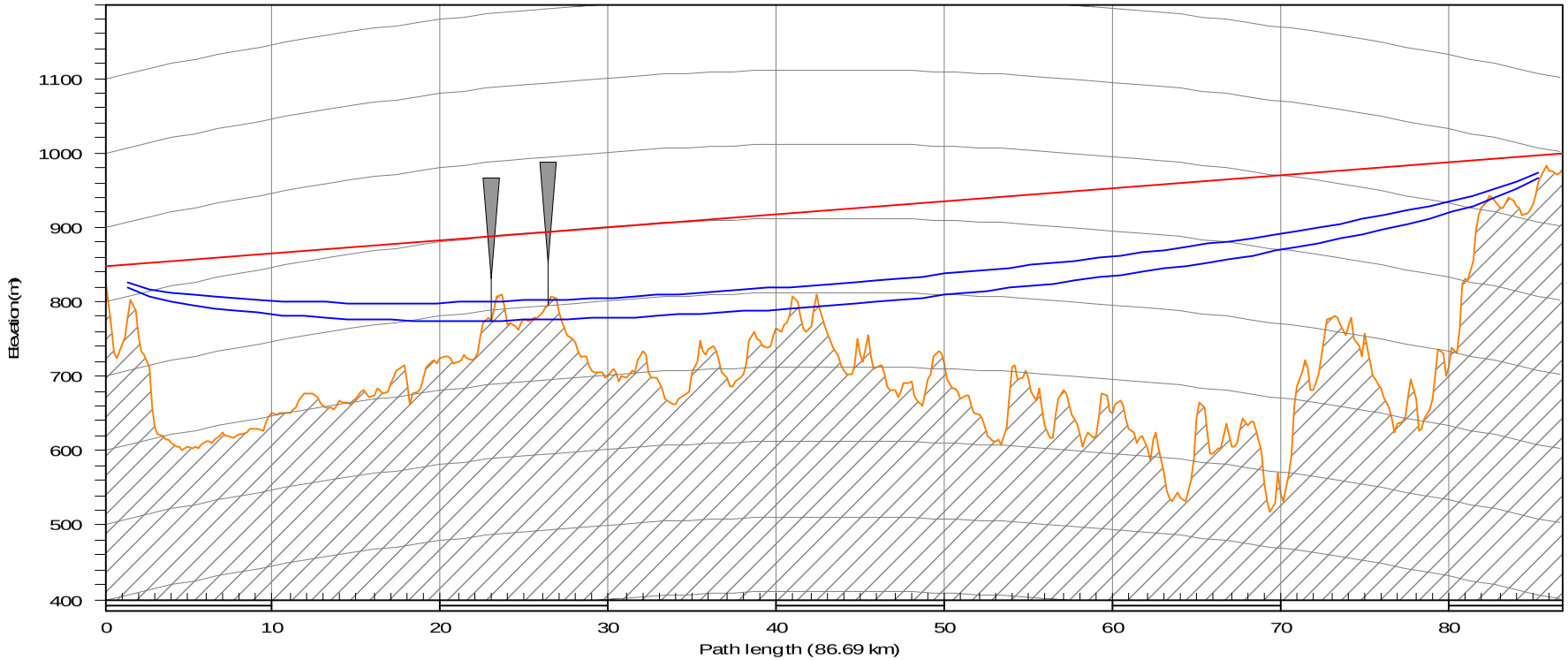
For the omnidirectional case $g_1(0) = g_1(\theta)$ & $g_2(0) = g_2(\theta)$
It can also be assumed that S_1 will approx equal D_p

