Proposed Development of

Bango Wind Farm

Southern Tablelands, New South Wales

Matters of National Environmental Significance Preliminary Documentation - Final

May 2018

Prepared for Bango Wind Farm Pty Ltd by CWP Renewables Pty Ltd

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Preface

This document is a response to the Australian Government Department of the Environment and Energy's request for Preliminary Documentation to describe the Action of the Bango Wind Farm. Headings used throughout the document relate directly to that request. Key terms used throughout the document are defined below:

Term	Meaning within this document
BGW	Box Gum Woodland
CEEC	Critically Endangered Ecological Community
DEE	The Department of the Environment and Energy, Australia
DPE	The NSW Department of Planning and Environment
Development Footprint	All areas impacted in constructing this Project (includes the 'permanent impact area' and the 'temporary impact area').
EEC	Endangered Ecological Community
EIS	The Bango Wind Farm Environmental Impact Statement, 2016
EMS	Environmental Management Strategy
EPA	Environmental Protection Authority
EPA Act	NSW Environmental Planning and Assessment Act, 1979
EPBC Act	Environmental Protection and Biodiversity Conservation Act, 1999
GSM	Golden Sun Moth
Locality	The Development Footprint plus a 10km buffer.
MNES	Matters of National Environmental Significance. MNES relevant to the Development Footprint and the proposed activities have been identified throughout the referral and State level approval process. Additional MNES for consideration have been highlights as part of the request for information and these have been included in this assessment.
OEH	Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
Permanent Impact Area	The footprint of the disturbance that will remain through the operational phase of the Project.
PD	Preliminary Documentation
PL1	Planning Layout 1, a configuration of project infrastructure for 75 turbines consisting of a 120.63 ha disturbance area. (Shown in Figure 2.1 - Figure 2.5)
PL2	Planning Layout 2, a configuration of project infrastructure for 61 turbines consisting of a 113.94 ha disturbance area. (Shown in Figure 2.1 - Figure 2.5)

The Project	The proposed Bango Wind Farm project
The Proponent	Bango Wind Farm Pty Ltd, a fully owned subsidiary of CWP Renewables
Study Area	The development footprint plus a 100m buffer.
SP	Superb Parrot
Temporary Impact Area	The footprint of the disturbance that will be required to facilitate construction but will be rehabilitated following the construction phase.
TEC	Threatened Ecological Community
WTG	Wind turbine generator; turbine.

1 BACKGROUND INFORMATION

Bango Wind Farm Pty Ltd (the Proponent) is proposing to install, operate and maintain up to 75 wind turbines and ancillary structures on an area of the Southern Tablelands, 20 km north of Yass, 14 km south-east of Boorowa and 80 km west of Goulburn (see Figure 1.1); known as the Bango Wind Farm (the Project). The Project straddles the boundary between the Hume and Eden-Monaro federal electorates in southern NSW. The wind turbines will be installed for the purpose of generating electricity from wind energy.

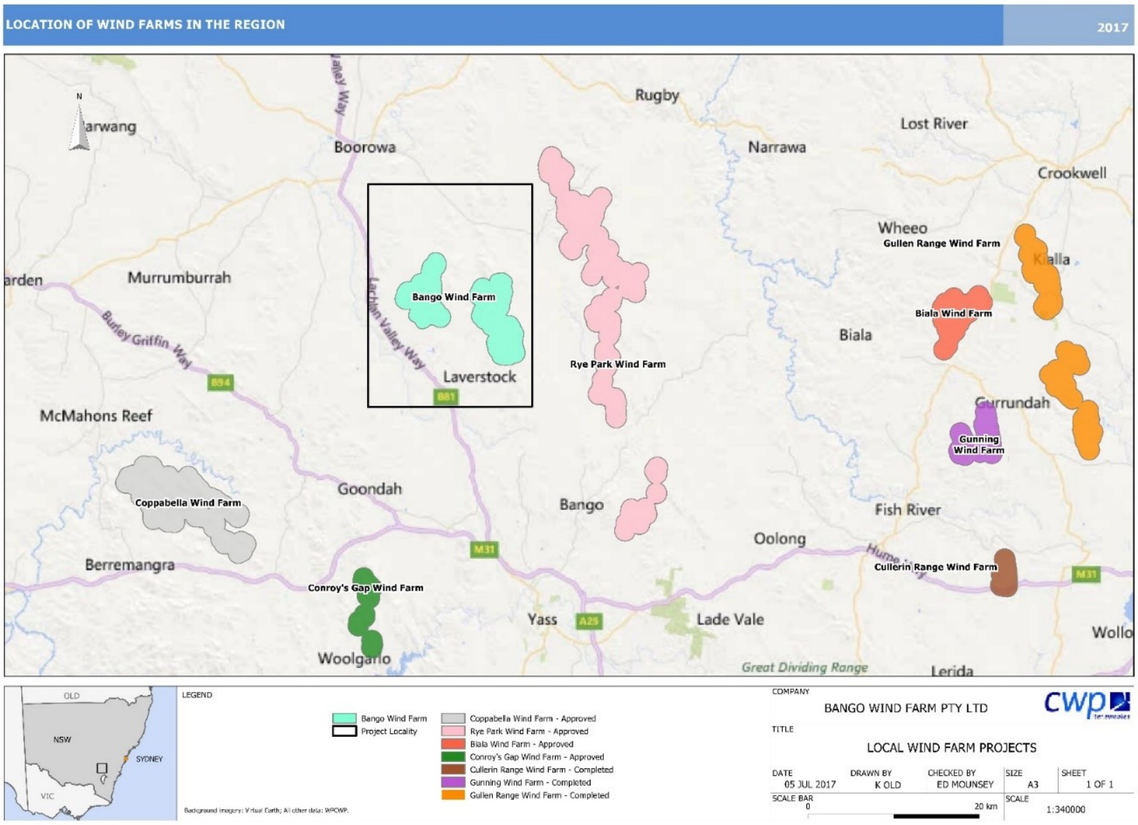

Figure 1.1: Wind Farms in the Region

1.1 PROPOSAL HISTORY

The Project proposal was referred to the Commonwealth in 2013 and was declared a controlled action for assessment by preliminary documentation under the EPBC Act. The referral submission defined a project consisting of up to 122 wind turbine generators, underground interconnections, electrical compounds (including substations and switching stations) and overhead transmission line. The referral is included as Appendix 1.

As a result of outcomes from the assessment of the Project under the State approval process (requiring an Environmental Impact Statement), and upon further considerations from the Proponent, the Project has been amended (see Section 2.8 for a detailed description of these amendments). Of most significance is the reduction in the Project size and extent, being reduced from 122 wind turbine generators to 75 wind turbine generators (a footprint area reduction from 251 ha down to 120.63 ha). This MNES report documents an assessment in accordance with the Preliminary Documentation request for the revised, current Project description.

1.2 PURPOSE AND NEED FOR THE PROPOSAL IN RELATION TO GOVERNMENT STRATEGIES

There has been growing global recognition for the need to mitigate the environmental effects associated with fossil fuel energy generation. Such thoughts have manifested into international, national and state-wide commitments supporting the development of clean and sustainable energy projects.

The primary objective of the Bango Wind Farm is to provide renewable energy to the Australian National Electricity Market. Electricity provided by the Bango Wind Farm would replace an equivalent amount of scheduled generation from higher cost fossil fuel generators, therefore avoiding the emission of approximately up to 600,000 tonnes of C02 per annum, and contributing to the local, national and international agenda of climate change mitigation.

In 2007, the Australian government ratified the Kyoto Protocol and committed to cut greenhouse gas emissions to 108% of 1990 levels. This was a watershed decision and a crucial step in determining Australia's position on climate change in the international arena. In December 2012, Australia agreed to the Doha Amendment to the Kyoto Protocol and committed to reduce emissions to 98% of 2000 levels over the eight-year period 2013 – 2020 (UNFCCC 2012).

The revised Renewable Energy Target (RET) legislation passed by the Federal Parliament in July 2015 set a new target of 33,000 GWh of Australia's electricity to be generated from large-scale renewable sources by 2020. Wind energy generation is a low cost, viable renewable energy source and can be readily implemented to meet a substantial percentage of this target.

At the COP21 climate talks in Paris (December 2015), the Australian Government committed to (and has now ratified) an emissions target of a 26-28% reduction compared to 2005 levels, by 2030.

The NSW Government has recently developed the NSW Climate Change Policy Framework (2016) in support of the COP21 commitments and to demonstrate action on climate change. While still in its infancy, long term objectives of this Framework include achieving net zero emissions by 2050 and enabling NSW to become more resilient to climate change.

The Project site and size has been carefully selected considering several factors, and the Project will play a significant role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of Global Warming and Climate Change; contributing up to 2.5 % (depending on the installed capacity) of the additional renewable energy generation needed to meet the legislated Australian target.

Both Yass Valley Council and Boorowa Council have Community Strategic Plans which outline environmental, social and economic objectives for the area, and the methods that may be used to achieve these. These are discussed further in section 7.4.

1.3 HOW THE PROPOSAL RELATES TO OTHER ACTIONS

There are no related actions to the Bango wind farm proposal.

1.4 WIND FARMS IN THE REGION

The proposed Project has been considered in the context of other wind farms in the region as part of this assessment. Figure 1.1 shows a number of other wind farm projects in the region. This includes projects currently operational and others with approval or under development.

Table 1.1 lists the seven wind farms, planned or existing, within 70 km of the Bango Wind Farm.

The PD Request highlights that the Project should be considered in the context of nearby wind farms, in particular those within the known breeding range of the Superb Parrot (*Polytelis swainsonii*), a species listed as vulnerable under the EPBC Act. The DEE reports three distinct and geographically separate locations for the species' breeding range. Of significance to the Project is the range described as a 'triangle bounded by Oolong, Yass and Young' (DEE, 2017). The proposed Bango Wind Farm, as well as the proposed Rye Park Wind Farm would be within this bounded triangle.

Table 1.1: Wind farms near Bango

Wind Farm	Capacity	Distance from Bango (km)	Approval/ Operational Status	
			EP&A Act	EPBC Act
Bango	75 WTGs	0	Recommended for Approval	Proposed
Rye Park	92 WTGs	20	Approved	Proposed
Conroy's Gap	Up to 30 MW	35	Approved	Approved
Coppabella	79 WTGs	40	Approved	Approved
Biala	31 WTGs	60	Approved	Not required
Gunning	46.5 MW	60	Operational	
Gullen Range	165.5 MW	70	Operational	
Cullerin Range	30 MW	70	Operational	

2 DESCRIPTION OF THE ACTION

2.1 OVERVIEW

The Project includes the installation, operation and associated maintenance of a wind farm that incorporates up to 75 wind turbines and ancillary structures. The proposed action is located in a landscape modified by agriculture with areas of cropping, improved pastures (of introduced grasses), grasslands of native species and small amounts of remnant vegetation largely restricted to the road reserves and ridgelines.

There are currently two layout options for consideration which differ slightly in number of turbines and subsequently layout position (PL1 with 75 turbines and PL2 with 61 turbines). These are outlined in Figure 2.1 to Figure 2.5. Despite being different in the number of turbines, they largely share the same proposed layout and impact area, as shown in Table 2.1.

Table 2.1: Comparison of layout options

	PL1	PL2
Number of turbines	Up to 75	Up to 61
Permanent and temporary impact area	121 ha	113 ha
Permanent impact area	86 ha	84 ha
Average impact width of road construction[1]	Approx. 10m	Approx. 10m

The development footprint for PL1 is slightly larger than PL2. The actual impact area for the Project will not exceed the Development Footprint for Planning Layout 1. Unless otherwise stated in this report, impacts for PL1 are quoted.

Approval is being sought for turbines with up to 200 m blade tip height. The final layout, turbine model and size will be determined via a competitive tender process once approvals have been attained.

The Project site area has generally been cleared of trees for the purposes of grazing sheep and cattle and planting crops. The wind turbine generators have been sited within the design constraints to maximise electricity production. It is standard that any approval from the DPE will include conditions around micro siting turbines away from habitat for vulnerable species and that any micro siting results in impacts that are no greater than those that have been assessed.

[1] *Wind Farm access tracks will be 6m wide. The area of impact for construction will be greater than 6m, but will vary depending on the amount of cut and fill required due to the changing topography across the wind farm. This has been evaluated in the project environmental impact assessment.*

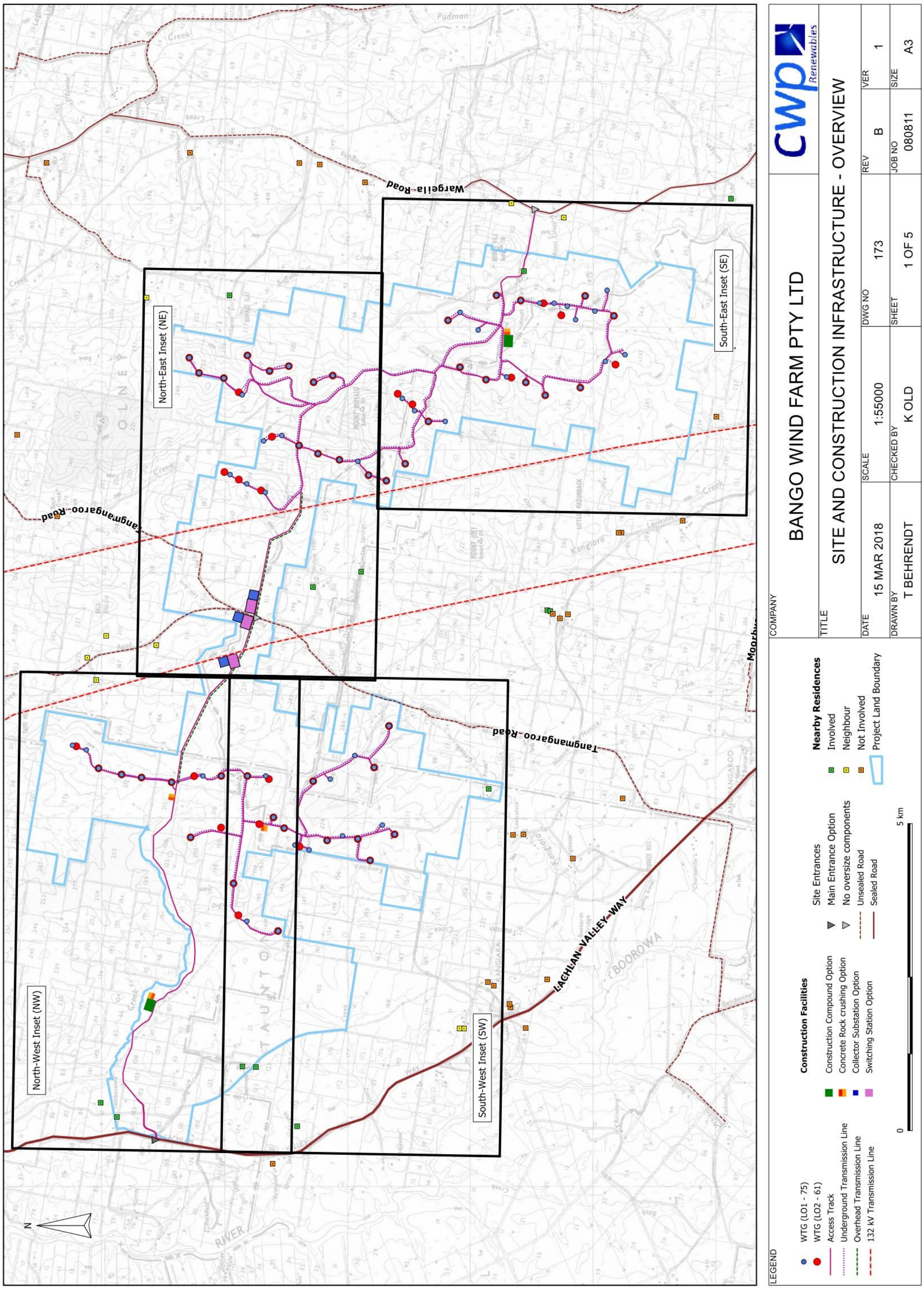

Figure 2.1: Bango Wind Farm Layout- Overview

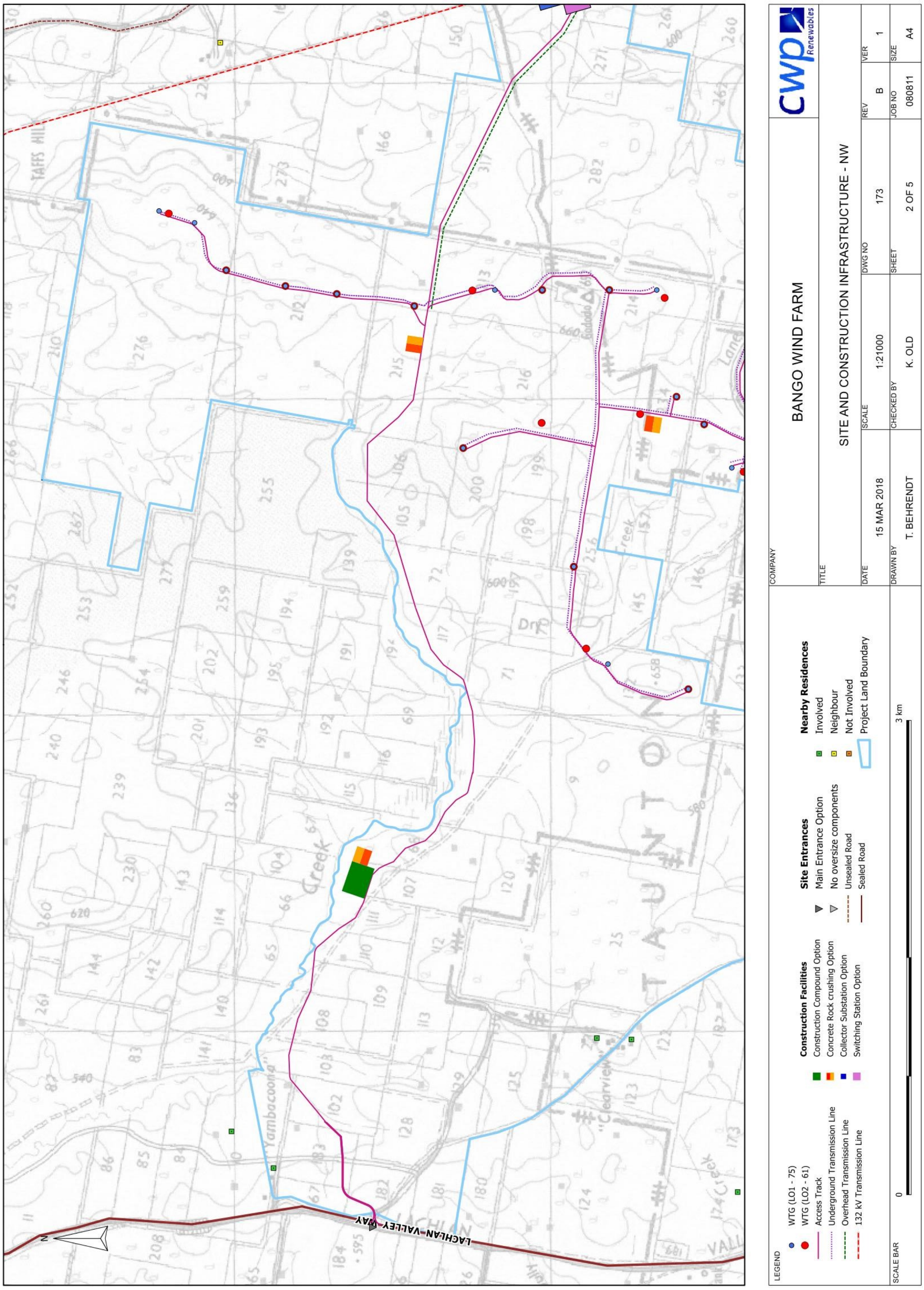

Figure 2.2: Bango Wind Farm Layout – NW Quadrant

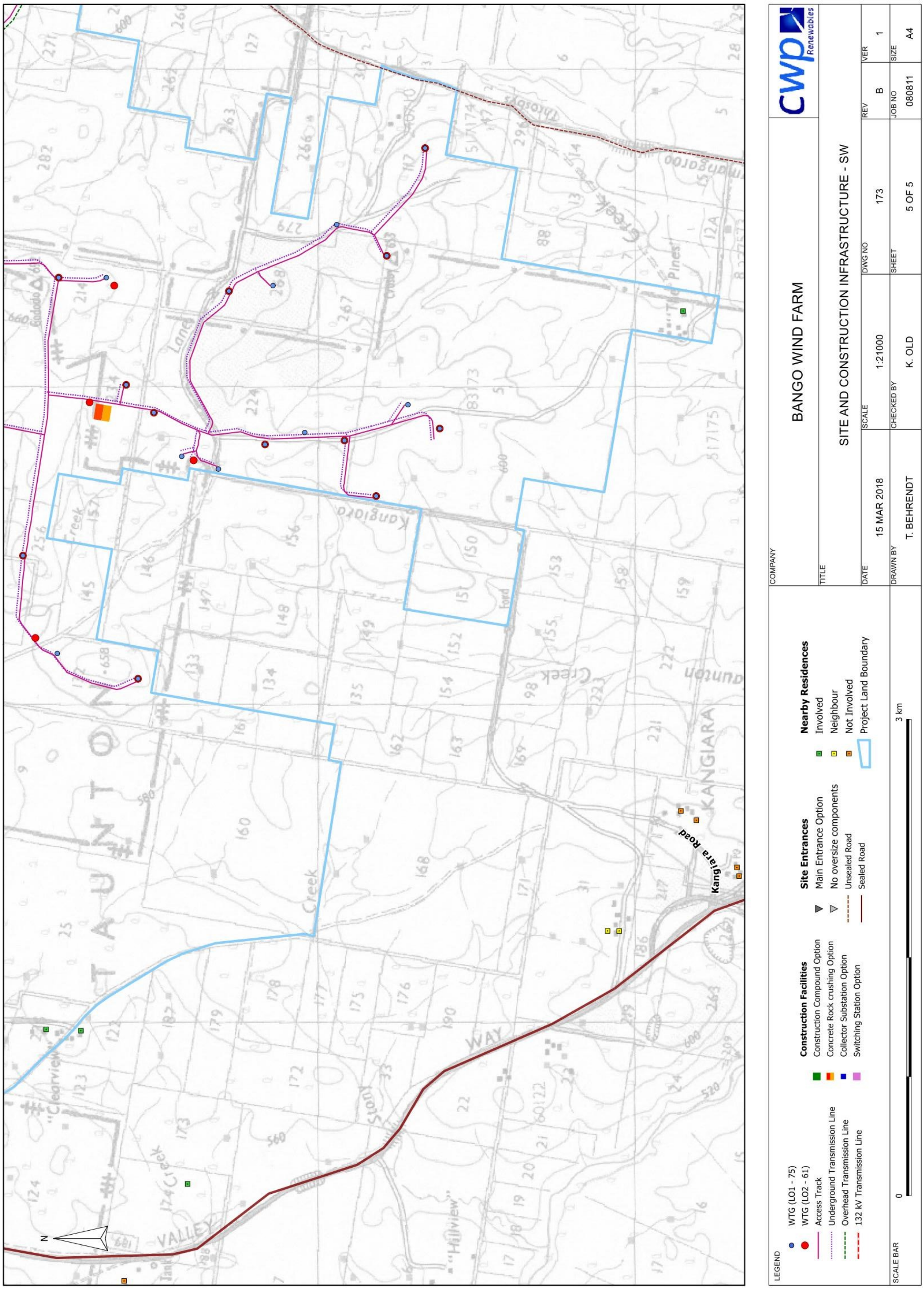

Figure 2.3: Bango Wind Farm Layout – SW Quadrant

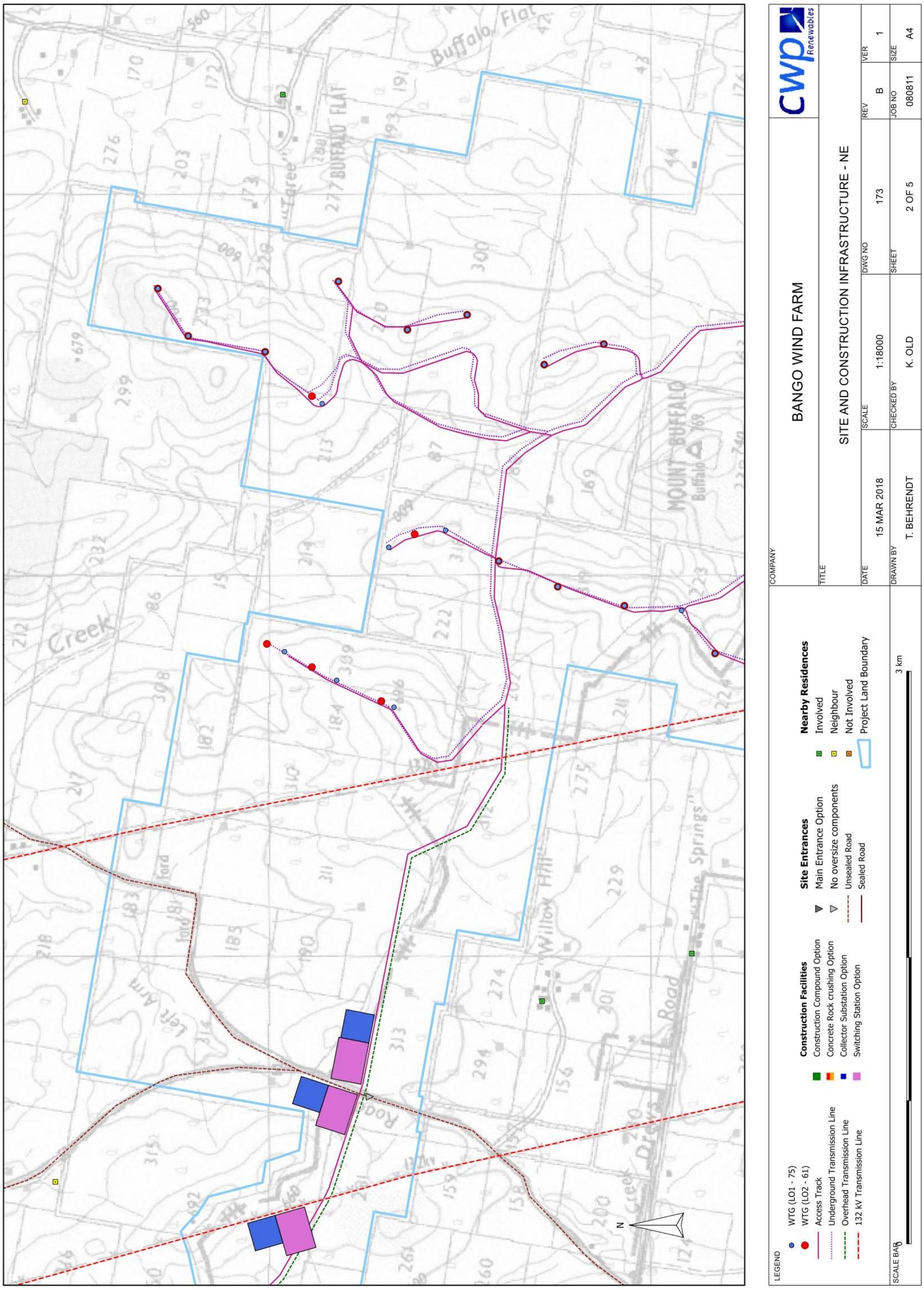

Figure 2.4: Bango Wind Farm Layout – NE Quadrant

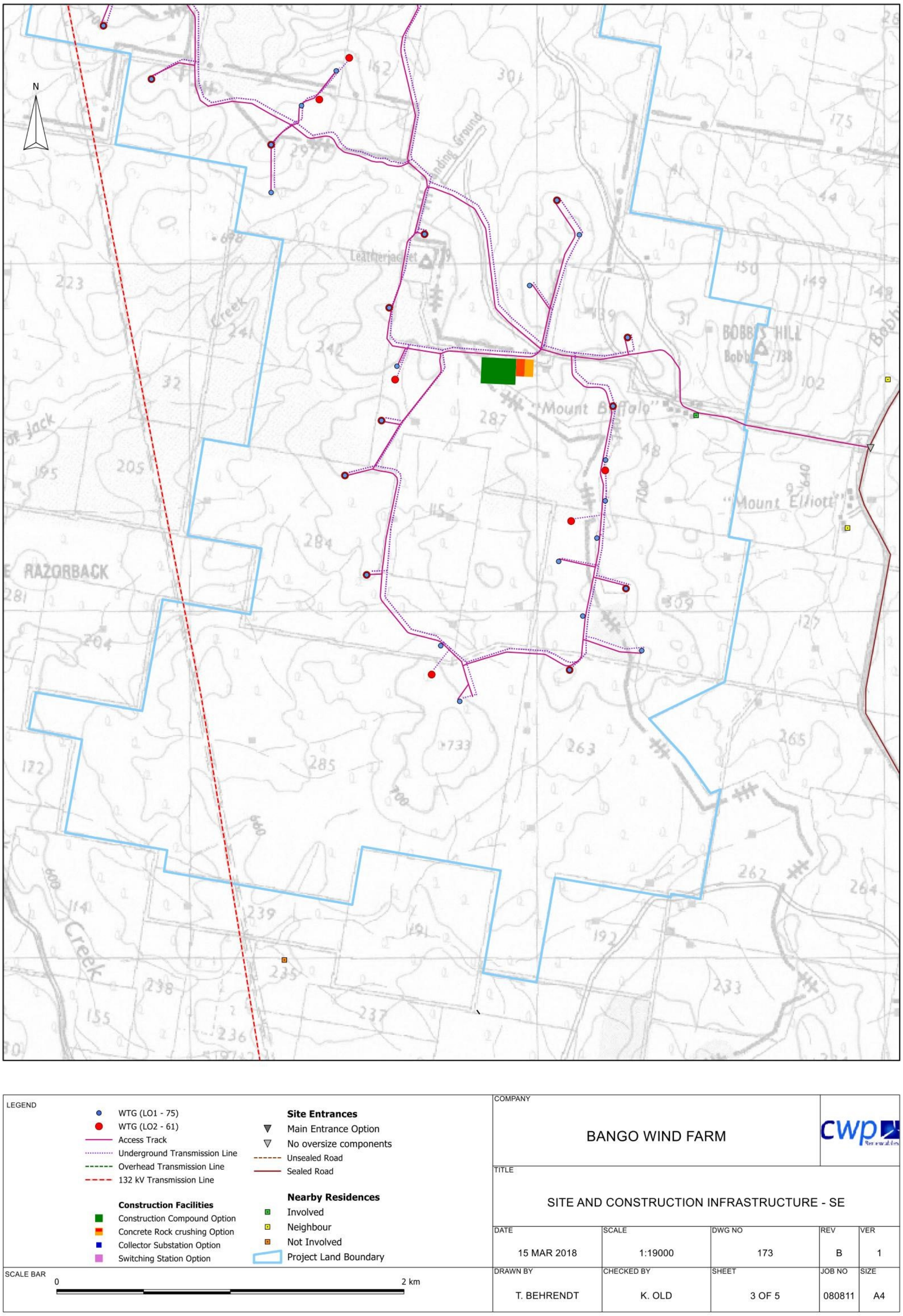

Figure 2.5: Bango Wind Farm Layout – SE Quadrant

The substation will be located centrally within the project, close to the 132kV overhead power line, in one of three locations, as indicated above. An example of the likely substation layout is shown in Figure 2.6.

Figure 2.6: Example of a 270 MW Wind Farm Substation

Locations for site construction compounds which would be used for stockpiling materials and holding machinery while not in use, are also shown in the Figures above.

Each wind turbine generator site will include a crane hardstand and laydown area adjacent to the foundation, as indicated in Figure 2.7.

Figure 2.7: Wind turbine generator Installation Showing Crane and Hardstand

The impact areas of the Project components are shown in Table 2.2.

Table 2.2: Project Component Impact Areas

Project Component	Approximate Dimensions
Permanent	
Wind turbine footings (max footprint)	25 by 25 m
Wind turbine assembly / crane hardstand areas	25 by 60 m
Collector substation (CS)	150 by 150 m
Site compounds (the extent of permanent section retained within temporary compound)	75 by 75 m
On-site access: new roads	6 m by 56 km
Overhead transmission lines / easement	45 m by 4.68 km (2 x 33 kV) 30 m by 0.65 km (2 x 33 kV, 1 x 132 kV)
Switching station (SS)	220 by 160 m
Wind monitoring masts	1 x 1 m (5 per mast)
Temporary (during construction)	
Earthworks alongside permanent infrastructure (roads / hardstands) [2]	10 m by 56 km (approx.)

[2] *Construction of the on-site access road network will require earth works that are beyond the limits of the permanent road impact within the Study area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for both Layout Options based on available contour and geotechnical data, to include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works.*

Project Component	Approximate Dimensions
Underground transmission lines[3]	3 m by 34 km
Concrete /asphalt batching plant	50 by 100 m
Rock crushing facility	50 by 100 m
Site compound and office	150 by 200 m

2.2 PROPOSED ACTION

The proposed action consists of both permanent and temporary infrastructure, as shown in Figure 2.1 to Figure 2.5. The permanent impact area covers 86 ha, and includes:

- 56 km of 6 m wide wind farm access tracks, with equivalent length of underground cable trenching;
- Up to 75 wind turbines (PL1) up to 200 m blade tip height, each with a foundation and hardstand;
- One collector substation with switching station, to connect the wind farm to the electricity grid. To be built in one of three location options;
- Up to 5.5 km of overhead power lines;
- One site office with storage compound;
- Four site entrances, with one main entrance off the state road (the Lachlan Valley Way) to allow all oversize components; and,
- Up to 4 permanent wind monitoring masts.

In addition, the temporary impact area required includes:

- Up to 4 concrete batch plants, each one up to 0.5 ha in area;
- Up to 4 rock crushing facilities, each one up to 0.5 ha in area;
- Up to two construction compounds, each up to 3 ha in area; and,
- Up to 9 temporary wind monitoring masts.

2.3 OFFSITE INFRASTRUCTURE REQUIRED

All oversize components will be transported to site via the Lachlan Valley Way, as shown in Figure 2.8. As a result, road widening to accommodate wind turbine components will not be required for wind farm construction. There are four site entrances all together and the remaining construction vehicles (not oversized) will use the most appropriate access route based on their origin, destination and the prevailing conditions. Local road surface upgrades and maintenance will be required throughout the construction period, as agreed with RMS and local government authorities, to ensure these roads remain fit for purpose.

The intended electricity grid connection is via transmission lines that cross the Project site to the substation location - this connection point will constitute part of the Project infrastructure.

[3] *Underground transmission lines are a temporary impact and where feasible will be installed either within or adjacent to on-site access roads and earthworks. The trenches for the cables are backfilled with excavated material and covered with topsoil post installation. Suitable rehabilitation measures will be used in consultation with ecologists and landowners.*

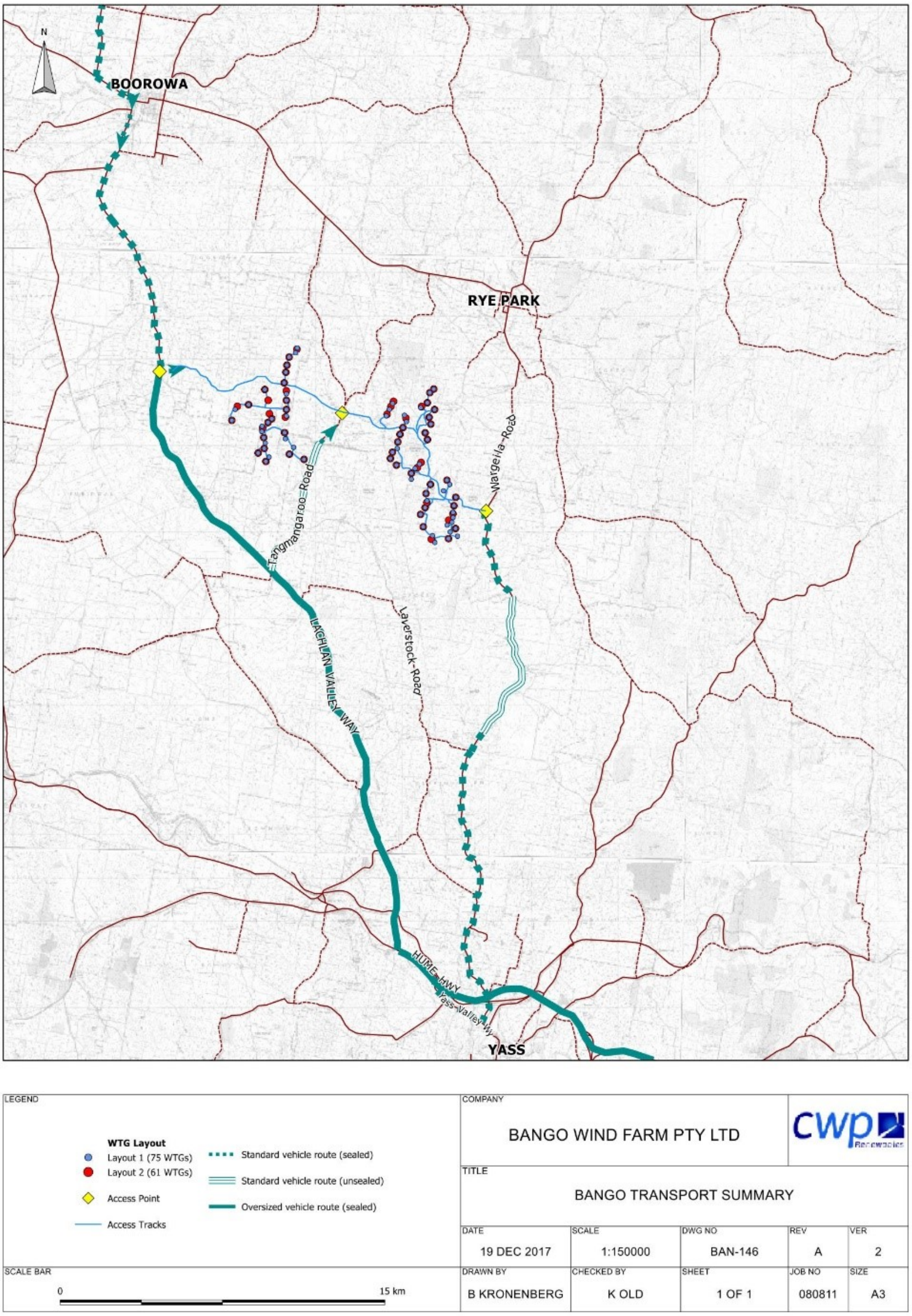

Figure 2.8: Bango Transport Routes Summary

2.4 CONSTRUCTION METHODS, TECHNIQUES AND MATERIALS

The following description of construction methods, techniques and materials required for construction of the Project are drawn from the Proponent's extensive previous experiences in large scale wind farm construction. Key activities involve:

- Pre-construction works, including detailed site investigation and surveys, and upgrading of access roads and entry points where required;
- Site establishment, including fencing, installation of environmental controls, site offices, laydown areas, batch plants and rock crushing facilities;
- Construction of site access tracks, to be surfaced with compactable, engineered, base material with suitable drainage;
- Turbine site preparation including a levelled area with an unsealed pavement surface;
- Substation site preparation;
- Formation of footings for each turbine – these will be approximately 4.5m deep, 25m in diameter, and constructed of reinforced concrete;
- Concrete footings for the substation;
- Trenching and installation of 33kV underground cables and communication cables within each of the wind turbine clusters;
- Installation of 33kV overhead transmission lines and communication cables between the wind turbine clusters and the main collector substation;
- Upgrade of transport routes to facilitate haulage of oversize and over mass wind turbine and collector substation components;
- Transportation of wind turbine and substation components from port of origin to the site storage and laydown areas;
- Transport of wind turbine components to wind turbine sites and substation components to the substation site;
- Erection of wind turbine structures, which cannot commence until most of the above steps have been completed, then large cranes are used for the assembly of the wind turbines;
- Installation of up to four permanent monitoring masts;
- Construction of a 132kV substation and switchyard with associated structures and buildings;
- Connection to the existing transmission line with an associated 30m wide easement;
- Installation of appropriate signage;
- Site restoration, revegetation of disturbed areas and completion of drainage works.

Blasting may be required for some turbine footings, access roads and site compounds. The extent has been considered as part of the development footprint and will be determined during detailed design. The DPE approval conditions will detail blasting limits allowable for the Project.

Resource requirements are typical of any new development site, including the provision of cement, gravel, sand, asphalt, water and road base material. Where possible and feasible, these will be sourced from within the Project area. Temporary rock crushing, as shown in Figure 2.9, and concrete batching facilities may also be established on-site.

Figure 2.9: Temporary on-site rock crusher

Figure 2.10: Gravel dressing around wind turbine base, with external transformer kiosk[4]

Figure 2.11: A typical wind turbine rotor installation[5]

All construction activities will be controlled by an Environmental Management Strategy (EMS), to be prepared and implemented under the EPA Act. The EMS will provide a framework for environmental management during the construction and operation of the Project, and on-going public and agency consultation. The EMS will guide compliance with the (pending) Development Consent (SSD-6686) and other relevant requirements. The EMS will consider *ISO 14001:2015 Environmental Management Systems – Requirements and Guidance for Use*.

The objectives of an EMS are to:

- Provide the overarching framework for minimising and controlling the environmental impacts of the Project using principles included in ISO 14001:2015;
- Ensure compliance with all relevant legislation, including the (pending) Development Consent and (pending) Commonwealth Approval;

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[4] Not all wind turbine generator models require an external transformer kiosk. Alternatives include the step-up transformer being located within the wind turbine tower.

[5] Note, certain wind turbine generator models have blades installed onto the hub individually.

- Enable the Project team to minimise disruption and inconvenience to the community during construction;
- Equip all Project staff and contractors with the appropriate training, equipment and delegations to implement their environmental obligations under this EMS; and
- Provide mechanisms to identify and manage environmental impacts arising from changes to design or construction methodology.

Sub-plans to the EMS will include the:

- Biodiversity Management Plan (including a biodiversity offset strategy);
- Aboriginal Heritage Management Plan; and
- Traffic Management Plan.

An example from a recent Project is the Crudine Ridge Wind Farm EMS (which can be found at https://www.crudineridgewindfarm.com.au/planning-and-approvals/).

2.5 OPERATION REQUIREMENTS AND ANTICIPATED MAINTENANCE WORKS

Once operational, the Project would be monitored both by on-site staff and via remote monitoring. Remote monitoring includes wind turbine performance assessment, wind farm reporting, remote resetting and pro-active computer control systems to monitor the performance of the wind farm. Any issues are reported directly to the on-site staff, who also manage site safety, environmental monitoring, landowner relations, routine servicing, malfunction rectification and any site visits.

The land leased by the Bango Wind Farm will include all permanent infrastructure, surrounded by a corridor of approximately 200m. On-site staff will be responsible for managing operations in accordance with the Operations Environmental Management Plan to be administered under the EMS.

Maintenance staff will be on-site throughout the operational period, making routine checks of all wind farm and substation infrastructure. Maintenance and visiting vehicles will use dedicated on-site roads and hardstand areas, which are all part of the permanent impact footprint, to access Project infrastructure. This will minimise the spread of weeds across the site and generally minimise post-construction impacts to vegetation for the Project.

Where ingress of weeds across the Project site a known issue, mitigation measures described in the EIS, such as introduction of wash-down areas, will be implemented.

Occasionally, access by medium and heavy vehicles may be required to repair or maintain overhead transmission line components. Maintenance which requires the replacement of major components, such as wind turbine blades, may require the use of cranes and ancillary equipment.

It is likely that the switching station will be operated by TransGrid, and a separate operational EMP will be prepared for the switching station, albeit governed by the Project commitments and pending consents.

2.6 TIMING AND DURATION

Table 2.3 shows approximate expected timing for key milestones.

Table 2.3: Expected Timing and Duration for Bango Wind Farm Milestones

Milestone	Start	Completed
NSW Department of Planning & Environment Assessment and recommendation (EP&A Act)	May 2017	February 2018
Planning Assessment Commission decision (EP&A Act)	February 2018	April/May 2018
Commonwealth Assessment decision (EPBC Act)	July 2017	May 2018
Preparation for construction[6]	April/May 2018	November 2018
Construction	January 2019	June 2020
Operation and maintenance	June 2020	2045 (with options to extend)

2.7 LOCATION, BOUNDARIES AND SIZE OF THE DISTURBANCE FOOTPRINT

The location of the Project is shown in Figure 1.1, with detailed project boundaries shown in Figure 2.1. Details of the disturbance footprint are given in Table 2.1.

Direct and indirect impacts will be minimised and controlled using the mitigation measures outlined in section 5.2.

2.8 INDICATIVE LAYOUT PLAN FOR THE AREA

The locality of the Project consists mainly of cleared land intended for grazing and cropping, with most host landowners using their properties primarily for grazing sheep and cattle.

Major reductions have occurred to the Project since it was declared a controlled action for assessment by preliminary documentation under the EPBC Act, in 2013. Of most significant note is the reduction in the Project size and extent, being reduced from 122 wind turbine generators down to 75 wind turbine generators and a footprint area reduction from 251 ha down to 121 ha.

Figure 2.12 provides detail associated with the Project layout, including information related to the Project reduction.

[6] This milestone will be reached once the project layout and environmental offsets are finalised, Construction Management Plans and Early Works are complete, and the Project has reached Financial Close.

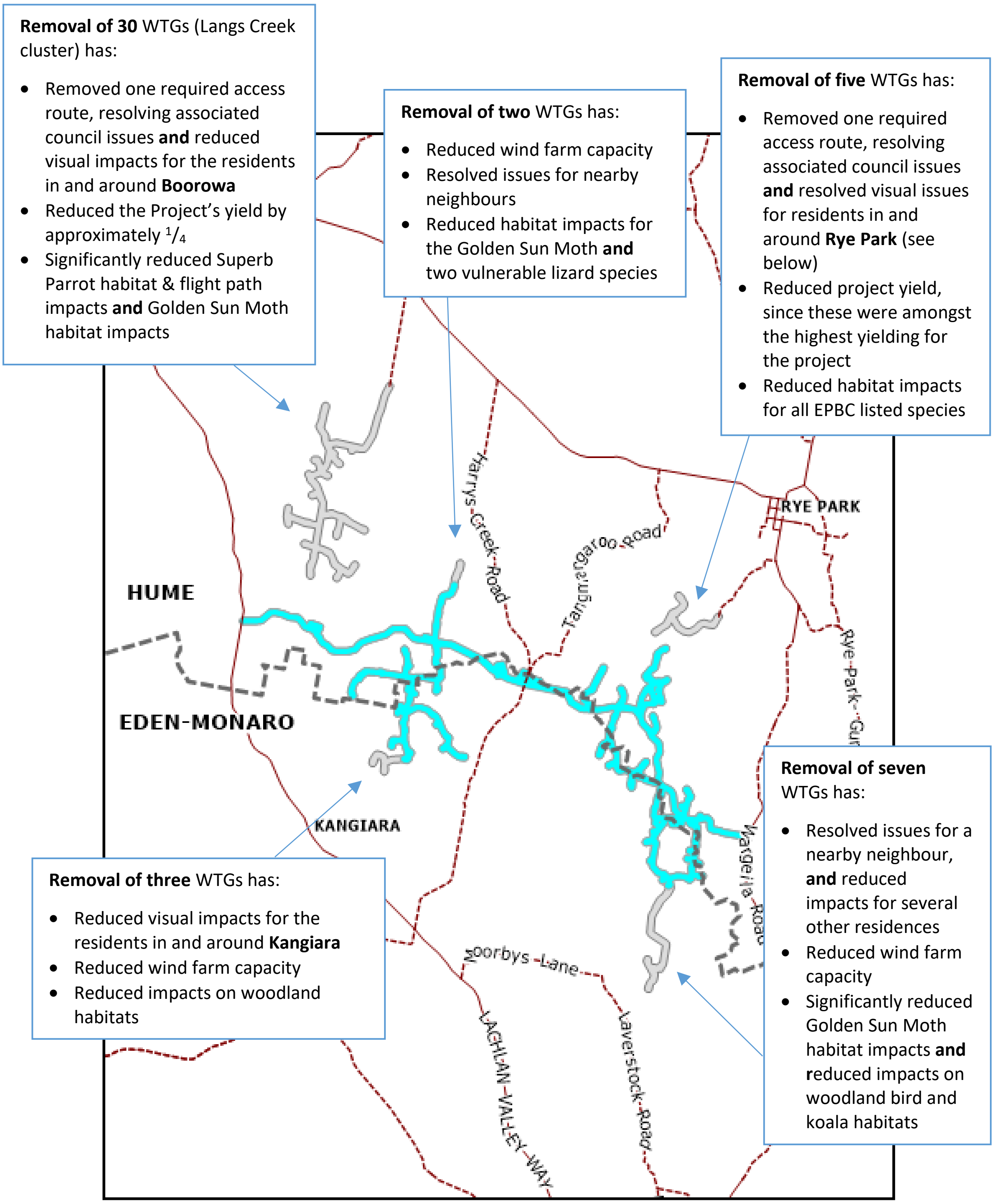


Figure 2.12: Areas of Turbines Removed from the Bango Wind Farm Layout

3 DESCRIPTION OF THE ENVIRONMENT AND MNES

MNES relevant to the Project have been identified during extensive surveys undertaken through 2012, 2013, and 2017 to inform the preparation of State and Commonwealth approvals documentation. In addition, the DEE highlighted specific MNES as part of the PD Request to be considered as part of this report. This section summarises the approach to identifying relevant MNES and provides required detail for each MNES identified.

3.1 SUMMARY OF ASSESSMENT (CURRENT LAND USE)

To identify and analyse the MNES of the Study Area, a literature and data review of the Locality was undertaken. This informed development and implementation of a detailed field survey program focussed on the Study Area. Information from the literature and database review and the field survey program was used to assess the potential impacts of the Project on the ecological features within the Study Area.

3.1.1 Literature and Data Review

Database searches were undertaken to identify EPBC Act listed threatened species, migratory species and Threatened Ecological Communities (TECs) known or likely to occur in the Study Area and surrounding Locality.

Database searches were current to March 2013 for the referral submission to the Commonwealth.

The databases searched are outlined below:

- Commonwealth Protected Matters Search Tool;
- Atlas of NSW Wildlife;
- Atlas of Living Australia;
- Atlas of Australian Birds;
- NSW Flora Online;
- Other sources:
    - bird records from the area held by Greening Australia; and
    - map of Golden Sun Moth records and habitat (DEWHA 2009).

A review of literature relevant to wind farms and the Locality included the following:

- Bango Wind Farm Preliminary Environmental Assessment (WPCWP 2011);
- Bango Wind Farm Preliminary Ecological Investigation (WPCWP 2012);
- Native Vegetation of the Southern Forests: South east Highlands, Australian Alps, South west Slopes, and SE Corner Bioregions (Gellie 2005);
- The Native Vegetation of Boorowa Shire (NSW National Parks and Wildlife Service (NPWS) 2002);
- Sustainable Farms: Pathways for a Rural Landscape – Project Update July 2008 – Bats (ANU 2008);
- Rugby Wind Farm Ecological Impact Assessment (ERM 2012); and
- AGL Dalton Power Project Environmental Assessment (URS 2011).

3.1.2 Survey Program

The field survey program was undertaken during the period July 2012 – February 2013 and aimed to establish species presence, particularly threatened species, and to record and map potential habitat for threatened species that have the potential to occur in the Study Area.

A total of 67 separate days were spent in the Study Area by various field teams, equating to approximately 130-person days of effort across the Study Area during the duration of the field investigation period. Broadly the program consisted of surveys for:

Flora:

- Vegetation mapping to identify TECs and habitat types; and
- Random meander for threatened species.

Fauna:

- Random meanders through fauna habitats;
- Diurnal searches for amphibians;
- Reptile trapping, tile grids and diurnal searches;
- Bird census and bird utilization survey;
- Camera trapping;
- Anabat ultrasonic detection units and harp trapping;
- Nocturnal call play-back and spotlighting;
- Harp trapping; and
- Opportunistic observations.

Targeted surveys were undertaken for a number of threatened species including the Golden Sun Moth and Superb Parrot.

An additional vegetation mapping effort was undertaken over two days in April 2017 to identify ecological features in some road reserve areas relevant to the development footprint.

Further additional flora survey and vegetation mapping was undertaken in October 2017 (ELA 2017) to verify vegetation mapping and collect data to inform offsetting calculations.

3.1.3 Likelihood of Occurrence Criteria

A Likelihood of Occurrence Assessment was undertaken for the species and ecological communities with potential to occur identified from the desktop and literature review. The Likelihood of Occurrence Assessment was informed by the results of the database searches followed by targeted and observational field investigations which have been undertaken in the Study Area by ERM since July 2012. The assessment grouped threatened ecological communities and threatened species into four likelihood categories based on the criteria outlined in Table 3.1.

Table 3.1: Likelihood of Occurrence Criteria

Category	Description
Known	The species/community has been recorded in the Study Area during recent field surveys; OR
	database records demonstrate that the species/community is known to occur in the Study Area.
Likely	The species/community has been recorded in the Locality in the last 10 years, and optimal habitat exists within the Study Area
Potential	The species/community has been recorded in the Locality in the last 10 years, but the habitat within the Study Area is sub-optimal; OR

Category	Description
	in the case of a bird or bat species, the species may fly over the Study Area; OR
	the precautionary principle has been applied to assume presence of the species/community for other reasons.
Unlikely	The species/community has not been recorded within the Locality within the last 10 years and optimal habitat does not occur within the Study Area.

3.2 ENVIRONMENTAL CONTEXT (LAND TOPOGRAPHY)

3.2.1 Land Use and Disturbance History

European settlement of the Boorowa region occurred during the early- to mid-1800's, with agriculture becoming the dominant industry of the area. Overall, the environment in the Study Area has been modified substantially, largely due to current and historical clearing and agricultural activities.

Prior to European settlement, the Study Area consisted of a mixture of open forest and grassy woodland (Keith 2004) on undulating topography. Currently, approximately 91% of the Study Area is cleared of tree cover or has had tree cover substantially reduced. Areas of woodland and open forest range from intact areas, to areas undergoing natural regeneration, and woodland areas in which the understorey and groundcover are substantially modified.

The Study Area comprises private farming properties, primarily used for livestock grazing and cropping. Some areas have a long history of pasture improvement, cropping and grazing. Other areas have not been ploughed or cultivated and scattered areas of exposed rock occur amongst the grasslands. In areas of heavy grazing, native flora cover is minimal and such areas are dominated by exotic pasture species. Derived native grassland occurs in areas of less intensive grazing. It appears that extensive clearing has occurred in the slopes and valleys within the Study Area, with intact native woodland areas generally restricted to the ridge tops and roadsides.

Figure 3.1 shows the land tenure across the site and the locations of conservation reserves in relation to the project area. Figure 3.2 to Figure 3.6 show high value vegetation areas in relation to the Project, as mapped in the NSW National Parks and Wildlife Service report on conservation value of Boorowa Shire (Priday et al 2002).

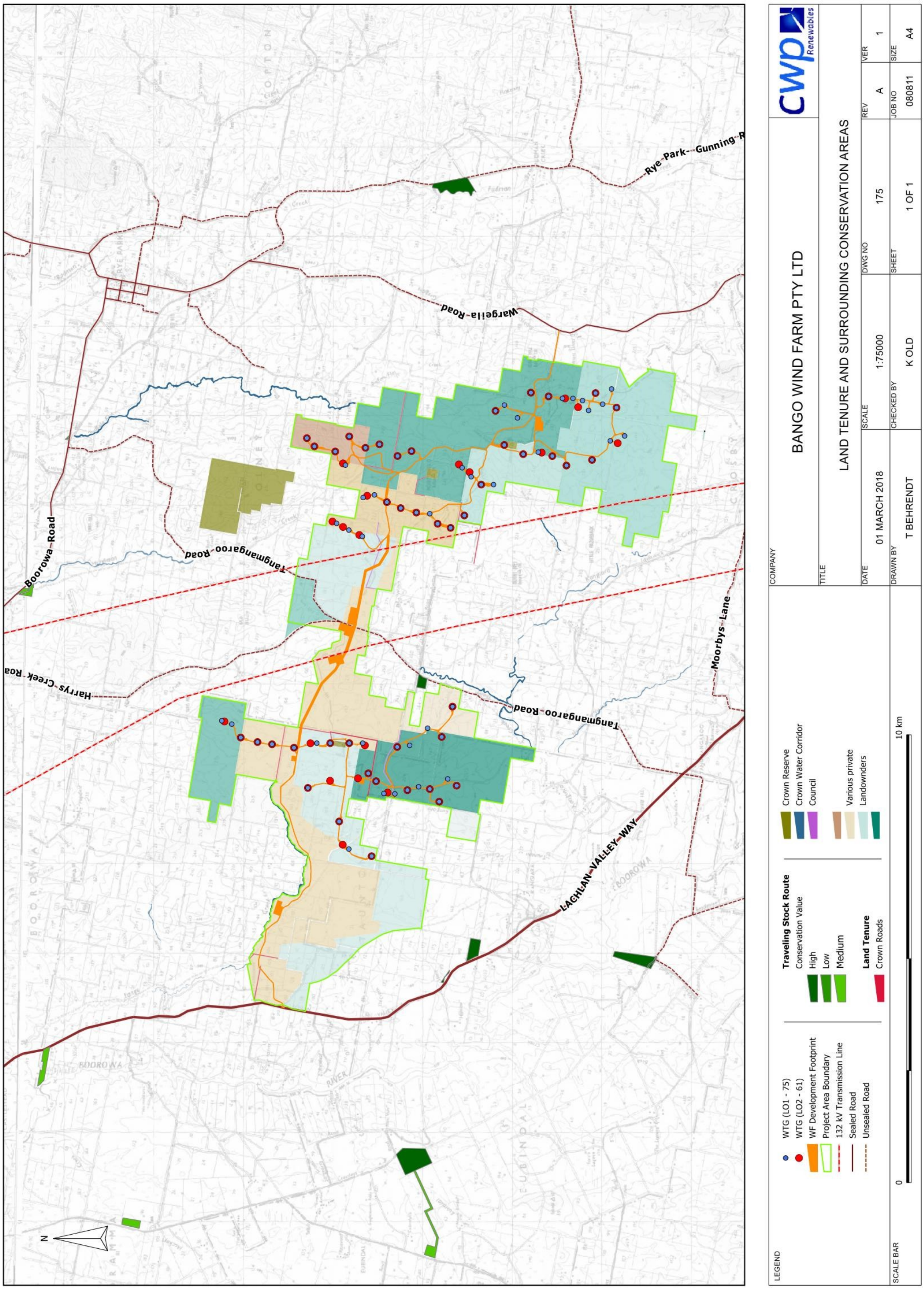


Figure 3.1: Land Tenure and Conservation Areas

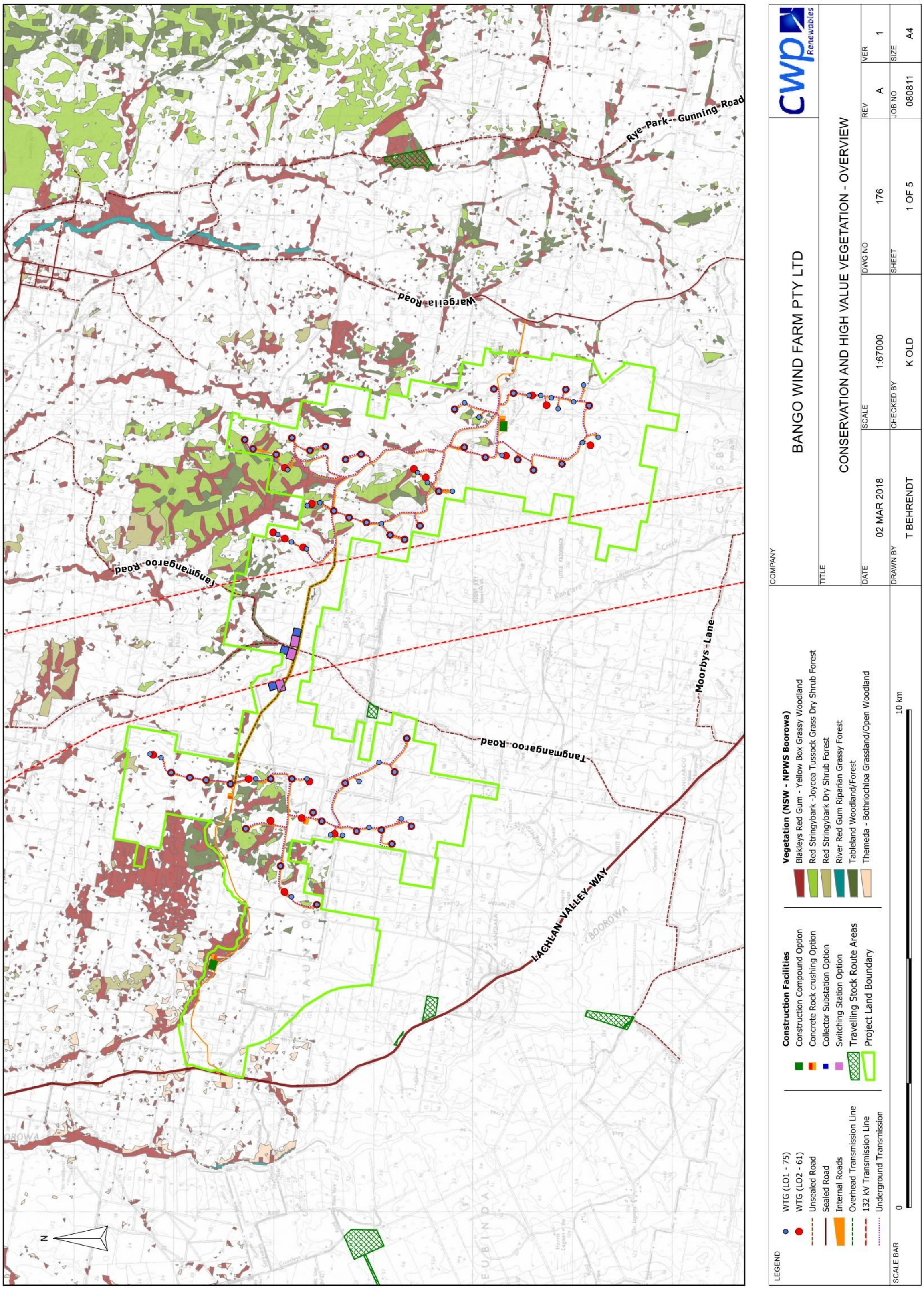


Figure 3.2: Conservation Areas and High Value Vegetation – Overview

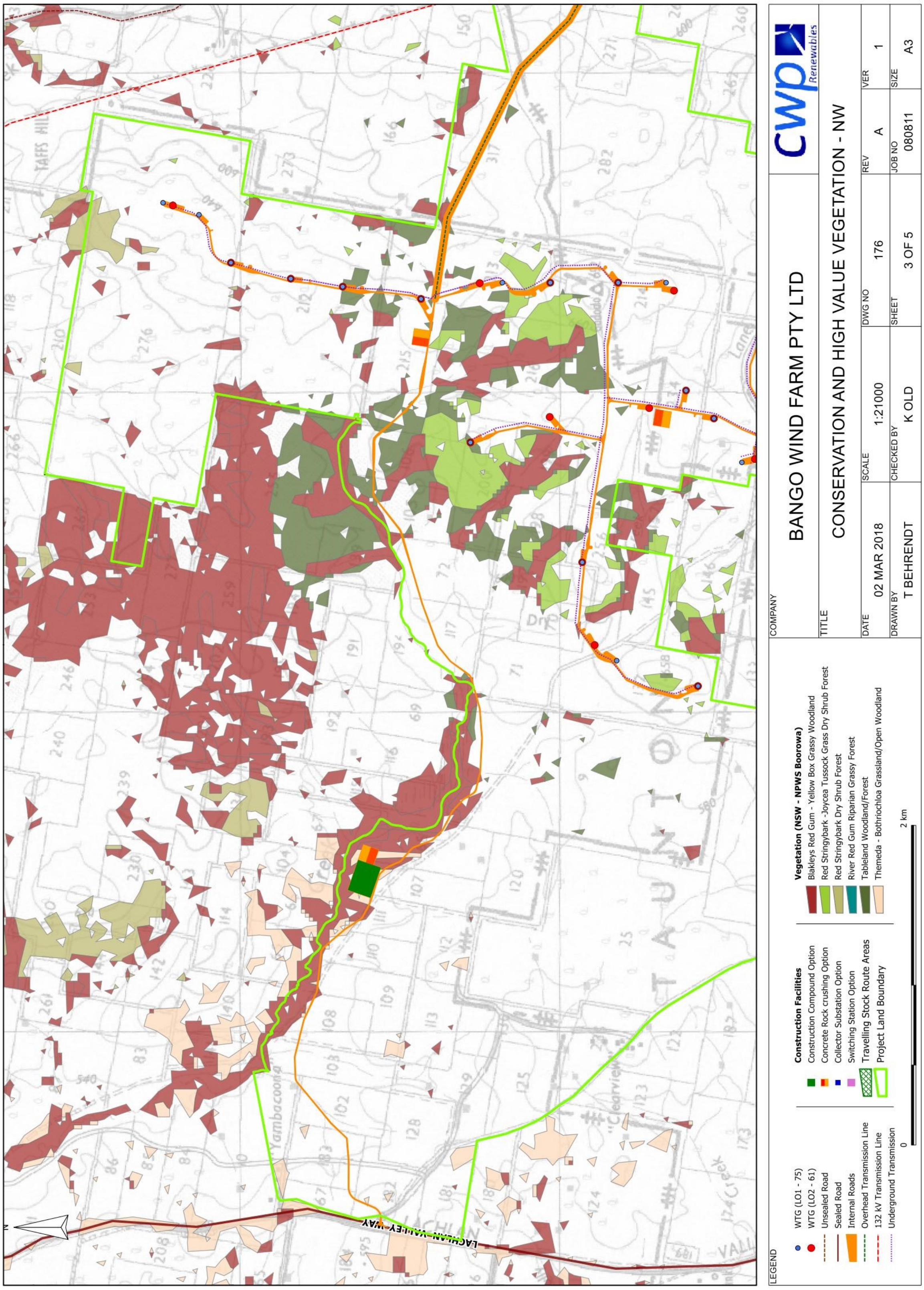


Figure 3.3: Conservation Areas and High Value Vegetation - NW Quadrant

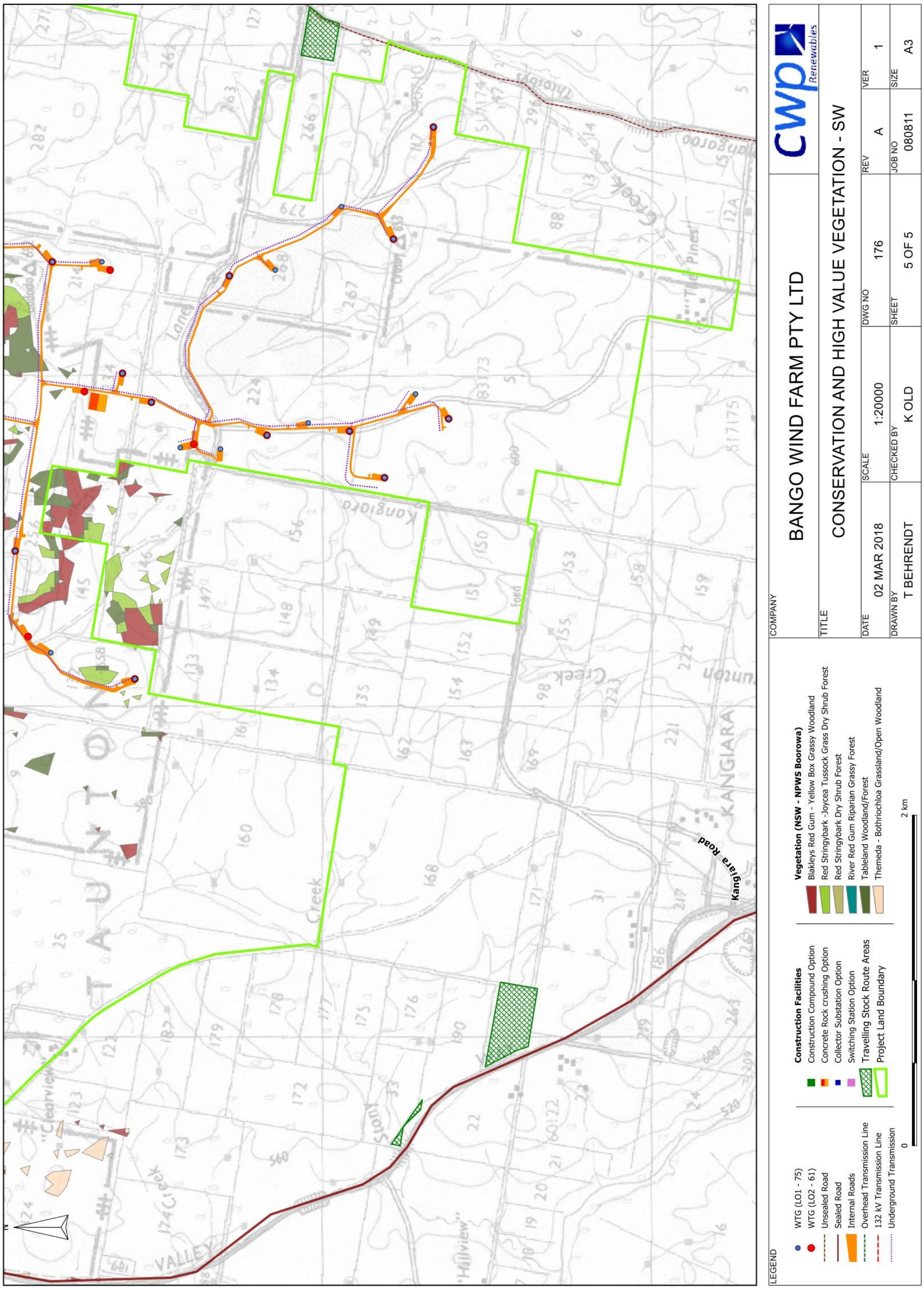


Figure 3.4: Conservation Areas and High Value Vegetation - SW Quadrant

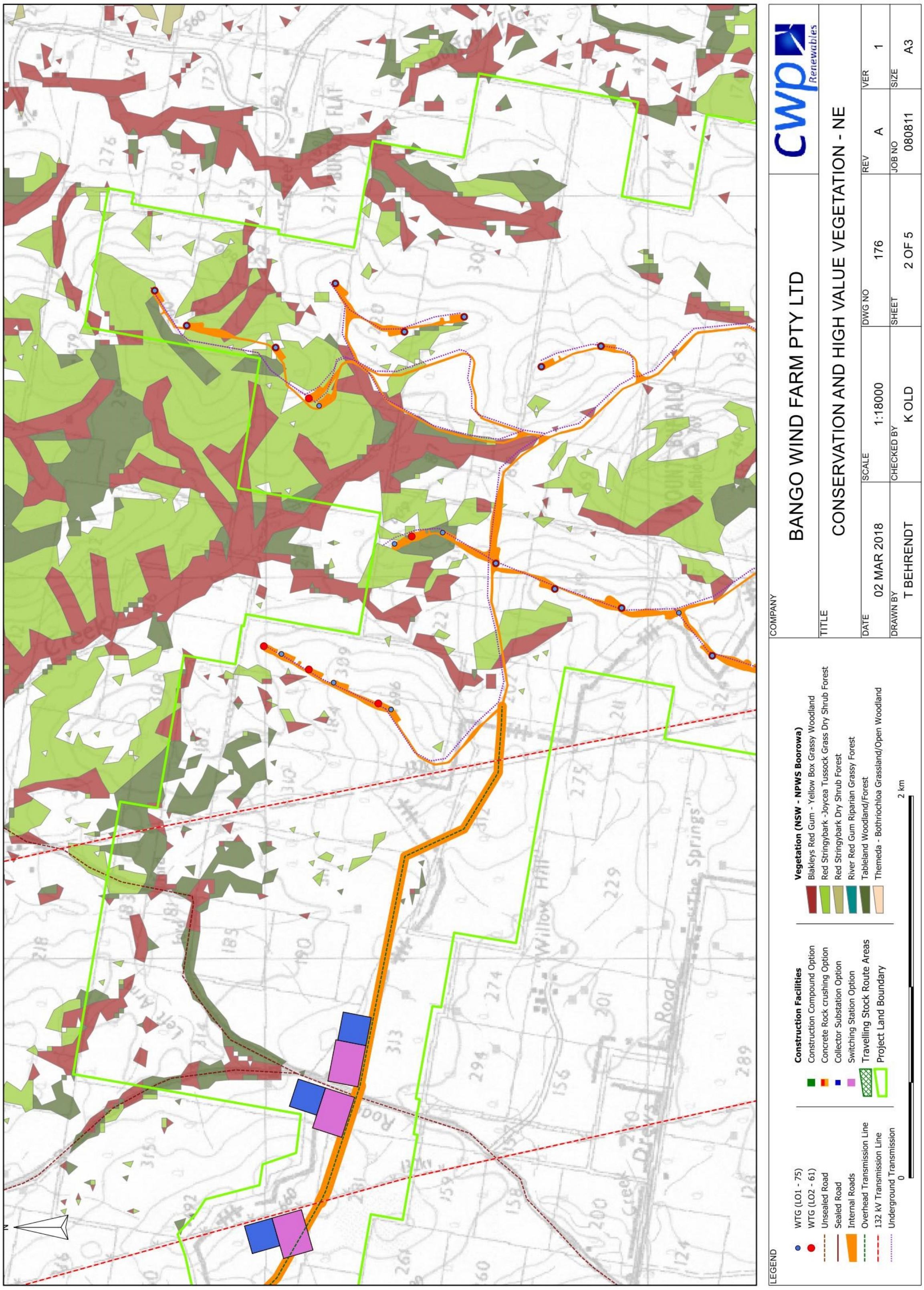


Figure 3.5: Conservation Areas and High Value Vegetation - NE quadrant

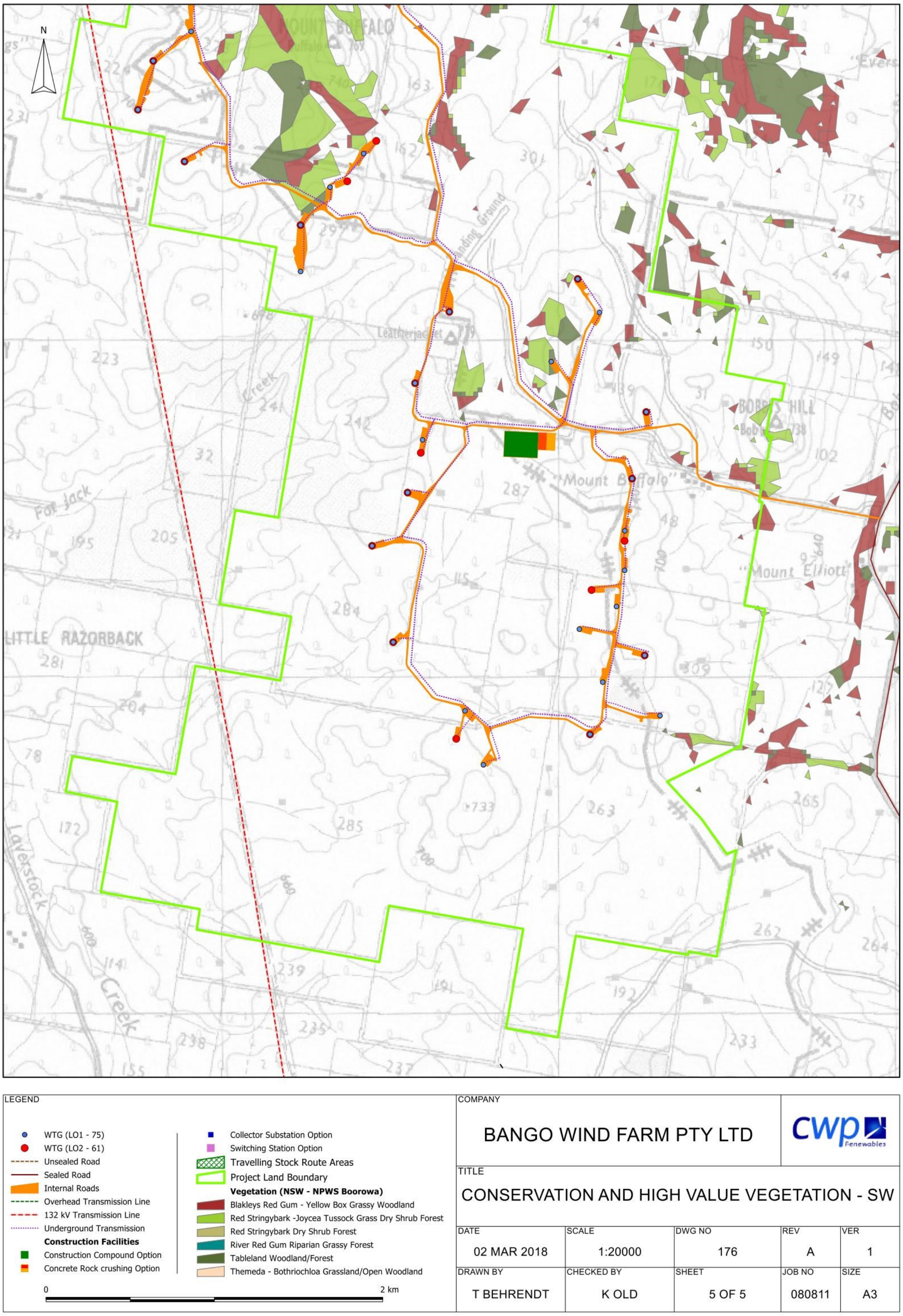


Figure 3.6: Conservation Areas and High Value Vegetation - SE Quadrant

The site topography ranges from 550m to 760m above mean sea level (AMSL). Within the site, two main ranges host the clusters of wind turbine generators, as shown in Figure 3.7. The Kangiara cluster to the west could be described as consisting of “rolling hills”, with the Mt Buffalo cluster to the east, being steeper and more “rugged”. All turbine locations are above 620m AMSL.

Also seen in Figure 3.7, the north-south ridge to the east of the Project shows where the Rye Park Wind Farm will be constructed.

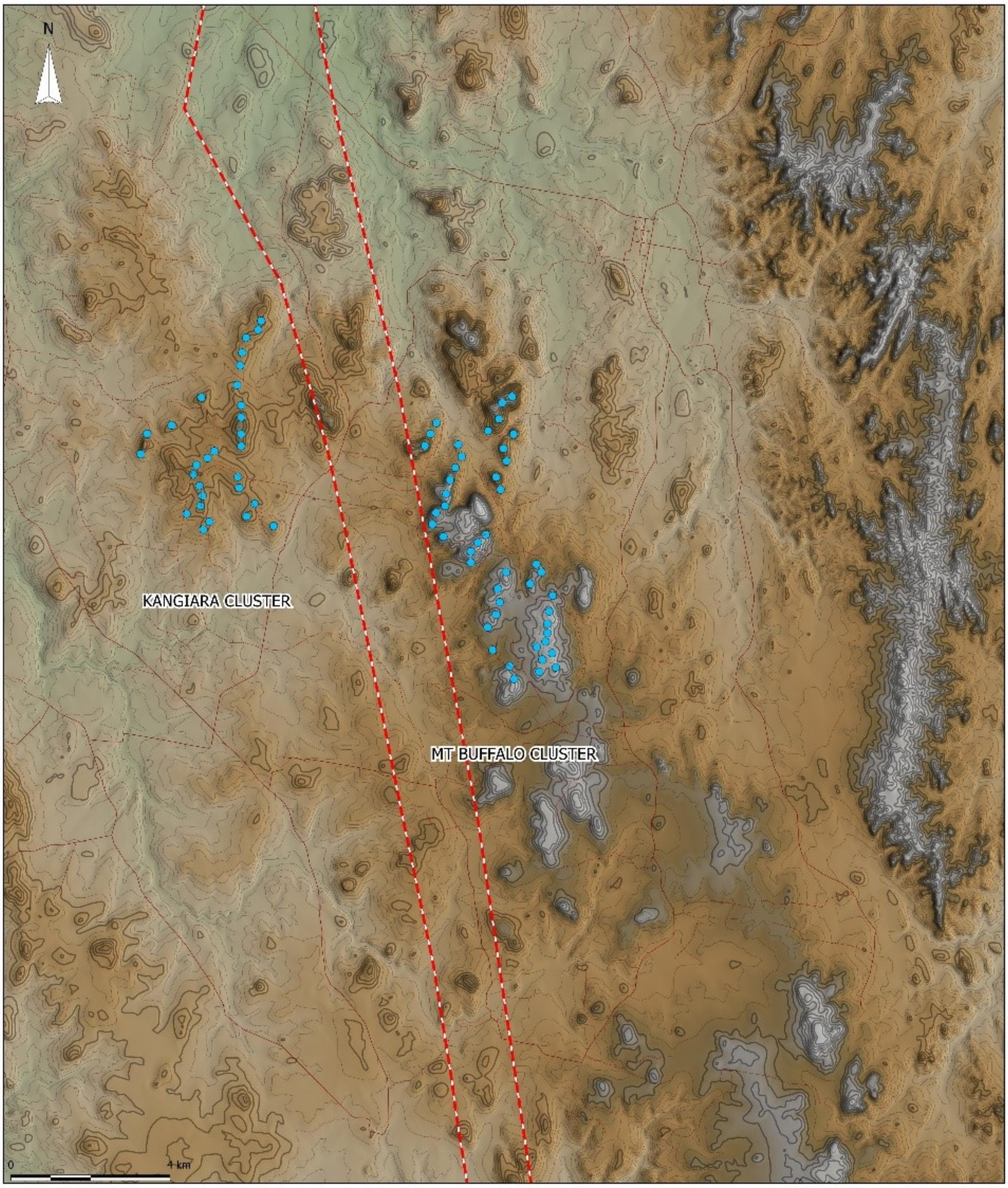


Figure 3.7 Topography within and surrounding the site

3.2.2 Matters of National Environmental Significance

There are nine prescribed MNES listed under the EPBC Act. Presence or likely presence of these prescribed matters in the Study Area has been assessed and outlined in Table 3.2.

Table 3.2: Presence of Prescribed MNES in the Study Area

Matter	Study Area
World Heritage Properties	There are no world heritage properties within the Study Area.
National Heritage Places	There are no national heritage properties within the Study Area.
Wetlands of International Importance	There are no wetlands of international importance associated with the Study Area.
Listed Threatened Species and Ecological Communities	There are threatened species and threatened ecological communities associated with the Study Area.
Migratory Species	There are migratory species that have potential to occur within the Study Area.
Commonwealth Marine Areas	There are no Commonwealth marine areas within the Study Area
The Great Barrier Reef Marine Park	The Great Barrier Reef is not associated with the Study Area.
Nuclear Actions	N/A to this project.
Water Resource (in relation to CSG)	N/A to this project.

3.2.3 Threatened Ecological Communities and Species

Three TECs listed under the EPBC Act with potential to occur within the Study Area were identified during the database searches.

Following the field survey program, it is confirmed that the Critically Endangered White Box, Yellow Box, Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurs in the Study Area along Lachlan Valley Way in the far west of the Study Area. Direct impacts to this TEC are avoided by the Project.

Twenty-eight threatened flora and fauna species listed under the EPBC Act were identified during the database searches. This information was used to assist survey design for the field survey program for the Environmental Impact Assessment (ERM 2013, supporting body of work for the EIS) (effort shown in figures Figure 3.8 to Figure 3.25, with further details found in Appendices 2 and 3. Data obtained from the field survey program contributed to the analysis of species' likelihood of occurrence. Consistent with the PD request, the tables below contain the outcomes of the likelihood of occurrence assessment for relevant MNES.

Based on this analysis, the focus MNES (and subject of this assessment) were found to be:

Threatened Ecological Communities:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Threatened Fauna:

- Golden Sun Moth *(Synemon plana)*;
- Superb Parrot *(Polytelis swainsonii)*;
- Regent Honeyeater *(Anthochaera (Xanthomyza) phrygia)*;
- Koala *(Phascolarctos cinereus)*;
- Eastern Long-eared Bat *(Nyctophilus corbeni) (syn: N.timorensis)*;
- Striped Legless Lizard *(Delma impar)*; and
- Pink-tailed Worm Lizard *(Aprasia parapulchella)*

Threatened flora

- Yass Daisy *(Ammobium craspedioides)*

The PD Request outlines required information regarding each of the focus MNES. The following tables list the focus MNES and provide the relevant survey and assessment details. More detail of survey effort is demonstrated in Appendices 2 and 3.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		
EPBC Act Status		Critically Endangered
Population Information in Locality		6,371.80 ha (using ERM=2.50 ha, and unverified polygons from Gellie[7] (2005) = 3,654.69 ha, and NPWS (2002) = 2,714.61 ha)
Survey	Timing	Surveys to identify the vegetation and flora present occurred in: - 2012: September, October, November and December; - 2013: February; - 2017: April; and - 2017: October. Spring/summer are appropriate times to identify the BGW CEEC as diagnosis is largely dependent on the understorey native species prevalence and diversity, which is best quantified during those seasons. Observations made in April are slightly outside the recommended period although the comparative field observations made at the time by the ecologist confirmed that areas of native and non-native understorey were clearly discernible from one another. Regarding survey periods and disturbance, the development footprint occurs in an agriculturally impacted landscape which is used for agricultural production (including grazing,

[7] White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived native grassland polygons were assigned to particular vegetation types in Gellie (2005) and NPWS (2002) as potentially being the EPBC Act-listed TEC. These were: Gellie 2005: Northern Slopes Dry Grass Woodland, Tableland Dry Grassy Woodland and Tablelands and Slopes Dry Herb-Grass Woodland; NPWS 2002: Blakely's Red Gum – Yellow Box Grassy Woodland, Kangaroo Grass – Red-leg Grass Grassland / Open Woodland and White Box Grassy Woodland.

		improved pasture and cultivation) therefore impacts are omnipresent. Consistent with the NSW BioBanking Assessment Methodology (BBAM) (2009), the Framework for Biodiversity Assessment (FBA) (2014) and DEC (2004) plot/transects were not undertaken in areas of recent significant disturbance, although it must be acknowledged that surveys occurred in areas that had been disturbed, such is the nature of the landscape.
	Location	Figure 3.8 to Figure 3.11 shows the development footprint relative to the survey effort and vegetation zones and shown in Figure 3.12 to Figure 3.16.
	Effort and Methods	Field methods used include: - 2012/2013: 28 plot/transects according to the BBAM (2009); 302.21km of traverse covering the entire development footprint including threatened flora meanders (collecting floristic inventory and observing vegetation type/zone boundaries) according to DEC (2004). - 2017 (April): qualitative vegetation observation. - 2017 (Oct/Nov): 12 plot/transects according to the NSW FBA (2014); vegetation boundary rectification during field traverse. Total plot/transects are distributed evenly across the proposed development footprint and the quantity and distribution meet the minimum requirement of the FBA (ELA 2017). Diagnostic tools and processes used to distinguish various vegetation conditions (including the presence/ absence of BGW CEEC) included: - NSW Biometric Vegetation Types (BVT) Database. - NSW Vegetation Information System (VIS). - Commonwealth Species Profiles and Threats Database (SPRAT) (DEE 2018a). - Commonwealth Conservation Advice (TSSC 2006). - Commonwealth White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands: EPBC Act Policy Statement (especially flow chart on page 5) (DEH 2006). The vegetation mapping from the EIS and RtS processes (ERM 2013, 2017a) were independently verified by ELA (2017) and confirmed as accurate.
	Results	ERM (2013) and ERM (2017a) identified the only patch of BGW CEEC in the development footprint being in the Tangmangaroo Road reserve. ERM (2017b) clarified the status of that patch with qualitative (non-metric) field observation to not be the BGW CEEC due to the absence of a native understorey. ELA (2017) in their revised mapping identified no areas of BGW CEEC with the general theme of their

		vegetation appraisal being that the majority was in very low condition (cleared overstory, non-native ground cover and improved pasture predominant). In the data review and appraisal, ELA (2017) identify one plot and patch approximately 100m into the paddock on the western side of Tangmangaroo Road containing vegetation of potentially high enough quality to meet the BGW CEEC although this was not verified further and nonetheless is outside the proposed development footprint. Using the revised vegetation mapping (ELA 2017), the total development footprint is calculated as: PL1: 120.81ha, PL2: 113.15ha comprising 76.45ha(PL1) / 76.28ha(PL2) (or 63.28%(PL1) / 67.41%(PL2)) of clearance in areas of exotic vegetation with non-native trees (low condition and 'cleared' land). A further 31.76ha(PL1) / 29.28ha(PL2) (or 26.29%(PL1) / 25.88%(PL2)) in areas of BGW (not meeting the Cth definition) which contain native trees but with a low native diversity or non-native understorey. An additional 9.28ha(PL1) / 7.27ha(PL2) is of woodland but not of the BGW CEEC characteristic species (Red Stringybark and Long-leaved Box). The remaining clearance areas are of vegetation zones LA103_MG_C (0.26ha in both PL1 & PL2). Of those, ERM's qualitative (non-metric) field observation undertaken in April 2017 in the Tangmangaroo Road reserve patch identified that the understorey was non-native (although there is no formal datasheet as no plot was undertaken in that road reserve at that time) and therefore was excluded from being BGW CEEC (referencing diagnostic flow chart on page 5 of DEH (2006)). Appendix 4 contains plot floristic data combining flora surveys from 2012-2013 and 2017. Figure 3.12 to Figure 3.16 shows the development footprint relative to the vegetation zones. For clarity, and to avoid potential confusion caused by the multiple surveys, uncertainty in the application of 'patch' between authors, and in applying the precautionary principal, the Tangmangaroo Road reserve could be considered the BGW CEEC which would mean the total BGW CEEC to be cleared in the proposed development footprint is 0.26ha. Detailed explanation describing vegetation type attribution is contained in Appendices 2 and 3. A summary for each vegetation zone includes (from ERM 2017a; ELA (2017)): - LA182 is a woodland characterised by Red Stringybark and Long-leaved Box occurring on skeletal, gravelly or stony soils of rises. Condition states include areas where canopy trees occur with a native storey of varying integrity, and areas of cleared trees with a ground layer (i.e. grassland) which is in varying degrees of native species predominance. -LA103 is a grassy open woodland characterised by Yellow Box and Blakely's Red Gum which occurs on lower parts of the landscape in the undulating valleys with deeper soils.