then

$$r_{ci} = \frac{l_i}{l_d} = \frac{4\pi S_2^{\ 2}}{\sigma}$$

= 4x π x 300²/1000
=1130 or 30.5dB at 300 metres

ATTACHMENT 13 – ENVIRONMENT and HERITAGE LINK PATH PROFILE SITE 9519 to 9534



9519	
Latitude	34 49 06.74 S
Longitude	148 43 42.86 E
Azimuth	32.82°
Elevation	827 m ASL
Antenna CL	20.0 m AGL

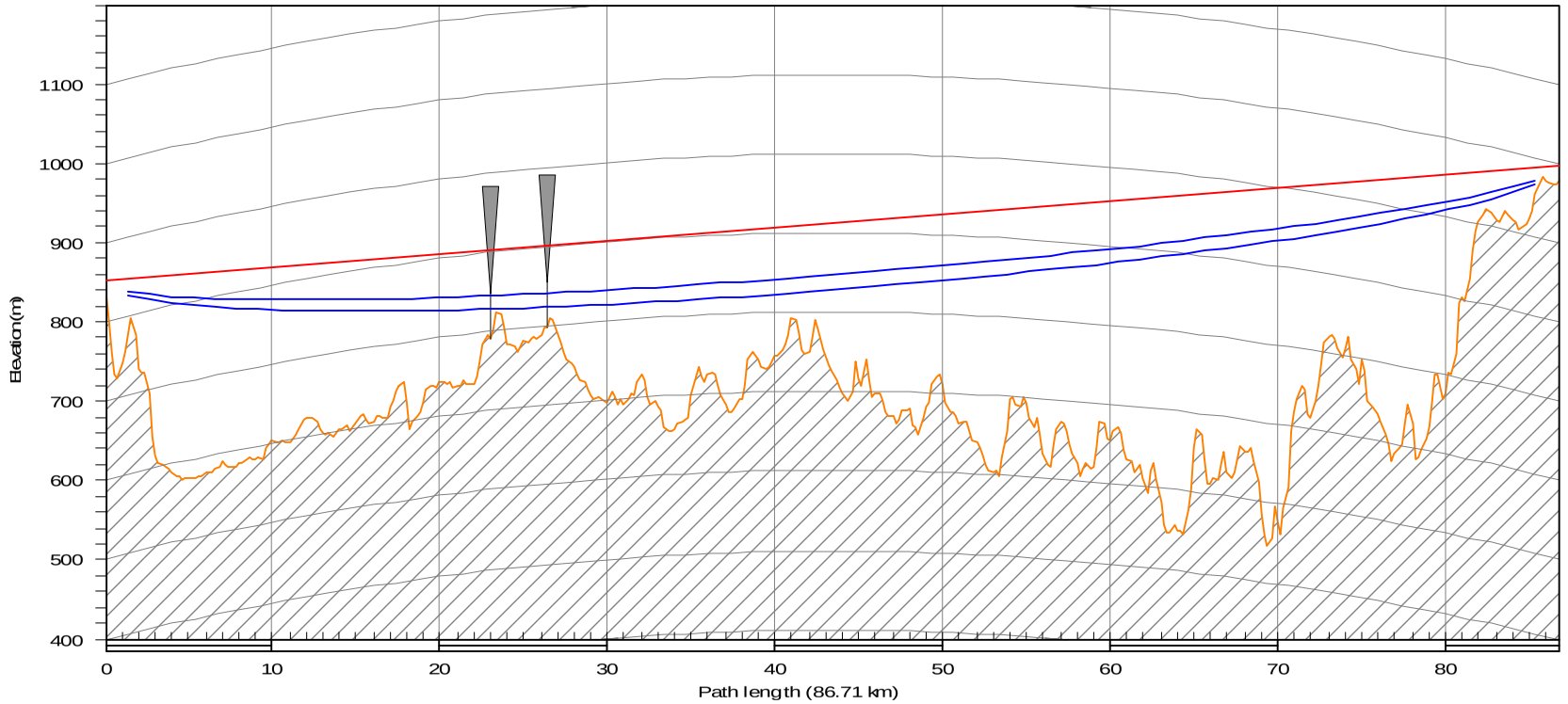
Frequency (MHz) = 400.0
K = 1.33
Fn = 0.60, 1.00

9534	
Latitude	34 09 38.62 S
Longitude	149 14 17.51 E
Azimuth	212.54°
Elevation	979 m ASL
Antenna CL	20.0 m AGL

Lawrence Derrick & Associates

Office of Environment & Heritage UHF Link	Apr 03 13	
192 m Wind Turbine Indicative positions		

ATTACHMENT 14 – ENVIRONMENT and HERITAGE LINK PATH PROFILE SITE 201826 to SITE 9534



201821	
Latitude	34 49 08.21 S
Longitude	148 43 44.55 E
Azimuth	32.78°
Elevation	831 m ASL
Antenna CL	22.0 m AGL

Frequency (MHz) = 900.0
K = 1.33
Fn = 0.60, 1.00

9534	
Latitude	34 09 38.62 S
Longitude	149 14 17.51 E
Azimuth	212.50°
Elevation	979 m ASL
Antenna CL	18.0 m AGL

Lawrence Derrick & Associates

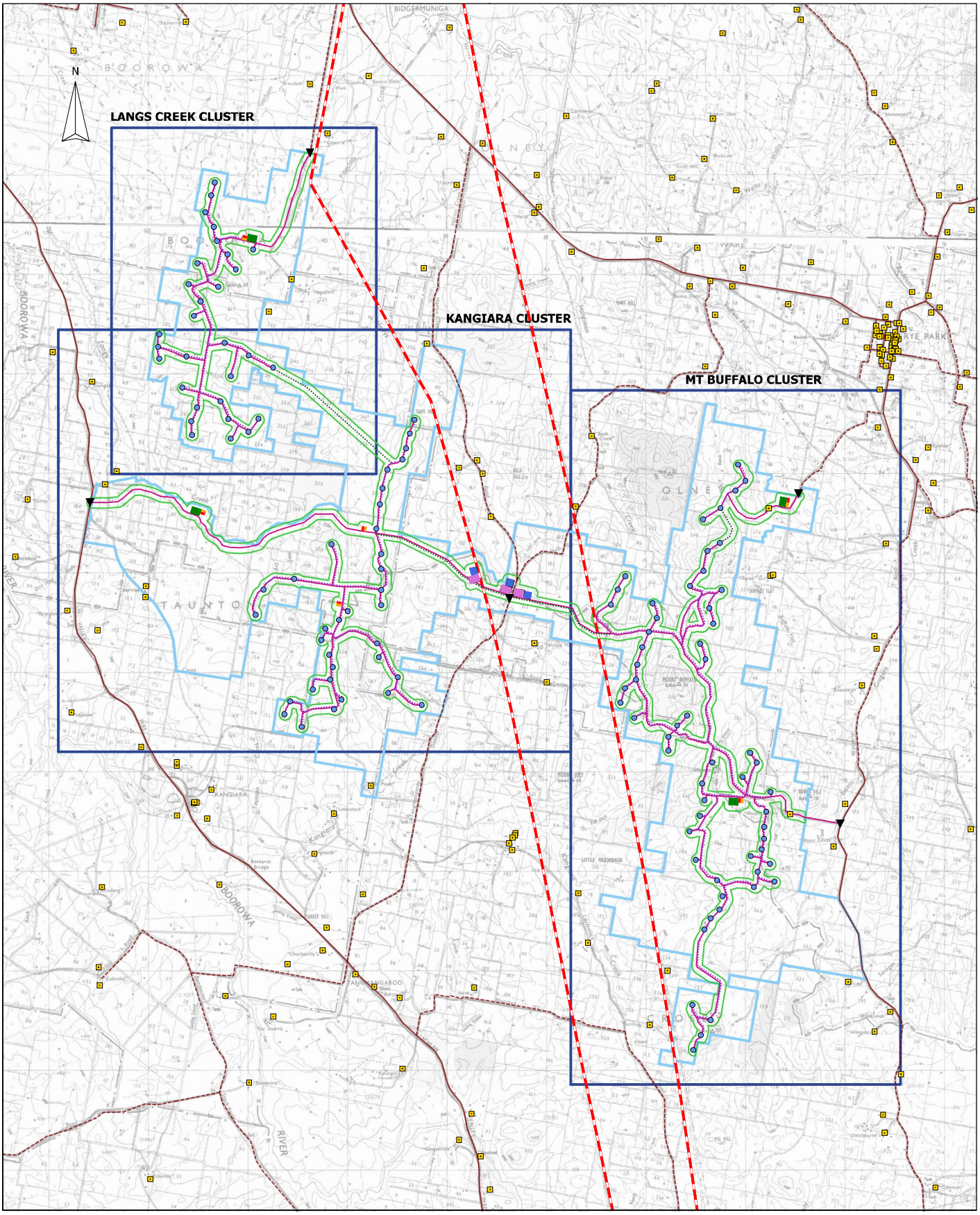
Office of Environment & Heritage UHF Link	Apr 03 13	
192 m turbines Indicative locations		