		Condition states include areas where canopy trees occur with a low diversity variously native and non-native understorey, and areas of cleared trees with a ground layer (i.e. grassland) which is in varying degrees of native species predominance. In summary, LA182 in the development footprint does not comprise any EEC under State or Commonwealth legislation. Some condition types of LA103 which occur in the development footprint meet the NSW BC Act (and former TSC Act) definitions of BGW, and 0.26ha meets the Commonwealth definition of BGW CEEC (applying a conservative approach despite speculation regarding the % native composition of the understorey). The 0.26ha BGW in the footprint is contextualised within the locality by ERM (2017b) which states that regional mapping products identify potentially 6,369.30 ha (using unverified polygons from Gellie (2005) = 3,654.69 ha, and NPWS (2002) = 2,714.61 ha) (refer footnote 7 three pages previous).
Likelihood of Occurrence		Known to occur in study area, 0.26 ha in development footprint.
Extent and quality of habitat		Refer previous subsection.
Suitability of Guidelines Used		Vegetation types were determined according to the methods described in previous section 'survey methods', which includes description of vegetation survey via combination of plot/transect data (according to BBAM (2009), FBA (2014)) and verification by traverse using DEC (2004). The vegetation mapping from the EIS and RtS processes (ERM 2013, 2017a) were independently verified by ELA (2017) and confirmed as accurate, with minor adjustments made to condition classes and boundaries.

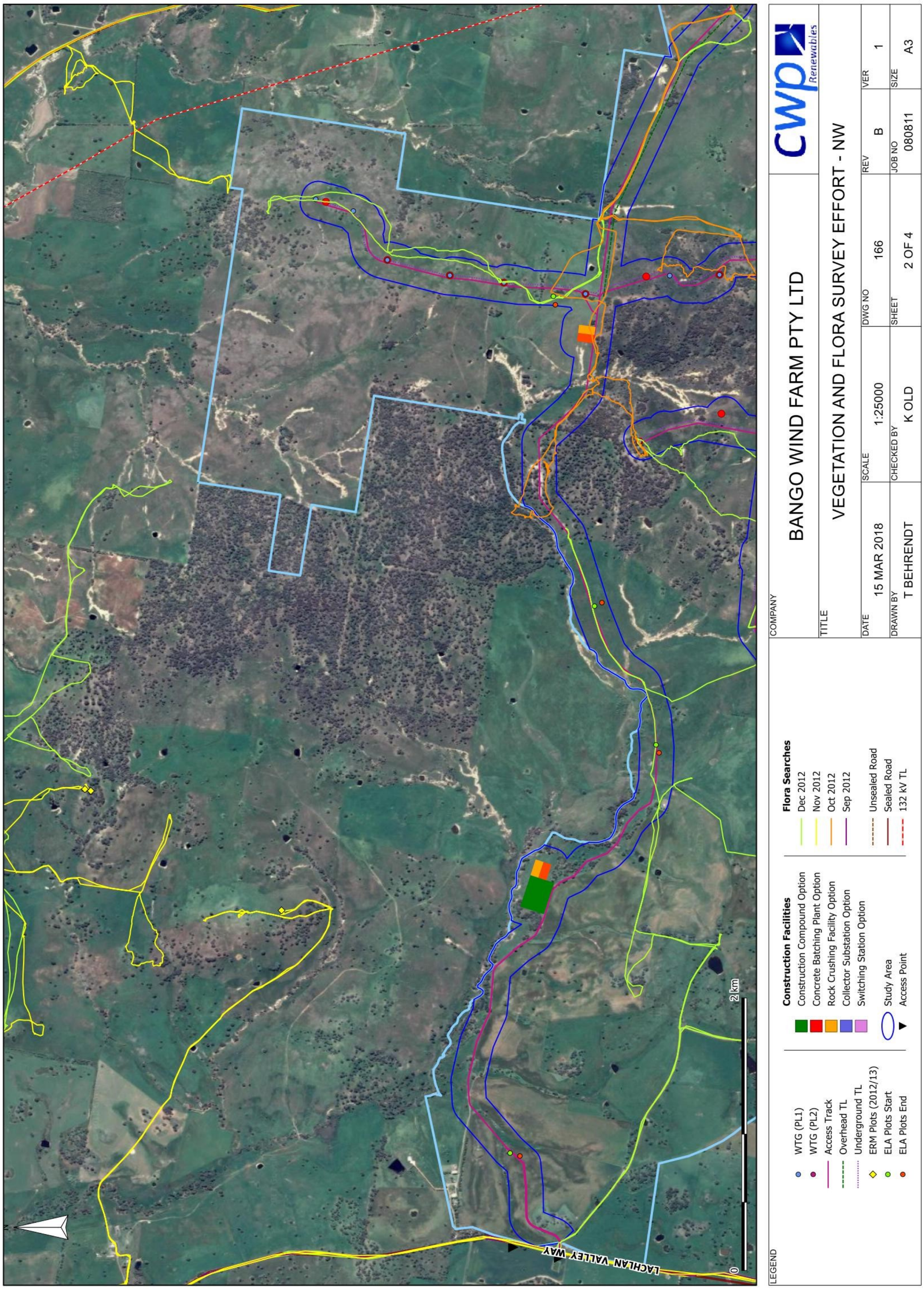


Figure 3.8: Flora Survey Effort - NW

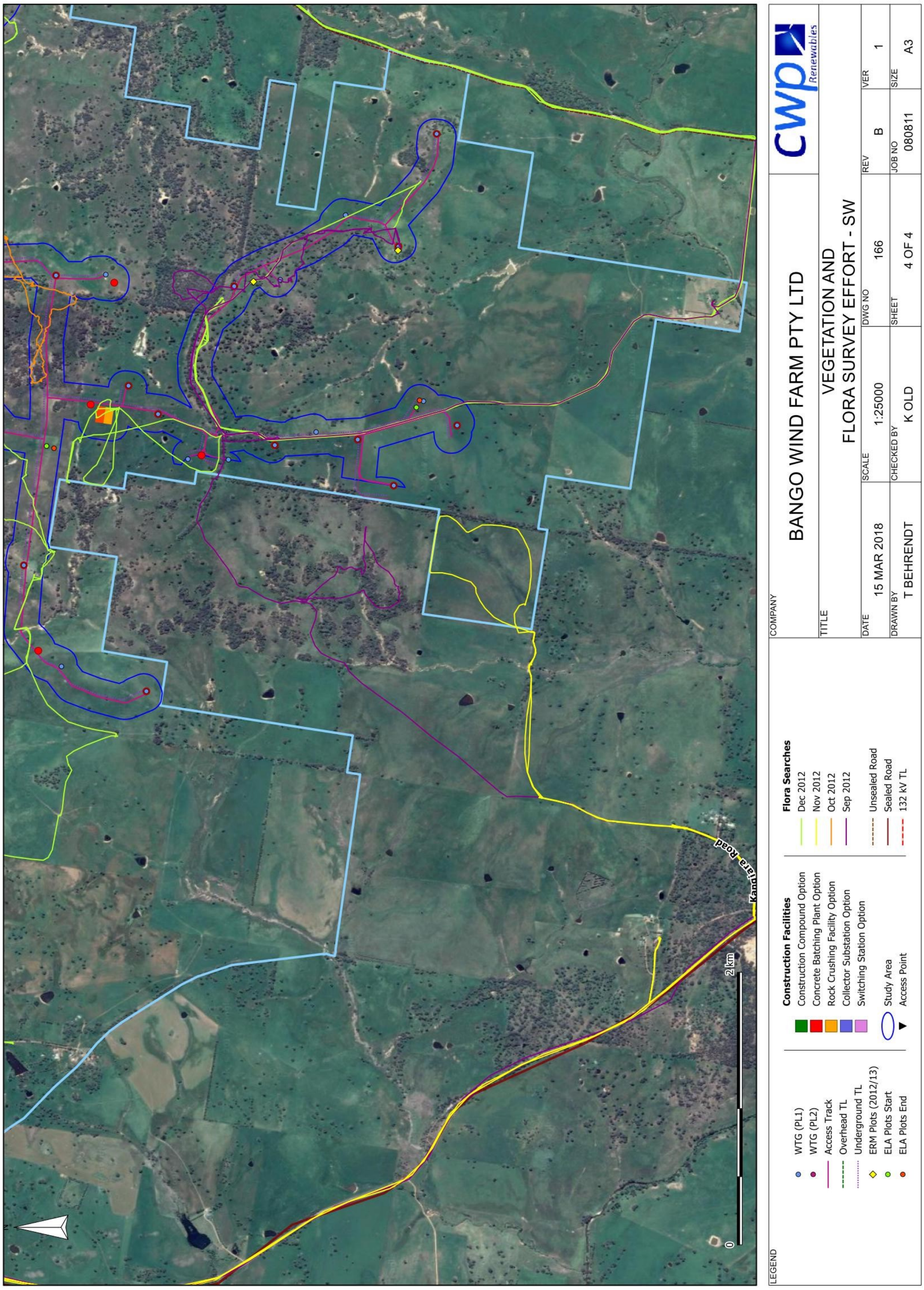


Figure 3.9: Flora Survey Effort - SW

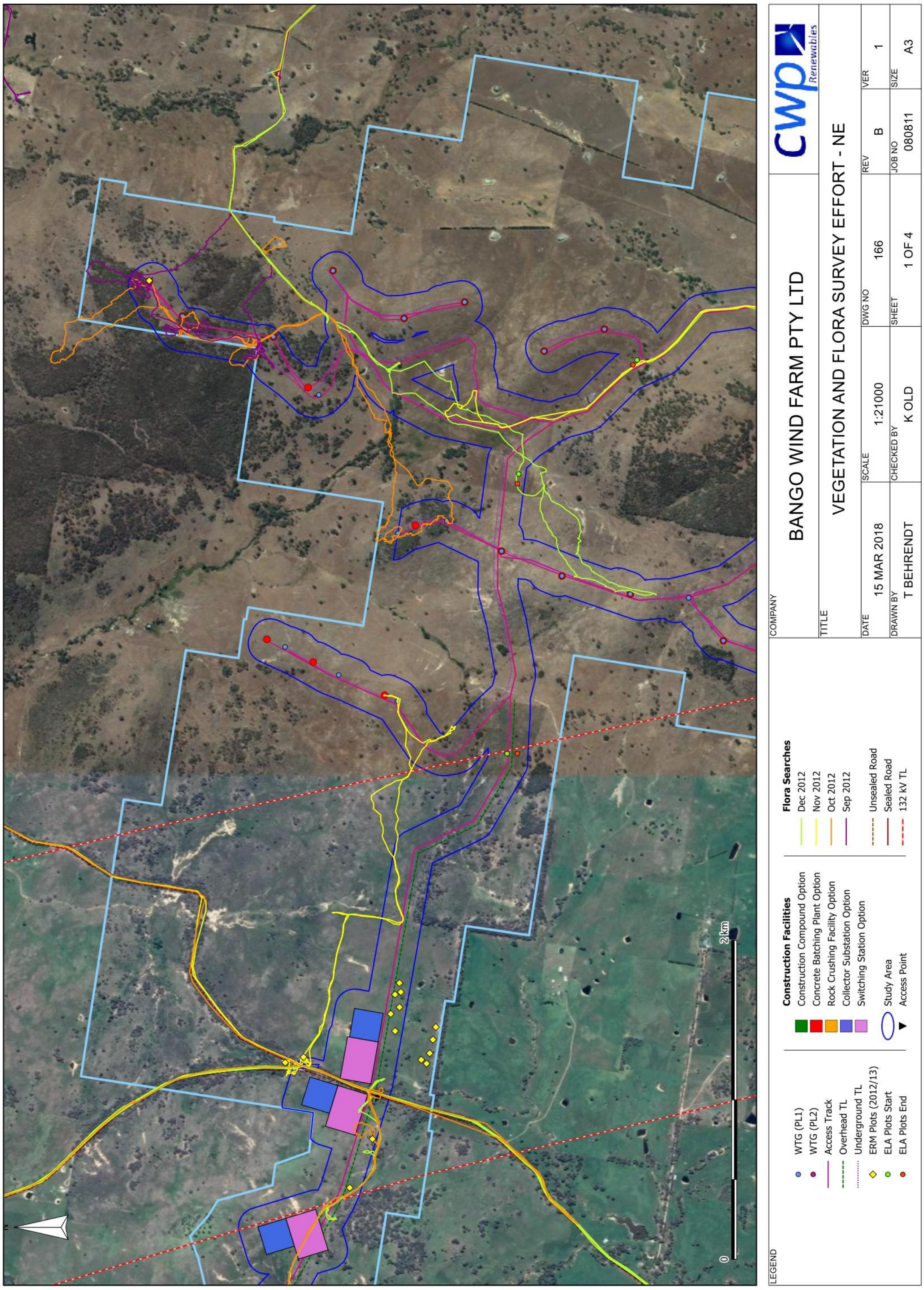


Figure 3.10: Flora Survey Effort - NE

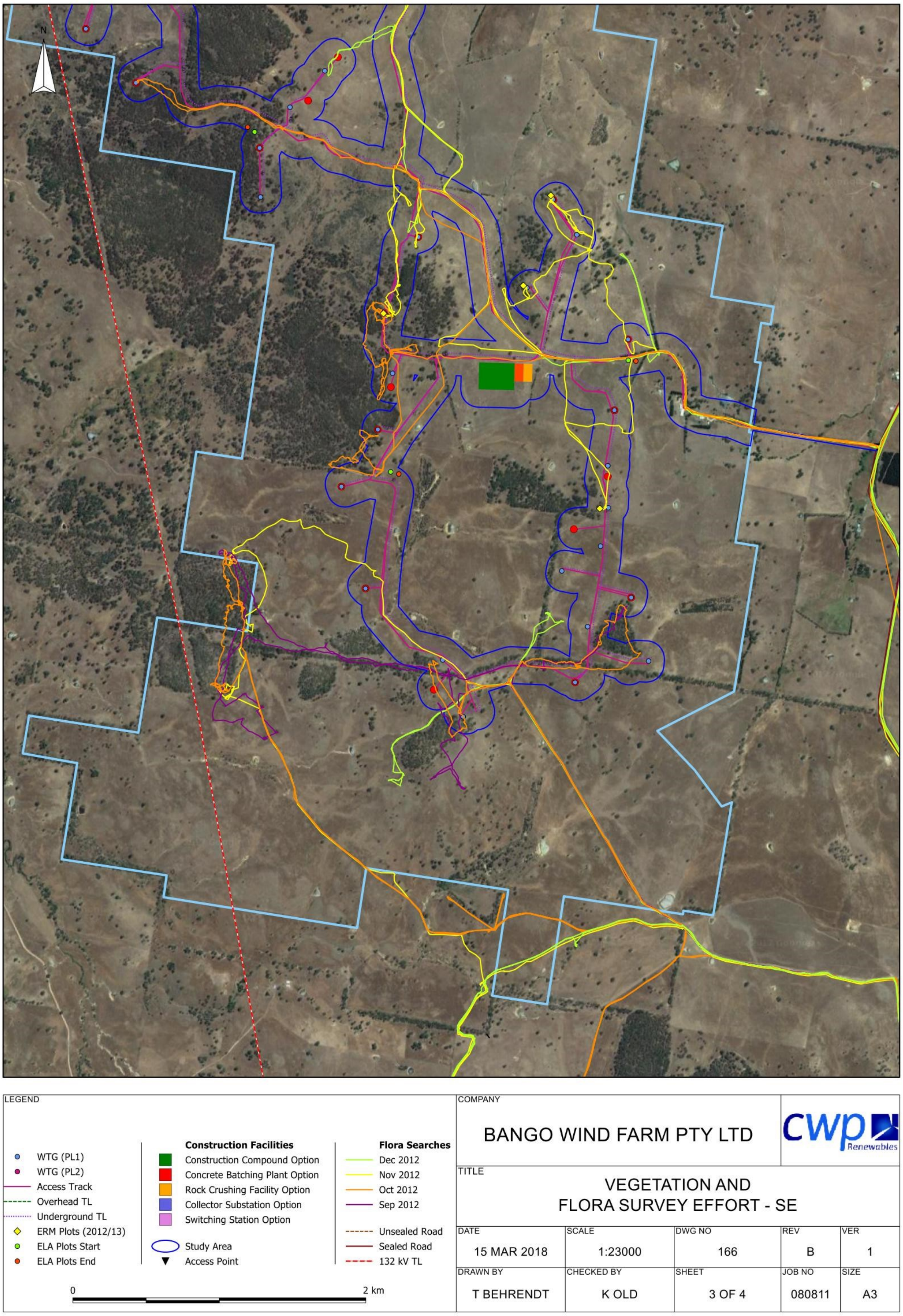


Figure 3.11: Flora Survey Effort – SE

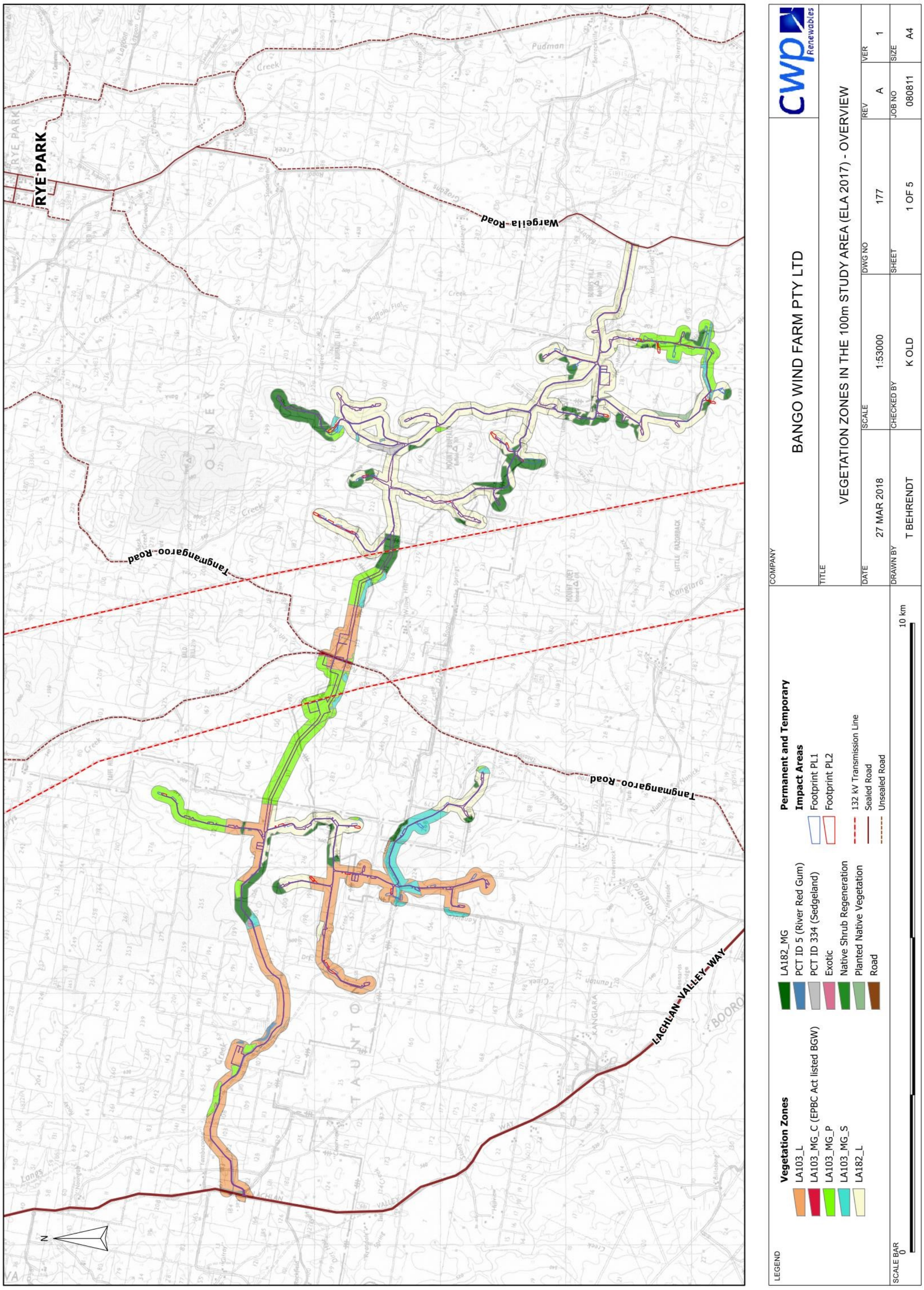


Figure 3.12: Vegetation Map - Overview

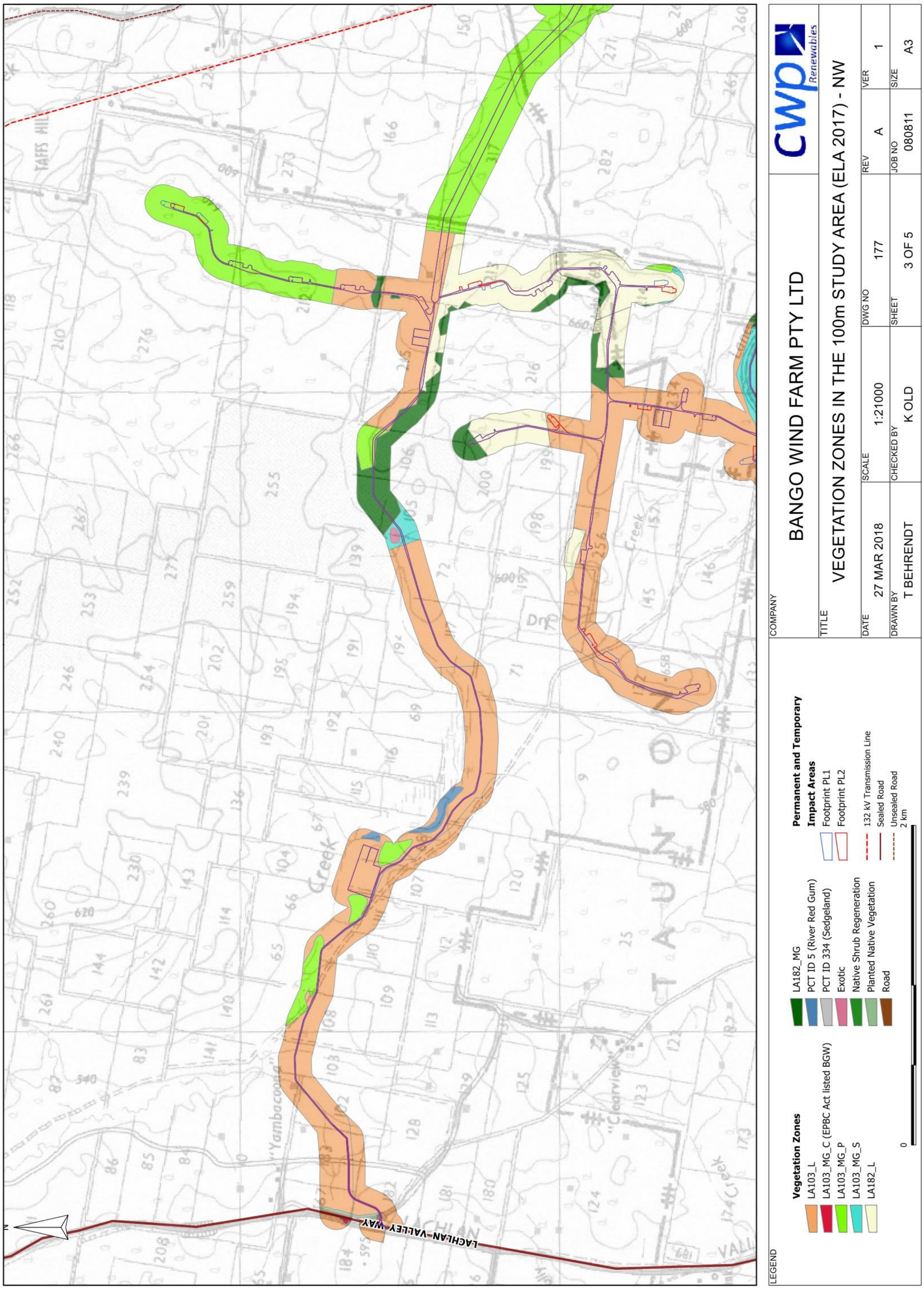


Figure 3.13: Vegetation Map - NW

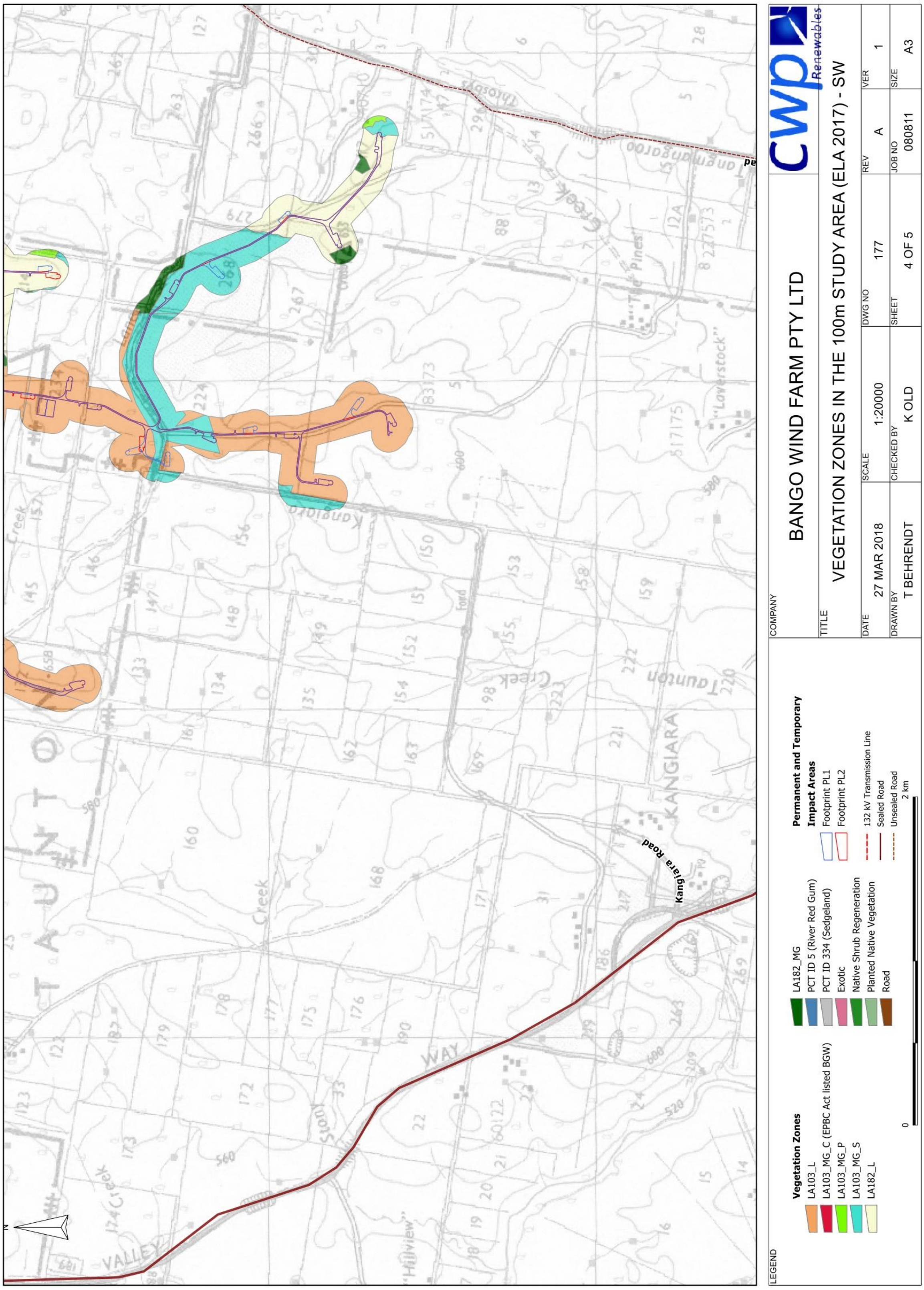


Figure 3.14: Vegetation Map - SW

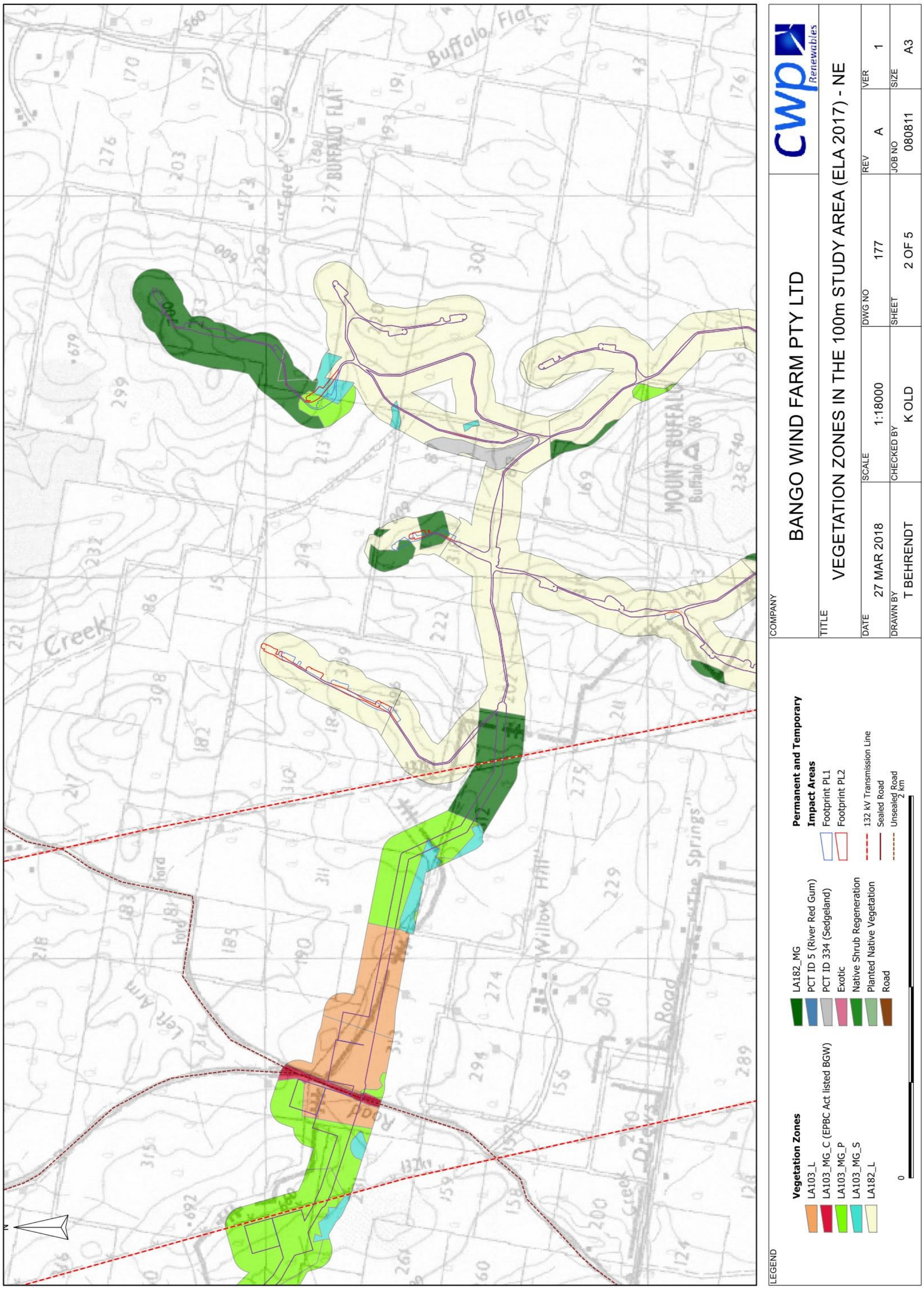


Figure 3.15: Vegetation Map - NE

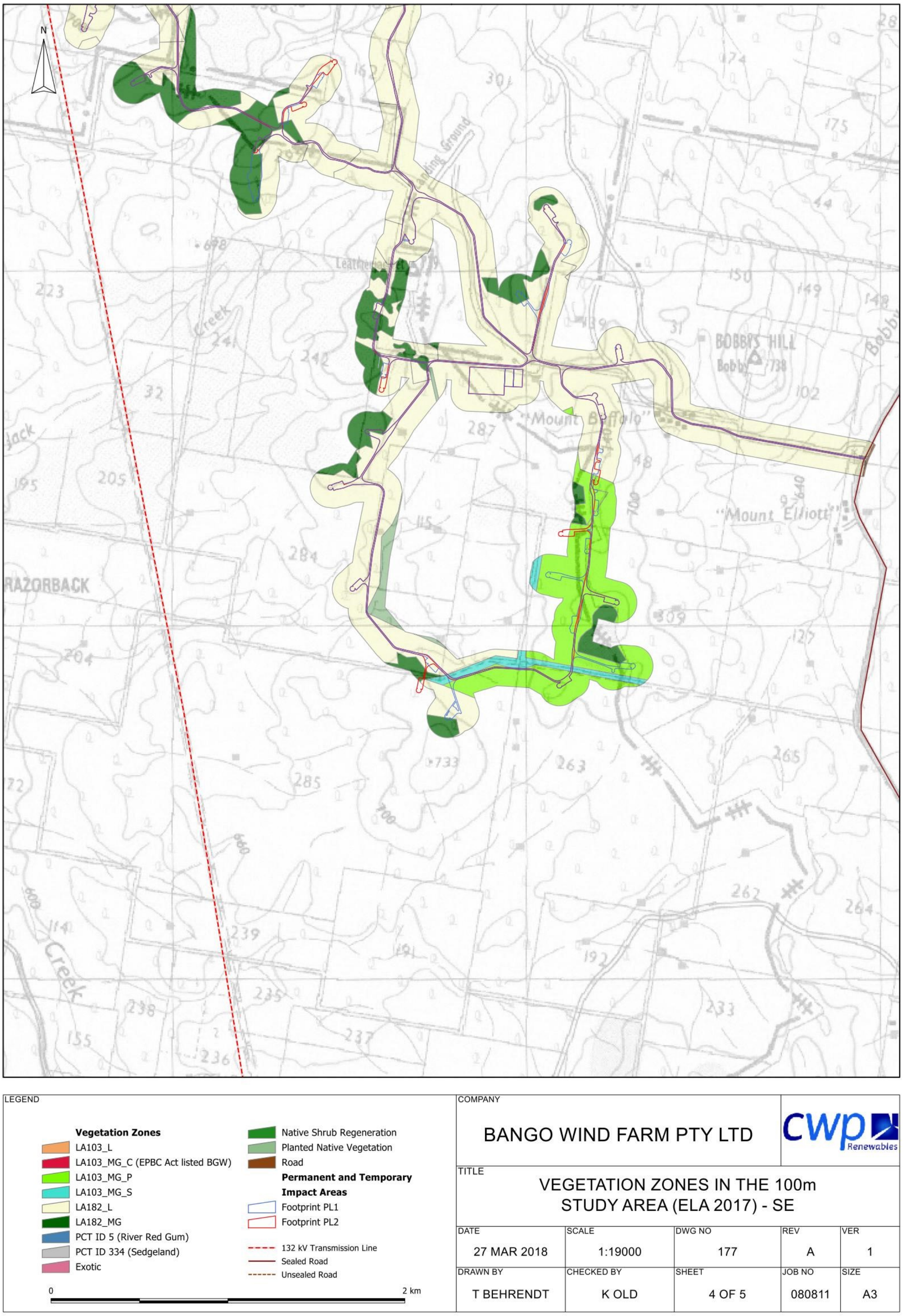


Figure 3.16: Vegetation Map - SE

Golden Sun Moth *(Synemon plana)*		
EPBC Act Status		Critically Endangered
Population Information in Locality		120 individuals (ERM (2013) count=104 + BioNET=16) 30,936.24 ha potentially suitable native grasslands (using ERM=2,318.70 ha, and unverified grassland modelling polygons (DECC 2007)=28,617.55 ha
Survey	Timing	Eight suitable days in summer 2012/2013.
	Location	Figure 3.17 to Figure 3.20 shows the GSM survey effort relative to the proposed development footprint, GSM records and GSM habitat.
	Effort and Methods	Meandering transects targeting GSM were undertaken over a total of 42.6 hours over eight suitable days. Opportunistic observations were also recorded over 13 days. The weather during the GSM survey days generally met the optimal survey weather conditions for the species.
	Results	A detailed description of GSM survey and results is contained in Annex F of ERM (2017a) (attached to this document). In summary, surveys conducted by ERM in summer 2012/2013 identified 104 individuals across the surveyed area; 82 of which were detected in 16 sightings within 500m of the proposed development footprint (refer Figure 3.17 to Figure 3.20). An estimate of the population numbers (i.e. individuals) within the study area or locality is difficult to make given the temporal variability (day to day, brief adult flight period / seasonal emergence) and inherent characteristics of visual detection (i.e. not feasible to count all individuals) (DEE 2018b). It is noted that BioNET contains only 12 records within 10km of +the development footprint which have been identified in the period of 1999 to 2000 which is most likely due to low survey effort (or reporting of results) due to the likely presence of suitable habitat. A population estimate for the 500m buffer area or the locality is not likely to be reliably extrapolated from the 82 individuals known from the 500m buffer area.
Likelihood of Occurrence		Known to occur in study area.
Individuals in study area		GSM habitat was mapped across the study area and locality (refer Figure 3.17 to Figure 3.21). Varying degrees of habitat suitability were identified during the study using field observations, ecologist judgement and the GSM preferred habitat characteristics (DEE 2018b). Categories include:

	- known and optimal habitat (tussock grass areas of spear grasses and wallaby grasses with short inter-tussock spacing); - potential habitat (adjudged to be of a lower quality than above but still suitable habitat); and - unsuitable habitat. Applying the precautionary principal and taking a conservative approach, the former two were combined for the impact assessment as being GSM habitat. Impact calculations used a 'merged worst case development footprint' (this combines PL1 and PL2) are 39.54ha (comprising 13.35ha known and optimal habitat, and 26.19ha potential habitat). A combination of the ERM (2013) vegetation mapping and modelled native grasslands in the locality (DECC 2007) were used to identify potential habitat for the GSM (the latter not field verified) (refer FIGURE 3). That process identified 30,936.24ha of potentially suitable habitat (ERM (2013) = 2,318.70ha and DECC (2007) = 28,617.55ha).
Suitability of Guidelines Used	Methods followed *Survey Guidelines for Detecting the Golden Sun Moth* (DEWHA 2009).

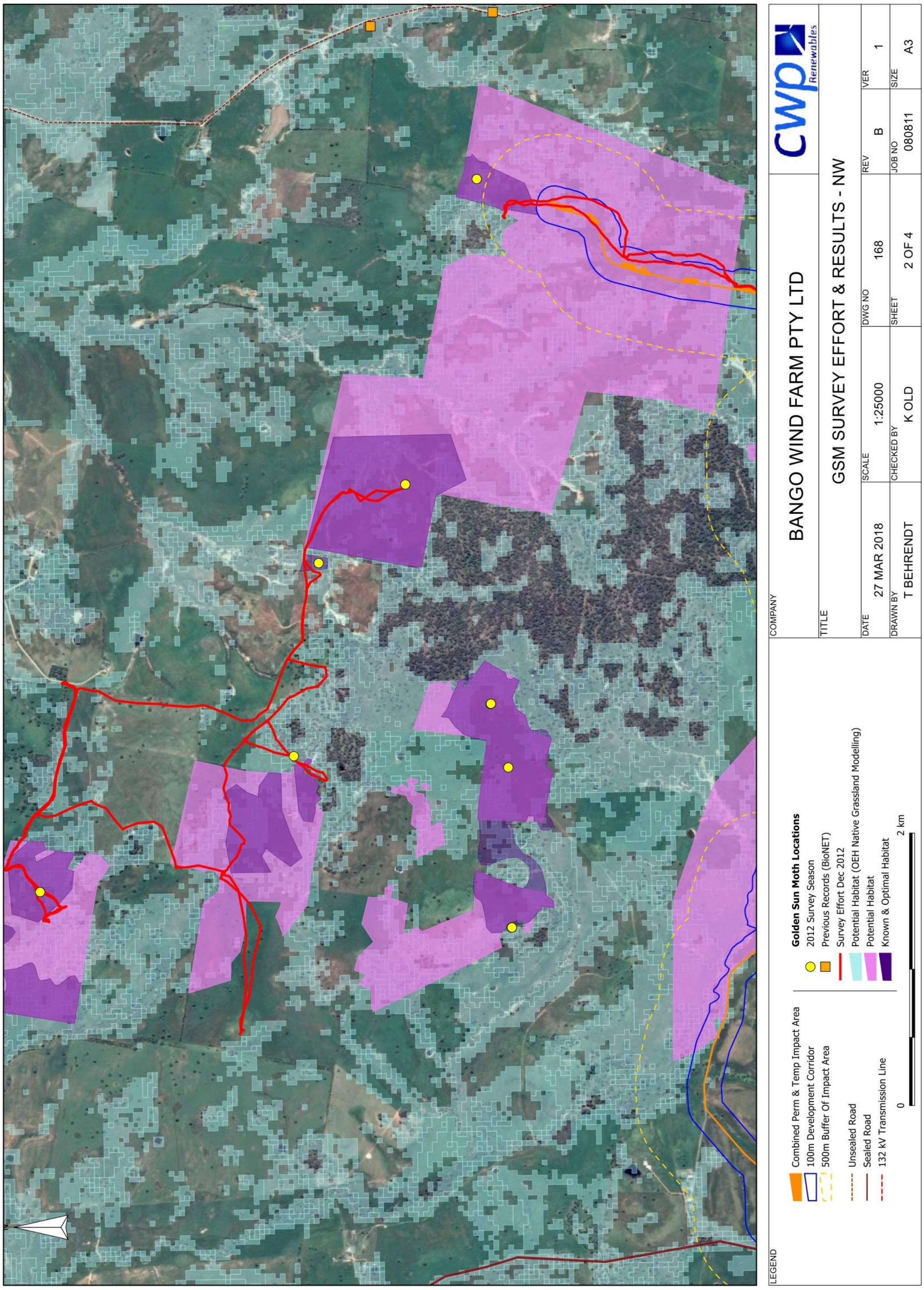


Figure 3.17: GSM Survey Effort - NW

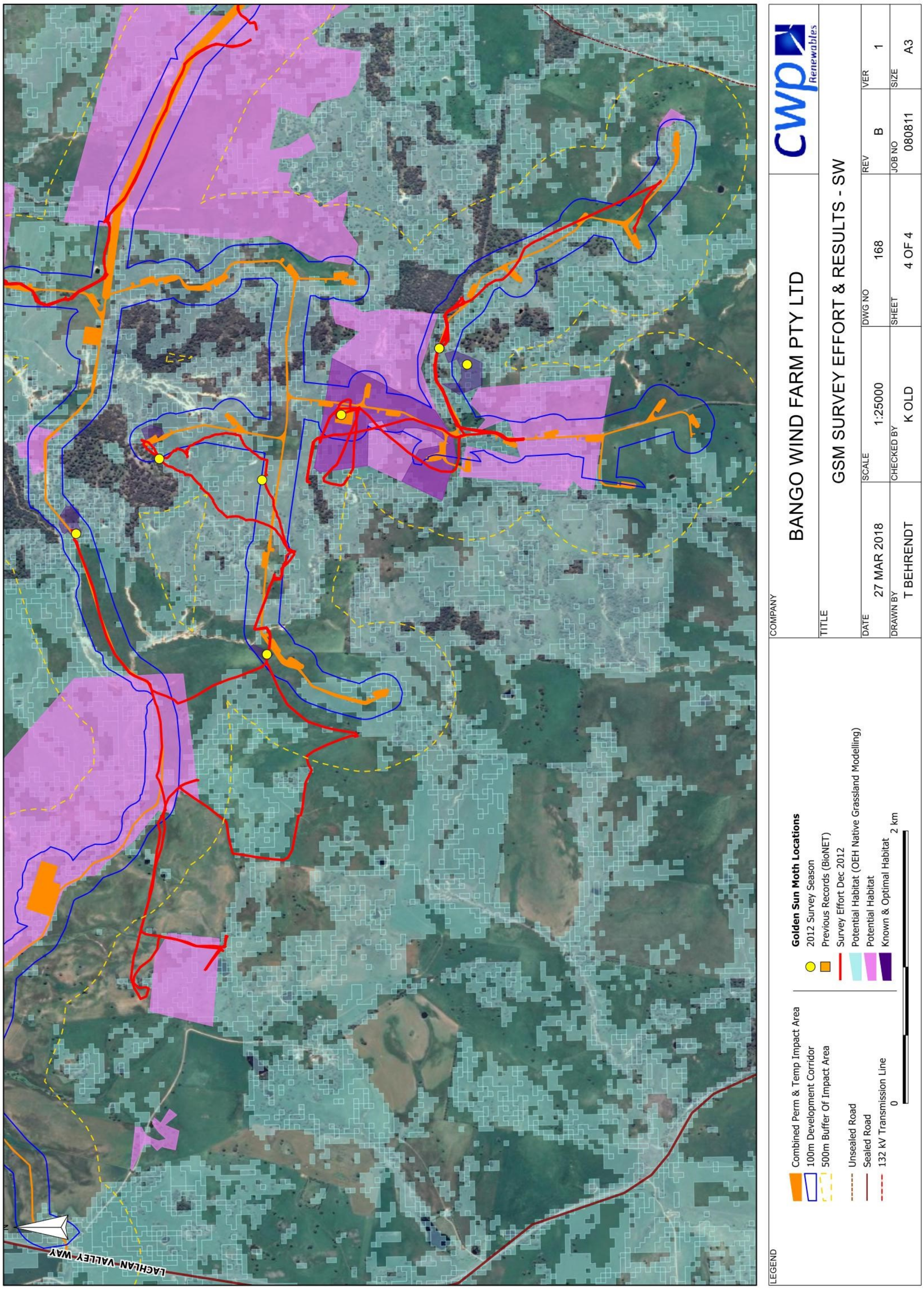


Figure 3.18: GSM Survey Effort - SW

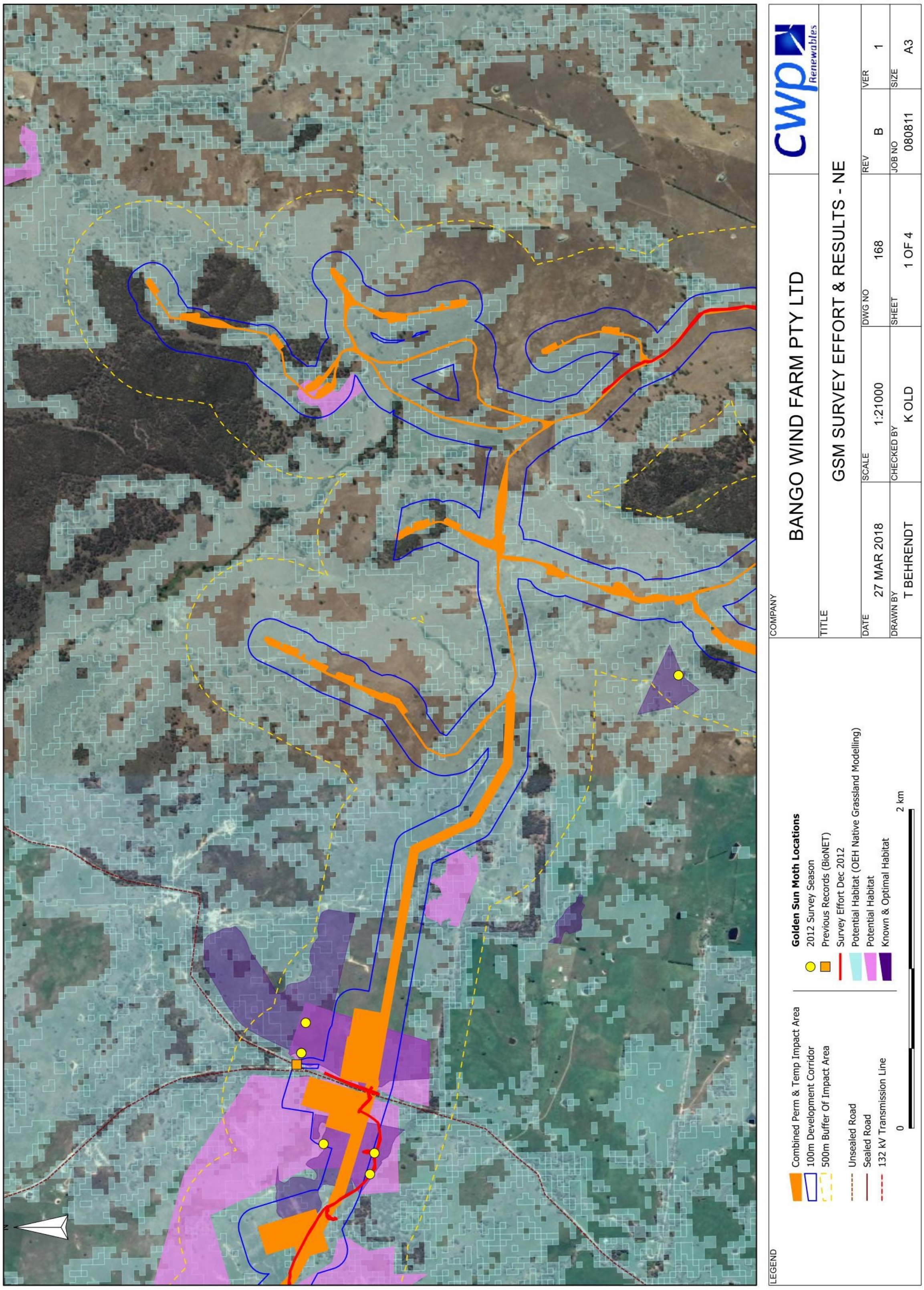


Figure 3.19: GSM Survey Effort - NE

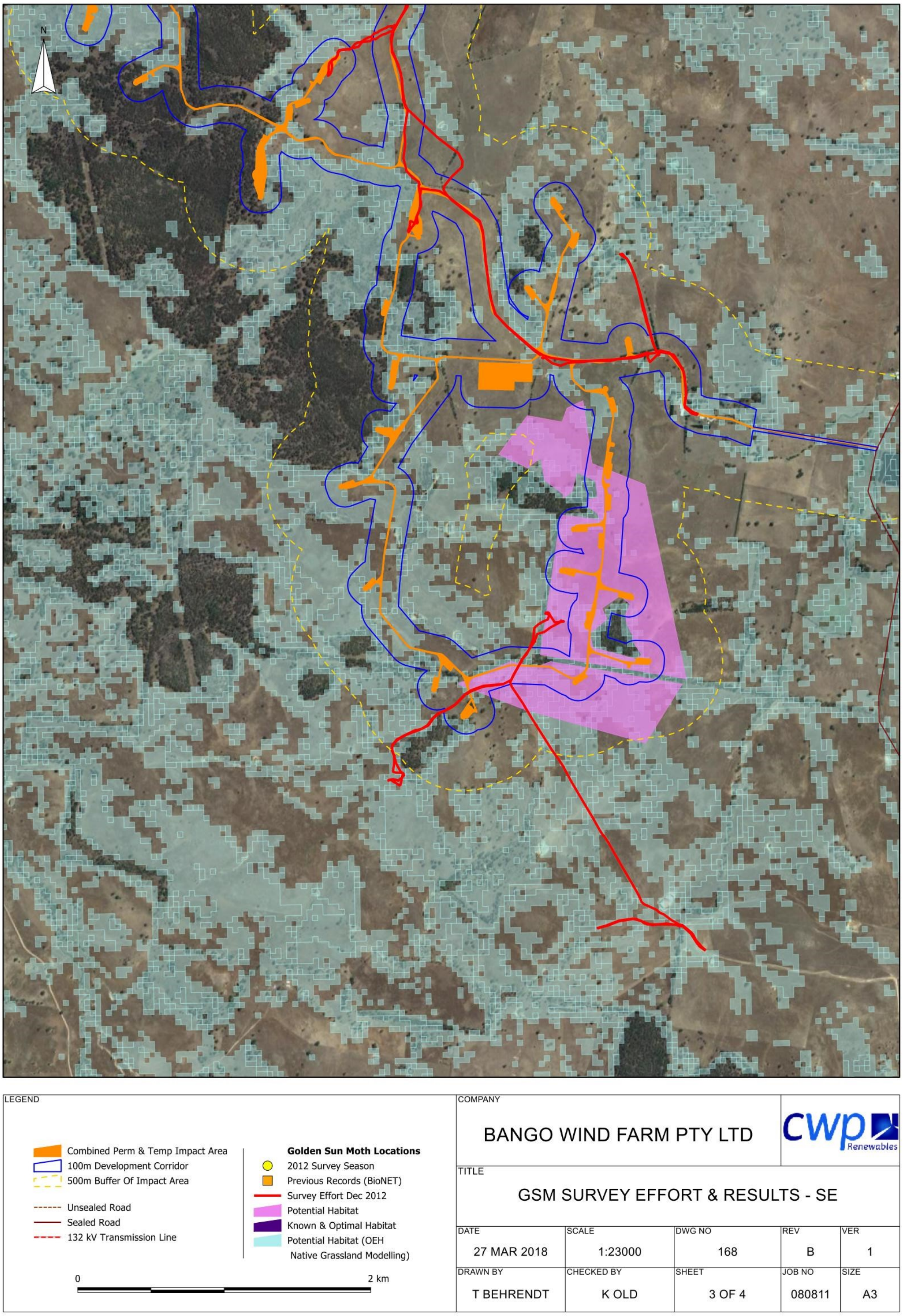


Figure 3.20: GSM Survey Effort - SE

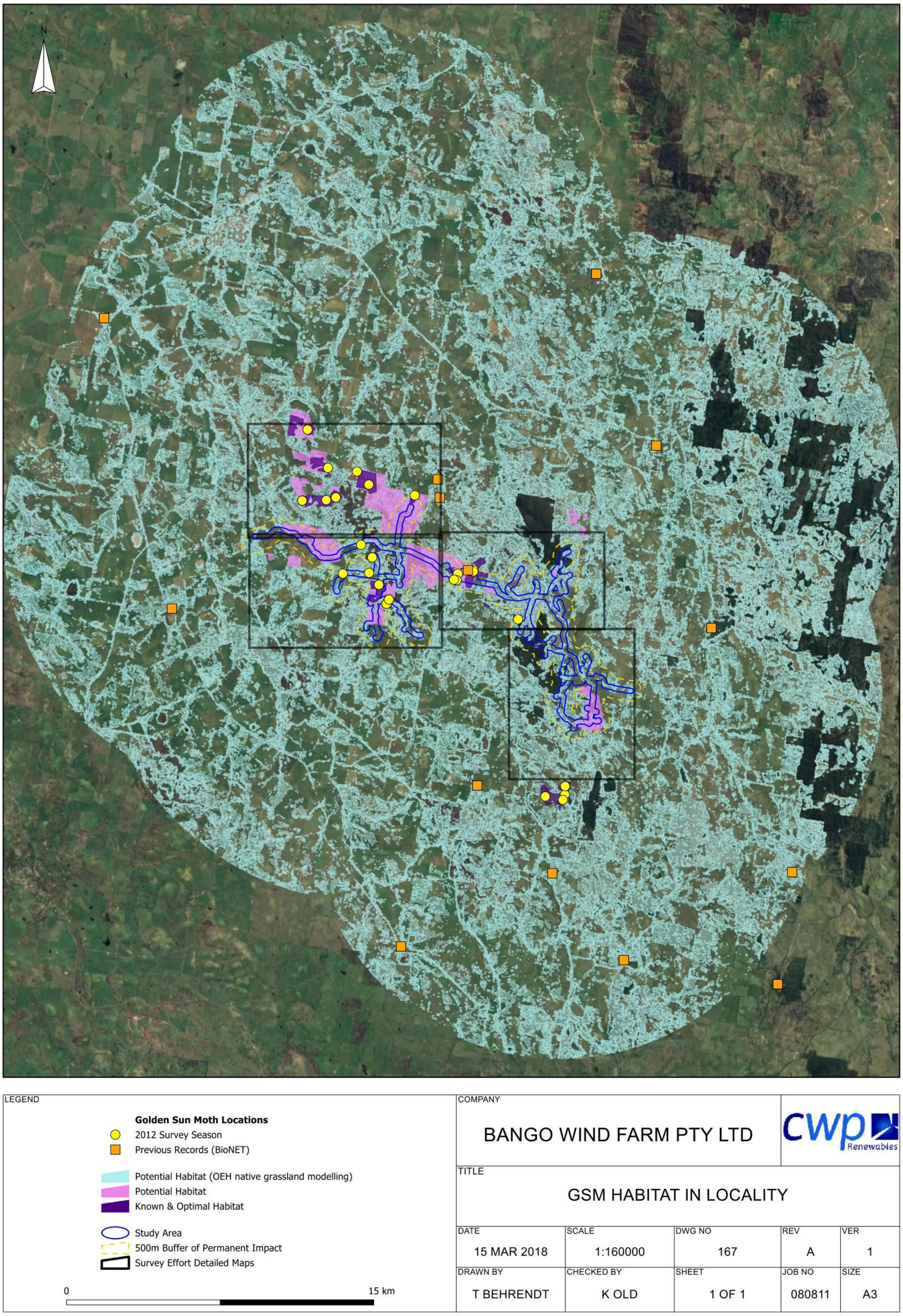


Figure 3.21: GSM in the Locality

Superb Parrot (Polytelis swainsonii)		
EPBC Act Status		Vulnerable
PopulatiInformation in Locality		192 individuals: (ERM (2013) count=150 + BioNET=42) Potential woodland habitats: 36,718.34 ha (using ERM=644.01 ha, and unverified polygons from Gellie (2005)=6,657.98 ha, and NPWS (2002)=29,416.35 ha) (using woodland types from those source mapping products).
Survey	Timing	Refer to "Effort and Methods" below.
	Location	Figure 3.22 to Figure 3.25 shows the bird survey effort (including for the Superb Parrot) relative to the proposed development footprint.
	Effort and Methods	The Survey guidelines for Australia's threatened birds (DEWHA 2010a) specific to the Superb Parrot (p201-2) state the recommended survey methods are: - area searches or transect surveys of 12 hours over 4 days during early morning or late afternoon (quantities relevant for areas <50ha); and/or - targeted searches of hollow bearing trees during breeding season of 12 hours over 4 days. The survey effort is detailed in Annexes B, C, D and E of ERM (2017a) (attached) and is summarised as: - bird utilisation survey[8] (static point observation at 20 stations for 15 minutes each, with replicates over subsequent months with 17 stations surveyed three times) (1/8/2012-23/2/2013); - bird census (area searches in woodlands by two ecologists of 17x 2ha areas for between 20 and 40 minutes) (1/8/2012-13/12/2012); - tree hollow identification (area covered being the proposed development footprint (as it was during the EIS (ERM 2013) plus a 500m buffer area (=4,981ha) with hollows categorised according to Superb Parrot suitability[9]); and

[8] Among data collected were flight direction and height above the ground (noting that the flight height classes were estimated by the observer in categories relative to approximate rotor swept area (RSA) being below RSA= 0-20m & 20-40m; at RSA=40-150m & 150-200m; above RSA=>200m).

[9] Superb parrot suitability according to Manning et al. (2012) being those hollows at between 5m and 13m above the ground and >5cm in diameter with 'primary' of species Blakely's Red Gum, Yellow Box, Apple Box, White Box, or dead stags, and 'secondary' of Red Stringybark.

		- foraging habitat assessment. Table 2.2 in Annex B of ERM (2017a) identifies that the area search method employed is consistent with that recommended by DEC (2004) and DEWHA (2010a). The sum total time of static point observation is 840 minutes or 14 hours and woodland bird surveys is 595 minutes or 9:55 hours over 6 days. The survey effort was discussed with the (then) SEWPaC in June 2013 following the original Controlled Action decision, in preparation for the earlier efforts to compile the preliminary documentation (PD). Discussion with SEWPaC on 21 June 2013 indicated that the SEWPaC expected the PD to be completed using existing data. The species was detected using the survey effort described above and treated accordingly through the impact assessment process.
	Results	Detailed results of the various survey methods are discussed in Annex C of ERM (2017a) and are shown in Figure 3.26 to Figure 3.30 and are summarised as: - bird utilisation survey: recorded 148 times from 8 BUS stations. All observations were of the species flying below RSA height (<40m above the ground). - bird census: recorded once at each of two locations: 1) in the Tangmangaroo Road reserve approximately 300m north of the transmission line crossing; and 2) at Taffs Hill which is 800m to the West of Harrys Creek Road and 1.3km north of WTG 76 (PL1), the most northerly turbine of the proposed development footprint. - tree hollow identification (preferred Superb Parrot hollow trees): no active nests were detected. Within 500m of the proposed development footprint: 81 primary hollows (in 53 hollow bearing trees) and 61 secondary hollows (in 34 hollow bearing trees). - foraging habitat assessment: identification of suitable foraging habitat being the cropland (cultivation areas) and all woodland areas. Figure 3.26 to Figure 3.30 shows the flight path mapping which was derived from the static point observations (BUS) identifying higher activity around the cropland in the north, locations of individuals observed throughout the study area, suitable tree hollows (the primary hollow trees mostly outside the development footprint throughout the now removed Langs Creek Cluster, along the Tangmangaroo Road reserve and in and south of the Mount Buffalo Cluster.
Likelihood of Occurrence		Known to occur in study area.

Individuals in study area	Population numbers: ERM surveys identified 150 Superb Parrots, all of which were flying below 40m above the ground, below RSA height. - Collision risk modelling was based on Superb Parrots counted flying at RSA height, rather than an overall population estimate, and the species was only detected during November and into the first week of December, and not in January and February. Noteworthy is that no individuals were observed flying in the RSA. A zero count in the RSA results in zero predicted collisions. - Using the ERM (2013) Superb Parrot count and BioNET records, the individuals known from the locality are 192 (ERM=150; BioNET=42) although it is most likely that the relative species counts between ERM effort and the BioNET records does not represent a higher concentration in the area in which ERM surveyed, but rather a function of greater survey effort / searcher intensity. Especially considering the area being a known habitat for the species (Birdlife International 2018) and the BioNET records being only a small observation period of 42 individuals in a period of 1999-2000. Due to the high number of individuals recorded at BUS locations in the Langs Creek cluster (48 at BUS Hopefield; 61 at BUS Taffs) this area has been excluded from the proposed development footprint in order to reduce the potential impact on the local population of SP. As a result, these areas are now separated from the development, which is concentrated on an area with very few observations of the SP. In total only 11 SP's have been sighted (formerly 96) across the revised project area plus a 500m buffer. A population estimate is not clearly possible based on the data available and no clear published method is available for estimating population numbers from species counts based on methods. The South Western Slopes Important Bird Area (SWS IBA) is estimated to contain 2,000-5000 individuals (Birdlife International 2018). It is not certain what proportion of the entire species' population were measured as using the site during the season surveyed, although it was almost certainly a very small proportion of the estimated 2,000-5,000 individuals in the SWS IBA (Birdlife International 2018). Furthermore, the majority of observations were in the Langs Creek cluster, which is now removed from the project, and those observed are likely to be a migratory or seasonal population (discussed below). - The SWS IBA delineates the distribution of the Superb Parrot (and Swift Parrot) through Boorowa, Yass and Queanbeyan in the south west, north to Orange (Birdlife International 2018); the study area occurs in this IBA and is bounded by a polygon of approximately 7,080ha in area, or 0.28% of the SWS IBA of 2,565,348ha. The population estimate in the large SWS IBA

	made in 2009 is 2,000-5,000 individuals (Birdlife International 2018). Considering the low likelihood that a true population estimate can be drawn from the data, it is not possible with certainty to state whether the proposed development footprint represents a large proportion of the population in the SWS IBA, although it is almost certainly not the case due to the relatively small spatial area of coverage of the proposed development footprint relative to the SWS IBA. Further, it is difficult to predict the future importance of the study area considering climate change. - BUS surveys conducted between 13/11/2012 and 27/2/2013 identified Superb Parrots in November and into the first week of December, after which none were detected (refer Annexes C & E of ERM (2017a). Those data indicate the population using the study area is not sedentary and migrate away from the study area in early summer. Foraging habitat: The method used to differentiate the foraging habitat is based on a combination of field observations and resource availability (mapped as per the vegetation mapping). Using ERM (2017a) and further consideration (using Birdlife International 2018), habitat for the species in the study area should be categorised as (and is shown in Figure 3.26 to Figure 3.30): - cropland / cultivation potential foraging habitat, supported by observational survey data identifying these areas being preferred by the species. - woodland of a largely 'intact' tree canopy condition (at or slightly below remnant quality) as per the vegetation mapping (i.e. all woodland types assigned the condition class suffix of "MG; MG_C; MG_S"). - cleared grassland areas with scattered paddock trees providing sparse foraging habitat. The proposed development footprint will remove relative to the study area: - 9.54ha(PL1) & 7.53ha(PL2) woodland of 181.97ha in the study area – likely preferred habitat. - 111.21ha(PL1) & 105.56ha(PL2) of agricultural grasslands and scattered paddock trees of 898.71ha in the study area – potential sparse foraging habitat. This amounts to a sum of 120.75ha(PL1) / 113.09ha(PL2) of habitat in the proposed development footprint relative to 1,084.66ha in the study area. Manning et al. (2007) identify optimal altitudinal range occupied by the species in the region is 350-550m ASL. Contours haves been mapped across the study area (Figure 3.31 to Figure 3.32). Notably, the bases of all WTGs stand at 620m or higher and therefore above the 550m ASL optimal altitudinal height range upper limit.

	Considering that data, none of the WTGs occur in the optimal altitudinal range identified by Manning et al. (2007). Nesting habitat: The tree hollow survey identified a total of 1,173 hollows. No active Superb Parrot nests were identified. A summary table of tree hollow data by species and size class, and raw hollow data is found in Appendix 5. Suitable tree hollow sizes were categorised as described previous according to Manning et al. (2012). Eight primary hollows are in the proposed development footprint. Occurring within 500m of the proposed development footprint are: 81 primary hollows (in 53 hollow bearing trees) and 61 secondary hollows (in 34 hollow bearing trees). Regarding retention of trees which will be capable of producing hollows in the future, design iterations have sought to minimise impacts to woodland areas and hollow bearing trees will be considered in detailed design consistent with any NSW approval conditions. ERM (2017a: p11) stated that the higher value habitat areas for the species were in the Langs Creek cluster containing a higher and more concentrated assemblage of potential nesting trees and foraging habitat (flowering Yellow Box, Blakely's Red Gum and Apple Box trees). Accordingly, to reduce potential impacts on the species, the Langs Creek cluster was removed during the project design and impact assessment iterations.
Suitability of Guidelines Used	Refer section above 'survey methods' for description of suitability of guidelines used.