ATTACHMENT 15

WIND FARM SITE LAYOUT INCLUDING POWER LINE ROUTES

LAYOUT OPTION 1

Map shown on following Page



LEGEND

Layout Option 1 (122 WTG)
- WTG
- Access Point
- Access Track
- Overhead Transmission Line
- Underground Transmission Line
- 132 kV Transmission Line

Construction Facilities
- Construction Compound
- Concrete Batching Plant
- Rock Crushing Facility
- Collector Substation
- Switching Station

- Residence
- Study Area
- Project Site
- Cluster
- Unsealed Road
- Sealed Road

Image, roads and houses: derived from GEODATA Topo250K; Transmission lines: 132kV and 330kV - TransGrid, 66kV - Essential Energy; All other data: WPCWP

COMPANY: BANGO WIND FARM PTY LTD

TITLE: FIGURE 3.1: LAYOUT OPTION 1, OVERVIEW

DATE	DRAWN BY	CHECKED BY	SIZE	SHEET
25 MAR 2013	N FINLAYSON	A MADDOCKS	A3	1 OF 1

SCALE BAR: 0 — 4 km

SCALE: 1:75000

FIGURE 3.1: LAYOUT OPTION 1, OVERVIEW

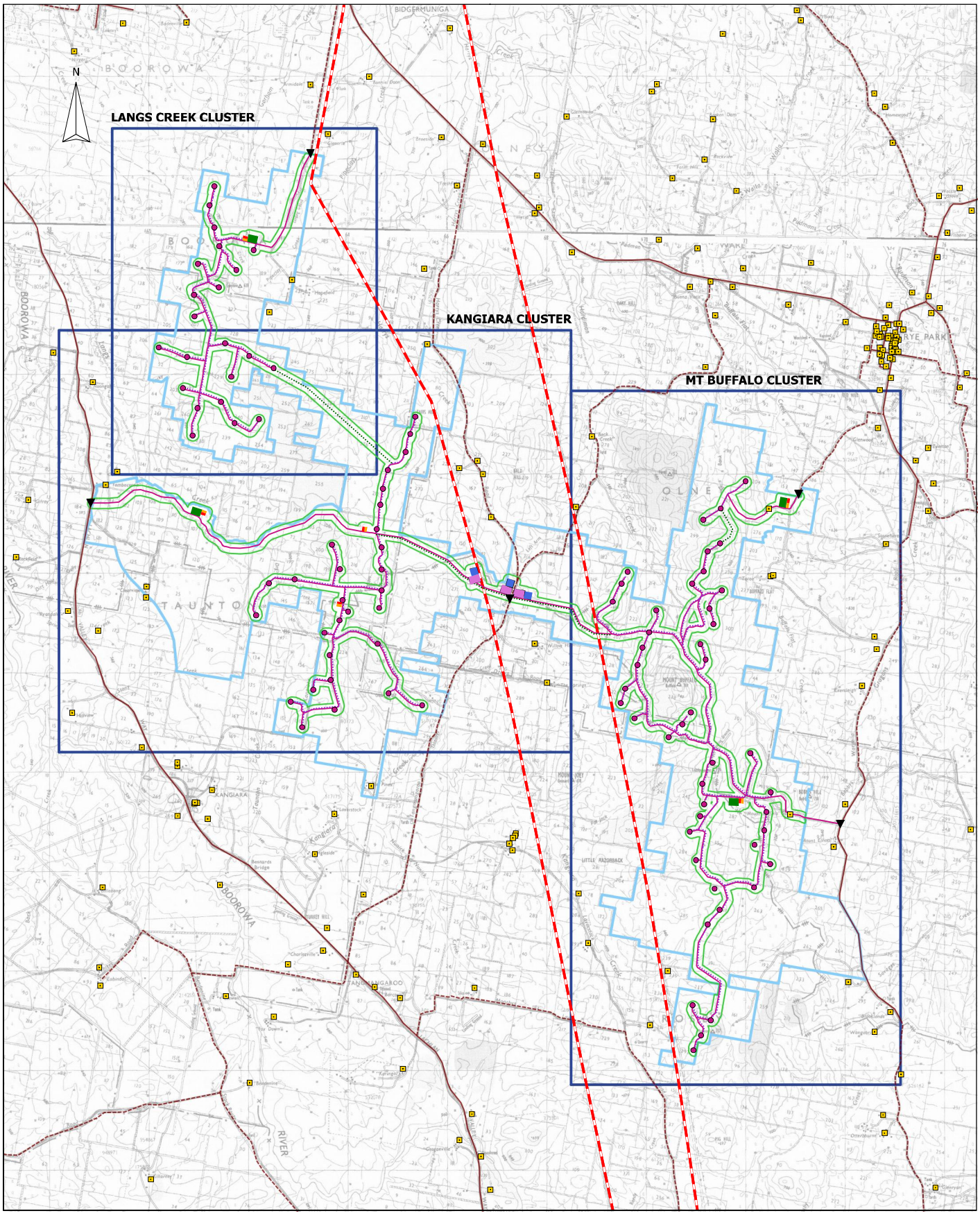
2013

ATTACHMENT 16

WIND FARM SITE LAYOUT INCLUDING POWER LINE ROUTES

LAYOUT OPTION 2

Map shown on following Page



LEGEND

Layout Option 2 (96 WTG)
- WTG
- Access Point
- Access Track
- Overhead Transmission Line
- Underground Transmission Line
- 132 kV Transmission Line

Construction Facilities
- Construction Compound
- Concrete Batching Plant
- Rock Crushing Facility
- Collector Substation
- Switching Station

- Residence
- Study Area
- Project Site
- Cluster
- Unsealed Road
- Sealed Road

Image, roads and houses: derived from GEODATA Topo250K; Transmission lines: 132kV and 330kV - TransGrid, 66kV - Essential Energy; All other data: WPCWP