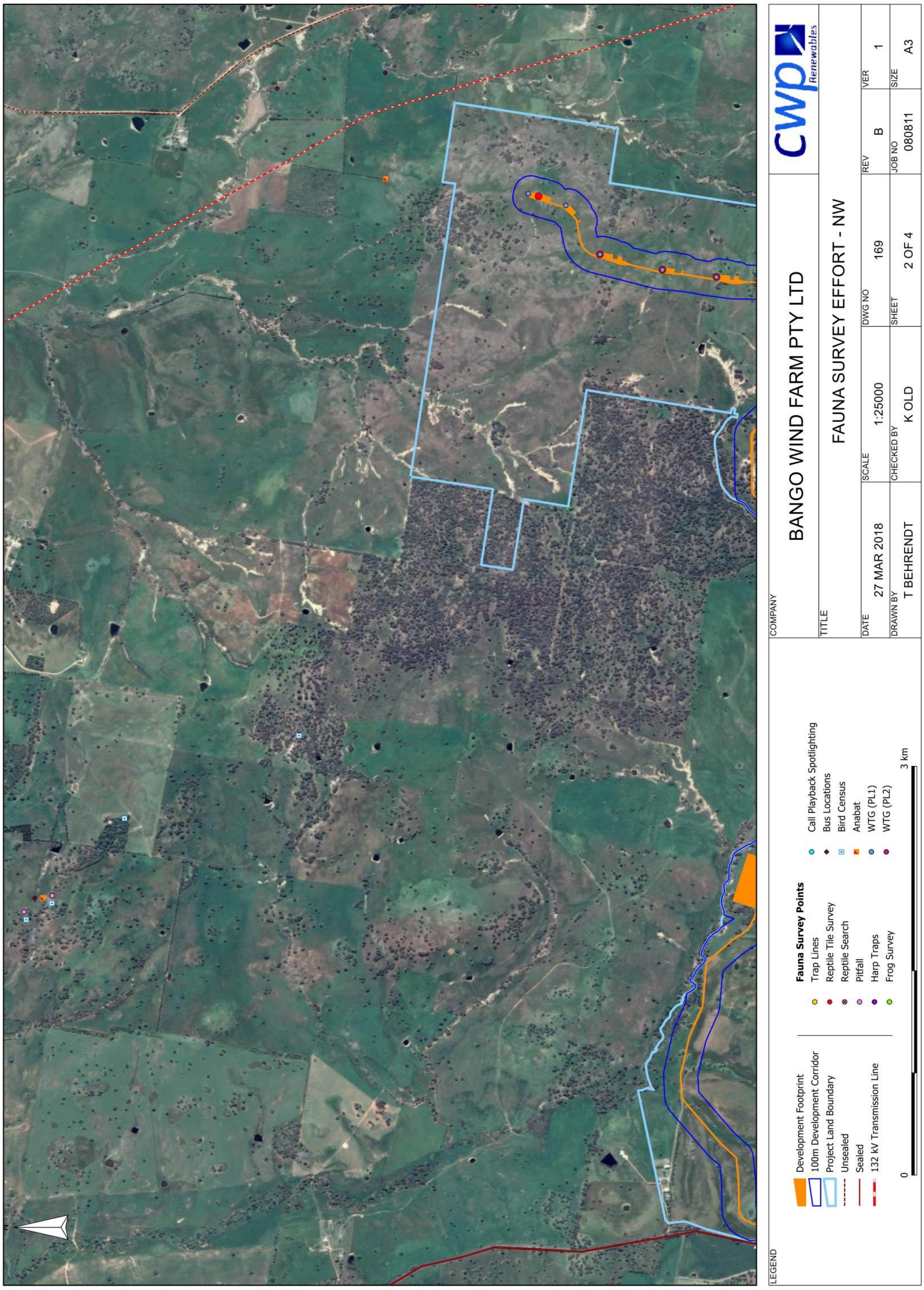


Figure 3.22: Fauna Survey Effort – NW

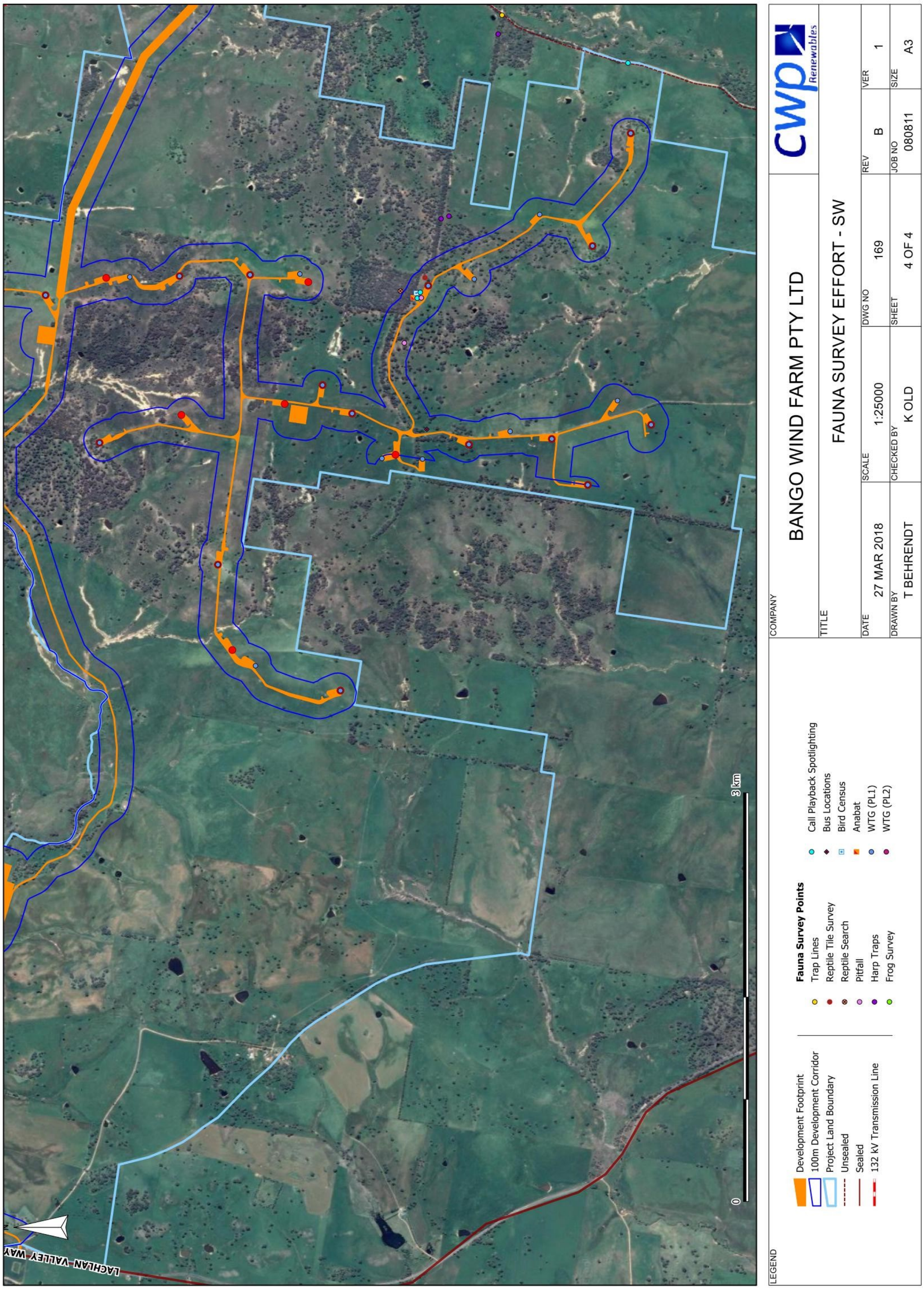


Figure 3.23: Fauna Survey Effort – SW

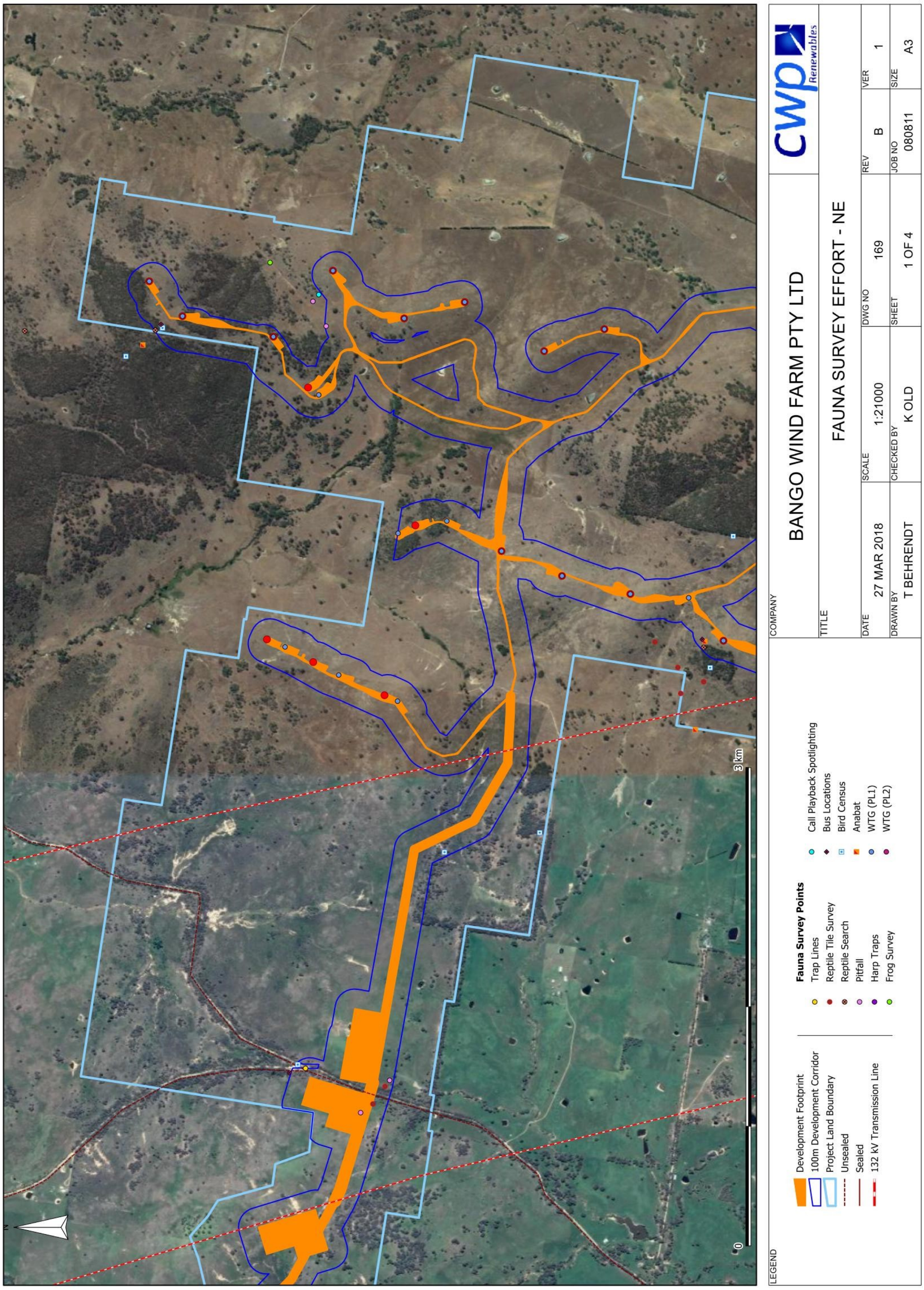


Figure 3.24: Fauna Survey Effort – NE

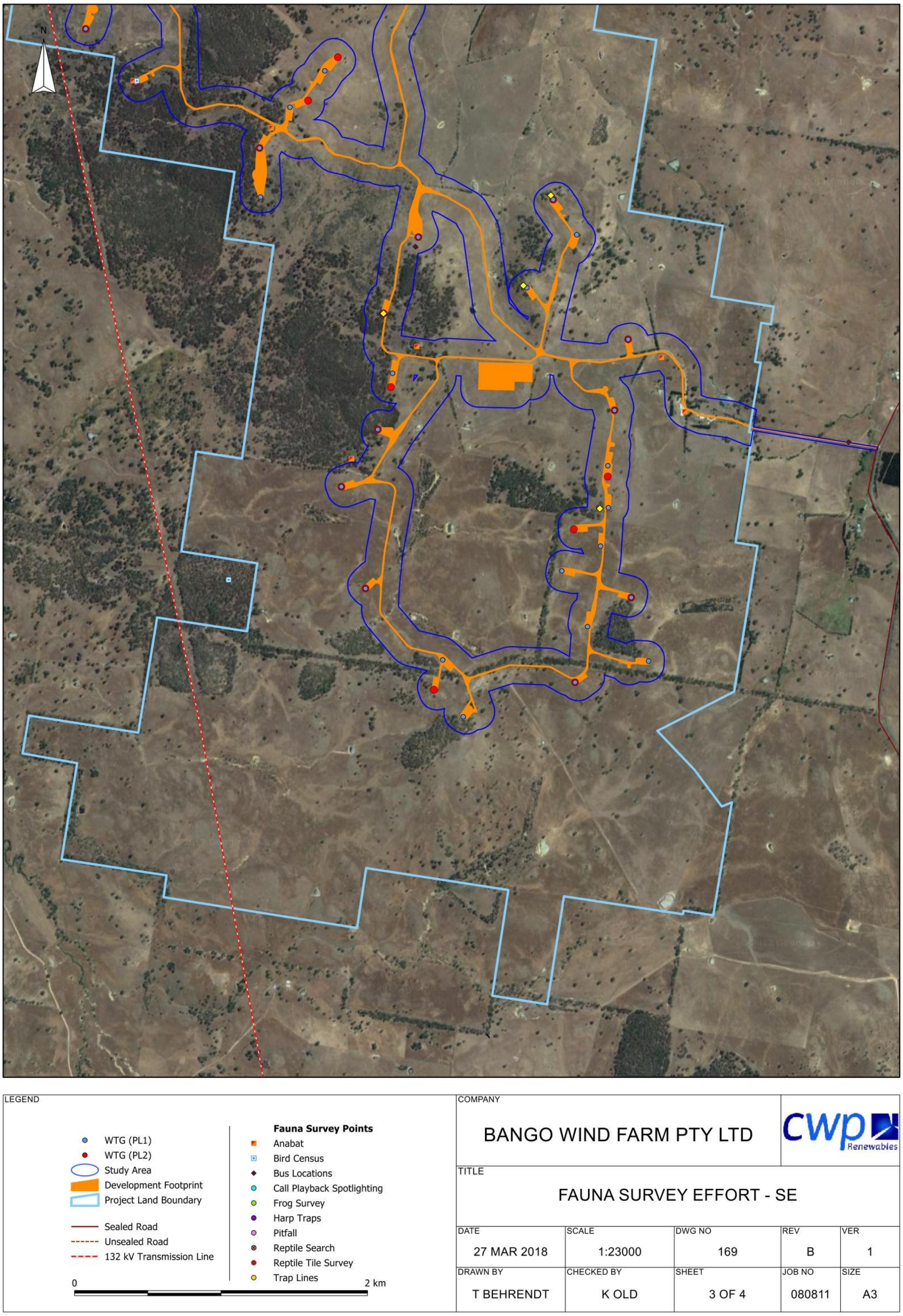


Figure 3.25: Fauna Survey Effort - SE

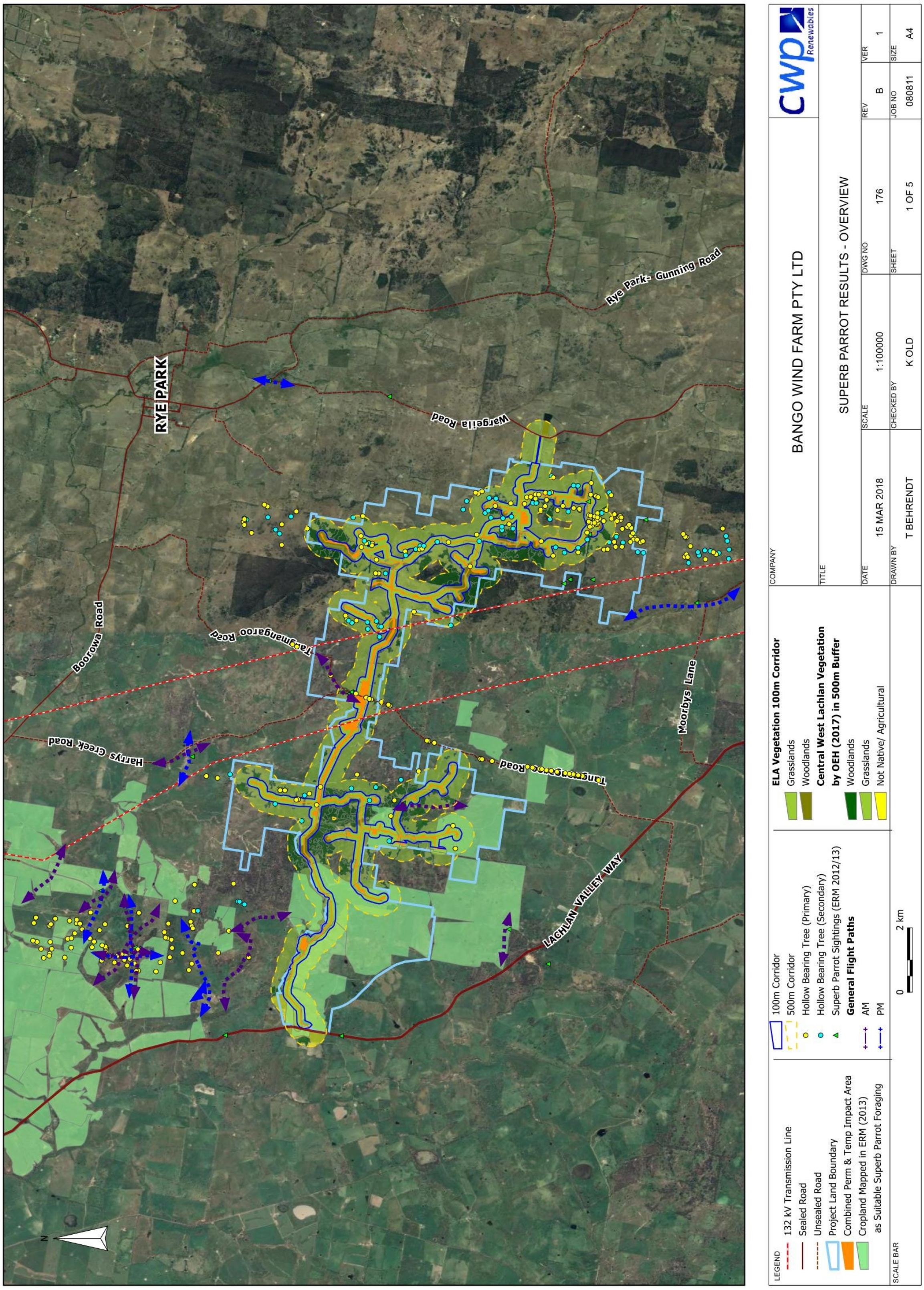


Figure 3.26: Superb Parrot Survey Results Overview

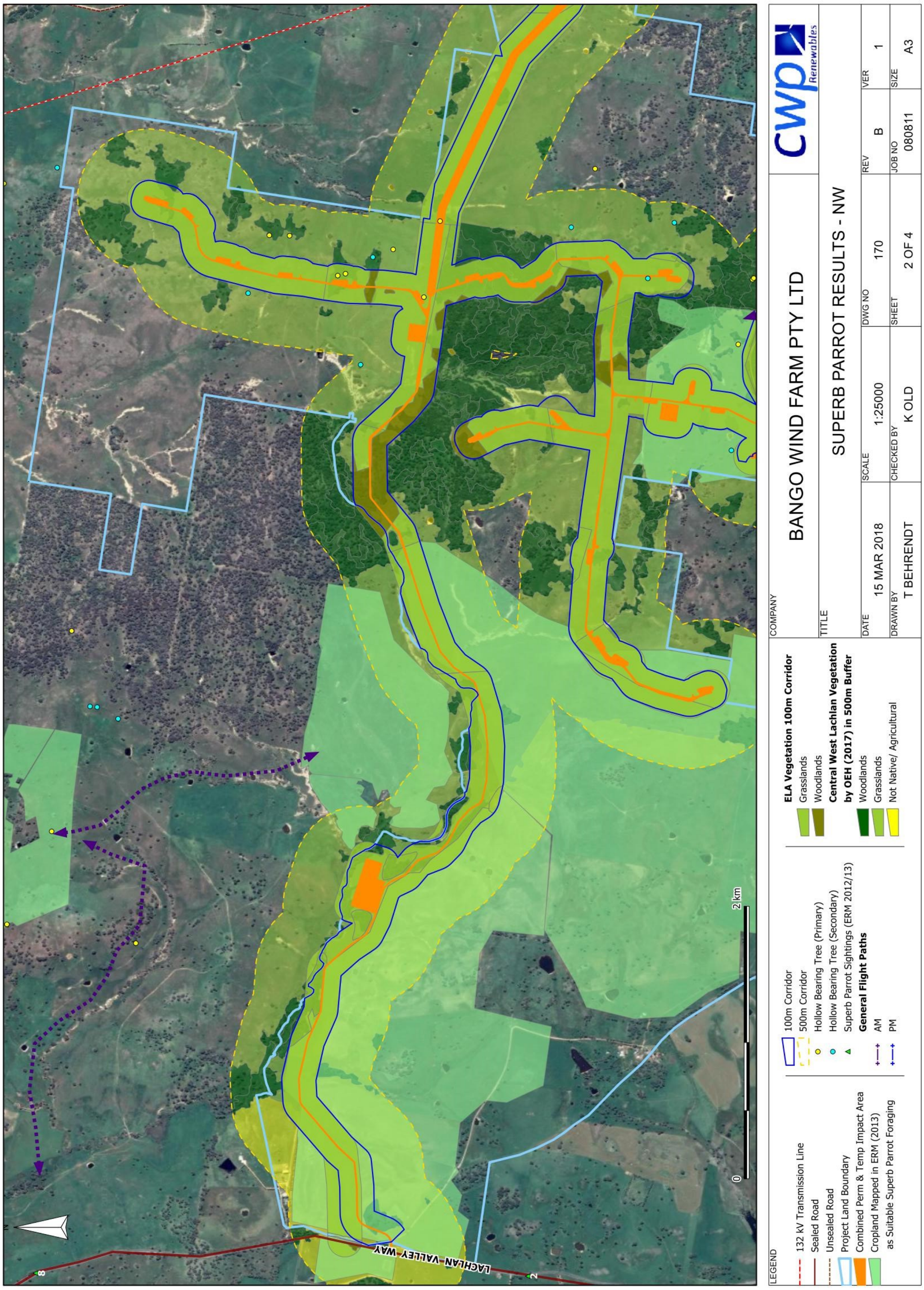


Figure 3.27: Superb Parrot Survey Results - NW

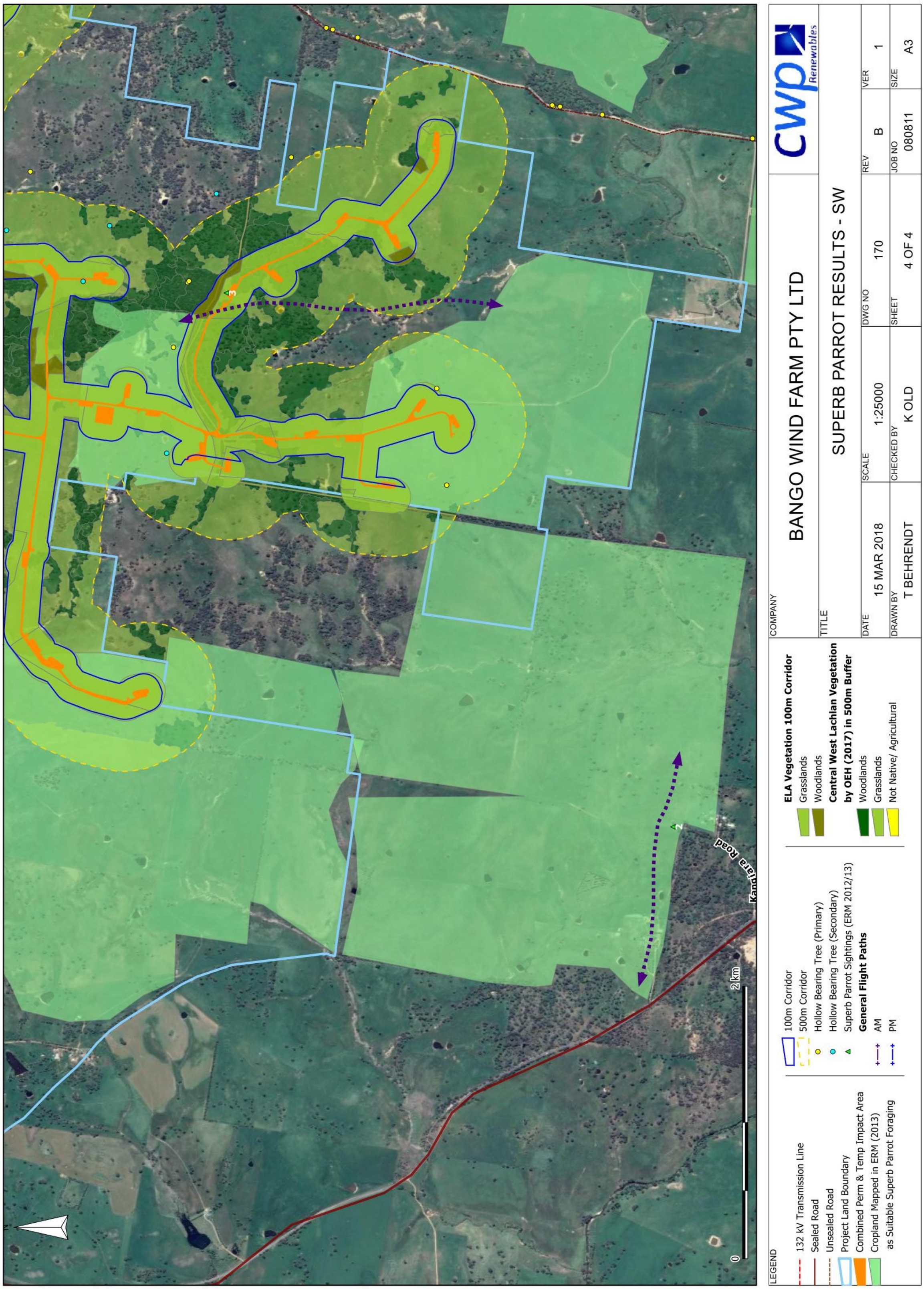


Figure 3.28: Superb Parrot Survey Results - SW

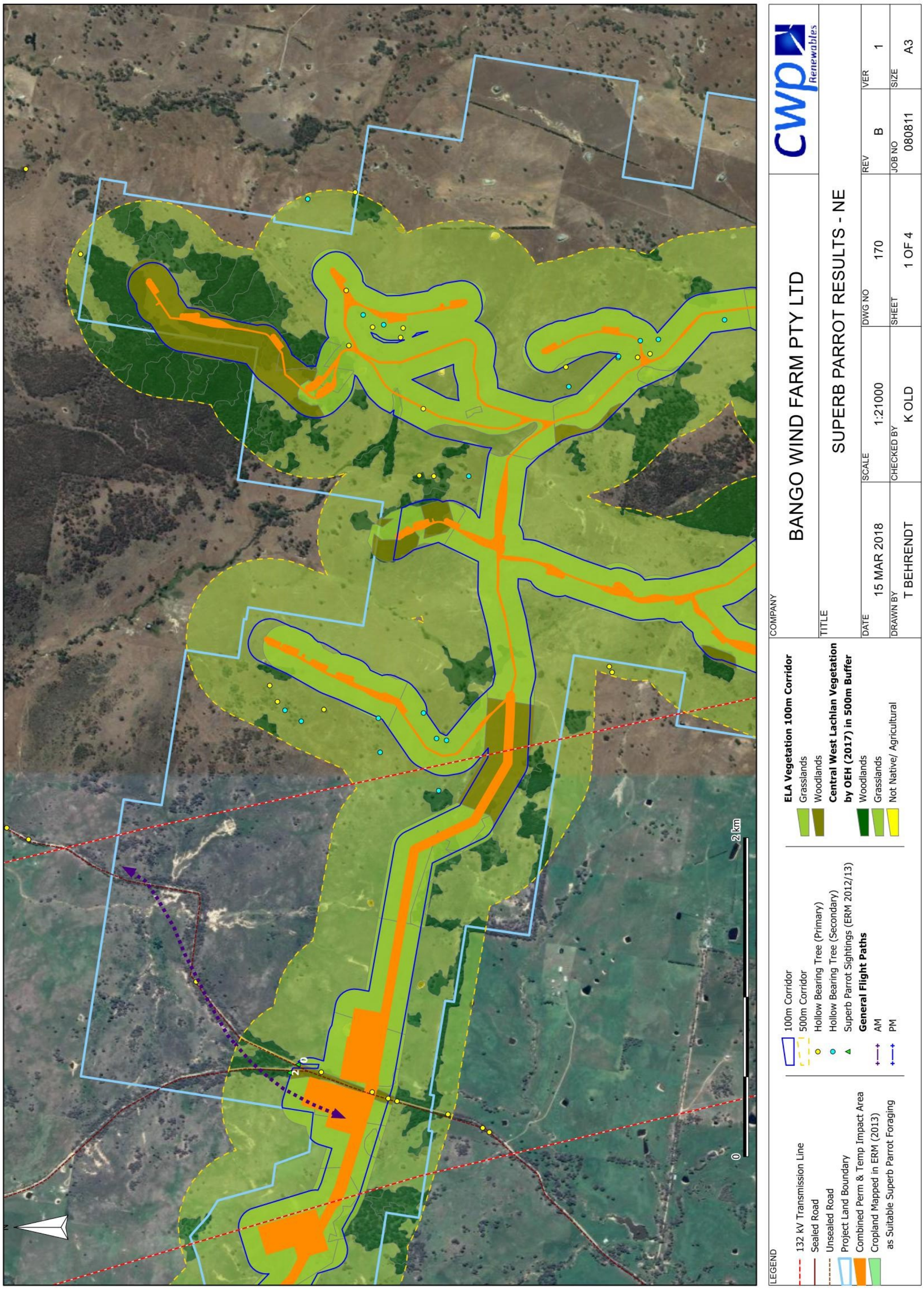


Figure 3.29: Superb Parrot Survey Results - NE

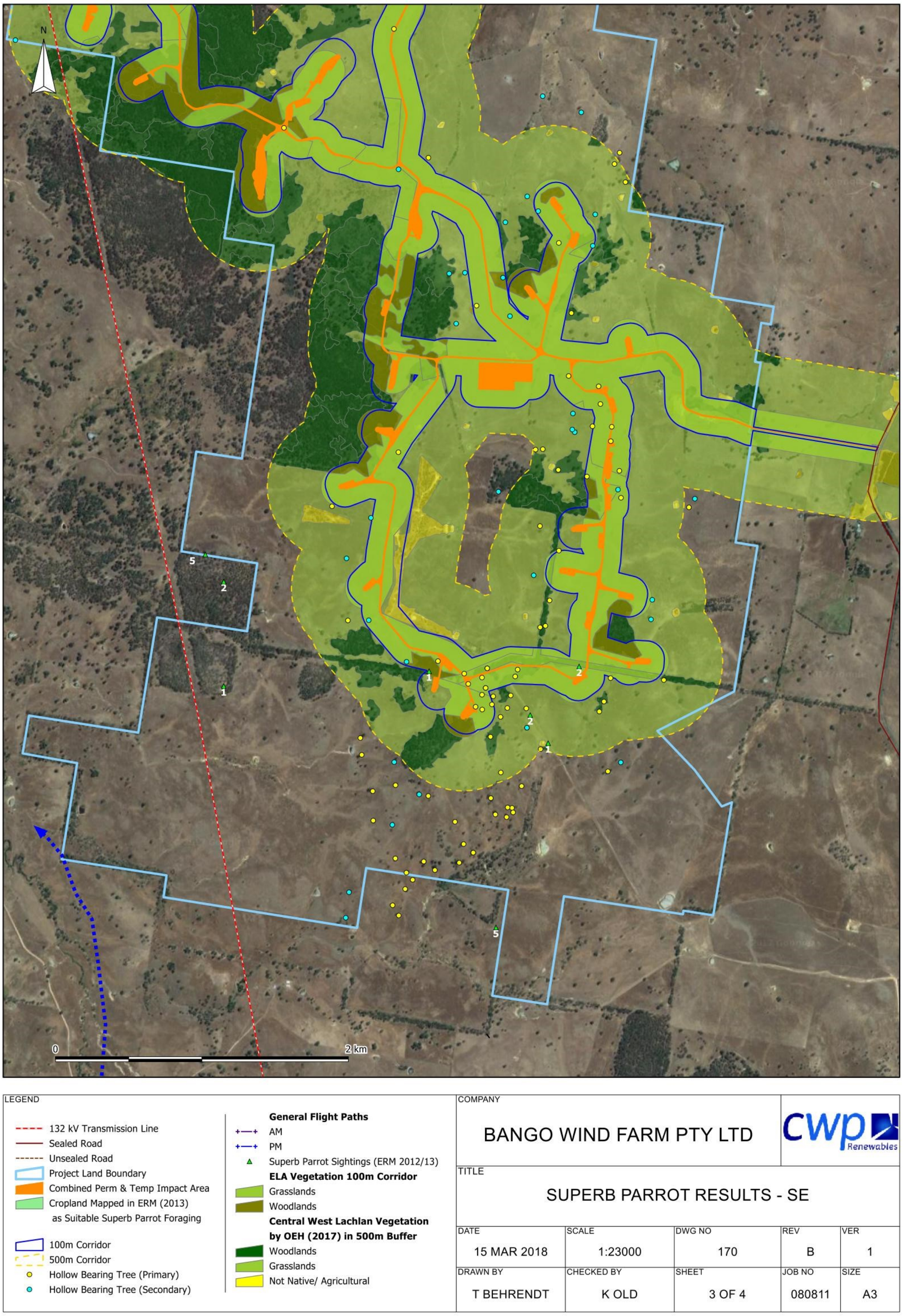


Figure 3.30: Superb Parrot Survey Results - SE

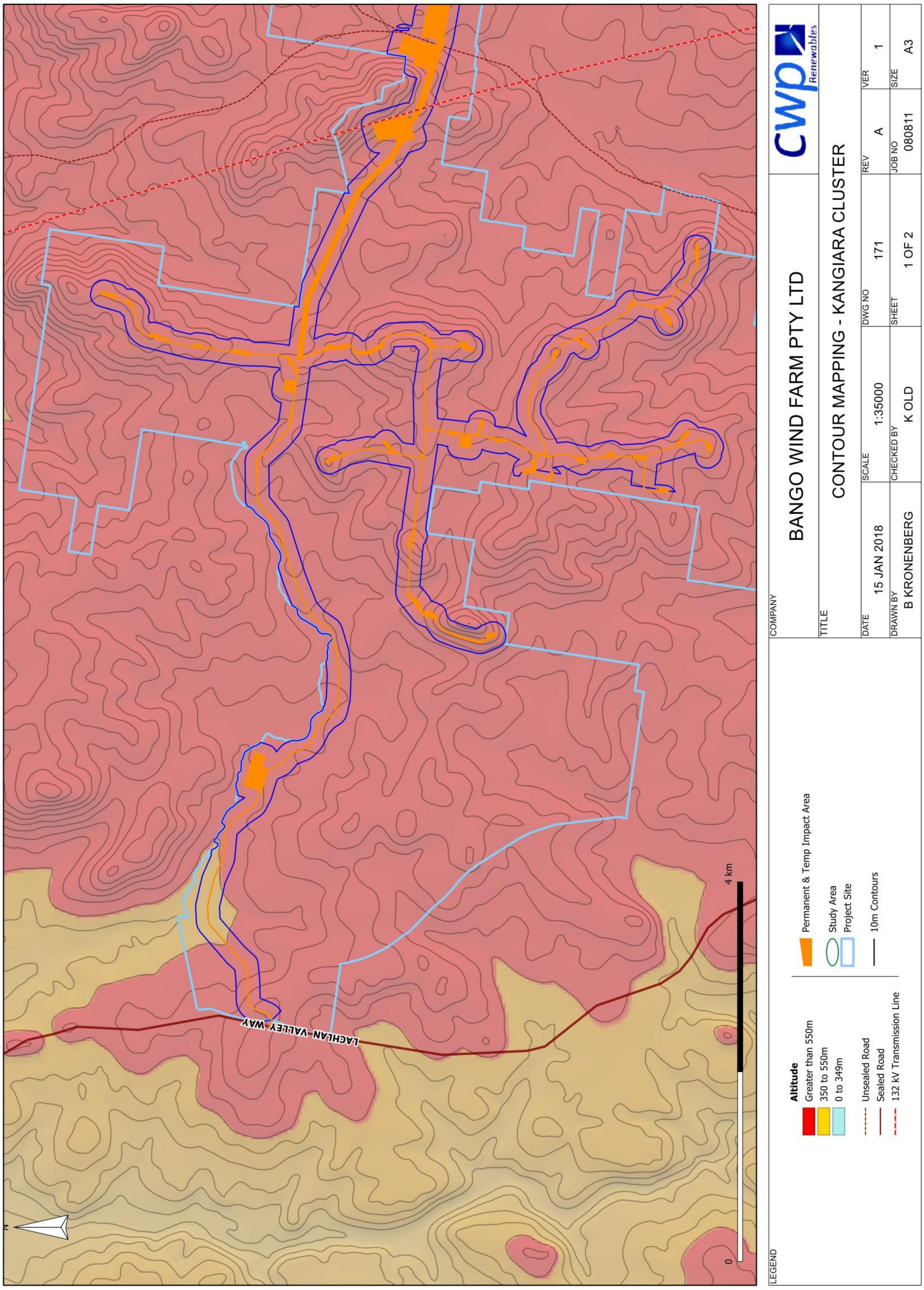
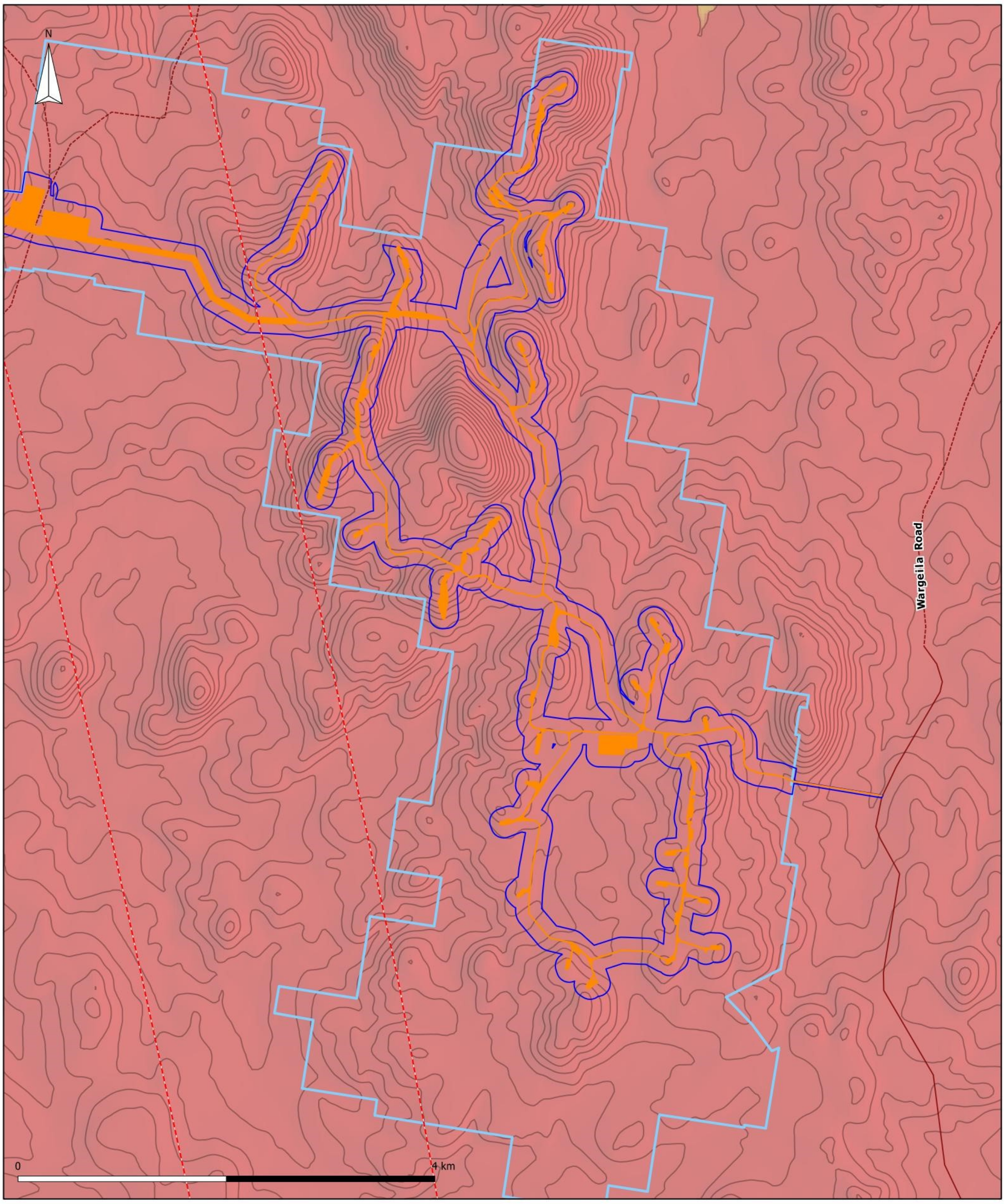


Figure 3.31: Site Contour details – West



LEGEND

Altitude
- Greater than 550m
- 350 to 550m
- 0 to 349m

- Unsealed Road
- Sealed Road
- 132 kV Transmission Line

- Permanent & Temp Impact Area
- Study Area
- Project Site
- 10m Contours

COMPANY: BANGO WIND FARM PTY LTD				cwp Renewables
TITLE: CONTOUR MAPPING - MT BUFFALO CLUSTER				
DATE: 15 JAN 2018	SCALE: 1:36000	DWG NO: 171	REV: A	VER: 1
DRAWN BY: B KRONENBERG	CHECKED BY: K OLD	SHEET: 1 OF 2	JOB NO: 080811	SIZE: A3

Figure 3.32: Site Contour details - East

Regent Honeyeater (Anthochaera (Xantholmyza) phrygia)		
EPBC Act Status		Critically Endangered
Population Information in Locality		Zero individuals (ERM (2013) & BioNET)
Survey	Timing	Refer to “Effort and Methods” below.
	Location	Figure 3.22 to Figure 3.25 shows the bird survey effort (including for the Regent Honeyeater) relative to the proposed development footprint
	Effort and Methods	BUS were undertaken from 14 November 2012 to 23 February 2013. Surveys were undertaken at different times of the day regardless of weather conditions. The methodology involved 15-minute fixed point, fixed radius counts at 20 survey sites spread across the Study Area. All small birds within 100 m of the point, all large birds within 800 m of the point, direction of flight the species was taking, distance from the survey point and the height the species was flying at measured in 20 m bands was recorded. Woodland bird surveys were carried out during early morning or late afternoon in areas of suitable habitat in late winter through to early summer (August – December) 2012. A total of 17 surveys were undertaken within or adjacent to areas of woodland habitat. Each survey was undertaken for a minimum of one hour. Bird surveys were completed by two observers for one hour.
	Results	Woodland bird surveys identified no individuals, and database records (BioNET) contain no records of the species in the locality. A full description of the woodland bird survey methods is provided in Annex B of ERM (2017a) (attached) and the project EIS (ERM 2013).
Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Nil
Suitability of Guidelines Used		BUS and Woodland Bird Surveys were undertaken in accordance with the AusWEA Interim Bird Risk Assessment Standards (2005). BUS methodology was consistent with both the Survey Guidelines for Australia’s Threatened Birds (DEWHA 2010a) and the Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft) (DEC 2004).

Koala (Phascolarctos cinerius)		
EPBC Act Status		Vulnerable
Population Information in Locality		3 individuals (ERM (2013) count = 0; BioNET = 3)
Survey	Timing	Survey timing for the Koala was: - call playback: November-December 2012 (4x sessions) - spotlighting: November 2012 - February 2013 (6 x 1hr sessions) - camera traps: November 2012 - December 2012 (8x cameras in place for 4 weeks)
	Location	Figure 3.22 to Figure 3.25 shows the mammal survey effort (including for the Koala) relative to the proposed development footprint.
	Effort and Methods	The referral of this project to the Commonwealth was made on 27/3/2013, with a controlled action decision being made on 7/5/2013. The EPBC Act Referral Guidelines for the Vulnerable Koala (DEE 2014) were published in 2014, after the controlled action decision. Therefore, characterising the Koala habitat in the study area according to those guidelines is not conducted. The EIS (ERM 2013) used a habitat assessment considering the presence and relative abundance of Koala feed tree species on the site as designated in the NSW Koala Recovery Plan (DECC 2008), for the Koala Management Area: Central and Southern Tablelands. This listed primary, secondary and supplementary feed tree species, of which the site only possessed secondary and supplementary species.
	Results	No Koalas were identified in the surveys, and the BioNET records contain three records in the locality, the most recent being 20 years ago. Potential feed trees in the Study Area include woodlands and paddock trees containing secondary and supplementary species (as listed in the Central and Southern Tablelands Koala Management Area (DECC 2008)).
Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Notwithstanding the previous discussion, the proposed development is not likely to fragment any habitat available to the Koala because it will not create wide or un-crossable barriers[10]* in the landscape which is already fragmented with patches of woodland occurring as 'islands' in a cleared, agricultural landscape. Elements of the proposed development are gravelled access tracks not wider than 10m joining cleared pads at the base of WTGs which will be approximately 5m in diameter of permanent impact and 14m

[10] Artificial barriers are defined in DEE (2014: p5) as being roads or fences without Koala crossing areas, or developments creating treeless areas >2km wide.

	in diameter of temporary impact. The adjacent laydown areas have an impact of 60x25 metres.
Suitability of Guidelines Used	N/A

Eastern Long-Eared Bat (Nyctophilus corbeni) (syn: N. timorensis)		
EPBC Act Status		Vulnerable
Population Information in Locality		Zero individuals (ERM (2013) & BioNET)
Survey	Timing	Refer to “Effort and Methods” below.
	Location	Figure 3.22 to Figure 3.25 shows the bat survey effort (including for the Nyctophilus sp.) relative to the proposed development footprint.
	Effort and Methods	Methods used were consistent with those recommended in NSW impact assessments (DEC 2004) and included passive echolocation recording, stag watching, and harp trapping. The Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b), being the Commonwealth recommended guidelines, state clearly that they are not mandatory guidelines (DEWHA 2010b: p1). Considering the methods recommended in the Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b) for this species: - Nyctophilus species are not distinguishable from other *Nyctophilus spp*. by recorded echolocation analysis (DEWHA 2010b:p10), although a recording of a *Nyctophilus spp*. should then be followed up with trapping (DEWHA 2010b:p48). - traps and nets should be used in a stratified variety of habitats. - surveys should occur between October and April for 20 trap nights (5 nights per effort). ERM (2013) survey effort involved echolocation recording at 13 locations for (minimum) two nights at each location over the period of November 2012 - February 2013 and a total of 12 trap nights (2x harp traps over 3 nights on two occasions) in February 2013.
	Results	The results of the survey methods (ERM 2013) were: - Echolocation recording: as stated in DEWHA (2010b: p48), *Nyctophilus corbeni/timorensis* are not distinguishable from some other *Nyctophilus spp.*. The survey effort for the EIS detected recordings of *Nyctophilus geoffroyii* and a *Nyctophilus sp.*. - Trapping: harp trapping was undertaken, capturing (among other species) the species: Nyctophilus geoffroyii.

		The species was not recorded in ERM (2013) and BioNET contains no records of the species in the locality. ERM concluded the species was unlikely to occur in the study area.
Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Refer previous subsection.
Suitability of Guidelines Used		Refer to “Effort and Methods” above.

Striped Legless Lizard *(Delma impar)*		
EPBC Act Status		Vulnerable
Population Information in Locality		Zero individuals (ERM (2013) & BioNET)
Survey	Timing	Refer to “Effort and Methods” below.
	Location	Figure 3.22 to Figure 3.25 shows the reptile survey effort (including for the SLL & PTWL) relative to the proposed development footprint.
	Effort and Methods	The Survey Guidelines for Australia's Threatened Reptiles (SEWPaC 2011), being the Commonwealth recommended guidelines, state clearly that they are not mandatory guidelines (SEWPaC 2011: p1). Methods used were: - pitfall trapping at three locations over four weeks in late November - late December 2012 (each location included 2x configurations in a cross shape of drift fencing, with 5x pits in each) (16,200 trap hours); - funnel trapping array at two locations over four weeks in late November - late December 2012 (each location included 1x configurations in a cross shape of drift fencing, with 12x traps at each) (12,960 trap hours); - artificial habitat (tile emplacement) established in July/August 2012, monitored fortnightly over November-December 2012, of 3x 50 tile grids and 3x 25 tile grids (17,136 trap hours); and - rock rolling over 8-person hours in suitable habitat in the period October 2012 - February 2013. These methods are consistent with the seasonality and recommended preferential order of methods (more preferred vs less preferred) for the species contained in SEWPaC 2011: pp86-7).
	Results	This species was not recorded by ERM (2013) and BioNET contains no records of either species in the locality. The species does not likely occur in the study area.

Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Species not recorded and not likely to occur (refer previous subsections).
Suitability of Guidelines Used		Refer to "Effort and Methods" above.

Pink-tailed Worm Lizard (Aprasia parapulchella)		
EPBC Act Status		Vulnerable
Population Information in Locality		Zero individuals (ERM (2013) & BioNET)
Survey	Timing	Refer to "Effort and Methods" below.
	Location	Figure 3.22 to Figure 3.25 shows the reptile survey effort (including for the SLL & PTWL) relative to the proposed development footprint.
	Effort and Methods	Methods used were - rock rolling over 8-person hours in suitable habitat in the period October 2012 - February 2013. These methods are consistent with the seasonality, and recommended methods detailed in SEWPaC 2011: p79).
	Results	This species was not recorded by ERM (2013) and BioNET contains no records of either species in the locality. The species does not likely occur in the study area.
Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Species not recorded and not likely to occur (refer previous subsection).
Suitability of Guidelines Used		Refer to "Effort and Methods" above.

Yass Daisy *(Aprasia parapulchella)*		
EPBC Act Status		Vulnerable
Population Information in Locality		141 individuals (ERM (2013) count=127 + BioNET=14)
Survey	Timing	October – December, 2012
	Location	Figure 3.8 to Figure 3.11 shows the development footprint and survey effort for threatened flora (including the Yass Daisy).
	Effort and Methods	Field methods to target this species included traversing the proposed development footprint, meandering as per DEC (2004) to focus attention in the areas of potentially suitable habitat (woodland and derived native grasslands). Traverse covered 273.94km comprising 74.10km (22-26/10/2012); 90.45km (12-16/11/2012); and 109.39km (17-21/12/2012). Surveys were timed to identify the species when detectable.

		The methods were vindicated as the species was identified in a woodland in a valley in the Mount Buffalo cluster of the proposed development footprint. No individuals were observed in the proposed development footprint.
	Results	Yass Daisy was identified in one location in the surveys across the study area, in a 288ha parcel of woodland (Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest). A population was counted of 127 individuals located as shown in Figure 3.33, more than 820m away from the proposed development footprint. BioNET contains 14 records of the species in the locality.
Likelihood of Occurrence		Unlikely to occur in study area.
Individuals in study area		Nil (nearest record >820m away from the development footprint).
Suitability of Guidelines Used		Refer to “Effort and Methods” above.

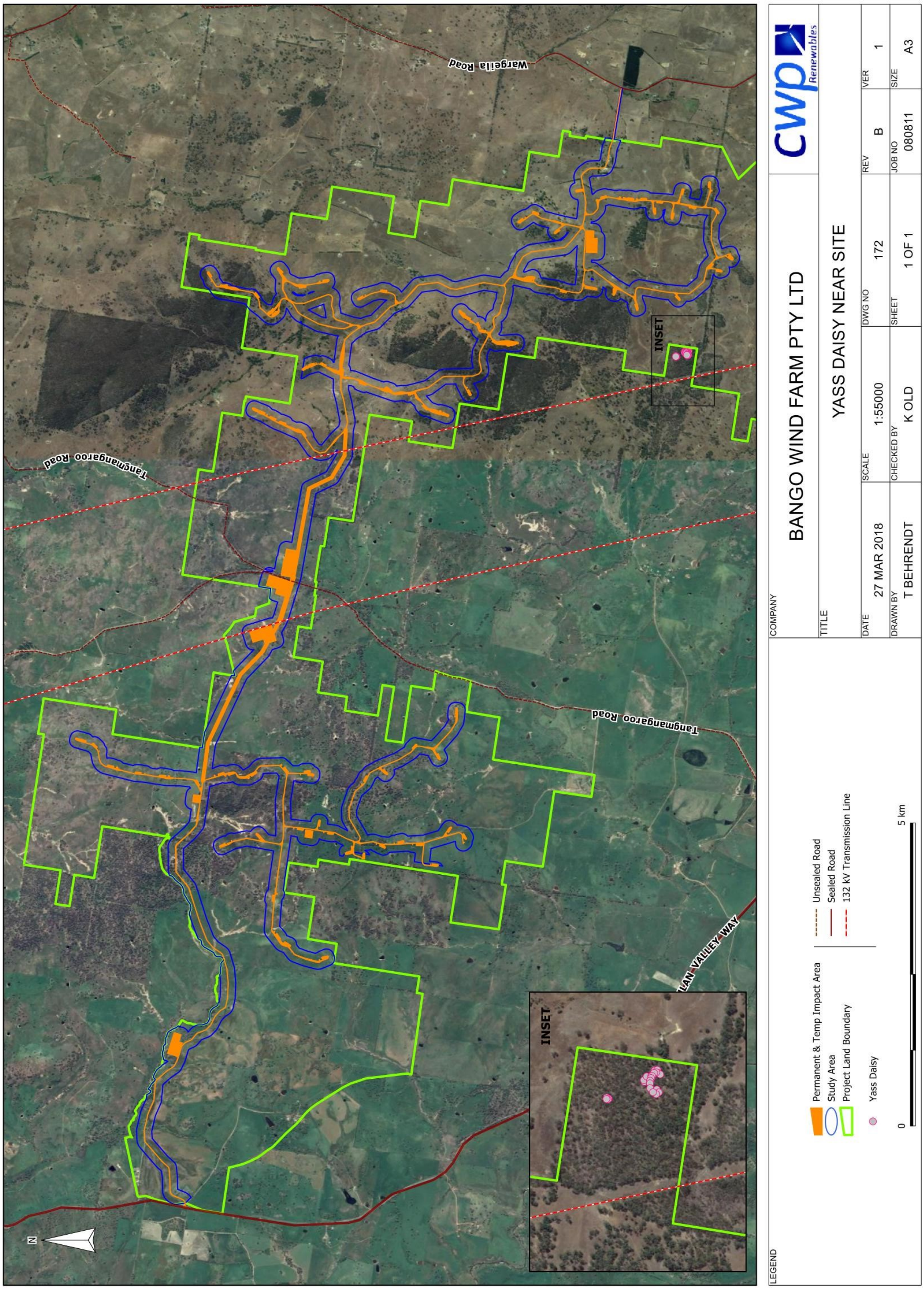


Figure 3.33: Yass Daisy Near Site

3.2.4 Migratory Species

Migratory species considered in the EIA (ERM 2013) that were identified as being known, likely or with potential to occur in the Study Area (at that point in time) were:

- Cattle Egret (Ardea ibis)
- Latham's Snipe (Gallinago hardwickii)
- White-bellied Sea-eagle (Haliaeetus leucogaster)
- White-throated Needletail (Hirundapus caudacutus)
- Rainbow Bee-eater (Merops ornatus)

3.2.5 Summary of Focus of MNES Relevant to the Following Assessment

Of the nine focus MNES discussed in this MNES Report, three have the potential to be affected by the Project:

- the threatened ecological community - White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC; and
- the threatened species - Golden Sun Moth (Synemon plana) and Superb Parrot (Polytelis swainsonii).

Therefore, these three MNES will be the focus of further assessment.

Avoidance measures have led to the removal of impacts to the Yass Daisy *(Ammobium craspedioides)*. As a result of the analysis presented here it is concluded that the Regent Honeyeater *(Anthochaera (Xanthomyza) phrygia)*, Koala *(Phascolarctos cinereus)*, Eastern Long-eared Bat *(Nyctophilus corbeni) (syn: N.timorensis)*, Striped Legless Lizard *(Delma impar)* and Pink-tailed Worm Lizard *(Aprasia parapulchella)* are unlikely to occur in the Study Area. On this basis, these matters are not considered relevant for further assessment.

4 RELEVANT IMPACTS

4.1 DIRECT IMPACTS

4.1.1 Box Gum Woodland

Section 3.2.3 of this report discusses the vegetation mapping process including the identification of Box Gum Woodland (BGW) CEEC. This includes cross reference to Appendix A of the ERM RtS report (ERM 2017a) (attached here as Appendix 2) describes the original rationale for identifying Box Gum Woodland. Since that time the vegetation mapping and impact area calculations have changed slightly, including during a thorough vegetation mapping review process undertaken in 2017 (ELA 2017; refer Appendix 3). For clarity, the vegetation mapping is shown in Figure 3.12 to Figure 3.16 and impact area calculations are shown in Table 4.1. The total impact for EPBC Act listed BGW TEC is 0.26ha.

Table 4.1: Bango Wind Farm Vegetation Impact Areas

Vegetation Type Identifier	Temporary + Permanent Impact Areas (ha)		NSW TSC Act Listed EEC	EPBC Act Listed TEC
	PL1	PL2		
LA103_L	35.90	35.11	-	-
LA103_MG_C	0.26	0.26	BGW	BGW
LA103_MG_P	28.35	26.36	BGW	-
LA103_MG_S	3.41	2.92	BGW	-
LA182_L	43.55	41.17	-	-
LA182_MG	9.28	7.27	-	-
Planted Native Vege	0.01	0.01	-	-
Road	0.05	0.05	-	-
Total	**120.81**	**113.15**		

4.1.2 Golden Sun Moth

Impacts to this species' habitat is identified in Section 3.2.3 as being 39.54ha (comprising 13.35ha known and optimal habitat, and 26.19ha potential habitat). Annex F of the ERM RtS report (ERM 2017a) (Appendix 2) describes in more detail the Golden Sun Moth (GSM) survey and impact assessment process. Figure 3.17 to Figure 3.21 have been prepared superseding the figures in ERM (2017a).

4.1.3 Superb Parrot

Annexes C, D & E of the ERM RtS report (ERM 2017a) (Appendix 2) describes in more detail the Superb Parrot (SP) survey and impact assessment process. Figure 3.26 to Figure 3.30 has been prepared superseding the figures in ERM (2017a). Further detail is explored below.

4.1.3.1 Impacts on Nesting habitat

The latest design footprint, that includes all Project infrastructure, intersects with eight primary hollow-bearing trees that will have to be removed. This loss will have a negligible impact driving competition for hollows for the species given the recorded 81 primary hollows in the 500m buffer area.

4.1.3.2 Impacts on Foraging habitat

Potential SP foraging habitat in the proposed development footprint was presented in section 3.

4.1.3.3 Collision risk

As discussed in section 3, ERM surveys identified 150 Superb Parrots, all of which were flying below 40m above the ground, below RSA height. A Collision Risk Model (CRM) run with zero birds observed at RSA would predict zero collisions. The CRM was run using one individual of the SP to create numbers for discussion and as the original EIA (ERM 2013) had used one individual which was scored as being within RSA, which on data review was found to be erroneously applied (all observations of SPs were at heights <40m above the ground).

The CRM has been calculated using the guidance of Scottish Natural Heritage (SNH) (2016) and uses wind turbine generator geometry, considers the amount of birds observed in a survey envelope, the characteristics of the bird (i.e. its presence at heights to intersect with the wind turbine generator rotors) and the proportion of the survey envelope which would be covered by the rotor swept area (RSA) should development proceed. The outputs are fundamentally based on the predicted interaction of birds with RSA i.e. how many birds are observed at RSA height. The CRM was applied in the following manner.

A 'risk window' is calculated using:

- distance over which data are collected at longest axis (21km) x height of airspace used by birds (200m) = 4.2km^2; and
- area covered by whole layout rotor swept area (RSA) (number of WTGs (PL1: 75; PL2: 61) x RSA (using standard circle area (πr^2) of 72m radius) = PL1:1.22145km2; PL2:0.99345)

To represent a 'proportion' of the measured area covered by the whole RSA per layout = PL1: 0.29082; PL2: 0.23653.

A 'band collision percent' is calculated using bird parameters (length=0.4m, wingspan=0.3m, flapping flight (not gliding), flight speed=15m/s) and WTG parameters (3 blades, rotor diameter=144m, rotation period=4.29s) which for the SP is 4.2%.

Then the predicted collisions are calculated using:

- birds observed at RSA height per month (148 total: Nov 2012=98, zero at RSA height; Dec 2012=50, none at RSA height) (birds below RSA are discarded, however 1x SP individual has been used in the data for November, consistent with (ERM 2017b));
- divided by number of survey points in that month where birds were observed at RSA (23 survey points in Nov 2012 – the month in which the one individual was observed which ERM (2017b) scored as being at RSA);
- calculates a number for birds at risk per hour (as birds observed at RSA x band collision percent = 0.173913); and

- extrapolates this to be a number of birds at risk per day (assuming 10.5hrs of activity per day) (1.826087) then a number of birds at risk per month (54.782609), and multiplies that to be a number of birds passing through RSA (birds per month x rotor area proportion or flight risk window: PL1=15.931957; PL2=12.957991).

To create a number of collisions per month based on the 'band collision percentage': PL1=0.637278; PL2=0.518320 considering no avoidance.

Then applying avoidance rates the numbers of predicted collisions are shown in Table 4.2:

Table 4.2: Predicted Superb Parrot Impacts for month of November

	No Avoidance	90%	95%	99%
PL1	0.637278	0.06373	0.031864	0.00637
PL2	0.518312	0.05183	0.025916	0.00518

4.1.3.4 Other impacts

There are no other negative impacts foreseen relating to habitat degradation from unauthorised access because these are private properties and the project will not meaningfully increase access, in fact will likely reduce it due to operational access restrictions.

4.2 MNES IN A 500M BUFFER AREA

This section discusses the impacts of the proposed development on the three MNES likely to be impacted by the proposed development relative to the 500m buffer area. All other MNES which may occur are discussed in sections 3.2.2, 3.2.3, and 4.1. The proposed development is not likely to have an impact on those.

4.2.1 Box Gum Woodland

Vegetation mapping for the Central West and Lachlan Catchments (OEH 2017) covering the buffer area of 500m around the proposed development area contains 147.30ha of vegetation types that may be the Commonwealth listed Box Gum Woodland[11]. The 0.26ha in the proposed development area would represent a relative loss of 0.18% of the mapped Box Gum Woodland in the 500m buffer area.

4.2.2 Golden Sun Moth

The known individuals and potential habitat for the Golden Sun Moth in a 500m buffer area around the proposed development are:

- 96 individuals (ERM (2013) count=82 + BioNET=1)

[11] Potential Commonwealth Box Gum Woodland taken from vegetation types in OEH (2017) as: Apple Box - Blakelys Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion; Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion; White Box - Blakelys Red Gum shrub/grass woodland on metamorphic hillslopes in the mid-southern part of the upper slopes sub-region of the NSW South Western Slopes Bioregion; and White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion.

- 2,481.33 ha potentially suitable native grasslands (using ERM=1,510.90 ha, and unverified grassland modelling polygons (DECC 2007)=970.43 ha)

Considering the proposed development will impact 39.54ha (refer to section 4.1.2), this equates to a relative loss of 1.59% loss of the potential habitat within the 500m buffer area.

4.2.3 Superb Parrot

The revision of the proposed development footprint was undertaken to avoid the area observed as being a high-use area of the Superb Parrot; that is, the Langs Creek cluster, where 109 of ERM's 150 observed individuals occurred (48 at BUS Hopefield; 61 at BUS Taffs). The area of the revised proposed development footprint plus a 500m buffer contains 11 individuals observed by ERM.

Woodland habitats are used to provide a comparative analysis of impacts to the habitat for the Superb Parrot in the buffer area of 500m around the proposed development. Polygons used were those woodland types from each of Gellie (2005) and NPWS (2002) thought to provide potential habitat to the species. A comparative analysis using the 'agricultural grasslands with scattered trees' is not possible as this is a degraded agricultural vegetation type with no direct equivalent types mapped as specific units in Gellie (2005) or NPWS (2002) because those products focus more on mapping remnant native vegetation patches. It can be taken that almost the entire landscape not mapped as woodland should be considered as 'agricultural grasslands with scattered trees'. Using those mapped woodland vegetation types:

- the proposed development will clear 9.54ha(PL1) or 7.53ha(PL2) woodland habitats; and
- the buffer area of 500m around the proposed development contains 1,638.79 ha (using ERM=453.11 ha, and unverified woodland polygons from Gellie (2005)=889.76 ha, and NPWS (2002)=295.92 ha); therefore
- the relative impact of clearing woodland habitat for the proposed development in the 500m buffer area is 0.58%(PL1) or 0.46%(PL2) of that which will remain within the 500m buffer area.

The relative impacts are not expected to result in a significant impact on the species (ERM 2017b).

4.3 BAROTRAUMA AND COLLISION RISK ON MNES

The EIA (ERM 2013) confirmed the presence of the Superb Parrot within the Study Area. Therefore, this section contains discussion regarding potential collision risk for the Superb Parrot only and excludes other EPBC listed bats and birds that are unlikely to occur in the Study Area. Collision risk is discussed in detail in section 4.1.3.3.

Four factors lead to the low likelihood of, and minimised impact to the Superb Parrot from the proposed development which are:

1) that no Superb Parrots were observed at RSA height;
2) static observation point-surveys (BUS surveys) between 13/11/2012 and 27/2/2013 identified a strongly seasonal pattern of Superb Parrot occurrence (following the first week of December none were detected);
3) the Langs Creek cluster of turbines has now been removed from the proposed development due to its possession of the highest value habitats in the study area (the overwhelming majority of individuals were observed there during site surveys (109 of 148) and the area contains high amounts of potential foraging and nesting habitat); and
4) the proposed development will lead to the clearing of only eight primary hollows are in the development footprint, avoiding clearing of 81 primary hollows in a 500m buffer area around the study area.

4.4 OBSERVED BAROTRAUMA AND COLLISION RISK IMPACTS TO MNES AT OTHER WIND FARMS

There are no readily available published results available to indicate that the Superb Parrot is suffering significant population decline due to wind farms.

4.5 IMPACT CERTAINTY AND PERMANENCE

Impact assessments are inherently uncertain as they are 'prediction' of impacts rather than retrospective measurements of impacts. The uncertainty in impact assessment predictions is minimised by following recommended published guidelines and sources for data collection and analysis. This report considers impacts to MNES using recommended DEE and NSW OEH guidelines (discussed throughout sections 3.2.3, 4, and 5) from surveys to impact assessment, to provide as much certainty as is possible in an impact assessment.

Performance of wind farms in NSW and impacts to bird and bat MNES are monitored routinely through consent conditions requiring Bird and Bat Adaptive Management Plans (BBAMPs), although the results are not publicly available. Therefore, it is not known whether any currently operating wind farms in NSW, more specifically in the south eastern part of NSW, are leading to unexpected impacts, or impacts outside predicted limits. It is expected that this project will contain conditions of consent specifying the requirement for a BBAMP, and that BBAMP will have to be prepared in consultation with the NSW Office of Environment and Heritage (OEH).

Relative landscape-scale impact assessments at the increasing scales of the study area, the 500m buffer area around, and the locality of the proposed development present low relative impacts from the proposed development compared to the habitats which will remain. It is unlikely that beyond the areas cleared for the development (converted from grassland or woodland to hardstand, gravel tracks or pads) that any other impacts will be permanent.

4.6 ADDITIONAL STUDIES SINCE REFERRAL AND UNKNOWNS OR UNCERTAINTIES

The referral was submitted to the (then) DSEWPC on 28 March 2013. This preceded the application for approval under the NSW State legislation, which involved the preparation and submission of the following reports:

- Ecological Impact Assessment (EIA) (ERM 2013); and
- Environmental Assessment (EA) (CWPR 2013).

Under the planning system in operation at the time in NSW those documents were subject to an adequacy review (to determine if the assessment satisfied the NSW Government requirements). Discussions were progressed with the DPE and the OEH. The project was then put on hold for reasons not relating to environmental planning, impact assessment, or approvals.

In 2016, the Project regained momentum and the EIS was placed on public exhibition under the NSW planning system in September 2016. The public exhibition attracted public and NSW Government Agency submissions.

In April 2017 a site visit was undertaken by an ERM ecologist to identify the vegetation present at some locations in the road reserve to inform the main roads access design, including Lachlan Valley Way and Tangmangaroo Road.

In May 2017 a Response to Submissions report was prepared which contained clarifying information relating to biodiversity-related submissions and contained additional data analysis under the following themes:

- Endangered Ecological Communities

- Habitat Loss
- Offset Calculations and BioBanking Assessment
- Woodland Birds
- Superb Parrots
- Hollow Bearing Trees and Bats
- Diurnal Birds of Prey and Collision Risk Modelling (CRM)
- Golden Sun Moth (GSM)
- Reptiles
- Squirrel Glider and Habitat Fragmentation
- Cumulative and Indirect Impacts
- Other Threatened Species Issues

A note to consider in analysing the RtS report is that some mapping and impact area calculations may have changed slightly during data analyses. Figures and area calculations contained in this main PD report should be used as the most current and up to date.

A thorough vegetation mapping data collection and review process was undertaken in spring 2017 (ELA 2017; refer Appendix 3) which made some adjustments to vegetation boundaries and clarified categorisation, including considering the legislative status of vegetation types such as the BGW TEC. Overall the review found the original vegetation mapping from 2013 to be reasonably accurate (ELA 2017) although adjustments were made.

Through collection of the additional detail required for State level approvals, comprehensive survey and analysis has been undertaken that includes assessment specific to the focus MNES. The information gathered as part of the State level approval has been used to inform the assessment of impact to MNES (in this report) and is considered to be of sufficient rigour given its attention to relevant guidelines.

4.7 LOCAL AND REGIONAL CONTEXT OF IMPACTS

In order to consider regional and cumulative impacts to the focus MNES an analysis of impact assessments described for other wind farms in the region was undertaken. This comprised five other wind farms located between 20 km and 70 km from the Bango Wind Farm. This analysis has included all focus MNES forming part of this MNES Report for context. The outcomes are summarised in Table 4.3.

Table 4.3: MNES Considerations for Wind Farms on the Locality

MNES	Bango WF	Rye Park WF (NGH 2014)	Conroy's Gap WF (NGH 2006)	Coppabella WF (NGH 2009)	Biala WF (ERM 2015)	Gullen Range WF (NGH 2008)
Distance (from Bango) and size	0km 75 WTGs	20km 92 WTGs	35km < 30 MW	40km 79 WTGs	60km 31 WTGs	70km 73WTGs
Golden Sun Moth	Following avoidance measures which have more than halved the proposed impacts since the EPBC referral (2013), residual impacts = **39.54ha** habitat.	The current total impact to these habitat types for this species **is 66ha**.	Potential Golden Sun Moth habitat exists, east of the development area. This habitat would not be directly or indirectly affected by the proposal and as a result, no significant impact is expected for the species.	Site is beyond the known distribution of the species.	No suitable habitat reported	It is highly unlikely that suitable habitat occurs.
Superb Parrot	Following avoidance measures, residual impacts = **9.54 ha**(PL1) / **7.53 ha**(PL2) habitat.	The total clearance impact to Box Gum Woodland habitat **is 25 ha**. The proposal will not remove known nest trees for the Superb Parrot as these have been buffered by 100m from infrastructure.	The proposal site is one of the most extensively cleared areas in the district. Turbine sites unlikely to provide quality foraging or migration habitat for the Superb Parrot. The frequency of parrots flying high over the turbine ridgetops, and the risk of blade strike, are likely to be low.	Habitat removal, particularly the removal of hollow bearing trees in mature woodland remnants, is considered to be a high risk for this species. The proposal would remove **approximately 11.5 ha** of woodland, however only 0.59 ha of this is within woodland of good, moderate to good and moderate condition. The proposal may disrupt the breeding cycle of Superb Parrot by reducing breeding habitat in mature forest remnants.	No reported impact to this species	Marginal potential foraging and nesting habitat is present within the study area, due to the lack of native understorey, with the exception of one paddock at Kialla. Collision and avoidance impacts may apply to this flocking species.

Table 4.4 shows the relative potential impacts to those two MNES from the Bango Wind Farm and the aggregate potential impact from the other five wind farms located between 20 km and 70 km away. Further discussion is provided following Table 4.4.

Table 4.4: Relative Potential Impact Area Contribution to Relevant MNES by Projects

MNES	Bango Wind Farm Impact Area	Other Wind Farms in Region Impact Area (refer Table 4.3)	Cumulative Impact
Golden Sun Moth (*Synemon plana*)	39.54 ha	66.00 ha	105.54 ha
Superb Parrot (*Polytelis swainsonii*)	9.54 ha[1]	36.50 ha	46.04 ha

4.7.1 Golden Sun Moth Regional Impacts Context

The Golden Sun Moth is found in an extent of occurrence of 13,100 km^2 across southern NSW, ACT and Victoria (DEE 2018b). There are 48 populations known from NSW (DEE 2018b). Potential habitat impacted by the development footprint will be 39.54 ha, which is provided in relative terms according to increasing geographical scale in Table 4.5.

Table 4.5: Relative GSM Habitat Impacts at Various Geographic Scales

Scale	Area (ha) of Potential Habitat	Relative Area Impacted at Scale
Development footprint	39.54	N/A
500 m buffer of development footprint	2,481.33[1]	1.59%
Locality (i.e. 10 km buffer around development footprint)	30,936.24[2]	0.13%
Species' occurrence extent	1,310,000.00[3]	<0.01%[4]

1. *Using ERM = 1,510.90 ha, and unverified grassland modelling polygons (DECC 2007) = 970.43 ha*
2. *Using ERM = 2,318.70 ha, and unverified grassland modelling polygons (DECC 2007) = 28,617.55 ha*
3. *DEE (2018b)*
4. *Calculated at 0.003% however presented in table to 2dp for consistency*

These calculations in Table 4.5 demonstrate an extremely small relative impact to the species' potential habitat across a variety of geographical scales. Large areas of potential habitat adjacent to the network-like development footprint will remain unimpacted by the Project with appropriate mitigation measures in place.

4.7.2 Superb Parrot Regional Impacts Context

The Bango Wind Farm is located in the far south eastern part of the Superb Parrot's breeding area with the south eastern corner considered to be around Yass (OEH 2014a). The species migrates to the north western slopes region of NSW during the winter and is generally absent from its breeding area during this time (OEH 2014a). The breeding area is reported as being approximately bounded by:

> "Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers" (OEH 2014a).

That breeding area is approximately 700,500 ha, with the Project in the far south eastern corner. The relative impact of direct habitat removal for the Project (9.54 ha(PL1)) is an extremely small proportion of that area (~0.001%). The Bango Wind Farm development footprint is within abounding polygon which covers approximately 7,080 ha in area, representing 1.01% of the species' breeding area. Even if the entire bounding polygon containing the development footprint was avoided (or 'quarantined' from use) by the species (which is thought unlikely), it is not likely that the removal of 1% of its breeding area would result in a significant long-term decline in the species population. Further, considering the Project is at the far south eastern part of the breeding area, the WTGs are not likely to provide a barrier to the movement of a significant proportion of migrating individuals, such that it would cause a significant long-term decline in the species population. This is supported by the site data collected during surveys which identified no Superb Parrots flying at, in or above RSA height; all were below 40m altitude.

4.8 IMPACTS OF MICRO-SITING

As is stated in the recommended conditions for NSW Government approval, Bango Wind Farm has made a commitment to further avoid impacts on ecological resources and ecologically sensitive areas, as far as practicable, in the micro-siting of turbines during the detailed design stage of the Project. Limitations on micro-siting of turbines under this recommendation include that:

- they remain within the development corridor;
- no wind turbine generator is moved more than 100 m from its approved location;
- the revised location of Turbine Nos. 14, 25, 27, 76 and 98 in Layout Option 1 and Turbine Nos. 22, 45 and 103 in Layout Option 2 are not moved any closer to an active Wedge-tailed eagle nest; and
- the revised location of the wind turbine generator and/or ancillary infrastructure would not result in any non-compliance with the conditions of the consent.

5 PROPOSED AVOIDANCE, MANAGEMENT AND MITIGATION MEASURES

5.1 AVOIDANCE: FEASIBILITY OF ALTERNATIVES CONSIDERED

Potential impacts to habitat for listed and threatened species and communities have been considered throughout the development of the Bango Wind Farm. Considerable changes have been made to the layout for this reason.

The reduction from 122 to 75 turbines in the Amended Development Application (May 2017) enabled two significant avoidance measures:

- Thirty wind turbine generators were removed from the Project, excising the Langs Creek Cluster, to avoid impacts to the Superb Parrot, and
- The strategic removal of an additional 17 wind turbine generators that required access via minor roads, so that a commitment to bring all oversize vehicles to site via Lachlan Valley Way could be made.

5.2 MITIGATION MEASURES

The content of the management plans containing the mitigation measures are expected to be clearly outlined in explicit detail in the NSW state approval (including that the approval will be conditional upon gaining secondary regulatory approvals for environmental management plans containing mitigation measures). Section 2 describes the approach to impact mitigation for the Project, which will be based around an EMS. The EMS and associated plans will provide a comprehensive and efficient approach to incorporating mitigation measures that reduce impacts on flora, fauna, vegetation, and more specifically MNES.

6 PROPOSED OFFSETS

This section references the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 – Environmental Offsets Policy* (DSEWPC 2012). This policy does not replicate the impact offsets requirements at the State level as:

> "A state or territory offset will count toward an offset under the EPBC Act to the extent that it compensates for the residual impact to the protected matter identified under the EPBC Act." (DSEWPC 2012): p23

The policy states that offsets are required where the residual impacts are thought to be significant (DSEWPC 2012: p12). The only MNES likely to be subject to a significant impact is the Golden Sun Moth (*Synemon plana*) (according to the criteria in DEWHA 2009), even following significant efforts by the proponent to reduce impacts to this species' habitat. Offsets are proposed for this species incorporated with the NSW State environmental approvals process detailed below.

Offsets for the proposed Project will primarily be land based and sought using the applicable NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014b) calculated as a metric representation using the current BioBanking Assessment Methodology (BBAM). Assessment for the Project has commenced, with the EIS submitted for approval to the NSW Government prior to the NSW Framework for Biodiversity Assessment (FBA) coming into force as applicable to all major projects. The metric analysis will be used to represent the offset requirement and the offset may be secured using a BioBanking agreement, although the NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014b) does not strictly enforce BioBanking Agreements as the only security (although states these are a preference).

The Proponent is progressing discussions with landholders in the region with candidate land suitable to host an offset. Part of this analysis is to consider the metric representation of biodiversity features of those sites (i.e. potential credits available) and analyse the capacity for the potential offset site to offset the Project impacts. The presence of Golden Sun Moth and habitat is a key focus of these considerations. It is anticipated that an offset site will be secured sufficient to meet the requirements of the NSW regulator and that this will also sufficiently provide an offset for impacts to habitat for the Golden Sun Moth.

7 SOCIAL AND ECONOMIC

During exhibition of the EIS, the project received 106 submissions, 57 of which were objections to the Project. All submissions were carefully considered and as a result, changes were made to reduce the impacts of the Project. Figure 2.12 shows the areas from where wind turbine generators have been removed, with comments about how they relate to environmental, social and economic impacts.

In general, the reductions to the layout have mitigated visual concerns for several nearby neighbours and reduced the impact on the local road network. Although these reductions may have reduced the potential economic benefit to local communities, there is potential for significant economic benefits to the region, including:

- The creation of 150 direct and 240 indirect FTE jobs during construction;
- 25 or more locals directly employed on site;
- Increase in opportunities for local businesses, including haulage and earthworks contractors, accommodation and hospitality suppliers, local professionals and consultants, diesel and plant mechanic services, waste disposal and cleaning services, catering suppliers, office suppliers, protective clothing, fuel, hardware and motor vehicle servicing;
- 10 direct and 30 indirect FTE jobs during operations;
- $12M estimated economic stimulus in the Yass Valley and Hilltops LGAs via Community Enhancement Funds and net rates returns; and
- $65M local economic stimulus through host landowner payments and new wage spending.

For more detail on the above figures, refer to the “Bango Economic Impact Report” in Appendix 6.

Details of the Project’s potential impact on land value, mineral exploration, tourism, community wellbeing, the Community Fund, the local economy, and health, are described below.

7.1 LAND VALUE

Community consultation reveals that the impact of wind farms on surrounding property prices is a source of debate and concern. Several local and international studies have been undertaken to identify and quantify any real impacts. A selection of the Australian studies includes:

- “Land Value Impact of Wind Farm Development: Crookwell NSW”, Henderson and Horning Property Consultants, 2006
- “Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia”, NSW Valuer General 2009
- “Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia”, Preston Rowe Paterson, 2013
- “Review of the Impact of Wind Farms on Property Values”, Urbis, 2016

The overwhelming conclusion is that wind farms do not negatively impact on property prices. The value of properties may go up and down for a range of reasons, including supply and demand, proximity to amenities and infrastructure, housing affordability and the desirability of the location. In most agricultural areas, the main determinant of property and land values is the productivity of the land for agricultural or livestock purposes, which is not affected by a wind farm.

7.2 MINERAL EXPLORATION

There is one current Exploration Licence (EL) in the area, EL8313, one Exploration Licence Application (ELA) both held by Ochre Resources Pty Ltd for metallic minerals prospecting. Ochre Resources is currently undergoing preliminary testing to evaluate their site’s potential for gold mining.

The Project has potential to inhibit any current or future exploration of the area for mineral resources during the construction and operation phases.

During the operation of the Project, mineral exploration can still occur around the wind turbine generators and associated infrastructure, and the upgrading of roads can assist in the matter. There will be a limit on the proximity such activity can occur to a wind turbine generator, to prevent any instability in ground conditions leading to wind turbine generator failure.

The Proponent will continue to liaise with Ochre Resources Pty Ltd, and provide updates of any modifications to the Project design that arise prior to and during the construction of the Project. The Proponent is prepared to work with exploration licence holders to ensure that prospecting can continue within the Project site, until the wind farm is operational.

7.3 TOURISM

Wind farms appear to generate great public interest, as experienced in many regions of Australia, including the Esperance and Albany Wind Farms in the southern region of Western Australia, Windy Hill Wind Farm near Ravenshoe, Queensland, Lake Bonney Wind Farm near Tantanoola, South Australia and Capital Wind Farm near Bungendore, Canberra. Tourists can drive around these wind farms on local roads, and even walk up to a wind turbine at the Albany Wind Farm. Additionally, Wattle Range Council in South Australia promotes its Woakwine Range Wind Farm tourist drive using the slogan “Experience 'Clean and Green' Living with the Canunda and Lake Bonney Wind Farms”.

With the potential for increased traffic from visitors, other economic opportunities exist through activities such as wind farm tours, souvenirs, accommodation, food and drink, which could form the basis of a wind tourism industry. Similarly, increased visitor numbers attracted by the wind farm could result in increased exposure to other local attractions and amenities not associated with the wind farm.

The Project will have the potential to increase visitor numbers to both councils, as demonstrated at other wind farms across Australia. However, as the Project occurs on private land, tourists will only be able to access the wind farm area from public roads. If increased traffic is recorded within the area, parking / stopping bays to provide a vantage point for the wind farm could be considered on appropriate local roads by the Proponent, subject to the suitability and availability of land.

7.4 COMMUNITY WELLBEING AND COMMUNITY FUND

7.4.1 Existing Situation

Both Yass Valley Council and Boorowa Council have Community Strategic Plans which outline environmental, social and economic objectives for the area, and methods that may be used to achieve these. (Note that Boorowa Council was merged with Young and Harden Councils to form Hilltops Council in 2016.) Overarching purposes of the Yass Valley Community Strategic Plan 2011-2030 (Yass Valley Council 2013) include “the need to develop sustainable and innovative solutions to manage our environmental impact” and “to manage the transition from an economy based more on traditional agricultural practices to one which is more diverse, robust and sustainable” (Yass Valley Council 2013). The Project will positively contribute to a number of the outlined long-term goals, including supporting “development strategies for agricultural resilience against climate fluctuations and change” and promoting “Yass Valley to a range of best practice examples of environmental sustainability in local industry and agriculture” (Yass Valley Council 2013).

Boorowa Council’s Community Strategic Plan 2032’s (Boorowa Council 2013) vision is to ensure the “economy is strong and productive, based on viable agriculture, innovative business enterprises and a skilled local workforce” (Boorowa Council 2013). In the context of these goals, the Council aims to "identify and develop partnerships to promote and encourage suitable renewable energy projects" and to "develop education and other initiatives that foster agricultural resilience against climate fluctuations and change" (Boorowa Council 2013). The Council also aims to "explore opportunities for diversification of local agriculture" and minimise their 'environmental footprint'" (Boorowa Council 2013). The Project is well suited to meet these long-term goals and aspirations by encouraging sustainability and promoting employment in the region.

7.4.2 Potential Impacts

Positive impacts of the Project on community wellbeing are expected to include:

During construction

- Increase of short-term workers in the community[12];
- Economic stimulus of increased commerce locally;
- The "buzz" off being involved in such a major project in support of clean energy; and
- The upgrade of roads to accommodate heavy vehicles during construction and operation (as required).

During operation

- A small number of local full-time jobs;
- A per-turbine contribution to a Community Fund for each local council involved, to be used on local community projects (see Section 7.4.3);
- Increased local understanding and education opportunities regarding renewable energy and issues around climate change; and
- Improvements to local roads

There are also some potential negative impacts of the Project, which may include:

During construction

- Roadworks which may cause delays or detours for local traffic
- Increased traffic on local roads which could cause delays or increase the safety risk
- Oversized vehicle movements that may cause delays
- Increase of short-term workers in the community[12]

During operation

- Certain locations across and adjacent to the site will experience increased noise due to the operation of the windfarm.
- Visual – the landscape will be visually altered by the wind turbines[12]. They will be visible from numerous locations across and around the site, some night lighting will be required by the Civil Aviation Safety Authority (CASA) and certain conditions will invoke blade glint and shadow flicker.

7.4.3 Management and Mitigation

During construction

Traffic and roads

Some temporary changes in traffic conditions are unavoidable, but the Construction Traffic and Transport Management Plan will outline all the traffic management measures to minimise the temporary, negative impacts to the community. These measures will include, but are not limited to:

[12] *This could be seen as a positive or a negative, depending on personal preferences.*

- Limiting the hours that oversized vehicles will be allowed to travel on certain roads
- Ensuring appropriate traffic safety measures are implemented
- Keeping the community informed about major traffic changes
- Keeping alternative travel routes available where possible
- Increased maintenance of unsealed roads

Although potentially inconvenient at the time, roadworks undertaken will improve the quality and safety of many roads in and around the Project site.

Increase of short-term workers

Where there are local contractors with suitable skills and availability, they will be engaged to work on the Project, but there will inevitably be an influx of short-term workers for the duration of project construction. The Bango Wind Farm Economic Impact Report (Appendix 6) indicates that there is adequate short-term housing to accommodate this influx, and that it will cause an overall stimulus to the local economy due to the increase in local spending.

During operations

Noise

Strict noise limits are placed on wind farms through the EPA Act, and a detailed analysis of the predicted noise impacts has been undertaken and is included in the Bango Wind Farm Amended DA. It shows that the there is one uninvolved dwelling that is forecast to experience noise exceeding imposed limits, under certain conditions. During operation of the wind farm, this residence will be monitored to ensure noise limits are not breached. Other residents close to the wind farm will be also be monitored and will be able to request noise monitoring if they are concerned about noise levels at their dwelling, and should unacceptable noise levels be apparent, mitigation measure must be implemented.

Visual

On completion of the wind farm, non-involved residents within 4 km of a turbine will have a right to request visual screening commensurate with their level of visual impacts. The Proponent will have an obligation to mitigate any unacceptable visual impacts.

Night lighting is usually required by CASA to identify the wind farm to aircraft at night. This lighting will be directed above horizontal to minimise the impact on surrounding dwellings.

Detailed studies have been undertaken to ensure no non-involved dwellings or public roads will be unduly impacted by blade glint or shadow flicker. Details of this analysis can be found in the Bango EIS.

Community Fund

The Proponent is committed to providing a Community Fund to benefit the community surrounding the Project. The purpose of the fund is to support community groups, programmes and activities that the community values or for which it requires support.

The Proponent is proposing to contribute $2,825 per installed wind turbine per annum (CPI indexed) to a Community Fund as each stage of the Project commences commercial operation. Contributions will continue annually for the lifetime of the Project until such date that the Project ceases operation and is decommissioned. Based on the two layout options proposed for the Project this could total up to $211,875 per annum, equating to up to $4.2 million over an estimated 20-year Project life. It is proposed that decisions on how the funds are to be allocated should be determined by a committee made up of representatives from the local community, Council and the Proponent.

The structure and administration of the Community Fund could include, but is not limited to:

- The fund split appropriately between the two Councils;
- The fund managed by a publicly-elected group;
- Funding to sporting clubs, infrastructure, education, etc;
- Funding to local environment and cultural heritage projects; and / or
- Variable funding to groups based on their proximity to the Project.

With the addition of the Community Fund and other secondary effects from the construction and operation of the Project, both Councils and surrounding towns are expected to experience an overall increase in community wellbeing.

There is also the possibility of a significant economic benefit to the council areas, supporting community-based projects from the combination of Community Funds provided by other proposed wind farms in the region.

7.5 LOCAL ECONOMY

7.5.1 Existing Situation

As previously discussed, the Project occurs across two Councils, Yass Valley and Hilltops (formerly Boorowa Council), so any existing or potential impacts will be localised within these Council areas. Comparative employment figures for a range of industries in each Council area are displayed in Table 7.1 and Table 7.2.

Table 7.1: Most common industries of employment in Yass Valley LGA, 2011

Industry	Yass Valley (%)
Central Government Administration	7.8
Sheep, Beef Cattle and Grain Farming	6.2
School Education	3.9
Cafes, Restaurants and Takeaway Food Services	3.9
Defence	2.8

Source: 2011 Census QuickStats – Yass Valley (A) LGA

Table 7.2: Most common industries of employment in Boorowa LGA, 2011

Industry	Boorowa (%)
Sheep, Beef Cattle and Grain Farming	28.8
School Education	4.8
Local Government Administration	4.6
Agriculture and Fishing Support Services	3.4
Hospitals	2.9

Source: 2011 Census QuickStats – Boorowa (A) LGA

7.5.2 Potential Impacts

Of all the stages of the Project, the construction and decommissioning stages will generate the largest economic gain for the greatest number of people and businesses in both Council areas. This is due to the hiring of a large temporary workforce over approximately two years of construction and later approximately one year of decommissioning. Employment opportunities would involve concreting, earth works, steel works and electrical cabling during construction, with demolition, removal and rehabilitation during decommissioning. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area. Where practicable the Proponent will source from local companies (as has commonly been the case with other wind farm developments around Australia), which is likely to include the utilisation of nearby quarries during construction. The Proponent has created a form on the Project website (www.bangowindfarm.com.au) to gather local business and contractor information. This is located under the 'Contact Us' section of the website, and by following the link to 'Contractors'.

Once the Project is operational there would be a small number of permanent jobs available. The Community Fund as discussed above would also provide financial benefits and improved equity to the surrounding communities, improving the existing economic situation.

More broadly, it is also anticipated that the Project could inject up to $225 million into the Australian economy. This estimate of the financial benefit to the Australian economy is based on a typical approximation of cost associated with building a project of this size, whilst recognising that the associated components (i.e. wind turbines) will be manufactured and procured overseas.

7.5.3 Management and Mitigation

To ensure that the local Council areas benefit from the construction of the Project, local contractors will be used where feasible. This will involve the Proponent liaising with local industry representatives to utilise the full potential of local resources. A number of local businesses have already made themselves and their services known to the Proponent.

7.6 HEALTH

Existing wind farm guidelines relating to noise, electromagnetic fields and visual amenity provide a robust framework which ensures that impacts, including purported health impacts, on the community are avoided, minimised or mitigated to an acceptable level.

Wind energy enjoys considerable public support, but it also has its detractors who have publicised their concerns that wind turbines can cause adverse health consequences. In response to concerns raised, over 25 reviews into wind turbines and human health have been undertaken around the world since 2003. Recent Australian publications relating to this issue include the 2016 National Wind Farm Commissioner's Annual Report and the Australian National Health and Medical Research Council (NHMRC)'s review in 2013.

The National Wind Farm Commissioner's Annual Report (2016) states that a number of complaints about wind farms received by their Office include references to health impacts as a result of wind farm operations. However, these complaints only provide anecdotal evidence and it is therefore difficult to confirm whether or not the stated health conditions reported by complainants are a direct result of the wind farm's operations or from some other cause. The National Wind Farm Commissioner goes on to provide the following recommendations:

- Federal and state governments should continue to assess the outcomes of research into wind farms and health, including outcomes of the two NHMRC funded wind farm health

studies and recommendations of the ISCOWT. Environmental standards should be monitored and reviewed in line with any recommendations arising from these programs.
- Residents living in the vicinity of an operating or proposed wind farm that are experiencing health conditions should be encouraged to seek appropriate medical advice to properly diagnose and treat any health-related conditions accordingly.
- Medical practitioners who identify causational links between a patient's health condition and their proximity to the operation of a wind farm should report such incidences in an appropriate way to the relevant professional body, association and/or government agency.
- Residents who are experiencing unacceptable noise levels from a wind farm should be encouraged to report such incidents to the wind farm operator, the compliance authority and/or the appropriate regulator.

The NHMRC undertook a 'rapid review of the evidence' on 'Wind Turbines and Health' in 2010, and in 2013 commissioned the University of Adelaide to undertake a systematic review of the human health effects of wind farms" (NHMRC 2013). The evidence collected in the review led to the conclusion that:

> *"There is no consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with self-reported human health effects. Isolated associations may be due to confounding, bias or chance."*

The 'NHMRC Statement: Evidence on Wind Farms and Human Health' (NHWMC 2015) was subsequently released in February 2015. The Statement concluded:

> *"...there is currently no consistent evidence that wind farms cause adverse health effects in humans."*

and stated that:

> *"Given the poor quality of current evidence and the concern expressed by some members of the community, there is a need for high quality research into possible health effects of wind farms, particularly within 1,500 metres"*

NHMRC issued a Targeted Call for Research into wind farms and human health in March 2015.

NSW Health has provided commentary on the issue, most notably in a submission on the Draft NSW Planning Guidelines: Wind Farms in 2012 stating that:

> *"there is currently no health evidence to support generic 2 km separation distances from proposed wind turbines".*

8 OTHER APPROVALS AND CONDITIONS

8.1 LOCAL OR STATE GOVERNMENT PLANNING

The proposal aligns with and will comply with relevant Federal, State and Local Government legislation, policy and guidelines. These are all considered and described in detail in the EIS but have also been listed below.

8.1.1 Local Government Legislation and Policy

Regional Policies

The Project lies within the Lachlan catchment. Under the SEARs, the Project must consider the Catchment Action Plan (CAP) relevant to the Lachlan catchment area, the Central West Local Land Services Transitional Catchment Action Plan, to conform to the principles of an ecologically sustainable landscape.

Local Environmental Plans

The Project site is located within the Hilltops (formerly Boorowa, Young and Harden) and Yass Valley Local Government Areas, and as such is subject to two Local Environmental Plans (LEPs); the Boorowa LEP (2012) and the Yass Valley LEP (2013). The LEPs are an established framework for development within local government areas. For the Project to be eligible for assessment under Part 4 of the EP&A Act, the proposed activity is required to be permissible under the relevant LEP.

Development Control Plans

The EP&A Act Division 6 specifies how local Council Development Control Plans (DCPs) are to be considered for projects assessed under the EP&A Act. Section 74BA (1) of the EP&A Act states the principle purpose of DCPs is to provide ‘guidance’ to development proponents and consent authorities and to assist ‘facilitating development that is permissible’. As such, DCP provisions are not ‘statutory requirements’.

South West Slopes Bush Fire Risk Management Plan and Southern Tablelands Bush Fire Management Plan

The Project will be subject to the South West Slopes Bush Fire Risk Management Plan and the Southern Tablelands Bush Fire Risk Management Plan and will comply with provisions contained in these. Issues associated with the Project will be incorporated into the EMP sub-plan to ensure any concerns arising are addressed.

8.1.2 State Government Legislation and Policy

State government legislation and policy relevant to the Project includes:

- *Environmental Planning and Assessment Act 1979*
- *State Environmental Planning Policies:*
    - *State and Regional Development - 2011*
    - *Infrastructure - 2007*
    - *Rural Lands - 2008*
    - *Koala Habitat (44)*
- *National Parks and Wildlife Act 1974*
- *Protection of the Environment Operations Act 1997*
- *Threatened Species Conservation Act 1995*
- *Threatened Species Conservation (Biodiversity Banking) Regulation 2008*
- *NSW Catchment Management Authority Act 2003*
- *Native Vegetation Act 2003*

- *Noxious Weeds Act 1993*
- *Fisheries Management Act 1994*
- *Contaminated Land Management Amendment Act 2008*
- *NSW Rural Fire Act 1997*
- *Roads Act 1993*
- *Crown Lands Act 1989*
- *The Heritage Act 1977*
- *Water Management Act 2000*
- *Water Act 1912*
- *Noise Regulations and Guidelines*
- *Road Authority Approvals and Permits*
- *NSW 2021: A Plan to Make NSW Number One*
- *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*
- *Wind Energy Framework, NSW 2016*

8.2 STATE OR COMMONWEALTH APPROVAL REQUIREMENTS

8.2.1 Environmental Planning and Assessment Act 1979

The Project is a State Significant Development and must be assessed under part 4 of the EP&A Act. The proposal has been assessed and recommended for approval by the Department of Planning and Environment, with a determination expected in April 2018.

8.2.2 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

The EPBC Act is the central piece of environmental legislation for the Australian Government. It provides the legal framework to protect and manage MNES, while also considering cultural values and society's economic and social needs. The purpose of this document is to provide additional information for the progression of the assessment of the action's impact under the EPBC Act.

8.3 ANY ADDITIONAL APPROVAL REQUIRED

Approvals under the EPA Act and the Commonwealth EPBC Act are the overarching approvals required. Through these two processes, a number of other agencies must be consulted in order to gain approval.

8.4 MONITORING, ENFORCEMENT AND REVIEW PROCEDURES

Approval under the EP&A Act ensures the following monitoring, enforcement and review procedures are in place for the wind farm.

8.4.1 Environmental Protection Licence

The Environment Protection Authority (EPA) issues environment protection licences to the owners or operators of various industrial premises under the Protection of the Environment Operations Act 1997 (POEO Act). Licence conditions relate to pollution prevention and monitoring, and cleaner production through recycling and reuse and the implementation of best practice. The Bango wind farm must obtain an Environmental Protection Licence and must abide by the conditions set within it.

8.4.2 Bird and Bat Adaptive Management Plan (BBAMP)

The objective of the BBAMP is to provide a program for monitoring the impacts on birds and bats from the wind farm, and an overall strategy for managing and mitigating any significant bird and bat impacts arising from the operation of the wind farm. This management action for monitoring turbine collisions and barotrauma was identified in Section 5.2.

8.4.3 Environmental Management Strategy (EMS)

The EMS is a document that sets out the Project's approach to environmental management. It sets out actions, responsibilities, accountabilities, monitoring, responses, and remedial processes. The contents of the EMS includes the environmental management plans required by the combined environmental impact assessment documents and consent conditions.

8.4.4 Operations Environmental Management Plan (OEMP)

As with the EMS, the OEMP is required to be approved by NSW Department of Planning and Environment prior to the project commencing the operations phase.

9 ENVIRONMENTAL POLICY AND PLANNING

The Proposed Development is being undertaken by Bango Wind Farm Pty Ltd, who's related entity CWP Renewables, a well-established Australian renewable energy company currently responsibly managing other operations in Australia. The proponent has an excellent record of responsible environmental management.

Bango Wind Farm Pty Ltd will be able to leverage from the experience of CWP Renewables, which has considerable experience developing, constructing and operating renewable energy projects in Australia. CWP Renewables has construction and operational management systems that are not only legislatively compliant, but also best practice.

Construction contractor selection will focus scrutiny on past environmental performance and proposed environmental management measures.

10 INFORMATION SOURCES

10.1 INFORMATION SOURCES PROVIDED IN THE PRELIMINARY DOCUMENTATION

Document Name / Reference Number	Author	Date / Currency	Description	Reliability	Uncertainties
Bango Wind Farm: Ecological Impact Assessment (EIA)	ERM	May 2013	Document contained detailed ecological impact assessment primarily for NSW environmental approvals process. Report was not assessed by the NSW Government agencies for approval or rejection as the project was placed on hold.	▪ Surveys and information contained has formed the basis of ensuing ecological assessments. ▪ Was undertaken for a footprint larger than the current proposed development footprint.	▪ Ecological surveys were targeted to maximize the likelihood of detecting species present, however due to seasonal variations in environmental parameters some species may not have been present during survey periods. ▪ On that basis a likelihood and risk-based criteria approach to potential occurrence has been used.
Bango Wind Farm: Environmental Impact Assessment (EA)	CWPR	June 2013	Document contained summary of the information in row above. Encompassed entire environmental aspects of development, not limited to ecology. Report was not assessed by the NSW Government agencies for approval or rejection as the project was placed on hold.	▪ Was written for larger footprint than current proposed development footprint.	▪ Nil
Bango Wind Farm: Environmental Impact Assessment	CWPR	2016	Document contained revised environmental impact assessment of the CWPR (2013) document when project was brought back off hold. Contained ecological impact assessment as per ERM (2013) and CWPR (2013).	▪ Was written for larger footprint than current proposed development footprint.	▪ Nil

Document Name / Reference Number	Author	Date / Currency	Description	Reliability	Uncertainties
Bango Wind Farm: Response to Submissions	ERM	May 2017	Document contained detailed response to submissions (public and NSW Government agency) on the ecological values and impact assessments. Included provision of additional information as requested. Also, included reduced footprint undertaken by proponent to reduce ecological impact and avoid particular ecological values of note.	▪ Recently produced considering the currently proposed layout. ▪ Is the current ecological impact assessment document on matters raised.	▪ Ecological surveys were targeted to maximize the likelihood of detecting species present, however due to seasonal variations in environmental parameters some species may not have been present during survey periods. ▪ On that basis a likelihood and risk based criteria approach to potential occurrence has been used.
Bango Wind Farm: Response to Submissions (RTS) and Amended Development Application (ADA)	CWPR	2017	Document contains summary of the assessments described in ERM (2017) among responses to all other submissions.	▪ Recently produced considering the currently proposed layout.	▪ Not yet approved. Some uncertainties exist relating to the final approval conditions.
Bango Wind Farm: Matters of National Environmental Significance Report – Preliminary Documentation	ERM	2017	Unpublished report to CWPR by ERM providing the detail regarding MNES.	▪ Prepared to address the DEE's PD request and provides data requested to support discussion contained in this document.	▪ Completed prior to ELA (2017) revision of vegetation mapping.
Bango Wind Farm – additional vegetation (BioBanking) plots to inform the Project's offset liability	ELA	2017	Letter prepared detailing data collection and analysis verifying vegetation mapping and offset liability.	▪ Secondary analysis of vegetation mapping and previous data collection.	▪ Nil

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Appendix 1

Bango Wind Farm Referral and Referral Decision

Referral of proposed action

Project title: Bango Wind Farm

1 Summary of proposed action

1.1 Short description

Wind Prospect Group (WP) and Continental Wind Partners (CWP), on behalf of Bango Wind Farm Pty Ltd, propose to construct and operate a renewable energy facility in the Southern Tablelands region of NSW entitled Bango Wind Farm (the Project). The proposed action incorporates the construction and commissioning of up to 122 wind turbine generators (WTGs), the construction of underground electrical interconnections, electrical compounds including substations and switching stations and connection to the existing electricity transmission network via an overhead transmission line. The Study Area is bordered by Boorowa to the north, with Yass 20 km to the south, and Binnalong 17 km to the south-west. The final number and position of the wind turbines and electrical infrastructure has been refined through an iterative design process and adjustments made with respect to social, environmental and/or engineering constraints.

Environmental and other technical studies are currently underway for the Project, which is to be assessed by the NSW Department of Planning and Infrastructure (DPI) under Part 3A of the *Environmental Planning and Assessment Act 1979*.

1.2 Latitude and longitude

Location Point	Latitude	Longitude
1	-34°28'56.720"	148°43'33.822"
2	-34°28'54.477"	148°46'10.573"
3	-34°26'44.677"	148°46'07.834"
4	-34°26'42.961"	148°48'05.343"
5	-34°31'02.556"	148°48'10.927"
6	-34°30'56.593"	148°54'42.941"
7	-34°39'03.296"	148°54'54.100"
8	-34°39'07.528"	148°50'19.250"
9	-34°35'52.840"	148°50'14.955"
10	-34°35'58.576"	148°43'42.539"

The shape of the Study Area is irregular. Please refer to *Figure 2*.

1.3 Locality and property description

The Project is centred approximately 20 km north of Yass and 7 km south-east of Boorowa, in southern New South Wales. *Figure 1* shows the locality of the Project. The individual turbine positions will be located at varying altitudes between 570 m to 760 m Australian Height Datum (AHD).

Currently fifteen (15) privately owned properties are being investigated for the proposed wind farm. The Study Area spans two local government areas (LGAs): Boorowa LGA and Yass Valley LGA, one Catchment Management Authority (CMA) area: Lachlan-Upper Slopes and two IBRA (Interim Biogeographic Regionalisation of Australia) regions: NSW South Western Slopes (Northern Inland Slopes, Upper Slopes subregion) and South Eastern Highlands (South Eastern Highlands subregion).

The landscape of the Study Area is highly modified and dominated by agricultural activities. The majority of native vegetation has either been cleared for grazing and cropping, or where remnants remain, they have been partially cleared to provide access for grazing. Some small patches of open woodland remain, however these are predominantly restricted to parts of the landscape dominated by poorer soils.

The following definitions are used to describe areas discussed in this referral:

- *Locality:* A term used to discuss the context of the Project within the broader landscape; defined as a buffer of 30 km around the Study Area.
- *Project Application Area (PAA):* The area in which the proponent has applied to develop the Project; the PAA is bound by the parcels of land associated with the Development Footprint.
- *Study Area:* The area which has been assessed for ecological values related to the Project; defined as a buffer of 100 m radius around the Development Footprint (refer *Figure 1* and *2*).
- *Development Footprint:* The area in which physical disturbance is proposed for development of the Project (refer *Figure 1*); includes the location of infrastructure and any required easements including Wind Turbine Generators (WTGs), access tracks including passing bays and cuttings, overhead power lines including stanchions and their associated easements, underground electrical reticulation routes, electrical compounds (switching stations and substations), office facilities, laydown areas and wind monitoring masts. Areas that will be temporarily disturbed during construction are included in this area. The Development Footprint is located wholly within the PAA.

1.4	**Size of the development footprint or work area (hectares)**	The Study Area covers an area of 1888.48 ha. Within the Study Area, the Development Footprint (as defined in *Section 1.*3) covers an area of 251.18 ha. This includes an area of 115.77 ha that will be rehabilitated upon completion of construction.
1.5	**Street address of the site**	The PAA does not have a street address, although the suitability of all potential sites were assessed as part of the planning process. The wind farm would be accessed from the existing local road network, using the Lachlan Valley Way, Hopefield Road, Wargeila Road, Dirthole Creek Road, and Tangamangaroo Road.

1.6 Lot description

The following lots fall within the (PAA).

Lot	Plan	Lot	Plan	Lot	Plan	Lot	Plan
1	DP1021835	285	DP754109	299	DP754135	276	DP754143
2	DP1048648	115	DP754109	301	DP754135	167	DP754143
1	DP1066947	309	DP754109	163	DP754135	28	DP754143
7	DP113987	191	DP754109	87	DP754135	151	DP754143
1	DP120064	292	DP754109	238	DP754135	204	DP754143
1	DP182264	263	DP754109	88	DP754135	207	DP754143
5	DP240710	279	DP754109	300	DP754135	230	DP754143
2	DP625285	287	DP754109	162	DP754135	229	DP754143
1	DP625285	297	DP754109	220	DP754135	254	DP754143
1	DP625384	139	DP754109	309	DP754135	246	DP754143
2	DP625384	48	DP754109	80	DP754135	260	DP754143
3	DP625384	31	DP754109	202	DP754135	183	DP754143
1	DP742223	268	DP754109	319	DP754135	227	DP754143
195	DP754103	284	DP754109	224	DP754135	241	DP754143
191	DP754103	233	DP754135	223	DP754135	73	DP754143
190	DP754103	204	DP754135	222	DP754135	53	DP754143
192	DP754103	281	DP754135	318	DP754135	266	DP754143
186	DP754103	317	DP754135	228	DP754135	240	DP754143
166	DP754103	213	DP754135	169	DP754135	258	DP754143
187	DP754103	153	DP754135	52	DP754143	212	DP754143
193	DP754103	186	DP754135	74	DP754143	224	DP754143
148	DP754103	298	DP754135	249	DP754143	216	DP754143
189	DP754103	295	DP754135	150	DP754143	234	DP754143
178	DP754103	146	DP754135	256	DP754143	2	DP802580
161	DP754109	297	DP754135	237	DP754143	1	DP802580
242	DP754109	195	DP754135	239	DP754143	1	DP83173
160	DP754109						

1.7 Local Government Area and Council contact (if known)

The project spans two LGAs:

- Boorowa LGA
  - Anthony McMahon, 02 6380 2000
- Yass Valley LGA
  - Kym Nixon, 02 6226 1477

1.8 Time frame

It is expected that the Bango Wind Farm will initially be commissioned for 25 years. The following time frame is proposed for construction and commissioning of the Project:

- Submit for Planning Consent – May 2013
- Consent Expected – Q1/2 2014
- Detail Design & Procurement – 2014/5
- Pre-Construction – Q2/3 2015
- Commence Construction – Q4 2015
- Operation – Q1/2 2017

1.9 Alternatives to proposed action		No
	x	Yes, you must also complete section 2.2
1.10 Alternative time frames etc	x	No
		Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
1.11 State assessment		No
	x	Yes, you must also complete Section 2.5
1.12 Component of larger action	x	No
		Yes, you must also complete Section 2.7
1.13 Related actions/proposals	x	No
		Yes, provide details:
1.14 Australian Government funding	x	No
		Yes, provide details:
1.15 Great Barrier Reef Marine Park	x	No
		Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

2.1 Description of proposed action

The Bango Wind Farm is situated 20 km north of Yass, 7 km south-east of Boorowa and 80 km west of Goulburn, New South Wales (NSW). The ridgeline is of moderate elevation (430 to 830 m above sea level, Australian Height Datum (AHD)). The nearest locality is Rye Park, which is located approximately 4 km to the north-east along Wargeila Road.

When first announced in February 2011 the Project consisted of up to 200 wind turbines and ancillary structures spread over 30 different properties. The 330 kV overhead transmission line 5 km north of Yass was being considered as the power export connection point. Since being announced, the Project has been revised to take into account findings from key assessments and consultation with interested stakeholders. This has resulted in a significant reduction in the extent of the wind farm and a re-design of the wind turbine layout to arrive at the two configurations presented in this EA.

The Project now comprises a wind farm with two potential wind turbine layouts; one consisting of up to 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 (the Project site). One or a combination of these wind turbine locations will be used in the construction of the Project, to be determined following final wind turbine selection post-consent. This EA addresses all wind turbine locations with regard to assessing worst-case impacts associated with the range of wind turbines available in the market.

The Project will consist of the following components:

- The installation of up to 122 wind turbines (Layout Option 1) or up to 96 wind turbines (Layout Option 2) with a maximum blade tip height of 192 m;
- A collector substation (CS) comprising cable marshalling, switchgear, high voltage transformers and associated protection and communications assets;
- A switching station (SS) comprising switching and protection devices, busbars, circuit breakers, isolators and communication assets;
- Approximately four separate site compound and lay down areas (part temporary, part permanent), including site operations facilities and services buildings;
- Underground transmission lines (up to 132 kilovolt (kV)) and control cables within and between each of the wind turbines and Clusters, 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;
- At least four separate on-site access roads from the public road network;
- Crane hardstand areas, turning heads and passing bays for the erection, assembly, commissioning, maintenance, recommissioning and decommissioning of the wind turbines;
- Up to six permanent wind monitoring masts (potentially including the retention of existing temporary monitoring masts);
- Appropriate wind farm signage both during the construction and operational phases of the proposed development; and
- Ancillary facilities.

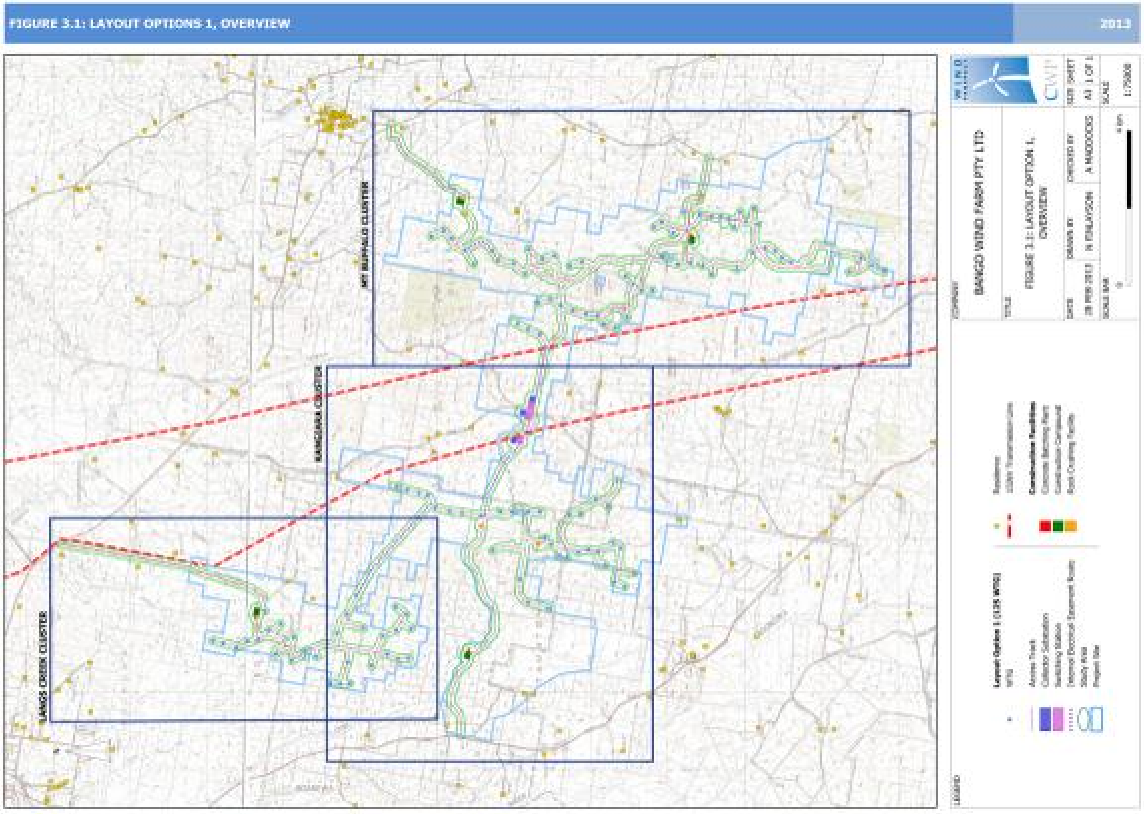


Figure 3.1 Layout Option 1, Overview

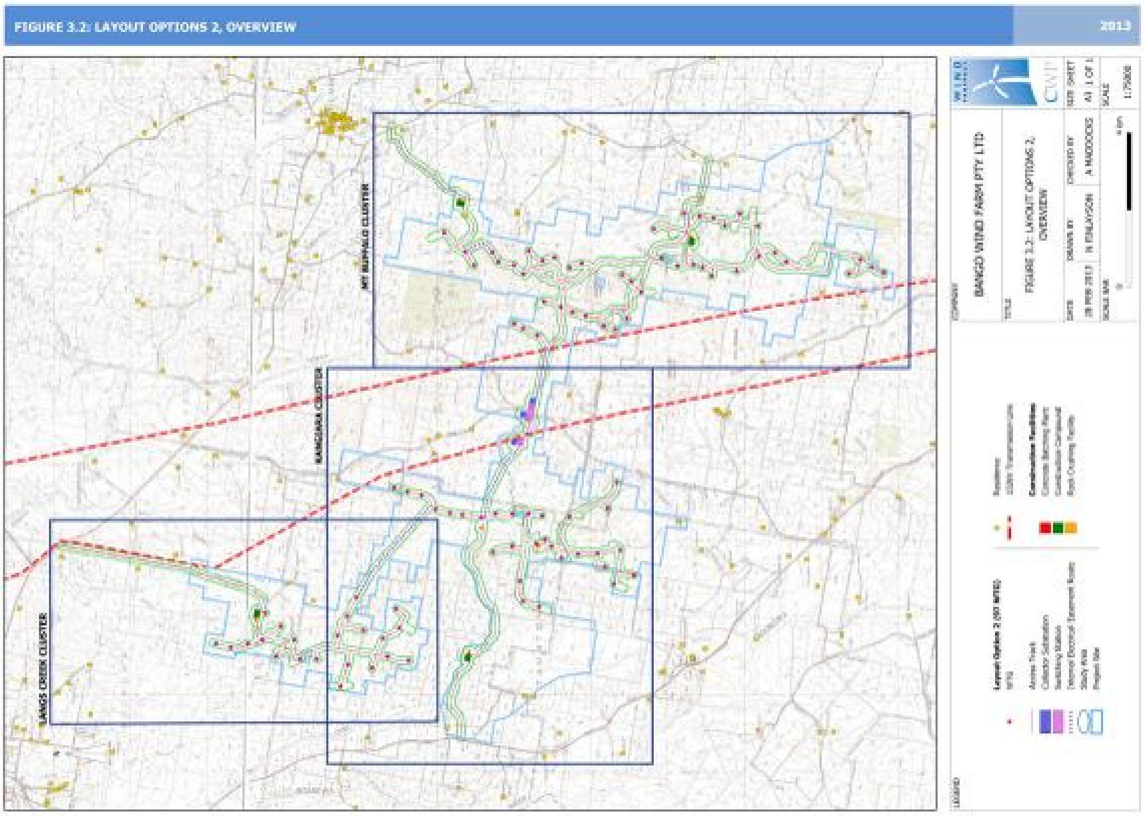


Figure 3.2 Layout Option 2, Overview

Typical dimensions of the components that comprise the Project are presented in **Table 3.1** below.

Table 3.1 Project components and approximate dimensions (based on greatest impact)

Project Component	Approximate Dimensions
Permanent	
Wind turbine footings (max footprint)	25 by 25 m
Wind turbine assembly / crane hardstand areas	25 by 60 m
Collector substation (CS)	150 by 150 m
Site compounds *(the extent of permanent section retained within temporary compound)*	75 by 75 m
On-site access: new roads	6 m by 83 km
Overhead transmission lines / easement [1] (Typical pole spacing as per **Table 3.3**)	30 m by 0.86 km (1 x 33 kV) 45 m by 7.82 km (2 x 33 kV) 75 m by 0.65 km (2 x 33 kV, 1 x 132 kV)
Switching station (SS)	220 by 160 m
Wind monitoring masts	1 by 1 m (5 per mast)
Temporary (during construction)	
Earthworks alongside permanent infrastructure (roads / hardstands) [2]	12 m by 83 km (est.)
Underground transmission lines [3]	3 m by 61 km
Concrete /asphalt batching plant	50 by 100 m
Rock crushing facility	50 by 100 m
Site compound and office	150 by 200 m

[1] *The final constructed easement width is up to 75 m for the internal overhead transmission lines, depending on their configuration. The maximum easement widths for each transmission line section have been assessed in detail for Ecology and Heritage and in the calculation of the Development footprint impact area. The actual impact area has been estimated to be 5 % of this total area given the low level of impacts associated with installing the overhead transmission lines and the sparse vegetation cover along the selected routes.*

[2] *Construction of the on-site access road network will require earth works that are beyond the limits of the permanent road impact within the Study area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for both Layout Options based on available contour and geotechnical data, to include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works.*

[3] *Underground transmission lines are a temporary impact and where feasible will be installed either within or adjacent to on-site access roads and earthworks. The trenches for the cables are backfilled with excavated material and covered with topsoil post installation. Suitable rehabilitation measures will be used in consultation with ecologists and landowners.*

Details of each of the component parts of the development are described in the following sections and in the accompanying figures. An outline of the construction and operational phases of the development are also provided, along with a timeframe detailing the proposed stages of activity pending Development Consent.

The Layout Options have been designed with respect to a number of technical, environmental and social factors and more detailed site assessments. Each layout ensures optimum, undisturbed use of the measured and predicted wind resource, after accommodating constraints, for the range of wind turbines currently being considered for the Project.

Given the scale of the Project it is likely that 'Clusters' of wind turbines will be constructed and commissioned in stages, which is discussed in more detail later in the chapter. Consequently, and for the benefit of stakeholder understanding, we have divided the Project into three main Clusters (**Table 3.2**).

Table 3.2 Wind Turbine Clusters

Wind Turbine Cluster	Maximum Number of Wind Turbines (Layout Option 1)	Maximum Number of Wind Turbines (Layout Option 2)	General location
Mt Buffalo Cluster	58	45	Eastern Cluster
Kangiara Cluster	34	29	Central Cluster
Langs Creek Cluster	30	22	North Western Cluster

Wind Farm Infrastructure

It is not yet known which model of wind turbine will be used for the Project as final wind turbine selection will occur through a competitive tender process pending Development Consent. However, in terms of generation capacity, the wind turbines currently available in the market place which are under consideration for this Project will be at least 1.5 MW in capacity. By way of example the Suzlon S88, 2.1 MW machine (as installed at the Capital Wind Farm, east of Lake George, NSW) is typical of the type of wind turbine that could be used. **Image 3.1** below displays a picture of a typical wind turbine, detailing the component parts.

Consideration will also be given to the use of different wind turbine sizes and manufacturers across the Project to better utilise the on-site wind resource profile. Under this circumstance, wind turbine dimensions would still fall within the permissible wind turbine sizes considered in this assessment.

Turbine Rotor

The wind turbines that will potentially be used for the Project will be three-bladed, semi-variable speed, pitch regulated machines with rotor diameters between 74 and 144 m and a swept area of 4,300 to 16,286 square metres (m^2). Typically, wind turbines of this magnitude begin to generate energy at wind speeds in the order of 3.5 to 4 metres per second (m/s) (approximately 13 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph). Wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 revolutions per minute (rpm) at low wind speeds and up to 18 rpm at higher wind speeds.

Towers and Blades

The supporting structure is comprised of a reducing cylindrical tower made out of either a welded steel shell or a concrete steel hybrid, fitted with an internal ladder or lift. The largest tower height under consideration is 120 m with an approximate diameter at the base of 4.5 m and 3 m at the top. It is important to note that the maximum blade length suitable for this tower height is 72 m which establishes the maximum proposed blade tip height of 192 m. Alternative tower heights between 80 and 120 m are also under consideration however, this is not exhaustive since new models and certified designs are continually entering the market place. The tower will typically be manufactured and transported to site in three to five sections for on-site assembly.

For the purpose of the Landscape and Visual Impact Assessment report a tower height of 120 m and a blade length of 72 m have been used for the visual analysis.

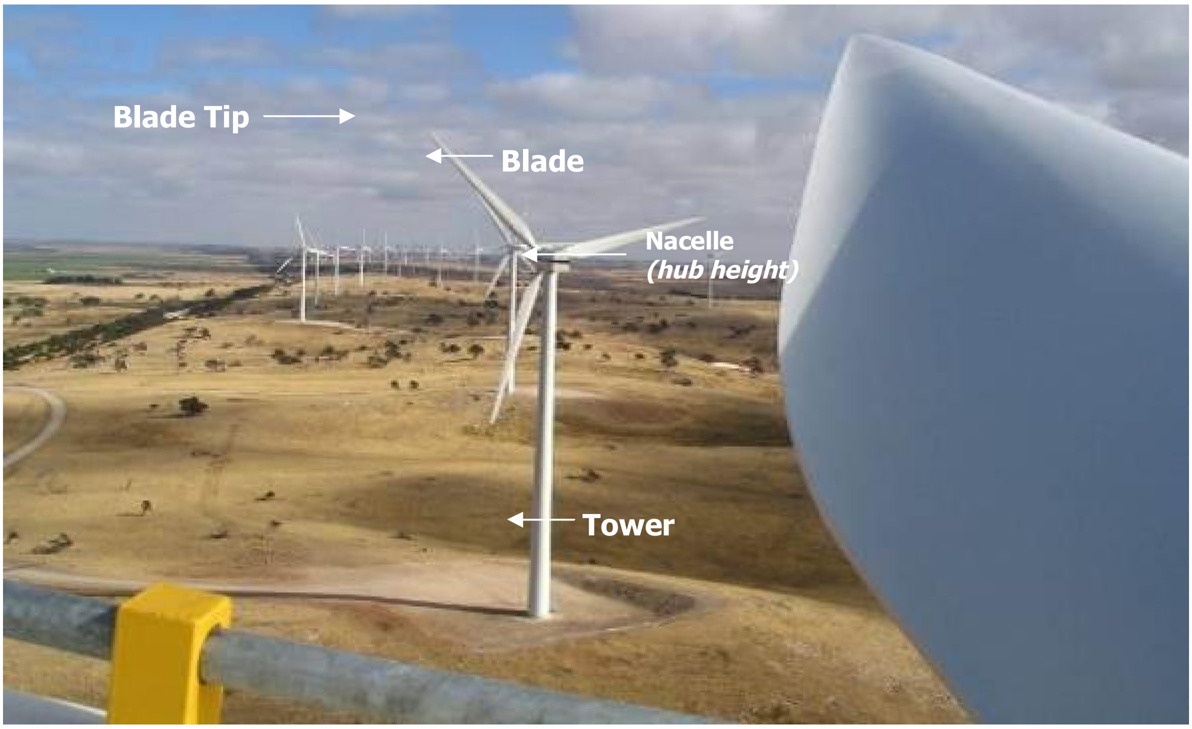


Image 3.1 Components of a wind turbine

Blade Tip

The blade tip will comprise the highest point of the wind turbine when in a vertical position. Given the wind turbines under consideration, a blade tip height of 192 m is considered to be the maximum. As new wind turbine models are regularly appearing on the market, blade tip height may vary by up to 5 m to accommodate potential changes to tower heights and blade lengths of new machines.

Nacelle

The nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower and can be 12 m long, 4.5 m high and 4.5 m wide. It encloses the gearbox, generator, transformers (model dependant), motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine.

Footings

Three types of foundation for the wind turbines will be considered pending geotechnical investigation of the ground conditions at the Project site. The following examples are based on a typical foundation design, but final wind turbine selection and geological surveys will dictate which is to be used.

Slab (gravity) foundations would involve the excavation of approximately 750 cubic metres (m^3) of ground material to a depth of approximately 2.5 m (based on a 21 m diameter circular foundation). Approximately 200 m^3 would, if suitable, be used as backfill around the wind turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. A slab foundation would involve installation of shuttering and steel reinforcement, followed by the pouring of concrete. (Refer to **Image 3.2** for an example of a gravity footing).

If slab plus rock anchor foundations are required, the construction of the foundation for each machine would involve the excavation of approximately 570 m^3 of ground material to a depth of approximately 2.5 m (based on a 17.5 m diameter circular foundation). Slab plus rock anchor foundations require shuttering and steel reinforcement, drilling of rock anchor piles up to a depth of approximately 20 m, concrete pour, after which the rock anchors are stressed and secured once the concrete has cured sufficiently. (Refer to **Image 3.2** for an example of a rock anchor footing).

Image 3.2 Typical gravity (left) and rock anchor (right) footings

It is necessary for detailed geotechnical surveys to be carried out during pre-construction work to determine the foundation type per wind turbine. It is feasible that more than one type of wind turbine foundation may be required for the Project, following the assessment of the individual wind turbine locations. New wind turbines are continually coming on to the market and it is possible that minor variations to these typical foundation dimensions could occur prior to final wind turbine selection.

Impact assessments undertaken for the Project assume the use of the largest foundation footprint for all wind turbines, i.e. slab (gravity) foundations, using the greatest on-ground footprint. A typical foundation size of 25 by 25 m is being considered as worst case for Layout Option 1, which reflects the largest known foundation impact based on currently available wind turbines. It is possible that larger foundations up to 30 by 30 m could be used for Layout Option 2, but the resultant overall impact is lower due to the fewer number of wind turbines and, therefore, foundations and hardstands required for that layout.

Crane Hardstand and Assembly Areas

Site access roads would have areas of hardstand (approximately 25 by 60 m) adjacent to each wind turbine for use during component assembly and by cranes during installation. The clearing of native vegetation for the construction of on-site access roads and hardstand areas will be minimised where practicable. If clearing is found to be unavoidable, this will be appropriately managed and carried out in accordance with Conditions of Approval. The on-site access roads would be surfaced with local stone to required load-bearing specifications. The nature and colour of surface stone would be selected to minimise visual impact prior to construction. The on-site access roads and hardstand areas would be maintained throughout the operational life of the Project and used principally for the periodic maintenance of the wind turbines. **Image 3.3** below shows a typical hardstand area adjacent to the wind turbine footing.

Image 3.3 Typical hardstand area adjacent to a rock anchor footing

Monitoring Masts

There is currently one temporary 60 m wind monitoring mast installed 5.8 km to the south east of the Project site, recording wind data for Project development and planning. It is expected that additional temporary masts will be installed in stages within the three clusters prior to the start of construction of the wind farm.

Up to six permanent wind monitoring masts, up to 120 m high, are proposed to be installed on-site. Locations for these masts are yet to be determined and will be influenced by the final wind turbine selection, but may include the locations of the existing temporary monitoring masts. These permanent masts will provide information for the performance monitoring of the wind turbines. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design. **Image 3.4** below shows both typical tubular and lattice wind monitoring mast designs.

Permanent wind monitoring masts will require a low voltage cable connection for power and also a communications cable to be laid. The trench required for this will be much smaller than for the cables between wind turbines. The connection would come directly from the closest wind turbine.

Image 3.4 Tubular (left) and lattice (right) wind monitoring masts

Electrical Infrastructure

The electrical works, including those incorporated in the wind turbine structures, will involve:

- Up to 122 wind turbine transformers (Layout Option 1) or up to 96 wind turbine generator (Layout Option 2);
- The establishment of a 150 by 150 m collector substation with 33 to 132 kV step up transformers, circuit breakers and isolators;
- The establishment of a 160 by 220 m switching station with 132 kV circuit breakers, isolators, metering, protections and communications assets;
- Approximately 61 km of up to 33 kV entrenched underground transmission lines and control cables;
- Approximately 9 km of up to 132 kV double circuit overhead transmission lines, some sections running in 2 or 3 parallel line configurations (see **Figure 3.1**); and
- Establishment of a typical operation facilities building to house control and communications equipment.

Generator Transformer

The wind turbine generators typically produce electricity at 0.69 kV which is stepped up to 33 kV (or greater) by the transformer located either in the nacelle, the base of the tower or adjacent to the base of the tower on a concrete pad. **Image 3.5** below shows an example of a transformer located outside of the tower.

The generator transformer may be oil-filled or a dry type depending on the wind turbine. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss reaching local water courses. The volume of oil used for generator transformers is in the order of 1,000 litres (L). The output from each of the wind turbines will be directed via 33 kV (or greater) underground and overhead transmission lines that link to the CS.

Image 3.5 Transformer adjacent to wind turbine

Collector Substation

The CS locations have been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.2**). Three potential locations have been identified for the CS, only one of which will be constructed, which are at a minimum distance of 0.88 km from any nearby residences. Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the CS that are visible from the surrounding country to reduce noise and visual impact. Emergency backup power for the CS will be supplied by an on-site diesel generator and batteries to maintain network communications and electrical protection capability.

The CS will occupy an area approximately 150 by 150 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The CS arrangement will include an array of cable marshalling, busbars, switchgear and protection, various voltage and current transformers, operation and facilities building with parking, communication facilities and tower, on-site batteries, diesel generator, lighting, a buried earth grid, lightening masts, power conditioning equipment and a reactive power control systems as agreed with TransGrid. The ground surface within the CS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. As the transformer(s) may contain upwards of 50,000 L of oil, provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components. This would involve constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the CS compound. The 2.25 ha area includes a provision for a 20 m Asset Protection Zone.

Switching Station

The switching station (SS) locations have equally been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.2**). Three locations have been identified for the SS, only one of which will be constructed, which are at a minimum distance of 0.93 km from any surrounding residences. Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the SS that are visible from the surrounding country to reduce noise and visual impact. The SS will require a standalone power supply from either the local 11 kV distribution network, which is located up to 3.5 km from the proposed SS locations, or an on-site generator.

The SS will occupy an area approximately 160 by 220 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The SS arrangement will include an array of busbars, circuit breakers, isolators, buried earth grid, various voltage and current transformers as agreed with TransGrid, power conditioning equipment, an operations and facilities building with parking and a secondary distribution supply source. The ground surface within the SS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. The 3.52 ha area includes a provision for a 20 m Asset Protection Zone.

The SS will most likely require communication facilities, including a communications tower to provide for communications redundancy which is expected to be up to 45 m in height depending on topographic conditions. Twenty-four hour low-intensity security night lighting or low intensity flood lighting within compounds in accordance with AS1680 will be incorporated into the design. TransGrid requires low-level and high-intensity lighting for operational safety reasons which will only be used intermittently for operational and emergency maintenance reasons.

The design of the SS will be developed in conjunction with TransGrid and comply with relevant technical, electrical and planning standards. As the SS will be owned and operated by TransGrid the operational period is likely to be beyond the timeframe of the Project. The SS could potentially increase network reliability and security of supply in the region and therefore TransGrid may wish to retain the SS beyond the operational life of the Project.

Overhead and Underground Transmission Lines and Control Cables

The electrical and control cables from the Langs Creek, Kangiara and Mt Buffalo Clusters will comprise a mix of underground and overhead transmission lines and will connect directly into the CS. It is intended that the CS and SS will be adjacent to each other, so no interconnecting electrical transmission lines will be required (see **Figures 3.1** to **3.2**). **Image 3.6** shows a typical overhead transmission line that could be implemented in this Project.

Image 3.6 Double-circuit overhead 33 kV transmission line

Underground Transmission Lines: Underground routes will generally be between the wind turbines and follow the route of the internal on-site access roads (refer to **Image 3.7** below). The final route will minimise vegetation clearing and avoid potential erosion and heritage sites, and will also depend on the ease of excavation, ground stability and cost. Location markers may be placed along the route of the underground transmission lines, if agreed by the participating landowners, for safety reasons. Placement of these lines below ground will result in minimal visual impact once the ground has been rehabilitated, if appropriate.

Image 3.7 Laying underground transmission line within the road network

Control Cables: Computerised controls within and between the wind turbines and the operation facilities building automatically control start-up, speed of rotation and cut-out at high wind speeds and during faults. Recording systems will monitor wind conditions and energy output at each of the wind turbines. Remote 24 hr monitoring and control of the Project will also be employed. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the clusters of wind turbines.

The installation of buried earthing conductors and electrodes will also be required in the vicinity of the wind turbines, the facilities building and the substations as required.

Overhead Transmission Lines: Approximately 9 km of overhead transmission line will be required to connect the wind turbines to the CS and SS (see **Figure 3.1**). Voltages ranging from 33 kV to 132 kV may be constructed in single or double-circuit configurations depending on the wind turbine selected for the site and any staging considerations. It may be necessary to run some overhead lines in parallel, due to the power export requirements of a particular cluster, contained within overlapping easements to minimise the impact area. The overhead transmission lines can be up to 50 m in height, comprising of two cross arms with insulators with a typical span length as shown in **Table 3.3**.

Table 3.3 Transmission Line Specifications

Voltage	Easement Width	Height of Pole	Typical Span Distance (Pole to Pole)
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

Note: All easement widths account for a double circuit on a single pole.

Depending on the size of wind turbine selected for the Project, it may be necessary to run two or more overhead transmission lines in parallel within the Project Site, from each Cluster to the CS and the from the SS to the point of connection (see **Figure 3.1**). In this case, two or more overhead transmission lines will follow the same centre line as shown on the map and their easements will overlap to minimise the impact of the easement corridor. For example, two 33 kV overhead transmission lines (each with a 30 m easement) running in parallel would require a total easement of 45 m (sharing a 15 m overlap). Alternatively, a 132 kV and two 33 kV overhead transmission lines would require a 75 m easement (retaining the greater easement requirements of 45 m for the 132 kV transmission line, plus the two 33 kV easements overlapping).

Operation Facilities Building

A facilities building will be constructed at the same location as the CS. The general location has been chosen to minimise the length of overhead and underground transmission lines and to minimise the visibility of the facilities building and CS. The building will house instrumentation, electrical and communications equipment, routine maintenance stores, a small work area and staff amenities. The facilities buildings will comply with all relevant building requirements.

Site Access Works

Site Entry

The Project site locality can be reached via the south from the Hume Highway utilising local roads north of Yass, including the Lachlan Valley Way, Boorowa Road, Tangmangaroo Road and Wargeila Road, to the Project Site.

Existing access roads are shown in **Figures 3.1** to **3.2** and can be classified into two broad categories:

- Classified Highways: Hume Highways (M31) and the Lachlan Valley Way (MR56), which are maintained by the NSW Transport, Roads and Maritime Service (RMS); and
- Local Roads: The direct access to the site is provided by local roads maintained by Yass Valley Council or Boorowa Council. The significant local roads in Boorowa LGA are Rye Park-Dalton Road, Wargeila Road, Tangmangaroo Road, Harry's Creek Road, Hopefield Road and Boorowa Road. The significant local roads in Yass Valley LGA are Lachlan Valley Way, Tangmangaroo Road, Moorbys Lane, Laverstock Road and Wargeila Road.

Yass Valley Council, Boorowa Council and the RMS have ongoing maintenance and improvement programmes for the roads and bridges under their authority. There are no known proposals for major road improvements on the access roads under consideration at the time of writing.

Access routes and points for over-size and over-mass vehicles (primarily those vehicles carrying wind turbine and electrical components) have been investigated from the south. The southern access route comprises the Hume Highway onto the Lachlan Valley Way, passage south-east of Boorowa and into the Project site via Boorowa Road, Hopefield Lane, Harry's Creek Road, Tangmangaroo Road and Wargeila Road.

Other roads in the locality may also be used both by over-size / over-mass vehicles, but will primarily be used by normal-sized vehicles such as tip-trucks, concrete agitator trucks (if required) and light vehicle transport both during construction and operation.

Note: Approximately 33 km of the arterial road access likely to be used for construction activities are unsealed. This has implications for water usage and dust suppression.

All entrances to the Project site from the existing arterial roads will be designed to allow long vehicles to safely exit from or re-enter the road whilst minimising the disruption to traffic. Further consultation will be undertaken with Council and RMS to confirm the final design.

On-site Access Roads

Other access consists of new on-site access roads between wind turbines, also comprising hardstand and turning head areas. The on-site access roads will follow existing farm tracks, where practicable, that traverse the ridgelines and plateaus. All roads leading from the arterial roads and all on-site access roads are likely to require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation.

Construction of the on-site access road network will require earth works to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for Layout Option 1 and Layout Option 2 that include impacts associated with permanent on-site access roads, hardstand and turning head areas in addition to the area considered the extent of the earth works.

The on-site access roads will be surfaced with compactable, engineered base material with suitable drainage. Some steep sections of on-site access roads may need to be surfaced with asphalt to enable haulage of heavy wind turbine components. Materials will be sourced locally where practicable, including the recycling of aggregate extracted during the construction process, and / or in consultation with the local Councils and landowners. Measures will be taken to minimise the risk of the spread of weeds from materials brought in for construction purposes through the Construction Environmental Management Plan (CEMP).

The required on-site access routes for the Project site are shown in **Figures 3.1** to **3.2** and described below:

- Mt Buffalo Cluster: Approximately 38 km of new internal on-site access road will be required;
- Kangiara Cluster: Approximately 29km of new internal on-site access road will be required; and
- Langs Creek Cluster: Approximately 16 km of new internal on-site access road will be required.

General vehicle movements

Access to wind turbines located at the end of a spur on a ridge generally requires a T or Y-section of road (referred to as a turning head) close to the hardstand area to allow semi-trailer trucks to turn around. These are graded the same as the proposed internal on-site access roads and are typically 30 to 40 m in length.

Alternatively, semi-trailer trucks can reverse back out of an access route, provided the Project site safety regulations permit, or entrances made wider (bell-mouth) to allow manoeuvring.

Hardstand areas equal 25 by 60 m, with an additional area equal to 25 by 25 m to accommodate each wind turbine foundation, and on-site access roads up to 6 m wide during the construction phase are proposed as maximum permanent impacts. These dimensions would be sufficient to allow for passing and turning vehicles unless obstructed by a component such as a blade laid down on the hardstand awaiting assembly. In such an instance semi-trailer trucks could either turn around in the adjacent turning head, or continue to the next wind turbine hardstand area to turn around. Construction contractors generally avoid double-handling of components and as such manage the delivery and installation process under a just-in-time management process, thereby reducing the number of components laid down on site at any one time.

The proposed dimensions of the on-site access roads and hardstand areas are sufficient for two cranes per wind turbine site to lift the components from the semi-trailer trucks, and for the trucks to drive on past to a suitable turning point, as described above.

Ancillary Roads and Remediation

Some additional temporary roads or tracks may also be required for construction of the overhead transmission lines and for access to erosion control sites. The erosion control sites will benefit from the use of excess rock excavated from wind turbine footings and will be chosen based on the availability of excess material, the need for erosion repair, and minimising the distance for material transport.

If the temporary roads are not required for the ongoing operation and maintenance works of the Project they will be removed and rehabilitated on completion of the construction phase, and in accordance with landowner preferences and environmental controls.

Utility Services

The Project will be connected to TransGrid's 132 kV transmission network and when not generating will draw a minor amount of electricity from the grid. Backup and emergency power at the CS will be supplied by on-site batteries and a standalone diesel generator. Auxiliary power at the SS will be supplied by a local 11 kV distribution line or on-site generator.

A telephone connection to the proposed operation facilities building, involving multiple telephone lines, will also be provided to enable remote monitoring and control of the Project.

Mobile telephone coverage is available on most of the ridgelines and plateaus with limited or no service available on the majority of the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, operation and maintenance teams will communicate using both mobile telephones and radios.

Water will be provided to the proposed facilities and auxiliary services building from a storage tank designed to collect water from roof drainage. An approved septic system or composting system will be installed to treat minor quantities of waste water. The Proponent will be responsible for the removal of all other wastes from the Project site.

Resource Requirements

Resource requirements are typical of any new development site, including the provision of cement, gravel, sand, water and road base material.

Cement for foundations will be sourced by the civil construction company awarded to undertake the Project. This may be sourced locally or from alternative suppliers.

Gravel and sand will be sourced locally and as close to the Project site where it is practicable to do so, including recycling material excavated from foundations and earthworks where possible. There is one operating quarry for unprocessed construction materials within the Project site located east of Tangmangaroo Road between the Kangiara Cluster and the Mt Buffalo Cluster. Additional operating and disused quarries are located within the locality of the Project site and these may be further utilised (subject to obtaining the necessary permits). In addition, several landowners have expressed interest in allowing gravel extraction from their properties, which would require the necessary extraction permits prior to use. Both gravel and sand will be required to mix the high strength concrete to pour wind turbine foundations. Gravel will also be required to dress the wind turbine sites, see **Image 3.5** above, and provide a low resistivity apron around the CS and SS.

Water requirements will be met by sourcing water from within the locality as long as a zero share licence can be obtained under the current water sharing plan. Where available, groundwater will be purchased from involved or adjacent landowner properties who hold groundwater licences and have unused allocations. The use of regulated surface water allocations from the nearby Wyangala Dam may also be an option. This source is controlled by State Water and its use would be subject to further discussions post consent. If water cannot be sourced locally, then it will be brought to site by external water suppliers under contract to the Project. It is estimated that in the order of 15.0 mega litres (ML) of water would be required to produce the quantity of concrete required for gravity footings for Layout Option 1, and as such can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only 11.0 ML of water would be required if standard rock anchors were used for all footings in Layout Option 1.

In addition, it is estimated that a further 32.8 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded on-site access road construction and dust suppression activities, including those associated with the 33 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to the NSW Office of Water (NOW) pending Development Consent.

Road base material will be required for construction of access roads to wind turbine sites and the substations. Part of the road base requirement may be sourced from material extracted from wind turbine footings with the remainder sourced on-site (subject to permitting) or imported to the Project site. Where additional material is required, local supplies of the same geological type could be sourced from the quarries indicated above, local landowner gravel supplies or external aggregate suppliers.

Given the scale of the Project it is anticipated that there will be no waste material exported from the Project site during construction. Top soil cleared during the construction phase will be used for remediation, and rock excavated from wind turbine footing preparations will be used for road base, back fill for foundations and / or erosion control purposes as far as practicable. Ancillary waste, such as packaging associated with component and stock pile deliveries, will be disposed of according to local Council requirements and will form part of the CEMP.

2.2 Alternatives to taking the proposed action

Wind Prospect CWP has undertaken early feasibility assessments for a number of potential wind farm sites across New South Wales (NSW). The results of these assessments have indicated that the Bango site is a preferred site for the development of a wind farm in NSW. Other wind farm sites identified by Wind Prospect CWP are not presented as alternatives to this action as these comprise separate projects that are also intended to be developed.

When first announced in February 2011 the Project consisted of up to 200 wind turbines and ancillary structures spread over 30 different properties. The 330 kV overhead transmission line 5 km north of Yass was being considered as the power export connection point. The project therefore extended over a much larger area, from Boorowa to just north of Yass during the initial design phase.

Since being announced, the Project has been revised to take into account findings from key assessments and consultation with interested stakeholders. Consideration was given to the impact of the project on the local community, including the expansion of residences north of Yass, based on an improved understanding of land use in the area. This has resulted in a significant reduction in the extent of the wind farm and a re-design of the wind turbine layout to arrive at the two configurations presented in this EA.

Following the reduction in the size of the project, further small-scale modifications have been made during the data gathering phase in preparation of the Environmental Assessment. Infrastructure, including access tracks and turbine locations, has been micro-sited to take into account site-specific environmental issues and minimise on-ground ecological impacts. This resulted in the removal of several turbines at various locations across the project site.

The Project now includes 122 wind turbines in Layout 1 and 96 turbines in Layout 2, plus associated infrastructure, as described in *Section 2.1*.

The final Project will comprise only one of the two turbine layout options, though can intermix turbine locations across both options. This referral assesses the potential impacts to Matters of NES associated with Layout 1 as this comprises the greatest impact area and, therefore, represents the worst case scenario.

2.3 Alternative locations, time frames or activities that form part of the referred action

N/A

2.4 Context, planning framework and state/local government requirements

Development of wind farms in NSW is subject to a range of local, state and Commonwealth legislation as discussed below.

Local Environmental Plans

<u>Boorowa Council</u>

Interim Development Order (IDO) No. 1 – Shire of Boorowa identifies that the Study Area is located within Non-Urban A and Non-Urban B zones. All development within these zones, excepting prohibited development, is permissible with Council consent. The proposed action would be described as 'generating works' which is not identified as a prohibited development and therefore, is permissible with consent.

<u>Yass Valley Council</u>

Yass Valley Council has a number of Local Environmental Plans which apply to the Yass Valley LGA as a result of the Council amalgamation of February 2004. Under the Yass LEP the project is located within land zoned No 1(a) Rural Agricultural. The objective of this zone is to set aside certain land for agricultural purposes and purposes incidental thereto. Agriculture (with some exceptions), dams and forestry developments are permissible without consent. The proposed action would come under the definition given in the Model Provisions as 'generating work' being 'a building or place used for the purpose of making or generating gas, electricity or other forms of energy'. As it is not a prohibited development and is consistent with the objectives of the LEP, the proposed action is therefore permissible with consent.

<u>State Legislation and Policy</u>

<u>Environment Planning and Assessment Act 1979</u>

The relevant planning legislation for NSW is the Environmental Planning and Assessment Act 1979 (EP&A Act). The EP&A Act instituted a system of environmental planning and assessment in NSW and is administered by the Department of Planning and Infrastructure (DoPI). Part 3A of the EP&A Act was introduced to deal with complex major projects of State or regional significance or critical infrastructure projects. Major projects are identified either in:

- *State Environmental Planning Policy (Major Development) 2005*; or
- an order by the Minister for Planning published in the NSW Government Gazette.

The wind farm is a facility for the generation of electricity with a capital investment value of more than $30 million, and therefore requires approval under transitional Part 3A of the EP&A Act as identified within State Environmental Planning Policy Major Development 2005.

<u>Threatened Species Conservation Act 1995</u>

Projects determined by a statutory authority of the NSW State Government are required to be assessed in accordance with the EP&A Act, as amended by the *Threatened Species Conservation Act 1995* (TSC Act). The TSC Act lists threatened species, populations and ecological communities under Schedules 1 and 2 of the Act, that are priorities for conservation within NSW. Schedule 3 of the TSC Act lists Key Threatening Processes for species, populations and ecological communities within NSW. The Project is required to assess the significance of potential impacts to threatened species considered likely to be affected by the proposed action under Section 5A of the NSW EP&A Act.

<u>Native Vegetation Act 2003</u>

The objectives of the *Native Vegetation Act 2003* (NV Act) include:

- to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State; and
- to protect native vegetation of high conservation value having regard to its contribution to matters such as water quality, biodiversity, or the prevention of salinity or land degradation.

Section 12 of the NV Act identifies that the clearance of 'native vegetation' requires approval in accordance with a development consent granted under the NV Act or in accordance with a property vegetation plan. Section 75U of the EP&A Act excludes projects approved under Part 3A of the EP&A Act from requiring "an authorisation referred to in section 12 of this (or under any Act to be repealed by that Act) to clear native vegetation". Therefore the NV Act does not apply to this action.

<u>NSW Draft Planning Guidelines for Wind Farms (NSW DPI) 2011</u>

These guidelines have been prepared in consultation with the community and energy industry to provide a regulatory framework to guide investment in wind farms across NSW, while minimising and avoiding any potential impacts on local communities. The purpose of the guidelines is to:

- provide a clear and consistent regulatory framework for the assessment and determination of wind farm proposals across the state;
- outline clear processes for community consultation for wind farm developments; and
- provide guidance on how to measure and assess potential environmental noise impacts from wind farms.

<u>Roads Act 1993</u>

Permits may be required under Section 138 of the Roads Act 1993 for underground cabling that could pass under the bordering roads. Advice will be sought from the associated road authority.

<u>State Environmental Planning Policy (Major Projects) 2005</u>

On 1 March 2011 an application was made to the Director General of The Department of Planning seeking to classify the Project as a Major Project and is subject to assessment under transitional Part 3A of the EP&A Act (MP11_0039). Director-

General Requirements were issued for this project on the 31 March 2011 and the approval authority will be the Minister for Planning.

State Environmental Planning Policy No 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) applies to land in the Boorowa LGA. SEPP 44 identifies land as *potential Koala habitat* if any of the tree species listed on Schedule 2 make up 15% of the canopy in a location and as *core Koala habitat* if a resident population of Koalas is identified as occurring at the location. If land subject to a development application is identified as core Koala habitat, SEPP 44 requires that a Koala plan of management must be developed before development consent can be granted. Under Part 3A of the EP&A Act there is no requirement for a development application and accordingly there is no trigger for the need for a Koala Plan of Management.

Commonwealth Legislation

This proposal is subject to the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which is the subject of this referral.

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

Wind Prospect CWP is in the process of preparing an EA for the Project in accordance with the requirements of the NSW EP&A Act, including the Director General's Requirements for the Project. The EA will include detailed independent assessment of key environmental issues, and is being prepared in parallel with detailed community consultation.

The EA will be placed on public exhibition and assessed by the NSW DPI. The DPI will invite submissions from community and public stakeholders during the public exhibition period and will consider the issues raised in any submissions in determining the application.

The EA will provide a comprehensive assessment of relevant environmental issues. In turn, these issues and their management strategies will play a key role in determining the final wind farm layout. The EA will address the Director-General's Requirements and will include the following key specialist assessments:

- Landscape and Visual Impact
- Noise
- Flora and Fauna
- Archaeological / Indigenous and European Heritage
- Traffic and Transport
- Aviation
- Communications (including Electromagnetic Interference)
- Electromagnetic Fields
- Water
- Fire and Bushfire
- Soils and Landforms
- Stakeholder Consultation
- Climate and Air Quality

2.6 Public consultation (including with Indigenous stakeholders)

Consultation will be required with a range of stakeholders including government agencies, neighbours to the wind farm and the broader local community.

A project-specific website was set up in March 2011 to coincide with the submission of the Preliminary Environmental Assessment (PEA) and to provide an online information source about the project. The website was designed to be interactive to allow for community feedback, including contact details for the proponent. The website is regularly updated with project information and allows people to provide comment via the 'Have Your Say' page.

Government and non-Government organisations, including local Aboriginal groups, were contacted by email and letter early on in the creation of the project to provide comment and input into project design. Similarly, a door-knocking exercise was undertaken within 2-3 km of the project to inform local residents of the wind farm, answer any questions and provide an initial newsletter.

Aboriginal consultants were used in the cultural heritage fieldwork studies to correctly identify, document and assess indigenous heritage items.

An Open Day was held on the 16th August 2012 at the Boorowa Bowling Club to allow people to find out more about the project and provide comments on the design and suitability of the wind farm. The event was advertised in the local papers and a media release put out, resulting in local radio coverage prior to the event. Comments were collated and fed back into the design process. A further Open Day will be held in March/April 2013 to present the final wind farm layout, prior to the lodgement of the planning application.

As part of the Draft NSW Planning Guidelines: Wind Farms, the Bango Wind Farm Community Consultation Committee is in the process of being established. Expressions of Interest were requested at the Open Day, though limited responses were received. A third round of requests for Expressions of Interest is due to be completed by the end of March 2013 and the inaugural meeting to be held not long afterwards.

2.7 A staged development or component of a larger project

Construction of the Project may be staggered; however the Project is not proposed as a staged development or component of a larger project.

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

To assess matters of national environmental significance a series of assessments have been undertaken. This includes field surveys to target matters of national environmental significance, which were commenced in July 2012 and continued through to February 2013. This EPBC referral document has been prepared using information collected from targeted field surveys and subsequent analysis.

A search of the Protected Matters Search Tool (PMST) was undertaken on 01 March 2013. The search covered the area within 10 km of the PAA (search area). The PMST did not identify any World Heritage Properties, National Heritage Places, the Great Barrier Reef Marine Park, or Commonwealth Marine Areas that relate to the search area.

The PMST search identified three declared Wetlands of International Importance downstream of the search area, three Threatened Ecological Communities, 19 Threatened Species and nine Migratory Species that may occur in, or may relate to, the search area. These items are discussed further in the relevant sections below.

3.1 (a) World Heritage Properties

Description

No World Heritage Properties occur in the Study Area or Locality.

Nature and extent of likely impact

The Project will not have any significantly adverse effects on any World Heritage Properties.

3.1 (b) National Heritage Places

Description

No National Heritage Places occur in the Study Area or Locality.

Nature and extent of likely impact

The Project will not have any significantly adverse effects on any National Heritage Properties.

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

No declared Ramsar wetlands occur in the Study Area or the Locality. However, the following three declared Wetlands of International Significance have been identified downstream of the search area by the PMST:

- Banrock Station wetland complex - located approximately 770 kilometres to the west of the Study Area. The site is a floodplain wetland complex comprising areas of freshwater and areas of secondary salinised floodplain with discrete wetland basins and channels. The site supports a high diversity of ecological communities (DSEWPaC 2011a);
- Coorong and Lakes Alexandrina and Albert Wetland - located approximately 885 kilometres to the south-west of the Study Area, in South Australia. The site is a long, shallow, brackish to hypersaline lagoon. It supports some threatened ecological communities and species, as well as extensive and diverse wetland assemblages (DSEWPaC 2011b); and
- Riverland - located in South Australia, approximately 730 kilometres to the west of the Study Area. The site incorporates a series of creeks, channels, lagoons, billabongs, swamps and lakes. The wetland is an important habitat for a large number of migratory and waterbirds (DSEWPaC 2011c) .

Nature and extent of likely impact

Given the extensive distances between the Study Area and the three wetlands (all in excess of 700 km), there are no anticipated impacts to Wetlands of International Importance as a result of the Project.

3.1 (d) Listed threatened species and ecological communities

Description

The PMST search identified three threatened ecological communities and eighteen threatened species that may occur in, or may relate to, the search area. Additional species and communities were identified from other sources and a total of 30 EPBC Listed threatened species and ecological communities were assessed for their likelihood of occurrence within the Study Area.

The likelihood of occurrence assessment was informed by the results of targeted and observational field investigations which have been undertaken in the Study Area by Environmental Resources Management Australia Pty Ltd (ERM) since July 2012. The assessment grouped threatened ecological communities and threatened species into four likelihood categories based on the criteria outlined in the table below.

Likelihood of Occurrence Criteria

Category	Description
Known	• the TEC/species has been recorded in the Study Area during recent field surveys; OR • database records demonstrate that the TEC or population is known to occur in the Study Area.
Likely	• the TEC/species has not been recorded in the Study Area during recent field surveys; AND • the TEC/species has been recorded in the Locality of the Study Area; AND • optimal habitat exists within the Study Area.
Potential	• the TEC/species has not been recorded in the Study Area during recent field surveys, AND • the TEC/species has been recorded in the Locality of the Study Area; AND • sub-optimal habitat exists within the Study Area; OR • in the case of a bird or bat species, the species may fly over the Study Area; OR • habitat preferences and distribution of the TEC/species are not known.
Unlikely	• the Study Area is within the known distribution for the TEC species; AND • the TEC/species has not been recorded within the Study Area, AND • TEC/species habitat is not within the Study Area; OR • TEC/species habitat exists on the site but is in a disturbed state such that it is below sub optimal.

Field Survey Methods

Flora and fauna surveys of the Study Area were undertaken from July 2012 to February 2013. The methods included targeted surveys for both NSW TSC Act and EPBC Act listed species and ecological communities that were identified as likely or having the potential to occur in the Study Area. Surveys were undertaken considering the EPBC recommended guidelines for field survey effort and timing for each individual or species group and have been summarised below. Specialists on the Golden Sun Moth were contracted to undertake habitat assessments and targeted surveys.

Summary of Survey Effort Targeting EPBC Listed Species

Target Species	Survey Technique	Survey Period	Effort
Striped Legless lizard	Pitfall Trapping	November 2012 - December 2012	• Three suitable locations established, • Cross configuration, • Five pits per configuration, • Two configurations per location, • Monitored for a period of four weeks.
Striped Legless lizard	Reptile Funnel Traps	November 2012 - December 2012	• Two suitable locations established, • Used when pitfalls could not be utilised, • Cross configuration used, • 12 traps per configuration, • Monitored for a period of four weeks
Striped Legless lizard	Tile Grids	July 2012 - December 2012	• Three 50 grids and three 25 tile grids, • Established in July 2012, • Monitoring from November 2012 to December 2012.

Target Species	**Survey Technique**	**Survey Period**	**Effort**
Threatened Mammals Arboreal and Terrestrial	Camera Traps	November 2012 - December 2012	• Eight remote camera traps deployed for a minimum of four weeks, • Four set up for arboreal monitoring, • Four set up for terrestrial monitoring.
Eastern Long-eared Bat	Anabat Utrasonic Detection Units	November 2012 - February 2013	• Anabat units deployed at 13 locations, • Deployed minimum two nights per location.
Eastern Long-eared Bat	Harp Trapping	Feb-13	• Harp traps deployed at two locations over three nights.
Threatened Nocturnal Species	Nocturnal Call Playback	November 2012 - December 2012	Nocturnal call playback session completed on five separate occasions in suitable conditions
Threatened Nocturnal Species	Spotlighting	November 2012 - February 2013	• Six spotlighting sessions • Three locations • One hour per session
Booroolong Frog	Frog Searches (nocturnal)	November 2012 - February 2013	• Visual and Call Surveys undertaken when suitable conditions, • Creeks and waterways searched for a period of one hour by two ecologists, • Two road based surveys undertaken during rain periods by two ecologists for one hour each.
Striped Legless lizard, Pink Tailed Worm Lizard	Reptile searches (diurnal)	November 2012 - February 2013	• Suitable habitat surveyed, • Rock turning suitable rocks.
Threatened Birds	Bird Census Surveys	November 2012 - February 2013	• 16 two hectare bird census completed at various locations throughout Study Area
Threatened Birds	Bird Utilisation Surveys (BUS)	July 2012 - February 2013	• 20 separate locations established, • 76 surveys completed.
Golden Sun Moth	Surveys were undertaken in accordance with the survey guidelines provided in the *Significant Impact Guidelines for the critically endangered Golden Sun Moth* (DEWHA 2009b). Random meanders were undertaken in areas of potential habitat. As the aim was to establish presence / absence across a wide area, transects were not undertaken as male GSM were readily flushed and therefore, presence was readily established.	November – December 2012	• Areas of suitable habitat surveyed across the Study Area over a period of approximately 17 days, between 10 am and 3 pm.
Golden Sun Moth	Habitat Mapping	September 2012 – December 2012	• Included in vegetation mapping of the Study Area.

Target Species	Survey Technique	Survey Period	Effort
Threatened Ecological Communities	Vegetation Mapping: all vegetation within the Study Area was surveyed and boundaries of different vegetation types were recorded on a GPS and aerial photographs. The *EPBC Act Policy Statement* for Box-Gum Grassy Woodland and Derived Native Grassland was used to determine whether a vegetation type met the criteria to be classified as the TEC (DEH 2006). Random meanders were undertaken throughout the Study Area and 20 m x 20 m quadrats were undertaken at selected sites that were representative of different vegetation types.	September 2012 – December 2012	All woodland areas were surveyed across the Study Area. Woodland areas with Yellow Box or Blakely's Red Gum or White Box were assessed against the criteria in the *EPBC Act Policy Statement* for Box-Gum Grassy Woodland and Derived Native Grassland. Random meanders were undertaken in all woodland areas and approximately 80% of grassland areas. Grassland areas that were not surveyed using the random meander method comprised pasture or cropping and were observed from the vehicle. Fifteen 20 m x 20 m quadrats were undertaken across the Study Area.
Threatened Plants	Areas of suitable habitat were surveyed during the flowering season for the species, in accordance with the flowering season at reference sites (where applicable). Random meanders were undertaken through all areas of suitable habitat within the Study Area.	September 2012 – December 2012	All areas of suitable habitat were targeted during the flowering season for each threatened plant. Random meanders were undertaken in all woodland areas and approximately 80% of secondary grassland areas. Grassland areas that were not surveyed using the random meander method comprised pasture or cropping and were observed from the vehicle.
All Threatened Species	Opportunistic Observations	July 2012 – February 2013	Opportunistic observations recorded at all times

Based on the literature review and information gathered during field survey, the results of the likelihood assessment are presented for threatened flora and threatened fauna below.

<u>Threatened Flora</u>

One threatened species, the Yass Daisy (*Ammobium craspedioides*) has been recorded in the Locality. The likelihood assessment identified an additional eight threatened flora species which have the potential to occur in the Study Area, as outlined below. Flora surveys have been undertaken throughout spring and summer 2012 - 2013. Surveys have targeted all the species listed in the table below which are either known, likely or have potential to occur in the Study Area. The results of the surveys have informed the final layout of the wind turbines and threatened flora will be predominantly avoided through sympathetic design of the wind farm layout.

Species Name	Common Name	Habitat and Distribution	Likelihood of occurrence within Study Area	EPBC Act Status*
Ammobium craspedioides	Yass Daisy	The Yass Daisy is found in moist or dry forest communities, Box-Gum Woodland and secondary grassland derived from clearing of these communities. It grows in association with a large range of eucalypts (*Eucalyptus blakelyi, E. bridgesiana, E. dives, E. goniocalyx, E. macrorhyncha, E. mannifera, E. melliodora, E. polyanthemos, E. rubida*) (OEH 2012).	Likely – recorded during recent field surveys in the Locality and optimal habitat occurs in the Study Area.	V

Species Name	**Common Name**	**Habitat and Distribution**	**Likelihood of occurrence within Study Area**	**EPBC Act Status***
Caladenia concolor	Crimson Spider Orchid	Occurs in regrowth woodland on granite ridge country that has retained a high diversity of plant species, including other orchids. The dominant trees are Blakely's Red Gum (*Eucalyptus blakelyi*), Red Stringybark (*E. macrorhyncha*), Red Box (*E. polyanthemos*) and White Box (*E. albens*); the diverse understorey includes Silver Wattle (*Acacia dealbata*), Hop Bitter-pea (*Daviesia latifolia*), Common Beard-heath (*Leucopogon virgatus*), Spreading Flax-lily (*Dianella revoluta*) and Poa Tussock (*Poa sieberiana*) (OEH 2012). Areas of suitable habitat were surveyed during the flowering season for the species, in accordance with the flowering season at reference sites. The species was not recorded during these surveys.	Potential - Optimal habitat present in woodlands with an undisturbed understory.	E
Diuris aequalis	Doubletail Buttercup	Occurs in forest, low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands (especially on the Great Dividing Range) (OEH 2012). Has not been recorded within the Study locality Areas of suitable habitat were surveyed during the flowering season for the species. Was not recorded during recent field surveys.	Likely - Optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	V
Eucalyptus robertsonii subsp. *hemisphaerica*	Robertson's Gum	Locally frequent in grassy or dry sclerophyll woodland or forest, on lighter soils and often on granite. Usually found in closed grassy woodlands in locally sheltered sites. Habitats include quartzite ridges, upper slopes and a slight rise of shallow clay over volcanics. Associated vegetation includes variously mixed woodlands of *Eucalyptus piperita, E. goniocalyx, E. dalrympleana, E. dives, E. mannifera* and *E. rossii* (OEH 2012). This species has not been recorded within the Study locality. Areas of optimal habitat were identified during recent surveys. The species was not recorded during recent field surveys.	Potential - Optimal habitat present in woodlands on the site.	V
Lepidium hyssopifolium	Aromatic Peppercress	The species occurs in a variety of habitats including woodland with a grassy understorey and grassland (OEH 2012). This species has not been recorded in the Study locality. Areas of optimal habitat were surveyed during recent surveys. The species was not recorded during recent field surveys.	Potential - Optimal habitat may be present in woodlands and secondary grassland.	E
Leucochrysum albicans var. *tricolor*	Hoary Sunray	The Hoary Sunray occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Plants can be found in natural or semi-natural vegetation and grazed or ungrazed habitat. Bare ground is required for germination (DSEWPaC 2012). This species has been recorded withinthe Study locality. Areas of optimal habitat were surveyed during the flowering season for the species. Was not recorded during recent field surveys.	Potential - Optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	E

Species Name	**Common Name**	**Habitat and Distribution**	**Likelihood of occurrence within Study Area**	**EPBC Act Status***
Pelargonium sp. Striatellum (G.W. Carr 10345)	Omeo Stork's Bill	The species has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities (OEH 2012). This species has not been recorded with the Study Locality.	Unlikely – Optimal or sub optimal habitat absent from the Study Area.	E
Prasophyllum petilum	Tarengo Leek Orchid	Occurs in open sites within Natural Temperate Grassland and grassy woodland in association with River Tussock (*Poa labillardieri*), Black Gum (*Eucalyptus aggregata*) and tea-trees (*Leptospermum* spp.) and within grassy groundlayers dominated by Kangaroo Grass under Box-Gum Woodland (OEH 2012).this species has been recorded within the Study Locality. This species has been recorded within the Study Locality. Areas of suitable habitat were surveyed during the flowering season for the species, in accordance with the flowering season at reference sites. The species was not recorded during these surveys.	Potential – Optimal may be habitat present in woodlands with an undisturbed understory.	E
Rulingia prostata	Dwarf Kerrawang	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland and Ephemeral Wetland floor, Blue leaved Stringybark (*E. 26gglomerate*) Open Forest, Brittle Gum (*E. mannifera*) Low Open Woodland and Scribbly Gum (*E. haemostoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest (OEH 2012). This species has not been recorded within the Study Locality.	Unlikely – Optimal and or sub optimal habitat absent from the Study Area.	E
Rutidosis leptorrhyncoides	Button Wrinklewort	Occurs in Box-Gum Woodland, secondary grassland derived from Box-Gum Woodland or in Natural Temperate Grassland; and often in the ecotone between the two communities (OEH 2012). This species has not been recorded within the Study Locality. Areas of optimal habitat were surveyed during the flowering season for the species. Was not recorded during recent field surveys.	Potential – Optimal or sub optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	E
Swainsona recta	Mountain Swainson Pea	Occurs in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*E. melliodora*), Candlebark Gum (*E. rubida*) and Long-leaf Box (*E. goniocalyx*). Grows in association with understorey dominants that include Kangaroo Grass (*Themeda australis*), poa tussocks (*Poa* spp.) and spear-grasses (*Austrostipa* spp) (OEH 2012). This species has not been recorded within the Study Locality. Areas of optimal habitat were surveyed during the flowering season for the species. Was not recorded during recent field surveys.	Potential - Optimal habitat may be present in woodlands with an undisturbed understory	E
**E = Endangered; V = Vulnerable*				

Threatened Fauna

One threatened insect and one threatened bird are known to occur in the Study Area (Golden Sun Moth (*Synemon plana*) and Superb Parrot (*Polytelis swainsonii*)); The likelihood assessment identified an additional five threatened fauna species which have the potential to occur in the Study Area: Pink-tailed Worm Lizard (*Aprasia parapulchella*), Striped Legless Lizard (*Delma impar*), Swift Parrot (*Lathamus discolour*), Eastern Long-eared Bat (*Nyctophilus corbeni*) and Koala (*Phascolarctos cinereus*). Fauna surveys have been undertaken throughout spring and summer 2012 – 2013 (refer to field methods table above), targeting the species listed in the table below which are either known, likely or have potential to occur in the Study Area.

The threatened fauna species likelihood assessment is provided below.

Species Name	Common Name	Habitat and Distribution	Likelihood of occurrence within Study Area	EPBC Act Status *
Insects				
Synemon plana	Golden Sun Moth	Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which the groundlayer is dominated by wallaby grasses (*Austrodanthonia* spp). Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks (inter-tussock spaces) is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses (*Austrostipa* spp.) or Kangaroo Grass (*Themeda australis*) (OEH 2012). Sites supporting Golden Sun Moth populations have generally been subject to light grazing. A number of populations occur in paddocks alongside where sheep and cattle graze. These sites have not undergone extensive pasture improvement or fertiliser usage and contain areas of primary Wallaby Grass cover. Based on recent observations at two ACT sites there is a possibility that Golden Sun Moth larvae feed on Chilean Needle Grass (*Nassella neesiana*) and Redleg Grass (*Bothriochloa macra*) (Braby & Dunford 2006). Subsequent surveys have recorded the Golden Sun Moth throughout the Study Area.	Known – species has been recorded within the Study Area during recent surveys	CE
Amphibians				
Litoria booroolongensis	Booroolong Frog	The Booroolong Frog occurs along permanent rocky streams with riffles and some fringing vegetation cover such as ferns, sedges or grasses (Anstis 2002; DECC 2005c; d; Robinson 1993, Cited in DSEWPaC 2012). Streams range from small slow-flowing creeks to large rivers (The Victorian Frog Group 1999, cited in DSEWPaC 2012). The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range (OEH). This species has not been recorded within the Study Locality or the Study Area. This species was not recorded during surveys; suitable habitat for this species had not been identified within the Study Area.	Unlikely - Optimal or sub optimal habitat does not occur within the Study Area.	E

Species Name	Common Name	Habitat and Distribution	Likelihood of occurrence within Study Area	EPBC Act Status *
Litoria raniformis	Growling Grass Frog	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat (OEH 2012). Has not been recorded during recent field surveys. This species has not been recorded within the Study Locality.	Unlikely – Optimal or sub optimal habitat does not occur within the Study Area.	V
Reptiles				
Aprasia parapulchella	Pink-tailed Worm-lizard	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks (OEH 2012). The closest record is approximately 23 km north-west of the Study Area. The species has not been recorded during targeted surveys. Surveys were undertaken in accordance with the Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011d) were optimal or sub optimal habitat was identified. The Study Area is within the known distribution for this species. Was not recorded during the field surveys.	Potential – Limited areas of sub optimal habitat occur.	V
Delma impar	Striped Legless Lizard	Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass (*Themeda australis*), spear-grasses (*Austrostipa* spp.) and poa tussocks (*Poa* spp.), and occasionally wallaby grasses (*Austrodanthonia* spp.) (OEH 2012). The closest record is approximately 24 km south of the Study Area. Surveys were undertaken in accordance with the Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011d). Was not recorded during the field surveys.	Potential – Limited areas of optimal habitat occur.	V
Birds				
Botaurus poiciloptilus	Australasian Bittern	The species is widespread in NSW and Victoria. In NSW, it occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers (Marchant & Higgins 1990; NPWS 1999; R. Jaensch June 2005, pers. Com, cited in DSEWPaC 2012). The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands (Marchant & Higgins 1990, cited in DSEWPaC 2012). Has not been recorded during recent field surveys.	Unlikely - due to absence of densely vegetated wetlands within the Study Area.	E

Species Name	**Common Name**	**Habitat and Distribution**	**Likelihood of occurrence within Study Area**	**EPBC Act Status ***
Lathamus discolor	Swift Parrot	The Swift Parrot is endemic to south-eastern Australia. It breeds only in Tasmania, and migrates to mainland Australia in autumn (Higgins 1999; Swift Parrot Recovery Team 2001, cited in DSEWPaC 2012). In north-eastern Victoria and on the western slopes of New South Wales, Mugga Ironbark and Grey Box are preferred. Box-ironbark occurs across a range of landforms, but drainage lines account for a disproportionately high number of Swift Parrot foraging sites. A variety of grassy woodland vegetation types are also used in these areas, including White Box woodland, Grey Box woodland and Grey Box/Yellow Gum woodland (Kennedy & Tzaros 2005; Swift Parrot Recovery Team 2001). White Box-Yellow Box-Blakely's Red Gum EEC woodland on the New South Wales tablelands and western slopes is utilised for foraging by this species (DSE, 2005; DEC NSW 2005, cited in DSEWPaC 2012). The species has not been recorded in the Study Area. This species has been recorded within the Study Locality. This species has not been recorded during field surveys. Species may fly over Study Area	Potential – Sub optimal habitat is restricted to some of the woodland areas.	E
Leipoa ocellata	Malleefowl	In New South Wales, the Malleefowl typically occurs west of the Great Dividing Range. Its distribution extends from Pilliga south-west to the districts of Griffith and Wentworth (Barrett et al. 2003; Benshemesh 2005b, cited in DSEWPaC 2012). It occupies shrublands and low woodlands that are dominated by mallee vegetation with sandy substrates and leaf litter. It also occurs in other habitat types including eucalypt or native pine Callitris woodlands, acacia shrublands, Broombush Melaleuca uncinata vegetation (Benshemesh 2005b; Marchant & Higgins 1993; Priddel & Wheeler 1995, cited in DSEWPaC 2012). Has not been recorded during recent field surveys. This species has not been recorded within the Study Locality.	Unlikely – Optimal or sub optimal habitat does not occur within the Study Area.	V, Mi
Polytelis swainsonii	Superb Parrot	In NSW the Superb Parrot mostly occurs west of the Great Divide, where it mainly inhabits the Riverina, the South-west Slope and Southern Tableland Regions: west to Mathoura, Boorooban, Goolgowi, and east to Canberra, Yass and Cowra. Its range extends north to around Narrabri and Wee Waa in the North-west Plain Region. They mainly inhabit forests and woodlands dominated by eucalypts, especially River Red Gums and box eucalypts such as Yellow Box or Grey Box. The species also seasonally occurs in box-pine (Callitris) and Boree (*Acacia pendula*) woodlands (Webster 1998, cited in DSEWPaC 2012). The Superb Parrot is dependent on aggregations of large hollow bearing trees and nests between September and December in hollow limbs or holes in the trunk of large eucalypts, mainly near water. In the inland slopes, most nests are in large Blakely's Red Gums, with many nest trees either dead or suffering from dieback (Manning et al. 2004). The entrance to the nesting cavity ranges from 5–13 m above the ground for nest trees on the inland slopes (Webster 1991; Webster & Ahern 1992; Manning et al. 2004). Birds nest deep within the tree hollow, sometimes even at ground level (North 1911). The same nest hollows are used in successive years, although it is not known if it is always by the same pair (Webster & Ahern 1992; Davey 1997;	Known - Recorded throughout the Study Area and breeding is known to occur.	V

		Manning et al. 2004). Occasionally a different hollow in the same tree is used, and nest trees may continue to be used even after the tree has died (DECCW in prep.). Much of the breeding habitat in the South-west Slopes is on private land (Webster 1988; Manning et al. 2004). Superb Parrots are rarely observed on the inland slopes during winter, with the few birds seen usually being breeding pairs (Webster 1988). Most of the breeding population from the inland slopes appears to move to the eucalypt-pine woodlands on the plains of west-central and north-central New South Wales (Webster 1988; DECCW in prep.).		
Rostratula australis	Australian Painted Snipe	The Australian Painted Stripe is most common in eastern Australia, they generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and clay pans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Targeted surveys and opportunistic observations have not recorded this species during recent field surveys. This species has not been recorded in the Study Locality.	Unlikely – Optimal habitat does not occur within the Study Area.	V, Mi,
Fish				
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	The Murray Cod is found in a wide range of warm water habitats, from clear, rocky streams to slow-flowing turbid rivers and billabongs (McDowall 1996, cited in DSEWPaC 2012). Generally, they are found in waters up to 5 m deep and in sheltered areas with cover from rocks, timber or overhanging banks (Kearney & Kildea 2001, cited in DSEWPaC 2012).	Unlikely – No optimal or sub optimal habitat present.	V
Macquaria australasica	Macquarie Perch	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water) (DSEWPaC 2012).	Unlikely - No optimal or sub optimal habitat present.	E
Mammals				
Nyctophilus corbeni	Eastern Long-eared Bat	The Eastern Long-eared Bat is distributed throughout inland NSW except in the north-west. It can be found in the Hunter Valley, extending from central NSW to the eastern Hunter Valley coast. The Eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodland and is known to roost in tree hollows, crevices, and under loose bark. Although records are sparse for this species targeted bat surveys in areas of potential habitat have been undertaken using Anabat ultrasonic detection and Harp Trapping as this species is very difficult to differentiate between other *Nyctophilus* species through call analysis. No Eastern Long-eared Bats were captured during trapping. Suitable habitat in the form box/ironbark/cypress-pine vegetation is not present on the Study Site. Has not been recorded within the Study Locality. Has not been recorded during recent field surveys.	Unlikely – No optimal habitat exists.	V

Species Name	**Common Name**	**Habitat and Distribution**	**Likelihood of occurrence within Study Area**	**EPBC Act Status ***
Petrogale penicillata	Brush-tailed Rock-wallaby	The Brush-tailed Rock Wallaby has declined significantly in the west and south of its range and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. They browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species has not been recorded within the Study Locality. This species has not been recorded west of Canberra. Has not been recorded during recent field surveys.	Unlikely – optimal habitat does not occur.	V
Phascolarctos cinereus	Koala	In NSW, the Koala inhabits a range of forest and woodland communities, including coastal forests, woodlands on the tablelands and western slopes, and woodland communities along watercourses. The primary feed trees in the Central and Southern Tablelands are the Ribbon Gum *Eucalytus viminalis* and the River Red Gum *Eucalyptus camaldulensis* with 18 secondary feed tree species including White Box *Eucalyptus albens*, Yellow *Box Eucalyptus melliodora*, Bundy *Eucalyptus nortonii* , Blakely's Red Gum *Eucalyptus blakelyi*, and Apple-topped Box *Eucalyptus bridgesiana*. There are two Stringybark supplementary species, including Red Stringybark *Eucalyptus macrorhyncha* and Yellow stringybark *Eucalyptus muelleriana* (OEH 2008). There are two records of this species within five kilometres of the Study Area. One is approximately three kilometres from a proposed turbine locations and was recorded in 1970, the other is from approximately 1.5 kilometres from a proposed turbine and was recorded in 1997 (OEH 2012). Feed trees exist within the site although these are paddock trees or amongst patchy vegetation. There have been no recent sightings and no evidence of Koala has been recorded during field surveys within areas of potential habitat. Has not been recorded during recent field surveys.	Potential – sub optimal habitat does occur	V
**CE=Critically Endangered; E = Endangered; V = Vulnerable; Mi=Migratory; Ma=Marine*				

Extensive surveys have been undertaken, targeting the species listed in the tables above that are known likely or have the potential to occur in the Study Area. The results of the surveys have informed the final layout of the wind turbines and important habitats for the species outlined above will primarily be avoided through sympathetic design. The design layouts have considered habitat condition for threatened fauna, with a number of turbines and access tracks being removed from the proposal or re-sited to minimise unnecessary impacts to MNES.

Endangered Ecological Communities

Three threatened ecological communities (TEC) were identified by the PMST to have the potential to occur in the search area. The results of the likelihood of occurrence assessment and field investigations are provided below.

Community	**EPBC Act Status***	**Potential to Occur within the Study Area**
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC	Known – scattered patches occur in the Study Area.
Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD	CEEC	Unlikely – was not recorded during recent surveys.
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC	Unlikely – was not recorded during recent surveys.
** CEEC = Critically Endangered Ecological Community; EEC = Endangered Ecological Community*		

One TEC has been identified in the Study Area: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland and Derived Grassland). The occurrence of this community is patchy and in some areas it occurs as derived native grassland. Patches of Yellow Box (*Eucalyptus melliodora*) with Blakelys Red Gum (*Eucalyptus blakelyi*) and other eucalypts occur across the Study Area. However, the understorey condition is generally poor and as such, the majority of these woodland patches do not meet the Commonwealth condition thresholds for this TEC. The current proposed layout avoids these woodland areas. Patches of grassland derived from Box Gum Woodland occur throughout the Study Area. The majority of these areas also do not meet the Commonwealth condition thresholds for Box-Gum Grassy Woodland and Derived Grassland. As such, only a small area of this TEC occurs in the Study Area (2.27 ha), largely along Tangmangaroo Road (see *Figure 3a*).

Natural Temperate Grassland has not been recorded in the Study Area. Areas of native grass within the Study Area are derived from Box-Gum Grassy Woodland and other Eucalypt Woodlands. Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia have not been recorded in the Study Area.

Nature and extent of likely impact

The three main ecological impacts associated with the development of wind farms are:

- Loss and degradation of Critically Endangered Ecological Communities / Endangered Ecological Communities as listed under the Commonwealth EPBC Act due to direct impacts such as clearing for turbine locations and access roads, and indirect impacts such as weed invasion;
- Loss or degradation of flora and fauna habitat due to direct impacts such as clearing for turbine locations and access roads, and indirect impacts to fauna species such as habitat avoidance; and
- Injury or death of birds and bats during operations due to collision with turbines and / or pulmonary barotrauma.

All three impacts can be managed by careful siting of turbines and related infrastructure, though it is expected that some impacts will still occur.

Assessments against the significant impact criteria for Matters of NES were undertaken for the species and TECs that are known, likely or have the potential to occur (DEWHA 2009). The assessments are provided in *Attachment 6* and a summary of the results is provided below.

Golden Sun Moth

Targeted surveys were undertaken for the Golden Sun Moth (GSM) during the flying season (late November 2012 – December 2013). The surveys were undertaken by experienced surveyors, Alison Rowell and Tom O'Sullivan and ERM personnel (see specialist reports in *Attachment 8*). Opportunistic sightings were also recorded throughout December and January.

The GSM were recorded in a number of locations across the Study Area in areas that comprise native grassland or grassy woodland habitat that was either dominated by, or contained a significant proportion of *Rytidosperma* spp. During the survey period, 105 male GSM and one female GSM were observed at 23 sites.

Infrastructure associated with the Project is proposed in areas where GSM were recorded and in areas of suitable habitat for the species. Through the iterative design process, areas of known and potential habitat have been avoided as much as possible. The Project does not involve clearing of habitat on a broad scale, rather, it comprises clearing of small areas and narrow linear areas. Many of the access roads are proposed along existing farm access tracks and there are areas comprising exotic pasture or weeds in which infrastructure can be placed.

Despite this, some areas of GSM habitat will be affected, given that the potential habitat for the GSM is widespread in the Study Area (810.19 ha) and access roads for the Project will be wider than existing farm tracks. However, as the development footprint is linear and narrow and the turbine and substation areas are small on a landscape scale, the overall development footprint both during construction and operation would only require clearing of a small area in comparison to the area of GSM habitat available in the Study Area. The completed infrastructure would not be at a scale that would impose a barrier to GSM movements.

GSM occur in grasslands and therefore, in areas that experience little shade. As such, the potential impacts of increased shade in GSM habitat caused by turbine towers has been considered. The potential impacts of shading are based on observed habitat characteristics of the species and have not undergone scientific experimentation and therefore, they are unconfirmed. Potential impacts include:

- changes to male and female behaviour during the flying season;
- changes to soil moisture and temperature, resulting in a change in species at a site; and
- cooler and moister soil conditions impacting the survival and growth of larvae.

These potential impacts have been associated with developments such as multi-storey carparks, which would create shading over a large area on a permanent basis (pers. comm. A Rowell and T O'Sullivan 2013). The wind turbines would create discrete narrow areas of shading that are not large enough or of a permanent nature (taking into account the movement of the sun) to create changes to soil moisture and temperature. The greatest shading impact would be the area around the base of the turbines, which will experience the largest area of shading for the longest periods of time. This area would already be disturbed for the turbine base. In terms of behaviour during the flying season, the extent of habitat in the Study Area is large and therefore, adult GSM would be able to avoid shaded areas (pers. comm. A Rowell and T O'Sullivan 2013).

The proposed action would result in removal of 100.88 ha of GSM habitat (82.48 ha permanent loss and 18.4 ha disturbed and rehabilitated after construction), which comprises 12% of the total area of habitat available in the Study Area. An assessment against the significant impact thresholds for the GSM in the *Significant Impact Guidelines for the critically endangered Golden Sun Moth* (DEWHA 2009b) was undertaken and is provided in *Attachment 6.* As greater than 0.5 ha of GSM habitat will be cleared, the proposed action meets both of the impact thresholds for habitat loss (refer *Attachment 6*). As such, the proposed action will have a significant impact on the GSM.

<u>Superb Parrot – Known to occur</u>

The Superb Parrot occurs throughout the Study Area and Locality. Extensive targeted survey for the species has been undertaken since July 2012 and into early 2013. Surveys have included identification of suitable nest hollows within 500 m of all proposed turbines, bird census surveys and bird utilisation surveys in which the flying height and direction are recorded at numerous sites across the Study Area. It is considered that the Superb Parrot population in the Study Area is an important population (in accordance with the significant impact criteria for vulnerable species) as the Boorowa region is well known as a key breeding area for Superb Parrots (Birdlife International 2013).

The species has been recorded 15 times and a total of 160 individuals across the Study Area in woodland areas, in stands of planted trees, foraging in native grassland, pasture and cropping paddocks (See *Figure 3b*). This species has not been recorded in the Study Area after the breeding season, which coincides with the end of the cropping season, ie all grain has been harvested. This may be an indication that the Study Area is utilised as foraging habitat and the species moves to areas of different resources after breeding. A total of 448 hollow bearing trees have been mapped within a buffer area of 500 meters of the proposed turbine locations. The distribution of these hollows is mostly uniform throughout the Study Area.

The primary impact to Superb Parrots associated with the Project is that of injury or death of individual Superb Parrots due to collision with turbines. The bird utilization surveys gathered data related to the flight activity of birds and this data has been used to assess the potential impacts to the species. The data obtained indicates that the species rarely flies within the height range of the proposed turbines (above 50 m).

The Project has been designed to avoid areas of woodland and paddock trees and therefore, is not likely to affect breeding habitat or cause fragmentation of habitat. Of the 405 mapped hollow bearing trees it is likely 15 will be removed as part of the proposed action. This constitutes approximately 3.34 % of the total number of hollow bearing trees available to the Superb Parrot within 500 m of a proposed turbine location. This species has been observed through bird utilisation surveys flying at a height that is below rotor height and thus, is unlikely to collide with a turbine. This species appears to utilise the Study Area on a seasonal basis that coincides with cropping practices and the breeding season. Foraging areas are widespread across the Locality and it is anticipated only 3.4 % of potential breeding habitat within 500 m of a proposed turbine will be impacted. Thus it is unlikely the proposed action will impact on the species, affect foraging or breeding habitat to the extent that the species is likely to decline. The results of the Significant Impact Assessment (see *Attachment 6*) completed for this species found that the proposed action would not significantly impact on the Superb Parrot.

Swift Parrot – Potential to Occur

The Swift Parrot is endemic to south-eastern Australia. It breeds only in Tasmania, and migrates to mainland Australia in autumn. This species prefers profuse flowering box ironbark woodlands in NSW for foraging habitat. No preferred foraging habitat has been identified within the Study Area. This species was not recorded during field surveys. The study Area does not form part of the annual migratory route for this species.

The project would not reduce the area of occupancy of the Swift Parrot. The project would not be fragmenting an existing important population as none has been identified within the Study Area. The Study Area would provide at best sub optimal foraging opportunities for the Swift Parrot. The proposed action will not result in the introduction of an invasive species to the habitat of the Swift Parrot. The Locality already comprises a highly fragmented landscape that is susceptible to the establishment of invasive species. The risk of collision is listed as a potential impact for this species. However, modelling of the cumulative collision risk impact to Swift Parrots was carried out in 2005 (Smales 2005). The results show that the cumulative impacts of collision with turbines on the overall population of Swift Parrots, for all current and presently proposed wind farms within the species' range, are very small (approximately one parrot every 10 years). It has been concluded from the Significant Impact Assessment (see *Attachment 6*) carried out on this species that the proposed action is unlikely to have a significant impact on the Swift Parrot.

Koala - Potential to Occur

In NSW, the Koala inhabits a range of forest and woodland communities, including coastal forests, woodlands on the tablelands and western slopes, and woodland communities along watercourses. The primary feed trees in the Central and Southern Tablelands are the Ribbon Gum *Eucalytus viminalis* and the River Red Gum *Eucalyptus camaldulensis* with 18 secondary feed tree species including White Box *Eucalyptus albens*, Yellow *Box Eucalyptus melliodora*, Bundy *Eucalyptus nortonii* , Blakely's Red Gum *Eucalyptus blakelyi*, and Apple-topped Box *Eucalyptus bridgesiana*. There are two Stringybark supplementary species, including Red Stringybark *Eucalyptus macrorhyncha* and Yellow stringybark *Eucalyptus muelleriana* (OEH 2008). The Koala has not been recorded within the Study Area and the results of habitat assessments indicate that this species has the potential to utilise the Study Area. Under the Significant Impact Guidelines an important Koala population has not been identified within the Study Area. This species was not recorded during field surveys. Secondary and supplementary habitat for this species does exist within the Study Area. The project would not reduce the area of occupancy of the Koala. This species has not been recorded within the Study Area. No habitat that is currently occupied by this species will be removed as part of the proposed action. Approximately 8.2 % of secondary and supplementary habitat would be removed as part of the proposal. No areas of optimal habitat would be removed as part of the proposed action and there is unlikely to be a disruption to the breeding cycle of this species as a result of the proposed action. It has been concluded from the Significant Impact Assessment (see *Attachment 6*) carried out on this species that the proposed action is unlikely to have a significant impact on the Koala.

Striped Legless Lizard - Potential to Occur

The Striped Legless Lizard is found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. It is also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Approximately 380.53 ha of secondary or sub optimal habitat for this species have been identified within the Study Area. Surveys were undertaken in areas of the most suitable habitat and this species was not recorded during the field surveys. No important populations have been for this species have been identified within the Study Area. The project would result in the removal of approximately 13 % of secondary habitat. The project would not reduce the area of occupancy of the Striped Legless Lizard in the Study Area. No habitat that is currently occupied by this species will be removed as part of the proposed action. The project would not be fragmenting an existing important population. The Study Area does not provide habitat that is critical to the survival of the Striped Legless Lizard. Some areas of habitat available to the Striped Legless lizard would be modified or destroyed. It has been concluded from the Significant Impact Assessment (see *Attachment 6*) carried out on this species that the proposed action is unlikely to have a significant impact on the Striped Legless Lizard.

Pink-tailed Worm-lizard - Potential to Occur

The Pink-tailed Worm-lizard inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. The closest record of this species is approximately 23 km north-west of the Study Area. The Study Area is within the known distribution for this species. The species has not been recorded during targeted surveys. Surveys were undertaken in accordance with the Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011d) where optimal or sub optimal habitat was identified.

No important populations have been for this species have been identified within the Study Area. Approximately 312.99 ha of secondary grassland dominated by native grasses has been identified within the Study Area. A small portion of this would form the most suitable habitat for this species due to the presence of small rocks in this community however this small portion would be regarded as sub optimal given the intensive grazing in those areas of the Study Area. The construction of the wind farm would result in the loss or modification of a small portion of habitat suitable for this species. The project would not reduce the area of occupancy of the Pink-tailed Worm-lizard. The project would not be fragmenting an existing important population. The Study Area does not provide habitat that is critical to the survival of the Pink-tailed Worm-lizard. The project involves the construction of access roads and the erection of wind turbine towers. The proposed action will not result in the introduction of an invasive species to the habitat of the Pink-tailed Worm-lizard. It has been concluded from the Significant Impact Assessment (see *Attachment 6*) carried out on this species that the proposed action is unlikely to have a significant impact on the Pink-tailed Worm-lizard.