COMPANY	BANGO WIND FARM PTY LTD
TITLE	FIGURE 3.2: LAYOUT OPTION 2, OVERVIEW

DATE	DRAWN BY	CHECKED BY	SIZE	SHEET
25 MAR 2013	N FINLAYSON	A MADDOCKS	A3	1 OF 1

SCALE BAR: 0 — 4 km

SCALE: 1:75000

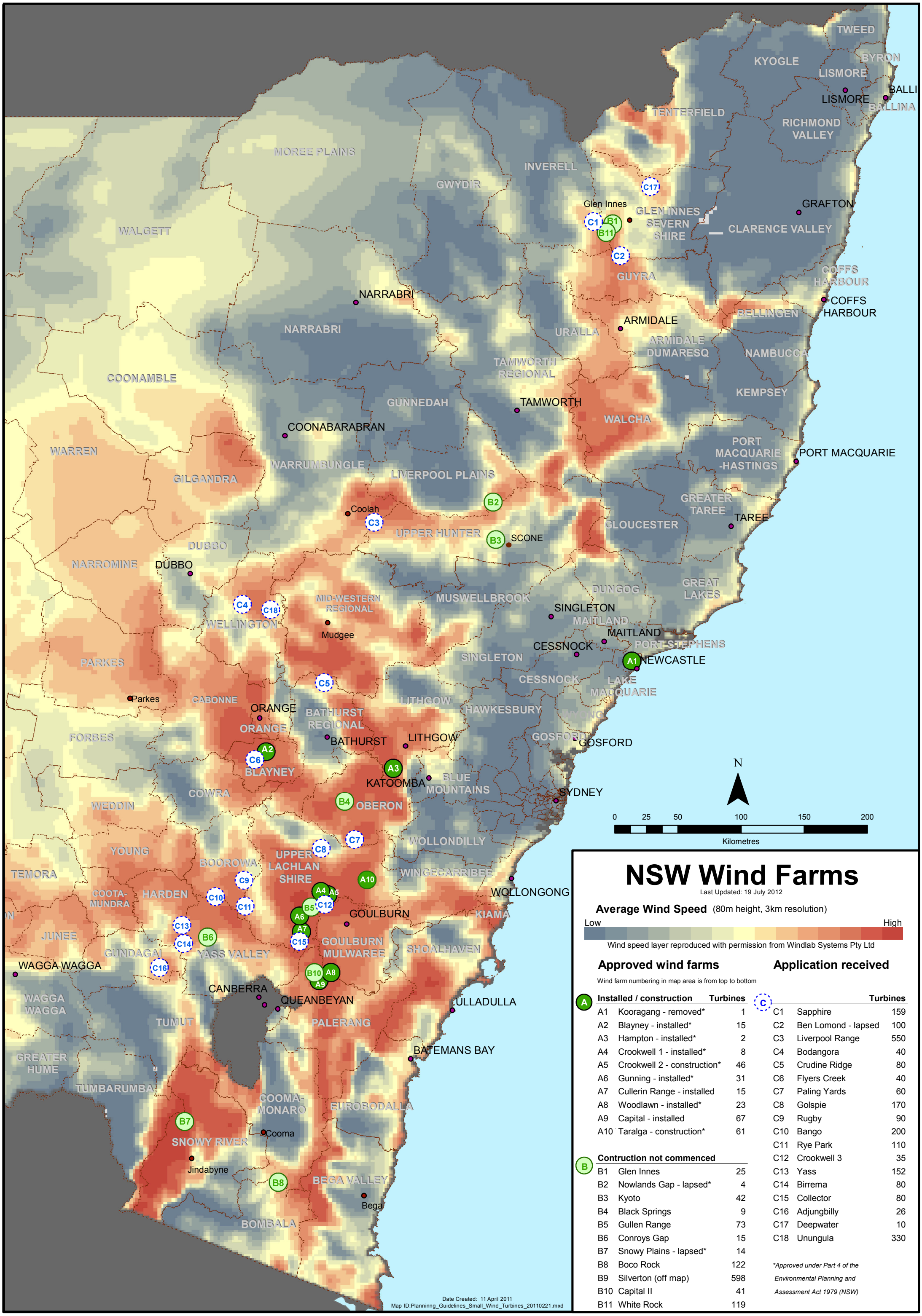
FIGURE 3.2: LAYOUT OPTION 2, OVERVIEW

2013

ATTACHMENT 17

MAP OF WIND FARMS IN NSW INCLUDING THOSE ADJACENT TO BANGO WIND FARM

Map shown on following page



NSW Wind Farms

Last Updated: 19 July 2012

Average Wind Speed (80m height, 3km resolution)

Low — High

Wind speed layer reproduced with permission from Windlab Systems Pty Ltd

Approved wind farms

Wind farm numbering in map area is from top to bottom

A

	Installed / construction	Turbines
A1	Kooragang - removed*	1
A2	Blayney - installed*	15
A3	Hampton - installed*	2
A4	Crookwell 1 - installed*	8
A5	Crookwell 2 - construction*	46
A6	Gunning - installed*	31
A7	Cullerin Range - installed	15
A8	Woodlawn - installed*	23
A9	Capital - installed	67
A10	Taralga - construction*	61

B

	Contruction not commenced	
B1	Glen Innes	25
B2	Nowlands Gap - lapsed*	4
B3	Kyoto	42
B4	Black Springs	9
B5	Gullen Range	73
B6	Conroys Gap	15
B7	Snowy Plains - lapsed*	14
B8	Boco Rock	122
B9	Silverton (off map)	598
B10	Capital II	41
B11	White Rock	119