<u>Box-Gum Grassy Woodland and Derived Grassland</u>

The majority of the Box-Gum Grassy Woodland and Derived Grassland across the Study Area does not meet the Commonwealth condition thresholds for this critically endangered ecological community. In particular, there are very few areas in which 12 or more native understory species (excluding grasses) occur or where there is natural regeneration of the dominant overstorey Eucalypts (DEH 2006). The Project will generally avoid areas in which canopy species occur.

Box-Gum Grassy Woodland and Derived Grassland occurs in the Study Area along Tangmangaroo Rd and extends along the road to the north and south of the Study Area. An overhead transmission line is proposed in this area. The area of Box-Gum Grassy Woodland within the Study Area comprises 2.27 ha and the area that is likely to be impacted is 0.26 ha.

An assessment against the significant impact criteria for critically endangered ecological communities (DEWHA 2009) was undertaken and is provided in *Attachment 6.* The proposed action is likely to have a significant impact on Box-Gum Grassy Woodland and Derived Native Grassland as it will reduce the extent of a critically endangered ecological community and increase fragmentation.

<u>Yass Daisy</u>

A population of Yass Daisy was identified approximately 750 m from the Study Area. It is considered to be an important population as it comprises over 200 individuals and therefore, is likely to be a key source population for dispersal. The species has not been observed within the Study Area despite targeted searches undertaken in the appropriate season (see Summary of Survey Effort table above). Areas comprising the species' woodland habitat will be avoided and therefore, will not be impacted by the Project. The species also occurs in derived native grassland and it is possible that areas of potential grassland habitat will be affected by the Project. The population of Yass Daisy that was recorded in the Locality occurs outside the Study Area and therefore, will not be affected by the Project. An important population of Yass Daisy has not been recorded in the Study Area. An assessment against the significant impact criteria for vulnerable flora species (DEWHA 2009) was undertaken for the Yass Daisy and is provided in *Attachment 6.* The Project would not result in a significant impact to an important population of the Yass Daisy.

<u>Other Threatened Plants</u>

An assessment against the significant impact criteria for endangered and vulnerable flora species (DEWHA 2009) was undertaken for the species that are likely or have the potential to occur in the Study Area and is provided in *Attachment 6.* The proposed action is unlikely to have a significant impact on the endangered or vulnerable flora species identified in the threatened flora table above.

3.1 (e) Listed migratory species

Description

A full listing of migratory species recorded within or predicted to occur within the Locality (10 km radius of the Study Area) has been compiled. These species were identified from the PMST search conducted on 01/03/2013. One Migratory species has been recorded in the Study Area (Rainbow Bee-eater) and six species may potentially occur or fly-over the Study Area (Fork-tailed Swift, Cattle Egret, Latham's Snipe, White-bellied Sea Eagle and Fork-tailed Swift). The assessment of likelihood is provided below.

Species Name	Common Name	Habitat and Distribution	Likelihood of occurrence within the Study Area	EPBC Act Status
Apus pacificus	Fork-tailed Swift	In NSW, the Fork-tailed Swift is recorded in all regions. This species is almost exclusively aerial. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They forage aerially, up to hundreds of metres above ground, but also less than 1 m above open areas or over water. Species has not been recorded in the Locality.	Unlikely – Sub optimal habitat	Mi, Mar
Ardea ibis	Cattle Egret	The Cattle Egret occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. They often forage away from water on low lying grasslands, improved pastures and croplands. It is commonly found in cattle fields and other farm areas that contain livestock. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. Species has not been recorded in the Locality.	Potential - Cattle Egrets may utilise the pasture and croplands, during wetter periods.	Mi, Mar
Gallinago hardwickii	Latham's Snipe	Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (Higgins & Davies 1996, cited in DSEWPaC 2012). Most birds spend the non-breeding period at sites located south of the Richmond River in New South Wales. In Australia, they generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (Frith et al. 1977; Naarding 1981, 1983, cited in DSEWPaC 2012).	Potential - may fly over the Study Area. Dams within the Study Area are unlikely to provide suitable foraging habitat.	Mi, Mar
Haliaeetus leucogaster	White-bellied Sea-Eagle	The White-bellied Sea-Eagle is distributed along the coastline of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia. The species is mostly recorded in coastal lowlands, but can occupy habitats up to 1400 m above sea level on the Northern Tablelands of NSW. Birds have been recorded at or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds (Boekel 1976; Favaloro 1944; Gosper 1981; Marchant & Higgins 1993, cited in DSEWPaC 2012).	Potential - may fly over the Study Area, however, suitable habitat does not occur in the Study Area.	Mi, Mar

Species Name	Common Name	Habitat and Distribution	Likelihood of occurrence within the Study Area	EPBC Act Status
Hirundapus caudacutus	White-throated Needletail	In eastern Australia the White-throated Needletail is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. The White-throated Needletail is almost exclusively aerial up to more than 1000 m above the ground (Coventry 1989; Tarburton 1993; Watson 1955, cited in DSEWPaC 2012). Although they occur over most types of habitat, they are most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy (Higgins 1999, cited in DSEWPaC 2012). Species has not been recorded in the Locality.	Potential - may fly over the Study Area. Species has not been recorded in the Locality.	Mi, Mar
Merops ornatus	Rainbow Bee-eater	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999, cited in DSEWPaC 2012). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (Higgins 1999, cited in DSEWPaC 2012).	Known -recorded within the Study Area.	Mi, Mar
Myiagra cyanoleuca	Satin Flycatcher	In NSW the Satin Flycatcher is widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains (Blakers et al. 1984; Cooper & McAllan 1995; Morris et al. 1981). They inhabit heavily vegetated gullies in wetter eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers et al. 1984; Emison et al. 1987; Officer 1969, cited in DSEWPaC 2012).	Unlikely - due to lack of optimal habitat.	Mi, Mar
Rhipidura rufifons	Rufous Fantail	The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns. This species has not been recorded within the Study Area and suitable habitat for this species does not exist within the Study Area.	Unlikely - due to lack of optimal habitat.	Mi,

Nature and extent of likely impact

Potential impacts to migratory species associated with the development of wind farms include:

- Loss or degradation of flora and fauna habitat due to direct impacts such as clearing for turbine locations and access roads, and indirect impacts to bird species such as habitat avoidance; and
- Injury or death of birds due to collision with turbines.

Extensive fauna surveys have been undertaken in the Study Area. It is unlikely that the Study Area provides an area of 'important habitat' for a migratory species, as described in the *Matters of National Environmental Significance Significant Impact Guidelines 1.1.* Therefore the Project is not expected to substantially modify, destroy or isolate an area of important habitat for a migratory species, and the project is not expected to result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

It is also considered unlikely that the Project will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. Therefore the project is not anticipated to result in significant impact to migratory species as described under the *Matters of National Environmental Significance Significant Impact Guidelines 1.1*.

3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2(c) instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

Description

The Project does not occur in the vicinity of any Commonwealth Marine Area.

Nature and extent of likely impact

The Project will not have any significantly adverse effects on any Commonwealth marine area.

3.1 (g) Commonwealth land

(If the action is on Commonwealth land, complete 3.2(d) instead. This section is for actions taken outside Commonwealth land that may have impacts on that land.)

Description

The Project does not occur within the Commonwealth land.

Nature and extent of likely impact

The Project will not have any significantly adverse effects on any Commonwealth land.

3.1 (h) The Great Barrier Reef Marine Park

Description

The Project does not occur in the vicinity of the Great Barrier Reef Marine Park.

Nature and extent of likely impact

There will be no impacts to the Great Barrier Reef Marine Park as a result if the proposed action.

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)

Is the proposed action a nuclear action?	X	No
		Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

3.2 (b)	**Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?**	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

3.2 (c)	**Is the proposed action to be taken in a Commonwealth marine area?**	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))

3.2 (d)	**Is the proposed action to be taken on Commonwealth land?**	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))

3.2 (e)	**Is the proposed action to be taken in the Great Barrier Reef Marine Park?**	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))

3.3 Other important features of the environment

3.3 (a) Flora and fauna

Flora

A total of 94 flora species have been recorded in the Study Area during field surveys. Fourteen of these are exotic species.

Three broad vegetation types occur in the Study Area as follows (refer *Figure 4*):

- Red Stringybark – Scribbly Gum – Red Box – Long-leaved Box Shrub Tussock Grass Open Forest;
- Box-Gum Grassy Woodland and Derived Native Grassland; and
- Modified Vegetation.

Red Stringybark – Scribbly Gum – Red Box – Long-leaved Box Shrub Tussock Grass Open Forest occurs on dry slopes and on ridgetops. The canopy is dominated by Red Stringybark (*Eucalyptus macrorhynca*) and Scribbly Gum (*Eucalyptus rossii*). The mid-storey is generally sparse and includes shrubs such as Urn Heath (*Melichrus urceolatus*) and Nodding Blue-lily (*Stypandra glauca*). In areas where the understorey is largely undisturbed, a diverse groundlayer of scattered native grasses, herbs and forbs occurs. Some grassland vegetation communities in the Study Area are derived from this vegetation type. Where this is the case, the canopy has been cleared and native grasses such as Wallaby Grasses (*Austrodanthonia* sp.) and Speargrasses (*Austrostipa* sp.) dominate.

Box-Gum Grassy Woodland and Derived Native Grassland occurs on lower slopes and gently undulating slopes in the Study Area. The canopy is dominated by Yellow Box (*Eucalyptus melliodora*) and Apple Box (*Eucalyptus bridgesiana*). The majority of the occurrences of this vegetation type lack a diverse groundlayer as they have undergone heavy grazing. The groundlayer in these areas are dominated by native and pasture grasses. In the small stands where a diverse native groundlayer occurs, this comprises a range of native herbs and forbs such as Scaly Buttons (*Leptorhyncos squamatus*) and Blue Bells (*Wahlenbergia spp.*). This vegetation type also occurs as derived native grassland and in these areas, the canopy species have been cleared and the area is dominated by native grasses, particularly Wallaby Grasses and Speargrasses, with pasture grasses also occurring.

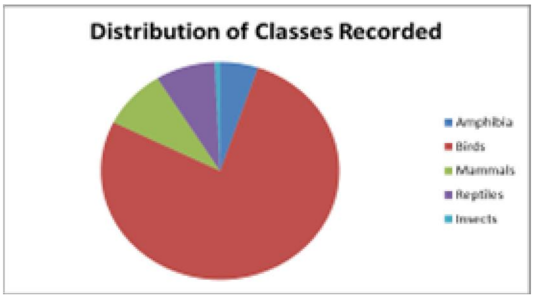
Areas of modified vegetation comprise planted non-indigenous native vegetation, cropping paddocks, areas of planted Pine Trees (*Pinus radiata*) and areas dominated by pasture grasses.

Fauna

A variety of fauna habitat resources exist within the Study Area, namely open country, paddock trees / open woodland, woodland/forest, rocky outcrops and aquatic habitats. The following table identifies the habitat resources that are present within each habitat type.

Habitat Type	**Habitat resources likely to be present**
Grassland / open country	Hollow bearing trees, water sources, tall grasses, low and open tussock grasses, scattered rocks, foraging resources.
Pasture with scattered trees	Hollow bearing trees, perches and roosts, low and open tussock grasses, scattered rocks, foraging resources.
Woodland / forest	Hollow-bearing trees, woody debris, hollow logs and forest litter, foraging resources.
Aquatic habitat	The majority of farm dams are small and have no fringing vegetation, however, they provide potential habitat for some water bird species and are a water source for a variety of native species.

Fauna surveys completed show a range of fauna species utilizing the habitat resources within the Study Area. A total of 136 species have been recorded from the Study Area and Locality through targeted surveys and opportunistic observations. A list of fauna species recorded within the Study Area to date by ERM in 2013 is provided in *Attachment 7* (note insectivorous Bat data is not included as it is yet to be finalised). A summary of the distribution of the Classes of fauna recorded is shown in the pie chart below.



Greening Australia Capital Region has assisted several landholders within the Study Area to establish Superb Parrot habitat enhancement sites. Methods used included revegetation, remnant protection, or patch enhancement, and grazing is limited in these patches. Three landholders within the Study Area currently have Superb Parrot habitat enhancement sites on their properties and ten additional sites within 6 km of the Study Area have also been established by Greening Australia Capital Region.

3.3 (b) Hydrology, including water flows

The Project is located in the Lachlan CMA. The Boorowa River runs from the south, around the western border to the north of the site where it meets the Lachlan River. There are a number of creeks in the vicinity of the Project site that drain to the Boorowa River. These include; Ryans Creek, Gotham Creek, Pipelay Creek, Harrys Creek, Kangiara Creek, and Langs Creek.

Based on the nature of the project and controls to be implemented, it is not expected that any of the local watercourses will be significantly affected by the development.

3.3 (c) Soil and Vegetation characteristics

Soils of the Goulburn 1:250,000 mapsheet were mapped by Hird (1991). Several polygons within the Study Area have not been attributed, however, of those that have, two soil groups (three soil landscapes) have been mapped: Shallow Soils (SLoc) and Yellow Earths (YEbi, YEct). Approximately 50% of the area mapped as Shallow Soils is covered in vegetation. The Yellow Earths have been more extensively cleared.

The majority of the Study Area has been cleared of native tree cover or native tree cover has been substantially reduced. Woodland and open forest areas still remain, however, the majority of the understorey and groundcover layers have been substantially modified due to grazing. Areas lacking tree cover comprise either native grassland derived from Eucalypt woodlands, areas of pasture or cropping.

Woodland occurs across the Study Area in small patches, as paddock trees or narrow linear corridors along roads. The largest and most intact woodland areas comprise Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest (refer *Figure 4*). Two larger patches of this vegetation community occur in the eastern section of the Study Area. This vegetation community also occurs in smaller patches throughout the Study Area and along roads, as paddock trees and as derived native grassland. Other woodland areas comprise Box Gum Woodland. This community occurs in small patches, along roadsides, as paddock trees and as derived native grassland. Much of the occurrence of Box Gum Woodland is in poor condition as it occurs in small patches that have been heavily grazed. The most intact areas of Box Gum Woodland occur along roads, although these are only narrow linear corridors.

The derived native grassland has undergone varying levels of grazing and pasture improvement and are dominated by native grasses such as Wallaby Grasses (*Austrodanthonia* sp.) and Speargrasses (*Austrostipa* sp.), with Kangaroo Grass (*Themeda australis*) and Wheatgrass (*Elymus scaber*). In general, these areas do not support a large variety of native forbs.

Areas of pasture comprise a mosaic of native and exotic grasses and forbs. Ruderal pasture weeds such as thistles (*Carthamus lanatus, Cirsium vulgare*), Horehound (*Marrubium vulgare*), mallow (*Malva* sp.) and Patterson's Curse (*Echium plantagineum*) occur in varying densities across the Study Area, however, generally were not observed in high densities. Sections of the Study Area are used for cropping and therefore, these areas do not support native species.

3.3 (d) Outstanding natural features

There are not considered to be any outstanding natural features in the Study Area.

3.3 (e) Remnant native vegetation

Remnant woodland patches are typically small and occur as isolated patches amongst grassland, pasture or cropping. The largest patches occur in the eastern section of the Study Area. Remnant woodlands also occur as linear corridors along roads. The remnant native vegetation comprises Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest, Box Gum Woodland and native grassland derived from these two communities.

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

The elevation of sites assessed, including access routes, ranges from approximately 550-760 m AHD. Elevation, geology, soil type and aspect influence the vegetation types found in different parts of the Study Area.

There are no proposed actions to be undertaken in a marine area.

3.3 (g) Current state of the environment

Prior to European settlement, the Study Area would have consisted of a mixture of open forest and woodland areas. Currently 42% of the Study Area has been cleared of tree cover and an additional 27% has had tree cover substantially reduced. Woodland and open forest areas still remain, however with the exception of those areas either ungrazed / intermittently grazed, the understorey and groundcover layers have been substantially modified. The rolling nature of the terrain has resulted in fairly even clearing on both the tops (recharge areas), slopes and bottom (discharge areas) of the hills within the Study Area.

Overall, the environment in the Study Area has been modified substantially, largely due to clearing and ongoing agricultural activities. The extent of modification varies across the Study Area, from pockets of largely intact native vegetation to scattered paddock trees and croplands. Areas that have undergone substantial modification still provide a range of habitat features for native species, including the threatened species that have been discussed in *Chapter 3.1.*

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

The Study Area does not occur in the vicinity of any Commonwealth heritage places

3.3 (i) Indigenous heritage values

The Study Area does not occur in the vicinity of any Indigenous heritage places listed under the EPBC Act. Indigenous heritage values are being addressed in the EA Report and in consultation with the local aboriginal communities.

3.3 (j) Other important or unique values of the environment

The Study Area is not located within any conservation reserve although Greening Australia Capital Region has assisted several landholders within the Study Area to establish Superb Parrot habitat enhancement sites and a section of one property is currently preserved under a 15 year conservation agreement as part of the federal Box-Gum Grassy Woodland Environmental Stewardship Program run by DSEWPaC. This area does not fall within the Study Area.

Mundoonen Nature Reserve, 36 km to the south-east of the centre of the Project site, is the closest nature reserve. A water-supply reserve is located 36 km to the south, Burrinjuck Nature Reserve is located 47 km to the south-south-west, Dananbilla Nature Reserve is located 47 km to the north-west, Koorawatha Nature Reserve is 56 km to the north-north-west and Keverstone State Forest is located 58 km to the north-east.

3.3 (k) Tenure of the action area (eg freehold, leasehold)

The majority of land in the proposed action area is freehold, privately owned land. There is a small percentage of Crown land that also falls in the proposed action area. For greater detail refer to Section 1.6.

3.3 (l) Existing land/marine uses of area

Agriculture is the major land use within both Boorowa LGA and Yass Valley LGAs, the majority of agricultural land being used for grazing. Land use mapping undertaken by OEH between October 1999 and October 2007 indicates that the other major land uses within Boorowa and Yass Valley LGAs are bushland and conservation – a statistic reflected in the Regional State of the Environment Report 2004-2009 (OCSE 2009).

According to OCSE (2009), Boorowa LGA does not contain any large reserves of Crown Land with the majority of land being within private ownership. In the past, extensive clearing of an estimated 85 % of the native vegetation within Boorowa LGA for farming has had a substantial impact, whereby almost all of the native vegetation communities have been cleared or substantially modified (OCSE 2009).

3.3 (m) Any proposed land/marine uses of area

There are no other known uses proposed for the Study Area.

4 Measures to avoid or reduce impacts

The key approach to the management of impacts to MNES for the proposed project relates to the layout design and the iterative process used to avoid impacts to ecological values where possible.

The design of the proposed wind farm has been undertaken in a manner that incorporates environmental, social and health constraints as far as is reasonably practical. Location of turbines, access tracks and associated infrastructure has been located in areas which maximise power generation, while avoiding impacts to ecological values. This has been an iterative process as information has come available, achieved through close consultation with ecological specialists and departmental agencies. The Project layout design has adopted avoidance and management measures in response to information gathered during the ecological field surveys, particularly in relation to threatened species and ecological communities listed under the EPBC Act and the NSW *Threatened species Conservation Act 1995*. This iterative planning approach has enabled Wind Prospect to avoid impacts wherever feasible, and to manage associated impacts such as habitat fragmentation and edge effects.

As described in Section 3, results of site investigations and assessment against the significant impacts criteria, the potential for significant impact to MNES as a result of the proposed project is considered unlikely for all relevant MNES with the exception of the GSM and Box-Gum Grassy Woodland and Derived Native Grassland CEEC. Approximately 100.88 ha of GSM habitat will be removed which is above the impact threshold defined by the significant impact guidelines. Approximately 0.26 ha of Box-Gum Grassy Woodland would be removed, reducing the extent of the CEEC and increasing fragmentation.

Management and mitigation measures will be implemented during both construction and operation of the proposed project to manage environmental impacts and will be supported by a number of management plans to be developed including a plan specific to the GSM and Box-Gum Grassy Woodland and Derived Native Grassland CEEC.

All contractors and visitors involved in both the construction phase and the operational phase will be made aware of the threatened flora and fauna species that are known or may be present and site inductions will incorporate education regarding management measures in place.

Construction Phase

The main activities of the construction phase relevant to environmental impacts include vegetation clearing, excavation and groundcover disturbance, and an increase in vehicular (and machinery) traffic in the Study Area. These activities will or have the potential to lead to:

- native flora and fauna habitat loss and / or disturbance
- potential for individual mortality by machinery and vehicle collision or trapping of fauna in open trenches
- increased noise disturbance to fauna
- spread of weed species
- potential for erosion and runoff to adjacent habitats
- dust generation
- increased bushfire risk
- increased hazardous materials spill risk

Management of each of these activities will be facilitated through the development and implementation of a Construction Environmental Management Plan (CEMP) for the proposed action.

Specific to MNES, the activities are likely to result in the loss of habitat for the GSM and clearing of Box-Gum Grassy Woodland and Derived Native Grassland CEEC. Other species with potential to occur may also be impacted in the event a population is identified. Measures to reduce general environmental impacts are summarised below as well as measures specific to the MNES potentially impacted.

Habitat Loss – General

Vegetation clearing will be minimised as far as practical during construction. Management measures will include:

- clear demarcation of the area to be cleared at the site (e.g. fencing or flagging) and on construction maps to limit the risk of accidental clearing (including adjacent habitats for MNES)
- laydown or temporary disturbance areas will be located in disturbed areas to avoid the unnecessary clearing of native flora and fauna habitat
- vehicles will remain on formed roads or tracks designed specifically for the purposes of the wind farm construction where possible
- care will to be taken when working near wooded areas to prevent damage to adjacent tree roots and indirect impact to habitat areas
- trenches will be excavated at least 15 m away from the base of trees where possible
- habitat features such as logs and large rocks within the proposed development areas will be relocated to adjacent areas to supplement habitat where possible.

Habitat Loss – Golden Sun Moth

Based on the infrastructure layout, which is considered to be a worst case scenario in terms of extent, 82.48 ha of GSM habitat will be removed (with an additional 18.4 ha disturbed and rehabilitated after construction). A GSM Management Plan will be developed and implemented to identify species and habitat specific measures such that the condition and extent of remaining habitat can be managed.

Management will include measures such as:

- movement through and disturbance to mapped GSM habitat will be minimised during the flying period, from November to January, if possible
- areas of habitat will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit risk of vehicles traversing through habitat accidently
- all vehicle movements will be contained to roads and tracks where possible.

Habitat Loss – Box-Gum Grassy Woodland and Derived Native Grassland

Based on the infrastructure layout, which is considered to be a worst case scenario in terms of extent, 0.26 ha of Box-Gum Grassy Woodland will be removed. A Box-Gum Grassy Woodland and Derived Native Grassland Management Plan will be developed and implemented to identify specific measures such that the condition and extent of remaining habitat can be managed.

Management will include measures such as:

- impacts will be minimised by siting the transmission lines and easements in areas that are already cleared for existing driveways and access gates where possible
- remaining Box-Gum Grassy Woodland areas will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit the risk of vehicles or machinery causing damage to these areas.

Habitat Loss – Potential to Occur Species

Ecological survey effort undertaken for the proposed project identified a number of species with potential to occur. Assessment against SEWPAC impact criteria identified it is unlikely that a significant impact will result from vegetation clearing to these species however after extensive survey effort there remains an element of uncertainty around the presence of important populations within the Study Area. To manage this risk, targeted pre-clearance surveys will be undertaken for each of the species with potential to occur (identified in Section 3.1(d)).

A pre-clearance protocol will be designed to define how each species will be targeted and will outline actions to be undertaken in the event a population is detected. Actions will include, but not limited to, the development and implementation of a species specific management plan that will identify management measures for the species during construction and operation.

Fauna Mortality

Vehicle and machinery activities have the potential to lead to mortality of fauna individuals. To manage the risk of fauna collision speed limits will be applied to travel within the site and appropriate signage provided. During vegetation clearing activities in known or potential fauna habitat areas fauna spotters will be present to remove and relocate individuals to adjacent habitats.

Fencing will be erected along open trenches to prevent fauna falling into open cavities. Trench monitoring will be undertaken to rescue trapped fauna and the frequency and details of monitoring will be outlined in the CEMP.

Increased Noise Disturbance

Increased activity in the Study Area and the use of machinery will result in an increase in noise locally. During the construction phase, construction movement adjacent to habitats for MNES will be minimised during breeding seasons. The breeding periods for susceptible threatened species known, likely or with potential to occur (Swift Parrot, Superb Parrot, Koala and migratory bird species with potential to occur) will be identified within the CEMP and considered during construction planning. Loud noises and excessive vibrations will not be undertaken during these periods where possible.

Weed Spread

The spread of weeds is a high risk with any large scale development that extends over a large geographic area. Stringent weed management measures will be implemented during and post construction to avoid weed invasion and edge effects across the Study Area, including adjacent habitats for threatened species. These measures will include (but not limited to):

- control of runoff that may contain weed seeds
- washing down of vehicles to prevent the spread of weeds between areas
- piling of soil that may contain seeds of exotic species at least 50 m away from creeks, drainage lines and other areas of native vegetation, to prevent spread into adjacent areas during rainfall or wind events
- topsoil recovery will be undertaken in areas that have a high proportion of native vegetation and few weeds in the ground layer of vegetation. All onsite staff and contractors will be made aware of noxious weeds present at the site and ways to prevent their spread
- any soil, rubble etc imported to the site is certified that it is free of weeds and weed seed
- revegetation of temporarily disturbed areas with locally native species characteristic of the cleared vegetation type

Erosion, Runoff and Dust

Erosion and sediment control measures will be included in the CEMP to limit runoff to adjacent habitat areas and watercourses. Details will include devices to be installed, monitoring requirements and corrective actions. Management measures will include:

- all erosion and sedimentation control devices regularly checked, cleared and repaired, particularly after periods of heavy rainfall
- rehabilitation and stabilisation methods to limit erosive and dust generation potential of earth areas exposed that are not required for permanent infrastructure
- disturbed soil surfaces should be stabilised as soon as practicable after works have ceased in the area
- stockpiles will be covered to prevent the loss of material during high wind and rain events, and appropriate sediment barrier fencing will be used in areas to inhibit the flow of sediment into surrounding areas
- stock pile locations will consider shelter from the wind where practicable

Before any remediation works that will further disturb the soil, grazing will be removed or minimised (with landowner agreement) and the grass allowed time to recover to minimise any areas of bare soil.

<u>Bushfire Risk</u>

Fire prevention measures will be outlined in a site Bushfire Emergency Plan (BEP). Basic fire-fighting equipment will be available at each active construction location and include fire extinguishers, knapsacks and other equipment suitable for initial response actions. Access tracks should be constructed with intermittent passing bays and with appropriate vertical clearance and suitability for all weather conditions such that emergency access is facilitated. Communications using mobile telephone and UHF radio communications where no mobile service is available should be active at all times. Identification of individual turbine locations and access gates using an appropriate numbering system for fire-fighting or emergency services. Maps will be provided to local rural fire service groups outlining turbine locations, access to nearest gates, keys to locked gates, location of reliable water supplies such as dams, locations of suitable landing areas for fire fighting aircraft.

<u>Hazardous Materials</u>

Hazardous materials such as oils will be used during the construction and operational phases of the proposed action. Storage of hazardous materials will be in designated areas specifically designed and constructed for containment. Emergency spill response procedures, including the location of spill kits, will be outlined in the project CEMP.

Hazardous materials will be handled and stored according to regulatory requirements and Australian Standards AS1940.

Operational Phase

The main activities of the operation phase relevant to environmental impacts include operation of the turbines (i.e rotation of the blade) and vehicular access for maintenance. These activities will have the potential to lead to:

- fauna - turbine collision or barotrauma
- hazardous materials spill risk
- change in fire regime

Management of each of these activities will be facilitated through the development and implementation of an Operational Environmental management Plan.

Specific to MNES, the activities are considered unlikely to have a significant impact.

<u>Turbine Collisions or Barotrauma</u>

The risk of turbine strike or barotrauma is considered low for the threatened bird and bat species that may utilise the site. Monitoring will be undertaken in accordance with the relevant monitoring guidelines provided by the Australian Wind Energy Association. Monitoring requirements will be outlined within a project specific monitoring program for MNES. The monitoring program will be developed in consultation with the relevant government environmental departments/agencies as required.

<u>Hazardous Materials</u>

Hazardous material will be used in the functioning of the infrastructure and vehicle used to access the site for maintenance. Spill containment will be provided as a prevention measure at locations where oil is present should the equipment's default containment become faulty. Emergency spill response procedures, including the location of spill kits, will be outlined in the project OEMP.

Hazardous materials will be handled and stored according to regulatory requirements and Australian Standards AS1940.

<u>Bush Fire</u>

The wind farm operator will maintain a limited fire fighting capability on site to control small grass fires and to assist fire authorities to control any larger fires that may occur on the site. All site vehicles will have diesel engines and will utilise designated site access roads to minimise the likelihood of igniting dry grass. On very rare occasions it is possible that equipment malfunctions could cause a fire on site and appropriate management plans will be developed to outline actions to be undertaken in such an event. Agreed procedures for liaison with fire fighting authorities will be developed to address the possibility of a bushfire occurring on-site.

Offsets

As additional information becomes available and the development footprint is finalised the final residual impact to MNES will be refined. The footprint used in this assessment is the worst case scenario. An offset strategy will be developed to identify and document offset obligations under both state and federal legislation and identify the strategy to achieving the appropriate offsets. The offset strategy will meet the requirements of both NSW and Commonwealth offsetting guidelines.

5 Conclusion on the likelihood of significant impacts

Identify whether or not you believe the action is a controlled action (ie. whether you think that significant impacts on the matters protected under Part 3 of the EPBC Act are likely) and the reasons why.

5.1 Do you THINK your proposed action is a controlled action?

	No, complete section 5.2
X	Yes, complete section 5.3

5.2 Proposed action IS NOT a controlled action.

Specify the key reasons why you think the proposed action is NOT LIKELY to have significant impacts on a matter protected under the EPBC Act.

5.3 Proposed action IS a controlled action

Type 'x' in the box for the matter(s) protected under the EPBC Act that you think are likely to be significantly impacted. (The 'sections' identified below are the relevant sections of the EPBC Act.)

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
X	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

The proposed action has the potential to impact EPBC listed Box-Gum Woodland as well as areas of potential habitat for EPBC listed threatened species resulting in habitat loss and fragmentation, potential for collision and barotrauma fatalities. If the Project is deemed to be a controlled action, it is considered preferable from the proponent's perspective that the project be assessed under the Accredited Process, given that the majority of the species and communities listed under the EPBC Act which are known, likely or have potential to occur are also listed under the NSW TSC Act.

6 Environmental record of the responsible party

NOTE: If a decision is made that a proposal needs approval under the EPBC Act, the Environment Minister will also decide the assessment approach. The EPBC Regulations provide for the environmental history of the party proposing to take the action to be taken into account when deciding the assessment approach.

		Yes	No
6.1	Does the party taking the action have a satisfactory record of responsible environmental management? Wind Prospect CWP, through its parent company Wind Prospect, has over 18 years of experience of successful wind farm development worldwide, and has been involved in over 2,500MW of approved wind generation (both onshore and offshore) with 380MW under construction or in operation throughout Australia. The South Australian office has significant experience in the mid-north region of South Australia, having successfully developed 265MW of wind energy projects in the area since 2003. Wind Prospect CWP has significant experience in the Monaro region having gained recent approval for the Boco Rock Wind Farm (2010) and is currently seeking consent for several other wind farm projects across NSW, namely: • Sapphire Wind Farm (Under Assessment, Controlled Action) • Crudine Ridge Wind Farm (On Exhibition, Controlled Action) • Golspie Wind Farm (DGR's Issued) • Uungula Wind Farm (DGR's Issued) Wind Prospect CWP is committed to renewable energy projects that respect the environment and benefit communities. For all of its projects Wind Prospect CWP ensures that wind farm planning and design is carried out to avoid significant environmental areas and minimise environmental impacts, and prepares a detailed Environmental Management Plan.	X	
6.2	Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources? If yes, provide details		X
6.3	If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework? If yes, provide details of environmental policy and planning framework Wind Prospect operates under the following environmental policies: • Environmental Policy • Carbon Neutral Policy • Project-specific Environmental Management Plans	X	
6.4	Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?	X	

Provide name of proposal and EPBC reference number (if known)

Wind Prospect has previously referred the following actions under the EPBC Act:

- Energy generation and supply, Crudine Ridge Wind Farm (Ref: 2011/6206)
- Energy generation and supply, Sapphire Wind Farm (Ref: 2011/5854)
- Energy generation and supply, Boco Rock Wind Farm (Ref: 2009/4905)
- Construction and operation of electrical connection line for Barunga Wind Farm (Ref: 2004/1803)
- Energy generation and supply, Hallett Wind Farm (Ref: 2004/1715)
- Energy generation and supply, Barunga Wind Farm (Ref: 2004/1357)
- Construction of a 14 km, 33kV distribution line, including connection to the Lake Bonney Central Wind Farm and Snuggery sub-station (Ref: 2003/1108)
- Transmission line servicing Yabmana Wind Farm (Ref: 2003/981)
- Energy generation and supply, Troubridge Point Wind Farm (Ref: 2003/952)
- Energy generation and supply, Lake Bonney Central Wind Farm (Ref: 2002/691)
- Energy generation and supply, Yabmana Wind Farm (Ref: 2001/530)
- Energy generation and supply, Green Point Wind Farm (Ref: 2001/529)

7 Information sources and attachments

(For the information provided above)

7.1 References

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http://www.environment.gov.au/epbc/publications/grey-box-booklet.html

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7.2 Reliability and date of information

The potential impacts to threatened Flora and Fauna including potential threatened Ecological Communities are based on desktop studies and field surveys undertaken by WPCWP in 2012, and targeted surveys undertaken by ERM which commenced in 2012 running through to 2013. This information has been reviewed to inform this referral and the planning process.

7.3 Attachments

Indicate the documents you have attached. All attachments must be less than two megabytes (2mb) so they can be published on the Department's website. Attachments larger than two megabytes (2mb) may delay the processing of your referral.

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project Locality (section 1)	✓	Att01: *Figure 1*-Locality Att02: *Figure 2* -Wind Farm Proposed Layout
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)		Att03: *Figure 3a* – Matters of National Environmental Significance Att04: *Figure 3b* - Matters of National Environmental Significance Att05: *Figure 4* – Vegetation Mapping
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)		
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)		
	copies of any flora and fauna investigations and surveys (section 3)	✓	Att06: Assessments against significant impact criteria Att07: Fauna Species List
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)	✓	Att08: Specialist Reports: GSM
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)		

8 Contacts, signatures and declarations

NOTE: Providing false or misleading information is an offence punishable on conviction by imprisonment and fine (s 489, EPBC Act).

Under the EPBC Act a referral can only be made by:

- the person proposing to take the action (which can include a person acting on their behalf); or
- a Commonwealth, state or territory government, or agency that is aware of a proposal by a person to take an action, and that has administrative responsibilities relating to the action[1].

Project title:

8.1 Person proposing to take action

This is the individual, government agency or company that will be principally responsible for, or who will carry out, the proposed action.

If the proposed action will be taken under a contract or other arrangement, this is:

- the person for whose benefit the action will be taken; or
- the person who procured the contract or other arrangement and who will have principal control and responsibility for the taking of the proposed action.

If the proposed action requires a permit under the Great Barrier Reef Marine Park Act[2], this is the person requiring the grant of a GBRMP permission.

The Minister may also request relevant additional information from this person.

If further assessment and approval for the action is required, any approval which may be granted will be issued to the person proposing to take the action. This person will be responsible for complying with any conditions attached to the approval.

If the Minister decides that further assessment and approval is required, the Minister must designate a person as a proponent of the action. The proponent is responsible for meeting the requirements of the EPBC Act during the assessment process. The proponent will generally be the person proposing to take the action[3].

Name	Adrian Maddocks
Title	Senior Development Manager
Organisation	Bango Wind Farm Pty Ltd
ACN / ABN (if applicable)	38 143 401 067
Postal address	PO Box 1708, Newcastle, NSW 2300
Telephone	02 4013 4640/0488 798 311
Email	adrian.maddocks@wpcwp.com.au
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence. I agree to be the proponent for this action. I acknowledge that I may be liable for fees related to my proposed action following the introduction of cost recovery under the EPBC Act.
Signature	A Maddocks

Date 27/3/13

[1] If the proposed action is to be taken by a Commonwealth, state or territory government or agency, section 8.1 of this form should be completed. However, if the government or agency is aware of, and has administrative responsibilities relating to, a proposed action that is to be taken by another person which has not otherwise been referred, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.

[2] If your referred action, or a component of it, is to be taken in the Great Barrier Reef Marine Park the Minister is required to provide a copy of your referral to the Great Barrier Reef Marine Park Authority (GBRMPA) (see section 73A, EPBC Act*). For information about how the GBRMPA may use your information, see http://www.gbrmpa.gov.au/privacy/privacy_notice_for_permits.*

[3] If a person other than the person proposing to take action is to be nominated as the proponent, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.

8.2 Person preparing the referral information (if different from 8.1)

Individual or organisation who has prepared the information contained in this referral form.

Name	Murray Curtis
Title	Partner
Organisation	Environmental Resources Management Australia Pty Ltd
ACN / ABN (if applicable)	ABN – 12 002 773 248; ACN – 002 773 248
Postal address	PO Box 5711 Port Macquarie NSW 2444
Telephone	02 65847155
Email	admin@erm.com
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence.

Signature M Curtis Date 27.3.13

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Notification of

REFERRAL DECISION AND DESIGNATED PROPONENT – controlled action
DECISION ON ASSESSMENT APPROACH – preliminary documentation

Bango Wind Farm, NSW (EPBC 2013/6810)

This decision is made under section 75 and section 87 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

proposed action	To construct and operate a wind farm and associated infrastructure, near Boorowa, NSW [See EPBC Act referral 2013/6810]

decision on proposed action	The proposed action is a controlled action. The project will require assessment and approval under the EPBC Act before it can proceed.
relevant controlling provisions	• Listed threatened species and communities (sections 18 & 18A) • Listed migratory species (sections 20 & 20A)
designated proponent	Bango Wind Farm Pty Ltd ACN: 143 401 067

assessment approach	The project will be assessed by preliminary documentation.
Decision-maker	
Name and position	James Tregurtha Assistant Secretary South Eastern Australia Environment Assessment Branch
Signature	
date of decision	7 May 2013

Appendix 2

Bango Wind Farm Biodiversity Response to Submissions

ERM Australia, 2017

Environmental Resources Management Australia Pty Ltd

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AUSTRALIA

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9 May, 2017

Kristin Old
CWP Renewables Pty Ltd
Floor 6, 45 Hunter St
NEWCASTLE, NSW, 2300

Our Reference: *0404134 BWF RTS_Draft V4*

Attention: **Kristin Old**

Dear Kristin,

RE: BANGO WIND FARM - BIODIVERSITY RESPONSE TO SUBMISSIONS

This letter details the biodiversity response to submissions (RtS) following public exhibition of the Bango Wind Farm (BWF) (the project). The letter is focussed on addressing the NSW Office of Environment (OEH) submission (DOC16/487191 dated 28/11/16). A number of public submissions relating to the ecological assessment were also been received during the public exhibition, and where these directly relate to the relevant OEH submissions we have included supportive comment in this letter.

We have also provided necessary detail to respond to matters raised by Department of Planning and Environment in their response to the EIS (2013), for the following key matters:

- Threatened and 'at risk' species – The following report and related Appendices consider any changes in possible impact on threatened or at risk species as a result of the revised wind turbine layout.
- Biobanking assessment – At this stage the Biobanking process has consisted of identifying candidate offset sites near the project, refining suitable candidate lands and the biodiversity characteristics of those lands, as well as confirming the willing participation of land owners. The results of this have been detailed in *Annex G.*
- Tanmangaroo & Wargeila Rds – ERM has completed a roadside vegetation task to identify vegetation types 10 m either side of any culverts, bridges and causeways (collectively referred to as drainage line crossings) that cross the roadways, and to identify any ecologically unconstrained areas of road verge that could potentially be used as passing areas.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

Offices worldwide

Additional survey mapping and data analysis – The following report and related Appendices presents required updates to the Ecological Assessment (2013). Whilst no additional field surveys were completed (with the exception of Roadside vegetation mapping), re-analysis of existing data and associated mapping was conducted. The response detail is contained in the body of this letter and attachments under the following themes:

- Endangered Ecological Communities (EECs)
- Habitat Loss
- Offset Calculations and BioBanking Assessment
- Woodland Birds
- Superb Parrots
- Hollow Bearing Trees and Bats
- Diurnal Birds of Prey and Collision Risk Modelling (CRM)
- Golden Sun Moth (GSM)
- Reptiles
- Squirrel Glider and Habitat Fragmentation
- Cumulative and Indirect Impacts
- Other Threatened Species Issues

The project layout has changed and reduced in size since the layout was placed on public exhibition. The amended layout comprises a significant reduction in the number of wind turbine generators (WTGs), removed as an avoidance measure to avoid impacts to neighbouring residents and sensitive ecological features identified during the Ecological Assessment (EA) (ERM 2013 in CWPR 2013).

The project is proceeding through this RtS process with two layouts that differ slightly in the number of WTGs and associated proposed infrastructure layouts: Planning Layout (PL) 1 is for 75 turbines, and PL2 for 61 turbines. Both PL1 and PL2 are considered separately in the below analyses, and in some cases the layouts have been merged to produce a worst-case impact area scenario. The project changes include:

- Reduction of WTGs from 122 to 75 (PL1) and from 96 to 61 (PL2);
- Removal of the Langs Creek cluster of WTGs;
- Removal of various other WTGs;

- No wind turbine or substation component oversize vehicle access to project via Tangmangaroo Road and Wargeila Road; and
- All wind turbine or substation component oversized vehicle access would now enter site through a single access point along Lachlan Valley Way.

1. ENDANGERED ECOLOGICAL COMMUNITIES (EECS)

Refer to *Annex A* for more information on this matter.

2. HABITAT LOSS

A summary of all fauna habitat types equivalent to vegetation zones and the associated area impacted by the development footprint has been presented in *Table 2.1*. *Annex A* contains a description of vegetation mapping and assignment of Biometric Vegetation Types (BVTs) and related condition classes describing the various structural characteristics (the BVT and the condition class together comprise what is referred to as the 'vegetation zone'). This classification is suitable for the relevant species or species groups as there are clear vegetation structural rules that apply to categorising each vegetation zone.

Table 2.1 Fauna Habitat Type, Composite Vegetation Zone and Area Impacted by Development Footprint

Fauna Habitat Type	Equivalent Vegetation Zone Code	Component Vegetation Zone Name	ERM (2013) Exhibited Permanent Area (ha)	ERM (2013) Exhibited Temporary	ERM (2013) Exhibited Total	PL1 Permanent	PL1 Temporary	PL1 Total	PL1 Total Differential from Exhibited EA (ERM 2013)	PL2 Permanent	PL2 Temporary	PL2 Total	PL2 Total Differential from Exhibited EA (ERM 2013)	Merged ('Worst Case') Permanent	Merged ('Worst Case') Temporary	Merged ('Worst Case') Total	Merged ('Worst Case') Total Differential from Exhibited EA (ERM 2013)
Native Grassland	LA103_MG_P	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands - Mod_Good - Poor	42.69	6.47	**49.16**	30.96	5.37	**36.33**	**-12.83**	29.90	4.34	**34.24**	**-14.92**	32.16	5.55	**37.71**	**-11.45**
Native Woodland	LA103_MG_C	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands - Mod_Good – Roadside	6.58	2.04	**8.62**	4.77	3.64	**8.41**	**-0.21**	4.21	2.20	**6.41**	**-2.21**	5.13	3.74	**8.87**	**0.25**
	LA103_MG_S	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands - Mod_Good – Medium															
	LA103_MG_H	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands - Mod_Good – High															
	LA182_MG	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion - Mod_Good															
Exotic Grassland	LA103_L	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands – Low	55.5	15.42	**70.92**	24.77	6.77	**31.53**	**-39.39**	24.47	6.29	**30.75**	**-40.17**	26.37	6.60	**32.96**	**-37.96**
	LA182_L	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion – Low															

Identification of fauna habitat areas (species or group) impacted by the project has been presented in *Table 2.2*. Specific threatened species habitat extent, quality and utility have been identified in the relevant sections below for the Golden Sun Moth, Superb Parrot and woodland birds.

Table 2.2 Fauna habitat areas (species or group)

Species	Impact	Habitat Type or Vegetation Zone	Totals in Area (ha) or Number (HBTs)* ERM (2013) Exhibited Total**	PL1 Permanent	PL1 Temporary	PL1 Total	PL1 Permanent Differential from Exhibited EA (ERM 2013)***	PL2 Permanent	PL2 Temporary	PL2 Total	PL2 Total Differential from Exhibited EA (ERM 2013)***	Merged ('Worst Case') Permanent	Merged ('Worst Case') Temporary	Merged ('Worst Case') Total	Merged ('Worst Case') Total Differential from Exhibited EA (ERM 2013)***
Superb Parrot	Habitat removal	Refer Section 5													
Powerful Owl, Barking Owl	Habitat removal	LA103_MG_C	6.58	4.77	3.64	8.41	-1.81	4.21	2.20	6.41	-0.57	5.13	3.74	8.87	-1.45
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	15	NA	NA	11	-4	NA	NA	9	-6	NA	NA	11	-4
Woodland Birds	Habitat removal	Refer Section 4													
Regent Honeyeater, Swift Parrot	Habitat removal (Foraging only)	LA103_MG_C	6.58	4.77	3.64	8.41	-1.81	4.21	2.20	6.41	-0.57	5.13	3.74	8.87	-1.45
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	15	NA	NA	11	-4	NA	NA	9	-6	NA	NA	11	-4
Turquoise Parrot, Gang- gang Cockatoo	Habitat removal, HBTs	LA103_MG_C	6.58	4.77	3.64	8.41	-1.81	4.21	2.20	6.41	-0.57	5.13	3.74	8.87	-1.45
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	15	NA	NA	11	-4	NA	NA	9	-6	NA	NA	11	-4
White-fronted Chat	Habitat removal	LA103_MG_P	42.69	30.96	5.37	36.33	-11.73	29.90	4.34	34.24	-12.79	32.16	5.55	37.71	-10.53
Squirrel Glider	Habitat removal, Fragmentation	LA103_MG_C	0.26												
		LA103_MG_H													
Koala	Habitat removal, Fragmentation	LA103_MG_C	6.58	4.77	3.64	8.41	-1.81	4.21	2.20	6.41	-0.57	5.13	3.74	8.87	-1.45
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	15	NA	NA	11	-4	NA	NA	9	-6	NA	NA	11	-4
Striped Legless Lizard	Habitat removal, disturbance	LA103_MG_P	42.69	30.96	5.37	36.33	-11.73	29.90	4.34	34.24	-12.79	32.16	5.55	37.71	-10.53
Pink-tailed Worm lizard	Habitat removal, disturbance	LA103_MG_P	42.69	30.96	5.37	36.33	-11.73	29.90	4.34	34.24	-12.79	32.16	5.55	37.71	-10.53
Rosenbergs goanna	Habitat removal, disturbance	LA103_MG_C	6.58	4.77	3.64	8.41	-1.81	4.21	2.20	6.41	-0.57	5.13	3.74	8.87	-1.45
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	15	NA	NA	11	-4	NA	NA	9	-6	NA	NA	11	-4

Spotted Harrier, Little Eagle, Square-tail Kite	Habitat removal, Blade strike	LA103_MG_C	**6.58**	4.77	3.64	**8.41**	**-1.81**	4.21	2.20	**6.41**	**-0.57**	5.13	3.74	**8.87**	**-1.45**
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	**15**	NA	NA	**11**	**-4**	NA	NA	**9**	**-6**	NA	NA	**11**	**-4**
Golden Sun Moth	Habitat removal	Refer Section 8													
Bats	Habitat removal, Blade Strike	LA103_MG_C	**6.58**	4.77	3.64	**8.41**	**-1.81**	4.21	2.20	**6.41**	**-0.57**	5.13	3.74	**8.87**	**-1.45**
		LA103_MG_H													
		LA103_MG_S													
		LA182_MG													
		HBTs	**15**	NA	NA	**11**	**-4**	NA	NA	**9**	**-6**	NA	NA	**11**	**-4**

*HBTs not identified as temporarily lost and considered all as permanent

**permanent impacts only shown in Table 6.7 of exhibited EA (ERM 2013)

***differential provided comparing permanent impacts from Table 6.7 of exhibited EA (ERM 2013) to permanent impacts on the proposed footprints to provide comparative data

3. OFFSET CALCULATIONS AND BIOBANKING ASSESSMENT

Due to changes in the project footprint a revised BioBanking credit calculation would be required, which would replace the existing representations of the BioBanking impact assessment and credit profile. This would be completed on the merged PL1 and PL2 development footprint as a 'worst-case scenario' of impacts. The revised calculation would present the credit profile of the project using the current BioBanking Assessment Methodology (BBAM) which includes a module for linear assessments such as wind farms. Work is progressing on identifying candidate offset sites near the project, refining suitable candidate lands and the biodiversity characteristics of those lands, as well as confirming the willing participation of land owners. The results of this task have been detailed in *Annex G*. The reassessment of potential candidate offset sites shows that it is likely that sufficient sites are available, and it is expected that a selection of these would meet the requirements of offsetting impacts associated with the reduced layout. A revised BioBanking assessment would be undertaken upon finalisation of the to-be-built layout.

4. WOODLAND BIRDS

Refer to *Annex B* for more information on this matter.

5. SUPERB PARROTS

Generally, the removal of the Langs Creek cluster and other WTGs at the extremities of the project would likely lead to a reduced impact on this species. As shown in the reanalysis of flight path mapping (*Annex A* of *Annex C*) the majority of flight path activity occurs in the area adjacent to the removed Langs Creek cluster. Refer to *Annex C* for more information on this matter. *Section 7.1* contains information regarding revised collision risk model (CRM) for this species.

6. HOLLOW BEARING TREES AND BATS

A revised analysis was undertaken to identify the hollow bearing trees (HBTs) within 500 m of a WTG. The results are contained in *Annex D*. Data does exist covering woodland tree height, HBT height and tree hollow height. A WTG setback analysis would be undertaken as part of the detailed survey design and micrositing. The results of this analysis would be considered to explore all opportunities to minimise impacts by ensuring micrositing places WTG away from HBTs or woodland edges. These results would be considered in conjunction with other project factors and the project conditions of approval. Layouts PL1 and PL2 have considered a setback distance of 30 m.

7. DIURNAL BIRDS OF PREY AND COLLISION RISK MODELLING (CRM)

Refer to *Annex E* for detailed Bird Utilisation Survey (BUS) methods, results (raw data is presented including distance observations) and related discussion.

Generally, the reduction from a maximum of 122 WTGs to a maximum of 75 WTGs would lead to a much reduced impact on avian species. With the removal of the whole Langs Creek cluster and other WTGs at the farthest previous extent of the project the project is becoming smaller in spatial extent.

The revised separation distances of Wedge-tailed Eagle nests from WTGs is provided in *Table 7.*

Table 7. WTG and Wedge-tailed Eagle Nest Separation

	PL1		PL2	
Wedge-tailed Eagle Nest Identifier	**WTG Identification Number**	**Separation Distance**	**WTG Identification Number**	**Separation Distance**
1	-	-	-	-
2	76	323	22	341
	98	426	29	575
	41	574		
3	27	251	45	304
	14	304		
	73	542		
4	81	0	10	0
	83	285	64	304
	48	304	3	537
	55	537		
5	25	401	103	401
6	-	-	-	-

Notes: 1. A 600m cut-off has been used for separation distance. Blank data means no trees within 600m.

7.1 COLLISION RISK MODEL

The CRM has been rerun based on OEH's recommendation of a 90% avoidance rate. The full CRM has also been run at each of the other avoidance rates (95% and 99%) to present the relative difference between them, using the revised project layouts. The results for each planning layout are in *Table 3* and *Table 4*. An important note to accompany these collision calculations is that the spatial extent used in the EA (ERM 2013) is 41 km. To diminish the spatial extent used in the model to the revised north-south distance (12km) provides a false representation of concentrated impacts which ignores the fact that the area used in the EA (ERM 2013) would now, following revisions of project layouts, have less WTGs in the area used. Hence the same avian observation data over the original spatial extent (41km) has been used in this recalculation.

Table 3 Number of Bird Collisions per Month using Planning Layout 1

Month-> Species	Nov			Dec			Jan			Feb		
Avoidance Factor	90%	95%	99%	90%	95%	99%	90%	95%	99%	90%	95%	99%
Superb Parrot	0.033	0.016	0.003	0	0	0	0	0	0	0	0	0
Little Eagle	0.033	0.017	0.003	0	0	0	0	0	0	0	0	0
Spotted Harrier	0	0	0	0.029	0.014	0.003	0	0	0	0	0	0
Wedge-tailed Eagle	0.055	0.027	0.005	0.024	0.012	0.002	0.260	0.130	0.026	0.168	0.084	0.017

Table 4 Number of Bird Collisions per Month using Planning Layout 2

Month-> Species	Nov			Dec			Jan			Feb		
Avoidance Factor	90%	95%	99%	90%	95%	99%	90%	95%	99%	90%	95%	99%
Superb Parrot	0.018	0.009	0.002	0	0	0	0	0	0	0	0	0
Little Eagle	0.020	0.010	0.002	0	0	0	0	0	0	0	0	0
Spotted Harrier	0	0	0	0.018	0.009	0.002	0	0	0	0	0	0
Wedge-tailed Eagle	0.029	0.014	0.003	0.043	0.021	0.004	0.137	0.069	0.014	0.089	0.044	0.009

8. GOLDEN SUN MOTH (GSM)

Generally, the removal of the Langs Creek cluster and other WTGs at the extremities of the project would likely lead to a reduced impact on this species. Refer to *Annex F* for more information on this species.

9. REPTILES

Striped Legless Lizards were targeted using pitfall trapping and artificial habitat emplacement and checking (tile grids). Pink-tailed Worm-lizards were targeted using checking (tile grids). Notwithstanding the efficacy of reported methods, the EA (ERM 2011, section 4.9) states that the impact assessment uses a precautionary principle to consider the potential impacts to species using the presence of potential habitat. Impact to these species has been shown in *Table 2.2.*

10. SQUIRREL GLIDER AND HABITAT FRAGMENTATION

All wind turbine and substation component oversize vehicle access to the project would be through a single entry point along Lachlan Valley Way. The project would not require clearing of roadside vegetation along Harry's Creek Road and Wargeila Road to allow oversize vehicle access to the project via those roads. Impacts to roadside vegetation along Tangmangaroo Road would be limited to a maximum 60 m wide strip where the overhead transmission line crosses, and where access roads meet Tangmangaroo Road. No other vegetation clearing would be required for oversize vehicle access along Tangmangaroo Road. The 60 m wide transmission line strip is required for electrical clearance safety. If this clearance requires removal of all trees, this may hinder Squirrel Glider movement across the gap as it is beyond the 50 m gliding distance recognised for this species on relatively flat terrain (Australian Museum 2011). Mitigation measures would be required to maintain connectivity for the species across that 60 m transmission line strip which may include, reducing the span of clearance to 45 m, vegetation retention (as long as electrical clearance safety can be maintained) or installation of glider poles located so no gap exceeds 50 m.

11. CUMULATIVE AND INDIRECT IMPACTS

A WTG setback analysis has been provided in *Annex D*. WTG setback from ecological features would be considered, among other parameters, during detailed design and WTG micrositing.

No discussion has been provided on the potential added proliferation of foxes in the area due to the project, as this is difficult to fathom given the existing agricultural nature of the region. The region is generally characterised as a fragmented landscape with large areas of grassland and 'islands' of woodland. Infrastructure such as access roads would not be creating any linear access tracks through woodlands for predators such as foxes to utilise in any substantially different situation than currently exists. It is more than likely that the fox presence in the region is driven by livestock farming cycles, the climate (prey presence), and control measures (or lack of) undertaken by responsible landholders, Government agencies and industry bodies.

It is not possible to quantify the potential ecological impacts of agricultural expansion that could be caused by road upgrades related to the project because the scenario has too many uncertainties. It is not clear how many landholders' or farmers' agricultural expansion proposals are suppressed by lack of suitable quality roads, or the thresholds of road quality that would allow agricultural expansion. The ecological impacts of increased grazing pressure are better addressed by the agricultural industry.

12. OTHER THREATENED SPECIES ISSUES

The preceding sections of this report describe in more detail some of the targeted methods for threatened species. Notwithstanding the efficacy of reported methods, the EA (ERM 2011, section 4.9) states that the impact assessment uses a precautionary principle to consider the potential impacts to species using the presence of potential habitat. Impacts to these species have been shown in *Table 2.2*

Reuse of felled native vegetation and habitat resources would be guided by the project conditions of approval and a Construction Environmental Management Plan (CEMP).

13. REFERENCES

Australian Museum (2011). Animal Species: Squirrel Glider.

https://australianmuseum.net.au/squirrel-glider

Yours sincerely,
for Environmental Resources Management Australia Pty Ltd

Guy Williams Principal Consultant	Murray Curtis Partner

Annexures

Annex A *Endangered Ecological Communities*
Annex B *Woodland Birds*
Annex C *Superb Parrot*
Annex D *Hollow Bearing Trees and Bats*
Annex E *Bird Utilisation Survey Results*
Annex F *Golden Sun Moth*
Annex G *Biobanking*

Annex A

Endangered Ecological Communities

1 INTRODUCTION

This report addresses:

- the extent of Endangered Ecological Communities across the Project Area;
- justification of the approach for classification of the extent of Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands (vegetation type LA103); and
- provides a review of vegetation mapping and impact assessment.

1.1 BOX GUM WOODLAND IN THE STUDY AREA

Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands (LA103) has been mapped in the Study Area and Locality. Three of the four LA103 Vegetation Zones mapped in the Study Area comprise White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland) Endangered Ecological Community (EEC) as listed under the *Threatened Species Conservation Act 1995* (TSC Act) according to the identification guidelines provided in the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS undated) and the NSW Scientific Committee Final Determination (OEH 2011). These are shown in *Figure 1.1.*

Discussion is provided below on the Vegetation Zones that constitute the EEC and justification is provided as to why the modified form of the Vegetation Zone does not constitute the EEC.

1.1.1 *Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Roadside (LA103_MG_C)*

Vegetation zone Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Roadside (LA103_MG_C) occurs generally along the public roads of the Study Area and locality especially along Tangmangaroo Road, Wargeila Road and Harry's Creek Road. It does not constitute the *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act) listed Threatened Ecological Community (TEC) because the understorey is not predominantly native. It does comprise the TSC Act-listed EEC as it has an intact canopy layer, which although currently made up of a weedy understorey, would likely respond to assisted natural regeneration. It is a woodland dominated by Yellow Box, or Blakley's Red Gum with a non-native grassy understorey (generally pasture grasses used in neighbouring agricultural areas). The vegetation zone meet the identification guidelines provided in the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS undated) and the NSW Scientific Committee Final Determination (OEH 2011).

1.1.2 *Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Medium (LA103_MG_S)*

Vegetation zone Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Medium (LA103_MG_S) constitutes the TSC Act-listed EEC, as it is grassy woodland dominated by Yellow Box. However, it does not meet the identification guidelines for the EPBC listed TEC as it does not contain 12 or more native understorey species (excluding grasses) and does not have an average of 20 or more mature trees per hectare, or natural regeneration of the dominant overstorey eucalypts. The condition of the vegetation zone has been reduced due to past clearing and regular grazing and / or ploughing.

The vegetation zone meets the identification guidelines for the TSC Act-listed EEC provided in the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS undated) and the NSW Scientific Committee Final Determination (OEH 2011).

1.1.3 *Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Poor (LA103_MG_P)*

Vegetation zone Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Poor (LA103_MG_P) constitutes the TSC Act-listed EEC, as it is a Derived Native Grassland (DNG) previously dominated by Yellow Box trees. This vegetation zone includes areas that have undergone grazing and / or ploughing. It does not meet the identification guidelines for the EPBC listed TEC as it does not comprise 12 or more native understorey species (excluding grasses) and does not have an average of 20 or more mature trees per hectare. The condition of the vegetation zone has been reduced due to past clearing and regular grazing and / or ploughing.

The vegetation zone meets the identification guidelines for the TSC Act-listed EEC provided in the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS undated) and the NSW Scientific Committee Final Determination (OEH 2011). While the vegetation zone lacks a canopy layer, it has the potential to respond to assisted natural regeneration.

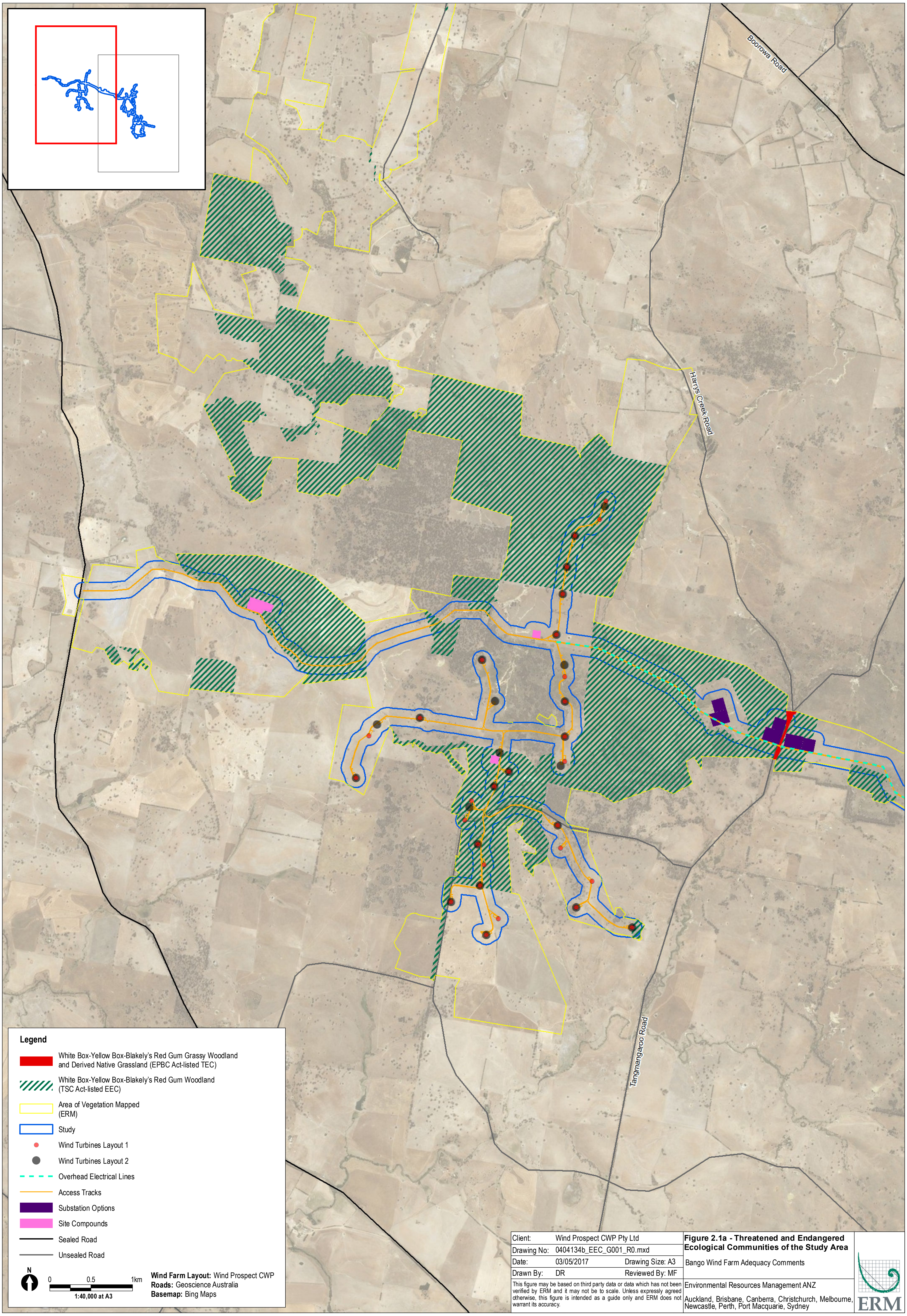
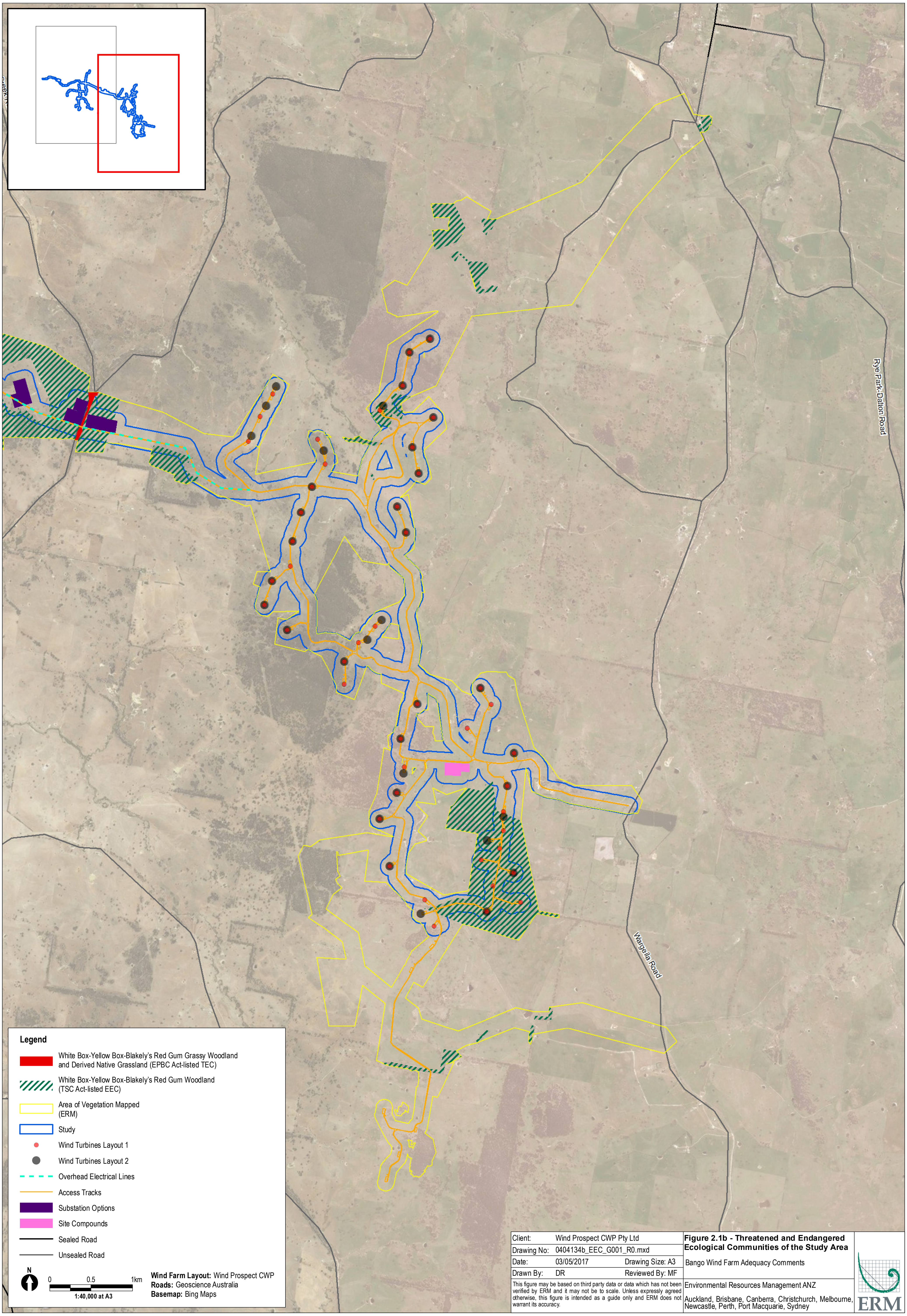


Figure 2.1a - Threatened and Endangered Ecological Communities of the Study Area



Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0404134b_EEC_G001_R0.mxd		
Date:	03/05/2017	Drawing Size:	A3
Drawn By:	DR	Reviewed By:	MF

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 2.1b - Threatened and Endangered Ecological Communities of the Study Area

Bango Wind Farm Adequacy Comments

Environmental Resources Management ANZ

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ERM

1.1.4 *Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands – Low (LA103_L)*

ERM in their assessment (2013) considered whether the Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands – Low (LA103_L) vegetation zone was representative of Box Gum Woodland EEC as it comprises sparsely distributed Yellow Box and, prior to clearing, would have comprised the Box Gum Woodland EEC. LA103_L includes the following areas:

- scattered Yellow Box over cropping; and
- scattered Yellow Box over pasture and ploughed areas.

In support of the EEC argument it is noted that the NSW Scientific Committee (2011) in their Final Determination regarding Box Gum Woodland state:

> "*Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact.*" (NSW Scientific Committee 2011).

However, the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS, undated) states:

> "*Sites where there is unlikely to be sufficient seed remaining in the soil for the understorey or overstorey to regenerate are not part of the EEC. For example, trees under which intensive cropping of annual crop species has occurred and is ongoing…..are unlikely to be part of the community.*"

Areas comprising this vegetation zone were assessed as not comprising the TSC Act-listed EEC or the EPBC Act-listed TEC as they have undergone ongoing, intensive cropping or regular ploughing and pasture improvement. This history of agricultural land use has depleted the soil seed bank such that it would not respond to assisted natural regeneration. These areas were however included in the LA103 Biometric Vegetation Type (BVT) as, due to the presence of a native canopy layer, they meet the BioBanking definition for low condition vegetation and do not meet the BioBanking definition for cleared land.

1.2 *VEGETATION IMPACT AREA CALCULATIONS*

The area of vegetation zones (including Box Gum Woodland) in the Study Area and Development Footprints is provided in *Table 2.1*.

Table 1.1 Area of Box Gum Woodland EEC in the Study Area and Development Footprint

Vegetation Zone Code	Vegetation Zone Name	TEC/EEC Status	Exhibited EA (ERM 2013) Study Area (ha)	Exhibited EA (ERM 2013) Footprint	PL1 Study Area	PL1 Footprint	PL2 Study Area	PL2 Footprint	Merged 'Worst Case' Scenario Study Area	Merged 'Worst Case' Scenario Footprint
Native Vegetation										
LA103_L	Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Low	NA	469.57	48.94	101.09	15.63	102.66	16.2	102.69	16.24
LA103_MG_P	Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Poor	Box Gum Woodland (TSC Act-listed EEC)	313	49.16	248.02	36.33	233.83	34.24	250.66	37.71
LA103_MG_C *	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands - Mod_Good - Roadside	Box Gum Woodland (TSC Act-listed EEC)	0	0	2.5	0.26	2.5	0.26	2.5	0.26
LA103_MG_S	Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – Medium	Box Gum Woodland (TSC Act-listed EEC)	65.27	3.08	50.4	2.25	48.2	2.19	52.93	2.8
LA103_MG_H	Apple Box - Yellow Box Dry Grassy Woodland of the South Eastern Highlands - Mod_Good – High	Box Gum Woodland (EPBC Act listed TEC & TSC Act-listed EEC)	2.27	0.26	0	0	0	0	0	0
LA182_L	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion - Low	NA	238.72	21.98	206.75	15.9	197.47	14.55	209.55	16.72

Vegetation Zone Code	Vegetation Zone Name	TEC/EEC Status	Exhibited EA (ERM 2013) Study Area (ha)	Exhibited EA (ERM 2013) Footprint	PL1 Study Area	PL1 Footprint	PL2 Study Area	PL2 Footprint	Merged 'Worst Case' Scenario Study Area	Merged 'Worst Case' Scenario Footprint
LA182_MG	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion - Mod_Good	NA	99.24	5.28	102.53	5.9	94.39	3.97	104.44	6.07
	Native Shrub Regeneration		NA**	NA**	0.01	0	0.01	0	0.01	0
	Planted Native Vegetation		NA**	NA**	4.59	0.18	4.54	0.18	4.59	0
Sum Native Vegetation					715.89	76.45	683.6	71.59	727.37	79.8
Non-native Land Cover										
	Bare Ground		NA**	NA**	0.03	0	0.03	0	0.03	0
	Cropping		NA**	NA**	68.18	3	66.02	2.48	68.18	2.99
	Pasture		NA**	NA**	440.94	41.35	443.97	40.05	447.82	43.75
	Road		NA**	NA**	0.2	0	0.2	0	0.2	0
Sum Non-native Land Cover					509.35	44.35	510.22	42.53	516.23	46.74
Total					**1225.24**	**120.8**	**1193.82**	**114.12**	**1243.6**	**126.54**

1. The BVT Code is provided with a suffix which is an abbreviation of the condition class.
2. Box Gum Woodland = White Box-Yellow Box-Blakely's Red Gum Woodland (TSC Act-listed EEC) and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act-listed TEC).

*denotes a vegetation not previously named in ERM (2013) - has been identified during more detailed roadside vegetation mapping

NA** denotes not reported as not relevant in ecological impact assessment

1.3 BOX GUM WOODLAND IN THE LOCALITY

Available vegetation mapping was used to map the extent of Box Gum Woodland in the Locality, ie within 10km of the Development Footprint. This comprised a desktop assessment only and as such, it is not confirmed whether the areas mapped as Box Gum Woodland, external to the Study Area, meet the description for the EPBC Act-listed TEC or the TSC Act-listed EEC.

The following vegetation mapping was used:

- *Australian Alps, South west Slopes, and SE Corner Bioregions* (Gellie 2005); and
- *The Native Vegetation of Boorowa Shire* (NSW National Parks and Wildlife Service (NPWS) 2002).

Based on the vegetation community descriptions provided in the above documents, the following vegetation communities that occur in the Locality comprise Box Gum Woodland:

- Gellie 2005:
  - Northern Slopes Dry Grass Woodland;
  - Tableland Dry Grassy Woodland; and
  - Tablelands and Slopes Dry Herb-Grass Woodland.
- NPWS 2002:
  - Blakelys Red Gum – Yellow Box Grassy Woodland;
  - Kangaroo Grass – Red-leg Grass Grassland / Open Woodland; and
  - White Box Grassy Woodland.

Based on this, the extent of Box Gum Woodland in the Locality is estimated to be 1,713 hectare (ha) and is shown in *Figure 2.2*.

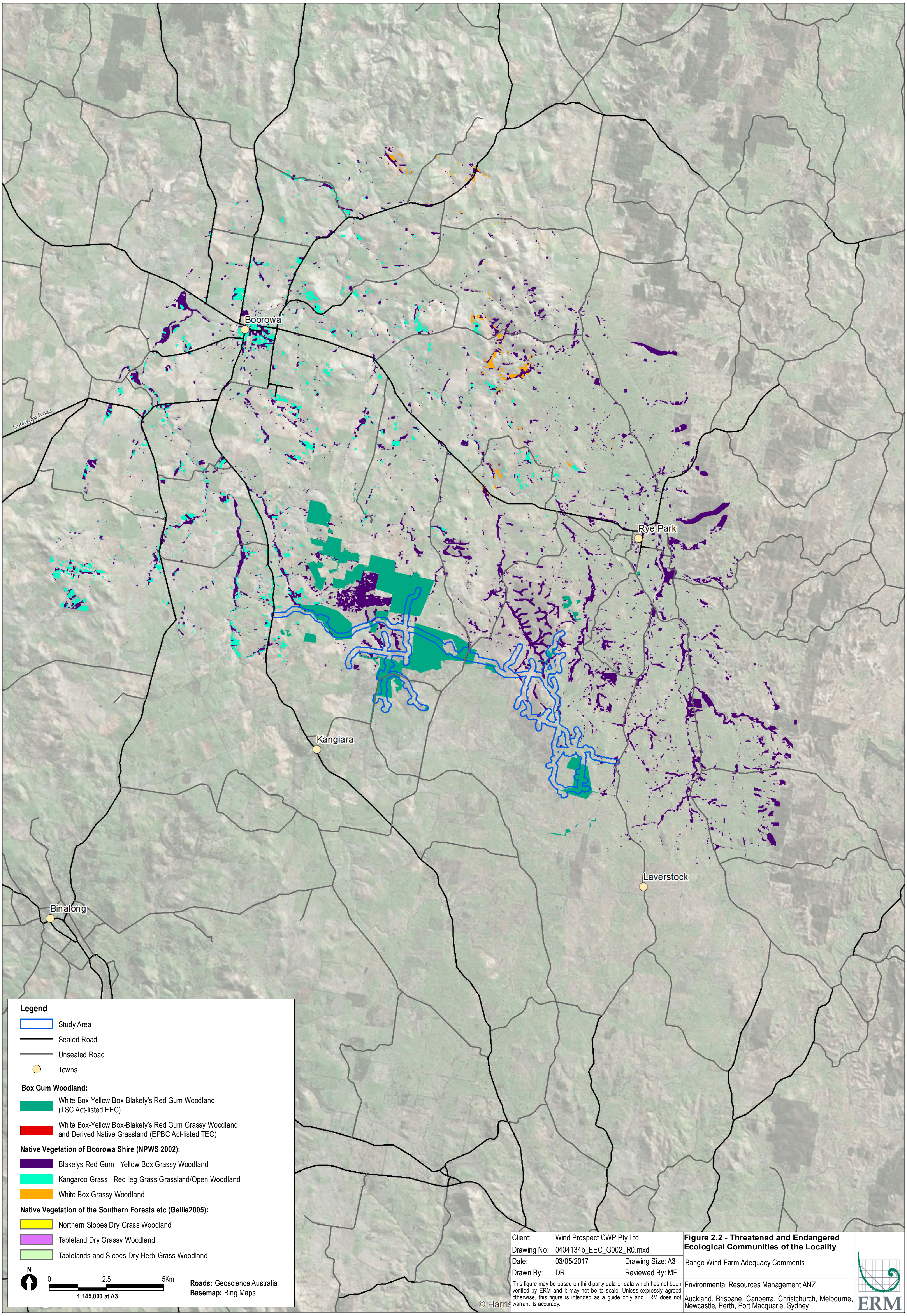


Figure 2.2 - Threatened and Endangered Ecological Communities of the Locality

Annex B

Woodland Birds

1 INTRODUCTION

This report provides details on woodland bird surveys and results.

2 METHODS

2.1 STRATIFICATION

To accurately survey the full range of potential habitats and vegetation types within the Study Area, the area was first assessed using aerial imagery. Areas of particular interest were then ground truthed and recorded as a stratification unit. This allowed the Study Area to be systematically sampled. Survey areas were stratified on biophysical attributes and by vegetation structure. Survey effort was then concentrated on those areas as stratification units.

Initially three main stratification units were observed: native grassland, native woodland and exotic grassland. These three major units (habitats) were stratified into sub-units according to their biophysical or vegetation structure attributes (refer *Table 2.1*).

Table 2.1 Stratification Units

Stratification Unit	Sub Unit
Native Woodlands	Apple Box – Yellow Box Grassy Woodland
	Yellow Box/ Blakely's Red Gum Open Woodland
	Red Stringybark Open Forest
	Scribbly Gum Woodland
	Stringybark Hilltop Low Woodland
	Scribbly Gum/Red Stringybark Woodland
	Yellow Box/Blakely's/Red Stringybark Open Woodland

2.2 PHYSICAL SURVEY METHOD

The native woodland stratification unit was targeted to survey for a number of threatened woodland birds identified from the literature and database review. Surveys for woodland birds were carried out during optimum times for the detection of woodland bird species in areas of suitable habitat when possible. A total of 17 surveys were undertaken within or adjacent to areas of woodland habitat. Each survey involved a two hectare area search for a minimum period of 20 minutes in early August due to cooler conditions and low activity; and 40 minutes in the optimal late Spring/early Summer season (refer *Table 2.2, Table 2.3* and *Table* 2.4). Bird surveys were completed by two observers. Birds were identified using 10 × 42mm binoculars and from characteristic calls. Within most stratification units a minimum of two bird surveys were completed on two separate days across the woodland survey sites.

During the survey period the same stratification unit was re-sampled on a number of occasions in a different location. This allowed for greater coverage of the woodland areas within the study area, thus producing a more detailed representation of the suite of woodland bird species.

This methodology is consistent with both the *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010) and the *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)* (DEC 2004).

Table 2.2 Survey Method Compliance

DEC (2004)	DEWHA (2010)	ERM
Area search methods, where observers walk around an area of pre-determined size for a pre-determined length of time. A 1ha (200m x 500m) 20-minute search minimum.	Area searches are typically conducted over plots of about 1–3 ha, for 10–20 min, though larger plots may be surveyed over hours, days and even months.	Two hectare area search for a minimum period of 20 minutes in early August due to cooler conditions and low activity, to 40 minutes in the optimal late Spring/early Summer season.

DEC (2004) – Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities.

DEWHA (2010) - Survey guidelines for Australia's threatened birds.

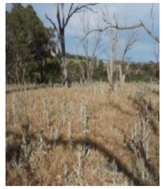
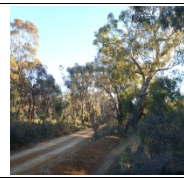
2.3 SURVEY SITE DETAILS

Table 2.4 describes the woodland bird survey locations by stratification sub units within the native woodland areas. Where sites had a similar vegetation community they were separated by levels of disturbance, structure and features.

Table 2.3 Woodland Bird Survey Timing and Locations

Point No	Date	Survey Type	Time Start	Time Finish	Location	Latitude	Longitude	Weather Conditions
WP001	1/08/2012	Bird Census	8:05	8:25	Cnr Tangamangaroo & Harrys Ck Rd	34.61175 S	148.8581 E	Still, 1°C, no cloud
WP002	1/08/2012	Bird Census	9:35	9:55	Taffs Hill	34.5166 S	148.7602 E	Light wind, 7°C, no cloud
WP003	1/08/2012	Bird Census	10:25	10:55	Taffs Hill	34.52608 S	148.7656 E	Light wind, 10°C, no cloud
WP016	2/08/2012	Bird Census	8:20	8:50	Thompson Property	34.58658 S	148.8523 E	Very light wind, 4°C, no cloud
WP018	2/08/2012	Bird Census	9:15	9:35	Willow Hill	34.58177 S	148.8562 E	Very light wind, 4°C, no cloud
WP022	2/08/2012	Bird Census	10:00	10:15	Yambacoona	34.56837 S	148.8384 E	Light wind, 14°C
WP024	2/08/2012	Bird Census	12:15	12:35	Yambacoona	34.57279 S	148.8395 E	Light wind, 14°C
31	21/11/2012	Bird Census	8:48	9:38	Taree	34.55528 S	148.8679 E	Calm, 8^{o}c
34	21/11/2012	Bird Census	15:35	16:14	Taffs Hill	34.51265 S	148.7546 E	Calm, 22^{o}c
36	22/11/2012	Bird Census	9:05	9:42	Pines	34.57336 S	148.7953 E	Light wind, 12^{0}C
37	22/11/2012	Bird Census	10:35	11:32	Cnr Tangamangaroo & Harrys Ck Rd	34.56156 S	148.8264 E	Light wind, 21^{0}C
31	22/11/2012	Bird Census	17:30	17:58	Taree	34.55528 S	148.8679 E	Light wind, 24^{0}C
34	23/11/2012	Bird Census	7:21	8:07	Taffs Hill	34.51125 S	148.7536 E	Light wind, 10^{0}C
-	5/12/2012	Bird Census	7:35	8:20	Hillview	34.55223 S	148.865 E	Moderate wind, 10^{0}C
-	5/12/2012	Bird Census	16:25	17:10	Willow Hill	34.58071 S	148.8487 E	Moderate wind, 22^{0}C
-	6/12/2012	Bird Census	16:20	17:05	Hillview	34.55223 S	148.865 E	Calm, 25^{0}C
56	13/12/2012	Bird Census	12:07	13:00	Lloyd Davis	34.64377 S	148.8712 E	Calm, 20^{0}C

Table 2.4 Woodland Bird Census Location Descriptions

Point No.	Location Name	Latitude	Longitude	Stratification Unit Description	Canopy Height	Understorey	Features	Disturbance	Image
31	Taree	34.55528 S	148.8679 E	Stringybark Hilltop Low Woodland	8m	Rocky substrate, patchy grassy understorey	Fallen Timber, some hollows	Moderate - high	
42	Taff's Hill	34.51125 S	148.7536 E	Yellow Box Blakleys Red Gum Open Woodland, semi riparian along creek line, scattered clusters of Red Gums	10-12m	Grassy understorey, weedy patches further up the slope	Some fallen timber and stags	High	
36	Pines	34.57336 S	148.7953 E	Scribbly Gum Woodland	8-10m	Patchy grassy understorey	Some fallen timber and stags	High	
56	Lloyd Davis	34.64377 S	148.8712 E	Stringybark Hilltop Low Woodland	10-12m	Grassy understorey,	Some fallen timber and stags. Rock outcrops on top of the slope	High	
WP001	Cnr Tangamangaroo & Harrys Ck Rd	34.56156 S	148.8264 E	Apple Box – Yellow Box Grassy Woodland	10-12m	Grassy understorey, some shrubs forbs and *Acacia* spp.	Some fallen timber and stags and hollows in the larger remnant trees	Moderate	
WP002	Taffs Hill (Greening Australia Block)	34.5166 S	148.7602 E	Yellow Box Open Woodland with revegetation mix of acacias and young eucalypt species	10-12m	Grassy	Some stags, little fallen timber	High	

Point No.	Location Name	Latitude	Longitude	Stratification Unit Description	Canopy Height	Understorey	Features	Disturbance	Image
WP003	Taffs Hill	34.52608 S	148.7656 E	Red Stringybark Woodland, open large remnant trees	12-14m	Grassy	Some fallen timber and stags scattered through this area	High	
WP016	Thompson Property	34.58658 S	148.8523 E	Red Stringybark Woodland, some semi mature and regrowth	8-12m	Dominate species Nodding Blue-lily and mixture of native and exotic grasses	Some fallen timber and stags scattered through this area	Moderate	
WP018	Willow Hill	34.58177 S	148.8562 E	Scribbly Gum/Red Stringybark Woodland	10-12m	Dominate species Nodding Blue-lily and mixture of native and exotic grasses	Some fallen timber and stags scattered through this area	Moderate	
WP022	Yambacoona	34.56837 S	148.8384 E	Yellow Box/Blakely's/Red Stringybark Open Woodland	8-10m	Grassy understorey some small shrubs Nodding Blue-lily and acacia species	Some fallen timber and stags scattered through this area	Moderate	
WP024	Yambacoona	34.57279 S	148.8395 E	Yellow Box/Blakely's/Red Stringybark open Woodland., semi mature some regrowth	8-10m	Grassy understorey some shrubs	Some fallen timber and stags scattered through this area	Moderate - high	
	Willow Hill	34.58071 S	148.8487 E	Stringybark Hilltop Low Woodland	6-8m	Rocky substrate, patchy grassy understorey some shrubs	Scattered fallen timber	High	
	Hillview	34.55223 S	148.865 E	Stringybark Hilltop Low Woodland	8m	Rocky substrate, patchy grassy understorey	Fallen Timber, some hollows	Low - moderate	

2.4 *RESULTS*

Bird surveys conducted in woodland or adjacent to woodland areas recorded 99 bird species (refer to ERM 2013 for a full list of the species recorded, results and figures showing locations).

3 *REFERENCES*

Baker-Gabb, D. 2011. **National Recovery Plan for the Superb Parrot *Polytelis swainsonii***. Department of Sustainability and Environment, Melbourne.

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Gibbons. P (2002). **Tree Hollows and Wildlife Conservation in Australia**. CSIRO.