Application received

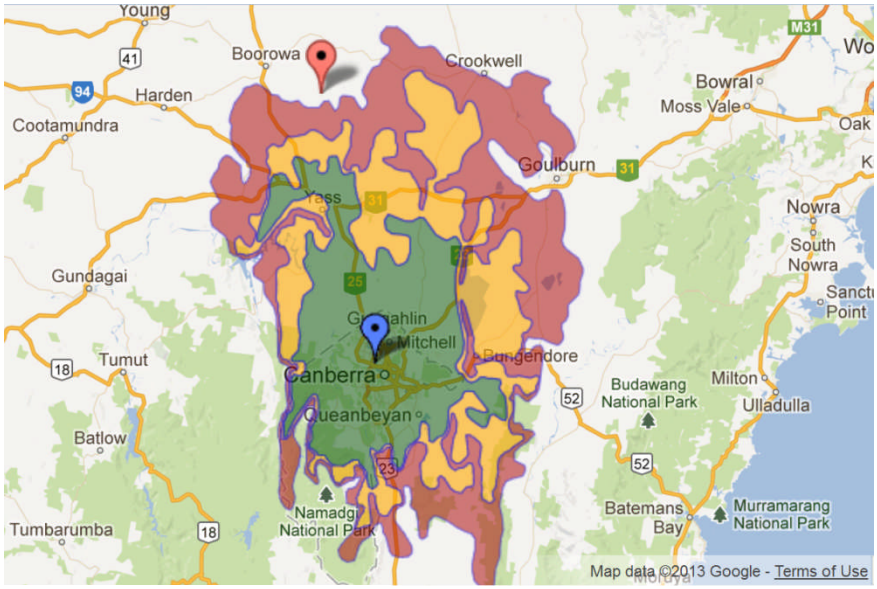
C

		Turbines
C1	Sapphire	159
C2	Ben Lomond - lapsed	100
C3	Liverpool Range	550
C4	Bodangora	40
C5	Crudine Ridge	80
C6	Flyers Creek	40
C7	Paling Yards	60
C8	Golspie	170
C9	Rugby	90
C10	Bango	200
C11	Rye Park	110
C12	Crookwell 3	35
C13	Yass	152
C14	Birrema	80
C15	Collector	80
C16	Adjungbilly	26
C17	Deepwater	10
C18	Unungula	330

Approved under Part 4 of the Environmental Planning and Assessment Act 1979 (NSW)

ATTACHMENT 18 – ABC PREDICTED TV COVERAGE FOR MAIN STATIONS

CANBERRA

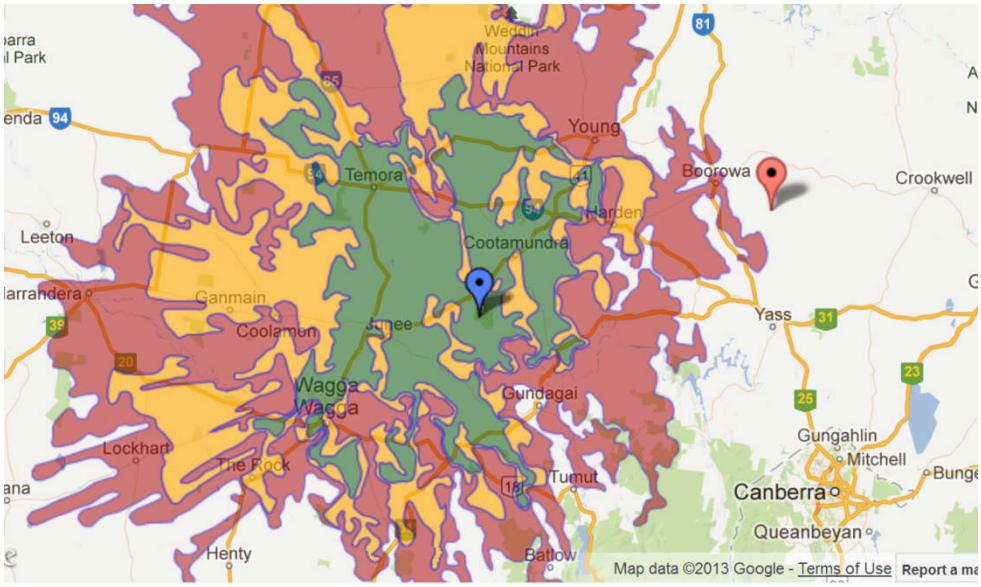


Map Keys

+ Primary Coverage:
(+ expand for details)
+ Secondary Coverage:
(+ expand for details)
+ Tertiary Coverage:
(+ expand for details)

Transmitter Icon - Blue
Bango Icon - Orange

SW SLOPES/E. RIVERINA



CENTRAL TABLELANDS