Manning. et al. (2012) **Hollow futures? Tree decline, lag effects and hollow-dependent species**. Fenner School of Environment and Society, The Australian National University, Canberra, ACT, Australia. Animal Conservation.

Office of Environment and Heritage (OEH) (2012). **Threatened Species Profiles.** http://www.environment.nsw.gov.au/threatenedspeciesapp/default.aspx?keywords=button

Annex C

Superb Parrot

1 INTRODUCTION

This report provides further analyses relating to the Superb Parrot (*Polytelis swainsonii*) and the project.

1.1 SPECIES BACKGROUND

The Superb Parrot is listed as a vulnerable species under both the TSC Act and the EPBC Act. The Superb Parrot is found throughout eastern inland NSW. The core breeding area for this species is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round (OEH 2012). This species is recognised as a significant species within the Study Locality and Boorowa is recognised as a stronghold for this species.

The preferred vegetation type of the Superb Parrot on the south west slopes is Box-Gum Grassy Woodland dominated by Yellow Box *(Eucalyptus melliodora*), Blakely's Red Gum (*E. blakelyi*) and White box (*E. albens*), often in conjunction with other species such as Apple Box (*E. bridgesiana*), Mealy Bundy (*E. nortonii*), Red Box (*E. polyanthemos*), Candlebark (*E. rubida*), Brittle Gum (*E. mannifera*), Grey Box (*E. macrocarpa*) and Red Stringybark (*E. macrorhyncha*) (Manning et al. 2012).

The Superb Parrot has a preference for medium to larger hollows of greater than 5cm in diameter and above one metre off the ground. This species prefers Blakely's Red Gum, Yellow Box, and Apple Box species and often nests in dead stags (Manning et al. 2012). The Superb Parrot often nests in clusters as they are a very colonial species (Gibbons 1968).

NSW OEH lists the threats to this species as including the removal of hollow bearing trees, clearing of woodland remnants, poor regeneration of nesting trees and food resources, feeding on grain spills and subsequently being struck by vehicles, loss of hollows to feral bees and native and exotic hollow-nesting birds, and illegal trapping which can also result in the destruction of hollows (OEH 2012).

Further to those threats listed by the NSW OEH, the EPBC Act also includes additional threats as including grazing stock as reducing the amount of food resources, hydrological changes impacting traditional breeding habitat, poisoning from pesticide sprays and beak and feather disease (DSEWPC 2013).

2 *METHODS*

To assess how the Superb Parrot utilises the Study Area a species utilisation and habitat based approach was undertaken. This methodology is consistent with Objective 2 of the National Recovery Plan for the Superb Parrot (*Polytelis swainsonii*) (Baker-Gabb 2011).

Objective 2; Increase the level of knowledge of the Superb Parrot's ecological requirements.

Performance criterion: Key ecological information collected, allowing potential colony sites, foraging sites and flight corridors to be identified, mapped and protected.

Action 2.1: Survey and map areas of River Red Gum forest in the Riverina and woodlands on the NSW/ACT slopes and tablelands with high potential to support breeding colonies.

Action 2.2: Investigate the foraging ecology of Superb Parrots.

Action 2.3: Identify and map all areas with high potential to be used for foraging during the breeding season, and areas used for foraging during the non-breeding season.

Action 2.4: Identify and map potential flight corridors between breeding colonies and potential or known foraging areas, and corridors used in the non-breeding season.

To assess the Superb Parrot's utilisation and preferred habitats across the Study Area a number of survey methods were used to record data, these are detailed below:

- BUS survey;
- Bird Census;
- Tree Hollow survey; and
- Habitat assessment.

2.1 *BUS*

BUS recorded the presence of this species and important flight path information. It was possible to construct an understanding of the daily movements of this species as surveys were conducted at various times of the day throughout and following the breeding season. The number of individuals recorded at each survey point provided information on areas that could be of greater value for foraging or breeding for this species.

2.2 *BIRD CENSUS*

The data from the bird census provides an insight into the stratification units preferred by this species within the landscape. This information was used to construct habitat preference maps for this species thus allowing a habitat based conservation approach to minimise impact to core habitat areas for this species within the area of disturbance.

2.3 *TREE HOLLOW SURVEY*

A hollow bearing tree survey was undertaken from January 2013 to February 2013 within an area bound by a 500m buffer around all proposed turbine locations. The survey was undertaken by two ecologists on foot and by vehicle. Hollow bearing trees were assessed visually, using binoculars. The total area surveyed for hollow bearing trees was approximately 4,981 hectares (ha). All hollow bearing trees with a diameter at breast height (DBH) greater than 50cm were mapped. The following information was collected:

- hollow size classes were recorded by diameter as follows;
- 0 – 5 cm = Small;
- 6 – 10 cm = Medium;
- 11 cm and above = Large;
- the height of the hollow from ground level;
- the species of tree;
- the height of the tree; and
- the DBH.

The information collected during the mapping of tree hollows was used to map the habitat resources (breeding and/or refuge), available for a range of hollow dependant species including Superb Parrots, large forest owls, small passerine birds, arboreal mammals and microbats. This information would be used to guide conservation decisions around areas that are recognised as potential Superb Parrot breeding habitat.

2.4 *HABITAT ASSESSMENT*

A habitat assessment was undertaken at the Study Area resolution. This enabled mapping of areas of known habitat utilised for foraging, i.e. grain fields, roosting and potential breeding habitat through the mapping of suitable hollow bearing trees. This information was able to be used to provide effective decisions to minimise any impacts the proposal may have on this species.

3 RESULTS

3.1 BUS RESULTS

3.1.1 *Number of Records*

The Superb Parrot was recorded 148 times from eight BUS locations. *Table 3.1* shows the number of Superb Parrots recorded from each BUS point during the survey period. The highest numbers of Superb Parrot recordings over the survey period were 64 from BUS 1 (Taff's) and 48 from BUS 2 (Hopefield). The next highest was 10 birds recorded from BUS 19 (Lavestock Rd. Montalta Gate) and nine recorded from BUS 10 (Springvale). The areas with the highest concentration of recordings coincided with those that were predominately croplands and where adjoining remnant native vegetation community was Box Gum woodland.

The absence of recordings from BUS locations in the south of the Study Area could be attributed to the land management practices i.e. grazing dominate land use in these areas thus limiting available foraging habitat, or that the vegetation communities within these areas are dominated by the Red Stringybark vegetation community and there is a noticeable lack of Box Gum Woodland in these areas. This difference in vegetation dominance could be related to lower soil quality on the rocky slopes in the south of the Study Area.

Table 3.1 Superb Parrot Records from BUS

BUS Number	BUS Location Name	No. Superb Parrots Recorded
1	BUS Taffs	64
2	BUS Hopefield	48
3	BUS Willow	0
4	BUS Wargeila	1
5	BUS Taree	0
6	BUS Taree 2	0
7	BUS Pines	5
8	BUS Yambacoona	6
9	BUS Glanmire	5
10	BUS Springvale	9
11	Springvale Property	0
12	BUS Mt Buffalo	0
13	BUS Lloyd Davis	0
14	Hopefield Lane	0
15	Hopefield Lane/Boorowa Rd	0
16	Harry's Ck Rd/Boorowa Rd	0
17	The Pines Property	0
18	Mt Buffalo Access Gate	0
19	Lavestock Rd. Montalta Gate	10
20	The Pines Access	0
Total		**148**

3.1.2 Flight Paths

During the survey period Superb Parrots were observed flying in all directions during the day, that being north, south, east and west. An analysis of the time of day which Superb Parrots were recorded was undertaken from the individual BUS points. Some correlations were observed regarding the species' movements.

The times of the BUS when Superb Parrots were recorded were categorised into morning (7:00 – 10:36 hours) (see *Table3.2)* and afternoons (12:10 – 16:30 hours) (see *Table 3.3*). Surveys carried out between these times and later in the afternoons did not record any Superb Parrots. This information showed that 117 Superb Parrots were recorded at six BUS points in the mornings (including nine that were recorded perching and 10 that were foraging in a pasture and some perched in a tree), and a total of 31 were recorded at five BUS points in the afternoon (including one recorded perching).

A summary of the general flight paths over the landscape as recorded from each of the BUS points are shown in and *Table 3.2* and *Table 3.3* and graphical representation of the data is shown in *Figure 3*.1 and *Figure 3.2.* The morning flight path summary shows the highest number of Superb Parrots flying in a southeast direction from BUS 2 (Hopefield). The second highest number of movements were northwest from BUS 1 (Taff's) with notable north and east movements also from BUS 1 (Taff's). These movements could relate directly to the cropping regimes at the time of the surveys as birds were observed moving between fields to forage. The observation of 30 Superb Parrots recorded during one BUS was due to a flock of parrots feeding on grain adjacent to BUS 2 (Hopefield).

The Superb Parrot was generally recorded less frequently during afternoon surveys. The highest number of birds was recorded moving in a south direction was at BUS 1 (Taff's), with equal numbers moving north at BUS 1 (Taff's) as BUS 19 (Lavestock Rd. /Montalta Gate). BUS 19 at Lavestock Rd./Montalta Gate also recorded an equal number moving in a south direction as those moving north. BUS Taff's also recorded a four birds moving in an easterly Direction. These movements also appeared to be related to relevant crop regimes as birds were observed moving between fields to forage.

The analysis of the results shows that in the mornings at most BUS points (aside from BUS Hopefield) Superb Parrots were recorded moving to the north, northeast and northwest.

A trend was less readily observable in the afternoon movements, however there were notable movements to the south and southeast and nearly an equal number of birds recorded moving north from BUS 1 (Taff's), BUS 3 (Wargelia) and BUS 19 (Lavestock Rd/Montalta Gate).

The general and predicted flight paths of both the mornings (AM) and afternoons (PM) have been plotted on *Annex A* along with areas that are potential or known foraging areas of cropped grain fields. The general flight path mapping was put together from the BUS data and field observations of the following behaviour:

- Superb Parrots were recorded moving between grain resources at different times of the day;
- Superb Parrots were often seen using paddock trees as rest areas;
- Superb Parrots were observed generally following gullies or depressions;
- Superb Parrots were often observed moving along roadsides in proximity to roadside vegetation; and
- Superb Parrots were rarely observed crossing the top of ridgelines.

Table 3.2 Superb Parrot Morning Flight Directions

BUS No.	BUS Location	Date	Time	Numbers Recorded	Height Class Relative to the ground 0-40, 40-150, >150	Distance From Observer (m)	Flight Direction	Notes
1	BUS Taffs	6/12/2012	7:05	1	0-40	40	S	
1	BUS Taffs	6/12/2012	7:05	2	0-40	50	S	
1	BUS Taffs	23/11/2012	7:28	8	0-40	60	NW	
1	BUS Taffs	23/11/2012	7:28	5	0-40	70	NW	
1	BUS Taffs	23/11/2012	7:28	4	0-40	80	NW	
1	BUS Taffs	6/12/2012	7:05	2	0-40	50	N	
1	BUS Taffs	6/12/2012	7:05	1	0-40	20	N	
1	BUS Taffs	6/12/2012	7:05	3	0-40	50	N	
1	BUS Taffs	6/12/2012	7:05	3	0-40	90	N	
1	BUS Taffs	6/12/2012	7:05	8	0-40	100	E	
1	BUS Taffs	29/11/2012	7:38	6	-	-	-	Perched
1	BUS Taffs	6/12/2012	7:05	3	-	-	-	Perched
2	BUS Hopefield	14/11/2012	7:55	30	-	10	-	Foraging in pasture and perched in trees took flight when disturbed
2	BUS Hopefield	14/11/2012	7:55	2	0-40	5	SE	
2	BUS Hopefield	14/11/2012	7:55	3	0-40	10	SE	
2	BUS Hopefield	14/11/2012	7:55	4	0-40	30	SE	
2	BUS Hopefield	14/11/2012	7:55	1	0-40	40	S	
2	BUS Hopefield	14/11/2012	7:55	7	0-40	5	NW	
7	BUS Pines	5/12/2012	10:35	1	0-40	80	SW	Very Windy
7	BUS Pines	6/12/2012	8:45	1	0-40	10	S	
7	BUS Pines	6/12/2012	8:45	3	0-40	5	S	
8	BUS Yambacoona	22/11/2012	10:36	1	0-40	10	S	
8	BUS Yambacoona	22/11/2012	10:36	5	0-40	40	NE	Travelling along Rd
9	BUS Glanmire	16/11/2012	8:55	4	0-40	20	W	
9	BUS Glanmire	16/11/2012	8:55	1	0-40	10	NE	
10	BUS Springvale	14/11/2012	7:37	3	0-40	10	NE	
10	BUS Springvale	14/11/2012	7:37	5	0-40	40	N	

Table 3.3 Superb Parrot Afternoon Flight Directions

BUS No.	BUS Location	Date	Time	Numbers Recorded	Height Class Relative to the ground 0-40, 40-150, >150	Distance From Observer (m)	Flight Direction	Notes/Ob. Type
1	BUS Taffs	21/11/2012	13:38	1	0-40	110	W	
1	BUS Taffs	3/12/2012	16:00	3	0-40	0	W	
1	BUS Taffs	22/11/2012	15:00	3	0-40	40	S	
1	BUS Taffs	5/12/2012	12:10	4	0-40	0	S	
1	Bus Taffs	15/11/2012	12:58	2	0-40	50	N	
1	BUS Taffs	21/11/2012	13:38	3	0-40	140	N	
1	BUS Taffs	3/12/2012	16:00	1	0-40	100	E	
1	BUS Taffs	5/12/2012	12:10	1	-	100	-	Perched in stag
2	BUS Hopefield	3/12/2012	16:30	1	0-40	60	E	
4	BUS Wargeila	4/12/2012	15:35	1	0-40	50	N	
10	BUS Springvale	5/12/2012	15:10	1	0-40	20	W	Very Windy
19	Lavestock Rd. Montalta Gate	6/12/2012	13:25	5	0-40	30	S	
19	Lavestock Rd. Montalta Gate	6/12/2012	13:25	2	0-40	20	N	
19	Lavestock Rd. Montalta Gate	6/12/2012	13:25	3	0-40	10	N	

Figure 3.1 Morning Flight Path Summary

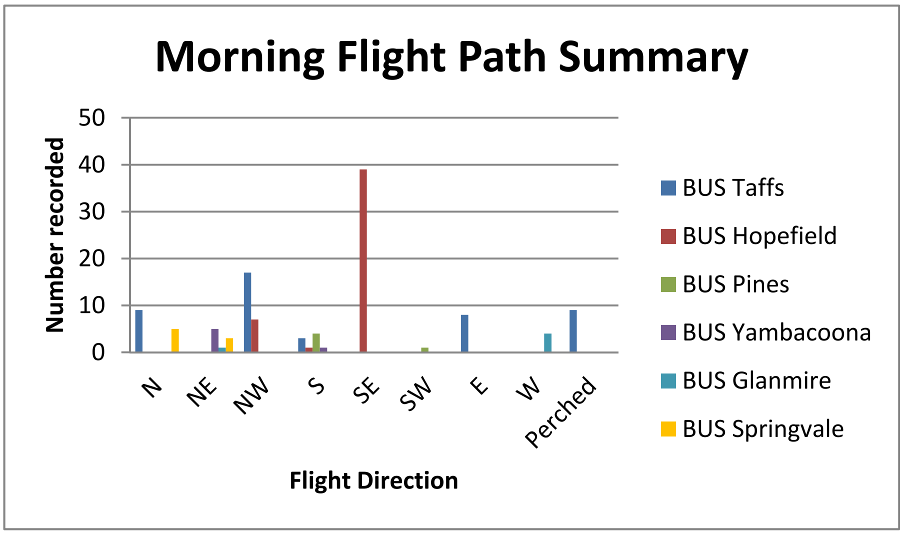
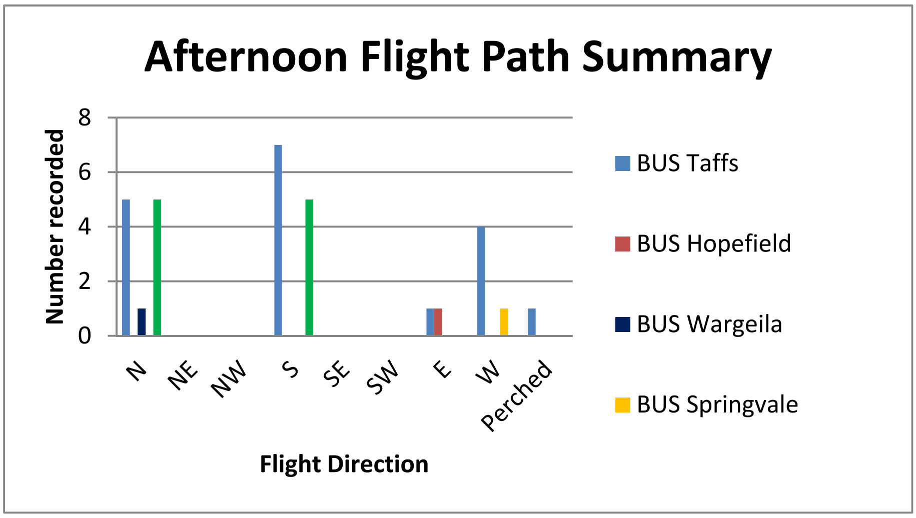


Figure 3.2 Afternoon Flight Path Summary



3.1.3 *Flight Path Barriers*

Plotting the general flight paths of the Superb Parrot in combination with the proposed turbine planning layouts it was observed that there are areas where turbines occur that could potentially impede or disrupt species movements through the landscape between potential nesting habitats and foraging resources (*Annex A*).

The following lines of turbines in *Table 3.4* have been identified as possibly creating flight path barriers for the Superb Parrot.

Table 3.4 Potential Flight Path Barriers

Planning Layout	Turbine Identification Number	Location	Barrier
130222_PL_1	113	Taff's Hill/ Hopefield	This line of Turbines may impede east – west movements between grain resources during the breeding season.
130222_PL_1	78	Taff's Hill/ Hopefield	
130222_PL_1	6	Taff's Hill/ Hopefield	
130222_PL_1	4	Taff's Hill/ Hopefield	
130222_PL_1	51	Taff's Hill/ Hopefield	
130222_PL_1	16	Taff's Hill/ Hopefield	
130222_PL_1	124	Taff's Hill/ Hopefield	
130222_PL_1	108	Taff's Hill	This line may impede the east -west flight path between grain resources and natural resources; this valley appeared to be a common flight path area.
130222_PL_1	116	Taff's Hill	
130222_PL_1	8	Taff's Hill	
130222_PL_1	126	Taff's Hill	This line of turbines may impede the east - west flight path following a small gully between resources.
130222_PL_1	127	Taff's Hill	
130222_PL_1	128	Taff's Hill	
130222_PL_1	31	Taff's Hill	May disrupt east - west flight path between resources, however birds may be inclined to follow the open woodland gully around the turbines.
130222_PL_1	20	Taff's Hill	
130222_PL_1	30	Taff's Hill	
130222_PL_1	132	Taff's Hill	May disrupt east - west flight path between resources, however birds may be inclined to follow the open woodland gully around the turbines.
130222_PL_1	131	Taff's Hill	
130222_PL_1	129	Taff's Hill	
130222_PL_2	86	Hopefield	May impede east - west flight path between resources.
130222_PL_2	37	Hopefield	
130222_PL_2	18	Hopefield	
130222_PL_2	70	Taff's Hill	This line may impede the east -west flight path between grain resources and natural resources, this valley appeared to be a common flight path area.
130222_PL_2	65	Taff's Hill	
130222_PL_2	35	Taff's Hill	
130222_PL_2	55	Pines	May impede east - west flight path between resources
130222_PL_2	49	Pines	
130222_PL_2	42	Pines	

The above information was compiled based on field observations and GIS analysis from a landscape resolution.

3.2 *BIRD CENSUS*

During the bird census, the Superb Parrot was recorded from two locations only: Taff's Hill, and the corner (cnr) of Tangamangaroo Road and Harrys Creek Road. The corresponding stratification units for these locations are Yellow Box Blakley's Red Gum Open Woodland and Apple Box – Yellow Box Grassy Woodland. Both of these areas represent preferred habitat for the Superb Parrot. Bird surveys were undertaken in both locations during Superb Parrot breeding season, no active nests were identified during the surveys.

3.3 *HABITAT ASSESSMENT*

A habitat assessment undertaken within the Study Area was aimed at identifying, recording and mapping areas that Superb Parrots were utilising during the survey period and mapping areas that are known to be preferred habitats for this species i.e. cropped fields for foraging and areas of Yellow Box Blakley's Red Gum Open Woodland and Apple Box – Yellow Box Grassy Woodland. *Annex A* shows the extent of these habitat areas.

The habitat assessment and mapping identified the northern areas toward Boorowa, and the north-western areas of the Study Area to be of higher value to the Superb Parrot throughout the breeding season than other parts of the Study Area. This is also evident from the numbers of birds recorded from this area. This is due to the abundance of foraging habitat from the grain cropping that is undertaken in these areas and the availability of preferred nectar from the blossoms of Yellow Box Blakely's Red Gum Open Woodland, and the Apple Box Yellow Box Grassy Woodland.

3.4 *TREE HOLLOW SURVEY*

A total of 1,237 hollows were recorded, comprised of 556 Small hollows (2-5cm), 509 medium hollows (6-10cm) and 172 large hollows (<11cm). The hollow bearing tree density in the area surveyed equates to an overall value of approximately 0.09 hollow bearing trees per hectare based on the survey results over the paddock areas. Compared to the density of hollow bearing trees in undisturbed (or remnant) woodland that is closer to 7–17 hollow bearing trees per hectare (OEH 2012), the numbers of hollows available for those species is very low. The dominant hollow bearing tree species were Scribbly Gum, Yellow Box, Blakely's Red Gum and Red Stringybark.

The preferred hollow size for the superb parrot is a medium hollow greater than five cm in diameter and approximately five to 13m off the ground (Manning et al. 2012). Preferred nesting trees are the Blakely's Red Gum, Yellow Box, Apple Box White Box species and dead stags (OEH 2012).

An analysis of the potential nesting habitat for the Superb Parrot has been undertaken. A total of 509 suitable sized hollows at preferred height above the ground were recorded. These were then grouped by species into primary species (Blakely's Red Gum, Yellow Box, Apple Box White Box and dead Stags) and secondary nesting trees (Red Stringybark).

A total of 48 primary nesting tree species, containing approximately 78 suitable hollows were recorded within 500m of turbine infrastructure . A further 13 secondary species containing 27 suitable hollows were also recorded. Also recorded were a total of 31 trees comprised of Inland Scribbly Gum and other eucalyptus species containing approximately 57 hollows of a suitable size. These hollow bearing trees have been plotted on a map (*Annex A*) along with proposed Turbine layouts. An analysis of the distance of these important hollows will be undertaken and mitigation measures such as appropriate set-backs from these features will be provided in subsequent reports in this series.

4 SUMMARY

From the information collected during desktop studies and from field surveys a comprehensive understanding of the habitats for woodland birds and Superb Parrot site utilisation within the Study Area and surrounds has been developed. Flight path mapping has provided important information to minimise any potential impacts to the Superb Parrot, decisions made around these flight paths would also flow on to the conservation of other species. The level of field investigation undertaken to date for the Superb Parrot and woodland birds has been sufficient to enable the impact assessment of threatened species.

The information collected has enabled the impact assessment to focus on a habitat preservation approach for the Superb Parrot and the listed threatened woodland bird species. This approach is consistent with Objective 2 of the *National Recovery Plan for the Superb Parrot* (Baker-Gabb 2011) and the required actions for the recovery of this species being: landscape retention and conservation of remaining trees both dead and alive, as large, dead trees have a vital ecological role to play in the conservation of many fauna species. Planning decisions following the mitigation hierarchy of '*Avoid, Mitigate* and lastly *Offset*' were made to avoid impacts on areas of high quality habitat that have the potential to be impacted upon.

5 *REFERENCES*

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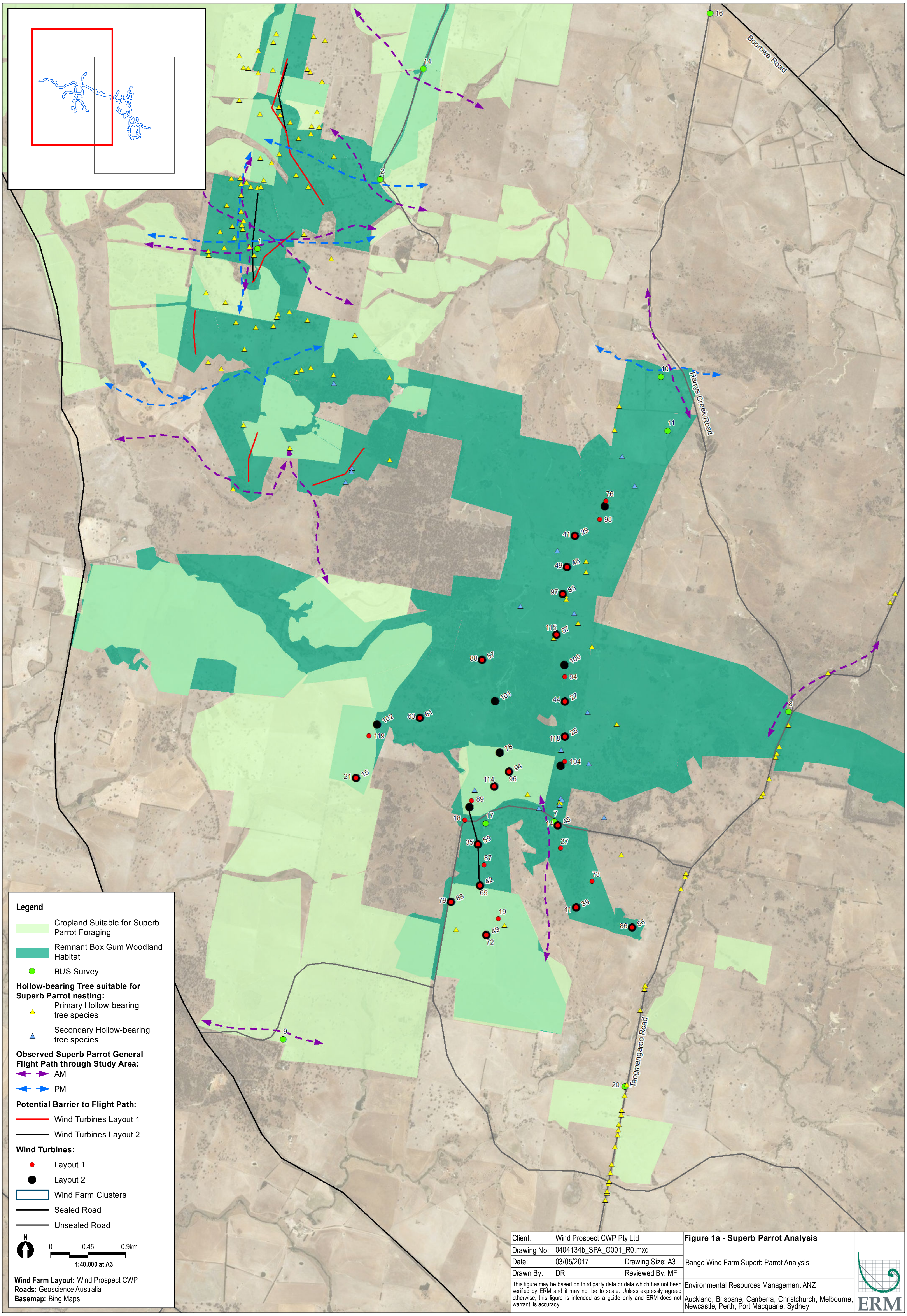
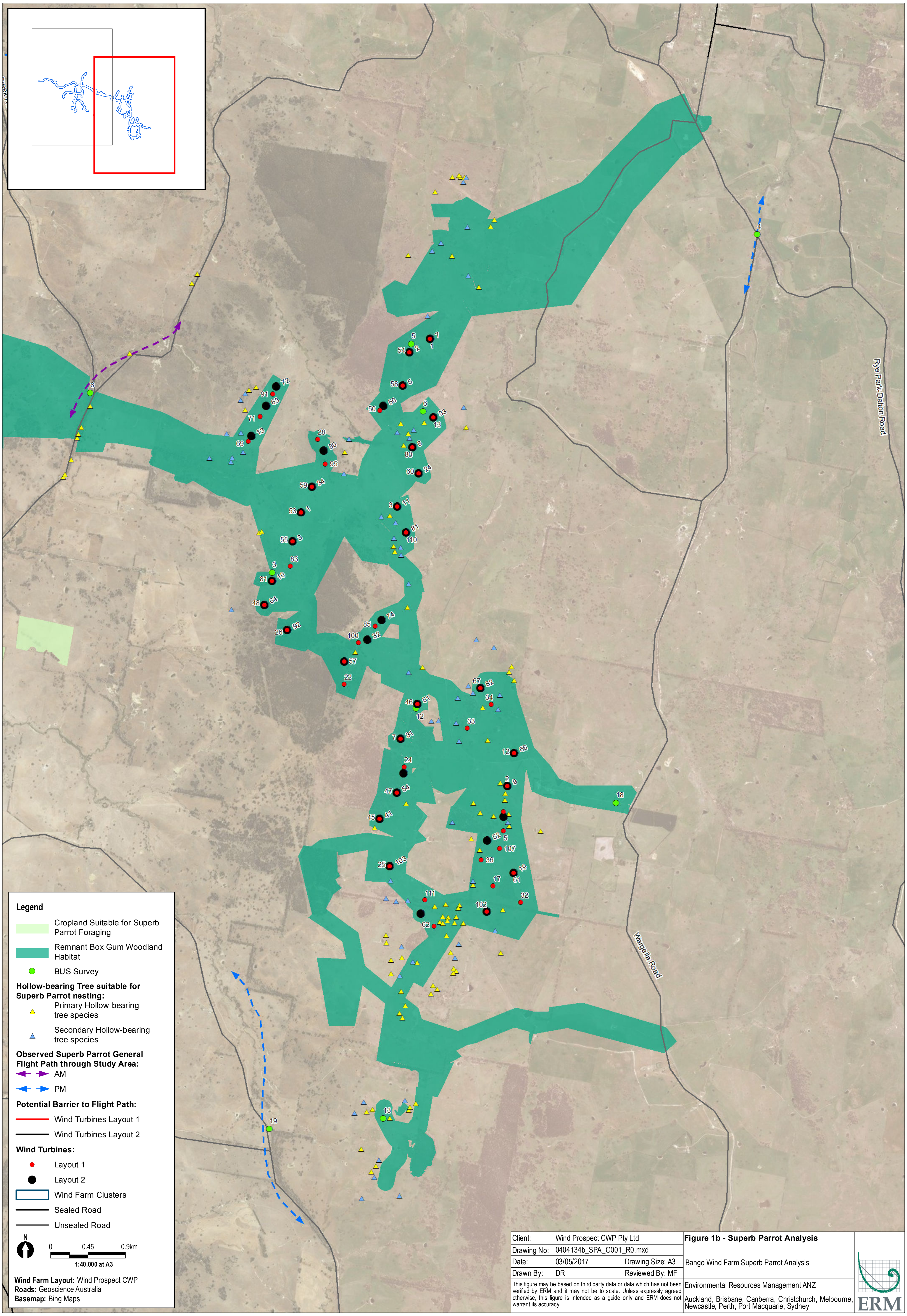
Annex A

Flight Path Mapping



Boorowa Road
Harrys Creek Road
Tangmangaroo Road
Legend
Cropland Suitable for Superb Parrot Foraging
Remnant Box Gum Woodland Habitat
BUS Survey
Hollow-bearing Tree suitable for Superb Parrot nesting:
Primary Hollow-bearing tree species
Secondary Hollow-bearing tree species
Observed Superb Parrot General Flight Path through Study Area:
AM
PM
Potential Barrier to Flight Path:
Wind Turbines Layout 1
Wind Turbines Layout 2
Wind Turbines:
Layout 1
Layout 2
Wind Farm Clusters
Sealed Road
Unsealed Road
N
0 0.45 0.9km
1:40,000 at A3
Wind Farm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps
Client: Wind Prospect CWP Pty Ltd
Drawing No: 0404134b_SPA_G001_R0.mxd
Date: 03/05/2017
Drawing Size: A3
Drawn By: DR
Reviewed By: MF
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Figure 1a - Superb Parrot Analysis
Bango Wind Farm Superb Parrot Analysis
Environmental Resources Management ANZ
Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney
ERM



Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0404134b_SPA_G001_R0.mxd		
Date:	03/05/2017	Drawing Size: A3	
Drawn By:	DR	Reviewed By: MF	

Figure 1b - Superb Parrot Analysis

Bango Wind Farm Superb Parrot Analysis

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Environmental Resources Management ANZ

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ERM

Annex D

Hollow Bearing Trees and Bats

PL1 Table

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
		m
1	250	277.68
	249	380.51
2	263	86.48
	264	93.94
	265	152.92
	262	160.86
	268	174.44
	266	234.47
	274	255.32
	267	260.92
	261	321.45
	269	340.15
	273	402.15
	270	444.86
	275	458.48
	272	459.98
	271	491.39
	276	495.69
3	292	139.13
	291	195.27
	293	223.03
	289	382.37
	290	383.83
	288	482.13
	287	497.75
5	271	90.36
	270	114.89
	273	212.19
	269	215.78
	272	352.44
	334	367.79
	268	372.78
	339	398.28
	264	453.46
	333	453.53
	274	463.24
	265	464.63
	267	482.57
	300	489.32
	275	493.67
7	279	412.93
	280	431.70
12	262	310.91
	225	351.35
	261	392.47
	263	394.02
	222	454.97
	240	491.46
	264	498.09
13	258	123.35
	257	276.76
	255	356.57
	256	382.85
	259	392.47
	254	395.87
	260	421.71
	251	466.52
	253	467.58
	252	490.86
14	149	223.22
	148	242.58
	147	274.16
	146	281.23
	142	284.46
	139	295.12

PL1		
Wind Turbine Generator Identification Number	**Hollow Tree Identification Number**	**Distance between WTG and HBT**
	140	305.24
	143	311.41
	145	314.17
	144	331.58
17	337	237.25
	336	242.58
	335	259.22
	338	266.86
	329	315.69
	331	359.28
	332	393.88
	340	417.56
	328	429.29
	334	454.83
	356	460.94
	327	479.76
	357	493.47
18	136	49.72
	132	266.14
	138	377.43
19	133	111.29
	134	273.45
22	248	409.68
24	278	443.02
	279	453.09
25	344	178.92
	345	199.37
	343	204.56
	348	391.22
	347	393.41
	341	396.46
	346	430.95
	349	471.00
	342	496.94
27	149	401.00
28	296	363.95
	298	375.61
	297	380.14
	295	398.69
32	330	136.38
	331	233.55
	329	234.28
	328	338.37
	332	343.59
	327	395.95
	326	464.84
33	238	146.04
	235	149.92
	237	166.59
	239	185.10
	236	185.79
	225	287.81
	282	300.30
	230	308.92
	234	341.63
	229	354.33
	281	358.70
	240	361.48
	233	386.27
	228	387.91
	231	434.03
	223	439.03
	224	439.03
	280	444.18
	279	445.64
	232	464.93

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
	227	494.98
34	228	69.05
	229	82.39
	223	108.97
	224	108.97
	230	111.19
	241	154.08
	227	207.03
	231	254.31
	222	285.99
	226	352.02
	232	352.39
	220	402.26
	234	405.31
	233	408.11
	225	439.30
	235	446.06
	221	449.23
	238	480.03
35	132	110.46
	136	347.72
36	334	114.45
	340	160.07
	335	178.95
	336	274.98
	339	279.65
	337	320.98
	338	338.58
41	158	273.72
	171	274.53
	170	313.52
	159	340.46
	160	453.49
44	173	308.71
	174	434.01
45	342	121.90
	341	240.93
	278	374.17
	345	402.41
46	280	268.39
	281	329.65
	246	394.99
	245	447.50
	236	487.88
	234	488.41
	233	496.79
47	278	172.09
	341	495.83
48	195	400.63
49	170	199.01
	171	226.30
	160	240.70
	159	246.47
	163	344.59
	161	389.46
	162	391.24
	158	401.96
50	254	298.55
	251	342.72
	255	446.48
	257	472.69
	256	493.27
54	250	487.46
55	192	390.36
	193	412.45
	194	415.24

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
57	248	177.69
58	254	459.25
59	294	422.80
60	253	344.24
	252	377.32
	256	433.06
	255	491.57
61	332	118.92
	331	165.46
	335	459.75
	329	465.78
	334	484.29
	336	495.01
	330	496.91
62	376	89.19
	377	114.35
	375	162.25
	378	175.71
	354	185.87
	381	190.16
	374	203.77
	358	204.69
	359	204.69
	380	210.15
	351	241.23
	355	243.35
	379	252.96
	373	292.56
	352	302.82
	353	302.82
	350	342.11
	371	357.88
	382	363.80
	383	363.80
	384	368.35
	357	369.22
	385	377.12
	356	404.28
	349	442.88
	386	460.98
	362	463.95
	372	471.73
	390	481.39
	370	485.02
67	227	30.58
	231	105.76
	226	146.89
	232	179.51
	230	244.43
	241	251.09
	233	297.26
	228	305.80
	229	309.62
	234	323.12
	223	341.37
	224	341.37
	221	398.52
	220	418.58
	219	456.99
	235	478.68
69	183	101.40
	185	132.47
	184	147.01
	186	187.50
	181	278.65
	182	279.50
	180	298.32

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
	179	323.62
	187	381.71
	178	470.84
71	187	194.03
	186	265.54
	185	302.85
	188	307.13
	189	331.36
	190	344.20
	191	359.43
	183	432.43
	182	453.23
	184	478.85
72	133	255.41
	135	366.49
	134	484.04
73	102	479.21
76	172	337.02
	157	395.92
79	135	337.61
80	253	50.38
	252	100.66
	256	110.25
	255	168.70
	257	211.55
	251	249.56
	254	317.35
	258	331.17
	299	477.51
81	193	447.86
83	193	454.55
85	248	393.19
	283	454.48
86	100	33.02
	101	183.38
87	132	335.26
89	138	133.06
	136	202.47
	137	342.20
	132	493.48
91	191	214.77
	190	285.82
	189	327.74
	187	380.49
	188	393.13
94	167	448.38
	168	480.98
	166	487.34
95	295	241.24
	294	257.93
	296	274.90
	297	414.98
	298	421.03
96	137	299.44
	141	357.21
	138	468.56
97	163	41.74
	162	81.58
	164	274.47
	160	389.17
	165	403.39
	159	483.88
	170	486.32
98	158	353.70
	172	423.01
100	248	120.16

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
	247	457.33
102	328	194.65
	329	200.95
	327	212.68
	326	258.57
	371	311.07
	356	331.13
	357	338.67
	337	357.82
	338	365.44
	373	369.69
	382	371.45
	383	371.45
	336	400.92
	379	407.47
	372	421.10
	380	461.78
	374	467.36
	335	480.55
	378	483.94
	330	499.31
104	153	142.61
	151	297.18
	152	312.87
	144	445.45
	145	464.43
	143	466.20
	142	492.61
	146	495.80
107	334	235.76
	271	294.31
	270	331.33
	339	359.03
	273	397.23
	340	409.86
	335	417.59
	332	418.04
	269	434.94
	272	488.61
	331	498.67
110	290	158.41
	289	163.51
	291	167.94
	287	194.16
	288	224.76
	285	267.40
	292	278.76
	286	282.92
	293	349.33
111	350	27.67
	351	143.46
	354	196.79
	349	203.60
	355	242.23
	352	255.15
	353	255.15
	358	288.07
	359	288.07
	375	294.96
	376	321.13
	346	347.74
	374	349.83
	377	355.82
	378	372.67
	347	409.64
	357	418.35
	356	425.15

PL1		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
	373	431.26
	379	452.50
	380	455.81
	348	468.29
	344	471.47
114	137	178.17
	138	242.11
	141	415.23
	136	489.99
115	168	52.69
	167	76.01
	165	298.09
	164	339.49
	162	442.14
	166	457.87
	163	484.72
118	153	167.04
	174	346.59
	173	404.91
	151	441.93
	175	445.99
	152	479.59
122	269	70.75
	273	132.35
	268	138.40
	270	145.44
	271	194.06
	264	219.03
	265	237.19
	274	264.59
	272	279.95
	267	284.91
	263	348.04
	266	352.38
	275	377.78
	276	416.75
	262	447.49

PL2 Table

PL2		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
		m
2	250	487.46
3	192	390.36
	193	412.45
	194	415.24
5	254	459.25
6	248	177.69
7	250	277.68
	249	380.51
8	253	50.38
	252	100.66
	256	110.25
	255	168.70
	257	211.55
	251	249.56
	254	317.35
	258	331.17
	299	477.51
9	263	86.48
	264	93.94
	265	152.92
	262	160.86
	268	174.44
	266	234.47
	274	255.32
	267	260.92
	261	321.45
	269	340.15
	273	402.15
	270	444.86
	275	458.48
	272	459.98
	271	491.39
	276	495.69
10	193	447.86
11	292	139.13
	291	195.27
	293	223.03
	289	382.37
	290	383.83
	288	482.13
	287	497.75
13	185	122.93
	186	155.33
	183	174.70
	184	220.72
	182	296.04
	187	320.72
	181	349.01
	180	369.70
	179	395.43
	188	449.37
16	269	72.55
	270	93.41
	273	117.28
	271	140.57
	268	198.28
	264	278.98
	272	280.93
	265	293.88
	274	309.89
	267	330.14
	275	396.45
	266	403.49
	263	407.77
	276	433.36

PL2		
Wind Turbine Generator Identification Number	**Hollow Tree Identification Number**	**Distance between WTG and HBT**
	339	471.80
	333	488.39
	334	498.19
19	332	118.92
	331	165.46
	335	459.75
	329	465.78
	334	484.29
	336	495.01
	330	496.91
22	172	350.16
	157	441.33
24	253	344.24
	252	377.32
	256	433.06
	255	491.57
25	153	167.04
	174	346.59
	173	404.91
	151	441.93
	175	445.99
	152	479.59
27	173	308.71
	174	434.01
28	328	194.65
	329	200.95
	327	212.68
	326	258.57
	371	311.07
	356	331.13
	357	338.67
	337	357.82
	338	365.44
	373	369.69
	382	371.45
	383	371.45
	336	400.92
	379	407.47
	372	421.10
	380	461.78
	374	467.36
	335	480.55
	378	483.94
	330	499.31
29	158	273.72
	171	274.53
	170	313.52
	159	340.46
	160	453.49
31	279	412.93
	280	431.70
32	248	203.94
	247	406.19
33	258	123.35
	257	276.76
	255	356.57
	256	382.85
	259	392.47
	254	395.87
	260	421.71
	251	466.52
	253	467.58
	252	490.86
34	294	422.80
41	342	121.90
	341	240.93

PL2		
Wind Turbine Generator Identification Number	**Hollow Tree Identification Number**	**Distance between WTG and HBT**
	278	374.17
	345	402.41
43	153	187.76
	151	346.51
	152	355.47
	144	393.04
	143	411.84
	145	414.35
	142	440.13
	146	442.60
	147	450.69
	148	481.31
44	350	161.42
	351	192.44
	354	195.53
	349	219.49
	376	252.95
	375	271.79
	355	278.63
	358	290.85
	359	290.85
	377	293.29
	352	322.82
	353	322.82
	346	331.17
	374	335.38
	378	336.42
	347	400.28
	380	404.41
	381	413.02
	379	425.27
	373	432.92
	348	454.88
	362	462.96
	357	462.99
	356	484.07
	360	494.59
45	149	223.22
	148	242.58
	147	274.16
	146	281.23
	142	284.46
	139	295.12
	140	305.24
	143	311.41
	145	314.17
	144	331.58
48	170	199.01
	171	226.30
	160	240.70
	159	246.47
	163	344.59
	161	389.46
	162	391.24
	158	401.96
49	133	255.41
	135	366.49
	134	484.04
50	254	301.81
	251	366.57
	255	455.45
	257	470.49
51	280	268.39
	281	329.65
	246	394.99
	245	447.50
	236	487.88

PL2		
Wind Turbine Generator Identification Number	Hollow Tree Identification Number	Distance between WTG and HBT
	234	488.41
	233	496.79
52	334	146.73
	339	191.44
	273	303.85
	271	318.37
	270	332.80
	340	342.89
	272	343.18
	269	415.30
	335	421.34
	277	473.29
	275	480.95
	276	494.95
54	278	172.09
	341	495.83
55	136	124.17
	138	212.09
	132	417.57
	137	420.59
56	100	33.02
	101	183.38
59	132	110.46
	136	347.72
63	187	251.24
	191	254.80
	190	275.33
	189	288.56
	188	311.88
	186	398.54
	185	443.62
64	195	400.63
66	262	310.91
	225	351.35
	261	392.47
	263	394.02
	222	454.97
	240	491.46
	264	498.09
68	135	337.61
72	191	239.26
	190	326.76
	189	378.44
	188	458.64
	187	466.44
74	283	353.08
	248	498.40
76	137	178.17
	138	242.11
	141	415.23
	136	489.99
78	137	331.79
80	296	259.14
	295	271.88
	297	338.77
	298	339.82
	294	374.67
81	290	158.41
	289	163.51
	291	167.94
	287	194.16
	288	224.76
	285	267.40
	292	278.76
	286	282.92
	293	349.33

PL2		
Wind Turbine Generator Identification Number	**Hollow Tree Identification Number**	**Distance between WTG and HBT**
82	227	30.58
	231	105.76
	226	146.89
	232	179.51
	230	244.43
	241	251.09
	233	297.26
	228	305.80
	229	309.62
	234	323.12
	223	341.37
	224	341.37
	221	398.52
	220	418.58
	219	456.99
	235	478.68
83	163	41.74
	162	81.58
	164	274.47
	160	389.17
	165	403.39
	159	483.88
	170	486.32
87	168	52.69
	167	76.01
	165	298.09
	164	339.49
	162	442.14
	166	457.87
	163	484.72
93	278	366.97
94	137	299.44
	141	357.21
	138	468.56
100	167	311.90
	168	345.10
	166	397.43
103	344	178.92
	345	199.37
	343	204.56
	348	391.22
	347	393.41
	341	396.46
	346	430.95
	349	471.00
	342	496.94

Annex E

Bird Utilisation Surveys Results

1 INTRODUCTION

Bird Utilisation Surveys (BUS) were undertaken in the period between 1 August 2012 to 23 February 2013 to capture data during the Superb Parrot breeding season and also record raptor species activity during this period.

1.1 METHODS

A fixed-point bird count method was utilised to conduct the BUS. This involved two observers stationed at a pre-determined point for a period of 15 minutes. Each observer undertook species sightings and identification of species with the aid of 10x42 mm binoculars. The following data was recorded:

- all small birds within 100m of the point;
- all large birds within 800m of the point;
- direction of flight the species is taking;
- distance from the survey point; and
- height the species is flying at measured in 20m vertical increments.

Twenty (20) BUS points were surveyed (see *Annex A*). BUS point locations were predominately on ridges or hills to gain optimum visibility of the surrounding area. BUS points were located at varying distances from habitat features such as hills/ridges, woodland and creeklines.

Twelve (12) of the points established were within the area of proposed disturbance footprint and the remaining eight (8) were control or reference BUS points, located outside the proposed disturbance footprint, in areas of representative habitat or areas that provided an unobscured view of the surrounding areas. Details of each BUS point are provided in *Table 1.1*.

Surveys were completed at different times of the day regardless of weather conditions and under optimum soaring conditions for raptor species (see *Table 1.2*). This provided an indication of the species that use the airspace under all conditions, and captured the early morning movements of woodland and parrot species.

The majority (17) of BUS points were surveyed on at least three different occasions, two BUS points were surveyed on two occasions, while one of the sites was visited once due to logistical challenges during the survey period.

The data collected from the BUS was used to assess the species at risk of collision with turbine rotors during wind farm operation, and the relative abundance of each species at risk.

Table 1.1 BUS Location Descriptions

BUS No.	BUS Location Name	Latitude (S)	Longitude (E)	Within Proposed Disturbance Footprint	Description	Altitude
1	BUS Taffs	-34.5117	148.7549	Yes	Top of ridge	594m
2	BUS Hopefield	-34.5039	148.7709	Yes	Adjacent to grain cropped fields	574m
3	BUS Willow	-34.5804	148.8503	Yes	Top of ridgeline adjacent to woodland patch	731m
4	BUS Wargeila	-34.5426	148.9133	No	Intersection Wargeila rd and Rye Park Rd, good visibility of surrounding landscape	551m
5	BUS Taree	-34.5552	148.8681	Yes	On ridgeline adjacent to woodland, good visibility	707m
6	BUS Taree 2	-34.5625	148.8698	Yes	On ridgeline, good visibility	639m
7	BUS Pines	-34.5736	148.7953	Yes	In paddock adjacent to woodland, good visibility	666m
8	BUS Yambacoona	-34.5612	148.8259	Yes	Mild hill, good visibility of surrounding area	633m
9	BUS Glenmire	-34.5978	148.7601	Yes	On ridgeline, good visibility	606m
10	BUS Springvale	-34.5249	148.8083	Yes	On mild slope good visibility to surrounding ridglines	547m
11	Springvale property	-34.5308	148.8094	Yes	On ridgline	574m
12	BUS Mt Buffalo	-34.5949	148.8696	No	On ridgline good visibility	735m
13	BUS Lloyd Davis	-34.6397	148.8663	Yes	On ridgline good visibility	712m
14	Hopefield Lane	-34.4918	148.7763	No	Adjacent to grain cropped fields	565m
15	Hopefield Lane/Boorowa Rd	-34.455	148.7851	No	Flat area – road intersection	503m
16	Harry's Ck Rd/Boorowa Rd	-34.4852	148.8139	No	Flat area – road intersection	497m

BUS No.	BUS Location Name	Latitude (S)	Longitude (E)	Within Proposed Disturbance Footprint	Description	Altitude
17	The Pines Property	-34.5739	148.7863	Yes	On mild rise, good visibility	667m
18	Mt Buffalo access gate	-34.6048	148.8961	No	At access gate, good visibility of surrounding landscape	641m
19	Lavestoc k Rd. Montalta gate	-34.641	148.8513	No	Good visibility of surrounding landscape	632m
20	The Pines access	-34.6023	148.8052	No	Intersection Tangamangaroo Rd, good visibility of surrounding ridges	575m

Table 1.2 *BUS Survey Times and Weather Conditions*

BUS No.	BUS Location Name	Date	Time	Temp (^{0}C)	Approx. Wind Speed and Direction
1	BUS Taffs	15/11/2012	12:58	23	15kmh SW
1	BUS Taffs	21/11/2012	13:38	27	15kmh WNW
1	BUS Taffs	22/11/2012	15:00	28	Calm 6kmh
1	BUS Taffs	23/11/2012	7:28	10	15kmh SE
1	BUS Taffs	29/11/2012	7:38	17	Calm 6kmh SSE
2	BUS Hopefield	14/11/2012	7:55	10	Calm
2	BUS Hopefield	3/12/2012	16:30	26	Calm
2	BUS Hopefield	5/12/2012	13:25	20	9kmh NW
3	BUS Willow	2/08/2012	10:00	12	Calm, fine
3	BUS Willow	4/12/2012	9:05	20	13kmh W
3	BUS Willow	5/12/2012	16:40	20	Very windy, NW
3	BUS Willow	13/12/2012	17:57	21	Calm
3	BUS Willow	25/01/2013	10:00	24	16kmhNNE
4	BUS Wargeila	4/12/2012	15:35	22	13kmh W
4	BUS Wargeila	18/01/2013	8:42	24	Calm
4	BUS Wargeila	25/02/2013	7:23	23	Calm
4	BUS Wargeila	27/02/2013	9:50	22	13kmh N
5	BUS Taree	16/11/2012	11:15	23	15kmh SW
5	BUS Taree	21/11/2012	8:15	27	Calm
5	BUS Taree	28/11/2012	7:18	15	Calm 4kmh
5	BUS Taree	4/12/2012	13:25	22	13kmh W
5	BUS Taree	5/12/2012	8:25	20	Calm
6	BUS Taree 2	22/11/2012	17:30	28	Calm 6kmh
6	BUS Taree 2	5/12/2012	8:55	20	Calm
6	BUS Taree 2	6/12/2012	11:15	14	Calm
7	BUS Pines	1/08/2012	15:00	12	6Kmh S
7	BUS Pines	15/11/2012	17:23	26	15kmh SW

BUS No.	BUS Location Name	Date	Time	Temp (^{0}C)	Approx. Wind Speed and Direction
7	BUS Pines	15/11/2012	17:23	26	15kmh SW
7	BUS Pines	21/11/2012	11:30	27	Calm
7	BUS Pines	5/12/2012	10:35	20	Calm
7	BUS Pines	6/12/2012	8:45	14	Calm
7	BUS Pines	11/12/2012	11:40	16	13kmh SE
9	BUS Glenmire	16/11/2012	10:36	16	Calm
8	BUS Yambacoona	14/11/2012	9:50	10	Calm
8	BUS Yambacoona	22/11/2012	10:36	28	Calm 6kmh
8	BUS Yambacoona	28/11/2012	12:30	26	Calm 4kmh
8	BUS Yambacoona	4/12/2012	16:50	22	13kmh W
10	BUS Springvale	14/11/2012	7:37	10	Calm
10	BUS Springvale	5/12/2012	15:10	20	9kmh NW
10	BUS Springvale	6/12/2012	14:57	24	6kmh W
10	BUS Springvale	27/02/2013	9:00	22	13kmh N
11	Springvale property	5/12/2012	15:35	20	9kmh NW
11	Springvale property	6/12/2012	14:35	24	6kmh W
12	BUS Mt Buffalo	15/11/2012	12:20	23	15kmh SW
12	BUS Mt Buffalo	4/12/2012	11:25	22	13kmh W
13	BUS Lloyd Davis	13/12/2012	13:50	21	Calm
13	BUS Lloyd Davis	17/12/2012	13:10	20	13kmh WNW
13	BUS Lloyd Davis	23/02/2013	15:25	21	26kmh
14	Hopefield Lane	3/12/2012	16:50	26	Calm
14	Hopefield Lane	5/12/2012	13:45	20	9kmh NW
14	Hopefield Lane	26/02/2013	17:37	27	9kmh WNW
14	Hopefield Lane	27/02/2013	8:00	22	13kmh N
15	Hopefield Lane/Boorowa Rd	5/12/2012	14:10	20	9kmh NW
15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	24	Calm
15	Hopefield Lane/Boorowa Rd	26/02/2013	17:07	27	9kmh WNW
15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	22	13kmh N
16	Harry's Ck Rd/Boorowa Rd	5/12/2012	14:40	20	9kmh NW
16	Harry's Ck Rd/Boorowa Rd	18/01/2013	11:38	27	Calm
16	Harry's Ck Rd/Boorowa Rd	23/01/2013	17:55	30	13kmh WNW
16	Harry's Ck Rd/Boorowa Rd	26/02/2013	16:40	27	9kmh WNW
17	The Pines Property	6/12/2012	9:15	14	Calm
17	The Pines Property	23/01/2013	16:50	30	13kmh WNW
17	The Pines Property	25/01/2013	11:20	24	16kmhNNE
18	Mt Buffalo Access Gate	6/12/2012	11:55	24	6kmh W
18	Mt Buffalo Access Gate	18/01/2013	9:22	24	Calm
18	Mt Buffalo Access Gate	27/02/2013	10:20	24	13kmh N
19	Lavestock Rd. Montalta Gate	6/12/2012	13:25	24	6kmh W
19	Lavestock Rd. Montalta Gate	18/01/2013	10:16	27	Calm

BUS No.	BUS Location Name	Date	Time	Temp (^0C)	Approx. Wind Speed and Direction
19	Lavestock Rd. Montalta Gate	21/02/2013	17:26	22	22kmh E
19	Lavestock Rd. Montalta Gate	23/02/2013	16:20	21	26kmh
20	The Pines Access	6/12/2012	14:20	24	6kmh W
20	The Pines Access	17/01/2013	7:53	18	Calm
20	The Pines Access	18/01/2013	11:05	27	Calm
20	The Pines Access	23/01/2013	17:20	30	13kmh WNW
20	The Pines Access	25/01/2013	11:50	24	16kmhNNE

Climate data sourced from field observations and BOM 070358 Yass Station

1.2 RESULTS

This section details the results of the BUS undertaken from August 2012 to end of February 2013. The comprehensive results of the BUS are provided in *Annex D* of the Ecological Impact Assessment report (ERM 2013).

A total of 1335 birds were recorded from 76 surveys at 20 different sites. There were 68 different species identified, with the most abundant being the Australian Magpie (*Corvus coronoides*) (159), the Superb Parrot (*Polytelis swainsonii*) (148), Crimson Rosella (*Platycercus elegans*) (93), and Sulphur-crested Cockatoo (*Cacatua galerita*) (94). The Superb Parrot is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Threatened Species Conservation Act 1995* (TSC Act).

The majority of birds observed during the BUS were flying moderate to short distances between trees, perching or moving on to the next tree or group of trees. Peak activity was generally recorded in the mornings or late afternoon BUS or on arrival to site when birds were flushed from the immediate area into the surrounding trees. Flocks of birds such as Eastern Rosellas (*Platycercus eximius*), Crimson Rosellas and Sulphur Crested Cockatoos were observed moving across the landscape generally following the contour of the landscape but often flying high over valleys, the Sulphur Crested Cockatoos were observed often flying much higher than the smaller parrot species. Birds were rarely observed to fly directly above, across or over the ridge tops.

1.2.1 Threatened Species

Threatened species listed under the EPBC Act and/or the TSC Act recorded during the BUS are listed in *Table 1.3* and include the Superb Parrot (*Polytelis swainsonii),* Brown Treecreeper *(Climacteris picumnus)*, Spotted Harrier (*Circus assimilis*) and Diamond Firetail (*Stagonopleura guttata*). The Rainbow Bee-eater (*Merops ornatus*) was also recorded which is listed as Migratory under the EPBC Act.

Table 1.3 Threatened Species Recorded during BUS

Species	Common Name	Status TSC Act	Status EPBC Act
Climacteris picumnus	Brown Treecreeper	V	
Merops ornatus	Rainbow Bee-eater		Mi
Polytelis swainsonii	Superb Parrot	V	V
Stagonopleura guttata	Diamond Firetail	V	
Circus assimilis	Spotted Harrier	V	
V = Vulnerable; Mi = Migratory			

Brown Treecreeper

The Brown Treecreeper was recorded from BUS Willow on one occasion only. A pair was observed in Stringybark Hilltop Low Woodland adjacent to the BUS point approximately 60m from the observers.

Rainbow Bee-eater

The Rainbow Bee-eater was recorded a total of 12 times from three BUS points: BUS 11 (Springvale property), BUS 10 (Springvale) and BUS 19 (Lavestock Rd. Montalta Gate). This species was commonly viewed perched in trees close to woodland edges foraging for insects.

Superb Parrot

The Superb Parrot was recorded 148 times from eight BUS locations (see *Annex A*). This was the most frequently recorded threatened species and the second most recorded species during the BUS. This species was most commonly observed in the areas where grain crops were being grown and in areas of Yellow Box Blakleys Red Gum Open Woodland and Apple Box – Yellow Box Grassy Woodland.

Diamond Firetail

The Diamond Firetail was recorded from one BUS only: BUS Springvale. This species was observed foraging on grass seeds in an open paddock in proximity to a fence line.

Spotted Harrier

The Spotted Harrier was observed from one BUS only, BUS Pines. This species was observed gliding over the open fields approximately 10m off the ground before settling on a fence post. This species was also regularly observed throughout the survey period in the same location.

2 *REFERENCES*

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Annex A

Raw Bird Utilisation Survey Data

Table A.1 Raw Bird Utilisation Survey Data

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Acanthiza reguloides	Buff-rumped Thornbill	2	0-40	0-20	Below RSA	4	S	1	BUS Taffs	22/11/2012	15:00	
Anthochaera carunculata	Red Wattlebird	1	0-40	0-20	Below RSA	100	-	1	BUS Taffs	21/11/2012	13:38	Perched
Artamus cyanopterus	Dusky Woodswallow	1	0-40	0-20	Below RSA	30	SW	1	BUS Taffs	23/11/2012	7:28	
Cacatua galerita	Sulphur-crested Cockatoo	10	0-40	20-40	At RSA	150	S	1	BUS Taffs	6/12/2012	7:05	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	50	E	1	Bus Taffs	15/11/2012	12:58	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	N	1	Bus Taffs	15/11/2012	12:58	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	30	SE	1	BUS Taffs	22/11/2012	15:00	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	50	W	1	BUS Taffs	22/11/2012	15:00	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	81-120	NE	1	BUS Taffs	22/11/2012	15:00	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	20	N	1	BUS Taffs	22/11/2012	15:00	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	60	S	1	BUS Taffs	22/11/2012	15:00	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	N	1	BUS Taffs	23/11/2012	7:28	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	50	N	1	BUS Taffs	23/11/2012	7:28	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	20	NW	1	BUS Taffs	23/11/2012	7:28	
Cacatua galerita	Sulphur-crested Cockatoo	3	0-40	0-20	Below RSA	90	-	1	BUS Taffs	29/11/2012	7:38	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	100	NE	1	BUS Taffs	3/12/2012	16:00	Observed/Heard call
Coracina novaehollandiae	Black-faced Cuckoo-shrike	5	0-40	20-40	At RSA	70	NE	1	BUS Taffs	23/11/2012	7:28	
Cincloramphus mathewsi	Rufous Songlark	4	0-40	0-20	Below RSA	30	-	1	Bus Taffs	15/11/2012	12:58	Flying from ground to trees
Cincloramphus mathewsi	Rufous Songlark	2	0-40	0-20	Below RSA	30	-	1	BUS Taffs	21/11/2012	13:38	Perched
Cincloramphus mathewsi	Rufous Songlark	1	0-40	0-20	Below RSA	30	S	1	BUS Taffs	21/11/2012	13:38	
Cincloramphus mathewsi	Rufous Songlark	1	0-40	0-20	Below RSA	40	-	1	BUS Taffs	22/11/2012	15:00	Perched
Cincloramphus mathewsi	Rufous Songlark	1	0-40	0-20	Below RSA	50	-	1	BUS Taffs	23/11/2012	7:28	Perched
Cincloramphus mathewsi	Rufous Songlark	2	0-40	0-20	Below RSA	30	-	1	BUS Taffs	29/11/2012	7:38	
Cincloramphus mathewsi	Rufous Songlark	1	-	0-20	Below RSA	40	-	1	BUS Taffs	6/12/2012	7:05	Perched
Colluricincla harmonica	Grey Shrike-thrush	1	-	0-20	Below RSA	80	-	1	BUS Taffs	6/12/2012	7:05	Calling in woodland
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2	0-40	0-20	Below RSA	60	W	1	BUS Taffs	21/11/2012	13:38	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	20	W	1	BUS Taffs	3/12/2012	16:00	Observed
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	10	S	1	BUS Taffs	5/12/2012	12:10	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	40	N	1	BUS Taffs	6/12/2012	7:05	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	80	S	1	BUS Taffs	6/12/2012	7:05	
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	100	W	1	BUS Taffs	23/11/2012	7:28	
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	40	-	1	BUS Taffs	29/11/2012	7:38	
Corvus coronoides	Australasian Raven	1	0-40	0-20	Below RSA	120	S	1	BUS Taffs	5/12/2012	12:10	
Corvus coronoides	Australasian Raven	2	-	0-20	Below RSA	120	-	1	BUS Taffs	6/12/2012	7:05	Perched
Cracticus tibicen	Australian Magpie	1	0-40	20-40	At RSA	100	N	1	Bus Taffs	15/11/2012	12:58	
Cracticus tibicen	Australian Magpie	3	0-40	20-40	At RSA	100	S	1	Bus Taffs	15/11/2012	12:58	
Cracticus tibicen	Australian Magpie	1	0-40	20-40	At RSA	50	NW	1	BUS Taffs	23/11/2012	7:28	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	5	N	1	BUS Taffs	22/11/2012	15:00	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	70	-	1	BUS Taffs	29/11/2012	7:38	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	80	W	1	BUS Taffs	5/12/2012	12:10	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	100	E	1	BUS Taffs	5/12/2012	12:10	
Cracticus tibicen	Australian Magpie	1	-	0-20	Below RSA	40	-	1	BUS Taffs	5/12/2012	12:10	Perched
Cracticus tibicen	Australian Magpie	4	-	0-20	Below RSA	80	-	1	BUS Taffs	6/12/2012	7:05	Perched
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	50	-	1	BUS Taffs	22/11/2012	15:00	
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	50	W	1	BUS Taffs	22/11/2012	15:00	
Eolophus roseicapilla	Galah	1	0-40	20-40	At RSA	80	S	1	BUS Taffs	21/11/2012	13:38	
Eolophus roseicapilla	Galah	1	0-40	0-20	Below RSA	140	N	1	BUS Taffs	21/11/2012	13:38	
Eolophus roseicapilla	Galah	1	0-40	0-20	Below RSA	30	N	1	BUS Taffs	22/11/2012	15:00	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	50	E	1	BUS Taffs	22/11/2012	15:00	
Eolophus roseicapilla	Galah	3	0-40	0-20	Below RSA	70	S	1	BUS Taffs	23/11/2012	7:28	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	20	-	1	BUS Taffs	29/11/2012	7:38	
Eolophus roseicapilla	Galah	1	0-40	0-20	Below RSA	60	E	1	BUS Taffs	6/12/2012	7:05	
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	80	N	1	BUS Taffs	5/12/2012	12:10	
Falco cenchroides	Nankeen Kestrel	1	0-40	20-40	At RSA	70	N	1	BUS Taffs	15/11/2012	12:58	
Falco peregrinus	Peregrine Falcon	1	40-150	40-150	At RSA	50	W	1	Bus Taffs	15/11/2012	12:58	
Falcunculus frontatus	Crested Shrike-tit	2	0-40	0-20	Below RSA	30	-	1	BUS Taffs	23/11/2012	7:28	Perched
Hirundo neoxena	Welcome Swallow	2	0-40	0-20	Below RSA	10	N	1	Bus Taffs	15/11/2012	12:58	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Malurus cyaneus	Superb Fairywren	1	0-40	0-20	Below RSA	40	-	1	BUS Taffs	21/11/2012	13:38	Calling in dense grass
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	15	N	1	BUS Taffs	22/11/2012	15:00	Perched in tree
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	70	-	1	BUS Taffs	5/12/2012	12:10	Calling in woodland
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	70	-	1	BUS Taffs	6/12/2012	7:05	Calling in woodland
Phaps chalcoptera	Common Bronzewing	1	0-40	0-20	Below RSA	80	S	1	BUS Taffs	6/12/2012	7:05	
Philemon citreogularis	Little Friarbird	1	0-40	0-20	Below RSA	60	-	1	Bus Taffs	15/11/2012	12:58	Perched in tree
Philemon citreogularis	Little Friarbird	1	0-40	0-20	Below RSA	40	-	1	BUS Taffs	21/11/2012	13:38	Calling in trees
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	50	SE	1	BUS Taffs	3/12/2012	16:00	Heard call
Platycercus elegans	Crimson Rosella	3	0-40	0-20	Below RSA	70	-	1	BUS Taffs	21/11/2012	13:38	Calling in trees
Platycercus elegans	Crimson Rosella	3	0-40	0-20	Below RSA	50	SW	1	BUS Taffs	23/11/2012	7:28	
Platycercus elegans	Crimson Rosella	2	-	0-20	Below RSA	50	-	1	BUS Taffs	5/12/2012	12:10	Perched in tree
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	40	SE	1	BUS Taffs	5/12/2012	12:10	
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	100	N	1	BUS Taffs	6/12/2012	7:05	
Platycercus eximius	Eastern Rosella	3	0-40	0-20	Below RSA	60	W	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	2	0-40	0-20	Below RSA	50	N	1	Bus Taffs	15/11/2012	12:58	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	110	W	1	BUS Taffs	21/11/2012	13:38	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	140	N	1	BUS Taffs	21/11/2012	13:38	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	40	S	1	BUS Taffs	22/11/2012	15:00	
Polytelis swainsonii	Superb Parrot	8	0-40	0-20	Below RSA	60	NW	1	BUS Taffs	23/11/2012	7:28	
Polytelis swainsonii	Superb Parrot	5	0-40	0-20	Below RSA	70	NW	1	BUS Taffs	23/11/2012	7:28	
Polytelis swainsonii	Superb Parrot	4	0-40	0-20	Below RSA	80	NW	1	BUS Taffs	23/11/2012	7:28	
Polytelis swainsonii	Superb Parrot	6	0-40	0-20	Below RSA	70	-	1	BUS Taffs	29/11/2012	7:38	Perched
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	0	W	1	BUS Taffs	3/12/2012	16:00	Observed/Heard call
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	100	E	1	BUS Taffs	3/12/2012	16:00	Observed/Heard call
Polytelis swainsonii	Superb Parrot	4	0-40	0-20	Below RSA	0	S	1	BUS Taffs	5/12/2012	12:10	
Polytelis swainsonii	Superb Parrot	1	-	0-20	Below RSA	100	-	1	BUS Taffs	5/12/2012	12:10	Perched in stag
Polytelis swainsonii	Superb Parrot	3	-	0-20	Below RSA	40	-	1	BUS Taffs	6/12/2012	7:05	Perched
Polytelis swainsonii	Superb Parrot	2	0-40	0-20	Below RSA	50	N	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	8	0-40	0-20	Below RSA	100	E	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	20	N	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	50	N	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	90	N	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	40	S	1	BUS Taffs	6/12/2012	7:05	
Polytelis swainsonii	Superb Parrot	2	0-40	0-20	Below RSA	50	S	1	BUS Taffs	6/12/2012	7:05	
Psephotus haematonotus	Red-rumped Parrot	5	0-40	0-20	Below RSA	80	E	1	BUS Taffs	6/12/2012	7:05	
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	50	-	1	BUS Taffs	21/11/2012	13:38	Perched in tree
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	10	S	1	BUS Taffs	21/11/2012	13:38	
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	20	S	1	BUS Taffs	22/11/2012	15:00	
Rhipidura leucophrys	Willie Wagtail	2	0-40	0-20	Below RSA	50	SW	1	BUS Taffs	3/12/2012	16:00	Heard call
Rhipidura leucophrys	Willie Wagtail	2	-	0-20	Below RSA	5	-	1	BUS Taffs	6/12/2012	7:05	Perched
Sturnus vulgaris	Common Starling	10	0-40	0-20	Below RSA	60	-	1	BUS Taffs	29/11/2012	7:38	
Sturnus vulgaris	Common Starling	50	0-40	0-20	Below RSA	100	SW	1	BUS Taffs	3/12/2012	16:00	Observed
Cacatua galerita	Sulphur-crested Cockatoo	20	0-40	0-20	Below RSA	30	N	2	BUS Hopefield	3/12/2012	16:30	Observed
Cacatua galerita	Sulphur-crested Cockatoo	5	-	0-20	Below RSA	50	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Cacatua galerita	Sulphur-crested Cockatoo	3	0-40	0-20	Below RSA	50	W	2	BUS Hopefield	5/12/2012	13:25	Perched
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	40	S	2	BUS Hopefield	3/12/2012	16:30	Observed
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	80	SE	2	BUS Hopefield	14/11/2012	7:55	
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	15	W	2	BUS Hopefield	14/11/2012	7:55	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	20	N	2	BUS Hopefield	3/12/2012	16:30	Observed/Heard call
Cracticus tibicen	Australian Magpie	1	-	0-20	Below RSA	15	-	2	BUS Hopefield	5/12/2012	13:25	Perched on fence
Cracticus tibicen	Australian Magpie	1	-	0-20	Below RSA	50	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Egretta novaehollandiae	White-faced Heron	2	0-40	0-20	Below RSA	10	E	2	BUS Hopefield	3/12/2012	16:30	Observed
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	20	S	2	BUS Hopefield	14/11/2012	7:55	
Eolophus roseicapilla	Galah	20	0-40	0-20	Below RSA	30	NE	2	BUS Hopefield	3/12/2012	16:30	Observed
Eolophus roseicapilla	Galah	6	-	0-20	Below RSA	10	-	2	BUS Hopefield	5/12/2012	13:25	On ground
Eolophus roseicapilla	Galah	2	-	0-20	Below RSA	50	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Eolophus roseicapilla	Galah	6	-	0-20	Below RSA	50	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Eolophus roseicapilla	Galah	20	0-40	0-20	Below RSA	80	S	2	BUS Hopefield	5/12/2012	13:25	
Malurus cyaneus	Superb Fairywren	1	0-40	0-20	Below RSA	5	S	2	BUS Hopefield	3/12/2012	16:30	Observed
Pardalotus striatus	Striated Pardalote	2	0-40	0-20	Below RSA	20	NW	2	BUS Hopefield	14/11/2012	7:55	
Pardalotus striatus	Striated Pardalote	2	0-40	0-20	Below RSA	30	N	2	BUS Hopefield	14/11/2012	7:55	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	20	E	2	BUS Hopefield	14/11/2012	7:55	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	100	NE	2	BUS Hopefield	3/12/2012	16:30	Observed
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	30	SE	2	BUS Hopefield	14/11/2012	7:55	
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	20	N	2	BUS Hopefield	3/12/2012	16:30	Observed
Polytelis swainsonii	Superb Parrot	30	0-40	0-20	Below RSA	10	SE	2	BUS Hopefield	14/11/2012	7:55	Forgaing in pasture and hanging in trees
Polytelis swainsonii	Superb Parrot	2	0-40	0-20	Below RSA	5	SE	2	BUS Hopefield	14/11/2012	7:55	
Polytelis swainsonii	Superb Parrot	7	0-40	0-20	Below RSA	5	NW	2	BUS Hopefield	14/11/2012	7:55	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	10	SE	2	BUS Hopefield	14/11/2012	7:55	
Polytelis swainsonii	Superb Parrot	4	0-40	0-20	Below RSA	30	SE	2	BUS Hopefield	14/11/2012	7:55	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	40	S	2	BUS Hopefield	14/11/2012	7:55	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	60	E	2	BUS Hopefield	3/12/2012	16:30	Observed
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	5	W	2	BUS Hopefield	3/12/2012	16:30	Observed/Heard call
Rhipidura leucophrys	Willie Wagtail	1	-	0-20	Below RSA	40	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Rhipidura leucophrys	Willie Wagtail	2	-	0-20	Below RSA	10	-	2	BUS Hopefield	5/12/2012	13:25	Perched
Sturnus vulgaris	Common Starling	10	0-40	0-20	Below RSA	100	N	2	BUS Hopefield	5/12/2012	13:25	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	5	0-40	0-20	Below RSA	20	-	3	BUS Willow	4/12/2012	9:05	Perched in tree
Cincloramphus mathewsi	Rufous Songlark	2	0-40	0-20	Below RSA	100	NW	3	BUS Willow	25/01/2013	10:00	perched
Climacteris picumnus	Brown Treecreeper	2	0-40	0-20	Below RSA	60	E	3	BUS Willow	25/01/2013	10:00	calling from tree
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2	0-40	0-20	Below RSA	200	NW	3	BUS Willow	13/12/2012	17:57	
Corvus coronoides	Australasian Raven	3	0-40	0-20	Below RSA	70	N	3	BUS Willow	25/01/2013	10:00	Perched
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	20	W	3	BUS Willow	4/12/2012	9:05	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	120	S	3	BUS Willow	4/12/2012	9:05	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	40	W	3	BUS Willow	5/12/2012	16:40	Very Windy
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	200	N	3	BUS Willow	13/12/2012	17:57	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	50	NE	3	BUS Willow	25/01/2013	10:00	
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	60	NW	3	BUS Willow	25/01/2013	10:00	perched
Falco cenchroides	Nankeen Kestrel	3	0-40	0-20	Below RSA	40	-	3	BUS Willow	5/12/2012	16:40	Hovering in wind
Falco cenchroides	Nankeen Kestrel	2	0-40	20-40	At RSA	80	NE	3	BUS Willow	25/01/2013	10:00	foraging
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	20	-	3	BUS Willow	4/12/2012	9:05	Calling in trees
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	30	S	3	BUS Willow	13/12/2012	17:57	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	20	W	3	BUS Willow	5/12/2012	16:40	Very Windy
Platycercus elegans	Crimson Rosella	3	0-40	0-20	Below RSA	40	NW	3	BUS Willow	25/01/2013	10:00	
Rhipidura leucophrys	Willie Wagtail	2	0-40	0-20	Below RSA	70	W	3	BUS Willow	25/01/2013	10:00	perched
Anthochaera carunculata	Red Wattlebird	4	0-40	0-20	Below RSA	50	W	4	BUS Wargeila	18/01/2013	8:42	
Artamus superciliosus	White-browed Woodswallow	7	0-40	0-20	Below RSA	20	-	4	BUS Wargeila	4/12/2012	15:35	Circling
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	50	NE	4	BUS Wargeila	4/12/2012	15:35	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	100	W	4	BUS Wargeila	4/12/2012	15:35	
Cacatua galerita	Sulphur-crested Cockatoo	5	0-40	0-20	Below RSA	80	NE	4	BUS Wargeila	18/01/2013	8:42	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	60	E	4	BUS Wargeila	18/01/2013	8:42	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	30	W	4	BUS Wargeila	18/01/2013	8:42	
Cacatua galerita	Sulphur-crested Cockatoo	3	0-40	0-20	Below RSA	150	NE	4	BUS Wargeila	25/02/2013	7:23	Perched
Cacatua galerita	Sulphur-crested Cockatoo	5	0-40	0-20	Below RSA	70	N	4	BUS Wargeila	27/02/2013	9:50	Perched
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	40	W	4	BUS Wargeila	4/12/2012	15:35	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	30	W	4	BUS Wargeila	18/01/2013	8:42	
Cormobates leucophaea	White-throated Treecreeper	1	-	0-20	Below RSA	40	-	4	BUS Wargeila	4/12/2012	15:35	Calling in woodland
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	25	E	4	BUS Wargeila	18/01/2013	8:42	On ground
Cracticus tibicen	Australian Magpie	8	0-40	0-20	Below RSA	100		4	BUS Wargeila	25/02/2013	7:23	Perched
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	150	NE	4	BUS Wargeila	25/02/2013	7:23	Flying
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	150	NW	4	BUS Wargeila	25/02/2013	7:23	Flying
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	70	N	4	BUS Wargeila	27/02/2013	9:50	Perched
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	50	N	4	BUS Wargeila	18/01/2013	8:42	
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	150	E	4	BUS Wargeila	25/02/2013	7:23	Perched
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	10	N	4	BUS Wargeila	4/12/2012	15:35	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	20	N	4	BUS Wargeila	4/12/2012	15:35	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	200	SE	4	BUS Wargeila	25/02/2013	7:23	Flying
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	150	N	4	BUS Wargeila	25/02/2013	7:23	Flying
Eurystomus orientalis	Dollarbird	1	0-40	0-20	Below RSA	30	N	4	BUS Wargeila	18/01/2013	8:42	
Grallina cyanoleuca	Magpie Lark	1	0-40	0-20	Below RSA	100		4	BUS Wargeila	25/02/2013	7:23	Perched
Malurus cyaneus	Superb Fairywren	4	0-40	0-20	Below RSA	100	S	4	BUS Wargeila	25/02/2013	7:23	Perched
Malurus cyaneus	Superb Fairywren	4	0-40	0-20	Below RSA	30	E	4	BUS Wargeila	27/02/2013	9:50	Perched
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	40	-	4	BUS Wargeila	4/12/2012	15:35	Calling in

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
												woodland
Phalacrocorax varius	Pied Cormorant	2	0-40	0-20	Below RSA		S	4	BUS Wargeila	25/02/2013	7:23	Flying
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	50	W	4	BUS Wargeila	27/02/2013	9:50	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	50	NE	4	BUS Wargeila	4/12/2012	15:35	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	50	E	4	BUS Wargeila	18/01/2013	8:42	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	50	N	4	BUS Wargeila	18/01/2013	8:42	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	45	NW	4	BUS Wargeila	18/01/2013	8:42	
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	150	NW	4	BUS Wargeila	25/02/2013	7:23	Perched
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	50	N	4	BUS Wargeila	4/12/2012	15:35	
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	30	N	4	BUS Wargeila	18/01/2013	8:42	on ground
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	20		4	BUS Wargeila	25/02/2013	7:23	Perched
Acanthiza reguloides	Buff-rumped Thornbill	2	0-40	0-20	Below RSA	-	N	5	BUS Taree	28/11/2012	7:18	
Aquila audax	Wedge-tailed Eagle	1	40-150	40-150	At RSA	300	N	5	BUS Taree	16/11/2012	11:15	Thermaling North
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	40	SW	5	BUS Taree	28/11/2012	7:18	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	100	W	5	BUS Taree	16/11/2012	11:15	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	30	SE	5	BUS Taree	16/11/2012	11:15	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	40	-	5	BUS Taree	21/11/2012	8:15	Calling in woodland
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	-	SW	5	BUS Taree	28/11/2012	7:18	
Cormobates leucophaea	White-throated Treecreeper	2	0-40	0-20	Below RSA	80	-	5	BUS Taree	16/11/2012	11:15	Calling in trees
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	100	-	5	BUS Taree	21/11/2012	8:15	Calling, perched in tree
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	100	S	5	BUS Taree	21/11/2012	8:15	
Corvus mellori	Little Raven	2	0-40	0-20	Below RSA	-	S	5	BUS Taree	28/11/2012	7:18	
Cracticus nigrogularis	Pied Butcherbird	1	0-40	0-20	Below RSA	60	N	5	BUS Taree	21/11/2012	8:15	
Cracticus tibicen	Australian Magpie	2	0-40	20-40	At RSA	70	E	5	BUS Taree	16/11/2012	11:15	
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	100	-	5	BUS Taree	16/11/2012	11:15	Perched in tree
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	60	-	5	BUS Taree	16/11/2012	11:15	Perched in tree
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	80	-	5	BUS Taree	16/11/2012	11:15	Perched in tree
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	90	-	5	BUS Taree	21/11/2012	8:15	Perched in tree
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	-	S	5	BUS Taree	28/11/2012	7:18	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	100	NE	5	BUS Taree	4/12/2012	13:25	Very Windy
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	40	S	5	BUS Taree	5/12/2012	8:25	Very Windy
Eopsaltria australis	Eastern Yellow Robin	1	0-40	0-20	Below RSA	-	NW	5	BUS Taree	28/11/2012	7:18	
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	20	W	5	BUS Taree	4/12/2012	13:25	Very Windy
Falco cenchroides	Nankeen Kestrel	1	0-40	0-20	Below RSA	110	S	5	BUS Taree	16/11/2012	11:15	
Falco cenchroides	Nankeen Kestrel	2	0-40	0-20	Below RSA	80	NE	5	BUS Taree	21/11/2012	8:15	
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	80	-	5	BUS Taree	16/11/2012	11:15	Calling in trees
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	80	-	5	BUS Taree	21/11/2012	8:15	Calling in woodland
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	40	-	5	BUS Taree	21/11/2012	8:15	Perched in tree
Pardalotus striatus	Striated Pardalote	?	0-40	0-20	Below RSA	-	SW	5	BUS Taree	28/11/2012	7:18	
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	40	-	5	BUS Taree	4/12/2012	13:25	Calling in woodland, Very Windy
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	20	-	5	BUS Taree	5/12/2012	8:25	Very Windy
Philemon citreogularis	Little Friarbird	1	0-40	0-20	Below RSA	80	-	5	BUS Taree	16/11/2012	11:15	Calling in trees
Philemon corniculatus	Noisy Friarbird	4	0-40	0-20	Below RSA	80	-	5	BUS Taree	21/11/2012	8:15	Calling in woodland
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	-	W	5	BUS Taree	28/11/2012	7:18	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	40	E	5	BUS Taree	16/11/2012	11:15	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	100	S	5	BUS Taree	21/11/2012	8:15	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	20	NE	5	BUS Taree	21/11/2012	8:15	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	-	W	5	BUS Taree	28/11/2012	7:18	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	NW	5	BUS Taree	28/11/2012	7:18	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	10	E	5	BUS Taree	5/12/2012	8:25	Very Windy
Acanthiza reguloides	Buff-rumped Thornbill	3	0-40	0-20	Below RSA	20	NW	6	BUS Taree 2	22/11/2012	17:30	Foraging
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	80	W	6	BUS Taree 2	5/12/2012	8:55	Very Windy
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	30	NW	6	BUS Taree 2	22/11/2012	17:30	
Cormobates leucophaea	White-throated Treecreeper	1	-	0-20	Below RSA	50	-	6	BUS Taree 2	6/12/2012	11:15	Calling in woodland
Cracticus tibicen	Australian Magpie	6	0-40	0-20	Below RSA	20	W	6	BUS Taree 2	22/11/2012	17:30	Perched
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	60	NE	6	BUS Taree 2	22/11/2012	17:30	Foraging on ground
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	100	W	6	BUS Taree 2	5/12/2012	8:55	Very Windy
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	200	S	6	BUS Taree 2	6/12/2012	11:15	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Dacelo novaeguineae	Laughing Kookaburra	1	-	0-20	Below RSA	100	-	6	BUS Taree 2	6/12/2012	11:15	Perched
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	200	S	6	BUS Taree 2	6/12/2012	11:15	
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	-	E	6	BUS Taree 2	22/11/2012	17:30	Perched
Gerygone albogularis	White-throated Gerygone	2	-	0-20	Below RSA	70	-	6	BUS Taree 2	6/12/2012	11:15	Calling in woodland
Grallina cyanoleuca	Magpie Lark	1	-	0-20	Below RSA	100	-	6	BUS Taree 2	6/12/2012	11:15	Calling in woodland
Pardalotus striatus	Striated Pardalote	2	0-40	0-20	Below RSA	-	N	6	BUS Taree 2	22/11/2012	17:30	Heard
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	50	-	6	BUS Taree 2	6/12/2012	11:15	Calling in woodland
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	5	N	6	BUS Taree 2	22/11/2012	17:30	
Philemon corniculatus	Noisy Friarbird	1	-	0-20	Below RSA	60	-	6	BUS Taree 2	6/12/2012	11:15	Calling in woodland
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	-	SE	6	BUS Taree 2	22/11/2012	17:30	Perched
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	10	N	6	BUS Taree 2	22/11/2012	17:30	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	W	6	BUS Taree 2	6/12/2012	11:15	
Strepera graculina	Pied Currawong	1	0-40	0-20	Below RSA	-	E	6	BUS Taree 2	22/11/2012	17:30	Heard
Strepera graculina	Pied Currawong	1	0-40	0-20	Below RSA	-	E	6	BUS Taree 2	22/11/2012	17:30	Heard
Anthochaera carunculata	Red Wattlebird	1	0-40	0-20	Below RSA	40	-	7	BUS Pines	21/11/2012	11:30	Perched in woodland
Anthochaera carunculata	Red Wattlebird	2	0-40	0-20	Below RSA	50	NW	7	BUS Pines	22/11/2012	8:45	
Anthochaera carunculata	Red Wattlebird	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	6/12/2012	8:45	Perched
Aquila morphnoides	Little Eagle	1	40-150	40-150	At RSA	0	NE	7	BUS Pines	15/11/2012	17:23	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	NW	7	BUS Pines	15/11/2012	17:23	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	E	7	BUS Pines	15/11/2012	17:23	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	50	-	7	BUS Pines	22/11/2012	8:45	Calling in woodland
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	50	W	7	BUS Pines	5/12/2012	10:35	Very Windy
Cacatua galerita	Sulphur-crested Cockatoo	-	-	0-20	Below RSA	40	S	7	BUS Pines	11/12/2012	11:40	
Colluricincla harmonica	Grey Shrike-thrush	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	6/12/2012	8:45	Perched in paddock tree
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2	0-40	0-20	Below RSA	20	SW	7	BUS Pines	15/11/2012	17:23	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2	0-40	0-20	Below RSA	20	NW	7	BUS Pines	22/11/2012	8:45	
Corvus coronoides	Australasian Raven	2	0-40	20-40	At RSA	80	E	7	BUS Pines	15/11/2012	17:23	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	50	E	7	BUS Pines	6/12/2012	8:45	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	-	0-20	Below RSA	50	N	7	BUS Pines	11/12/2012	11:40	
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	15/11/2012	17:23	Calling in woodland
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	60	-	7	BUS Pines	21/11/2012	11:30	Calling in woodland
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	70	-	7	BUS Pines	22/11/2012	8:45	Calling in trees
Cormobates leucophaea	White-throated Treecreeper	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	6/12/2012	8:45	Calling in woodland
Cormobates leucophaea	White-throated Treecreeper	-	-	0-20	Below RSA	50	E	7	BUS Pines	11/12/2012	11:40	
Corvus coronoides	Australasian Raven	1	0-40	0-20	Below RSA	20	S	7	BUS Pines	15/11/2012	17:23	
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	60	SW	7	BUS Pines	15/11/2012	17:23	
Corvus coronoides	Australasian Raven	1	0-40	0-20	Below RSA	50	S	7	BUS Pines	15/11/2012	17:23	
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	50	W	7	BUS Pines	21/11/2012	11:30	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	70	-	7	BUS Pines	6/12/2012	8:45	Perched
Cracticus tibicen	Australian Magpie	-	-	0-20	Below RSA	40	N	7	BUS Pines	11/12/2012	11:40	
Cracticus torquatus	Grey Butcherbird	-	-	0-20	Below RSA	50	NW	7	BUS Pines	11/12/2012	11:40	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	50	W	7	BUS Pines	5/12/2012	10:35	Very Windy
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	50	E	7	BUS Pines	6/12/2012	8:45	
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	60	-	7	BUS Pines	21/11/2012	11:30	Calling in woodland
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	80	-	7	BUS Pines	22/11/2012	8:45	Calling in woodland
Gerygone albogularis	White-throated Gerygone	-	-	0-20	Below RSA	100	E	7	BUS Pines	11/12/2012	11:40	
Gerygone albogularis	White-throated Gerygone	-	-	0-20	Below RSA	70	NW	7	BUS Pines	11/12/2012	11:40	
Gerygone albogularis	White-throated Gerygone	-	-	0-20	Below RSA	70	SE	7	BUS Pines	11/12/2012	11:40	
Grallina cyanoleuca	Magpie Lark	-	-	0-20	Below RSA	50	W	7	BUS Pines	11/12/2012	11:40	
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	70	-	7	BUS Pines	21/11/2012	11:30	Calling in woodland
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	40	-	7	BUS Pines	22/11/2012	8:45	Calling in trees
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	6/12/2012	8:45	Perched
Pardalotus striatus	Striated Pardalote	-	-	0-20	Below RSA	30	SE	7	BUS Pines	11/12/2012	11:40	
Philemon citreogularis	Little Friarbird	1	0-40	0-20	Below RSA	20	-	7	BUS Pines	6/12/2012	8:45	Perched
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	30	-	7	BUS Pines	22/11/2012	8:45	Perched
Philemon corniculatus	Noisy Friarbird	-	-	0-20	Below RSA	60	NE	7	BUS Pines	11/12/2012	11:40	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	-	7	BUS Pines	21/11/2012	11:30	Feeding in woodland
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	40	-	7	BUS Pines	22/11/2012	8:45	Perched
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	W	7	BUS Pines	6/12/2012	8:45	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Platycercus elegans	Crimson Rosella	-	-	0-20	Below RSA	30	N	7	BUS Pines	11/12/2012	11:40	
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	40	-	7	BUS Pines	15/11/2012	17:23	Perched in tree
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	30	W	7	BUS Pines	21/11/2012	11:30	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	80	SW	7	BUS Pines	5/12/2012	10:35	Very Windy
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	10	S	7	BUS Pines	6/12/2012	8:45	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	5	S	7	BUS Pines	6/12/2012	8:45	
Rhipidura albiscapa	Grey Fantail	1	0-40	0-20	Below RSA	60	-	7	BUS Pines	21/11/2012	11:30	Calling in woodland
Todiramphus sanctus	Sacred Kingfisher	1	0-40	0-20	Below RSA	70	-	7	BUS Pines	22/11/2012	8:45	Calling in woodland
Todiramphus sanctus	Sacred Kingfisher	1	0-40	0-20	Below RSA	50	-	7	BUS Pines	6/12/2012	8:45	Calling in woodland
-	Unidentified Honeyeater	1	0-40	0-20	Below RSA	50	-	8	BUS Yambacoona	14/11/2012	9:50	Moving in trees
Acanthiza lineata	Striated Thornbill	10	0-40	0-20	Below RSA	50	-	8	BUS Yambacoona	14/11/2012	9:50	Foraging in trees
Anthochaera carunculata	Red Wattlebird	1	0-40	0-20	Below RSA	100	-	8	BUS Yambacoona	14/11/2012	9:50	Calling in trees
Cormobates leucophaea	White-throated Treecreeper	2	0-40	0-20	Below RSA	50	-	8	BUS Yambacoona	14/11/2012	9:50	Foraging in trees
Corvus coronoides	Australasian Raven	1	0-40	0-20	Below RSA	100	SE	8	BUS Yambacoona	14/11/2012	9:50	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	70	S	8	BUS Yambacoona	14/11/2012	9:50	
Eolophus roseicapilla	Galah	1	0-40	0-20	Below RSA	20	N	8	BUS Yambacoona	4/12/2012	16:50	Observed/Heard call
Gerygone albogularis	White-throated Gerygone	1	0-40	0-20	Below RSA	5	W	8	BUS Yambacoona	28/11/2012	12:30	
Malurus cyaneus	Superb Fairywren	5	0-40	0-20	Below RSA	30	-	8	BUS Yambacoona	14/11/2012	9:50	Foraging in grass
Malurus cyaneus	Superb Fairywren	3	0-40	0-20	Below RSA	3	W	8	BUS Yambacoona	28/11/2012	12:30	
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	20	N	8	BUS Yambacoona	4/12/2012	16:50	Observed
Pachycephala rufiventris	Rufous Whistler	1	0-40	0-20	Below RSA	35	E	8	BUS Yambacoona	28/11/2012	12:30	
Pachycephala rufiventris	Rufous Whistler	1	0-40	0-20	Below RSA	10	W	8	BUS Yambacoona	4/12/2012	16:50	Observed/Heard call
Petroica rosea	Rose Robin	2	0-40	0-20	Below RSA	10	-	8	BUS Yambacoona	22/11/2012	10:36	Perched
Petroica rosea	Rose Robin	2	0-40	0-20	Below RSA	10	S	8	BUS Yambacoona	4/12/2012	16:50	Observed
Philemon corniculatus	Noisy Friarbird	2	0-40	0-20	Below RSA	70	-	8	BUS Yambacoona	14/11/2012	9:50	Perched
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	20	SE	8	BUS Yambacoona	22/11/2012	10:36	
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	30	S	8	BUS Yambacoona	28/11/2012	12:30	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	50	E	8	BUS Yambacoona	14/11/2012	9:50	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	30	S	8	BUS Yambacoona	14/11/2012	9:50	
Platycercus elegans	Crimson Rosella	3	0-40	0-20	Below RSA	20	S	8	BUS Yambacoona	22/11/2012	10:36	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	S	8	BUS Yambacoona	22/11/2012	10:36	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	5	S	8	BUS Yambacoona	22/11/2012	10:36	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	5	N	8	BUS Yambacoona	22/11/2012	10:36	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	20	SW	8	BUS Yambacoona	28/11/2012	12:30	
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	30	NW	8	BUS Yambacoona	28/11/2012	12:30	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	40	N	8	BUS Yambacoona	4/12/2012	16:50	Observed
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	50	S	8	BUS Yambacoona	14/11/2012	9:50	
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	30	S	8	BUS Yambacoona	28/11/2012	12:30	
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	10	S	8	BUS Yambacoona	4/12/2012	16:50	Observed
Polytelis swainsonii	Superb Parrot	5	0-40	0-20	Below RSA	40	NE	8	BUS Yambacoona	22/11/2012	10:36	Travelling along rd
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	10	S	8	BUS Yambacoona	22/11/2012	10:36	
Rhipidura albiscapa	Grey Fantail	1	0-40	0-20	Below RSA	30	-	8	BUS Yambacoona	14/11/2012	9:50	Perched in tree
Rhipidura albiscapa	Grey Fantail	2	0-40	0-20	Below RSA	20	S	8	BUS Yambacoona	22/11/2012	10:36	
-	Unidentified bird	1	0-40	20-40	At RSA	100	W	9	BUS Glanmire	16/11/2012	8:55	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	20-40	At RSA	80	E	9	BUS Glanmire	16/11/2012	8:55	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	20-40	At RSA	70	E	9	BUS Glanmire	16/11/2012	8:55	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	100	NE	9	BUS Glanmire	16/11/2012	8:55	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	100	NE	9	BUS Glanmire	16/11/2012	8:55	
Eolophus roseicapilla	Galah	2	40-150	20-40	At RSA	30	NW	9	BUS Glanmire	16/11/2012	8:55	
Eolophus roseicapilla	Galah	2	0-40	40-150	At RSA	80	N	9	BUS Glanmire	16/11/2012	8:55	
Falco cenchroides	Nankeen Kestrel	1	0-40	20-40	At RSA	10	N	9	BUS Glanmire	16/11/2012	8:55	
Polytelis swainsonii	Superb Parrot	1	0-40	20-40	At RSA	10	NE	9	BUS Glanmire	16/11/2012	8:55	
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	70	NE	9	BUS Glanmire	16/11/2012	8:55	
Polytelis swainsonii	Superb Parrot	4	0-40	0-20	Below RSA	20	W	9	BUS Glanmire	16/11/2012	8:55	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
-	Unidentified small bird	2	0-40	0-20	Below RSA	30	N	10	BUS Springvale	14/11/2012	7:37	
Anas superciliosa	Pacific Black Duck	1	0-40	0-20	Below RSA	20	W	10	BUS Springvale	14/11/2012	7:37	Flying along creek
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	NE	10	BUS Springvale	14/11/2012	7:37	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Cacatua galerita	Sulphur-crested Cockatoo	4	0-40	0-20	Below RSA	200	E	10	BUS Springvale	27/02/2013	9:00	Perched
Chenonetta jubata	Australian Wood Duck	2	0-40	0-20	Below RSA	70	S	10	BUS Springvale	27/02/2013	9:00	
Colluricincla harmonica	Grey Shrike-thrush	3	0-40	0-20	Below RSA	20	W	10	BUS Springvale	14/11/2012	7:37	Flying along creek
Corvus mellori	Little Raven	2	0-40	20-40	At RSA	40	S	10	BUS Springvale	27/02/2013	9:00	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	30	SE	10	BUS Springvale	14/11/2012	7:37	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	70	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	20	W	10	BUS Springvale	6/12/2012	14:57	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	100	E	10	BUS Springvale	27/02/2013	9:00	Perched
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	200	E	10	BUS Springvale	27/02/2013	9:00	Perched
Egretta novaehollandiae	White-faced Heron	1	0-40	0-20	Below RSA	10	SE	10	BUS Springvale	14/11/2012	7:37	
Egretta novaehollandiae	White-faced Heron	1	0-40	0-20	Below RSA	50	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	50	S	10	BUS Springvale	5/12/2012	15:10	Very Windy
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	10	-	10	BUS Springvale	6/12/2012	14:57	Perched
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	50	N	10	BUS Springvale	6/12/2012	14:57	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	50	W	10	BUS Springvale	6/12/2012	14:57	
Eolophus roseicapillus	Galah	2	0-40	0-20	Below RSA	50	N	10	BUS Springvale	14/11/2012	7:37	
Lichenostomus pencillatus	White-plumed Honeyeater	2	0-40	0-20	Below RSA	10	W	10	BUS Springvale	6/12/2012	14:57	
Malurus cyaneus	Superb Fairywren	5	0-40	0-20	Below RSA	15	W	10	BUS Springvale	14/11/2012	7:37	Flying along creek
Malurus cyaneus	Superb Fairywren	6	0-40	0-20	Below RSA	10	-	10	BUS Springvale	6/12/2012	14:57	Perched
Merops ornatus	Rainbow Bee-eater	2	0-40	0-20	Below RSA	40	-	10	BUS Springvale	14/11/2012	7:37	Perched
Merops ornatus	Rainbow Bee-eater	1	0-40	0-20	Below RSA	30	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Merops ornatus	Rainbow Bee-eater	2	0-40	0-20	Below RSA	5	-	10	BUS Springvale	6/12/2012	14:57	Perched
Pardalotus striatus	Striated Pardalote	1	0-40	0-20	Below RSA	10	-	10	BUS Springvale	6/12/2012	14:57	Perched
Petrochelidon ariel	Fairy Martin	7	0-40	0-20	Below RSA	70	E	10	BUS Springvale	14/11/2012	7:37	Flying across grassland
Phaps chalcoptera	Common Bronzewing	1	0-40	0-20	Below RSA	10	E	10	BUS Springvale	27/02/2013	9:00	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	40	-	10	BUS Springvale	6/12/2012	14:57	Perched
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	30	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	50	-	10	BUS Springvale	6/12/2012	14:57	Perched
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	30	W	10	BUS Springvale	6/12/2012	14:57	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	10	NE	10	BUS Springvale	14/11/2012	7:37	
Polytelis swainsonii	Superb Parrot	5	0-40	0-20	Below RSA	40	N	10	BUS Springvale	14/11/2012	7:37	
Polytelis swainsonii	Superb Parrot	1	0-40	0-20	Below RSA	20	W	10	BUS Springvale	5/12/2012	15:10	Very Windy
Stagonopleura guttata	Diamond Firetail	1	0-40	0-20	Below RSA	10	-	10	BUS Springvale	6/12/2012	14:57	Perched
Egretta novaehollandiae	White-faced Heron	1	0-40	20-40	At RSA	100	N	11	Springvale property	5/12/2012	15:35	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	60	E	11	Springvale property	5/12/2012	15:35	
Cracticus tibicen	Australian Magpie	2	-	0-20	Below RSA	40	-	11	Springvale property	5/12/2012	15:35	On ground
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	50	E	11	Springvale property	6/12/2012	14:35	
Elanus axillaris	Black-shouldered Kite	1	0-40	0-20	Below RSA	150	-	11	Springvale property	5/12/2012	15:35	Hovering in wind
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	20	W	11	Springvale property	5/12/2012	15:35	
Malurus cyaneus	Superb Fairywren	4	0-40	0-20	Below RSA	20	-	11	Springvale property	6/12/2012	14:35	Along creek
Merops ornatus	Rainbow Bee-eater	2	0-40	0-20	Below RSA	30	E	11	Springvale property	6/12/2012	14:35	
Neochmia temporalis	Red-Browed Finch	1	-	0-20	Below RSA	20	-	11	Springvale property	5/12/2012	15:35	On ground
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	30	SW	11	Springvale property	5/12/2012	15:35	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	20	S	11	Springvale property	5/12/2012	15:35	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	80	N	11	Springvale property	5/12/2012	15:35	
Platycercus elegans	Crimson Rosella	4	-	0-20	Below RSA	40	N	11	Springvale property	5/12/2012	15:35	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	40	N	11	Springvale property	6/12/2012	14:35	
Rhipidura leucophrys	Willie Wagtail	1	-	0-20	Below RSA	40	-	11	Springvale property	5/12/2012	15:35	Perched
Rhipidura leucophrys	Willie Wagtail	2	0-40	0-20	Below RSA	20	-	11	Springvale property	6/12/2012	14:35	Along creek
Sturnus vulgaris	Common Starling	4	0-40	0-20	Below RSA	30	W	11	Springvale property	5/12/2012	15:35	
Sturnus vulgaris	Common Starling	1	0-40	0-20	Below RSA	50	S	11	Springvale property	5/12/2012	15:35	
Sturnus vulgaris	Common Starling	1	0-40	0-20	Below RSA	30	E	11	Springvale property	6/12/2012	14:35	
Sturnus vulgaris	Common Starling	1	0-40	0-20	Below RSA	50	W	11	Springvale property	6/12/2012	14:35	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Sturnus vulgaris	Common Starling	1	0-40	0-20	Below RSA	50	W	11	Springvale property	6/12/2012	14:35	
Threskiornis spinicollis	Straw-necked Ibis	2	-	0-20	Below RSA	40	-	11	Springvale property	5/12/2012	15:35	On ground
Anthus novaeseelandiae	Australasian Pipit	1	0-40	0-20	Below RSA	30	E	12	BUS Mt Buffalo	4/12/2012	11:25	Very Windy
Cracticus tibicen	Australian Magpie	1	0-40	20-40	At RSA	80	NE	12	BUS Mt Buffalo	15/11/2012	12:20	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	50	-	12	BUS Mt Buffalo	15/11/2012	12:20	Perched in tree
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	90	NW	12	BUS Mt Buffalo	15/11/2012	12:20	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	90	NE	12	BUS Mt Buffalo	15/11/2012	12:20	
Cracticus tibicen	Australian Magpie	5	0-40	0-20	Below RSA	80	-	12	BUS Mt Buffalo	15/11/2012	12:20	Flying between trees
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	80	NE	12	BUS Mt Buffalo	15/11/2012	12:20	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	90	SW	12	BUS Mt Buffalo	15/11/2012	12:20	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	80	E	12	BUS Mt Buffalo	4/12/2012	11:25	Very Windy
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	100	S	12	BUS Mt Buffalo	4/12/2012	11:25	Very Windy
Aquila audax	Wedge-tailed Eagle	2	0-40	20-40	At RSA	100	E	13	BUS Loyde Davis	23/02/2013	15:25	Flying
-	Unidentified small bird	3	0-40	0-20	Below RSA		W	13	BUS Loyde Davis	23/02/2013	15:25	
-	Unidentified Thornbill	1	0-40	0-20	Below RSA	30	NW	13	BUS Loyde Davis	23/02/2013	15:25	Foraging on ground
-	Unidentified Thornbill	1	0-40	0-20	Below RSA	40	NW	13	BUS Loyde Davis	23/02/2013	15:25	Flying
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	2	0-40	0-20	Below RSA	40	W	13	BUS Loyde Davis	13/12/2012	13:50	
Anthus novaeseelandiae	Australasian Pipit	1	0-40	0-20	Below RSA	20	W	13	BUS Loyde Davis	13/12/2012	13:50	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	60	NE	13	BUS Loyde Davis	13/12/2012	13:50	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	75	NE	13	BUS Loyde Davis	17/12/2012	13:10	
Falco cenchroides	Nankeen Kestrel	1	0-40	20-40	At RSA	80	W	13	BUS Loyde Davis	13/12/2012	13:50	
Falco cenchroides	Nankeen Kestrel	1	0-40	0-20	Below RSA	200	W	13	BUS Loyde Davis	13/12/2012	13:50	
Hirundo neoxena	Welcome Swallow	1	0-40	0-20	Below RSA	100	NE	13	BUS Loyde Davis	23/02/2013	15:25	Flying
Hirundo neoxena	Welcome Swallow	1	0-40	0-20	Below RSA	10	S	13	BUS Loyde Davis	23/02/2013	15:25	Flying
Hirundo neoxena	Welcome Swallow	5	0-40	0-20	Below RSA	30	S	13	BUS Loyde Davis	23/02/2013	15:25	Flying
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	20	NE	13	BUS Loyde Davis	17/12/2012	13:10	
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	30	NW	13	BUS Loyde Davis	23/02/2013	15:25	Foraging on ground
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	10	0-40	0-20	Below RSA	70	E	14	Hopefield Lane	27/02/2013	8:00	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	1	0-40	0-20	Below RSA	25	E	14	Hopefield Lane	27/02/2013	8:00	
Anthus novaeseelandiae	Australasian Pipit	2	0-40	0-20	Below RSA	10	NW	14	Hopefield Lane	26/02/2013	17:37	Flying
Aquila audax	Wedge-tailed Eagle	2	40-150	40-150	At RSA	50	S	14	Hopefield Lane	3/12/2012	16:50	Observed
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	70	S	14	Hopefield Lane	27/02/2013	8:00	Perched
Circus assimilis	Spotted Harrier	1	40-150	40-150	At RSA	50	S	14	Hopefield Lane	3/12/2012	16:50	Observed
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2	0-40	0-20	Below RSA	60	E	14	Hopefield Lane	26/02/2013	17:37	Perched
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	100	N	14	Hopefield Lane	27/02/2013	8:00	Perched
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	70	N	14	Hopefield Lane	27/02/2013	8:00	Flying between trees
Corvus coronoides	Australasian Raven	5	40-150	40-150	At RSA	50	S	14	Hopefield Lane	3/12/2012	16:50	Observed
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	60	W	14	Hopefield Lane	26/02/2013	17:37	Perched
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	80	NE	14	Hopefield Lane	27/02/2013	8:00	Perched
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	70	N	14	Hopefield Lane	27/02/2013	8:00	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	40	E	14	Hopefield Lane	3/12/2012	16:50	Observed
Eolophus roseicapilla	Galah	3	0-40	0-20	Below RSA	50	E	14	Hopefield Lane	26/02/2013	17:37	On ground
Falco berigora	Brown Falcon	2	40-150	40-150	At RSA	50	S	14	Hopefield Lane	3/12/2012	16:50	Observed
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	25	S	14	Hopefield Lane	27/02/2013	8:00	
Grallina cyanoleuca	Magpie Lark	1	0-40	0-20	Below RSA	70	W	14	Hopefield Lane	26/02/2013	17:37	Perched
Hirundo neoxena	Welcome Swallow	2	0-40	0-20	Below RSA	20	S	14	Hopefield Lane	5/12/2012	13:45	Very Windy
Malurus cyaneus	Superb Fairywren	1	-	0-20	Below RSA	10	-	14	Hopefield Lane	5/12/2012	13:45	Calling in trees
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	70	E	14	Hopefield Lane	26/02/2013	17:37	Perched
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	70	W	14	Hopefield Lane	26/02/2013	17:37	Perched
Platycercus eximius	Eastern Rosella	3	0-40	0-20	Below RSA	60	W	14	Hopefield Lane	27/02/2013	8:00	Perched
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	5	E	14	Hopefield Lane	27/02/2013	8:00	
Platycercus eximius	Eastern Rosella	6	0-40	0-20	Below RSA	25	E	14	Hopefield Lane	27/02/2013	8:00	
Psephotus haematonotus	Red-rumped Parrot	6	0-40	0-20	Below RSA	10	E	14	Hopefield Lane	27/02/2013	8:00	
Sturnus vulgaris	Common Starling	10	0-40	0-20	Below RSA	70	W	14	Hopefield Lane	26/02/2013	17:37	Perched
-	Unidentified small bird	1	0-40	0-20	Below RSA	50	SE	15	Hopefield Lane/Boorowa Rd	5/12/2012	14:10	Very Windy
Anthus	Australasian Pipit	1	0-40	0-20	Below RSA	5	W	15	Hopefield	26/02/2013	17:07	

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
novaeseelandiae									Lane/Boorowa Rd			
Corvus coronoides	Australasian Raven	2	0-40	0-20	Below RSA	120	SE	15	Hopefield Lane/Boorowa Rd	5/12/2012	14:10	Very Windy
Corvus coronoides	Australasian Raven	3	0-40	0-20	Below RSA	80	NW	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Corvus coronoides	Australasian Raven	5	40-150	40-150	At RSA	100	NW	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Corvus mellori	Little Raven	2	0-40	0-20	Below RSA	60	E	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	120	W	15	Hopefield Lane/Boorowa Rd	26/02/2013	17:07	Perched on fence
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	40	W	15	Hopefield Lane/Boorowa Rd	26/02/2013	17:07	Flying
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	60	E	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	100	W	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	Flying
Elanus axillaris	Black-shouldered Kite	1	0-40	0-20	Below RSA	70	SW	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Eolophus roseicapilla	Galah	2	0-40	0-20	Below RSA	60	N	15	Hopefield Lane/Boorowa Rd	5/12/2012	14:10	Very Windy
Eolophus roseicapilla	Galah	1	40-150	40-150	At RSA	70	W	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Grallina cyanoleuca	Magpie Lark	2	0-40	0-20	Below RSA	100	W	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	
Malurus cyaneus	Superb Fairywren	4	0-40	0-20	Below RSA	5	-	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	3	E	15	Hopefield Lane/Boorowa Rd	26/02/2013	17:07	
Malurus cyaneus	Superb Fairywren	3	0-40	0-20	Below RSA	5	E	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	Perched
Platycercus elegans	Crimson Rosella	4	0-40	0-20	Below RSA	4	W	15	Hopefield Lane/Boorowa Rd	26/02/2013	17:07	
Rhipidura leucophrys	Willie Wagtail	1	-	0-20	Below RSA	15	-	15	Hopefield Lane/Boorowa Rd	18/01/2013	8:09	
Rhipidura leucophrys	Willie Wagtail	3	0-40	0-20	Below RSA	5	E	15	Hopefield Lane/Boorowa Rd	27/02/2013	7:40	Perched
-	Unidentified small bird	6	0-40	0-20	Below RSA	150	-	16	Harry's ck rd/Boorowa Rd	5/12/2012	14:40	Circling
Ardea pacifica	White-necked Heron	1	40-150	40-150	At RSA	100	E	16	Harry's ck rd/Boorowa Rd	18/01/2013	11:38	
Chenonetta jubata	Australian Wood Duck	29	0-40	0-20	Below RSA	200	W	16	Harry's ck rd/Boorowa Rd	26/02/2013	16:40	In and around dam
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	100	S	16	Harry's ck rd/Boorowa Rd	5/12/2012	14:40	
Cracticus tibicen	Australian Magpie	3	-	0-20	Below RSA	50	-	16	Harry's ck rd/Boorowa Rd	5/12/2012	14:40	On ground
Cracticus tibicen	Australian Magpie	1	-	0-20	Below RSA	120	-	16	Harry's ck rd/Boorowa Rd	5/12/2012	14:40	Perched on powerline
Eolophus roseicapilla	Galah	10	0-40	0-20	Below RSA	250	W	16	Harry's ck rd/Boorowa Rd	23/01/2013	17:55	
Falco cenchroides	Nankeen Kestrel	1	0-40	20-40	At RSA	200	-	16	Harry's ck rd/Boorowa Rd	5/12/2012	14:40	Hovering in wind
Hirundo neoxena	Welcome Swallow	15	0-40	0-20	Below RSA	70	N	16	Harry's ck rd/Boorowa Rd	18/01/2013	11:38	Flying over dam
Ocyphaps lophotes	Crested Pigeon	1	0-40	0-20	Below RSA	100	N	16	Harry's ck rd/Boorowa Rd	23/01/2013	17:55	Perched on powerline
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	S	17	The Pines Property	6/12/2012	9:15	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	0-40	0-20	Below RSA	5	S	17	The Pines Property	6/12/2012	9:15	
Corvus coronoides	Australasian Raven	1	0-40	0-20	Below RSA	80	-	17	The Pines Property	6/12/2012	9:15	Perched
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	30	SW	17	The Pines Property	6/12/2012	9:15	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	70	SE	17	The Pines Property	23/01/2013	16:50	Perched
Cracticus tibicen	Australian Magpie	5	0-40	0-20	Below RSA	60	W	17	The Pines Property	25/01/2013	11:20	Perched
Grallina cyanoleuca	Magpie Lark	1	0-40	0-20	Below RSA	70	S	17	The Pines Property	23/01/2013	16:50	Perched
Microeca fascinans	Jacky Winter	2	-	0-20	Below RSA	30	-	17	The Pines Property	6/12/2012	9:15	Perched
Pachycephala rufiventris	Rufous Whistler	1	-	0-20	Below RSA	10	-	17	The Pines Property	6/12/2012	9:15	Perched
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	50	-	17	The Pines Property	6/12/2012	9:15	Calling in trees
Platycercus elegans	Crimson Rosella	2	-	0-20	Below RSA	20	-	17	The Pines Property	6/12/2012	9:15	Perched
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	100	SW	17	The Pines Property	23/01/2013	16:50	Perched

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Platycercus elegans	Crimson Rosella	4	0-40	0-20	Below RSA	40	N	17	The Pines Property	25/01/2013	11:20	Perched
Platycercus eximius	Eastern Rosella	5	0-40	0-20	Below RSA	20	W	17	The Pines Property	6/12/2012	9:15	
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	100	W	17	The Pines Property	23/01/2013	16:50	Perched
Anthus novaeseelandiae	Australasian Pipit	1	-	0-20	Below RSA	10		18	Mt Buffalo Access Gate	6/12/2012	11:55	Perched
Anthus novaeseelandiae	Australasian Pipit	2	0-40	0-20	Below RSA	25	S	18	Mt Buffalo Access Gate	18/01/2013	9:22	
Aquila audax	Wedge-tailed Eagle	1	40-150	40-150	At RSA	80	NE	18	Mt Buffalo Access Gate	18/01/2013	9:22	
Aquila audax	Wedge-tailed Eagle	1	40-150	40-150	At RSA	100	E	18	Mt Buffalo Access Gate	18/01/2013	9:22	
Cacatua galerita	Sulphur-crested Cockatoo	16	0-40	20-40	At RSA	100	E	18	Mt Buffalo Access Gate	18/01/2013	9:22	
Corvus coronoides	Australasian Raven	1	40-150	40-150	At RSA	100	E	18	Mt Buffalo Access Gate	18/01/2013	9:22	Chaseing WTE
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	70	N	18	Mt Buffalo Access Gate	18/01/2013	9:22	in tree
Cracticus tibicen	Australian Magpie	5	0-40	0-20	Below RSA	80	W	18	Mt Buffalo Access Gate	27/02/2013	10:20	Perched
Dacelo novaeguineae	Laughing Kookaburra	1	0-40	0-20	Below RSA	100	W	18	Mt Buffalo Access Gate	27/02/2013	10:20	Perched
Falco berigora	Brown Falcon	1	0-40	0-20	Below RSA	5	W	18	Mt Buffalo Access Gate	6/12/2012	11:55	
Grallina cyanoleuca	Magpie Lark	2	0-40	0-20	Below RSA	80	E	18	Mt Buffalo Access Gate	27/02/2013	10:20	Perched
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	80		18	Mt Buffalo Access Gate	6/12/2012	11:55	Perched
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	70	N	18	Mt Buffalo Access Gate	18/01/2013	9:22	
Sturnus vulgaris	Common Starling	1	0-40	0-20	Below RSA	40	E	18	Mt Buffalo Access Gate	6/12/2012	11:55	
Anthochaera carunculata	Red Wattlebird	1	0-40	0-20	Below RSA	30	W	19	Lavestock rd. Montalta Gate	18/01/2013	10:16	
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	40	-	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	Perched
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	100	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Cacatua galerita	Sulphur-crested Cockatoo	2	0-40	0-20	Below RSA	120	NW	19	Lavestock rd. Montalta Gate	18/01/2013	10:16	perched
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	50	S	19	Lavestock rd. Montalta Gate	21/02/2013	17:26	Flying
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	70	E	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Colluricincla harmonica	Grey Shrike-thrush	1	0-40	0-20	Below RSA	20		19	Lavestock rd. Montalta Gate	23/02/2013		Perched
Corvus mellori	Little Raven	1	0-40	0-20	Below RSA	120	N	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	30	-	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	Perched
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	20	S	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Cracticus tibicen	Australian Magpie	2	0-40	0-20	Below RSA	70	W	19	Lavestock rd. Montalta Gate	21/02/2013	17:26	Flying
Cracticus tibicen	Australian Magpie	4	0-40	0-20	Below RSA	100	W	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Falco cenchroides	Nankeen Kestrel	1	0-40	0-20	Below RSA	100	NW	19	Lavestock rd. Montalta Gate	18/01/2013	10:16	perched
Haliastur sphenurus	Whistling Kite	1	40-150	40-150	At RSA	60	E	19	Lavestock rd. Montalta Gate	18/01/2013	10:16	Took off from perch
Manorina melanocephala	Noisy Miner	1	0-40	0-20	Below RSA	20	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Merops ornatus	Rainbow Bee-eater	1	0-40	0-20	Below RSA	30	SW	19	Lavestock rd. Montalta Gate	21/02/2013	17:26	Flying
Merops ornatus	Rainbow Bee-eater	3	0-40	0-20	Below RSA	0		19	Lavestock rd. Montalta Gate	21/02/2013	17:26	Perched
Merops ornatus	Rainbow Bee-eater			0-20	Below RSA			19	Lavestock rd. Montalta Gate	23/02/2013		Heard
Philemon corniculatus	Noisy Friarbird	1	0-40	0-20	Below RSA	30	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	30	-	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	Perched
Platycercus elegans	Crimson Rosella	6	0-40	0-20	Below RSA	70	NW	19	Lavestock rd. Montalta Gate	21/02/2013	17:26	Perched in tree
Platycercus elegans	Crimson Rosella	1	0-40	0-20	Below RSA	20	NW	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Platycercus eximius	Eastern Rosella	4	0-40	0-20	Below RSA	20	S	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Platycercus eximius	Eastern Rosella	4	0-40	0-20	Below RSA	20	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Platycercus eximius	Eastern Rosella	4	0-40	0-20	Below RSA	100	S	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	100	N	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Platycercus eximius	Eastern Rosella	7	0-40	0-20	Below RSA	100	W	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Platycercus eximius	Eastern Rosella	2	0-40	0-20	Below RSA	80	E	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Platycercus eximius	Eastern Rosella	6	0-40	0-20	Below RSA	15	N	19	Lavestock rd. Montalta Gate	23/02/2013		Flying
Polytelis swainsonii	Superb Parrot	2	0-40	0-20	Below RSA	20	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Polytelis swainsonii	Superb Parrot	3	0-40	0-20	Below RSA	10	N	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Polytelis swainsonii	Superb Parrot	5	0-40	0-20	Below RSA	30	S	19	Lavestock rd. Montalta Gate	6/12/2012	13:25	
Rhipidura albiscapa	Grey Fantail	1	0-40	0-20	Below RSA	12		19	Lavestock rd. Montalta Gate	23/02/2013		Perched

Scientific Name	Common Name	Count	0-40, 40-150, >150	0-20, 20-40, 40-150, 150-200, >200	Relative Height	Distance (m)	Flight Direction	BUS No.	BUS Location	Date	Time	Notes/ Observation Type
Rhipidura albiscapa	Grey Fantail	1	0-40	0-20	Below RSA	8		19	Lavestock rd. Montalta Gate	23/02/2013		Perched
-	Unidentified Thornbill	4	-	0-20	Below RSA	20	-	20	The Pines Access	6/12/2012	14:20	Calling in road reserve
Anthus novaeseelandiae	Australasian Pipit	1	0-40	0-20	Below RSA	20	E	20	The Pines Access	23/01/2013	17:20	
Ardea pacifica	White-necked Heron	1	0-40	0-20	Below RSA	100	W	20	The Pines Access	25/01/2013	11:50	foraging in paddock
Cacatua galerita	Sulphur-crested Cockatoo	8	-	0-20	Below RSA	50		20	The Pines Access	17/01/2013	7:53	Perched
Cacatua galerita	Sulphur-crested Cockatoo	1	0-40	0-20	Below RSA	200	W	20	The Pines Access	25/01/2013	11:50	
Cracticus tibicen	Australian Magpie	1	0-40	0-20	Below RSA	40	N	20	The Pines Access	6/12/2012	14:20	
Cracticus tibicen	Australian Magpie	2	-	0-20	Below RSA	50		20	The Pines Access	17/01/2013	7:53	On ground
Cracticus tibicen	Australian Magpie	3	0-40	0-20	Below RSA	90	NW	20	The Pines Access	18/01/2013	11:05	Perched
Egretta novaehollandiae	White-faced Heron	3	0-40	0-20	Below RSA	100	W	20	The Pines Access	25/01/2013	11:50	foraging in paddock
Eolophus roseicapilla	Galah	2	-	0-20	Below RSA	40		20	The Pines Access	17/01/2013	7:53	Perched in trees
Eolophus roseicapilla	Galah	10	0-40	0-20	Below RSA	60		20	The Pines Access	17/01/2013	7:53	
Eolophus roseicapilla	Galah	1	0-40	0-20	Below RSA	10		20	The Pines Access	17/01/2013	7:53	
Grallina cyanoleuca	Magpie Lark	1	0-40	0-20	Below RSA	50	SE	20	The Pines Access	23/01/2013	17:20	Perched
Malurus cyaneus	Superb Fairywren	3	-	0-20	Below RSA	20	-	20	The Pines Access	6/12/2012	14:20	Calling in road reserve
Malurus cyaneus	Superb Fairywren	3	-	0-20	Below RSA	30		20	The Pines Access	17/01/2013	7:53	Calling in road reserve
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	25	E	20	The Pines Access	18/01/2013	11:05	In Acacia thicket
Malurus cyaneus	Superb Fairywren	2	0-40	0-20	Below RSA	50	SE	20	The Pines Access	23/01/2013	17:20	Perched
Malurus cyaneus	Superb Fairywren	3	0-40	0-20	Below RSA	10	E	20	The Pines Access	25/01/2013	11:50	Perched
Pachycephala rufiventris	Rufous Whistler	1	0-40	0-20	Below RSA	50	SE	20	The Pines Access	23/01/2013	17:20	Perched
Pardalotus striatus	Striated Pardalote	1	-	0-20	Below RSA	50	-	20	The Pines Access	6/12/2012	14:20	Perched
Platycercus elegans	Crimson Rosella	2	-	0-20	Below RSA	40		20	The Pines Access	17/01/2013	7:53	Perched
Platycercus elegans	Crimson Rosella	2	0-40	0-20	Below RSA	20		20	The Pines Access	17/01/2013	7:53	Along road reserve
Platycercus eximius	Eastern Rosella	1	0-40	0-20	Below RSA	30		20	The Pines Access	17/01/2013	7:53	
Rhipidura leucophrys	Willie Wagtail	1	-	0-20	Below RSA	20		20	The Pines Access	17/01/2013	7:53	Calling from trees
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	20	NE	20	The Pines Access	18/01/2013	11:05	Perched
Rhipidura leucophrys	Willie Wagtail	1	0-40	0-20	Below RSA	50	SE	20	The Pines Access	23/01/2013	17:20	Perched
Rhipidura leucophrys	Willie Wagtail	2	0-40	0-20	Below RSA	10	E	20	The Pines Access	25/01/2013	11:50	Perched

Annex F

Golden Sun Moth

1 INTRODUCTION

This report provides further details relating to the Golden Sun Moth (GSM) (*Synemon plana*) and the project.

2 METHOD

Meandering transects targeting GSM were undertaken over a total of eight suitable days (refer to *Figure 2.1* and *Table 2.1*). Opportunistic observations were recorded over a total of 13 days.

Table 2.1 Survey Details

Date	Time
23/11/12	9:15 – 15:15
11/12/12	10:30 – 16:00
12/12/12	10:20 – 16:20
13/12/12	11:15 – 14:00
14/12/12	11:45 – 14:00
18/12/12	10:00 – 16:10
19/12/12	9:25 – 17:15
20/12/12	10:00 – 14:00

Weather conditions during survey days are provided in *Table 2.2.*

Table 2.2 Weather Conditions during Survey

Date	Rain	9:00 AM				3:00 PM			
		Temp	Cloud Cvr	Wind		Temp	Cloud Cvr	Wind	
	(mm)	(°C)	(8^{th})	Dir	Spd (km)	(°C)	8th	Dir	Spd (km)
23/11/12	0	16.5	1	SE	15	27	2	SE	19
11/12/12	0	16.5	4	SE	13	24	2	ESE	15
12/12/12	0	19.5	4	NE	17	27	4	E	7
13/12/12	0	21	0		Calm	27		-	-
14/12/12	0	21	8		Calm	29.5	8	NW	6
18/12/12	0	16.5	0		Calm	27.5	0	WNW	13
19/12/12	0	21	0	W	15	33.7	1	W	9
20/12/12*	0	-	-	-	-	-	-	-	-

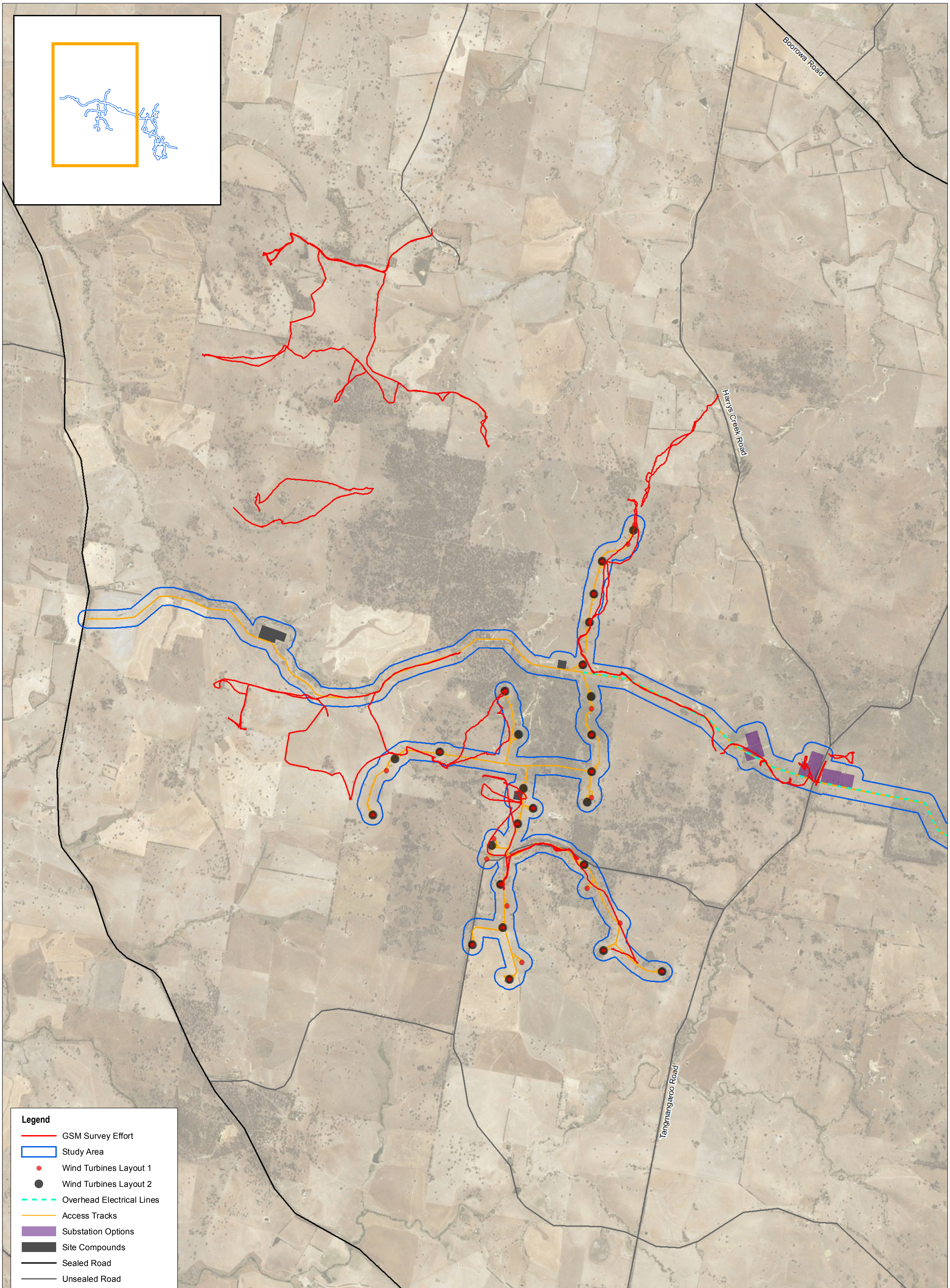
Source: Australian Government Bureau of Meteorology (Yass: Rural Fire Service)

*Data not available.

Optimal weather conditions for observing GSM are:

- warm to hot (above 20°C by 10:00 am);
- clear or mostly cloudless skies;
- still or relatively still wind conditions; and
- at least two days since rain.

The weather during the GSM survey days generally met these conditions. There was little rainfall during the survey season, however, GSM were observed on all of the survey days.



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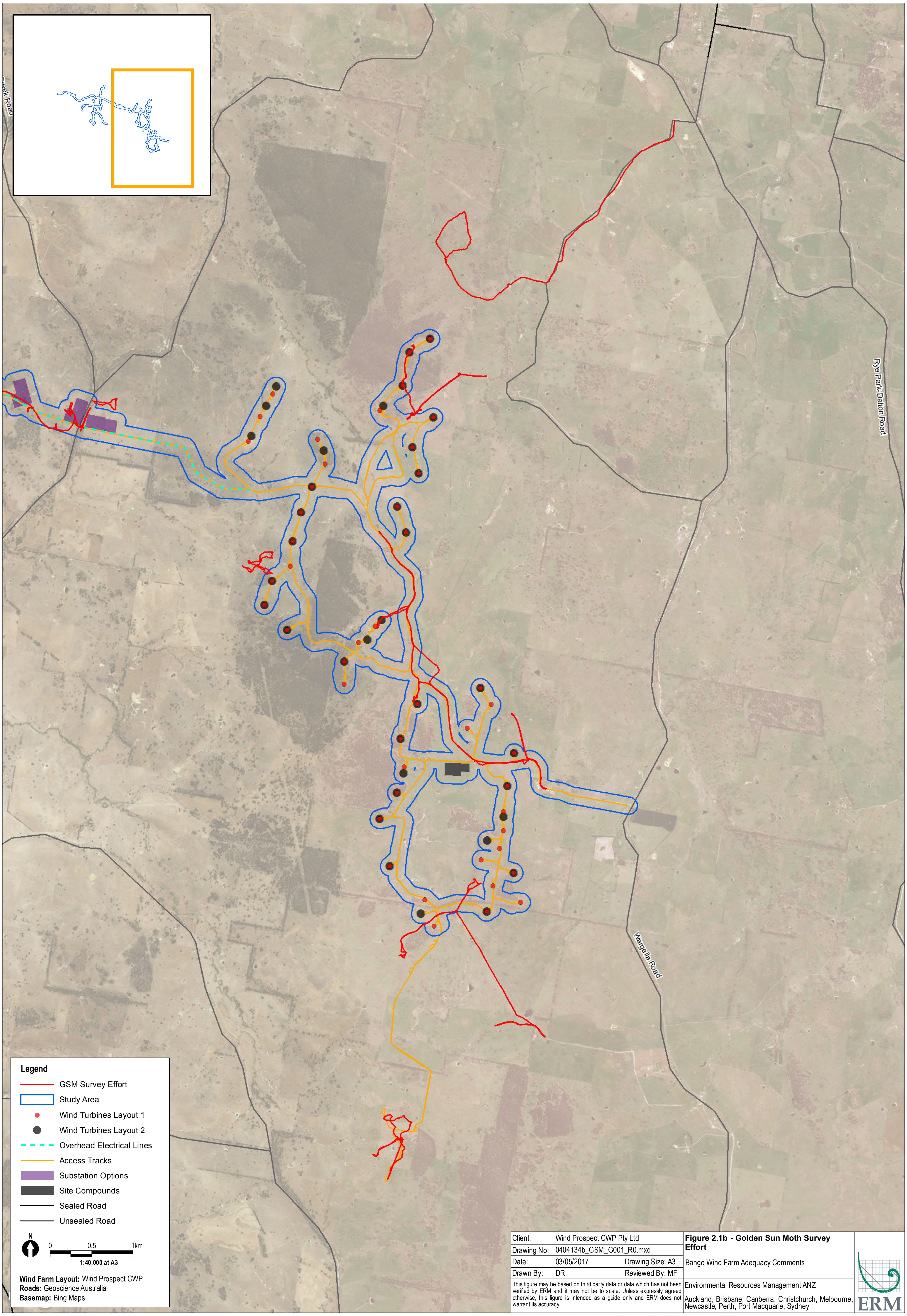
Drawing No:	0404134b_GSM_G001_R0.mxd		
Date:	03/05/2017	Drawing Size: A3	
Drawn By:	DR	Reviewed By: MF	

Figure 2.1a - Golden Sun Moth Survey Effort

Bango Wind Farm Adequacy Comments

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney



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Drawing No:	0404134b_GSM_G001_R0.mxd
Date:	03/05/2017 Drawing Size: A3
Drawn By:	DR Reviewed By: MF

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 2.1b - Golden Sun Moth Survey Effort

Bango Wind Farm Adequacy Comments

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

3 RESULTS

3.1 GSM HABITAT

GSM habitat in the Study Area was assigned based on field observations and vegetation mapping. Two GSM habitat types were assigned in the Study Area:

- Known and Optimal: treated as the identified best quality and optimal, supported by field observations. Optimal habitat within the area is patches of Speargrass and Wallaby Grass that are relatively short with spaces between the tussocks.

- Potential: based on field observation of habitats of a lower suitability than the 'known and optimal' habitats.

Using a precautionary approach, all these habitat types are combined and considered as GSM habitat for the impact assessment (refer *Figure 3.1*).

Prediction of the extent of GSM habitat in the locality beyond the Study Area is based upon a review of OEH's derived native grassland modelling for the south-western slopes (refer *Figure 3.1* labelled as 'potential – OEH native grassland modelling'). The modelling consists of two datasets: woody grassland; and non-woody grassland (DECC 2007). The non-woody grassland modelling mapped extent of grassland and provides a probability rank to identify where areas of non-woody grassland have a 'moderate' to 'high' probability of supporting native grassland either native grassland or native grassland derived from clearance of woodland.

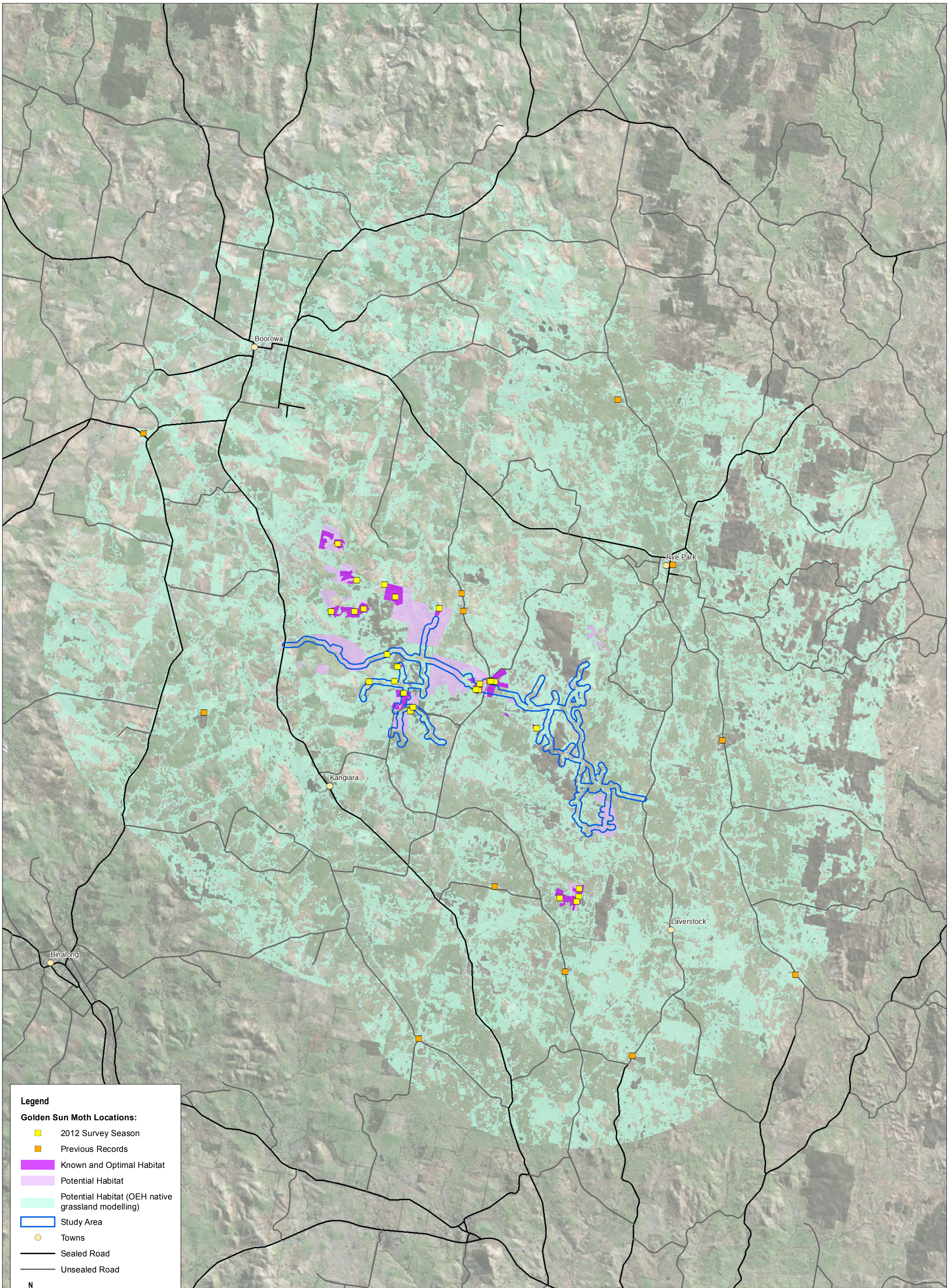
The non-woody grassland modelling for the Study Area identifies areas with a moderate to high probability of containing native grasslands of conservation significance. For the purposes of the desktop assessment of potential grassland habitats supporting GSM in the locality, these areas have been assumed to comprise native grassland and accordingly provide potential GSM habitat. The area of grassland predicted to have a moderate to high probability of being native grasslands of conservation significance within the Locality is 44,507ha. It should be noted that this extent value has been determined purely on the basis of a desktop assessment, and accordingly only provides an indication of 'potential' GSM habitat in the Locality.

3.1.1 Habitat Extent

The extent of habitat in the Study Area and Development Footprint for each of PL1, PL2 and the merged 'worst-case' development footprint is shown in *Table 3.1*.

Table 3.1 Area (ha) of GSM Habitat Impacted by the Development Footprints

	ERM (2013) Exhibited Permanent	ERM (2013) Exhibited Temporary	ERM (2013) Exhibited Total	PL1 Permanent	PL1 Temporary	PL1 Total	PL1 Total Differential from Exhibited EA (ERM 2013)	PL2 Permanent	PL2 Temporary	PL2 Total	PL2 Total Differential from Exhibited EA (ERM 2013)	Merged ('Worst Case') Permanent	Merged ('Worst Case') Temporary	Merged ('Worst Case') Total	Merged ('Worst Case') Total Differential from Exhibited EA (ERM 2013)
Known and optimal habitat				11.39843	1.710613	13.109043		11.44259	1.514282	12.956872		11.716629	1.637846	13.354475	
Potential				21.319448	3.7373	25.056748		20.217726	2.895825	23.113551		22.204488	3.981703	26.186191	
Sum	82.48	18.4	**100.88**	32.717878	5.447913	**38.165791**	**-62.714209**	31.660316	4.410107	**36.070423**	**-64.809577**	33.921117	5.619549	**39.540666**	**-61.339334**



Wind Farm Layout: Wind Prospect CWP
Roads, Contours: Geoscience Australia
GSM: ERM, NSW Wildlife Atlas
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0404134b_GSM_G002_R0.mxd		
Date:	03/05/2017	Drawing Size: A3	
Drawn By:	DR	Reviewed By: MF	

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Figure 3.1 - Golden Sun Moth Locations and Habitat

Bango Wind Farm Adequacy Comments

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ERM

4 IMPACTS

4.1 AVOIDANCE

The revised impacts presented as part of this RtS are 39.54 ha (worst case footprint) compared to 100.87 as reported in ERM (2011). The presence of GSM habitat and where possible avoidance will be incorporated into the final layout as much as possible through micrositing of wind farm infrastructure.

Other avoidance measures include siting of infrastructure in areas that are already cleared (such as existing farm access tracks), or areas of the landscape that do not provide suitable habitat (such as depressions in paddocks where the increased moisture produces dense grasslands that are not suitable for GSM). Paddocks in the Study Area generally comprise a mosaic of optimal and sub-optimal habitats. Therefore, in some cases micro-siting to avoid areas of optimal habitat can occur.

4.2 IMPACTS OF SHADING

The impacts of shading were considered in the ERM (2013) and have been further investigated through application of a shadow model.

To determine the duration over which a wind turbine generator (WTG) would cause shadow, shadow modelling was undertaken using FindMyShadow.com.

The following parameters were used in the model:

- Location: 34.565312º S, 148.828697º E;
- Date: 01 November 2013 (this date is early in the GSM flying season, however, it has been selected to represent the worst case scenario as shadows are longer at this time than later in the season);
- Time: 6:00 – 18:00; and
- Feature dimensions: 3m (width) x 3m (length) x 10m (height). The model uses a square structure, whereas the WTG bases are circular. A 3m x 3m square provides the closest area to the circular base of the largest WTGs under consideration for the Project (4.5 m at their base).

The modelling showed that shadows that linger over an area for greater than two hours between 10:00 and 15:00 are restricted to within 11m of the WTG base (see *Annex A*). This falls within the hardstand area of the WTG footings (25m x 25m). While the WTGs are taller than the 10m used in the model, this does not change the area in which shadows linger for longer than 2 hours. Furthermore, the WTGs become narrower towards their top and therefore, the shadows cast by the upper sections of the tower would linger over a shorter time period.

REFERENCES

Department of Environment and Heritage (DEH (now DSEWPC)) (2006) **EPBC Act Policy Statement: White Box – Yellow Box – Blakelys Red Gum grassy woodlands and derived native grasslands**. http://www.environment.gov.au/epbc/publications/pubs/box-gum.pdf

ERM (2013) **Bango Wind Farm: Ecological Impact Assessment** Report prepared for WPCWP.

Gellie N.J.H. (2005) 'Native Vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes, and SE Corner Bioregions'. **Cunninghamia,** volume 9 (2), pp 219 – 253.

National Parks and Wildlife Service (NPWS), June 2002. The Native Vegetation of Boorowa Shire. http://www.environment.nsw.gov.au/resources/nature/sbsNssScopeBoorowa.pdf

OEH (2011) **White Box Yellow Box Blakely's Red Gum Woodland - endangered ecological community listing: NSW Scientific Committee - final determination.** http://www.environment.nsw.gov.au/determinations/BoxgumWoodlandEndComListing.htm

Annex A

WTG Shading Model

FindMyShadow

Bespoke Shadow Plotting

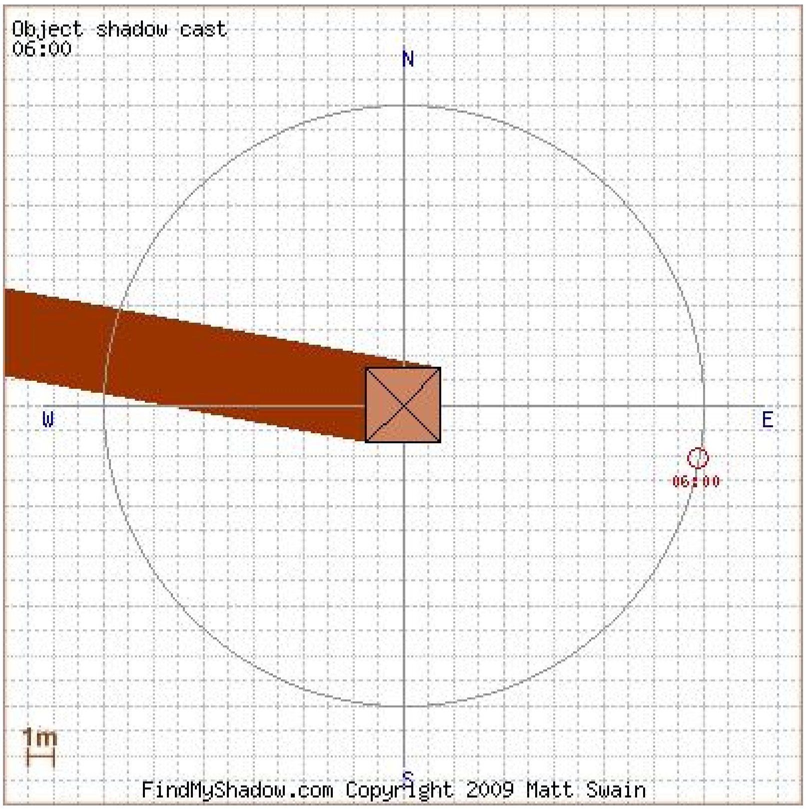
Select Location :: Select Date :: Draw your Scene :: **Calculate Shadows** :: Print Report

This page shows the shadows cast by the objects you just drew, at a sample of times on the date you selected where the sun is above the horizon, at the location you defined.

Your Results

You specified the following details:

Location:	34.565312° S 148.828697° E	Date:	01-11-2013	Timezone:	(GMT +10.0)	True North Offset:	0°



Animated view - hover over an hour in the table b

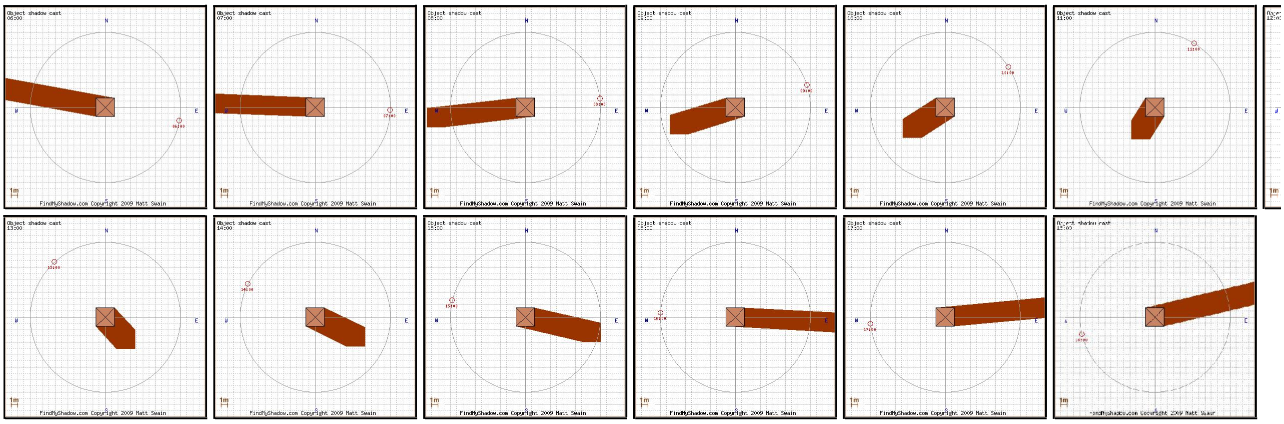
Sun-up hours:

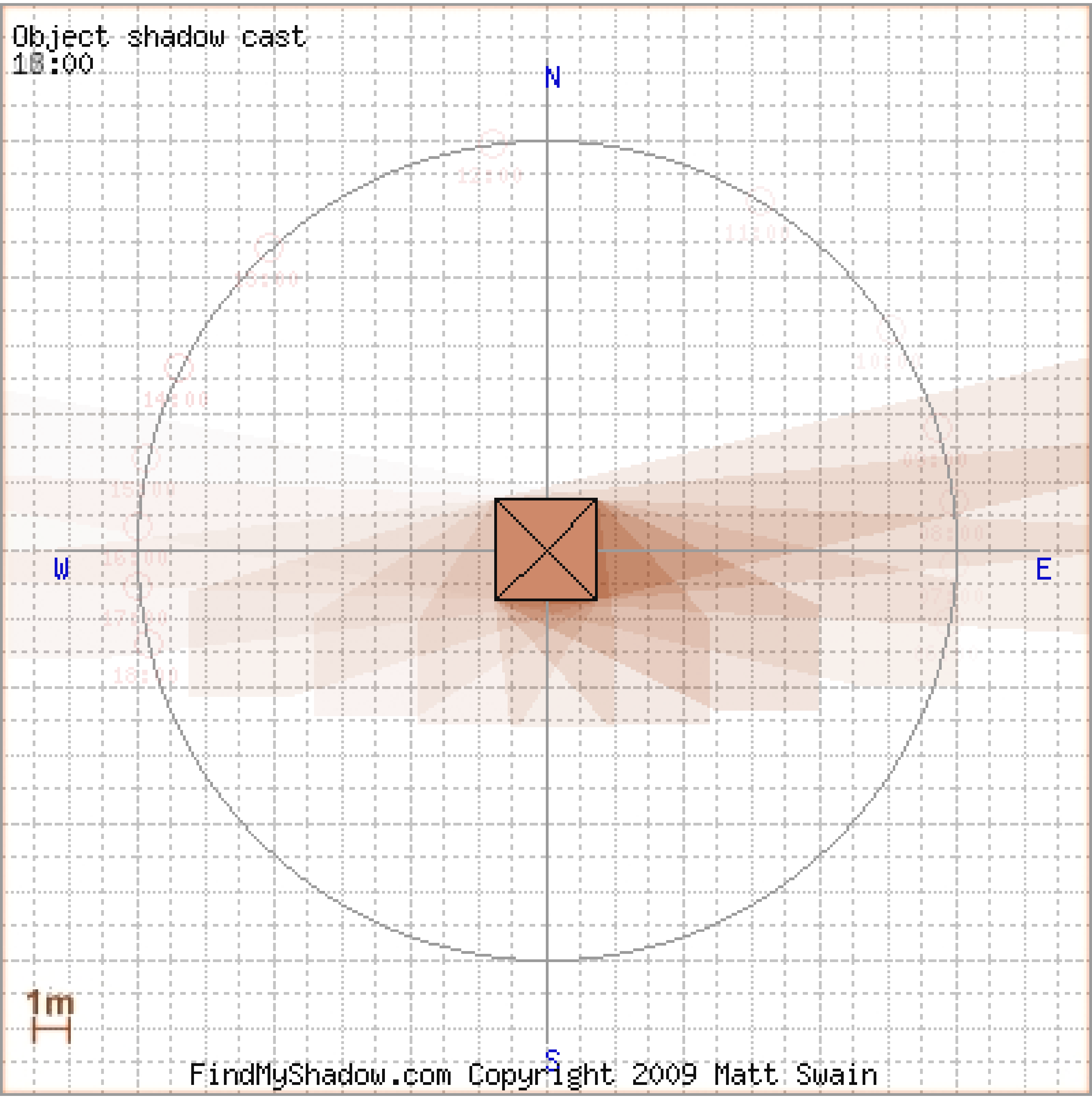
06
07
08
09
10
11
12
13
14
15
16
17
18

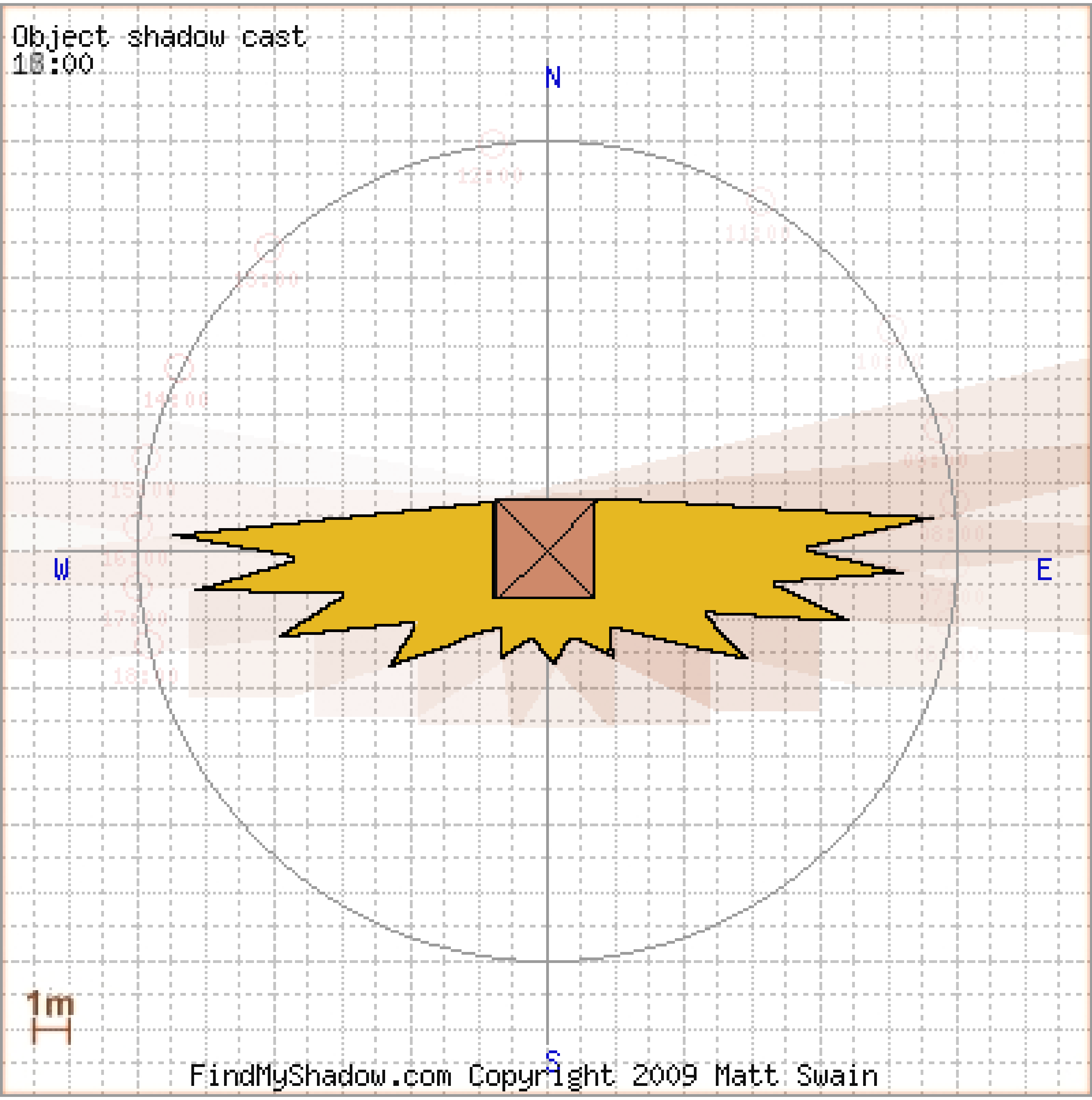
Notes:

All angles (azimuth) relative to true north, and not magnetic north, which varies by location

Times are in the local timezone set (GMT +10.0)




Object shadow cast
18:00
N
W
E
S
1m
FindMyShadow.com Copyright 2009 Matt Swain


Object shadow cast
18:00
N
W
E
S
1m
FindMyShadow.com Copyright 2009 Matt Swain

Annex G

Biobanking

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9 May, 2017

Kristin Old
CWP Renewables
Floor 6, 45 Hunter St
NEWCASTLE, NSW, 2300

Our Reference: *0404134L01 Potential Offset Sites_F*

Attention: **Kristin Old**

Dear Kristin,

RE: BANGO WIND FARM - CANDIDATE OFFSET PROPERTIES

This letter provides an outline of the methods and results of the candidate offset properties vegetation investigation. The process has been undertaken using desktop information only.

1. METHOD

Cadastral properties offered by interested land holders CWPR provided to ERM were intersected with available vegetation mapping products:

- *Australian Alps, South west Slopes, and SE Corner Bioregions* (Gellie 2005); and
- *The Native Vegetation of Boorowa Shire* (NSW National Parks and Wildlife Service (NPWS) 2002).

Those products have different spatial scales and representations/nomenclature of the diversity of vegetation types in the coverage area, although as a desktop exercise provides the best available information. *Table 1* contains the equivalents applied.

Table 1 Mapping Product Vegetation Type and Potential Equivalent Biometric Vegetation Type (BVT)

Boorowa LGA (NPWS 2002) Vegetation Type	BVT Equivalent Code	BVT Equivalent
Blakleys Red Gum - Yellow Box Grassy Woodland	LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands
Red Stringybark - Joycea tussock grass dry shrub open forest	LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion

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A.B.N. 12 002 773 248

Offices worldwide

Southern Forests (Gellie 2005) Vegetation Type*	BVT Equivalent Code	BVT Equivalent
Northern Slopes Dry Grass Woodland	LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands
Tableland Dry Grassy Woodland	LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion
Tablelands and Slopes Dry Herb-Grass Woodland	LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands
Tableland Woodland/forest	LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest of the NSW South Western Slopes Bioregion

Notes: 1. note equivalents difficult to make from Gellie (2005)

The number of credits required has been reproduced from Tables 6.14 and 6.15 from ERM (2013) to demonstrate the required areas for offsetting that were calculated at that time with that proposed footprint.

Table 2 Ecosystem Credit requirements and their equivalent in hectares (Table 6.14 from ERM 2013)

BVT Code	BVT name	Area in Development Footprint (ha)	Required Credits	Equivalent Hectares required
LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	83.63	1428	153.5
LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	21.14	399	42.9

1. *Data are based on the Credit Report provided in Annex H and the BioBanking Credit Converter*

Table 3 Species Credit requirements and their equivalent in hectares

Species Name	Common Name	TSC Act Status	Extent of impact	Number of credits required	Equivalent hectares required
Hieraaetus morphnoides	Little Eagle	Vulnerable	6.58	89	15
Circus assimilis	Spotted Harrier	Vulnerable	6.58	89	15
Synemon plana	Golden Sun Moth	Endangered	82.48	2062	344

1.1 LIMITATIONS

Limitations to this desktop assessment for candidate offset properties include:

- Vegetation type equivalents are not certain and based on an estimate.
- Areas required for offsets are derived from the credit to hectare calculator (ERM 2013) using the development footprint as was exhibited in the EA. No recalculation has been undertaken.
- Cadastral intersect and sum of areas completed – no appraisal of actual site attributes, or whether the land areas are useable as offsets.
- Cadastral intersect used whole cadastral parcel and all vegetation within it, with no direction of a landholder's desired land areas.
- No species credit species analyses are possible as their presence must be determined by survey.

2. RESULTS

The areas of vegetation types on each landholder's properties are shown in *Annex A*. There are a number of limitations on the reliability of this desktop analysis and further work is required to refine the suitability of the candidate offset lands, including spatial and aerial photo analyses to rank site suitability using (but not limited to):

- Patch sizes
- Mapped polygon accuracy with visible bushland
- Connectivity to reserves or other bushland
- Verify composition of cadastral parcels and bushland areas

Once these data are known a selection of the top ranked or preferred offset lands could be field verified. The reassessment of potential candidate offset sites shows that it is likely that sufficient sites are available, and it is expected that a selection of these would meet the requirements of offsetting impacts associated with the reduced layout. Discussions and negotiations would be required with the land holder to discuss roles, responsibilities and obligations; and with the Office of Environment and Heritage and Department of Planning and Environment to ascertain their complicity with this approach. Refinement of candidate sites and a clear strategy to obtain an offset for the project would be the conclusion of the above work, a precursor to preparing an offset package detailing the offset.

Yours sincerely,
for Environmental Resources Management Australia Pty Ltd

Guy Williams
Principal Ecologist

Annex A

Landholders and Vegetation Types Present

Landowner	Vegetation Type	Area (ha)
John McGrath	Blakleys Red Gum - Yellow Box Grassy Woodland	47.04
John McGrath	Tableland Woodland/forest	22.68
Malcolm Curthoys	Blakleys Red Gum - Yellow Box Grassy Woodland	5.86
Malcolm Curthoys	Red Stringybark - Joycea tussock grass dry shrub open forest	8.23
Malcolm Curthoys	Tableland Woodland/forest	0.09
Margaret & Jenny Dwyer	Blakleys Red Gum - Yellow Box Grassy Woodland	11.22
Margaret & Jenny Dwyer	Red Stringybark - Joycea tussock grass dry shrub open forest	5.44
Margaret & Jenny Dwyer	Tableland Woodland/forest	4.29
Margaret, Daniel & Dermot McGrath	Blakleys Red Gum - Yellow Box Grassy Woodland	21.82
Margaret, Daniel & Dermot McGrath	Red Stringybark - Joycea tussock grass dry shrub open forest	24.15
Margaret, Daniel & Dermot McGrath	Tableland Woodland/forest	49.10
Peter Thompson	Blakleys Red Gum - Yellow Box Grassy Woodland	1.97
Peter Thompson	Red Stringybark - Joycea tussock grass dry shrub open forest	4.14
Peter Thompson	Tableland Woodland/forest	3.45
Terence James McGrath	Blakleys Red Gum - Yellow Box Grassy Woodland	7.41
Terence James McGrath	Red Stringybark - Joycea tussock grass dry shrub open forest	1.29
Terence James McGrath	Tableland Woodland/forest	4.42
Tom Gunthorpe	Blakleys Red Gum - Yellow Box Grassy Woodland	7.86
Tom Gunthorpe	Red Stringybark - Joycea tussock grass dry shrub open forest	31.83
Tom Gunthorpe	Tableland Woodland/forest	7.02
Giles	Tablelands and Slopes Dry Herb-Grass Woodland	462.231
Bush	Tablelands Dry Shrub-Tussock Grass Forest	31.3798
Bush	Northern Slopes Dry Grass Woodland	21.6541
Day	Northern Slopes Dry Grass Woodland	52.9243
Day	Tablelands Acacia-Grass-Herb Dry Forest	0.94327
Day	Tablelands and Slopes Dry Herb-Grass Woodland	73.2296
Day	Tablelands and Slopes Herb Grassland/Woodland	110.306
Day	Tablelands Dry Shrub-Tussock Grass Forest	17.0932
Medway	Central North Slopes Dry Grass Woodland	44.8854
Medway	Northern Slopes Dry Grass Woodland	314.25
Medway	Northern Tablelands and Slopes Dry Shrub-Grass Forest	198.878
Medway	Tablelands and Slopes Dry Herb-Grass Woodland	2.35496
Medway	Western Slopes Moist Herb-Sedge-Grass Woodland	7.73453
Middleton	Tablelands and Slopes Dry Herb-Grass Woodland	430.727
Moorby	Northern Tablelands and Slopes Dry Shrub-Grass Forest	75.6076
Moorby	Tableland Dry Grassy Woodland	48.4758
Moorby	Tablelands and Slopes Dry Herb-Grass Woodland	180.576

Appendix 3

Bango Wind Farm
Additional Vegetation (BioBanking) Plots to Inform the Project's Offset Liability

ELA Australia, 2017

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Kristin Old
CWP Renewables Pty Ltd
Level 6, Suite A
41-45 Hunter Street
Newcastle NSW 2300

17SYD-8339

8 December 2017

Dear Kristin,

Bango Wind Farm – additional vegetation (BioBanking) plots to inform the Project's offset liability

CWP Renewables (CWP) are proposing to construct the Bango Wind Farm (the Project), consisting of up to 75 wind turbines (reduced from the originally proposed 122 turbines), located 30 km north of Yass. The Project Environmental Impact Statement (EIS) was exhibited in late 2016 and included a commitment to prepare a Biodiversity Offset Strategy (BOS) in accordance with the BioBanking Assessment Methodology (BBAM). In response to the EIS, Office of Environment and Heritage (OEH) requested further information, including quantitative vegetation data using BBAM and for the offsets to be re-calculated using the Framework for Biodiversity Assessment (FBA).

It is noted that Environmental Resource Management (ERM) commenced the Environmental Assessment for the project following the provision of the Director General's Requirements (DGRs) under the now repealed Part 3A provisions of the *Environmental Planning and Assessment Act 197*9 (EP&A Act). However, NSW Department of Planning and Environment (DP&E) issued Secretary's Environmental Assessment Requirements (SEARs) on 6 November 2015, which supersede the DGRs, as part of the conversion to a State Significant Development (SSD) under Part 4 of the EP&A Act. It is also noted that the Framework for Biodiversity Assessment (and the NSW Biodiversity Offsets Policy for Major Projects) was established in October 2014, after the vegetation surveys were completed for the Project.

Eco Logical Australia (ELA) on behalf of CWP completed additional vegetation surveys (12 plots / transects) to assess vegetation condition in response to OEH comments on the Project EIS and the vegetation condition present within the site. The additional vegetation plots conducted will be used to inform the Project's offset liability calculated by the FBA.

The surveys confirmed the low condition of the site; pasture improved paddocks dominated by exotic grasses with scattered paddock trees and very low native diversity. Grazing was a feature across the majority of the site. The limited additional surveys also noted potential irregularities with the mapped Plant Community Types (PCTs), which, with the biometric data are used to calculate the project offset liability. Where appropriate, and data supported a change, the vegetation zone boundaries were changed to reflect the field observations (ELA) and/or ERM plot data.

Following recent updates to regional vegetation mapping, it is likely that more than two PCTs exist within the study area, and a different selection of PCTs and/or vegetation zones more appropriate. However, it is acknowledged that at the time of the original surveys, the PCTs available for selection were likely to be the most suitable. Nevertheless, the final offset outcome (liability) is unlikely to change significantly with a different selection of PCTs. This is because the PCTs would be interchangeable within the offset rules, and the benchmark values (basis for the credit calculations) are likely to be similar, due to similarity in PCT structure (formation) and position across the landscape. In consideration of the above, it is proposed that agreement from OEH is sought to use the original PCTs selected by ERM, with the recent updated condition mapping to calculate the Project's offset liability.

We note that the Red Stringybark vegetation type mapped at Bango is also mapped in the Crudine Wind Farm offset property and any surplus credits from this site would thus be able to be used to meet the offset requirement for the Bango project. The White Box-Yellow Box at Crudine is a different PCT to that mapped at Bango but the same NSW and Commonwealth listed ecological community, and thus subject to the variation rules may be able to be used to meet the offset requirements at Bango. This will be confirmed once the offset calculations are completed.

Yours sincerely,

Matthew Dowle and Robert Humphries
Senior Ecologist (Accredited Assessor) and Manager, Biodiversity Offset Programs

ATTACHMENT A – Vegetation Condition Plots

Background

CWP Renewables (CWP) are proposing to construct the Bango Wind Farm (Project), consisting of up to 75 wind turbines (reduced from the originally proposed 122 turbines), located approximately 30 km north of Yass, in NSW. The Project Environmental Impact Statement (EIS) was exhibited in late 2016 and included a commitment to prepare a Biodiversity Offset Strategy (BOS) in accordance with the BioBanking Assessment Methodology (BBAM 2014).

In response to the EIS, OEH made a submission requesting further information, including quantitative vegetation data collection using the BBAM, to assess vegetation condition within the project footprint. Following the field surveys and vegetation condition data, offsets for the project were to be calculated in accordance with Framework for Biodiversity Assessment (FBA) and the NSW Biodiversity Offsets Policy for Major Projects 2014.

The Project is currently seeking approval under the State Significant Development (SSD) provisions (Division 4.1) of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project will also be assessed with respect to Commonwealth legislation as part of the EIS under the EP&A Act, through the Bilateral Agreement with the NSW and Commonwealth Governments.

It is noted that Environmental Resource Management (ERM) commenced the Environmental Assessment for the project following the Projects announcement in 2011 and the provision of the Director General's Requirements (DGRs) under the now repealed Part 3A provisions of the EP&A Act. However, NSW Department of Planning and Environment (DP&E) issued Secretary's Environmental Assessment Requirements (SEARs) on 6 November 2015, which supersede the DGRs, as part of the conversion to a SSD under Part 4 of the EP&A Act.

It is also noted that the Framework for Biodiversity Assessment (and the NSW Biodiversity Offsets Policy for Major Projects) was established in October 2014, after the vegetation surveys were completed by ERM for the Project. However, the field survey methodologies are compatible, with data collected using the BBAM, applicable to the FBA and offset calculations (other than cover and abundance data that is not used in credit calculations but helps justify PCTs). The differences between the BBAM and FBA lay largely within the operation of the online calculator tool, and variation rules around red flags and offset thresholds related to vegetation condition.

This letter reports on the field surveys conducted by ELA. The information from the field surveys will be used to determine the final biodiversity impact of the project (offset liability), and to inform the BOS. It is noted that OEH requested the further survey of 25 vegetation plots / transects. However, through correspondence between DP&E and CWP, 12 plots were determined to be sufficient to assess and justify the vegetation condition, and are the subject of this letter report.

Methodology

A desktop review of the EIS, it's supporting documentation, regulator comments and previous vegetation mapping undertaken by ERM was conducted prior to the field surveys. A 100 metre buffer around the revised potential impact footprint was developed. This was to provide context for the vegetation mapping, and to determine the ERM plots that would be most relevant for input into the updated offset credit calculations. It is important to acknowledge that the revised impact footprint is likely to represent a conservative impact, and will be subject to further alignment to avoid significant or important ecological features during the construction phase (if required), such as paddock trees.

The approximate survey locations for the additional plots (to assess condition of vegetation zones) were determined by ERM and shown in Figures 1a & 1b of ERM Responses to OEH (figures provided to ELA by CWP). The surveyed additional plot locations are shown in **Figure 1** and **Figure 2**. It should be noted that due to temporary access issues, one of the proposed plot locations was moved to another landowner's property within the same vegetation zone, and not all impact areas were inspected due to the focus on additional plots and confirming vegetation condition.

All field surveys were conducted in accordance with the FBA, and build on the existing information collected as part of the EIS by ERM. At each survey site (plot) conducted by ELA, the following information was collected:

- site ID, plot photos, date and name of recorder(s)
- plot orientation, slope, and aspect
- easting and northing at either end of the 50 m transect
- a plot-based 400 m^2 (20 m x 20 m) full floristic survey, documenting each flora species cover and abundance
- a plot and transect survey (20 x 50), documenting canopy and mid-storey cover every 5 m along a 50 m transect, and ground cover every 1 m. Number of hollow bearing trees, length of fallen logs >10 cm width and proportion of regenerating canopy species was also recorded.

During the field surveys, if vegetation boundaries required updating, they were altered and used to inform the revised vegetation mapping (**Figure 1** and **Figure 2**) and offset calculations (to be conducted). The offset calculations are provided separate to this document.

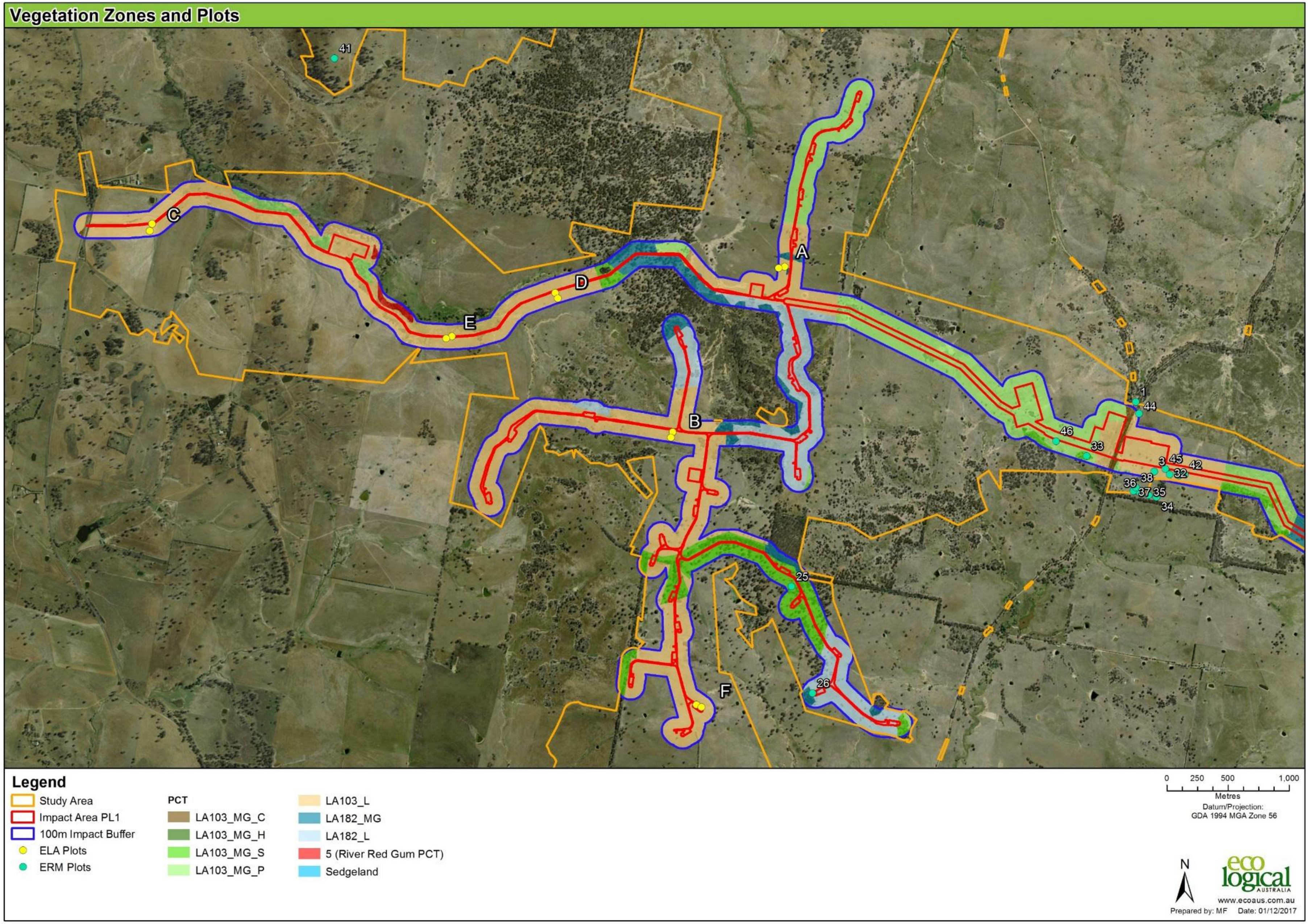


Figure 1: Vegetation mapping and additional plot locations (west)

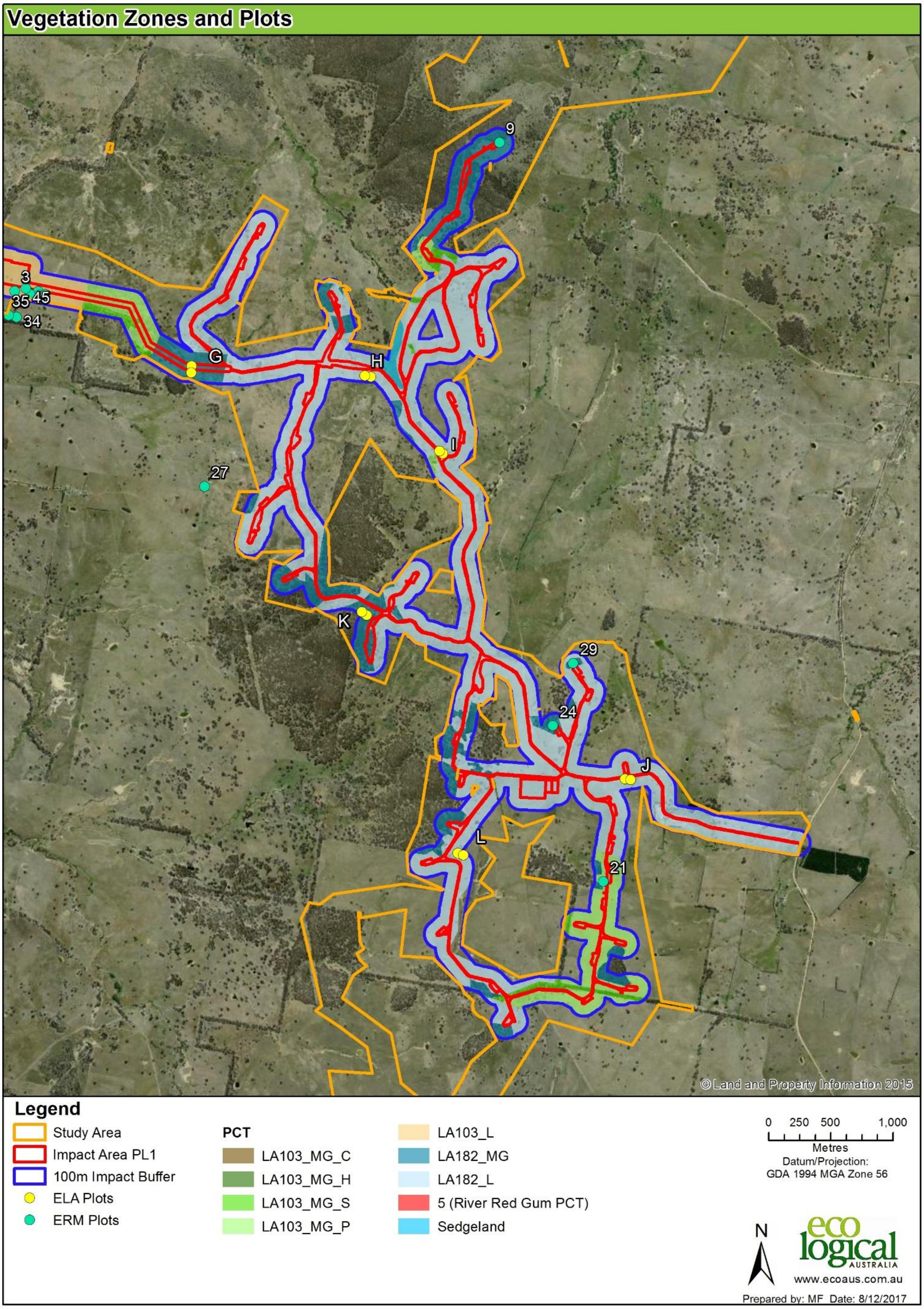


Figure 2: Vegetation mapping and additional plot locations (east)

Results

Field surveys confirmed the generally ‘low’ condition of the site; paddocks of exotic grasses and scattered paddock trees. Vegetation condition data was collected from twelve plots / transects. Locations of plots are shown in **Figure 1** and **Figure 2** and the biometric data shown below in **Table 1.**

The higher elevation areas of the site featuring skeletal and less fertile soils occurred on steep hill slopes, rocky slopes and crests, and were dominated by a Long-leaved Box (*Eucalyptus goniocalyx*) and Red Stringybark (*Eucalyptus macrorhyncha*) vegetation community. The lower lying areas, flats, lower hillslopes, drainage lines and gully channels were dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely’s Red Gum (*Eucalyptus blakelyi*), the majority of which represented the listed ecological community; Box-Gum Woodland (see below). However, Yellow Box and Blakely’s Red Gum individuals were also scattered across the site in the higher areas.

Two Plant Community Types (PCTs – LA103 & LA182) were mapped by ERM within the study area and assigned to the vegetation described above. The ERM mapped PCTs were:

- LA103 (PCT 654) - *Apple Box - Yellow Box dry grassy woodland of the South-Eastern Highlands Bioregion.* Met the definition for Box-Gum Woodland when mapped in moderate to good condition.
- LA182 (PCT 290) - *Red Stringybark - Red Box - Long-leaved Box - Inland Scribbly Gum tussock grass - shrub low open forest on hills in the southern part of the NSW South Western Slopes Bioregion.*

PCT 5 (*River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion*) and PCT *335* (*Tussock grass - sedgeland fen - rushland - reedland wetland in impeded creeks in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion*) were included in the revised vegetation mapping. However, these PCTs do not occur in the impact area, and no plots were conducted within the PCTs.

Vegetation condition

The surveys confirmed the study area’s low condition across the majority of site (pasture improved exotic grass paddocks with scattered paddock trees), with grazing and agricultural practices a common feature. Areas previously mapped as cropping, pasture and low condition PCTs all contained an exotic understorey (exotic pasture species) comprising greater than 50% of the ground cover (typically >90% exotic), and consequently were mapped as exotic/cleared vegetation. These areas lacked a native canopy, and were determined as meeting the ‘low condition’ vegetation (or cleared land) definition under the FBA. They were combined in the revised mapping and assigned the low condition PCT that was likely to have been present prior to disturbances.

> *Vegetation in low condition:*
>
> *a) woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either:*
> *– less than 50% of ground cover vegetation is indigenous species, or*
> *– greater than 90% of ground cover vegetation is cleared,*
> *OR*
> *b) native grassland, wetland or herbfield where either:*
> *– less than 50% of ground cover vegetation is indigenous species, or*
> *– more than 90% of ground cover vegetation is cleared*

Where woody vegetation and canopy trees were present, such as along road verges and boundary fences, native species were often observed in the ground layer, and the denser patches of vegetation contained native species in all structural layers. These areas represented vegetation in ‘moderate to good condition’ under the FBA. Other areas meeting the ‘moderate to good’ condition class included areas containing a native canopy, but were dominated by exotic grasses in the understorey, and areas with no canopy, but contained a native understorey. The definition of moderate to good vegetation in FBA is:

> *Vegetation in moderate to good condition: native vegetation that is not in low condition*

Box-Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) is listed as a critically endangered ecological community under the NSW *Biodiversity Conservation Act 2016* (BC Act – formerly the *Threatened Species Conservation Act 1995*) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). For further information regarding areas of Box-Gum Woodland within the Project, including listing under the TSC/BC Act and EPBC Act, refer to the EIS and supporting documentation.

In the revised mapping, LA103 generally met the definition for Box-Gum Woodland under the BC Act, where it was mapped in moderate to good condition (FBA definition). However, no vegetation plots conducted in LA103 in the recent surveys met the definition of Box-Gum Woodland under the EPBC Act. Areas mapped as low condition were limited to scattered paddock trees and did not meet the listing criteria for Box-Gum Woodland.

Table 1: ELA Biobanking plot data

Plot	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone	Site Value	Condition
A	0	0	0	0	0	0	96	0	0	0	664732	6175244	55	0	Low
B	1	0	0	0	0	0	92	0	0	0	663846	6173791	55	6	Low
C	1	0	0	0	0	0	88	0	0	0	659776	6175614	55	6	Low
D	1	0	0	0	0	0	98	0	0	0	662831	6174998	55	6	Low
E	6	0	0	0	0	0	94	0	0	0	661970	6174639	55	6	Low
F	0	0	0	0	0	0	94	0	0	2	664050	6171646	55	0	Low
G	26	0	0	40	12	18	32	0	1	6	669051	6173176	55	34	M/G
H	3	0	0	0	0	0	98	0	0	0	670567	6172930	55	6	Low
I	2	20	0	0	0	0	94	1	0	33	671034	6172235	55	22	Low[3]
J	0	0	0	0	0	0	92	0	0	0	672632	6169644	55	0	Low
K	23	23	0	20	2	6	0	3	1	56	670486	6170758	55	77	MM/G
L	1	0	0	0	0	0	98	0	0	0	671285	6169029	55	6	Low

Vegetation Zones[1] and plots[2]		Key			
LA103_Poor	Plot E	*NPS*	Native plant species	*EPC*	Exotic plant cover (%)
LA103_Low	Plots A & B	*NOS*	Native over-storey cover (%)	*NTH*	Number of trees with hollows
LA182_M-G	Plot K	*NMS*	Native mid-storey cover (%)	*OR*	Proportion of over-storey regeneration
LA182_Low	Plots G & I	*NGCG*	Native ground cover grasses (%)	*LFL*	Length of fallen logs (>10cm width) (m)
Cropping	Plots C & F	*NGCS*	Native ground cover shrubs (%)	*Site Value*	Biometric score calculated within the offsets calculator
Pasture	Plots D, H, J, L	*NGCO*	Native ground cover other (%)		

[1] The 'LA103' and 'LA182' codes refer to the Biometric Vegetation Type of the PCT within the Lachlan Catchment (as used in the EIS).

[2] Original plot allocation was determined prior to field work. The revised mapping includes cropping and pasture into low categories PCTs, as all sites lacked canopy cover, and were dominated by an exotic ground layer.

[3] The plot met the definition for low condition vegetation. However, the HBT and fallen logs is contributing to the site value score >17.

Site value score was calculated using the biometric tool, which underpins the calculations in the offset calculator. As a qualitative measure, the site value score can provide an indication of the condition of the site, and can be used to inform the allocation of vegetation zones (relatively homogenous area of native vegetation on a development or biobank site that is the same PCT and broad condition state). Site value scores below 17 do not require offsets under the FBA and NSW Major Projects Offset Policy. It is noted that when the offset liability for the project is calculated, plots within a vegetation zone will be averaged, and the above scores may differ slightly. Furthermore, the offset tool will incorporate the landscape value score, which will influence the final offset liability.

Table 2 provides the plot data collected by ERM over the original study area. A sub-set of these plots (**bold**) will be combined with the additional plots collected by ELA and entered in the credit calculator to determine the updated offset liability. Eleven of these plots (*italics*) were to be excluded by ERM due to the locations in close proximity to each other. The plot data below was provided by ERM, along with data sheets. It is noted that high cover scores were recorded for a number of attributes NOS, NMS, NGCG, NGCS, NGCO and EPC. These high scores were not reflected in the recent field surveys, and are possibly a result of seasonal / temporal differences, presence of exotic annuals, or survey techniques.

Table 2: Plot data provided to ELA by ERM, broken down into vegetation zones and formatted for the calculator

Plot	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone	Veg #
1	**13**	**4%**	**2%**	**40%**	**10%**	**10%**	**0%**	**5**	**1**	**33**	**667566**	**6174127**	**55**	**1**
9	**17**	**0%**	**0%**	**90%**	**2%**	**0%**	**6%**	**0**	**1**	**75**	**671622**	**6174752**	**55**	**5**
13	7	0%	0%	62%	0%	0%	74%	0	0	21	661761	6178110	55	3
21	**11**	**24%**	**0%**	**70%**	**0%**	**10%**	**100%**	**0**	**1**	**37**	**672458**	**6168801**	**55**	**3**
22	4	26%	0%	0%	0%	14%	78%	0	1	11	661750	6178075	55	3
24	**8**	**17%**	**0%**	**80%**	**0%**	**44%**	**100%**	**2**	**1**	**32**	**672052**	**6170057**	**55**	**5**
25	**8**	**35%**	**0%**	**18%**	**0%**	**0%**	**54%**	**2**	**1**	**37**	**664748**	**6172616**	**55**	**2**
26	**3**	**29%**	**0%**	**0%**	**0%**	**0%**	**96%**	**1**	**1**	**100**	**664921**	**6171742**	**55**	**5**
27	29	28%	0%	94%	68%	92%	100%	1	1	36	669249	6171984	55	5
28	**5**	**41%**	**1%**	**2%**	**2%**	**24%**	**96%**	**1**	**1**	**75**	**671470**	**6165037**	**55**	**5**
29	**7**	**10%**	**0%**	**36%**	**0%**	**14%**	**100%**	**1**	**0**	**12**	**672216**	**6170560**	**55**	5
33	**11**	**9%**	**0%**	**64%**	**0%**	**0%**	**18%**	**1**	**1**	**4**	**667164**	**6173685**	**55**	**2**
39	10	5%	0%	82%	0%	0%	12%	0	0	6	661161	6180345	55	5
41	8	0%	0%	100%	0%	32%	100%	0	0	0	661007	6176938	55	3
43	**4**	**19%**	**0%**	**0%**	**0%**	**0%**	**68%**	**3**	**1**	**79**	**661639**	**6178791**	**55**	**3**
44	14	0%	0%	100%	6%	100%	100%	0	0	0	667593	6174032	55	3
46	**6**	**0%**	**0%**	**84%**	**6%**	**0%**	**34%**	**0**	**1**	**0**	**666913**	**6173805**	**55**	**4**
Plots to be excluded from further assessment														
3	*7*	*0%*	*0%*	*8%*	*0%*	*0%*	*78%*	*0*	*0*	*0*	*667719*	*6173557*	*55*	3
30	*11*	*0%*	*0%*	*50%*	*0%*	*0%*	*82%*	*0*	*0*	*0*	*667908*	*6173555*	*55*	3
31	*16*	*0%*	*0%*	*40%*	*0%*	*0%*	*80%*	*0*	*0*	*0*	*667920*	*6173524*	*55*	3
32	*11*	*0%*	*0%*	*46%*	*0%*	*0%*	*66%*	*0*	*0*	*0*	*667843*	*6173532*	*55*	3
34	*12*	*0%*	*0%*	*30%*	*0%*	*2%*	*70%*	*0*	*0*	*0*	*667736*	*6173348*	*55*	3
35	*11*	*0%*	*0%*	*32%*	*0%*	*0%*	*86%*	*0*	*0*	*0*	*667672*	*6173364*	*55*	3
36	*11*	*0%*	*0%*	*42%*	*0%*	*0%*	*76%*	*0*	*0*	*0*	*667601*	*6173382*	*55*	2
37	*10*	*0%*	*0%*	*12%*	*0%*	*0%*	*94%*	*0*	*0*	*0*	*667549*	*6173398*	*55*	2
38	*11*	*0%*	*0%*	*24%*	*0%*	*0%*	*76%*	*0*	*0*	*0*	*667569*	*6173425*	*55*	2
42	*10*	*0%*	*0%*	*38%*	*0%*	*0%*	*88%*	*0*	*0*	*0*	*667968*	*6173531*	*55*	3
45	*8*	*0%*	*0%*	*12%*	*0%*	*4%*	*100%*	*0*	*0*	*0*	*667809*	*6173579*	*55*	*3*

Veg # = Vegetation Zone (PCT in brackets), based on revised mapping			
1	LA103_MG_C (654)	4	LA182_MG (290)
2	LA103_MG_P (654)	5	LA182_Low (290)
3	LA103_Low (654)		

Direct impacts to vegetation

The predicted impacts and clearing required for the project is approximately 120.7 hectares. This will occur over two PCTs and five vegetation zones, as a result of the revised mapping. The vast majority of impacts (90 ha, or 75%) will occur in areas of exotic vegetation and lacking a native canopy; mapped as low condition (or cleared land) PCTs (**Table 3**). The next largest impact (20 ha or 17%) will occur in areas mapped as LA103 in poor condition; native canopy with an exotic or poorly diverse understorey. When the Biometric plot data is entered into the calculator, these poorer condition areas are likely to have a small (or zero in the case of low condition) offset requirements.

Table 3: Project impacts and plots to be used for impact calculations

Vegetation type (PCT)	Impact area (ha)	Number of plots required under FBA	Plots to be used for calculations
1 - LA103_MG_C (654)	0.26	1	1
2 - LA103_MG_S (654)	3.51	2	25, 33
3 - LA103_MG_P (654)	28.36	4	13^, 21, 22^, 43
4 - LA103_Low (654)	35.68	4 (or 3 for low condition)	46, A, B, C, D, E, F
5 - LA182_MG (290)	9.21	3	9, 24, 26, 28, 29, G, K
6 - LA182_Low (290)	43.67	4 (or 3 for low condition)	H, I, J, L
Total	**120.71**	**18 (16)**	**25**

**LA103_MG_S originally mapped by ERM has been included with LA103_MG_P in the revised mapping due to the similarity in plot data.*
^ Outside 100 m buffer area, but within the original study area.

Discussion and implications

Review of vegetation mapping

The vegetation surveys amended some vegetation boundaries and noted potential irregularities with the previously mapped Plant Community Types (PCTs). The PCT, along with the biometric data and other landscape information are used to calculate the project offset liability. It is likely that more than two PCTs exist within the study area, and a different selection of PCTs and vegetation zones could be applicable to the project. For example, the latest available broad-scale desktop mapping (Central West / Lachlan Catchment – OEH 2017) is provided in **Figure 3**. However, it is acknowledged that at the time of the original surveys, the PCTs mapped were possibly the most appropriate, based on the PCTs available in the NSW Vegetation Information System (VIS) classification database and Biobanking calculator at the time.

Following a detailed desktop review of the original plot data, and combined where possible with the recent vegetation surveys, vegetation boundaries were amended and presented in **Figure 1** and **Figure 2**. The review of the original plot data (provided following the field surveys) noted irregularities, including (but not limited to):

- Plots located in higher condition vegetation containing data representing poorer condition vegetation. Furthermore, these plots were in lower condition than those mapped in the originally poor condition vegetation, and vice versa. For example:
    - Plots 13 & 22 (outside revised impact area and 100 metre buffer) were mapped as medium condition vegetation. However, both contained an understorey with a higher exotic cover than native cover and low native diversity (7 & 4 respectively). Plot 13 also had no canopy, suggesting it may meet the definition of low condition vegetation under the FBA.
    - Plot 33 (occurring outside the revised project footprint) was mapped in poor condition and contained a native canopy, moderate native diversity and native dominated understorey. On face value, this plot was close to meeting the EPBC Act definition for Box-Gum Woodland.
- A number of plots were located on the boundary of vegetation zones. For example:
    - Plot 9, 26, 44 & 46 are mapped on the boundary of vegetation zones, in the poorer condition vegetation than the data reflects.

- Data from the plots did not represent the vegetation mapping it was located in. For example:
  - Plot 25 was originally mapped as LA182, but the data sheet identified a dominant *Eucalyptus albens* (White Box) and *Eucalyptus blakelyi* (Blakely's Red Gum) vegetation community, with *Eucalyptus macrorhyncha* (Red Stringybark) also occurring. These dominant canopy species represent characteristic species for Box-Gum Woodland.

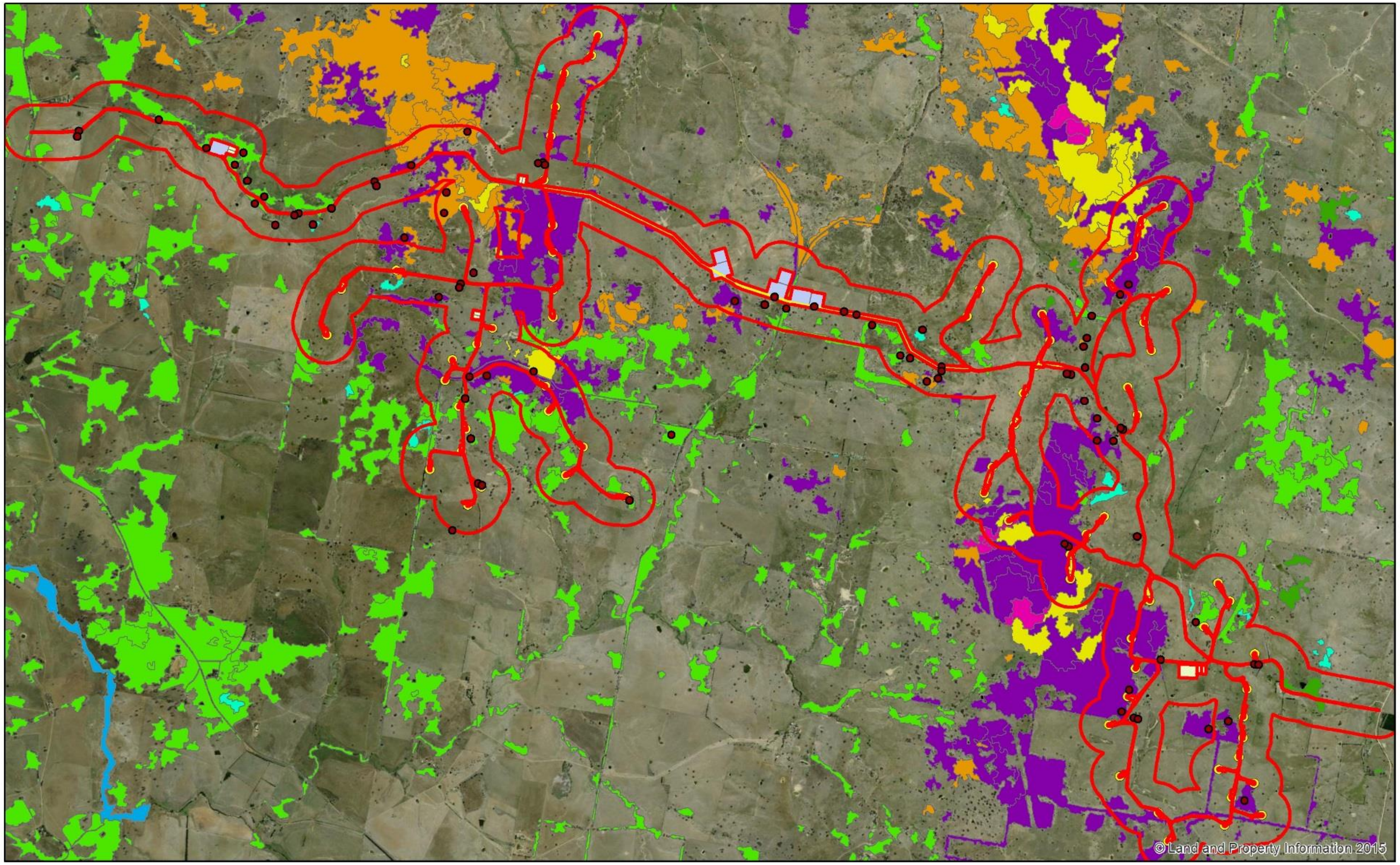
Vegetation mapping implications

Based on the revised mapping, the final offset outcome (liability) for the project is unlikely to increase, and in fact may have a lower offset liability. This is because the majority of the site represents exotic pastures with no canopy (or occasional paddock trees) and meets the definition of 'low condition' under the FBA. It is noted that more areas within the site have been mapped in moderate to good condition than depicted in the EIS (plots mapped in low condition vegetation but represent moderate to good vegetation have been re-allocated based on the plot data provided, and vice versa). These areas will require a higher offset than originally indicated. However, in the original Biodiversity Assessment Report for the EIS, offsets were calculated for 'low condition' areas'; but following the revised mapping, these areas under the FBA will most likely (and as shown in **Table 1**) have site value scores <17, and therefore no offsets would be required.

Furthermore, the final offset outcome (liability) for the project is unlikely to change significantly with a different selection of PCTs or vegetation zones. This is because the PCTs would be interchangeable within the offset rules, and the benchmark values (basis for the credit calculations) are likely to be comparable, due to the similarity in PCT formation, Keith class and position across the landscape. Furthermore, the majority of the site is in low condition and the selection of PCTs using the VIS classification database (as required by the FBA) can be problematic and difficult.

It is noted that PCTs have been added to the VIS database and FBA calculator since it was run by ERM (such as those in **Figure 3**). This is because PCTs are revised by OEH through broad-scale mapping projects and the new (or revised) PCTs, and their descriptions are added to the VIS database. However, the old PCTs are not always discontinued or removed. This creates a situation where a number of very similar and overlapping PCTs are available for selection. For example, PCT 352 identified in **Figure 3** does not contain any benchmark data from 2008, and therefore would not have been available in the calculator at the time of the original surveys.

In consideration of the above factors, it is proposed that following agreement by OEH, the originally selected PCTs by ERM and the information collected by both ERM and ELA continue to be used to calculate the Project's offsets. The vegetation mapping for the project has implications when considering suitable offsets, based on the selection of PCTs. It also has implications should OEH audit the data, with similar irregularities likely to be identified. Therefore, confirmation from OEH that the revised vegetation mapping is appropriate should be conducted prior to calculating the project offset liability.



Legend

- 5;River Red Gum herbaceous-grassy very tall open forest wetland on floodplains in lower slopes of NSW SWS
- 266;White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- 277;Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- 283;Apple Box - Blakelys Red Gum moist valley and footslopes grass-forb open forest of the NSW SWS
- 287;Long-leaved Box - Red Box - Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion
- 322;Inland Scribbly Gum - Red Stringybark - Black Cypress Pine hillslope shrub-tussock grass open forest on sandstone ranges in the NSW CW
- 348;Red Stringybark - Long-leaved Box - Joycea pallida grassy open forest in the upper Lachlan catchment, NSW SWS and South Eastern Highlands
- 352;Red Stringybark - Blakelys Red Gum hillslope open forest on meta-sediments in the Yass - Boorowa - Crookwell region

Figure 3: 2017 broad-scale vegetation mapping (OEH 2017)

Appendix 4

Raw Plot Data

ERM and ELA Combined Spreadsheets:

1. Matrix of plot floristics (2017 plots)
2. PDF Datasheet Key (2012-2013 plots)
3. PDF Datasheets (2012-2013 plots)

Species	Exotic	Growth Form Group	Source (Year)	Plot A	Plot B	Plot C	Plot D	Plot E	Plot F	Plot G	Plot H	Plot I	Plot J	Plot K	Plot L
Acaena ovina		Forb (FG)	ELA (2017)							1					
Aristida ramosa		Grass & grasslike (GG)	ELA (2017)							15					
Astroloma humifusum		Shrub (SG)	ELA (2017)							<1					
Austrostipa bigeniculata		Grass & grasslike (GG)	ELA (2017)							5					
Austrostipa scabra		Grass & grasslike (GG)	ELA (2017)							<1				<1	
Billardiera scandens		Other (OG)	ELA (2017)											<1	
Brachyloma daphnoides		Shrub (SG)	ELA (2017)							<1				<1	
Carex appressa		Grass & grasslike (GG)	ELA (2017)					<1			<1				
Cassinia arcuata		Shrub (SG)	ELA (2017)							10				<1	
Cheilanthes sieberi		Fern (EG)	ELA (2017)							<1				<1	
Convolvulus erubescens		Other (OG)	ELA (2017)							<1					
Desmodium varians		Other (OG)	ELA (2017)							<1					
Drosera peltata		Forb (FG)	ELA (2017)							<1					
Erodium crinitum		Forb (FG)	ELA (2017)					<1							
Eucalyptus goniocalyx		Tree (TG)	ELA (2017)											2	
Eucalyptus rossii		Tree (TG)	ELA (2017)											15	
Gonocarpus tetragynus		Forb (FG)	ELA (2017)							1				<1	
Goodenia hederacea		Forb (FG)	ELA (2017)							<1				<1	
Hibbertia obtusifolia		Shrub (SG)	ELA (2017)							<1				<1	
Hydrocotyle laxiflora		Forb (FG)	ELA (2017)							<1				<1	
Hypericum gramineum		Forb (FG)	ELA (2017)					<1							
Juncus spp.		Grass & grasslike (GG)	ELA (2017)					<1			<1				
Lepidosperma laterale		Grass & grasslike (GG)	ELA (2017)											<1	
Lomandra bracteata		Grass & grasslike (GG)	ELA (2017)											<1	
Lomandra filiformis		Grass & grasslike (GG)	ELA (2017)							10					
Lomandra multiflora		Grass & grasslike (GG)	ELA (2017)							<1				<1	
Melichrus urceolatus		Shrub (SG)	ELA (2017)							<1				<1	
Oxalis perennans		Forb (FG)	ELA (2017)									<1			
Phyllanthus hirtellus		Shrub (SG)	ELA (2017)											<1	
Poa sieberiana		Grass & grasslike (GG)	ELA (2017)											<1	
Pomax umbellata		Forb (FG)	ELA (2017)											<1	
Rumex brownii		Forb (FG)	ELA (2017)		<1	<1	<1	<1			<1	<1			<1
Rytidosperma spp.		Grass & grasslike (GG)	ELA (2017)							5					
Rytidosperma pallidum		Grass & grasslike (GG)	ELA (2017)											5	
Schoenus apogon		Grass & grasslike (GG)	ELA (2017)					<1		5					
Senecio prenanthoides		Forb (FG)	ELA (2017)											<1	
Solenogyne dominii		Forb (FG)	ELA (2017)							<1					
Stypandra glauca		Forb (FG)	ELA (2017)											5	
Themeda triandra		Grass & grasslike (GG)	ELA (2017)							5					
Thysanotus patersonii		Other (OG)	ELA (2017)											<1	
Triptilodicus spp.		Forb (FG)	ELA (2017)							<1					
Vittadinia cuneata		Forb (FG)	ELA (2017)							<1					
Vittadinia muelleri		Forb (FG)	ELA (2017)							<1					
Wahlenbergia spp.		Forb (FG)	ELA (2017)											<1	
Wurmbea dioica subsp. dioica		Forb (FG)	ELA (2017)							<1					

Acetosella vulgaris	*	0	ELA (2017)	<1			<1	<1	<1		<1	<1		
Aira spp.	*	0	ELA (2017)	<1						5				<1
Arctotheca calendula	*	0	ELA (2017)	<1	<1	<1	<1	<1			<1	<1	<1	<1
Avena barbata	*	0	ELA (2017)						<1		<1	<1	<1	<1
Briza maxima	*	0	ELA (2017)							<1				
Bromus hordeaceus	*	0	ELA (2017)	<1	10	<1	10	5	30	3	10	1	1	5
Cirsium vulgare	*	0	ELA (2017)			<1			5					
Erodium botrys	*	0	ELA (2017)	40	1		2	<1			<1	<1	10	1
Gamochaeta spp.	*	0	ELA (2017)			<1								
Holcus lanatus	*	0	ELA (2017)					<1				<1		
Hordeum leporinum	*	0	ELA (2017)	<1	1	10		<1	10		<1	1		<1
Hypochaeris radicata	*	0	ELA (2017)	<1	<1	<1	<1	<1	1	5	<1		<1	<1
Juncus capitatus	*	0	ELA (2017)			<1								
Linaria pelisseriana	*	0	ELA (2017)							<1				
Lolium perenne	*	0	ELA (2017)			10			15		3	2	<1	2
Malva spp.	*	0	ELA (2017)			<1				<1				
Onopordum spp.	*	0	ELA (2017)									<1		
Petrorhagia nanteuilii	*	0	ELA (2017)							<1				
Phalaris aquatica	*	0	ELA (2017)			<1					<1	2		5
Poa annua	*	0	ELA (2017)									<1	<1	
Tolpis barbata	*	0	ELA (2017)							<1				
Trifolium campestre	*	0	ELA (2017)	<1				<1	1		<1	<1	<1	5
Trifolium spp.	*	0	ELA (2017)						<1	1				
Trifolium subterraneum	*	0	ELA (2017)	50	25	<1	30	20	15	1	15	30	20	20
Vulpia spp.	*	0	ELA (2017)	<1	55	60	50	60	15	1	65	60	30	50

T/P Number	Field Plot Name*	PDF Page Order	Latitude	Longitude	Zone
22	YB2	1	6178074.856	661749.9964	55
13	NG2	2	6178109.941	661761.1674	55
43	YB1	3	6178791.126	661639.3552	55
39	NG1	4	6180345.39	661161.0294	55
25	WP13	5	6172616.067	664747.738	55
9	LA182/6	6	6174752.491	671622.1282	55
26	WP12	7	6171742.395	664921.0118	55
44	NG3	8	6174031.915	667593.4943	55
28	LA182/5	9	6165036.848	671469.8096	55
24	LA182/2	10	6170057	672051.9745	55
29	LA182/1	11	6170559.541	672215.9233	55
41	NG4	12	6176937.887	661007.4701	55
21	LA182/4	13	6168801.371	672458.1118	55
27	LA182/3	14	6171983.709	669248.7984	55
33	LA103/MGS1	15	6173684.768	667163.8358	55
46	LA103/MGS2	16	6173805.45	666913.0695	55
1	LA103/MGM1	17	6174126.932	667566.2995	55

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** ______ **Recorder(s):** ______

Vegetation type: 48 T/P #: 482 Taffs Hill **AMG Zone** 55 **Easting/Northing:** 661751 6178075 **Photos:** ?: 296

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. melliodora	✓		Austrodanthonia sp. 3		Hydrocotyle lax 2	Rye Grass 5	
					Aust. Bindweed 1	Sorrel 4	
						Great Brome 3	
						Thistle 3	
						Barley Grass 3	
						Yellow flower	
						sample 2	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 13/11/12 **Recorder(s):** EC, JM

Vegetation type: NG T/P #: NG2 Taffs Hill **AMG Zone** 55 **Easting/Northing:** 661761 6178110 **Photos:** 1:295

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
			Austrodanthonia sp. x2 ! 3		Kidneyweed 3	Catsear 3	
			Austrostipa bigen. 5		Wahlenbergia communis 1	RT Fescue ? 5	
			Austrostipa scabra 4		Small lf St Wort 1	Rye Grass 3	
			Elymus scaber 2			Bearded Oats 1	
						Thistle 1	
						Sorrel 3	
						Clover 2	
						Great Brome 3	
						Oxalis perennans 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =
SITE AND OTHER NOTES:							

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 13/11/12 **Recorder(s):** EC, JM

Vegetation type: 4B T/P#: 4B1 **AMG Zone** 55 **Easting/Northing:** 661639 6178791 **Photos:** J: 0121 - 0123

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. melliodora 5	✓		Austrostipa scabra 1		Lomandra filiformis 1	Barley Grass 5	
			Austrostipa bigen. 1			Scotch Thistle 3	
						Rye Grass 3	
						Clover 1	
						Sorrel 1	
						Catsear 1	
						Patersons Curse 2	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Formerly Box Gum W'land

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bargo WF **Date:** 12/11/12 **Recorder(s):** EC, JM

Vegetation type: NG T/P #: NG1/BGDNG **AMG Zone** 55 **Easting/Northing:** 661160, 6180345 WP78 **Photos:** 294

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
			Austrodanthonia 4		Wahlenbergia communis 1		
			Elymus scaber 3		Oxalis perennans 1	Clover	
			Austrostipa scabra 4		Fuzzy New Holland	Catsear 3	
			Microlaena 1		Daisy 1	Soft Brome	
			Austrostipa bigeniculata 4		Goodenia sp. 1	Aira 1	
					(sample)	Sorrel 3	
						Thistle 3	
						Scotch Thistle 1	
						Rye Grass 4	
						Gamochaeta sp. 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 27/09/12 **Recorder(s):** EC

Vegetation type: E. albens E. blakelyi **AMG Zone** ______ **Easting/Northing:** NP13 **Photos:** 273 to N

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. albens			Poa sieberiana			Sheep Sorrel	
E. blakelyi			3 awn (sample)			Cadeweed	
E. macrorhyncha						Clover	
Tiny leaf [illegible]						Yorkshire fog	
[illegible] (sample)	- dirty	rough base smooth	white/grey but dirty	look		Dandelion	
						Sedges & Clover	(sample)
Amyema miquelii							

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) =
Number of trees =
Sample area =

Whole zone
Number of trees with hollows =
Sample area =
Benchmark value =

Native mid-storey	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plants	Fallen logs
Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

Track - existing track - clearing unlikely.

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 28/09/12 **Recorder(s):** EC

Vegetation type: E. rossii, macro, bride desired grassland **AMG Zone** ______ **Easting/Northing:** WP17 T1 **Photos:** 287 to E

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
		Euc. regrowth	3 awn grass	Styphandra glauca	Fern (sample)	Pasture grass	
		Rosemary (sample)	Snowgrass		Pink flower (sample)	Sheeps sorrell	
		Spiky [illegible] (sample)			Early Nancy	Clover	
					Green Flower (sample)	Dandelion	
						Purple flower	
						(sample)	same as
					Cheilanthes sieberi	track	sample)
						Yellow flower (sample)	
					Phyllanthus hirtellus	Purple	

Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 27/09/12 **Recorder(s):** EC, CS

Vegetation type: ______ **AMG Zone** ______ **Easting/Northing:** WP12 TU **Photos:** 272 to W

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. blakelyi		—				grass (s1)	
E. rossii						herb (s2)	
E. bridgesiana						herb (s3)	
E. albens –	in 20x	50 but not 20x20				spade leaf (s4) –	dock ?
						purple fl (s5)	
						Cottonwood	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 14/11/12 **Recorder(s):** HM, EC

Vegetation type: NG T/P# : NG3 **AMG Zone** 55 **Easting/Northing:** WP86 **Photos:** ______

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
—		Sifton Bush 3	Austrodanthonia (S) 5		Austral Sunray 4	Aira 5	
		Euc. regrowth 2	Aristida ramosa 3		Small native St Wort 3	Catsear 2	
					Onion Orchid 1	Yellow Hawkweed 2	
					Yellow Flower (S) 2	Quaking Grass 2	
					Common Bog Sedge 1	Shivery Grass 2	
					Smooth Solenogyne 1	Yorkshire Fog 2	
					Gallium a 1	Sorrel 1	
					Haloragis heterophylla 2	Proliferous Pink 1	
					Wahlenbergia communis 1	RT Fescue 3	
					Cheilanthes sieberi 1	Clover 2	
					~~Bulbine bulbosa~~ 4	Plantain 1	
						Pelisser's Toadflax 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bango WF **Date:** 14/11/12 **Recorder(s):** EC, HM

Vegetation type: LA182 T/P#: LA182-1 **AMG Zone** WP87 55 **Easting/Northing:** 671469 6165037 **Photos:** 299

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. bridgesiana 4	✓	juvenile E. rossii 3	Acacia implexa 1		Hydrocotyle laxiflora 2	Rye Grass 4	
E. rossii 3	✓	" E. bridgesiana 3				Great Brome 3	
E. melliodora 3	✓					Catsear 1	
						Capeweed 1	
						Rats Tail Fescue 3	
						Barley Grass 3	
						Solanum sp. 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bango WF **Date:** 15/11/12 **Recorder(s):** SC, HM

Vegetation type: LA182 VPW: LD182-2 **AMG Zone** 55 WP90 **Easting/Northing:** 672051 6170057 **Photos:** 307

Native over-storey species list At 10 points along the 50-m transect	**Regen-eration** (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. macrorhynca 3	✓		Elymus scaber		Lomandra filiformis 1	Sorrel 4	
			Austrostipa scabra 3		Hydrocotyle laxiflora 1	Catsear 2	
			Austrodanthonia (tall) 3			Bearded Oats 1	
			" " (short) 3			Great Brome 2	
			Microlaena stipoides 3			RT Fescue 3	
						Rye Grass 3	
						Barley Grass 2	
						Cackweed 1	
						Yorkshire Fog 2	
						Scotch Thistle 1	
						Clover 2	
						Sample grass 3	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bargo WF **Date:** 15/11/12 **Recorder(s):** EC, HM

Vegetation type: LA182 (low) T/P#: LA182-1 **AMG Zone** 55 **Easting/Northing:** WP89 672216 6170560 **Photos:** 306

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. goniocalyx (NOT IN	20x20)	—	Microlaena stipoides 3		Lomandra filiformis 1	Sorrel 5	
			Austrostipa bigeniculata 2			Scotch Thistle 1	
			Austrodanthonia (short			Rye Grass 5	
			hairy one) 1			Bearded Oats 1	
			Austrostipa scabra 1			Great Brome 3	
			Austrodanthonia (tall) 2			RT Fescue 2	
						Barley Grass 3	
						Clover 3	
						Catsear 2	

Over-storey summary	Mid-storey	Grasses	Shrubs	Other	Exotic	Fallen logs
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

BioBanking
Biodiversity Banking and Offsets Scheme

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

Site type: Development / BioBank **Proposal ID:** Ranzo WF **Date:** 16/11/12 **Recorder(s):** EC, HM

Vegetation type: NG T/P #: NG4 **AMG Zone** 55 WP99 **Easting/Northing:** 661007 6176938 **Photos:** 333 - 335

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
			Austrodanthonia 5		Bindweed 2	Clover 3	
			(less hairy/less blue		Hydrocotyle 3	Shivery Grass 1	
			leaves)		Wahlenbergia communis 1	Catsear 3	
			Elymus scaber 3		Austral Sunray 1	RT fescue 2	
			Microlaena stipoides 1			Sorrel 3	
			Austrostipa scabra 3			Aira 1	
						Rye Grass 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bargo WF **Date:** 15/11/12 **Recorder(s):** EC, HM

Vegetation type: LA182 T/P#: LA182-4 **AMG Zone** 55 **Easting/Northing:** NP94 672458 6168801 **Photos:** 317

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. melliodora 3	✓		Austrostipa bigen. 3	Acacia implexa 1	Hydrocotyle laxiflora 2	Thistle 1	
E. macrorhynca 3	✓		" scab. 3		Lomandra filiformis 1	RT Fescue 4	
E. bridge			Austrodanthonia 3			Clover 3	
			Elymus scaber 1			Sorrel 3	
			Poa sieberiana 1			Great Brome 1	
						Rye Grass 1	
						Aira 1	
						Catsear 1	
Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =		Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** Bongo WF **Date:** 15/11/12 **Recorder(s):** SC, HM

Vegetation type: LA182 T/P #: LA 182 - 3 **AMG Zone** 55 **Easting/Northing:** Same as T4 **Photos:** 308

Native over-storey species list At 10 points along the 50-m transect	**Regen-eration** (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. rossii 5	✓		Daphne Heath 2 →	→	Lomandra filiformis 4B cor.	Catsear 3	
E. bridgesiana 3	✓		Stypandra glauca 4 →	→	" " Fl. 2	Aira 4	
				Hibbertia obtusifolia 1	Cheilanthes sieberi 1	Quaking Grass 4	
			Poa sieberiana 2	Melichrus urceolatus 1	Orchid ? 1	Shivery Grass 1	
			Microlaena	Common Thyme Spurge 1	Wahlenbergia communis 2		
			Aristida ramosa		Hydrocotyle laxiflora 3		
			Austrodanthonia (tall) 1		Luzula 1		
			Joycea pallida 3		Goodenia		
					Poranthera 1		
					Acaena ovina 1		
					Goodenia hederacea 1		
					Common Raspwort 1		
Total number of species =					Austral Sunray 1		
Foliage cover (%) =					Native small St wort 1		
Benchmark value (%FC) =					Velleia paradoxa 1		
Average crown diameter =					~~Rush~~ Onion Orchid 1		
Average foliage cover (%) =					Daucus glochidiatus 1		
Number of trees =							
Sample area =							
Whole zone							
Number of trees with hollows =							
Sample area =		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
Benchmark value =		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** BANGO **Date:** 26 FEB 13 **Recorder(s):** JL & AC

Vegetation type: LA103_M6_S_1 **AMG Zone** ____ **Easting/Northing:** WP 13 **Photos:** ____

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
			Austrodanthonia	Hibbertia obtusifolia	Woody flower sample	Quivering grass	
			Austrostipa Scabra?		Lomandra ~~sp.~~ filiformis	Proliferous pink	
			Poa sieberiana		Desmodium varians		
			Themeda triandra		Leptorhyncos squamatus	Cats ear	
			Elymus scaber		subsp. alpinus	Rats tail fescue	
						Cynosurus echinatus	
Total number of species =							
Foliage cover (%) =				~~Shrub sample~~			
Benchmark value (%FC) =						~~Cactus weed~~	
Average crown diameter =						~~Vase grass~~	
Average foliage cover (%) = Number of trees =					~~Yellow button~~	~~Barb-wire grass~~	
Sample area =					~~Mushroom flower~~	~~Spiky grass~~	
Whole zone					Pine cone flower	Flower spike (brown)	
Number of trees with hollows =					~~Flower spike~~	Aira sp?	
Sample area =		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
Benchmark value =		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** BANGO **Date:** 26 FEB 13 **Recorder(s):** JL, AC

Vegetation type: LA103 MG S 2 **AMG Zone** ____ **Easting/Northing:** WP 13 **Photos:** ____

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
			Austrodanthonia	Hibbertia obtusifolia	Sedge	Aira	
			Themeda australis			Quivering grass	
			Austrostipa			Quaking grass	
						Cats ear	
						Common centauri (?)	
						Rats tail fescue	
						Cassinia arcuata	
						Cynosorus echinatus	
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =					Grey forb	~~Bent grass (?)~~	
Average crown diameter =				~~Shrub sample~~		~~Rat's tail fescue~~	
Average foliage cover (%) =						~~Couch grass~~	
Number of trees =						Clustered flower sedge	
Sample area =							
Whole zone							
Number of trees with hollows =							
Sample area =		Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
Benchmark value =		Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =
SITE AND OTHER NOTES:							

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Transect plot worksheet

BioBanking
Biodiversity Banking and Offsets Scheme

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

Site type: Development / BioBank **Proposal ID:** ______ **Date:** 24/2 **Recorder(s):** JL, AG

Vegetation type: LA 103 MGM 1 **AMG Zone** ______ **Easting/Northing:** WP 001 **Photos:** ______

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
E. melliodora		Acacia implexa?	Austrodanthonia sp.	Cassinia arcuata	Sedge,	Quaking grass	
E. blakelyi			Cocksfoot (Dactylis glomerata)	Calytrix tetragonia	Lomandra ~~sp~~ filiformis	Quivering grass	
		Acacia (sickle leaf)	Poa sieberiana		Cheilanthes sieberi	Aira	
		Chrysocephalum apiculatum				Proliferous pink	
						Bromus molliformis	
						Vulpes sp. (RTF)	
				~~Unknown shrub~~		Unknown grass	
						Brown flower spike	

Total number of species = Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = Number of trees = Sample area = **Whole zone** Number of trees with hollows = Sample area = Benchmark value =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total no of species = Foliage cover (%) =	Total (m) = Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Appendix 5

Bango Wind Farm

Hollow Bearing Tree Locations

Tree species	Superb Parrot preference	Hollow count small <5cm dia.	Hollow count medium 6 -10 cm dia.	Hollow count large > 10 cm dia.
Apple Box	Primary	11	20	7
Blakley's Red Gum	Primary	27	69	42
Box	Primary	3	3	1
Eucalyptus sp.	NA	2	3	0
Grey Box	Primary	12	4	1
Inland Scribbly Gun	Other	5	13	15
Red Stringybark	Secondary	110	102	22
Scribbly Gum	Other	3	11	5
Stag	Primary	169	139	49
Yellow Box	Primary	101	145	79
Sum		**443**	**509**	**221**

SUM TOTAL	**1173**

Raw Data - Hollow Bearing Tree locations

								Small <5cm dia.		Medium 6 -10 cm dia		Large > 10 cm dia.	
ID	Latitude	Longitude	Elevation	Tree species	Superb Parrot preference	Diameter at breast height (cm)	Tree height (m)	Count	Hollow height (m)	Count	Hollow height (m)	Count	Hollow height (m)
1	-34.5106	148.751839	590.4388	Yellow Box	Primary	95	18	0		1	4	0	
2	-34.51	148.749993	566.7168	Yellow Box	Primary	90	12	0		1	1	0	
3	-34.507	148.750801	582.0043	Stag	Primary	70	12	0		3	0	0	
5	-34.5041	148.751357	582.617	Yellow Box	Primary	150	22	0		6	0	1	8
6	-34.5041	148.75249	586.4942	Yellow Box	Primary	95	14	0		1	4	0	
7	-34.5019	148.755088	569.1043	Yellow Box	Primary	105	20	0		1	7	2	5 to 9
8	-34.5024	148.756631	581.139	Yellow Box	Primary	80	15	0		2	7	0	
10	-34.4971	148.754978	591.1559	Yellow Box	Primary	70	12	1	4	2	6	0	
12	-34.4956	148.752193	585.0084	Yellow Box	Primary	60	14	1	5	1	7	0	
13	-34.492	148.752683	561.5928	Yellow Box	Primary	85	16	1	4	2	0	0	
16	-34.4901	148.754586	561.7164	Yellow Box	Primary	100	18	0		1	7	0	
20	-34.4892	148.756584	555.7762	Yellow Box	Primary	160	14	0		1	4	1	2
21	-34.4923	148.756569	564.2716	Yellow Box	Primary	90	14	0		1	8	0	
22	-34.4963	148.75741	616.7991	Stag	Primary	65	5	0		1	0	0	
23	-34.4971	148.757594	606.4046	Yellow Box	Primary	90	16	0		1	5	0	
25	-34.4979	148.758981	607.9364	Yellow Box	Primary	50	12	0		1	2	0	
29	-34.4996	148.760087	573.4676	Yellow Box	Primary	66	11	0		1	4	0	
31	-34.5036	148.75985	610.0234	Yellow Box	Primary	100	18	1	5	1	6	0	
32	-34.5049	148.761502	613.1079	Stag	Primary	110	12	0		1	7	0	
38	-34.5124	148.754478	594.0332	Stag	Primary	70	10	3	6	2	5	0	
41	-34.5771	148.804278	620	Stag	Primary	60	6	3	2 to 4	2	5	1	4
64	-34.5116	148.75385	600.6034	Stag	Primary	60	8	0		3	6	1	6
67	-34.5097	148.752943	611.0978	Yellow Box	Primary	0	0	2	5	2	4	1	5
68	-34.5093	148.751549	602.6406	Yellow Box	Primary	60	10	2	4 to 5	1	3	1	4
69	-34.5087	148.753061	603.96	Stag	Primary	60	5	3	3 to 5	5	0	1	2 to 5
70	-34.5092	148.752812	606.8948	Stag	Primary	55	10	4	2 to 8	1	3	0	
71	-34.5077	148.752686	597.028	Yellow Box	Primary	140	18	4	2 to 4	2	0	4	4 to 6
73	-34.5059	148.752633	597.4897	Yellow Box	Primary	65	10	3	4 to 7	2	5	2	4 to 5
74	-34.5047	148.752634	598.1679	Yellow Box	Primary	70	15	3	5 to 10	4	0	1	8
75	-34.5046	148.753333	599.9765	Stag	Primary	60	10	3	6 to 8	2	5	1	4
76	-34.505	148.753915	602.8935	Yellow Box	Primary	60	9	0		2	4	1	4
77	-34.5051	148.75481	607.4291	Yellow Box	Primary	60	8	4	3 to 5	1	6	0	
78	-34.505	148.755224	607.2676	Yellow Box	Primary	150	10	2	3 to 4	1	3	3	3 to 8
79	-34.5042	148.755611	600.9281	Yellow Box	Primary	180	8	4	2 to 8	2	0	4	4 to 6
80	-34.5014	148.75759	594.046	Stag	Primary	70	10	4	7	3	0	0	
82	-34.4926	148.754648	579.6813	Yellow Box	Primary	140	10	2	4	1	0	0	
83	-34.4921	148.753311	580.3514	Yellow Box	Primary	120	10	4	8	1	3	3	4 to 5
84	-34.4907	148.752101	589.913	Yellow Box	Primary	150	10	4	4 to 6	3	4	0	
86	-34.4883	148.756924	560.8539	Stag	Primary	80	8	3	4	3	0	0	
88	-34.4885	148.761851	550.7567	Yellow Box	Primary	90	8	2	4	2	5	1	5
89	-34.4889	148.763361	543.7731	Stag	Primary	80	10	6	3 to 6	3	0	1	4
91	-34.4921	148.761077	553.045	Stag	Primary	80	12	4	10	2	6	1	5
92	-34.4924	148.761522	549.0046	Yellow Box	Primary	60	10	2	4	6	0	0	
93	-34.4934	148.763066	550.8843	Yellow Box	Primary	80	8	3	6 to 7	2	6	1	5
93	-34.4934	148.763066	550.8843	Yellow Box	Primary	120	12	0		2	0	1	6
94	-34.4967	148.762473	558.8652	Yellow Box	Primary	100	10	4	8 to 9	5	6	1	6
95	-34.4983	148.761784	569.5468	Yellow Box	Primary	120	10	3	7	2	6	1	5
96	-34.4984	148.762771	560.3111	Yellow Box	Primary	140	14	6	6	2	7	4	7
98	-34.4991	148.761664	569.6918	Stag	Primary	120	9	2	6 to 8	3	5	1	5
99	-34.5015	148.764795	575.723	Yellow Box	Primary	130	12	0		1	6	1	6
101	-34.5101	148.761032	632.6692	Yellow Box	Primary	90	13	2	4	3	5	0	
103	-34.5127	148.764699	627.106	Yellow Box	Primary	90	16	2	10	11	9	3	7 to 8
106	-34.5117	148.750531	581.9932	Blakley's Red Gum	Primary	140	14	2	7	4	5	4	5 to 6
108	-34.5126	148.748513	576.0918	Yellow Box	Primary	110	12	3	6	2	5	2	6
109	-34.5121	148.748439	573.9028	Yellow Box	Primary	80	10	0		2	6	0	
110	-34.5166	148.748292	579.9529	Stag	Primary	110	8	2	6	3	5	0	
111	-34.5176	148.75087	585.5657	Yellow Box	Primary	120	9	0		1	5	1	5
116	-34.5198	148.752266	595.7142	Yellow Box	Primary	110	9	3	7	2	5	2	6
117	-34.5203	148.754872	606.9619	Stag	Primary	80	10	2	4 to 6	1	5	0	
118	-34.5227	148.753469	618.9603	Yellow Box	Primary	140	14	3	5	3	6	3	7
119	-34.5249	148.750465	595.9763	Yellow Box	Primary	130	12	0		1	4	1	5
121	-34.5242	148.748716	606.0002	Blakley's Red Gum	Primary	50	7	0		1	0	0	
123	-34.5202	148.757201	626.2738	Yellow Box	Primary	110	8	3	2.5	1	4	1	4
124	-34.5192	148.75762	626.9567	Stag	Primary	60	8	0		2	5	0	
125	-34.5188	148.757771	630.41	Stag	Primary	120	10	0		2	3	2	6
126	-34.5186	148.759292	629.5256	Yellow Box	Primary	120	11	0		3	6	2	5
127	-34.5195	148.76169	644.9128	Stag	Primary	100	6	2	4 to 5	2	4	1	3
128	-34.5251	148.760357	611.3079	Stag	Primary	80	9	5	6 to 9	1	8	0	
129	-34.5248	148.760998	612.8394	Blakley's Red Gum	Primary	80	9	0		1	5	3	7
130	-34.5246	148.7622	617.3451	Yellow Box	Primary	70	12	2	8	1	5	1	7 to 9
131	-34.521	148.767989	625.3424	Blakley's Red Gum	Primary	100	10	0		1	6	0	
133	-34.5255	148.772578	625.4261	Blakley's Red Gum	Primary	70	11	0		1	6	0	
136	-34.5263	148.765297	628.2152	Red Stringy Bark	secondary	60	6	3	4	3	0	0	
137	-34.5253	148.76521	625.551	Blakley's Red Gum	Primary	70	8	2	3	3	4	2	3
138	-34.5345	148.772855	626.7635	Yellow Box	Primary	70	7	2	4	2	3	0	
139	-34.537	148.767058	628.2058	Red Stringy Bark	secondary	80	8	2	2	1	4	0	
140	-34.5359	148.767828	633.7839	Red Stringy Bark	secondary	80	7	2	4	1	4	0	
141	-34.5355	148.767874	634.3466	Red Stringy Bark	secondary	80	7	1	3	1	2	0	

142	-34.538	148.752257	591.8443	Yellow Box	Primary	70	8	0		1	4	0	
146	-34.531	148.753505	616.6948	Blakley's Red Gum	Primary	100	10	0		2	5	0	
148	-34.5334	148.759632	624.1694	Blakley's Red Gum	Primary	70	8	0		1	4	0	
182	-34.585	148.789037	640.1833	Stag	Primary	90	7	2	6	2	4	1	5
184	-34.5855	148.782659	626.3668	Blakley's Red Gum	Primary	85	12	0		2	6	0	
187	-34.5703	148.78476	660.1995	Red Stringy Bark	secondary	120	5	0		1	4	0	
189	-34.5722	148.793273	665.8801	Scribbly Gum	other	55	10	0		1	4	0	
190	-34.5707	148.791749	659.0278	Stag	Primary	100	10	2	6	1	6	0	
194	-34.571	148.796123	659.0149	Scribbly Gum	other	60	7	1	4	2	0	4	5 to 7
195	-34.5712	148.796344	658.486	Scribbly Gum	other	80	8	2	4	4	0	1	4
196	-34.5715	148.79602	661.4753	Apple Box	Primary	50	7	0		2	0	2	3 to 4
197	-34.5715	148.796116	661.864	Apple Box	Primary	80	10	0		2	3	1	3
198	-34.5718	148.796009	663.6384	Scribbly Gum	other	100	12	0		3	10	2	6
200	-34.573	148.801878	644.0375	Red Stringy Bark	secondary	100	12	0		2	8	2	8
202	-34.5672	148.799771	650.5353	Red Stringy Bark	secondary	100	10	0		3	7	0	
204	-34.5658	148.796099	687.3456	Red Stringy Bark	secondary	100	8	0		1	3	0	
206	-34.5282	148.802922	562.1482	Stag	Primary	100	10	0		2	8	1	4
207	-34.5308	148.802357	593.867	Stag	Primary	80	8	2	4	2	4	0	
208	-34.5337	148.8034	646.01	Red Stringy Bark	secondary	90	10	3	8 to 10	1	8	0	
209	-34.5369	148.805179	606.1334	Scribbly Gum	other	110	12	0		1	5	0	
211	-34.5452	148.79894	641.6413	Apple Box	Primary	100	8	2	5	3	6	1	4
212	-34.5463	148.798914	634.1207	Yellow Box	Primary	120	12	0		2	6	2	5
215	-34.5494	148.796409	641.2619	Stag	Primary	70	12	0		2	8	2	7 to 10
216	-34.5489	148.796284	642.139	Yellow Box	Primary	120	10	0		2	5	0	
217	-34.5508	148.7975	629.287	Red Stringy Bark	secondary	180	12	3	10	2	6	0	
218	-34.5519	148.798011	626.3502	Blakley's Red Gum	Primary	150	8	0		2	0	0	
219	-34.5545	148.799876	626.0778	Yellow Box	Primary	100	16	0		1	10	0	
221	-34.5536	148.794862	647.5685	Box	Primary	150	10	3	4 to 5	3	0	1	6
222	-34.5502	148.790409	622.8409	Red Stringy Bark	secondary	80	8	3	5	3	5	0	
224	-34.5441	148.795125	650.5709	Red Stringy Bark	secondary	110	8	2	5	3	6	0	
229	-34.5616	148.799469	663.9402	Red Stringy Bark	secondary	90	11	0		1	8	0	
232	-34.5629	148.803329	644.2053	Stag	Primary	80	9	0		2	0	1	4
233	-34.5681	148.841815	665.9266	Red Stringy Bark	secondary	90	9	2	6	1	6	0	
235	-34.5685	148.844651	685.8955	Red Stringy Bark	secondary	100	10	3	5 to 7	2	0	0	
237	-34.568	148.844756	689.1899	Red Stringy Bark	secondary	100	10	2	6	1	5	0	
238	-34.5654	148.843977	675.6766	Red Stringy Bark	secondary	90	12	0		1	7	0	
240	-34.5674	148.846195	688.9388	Red Stringy Bark	secondary	90	12	0		1	6	1	7
241	-34.5653	148.845899	688.7084	Red Stringy Bark	secondary	90	11	2	7	1	6	0	
243	-34.5628	148.84639	639.3197	Blakley's Red Gum	Primary	110	10	2	6	2	7	0	
244	-34.5617	148.84573	626.9042	Red Stringy Bark	secondary	90	10	0		1	4	0	
245	-34.561	148.846345	622.4668	Red Stringy Bark	secondary	100	9	0		2	5	2	7
246	-34.5606	148.846831	618.7063	Apple Box	Primary	90	12	0		1	9	1	10
247	-34.5603	148.84774	614.3688	Stag	Primary	90	12	2	10	2	7	0	
248	-34.576	148.848809	686.5732	Stag	Primary	65	7	3	4 to 7	2	0	0	
250	-34.5761	148.848488	680.8694	Apple Box	Primary	90	9	0		1	6	0	
251	-34.5845	148.845021	649.5185	Red Stringy Bark	secondary	90	9	2	6	1	5	0	
253	-34.5386	148.870867	591.1299	Stag	Primary	100	7	3	3 to 4	3	6	1	6
255	-34.5424	148.87522	626.0446	Red Stringy Bark	secondary	150	9	2	4 to 5	1	5	0	
257	-34.5423	148.878238	586.2524	Yellow Box	Primary	80	9	0		1	4	0	
258	-34.5416	148.878718	571.4238	Yellow Box	Primary	90	12	0		1	6	0	
259	-34.5375	148.874528	612.8754	Red Stringy Bark	secondary	90	8	2	7	2	7	0	
261	-34.537	148.874911	607.4612	Red Stringy Bark	secondary	100	10	3	8	2	0	0	
262	-34.537	148.874697	608.9516	Stag	Primary	100	10	6	8 to 9	3	0	0	
263	-34.5369	148.874204	619.3599	Stag	Primary	70	10	3	7	2	0	0	
264	-34.5368	148.87395	617.6844	Stag	Primary	80	10	3	4 to 7	3	0	0	
265	-34.537	148.873074	613.0784	Stag	Primary	100	8	0		4	0	2	6 to 7
266	-34.5442	148.871759	605.6132	Red Stringy Bark	secondary	100	10	2	9	1	7	1	8
270	-34.5456	148.867483	613.817	Stag	Primary	50	7	2	5 to 6	2	6	0	
271	-34.5451	148.870626	603.4061	Red Stringy Bark	secondary	90	10	0		1	4	1	8
272	-34.5456	148.87321	613.477	Apple Box	Primary	110	11	3	4 to 7	1	6	0	
273	-34.5477	148.87542	594.8914	Red Stringy Bark	secondary	80	10	2	5 to 7	1	5	0	
274	-34.5489	148.876846	595.7578	Apple Box	Primary	150	8	3	4 to 6	1	4	0	
275	-34.5902	148.882086	669.2669	Stag	Primary	80	9	1	7	2	5	0	
276	-34.5917	148.882444	676.433	Apple Box	Primary	70	7	1	6	1	4	0	
277	-34.5908	148.881769	672.3763	Apple Box	Primary	55	6	2	4	1	2	0	
279	-34.5949	148.880438	696.1381	Red Stringy Bark	secondary	70	8	0		1	6	0	
280	-34.5983	148.879129	703.9218	Blakley's Red Gum	Primary	70	10	0		1	5	0	
281	-34.5924	148.876419	685.8876	Red Stringy Bark	secondary	80	8	1	7	1	6	0	
285	-34.5948	148.878355	712.538	Stag	Primary	80	9	6	7	1	6	0	
286	-34.5931	148.877093	696.7122	Red Stringy Bark	secondary	70	9	2	7	2	6	0	
288	-34.5937	148.875077	686.9823	Red Stringy Bark	secondary	80	8	0		3	0	0	
293	-34.5965	148.874929	700.5881	Red Stringy Bark	secondary	60	8	0		1	5	0	
294	-34.5984	148.87536	701.5182	Red Stringy Bark	secondary	80	8	4	6 to 7	3	0	0	
296	-34.5933	148.880592	697.053	Red Stringy Bark	secondary	120	8	0		2	3	0	
297	-34.5882	148.879734	671.6132	Red Stringy Bark	secondary	80	9	1	4	2	5	0	
299	-34.5873	148.877368	654.9125	Red Stringy Bark	secondary	90	10	2	4	2	0	0	
300	-34.5905	148.870356	685.2423	Stag	Primary	70	8	3	4 to 7	1	5	0	
301	-34.591	148.868524	698.7548	Red Stringy Bark	secondary	90	9	2	4	2	5	0	
303	-34.5889	148.861495	745.1891	Stag	Primary	60	6	2	4	1	2	0	
306	-34.5515	148.872047	643.61	Stag	Primary	75	9	4	6 to 7	0	0	0	0
307	-34.5522	148.870151	658.8	Inland Scribbly Gum	other	70	9	1	3	3	0	0	0
308	-34.5649	148.866485	630.27	Inland Scribbly Gum	other	75	12	2	9	1	8	1	8

309	-34.5663	148.86735	656.22	Grey Box	Primary	120	9	2	2 to 4	1	0	0	0
310	-34.5664	148.867883	673.22	Grey Box	Primary	140	10	6	4 to 7	0	0	0	0
311	-34.5639	148.866898	629.75	Stag	Primary	0	6	0	0	1	5	1	5.5
312	-34.565	148.867932	654.67	Stag	Primary	65	0	0	0	3	6	0	0
313	-34.5655	148.868069	662.44	Red Stringy Bark	secondary	50	7	0	0	3	0	0	0
314	-34.5646	148.868625	661.43	Red Stringy Bark	secondary	90	10	0	0	4	0	2	8
315	-34.5638	148.869999	652.84	Stag	Primary	70	9	1	5 to 7	1	0	0	0
316	-34.562	148.875154	590.53	Red Stringy Bark	secondary	90	0	0	0	4	0	0	0
317	-34.5642	148.875541	588.97	Stag	Primary	100	10	1	7	1	7	0	0
318	-34.6015	148.878958	714.13	Stag	Primary	60	7	3	4 to 7	0	0	0	0
319	-34.602	148.880798	736.32	Stag	Primary	60	9	5	8	0	0	0	0
320	-34.6029	148.880908	742.36	Stag	Primary	70	8	3	2 to 6	2	0	0	0
321	-34.604	148.881602	755.69	Stag	Primary	80	7	1	5	1	7	1	2
322	-34.604	148.880421	745.23	Yellow Box	Primary	90	7	2	2	0	0	0	0
323	-34.6034	148.879222	731.48	Red Stringy Bark	secondary	100	7	1	4.5	0	0	0	0
324	-34.6042	148.879181	737.08	Red Stringy Bark	secondary	60	7	3	3.5 to 6	0	0	0	0
325	-34.6048	148.881544	756.58	Stag	Primary	70	7	2	6 to 7	2	0	0	0
326	-34.6063	148.882071	741.43	Stag	Primary	60	8	1	5	1	0	0	0
327	-34.6072	148.881986	737.31	Red Stringy Bark	secondary	50	8	1	7	2	7	0	0
328	-34.6076	148.882171	735.34	Stag	Primary	65	9	2	8	1	5	0	0
329	-34.6062	148.878323	722.11	Stag	Primary	55	7	0	0	1	0	1	6
330	-34.6065	148.880081	737.84	Stag	Primary	55	7	1	6	1	6	0	0
331	-34.6043	148.879331	738.98	Red Stringy Bark	secondary	60	8	2	4 to 7	0	0	0	0
332	-34.6052	148.877372	720	Stag	Primary	55	0	1	6	1	0	1	5
333	-34.6052	148.876929	714.39	Stag	Primary	120	8	8	5 to 8	0	0	0	0
334	-34.6073	148.874653	708.1	Red Stringy Bark	secondary	70	8	1	7	1	7	0	0
335	-34.6053	148.868514	709.65	Stag	Primary	70	6	0	0	1	0	2	5 to 6
336	-34.5988	148.872058	707.31	Red Stringy Bark	secondary	110	8	0	0	0	0	2	3 to 6
337	-34.5963	148.871632	721.4	Red Stringy Bark	secondary	65	7	0	0	1	4	0	0
338	-34.5963	148.872595	705.31	Red Stringy Bark	secondary	100	8	0	0	1	7	1	5
339	-34.5979	148.87331	696.15	Blakley's Red Gum	Primary	90	13	1	6	0	0	0	0
340	-34.584	148.868242	649.76	Yellow Box	Primary	110	15	0	0	2	7	1	4
341	-34.5814	148.868347	646.64	Red Stringy Bark	secondary	70	6	2	4	3	4	0	0
342	-34.5779	148.866431	654.03	Stag	Primary	65	12	2	11	1	9	2	6 to 7
343	-34.5783	148.867243	655.00	Red Stringy Bark	secondary	70	8	0	0	2	0	0	0
344	-34.5775	148.86717	659.73	Red Stringy Bark	secondary	70	10	2	5	1	5	0	0
345	-34.5773	148.866232	650.05	Stag	Primary	80	12	2	8 to 10	1	7	3	5 to 7
346	-34.5764	148.866216	649.31	Red Stringy Bark	secondary	55	8	0	0	0	0	1	6
347	-34.5764	148.866289	653.34	Red Stringy Bark	secondary	65	8	0	0	1	5	1	6
348	-34.5748	148.866489	677.88	Eucalyptus sp.		80	10	0	0	2	0	0	0
349	-34.574	148.865684	673.48	Stag	Primary	55	8	4	6 to 7	1	4	0	0
350	-34.5741	148.864582	650.82	Red Stringy Bark	secondary	55	6	2	4	3	0	0	0
351	-34.5695	148.859539	627.85	Red Stringy Bark	secondary	55	9	0	0	2	0	1	5
352	-34.5679	148.859538	624.50	Yellow Box	Primary	65	13	0	0	0	0	1	8
353	-34.5672	148.859578	618.60	Yellow Box	Primary	110	11	0	0	2	6	2	6
354	-34.5658	148.860131	612.11	Inland Scribbly Gum	other	70	12	0	0	1	5	1	9
355	-34.5657	148.860078	610.21	Inland Scribbly Gum	other	55	10	0	0	0	0	2	4 to 5
356	-34.5674	148.863338	612.85	Yellow Box	Primary	75	11	0	0	0	0	1	6
357	-34.6077	148.886702	701.60	Red Stringy Bark	secondary	70	8	7	3 to 7	0	0	0	0
358	-34.6396	148.867146	733.37	Stag	Primary	60	5	0	0	1	0	0	0
359	-34.6388	148.869635	723.47	Grey Box	Primary	55	9	2	5 to 7	2	0	1	9
360	-34.6384	148.869772	714.10	Stag	Primary	60	4	2	3 to 4	3	0	0	0
361	-34.638	148.87053	703.90	Stag	Primary	80	5	2	2 to 4	4	0	3	3 to 5
362	-34.6377	148.869113	703.99	Inland Scribbly Gum	other	60	6	2	5	2	5	0	0
363	-34.6379	148.863666	705.91	Inland Scribbly Gum	other	100	11	0	0	1	5	1	6
364	-34.6387	148.864831	706.32	Stag	Primary	60	7	0	0	1	4	0	0
365	-34.639	148.864077	702.23	Stag	Primary	50	8	3	7	2	4	0	0
366	-34.6383	148.864175	707.74	Stag	Primary	50	5	2	4 to 5	0	0	1	4
367	-34.6392	148.862498	685.72	Red Stringy Bark	secondary	65	9	2	5 to 6	1	5	0	0
368	-34.6431	148.863475	691.62	Stag	Primary	50	8	1	3	1	7	0	0
369	-34.6416	148.864559	697.94	Red Stringy Bark	secondary	110	10	1	7	0	0	0	0
370	-34.6414	148.865458	709.64	Red Stringy Bark	secondary	80	7	1	4	0	0	0	0
371	-34.6456	148.864846	713.75	Stag	Primary	80	5	0	0	1	3	1	2
372	-34.6442	148.865787	706.33	Red Stringy Bark	secondary	0	6	0	0	1	3	1	1 to 3
373	-34.6449	148.865446	709.39	Yellow Box	Primary	90	9	1	6	1	4	1	5
374	-34.6462	148.86522	715.49	Red Stringy Bark	secondary	90	8	3	4 to 7	1	5	0	0
375	-34.6484	148.863627	695.30	Red Stringy Bark	secondary	70	8	2	2 to 4	1	4	0	0
376	-34.6485	148.866192	676.31	Red Stringy Bark	secondary	70	7	1	5	0	0	0	0
377	-34.6429	148.865954	717.39	Red Stringy Bark	secondary	60	7	2	3 to 4	0	0	0	0
378	-34.6481	148.868592	673.31	Red Stringy Bark	secondary	90	7	1	3 to 4	2	5	0	0
379	-34.6478	148.869959	663.03	Red Stringy Bark	secondary	100	11	6	4 to 10	0	0	0	0
380	-34.6471	148.872065	674.72	Stag	Primary	90	8	2	6 to 8	0	0	0	0
381	-34.6214	148.881367	696.44	Yellow Box	Primary	90	10	0	0	2	8	0	0
382	-34.621	148.882158	701.43	Red Stringy Bark	secondary	60	8	0	0	0	0	1	6
383	-34.619	148.880564	707.10	Inland Scribbly Gum	other	100	8	0	0	1	5	3	4 to 7
384	-34.6184	148.88084	706.60	Yellow Box	Primary	110	11	0	0	0	0	4	5 to 7
385	-34.6179	148.881125	707.93	Stag	Primary	50	8	2	6 to 7	0	0	1	4
387	-34.6167	148.881531	713.17	Yellow Box	Primary	65	8	3	7	1	4	0	0
388	-34.6168	148.884798	717.27	Stag	Primary	50	4.5	0	0	0	0	1	4
389	-34.6138	148.884012	721.98	Red Stringy Bark	secondary	60	8	1	4-4.5	0	0	0	0
390	-34.6128	148.884089	725.18	Red Stringy Bark	secondary	60	6.5	2	3	0	0	0	0
391	-34.6081	148.88634	721.10	Stag	Primary	60	7	3	4 to 6	2	0	0	0

392	-34.6103	148.87836	747.09	Blakley's Red Gum	Primary	70	8	0	0	1	5	0	0
393	-34.6128	148.87779	731.56	Stag	Primary	60	9	0	0	0	0	2	3 to 4
394	-34.6136	148.877538	726.21	Inland Scribbly Gum	other	80	8.5	0	0	1	0	1	5
395	-34.6141	148.877533	726.59	Blakley's Red Gum	Primary	100	9	3	3 to 6	4	0	0	0
396	-34.6142	148.87721	722.89	Stag	Primary	65	7	0	0	0	0	1	5
397	-34.609	148.877199	732.86	Stag	Primary	70	9	3	8 to 9	2	0	0	0
398	-34.6115	148.876816	725.45	Red Stringy Bark	secondary	75	9	3	6 to 8	0	0	0	0
399	-34.6086	148.866828	701.64	Red Stringy Bark	secondary	80	10	1	6	0	0	1	5
400	-34.608	148.864443	701.07	Stag	Primary	90	9	3	5.5-8	1	8	0	0
401	-34.6138	148.865417	678.95	Stag	Primary	95	8	1	4	0	0	1	4.5
402	-34.6138	148.866696	683.02	Red Stringy Bark	secondary	80	6	2	4 to 5	2	0	0	0
403	-34.6107	148.865334	697.97	Red Stringy Bark	secondary	65	8	0	0	0	0	1	4
404	-34.616	148.867448	694.95	Inland Scribbly Gum	other	95	9	0	0	1	3	1	0 to 2
405	-34.6157	148.866766	693.66	Inland Scribbly Gum	other	50	6	0	0	0	0	3	2 to 5
406	-34.6157	148.866127	688.84	Inland Scribbly Gum	other	100	8	0	0	1	3	2	4
407	-34.6159	148.869015	700.41	Red Stringy Bark	secondary	70	7	1	5	1	6	0	0
408	-34.6159	148.87094	707.68	Stag	Primary	70	7	0	0	0	0	1	4.5
409	-34.6165	148.872552	704.24	Stag	Primary	50	5	2	5	3	0	1	4
410a	-34.6162	148.873966	699.82	Blakley's Red Gum	Primary	60	7	0	0	2	0	2	3 to 4
410b	-34.6162	148.873966	699.82	Blakley's Red Gum	Primary	50	8.5	0	0	0	0	1	2.5
411	-34.617	148.872799	706.61	Yellow Box	Primary	75	10	0	0	0	0	2	3 to 6
412	-34.6167	148.873643	702.59	Yellow Box	Primary	80	7	0	0	0	0	1	2
413	-34.6163	148.87583	704.37	Yellow Box	Primary	85	10	0	0	2	0	0	0
414	-34.6166	148.87568	704.52	Yellow Box	Primary	95	9	1	6	2	0	0	0
415a	-34.6172	148.873866	704.07	Red Stringy Bark	secondary	90	7	3	5 to 6	0	0	0	0
415b	-34.6172	148.873866	704.07	Stag	Primary	70	9	3	4 to 5	0	0	0	0
416	-34.6197	148.86618	683.47	Yellow Box	Primary	80	8	0	0	1	6	0	0
417	-34.6206	148.866265	682.98	Yellow Box	Primary	100	15	0	0	1	5	4	2 to 12
418	-34.621	148.868257	697.61	Red Stringy Bark	secondary	70	11	0	0	2	7	0	0
419	-34.6224	148.866941	686.62	Yellow Box	Primary	65	11	2	6	1	6	0	0
420	-34.6239	148.866972	687.12	Stag	Primary	70	8	1	6	2	0	0	0
421	-34.6275	148.865486	681.61	Red Stringy Bark	secondary	95	8	3	5 to 7	0	0	0	0
422	-34.6288	148.865285	679.69	Red Stringy Bark	secondary	80	9	0	0	0	0	1	4.5
423	-34.6241	148.868141	698.32	Red Stringy Bark	secondary	80	6	0	0	1	5	1	4
424	-34.6221	148.86834	702.76	Stag	Primary	60	5.5	1	3	1	4	1	3
425	-34.6226	148.869793	729.14	Red Stringy Bark	secondary	60	10	1	5	1	0	0	0
426	-34.6227	148.870349	730.82	Grey Box	Primary	70	12	2	5	1	2	0	0
427	-34.6182	148.87636	707.47	Blakley's Red Gum	Primary	80	7	0	0	2	5	0	0
428	-34.6203	148.877239	703.65	Yellow Box	Primary	100	9	1	6	0	0	1	5
429	-34.6176	148.875404	709.08	Yellow Box	Primary	80	11	0	0	2	0	0	0
430	-34.6176	148.874331	710.55	Stag	Primary	60	7	0	0	1	7	1	6
431	-34.6176	148.873644	711.77	Yellow Box	Primary	65	1	0	0	2	0	1	6
432	-34.6182	148.87325	718.34	Yellow Box	Primary	90	10	2	7	1	5	1	6
433	-34.6183	148.873657	718.46	Yellow Box	Primary	80	9	4	6 to 7	1	6	1	7
434	-34.618	148.874253	713.89	Yellow Box	Primary	60	10	2	4 to 6	1	5	0	0
435	-34.6182	148.875197	710.92	Yellow Box	Primary	100	8	0	0	2	4	0	0
436	-34.6187	148.874782	713.84	Yellow Box	Primary	50	10	1	5	0	0	1	5
437	-34.6197	148.874165	724.55	Yellow Box	Primary	70	9	0	0	1	6	0	0
438a	-34.6192	148.8764	705.26	Blakley's Red Gum	Primary	55	7.5	0	0	0	0	1	4
438b	-34.6192	148.8764	705.26	Red Stringy Bark	secondary	55	7.5	0	0	0	0	1	4
440	-34.6206	148.875777	707.93	Eucalyptus sp.		70	8	2	5.6	1	4	0	0
441	-34.6215	148.874798	713.63	Stag	Primary	75	7	0	0	3	0	0	0
442	-34.6221	148.87536	704.40	Inland Scribbly Gum	other	65	8	0	0	1	4	0	0
443	-34.6222	148.876075	700.89	Blakley's Red Gum	Primary	50	8	0	0	0	0	1	5.5
444	-34.6233	148.875485	695.27	Blakley's Red Gum	Primary	95	8	0	0	0	0	5	5 to 7
445	-34.6232	148.875216	696.79	Blakley's Red Gum	Primary	55	7	1	4.5	1	5	1	4.5
446	-34.6228	148.874186	706.10	Blakley's Red Gum	Primary	60	9	1	4	0	0	3	3 to 5
447	-34.6235	148.875552	694.13	Blakley's Red Gum	Primary	110	9	2	2 to 3	1	3	3	2 to 6
448	-34.6237	148.875151	694.96	Blakley's Red Gum	Primary	60	0	2	7	2	3	0	0
449	-34.6236	148.874464	698.53	Blakley's Red Gum	Primary	70	9	0	0	0	0	2	2 to 5
450	-34.624	148.871988	706.91	Blakley's Red Gum	Primary	50	7	0	0	0	0	1	5
451	-34.6251	148.872516	695.43	Blakley's Red Gum	Primary	70	8	0	0	1	4	1	5
452	-34.6255	148.873104	690.24	Blakley's Red Gum	Primary	75	10	0	0	2	0	0	0
453	-34.626	148.872246	688.81	Yellow Box	Primary	90	0	0	0	1	4	0	0
454	-34.6264	148.870754	686.48	Yellow Box	Primary	100	10	0	0	0	0	0	0
455	-34.626	148.87007	687.80	Blakley's Red Gum	Primary	70	9	0	0	0	0	3	3 to 7
456	-34.6258	148.868329	683.18	Blakley's Red Gum	Primary	80	9	0	0	1	6	0	0
457	-34.6265	148.869005	681.55	Blakley's Red Gum	Primary	90	10	0	0	0	0	1	5
458	-34.6269	148.86939	680.80	Blakley's Red Gum	Primary	50	9	1	4.5	0	0	1	3.5
459	-34.6274	148.868931	679.57	Blakley's Red Gum	Primary	60	9	0	0	2	0	0	0
460	-34.6282	148.868162	681.74	Blakley's Red Gum	Primary	60	7	0	0	2	6	1	3
461	-34.6287	148.868538	677.41	Blakley's Red Gum	Primary	70	7	0	0	2	5	0	0
463	-34.6185	148.801784	594.92	Yellow Box	Primary	65	9	0		2	0	2	4
464	-34.6148	148.802945	583.03	Blakley's Red Gum	Primary	70	7	0		1	2	0	
465	-34.614	148.803143	582.22	Blakley's Red Gum	Primary	90	10	0		1	7	2	6
466	-34.6138	148.803139	583.17	Yellow Box	Primary	65	9	0		1	7	1	5
467	-34.6129	148.803304	582.90	Blakley's Red Gum	Primary	0	8	0		1	5	0	
468	-34.6127	148.803411	582.63	Blakley's Red Gum	Primary	50	7	0		1	45	0	
469	-34.6118	148.803558	582.64	Stag	Primary	60	7	3	4	1	4	0	
470	-34.6108	148.803734	589.36	Blakley's Red Gum	Primary	70	9	2	4 to 6	3	0	0	
471	-34.6089	148.804115	590.26	Stag	Primary	60	7	3	4 to 6	1	4	0	
473	-34.6076	148.804396	587.57	Apple Box	Primary	60	8	0		2	0	1	4

474	-34.6071	148.80452	593.11	Blakley's Red Gum	Primary	70	8	1	3	1	5	0	
475	-34.6065	148.804571	596.83	Yellow Box	Primary	1	8	2	6	1	3	0	
476	-34.6054	148.804856	597.36	Yellow Box	Primary	1	10	2	7 to 8	5	0	0	
477	-34.6049	148.804908	598.04	Stag	Primary	50	5	1	4	2	0	2	3 to 4
478	-34.6033	148.805271	589.15	Blakley's Red Gum	Primary	1	7	0		2	0	0	
479	-34.6021	148.805518	586.00	Blakley's Red Gum	Primary	70	8	3	3	3	0	0	
480	-34.594	148.80709	577.64	Yellow Box	Primary	40	5	0		1	3	0	
481	-34.5917	148.807623	578.68	Stag	Primary	60	4	0		2	3	2	3 to 4
482	-34.5913	148.807649	578.67	Blakley's Red Gum	Primary	35	8	0		1	4	0	
483	-34.5913	148.807716	578.69	Blakley's Red Gum	Primary	90	6	0		2	0	2	3 to 5
484	-34.5807	148.812178	592.25	Yellow Box	Primary	2	2	0		1	4	2	7 to 8
486	-34.5793	148.812709	594.50	Blakley's Red Gum	Primary	65	9	1	5	2	0	0	
487	-34.579	148.81282	597.61	Apple Box	Primary	80	9	0		3	5	1	5
488	-34.5705	148.822571	611.28	Apple Box	Primary	150	9	0		1	7	0	
489	-34.5701	148.822812	609.05	Blakley's Red Gum	Primary	55	10	1	4	2	0	0	
491	-34.5685	148.82358	613.44	Blakley's Red Gum	Primary	40	8	0		1	1	0	
493	-34.5662	148.824319	619.66	Apple Box	Primary	70	8	0		1	4	0	
494	-34.5658	148.824472	621.29	Stag	Primary	70	4	2	2 to 4	1	3	1	3
495	-34.565	148.824834	624.01	Blakley's Red Gum	Primary	50	8	0		1	6	0	
496	-34.5627	148.825955	637.80	Stag	Primary	70	7	2	4 to 5	2	5	0	
500	-34.5568	148.83105	608.13	Blakley's Red Gum	Primary	50	7	0		1	4	1	3
501	-34.5491	148.839068	573.95	Blakley's Red Gum	Primary	70	9	2	7	1	3	1	5
502	-34.548	148.839721	568.26	Blakley's Red Gum	Primary	90	10	0		1	6	0	

Appendix 6

Bango Wind Farm

Economic Impact Assessment

ESSENTIAL ECONOMICS

Bango Wind Farm

Economic Impact Assessment

FINAL

Prepared for

CWP Renewables on behalf of *Bango Wind Farm Pty Ltd*

by

Essential Economics Pty Ltd

November 2017

Authorship

Report stage	Author	Date	Review	Date
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Contents

EXECUTIVE SUMMARY

CWP Renewables on behalf of *Bango Wind Farm Pty Ltd* have commissioned Essential Economics Pty Ltd to prepare an Economic Impact Assessment (EIA) for the proposed Bango Wind Farm development to be located on a 5,200ha site between Boroowa and Yass in southern NSW.

The capacity of the turbines to be installed is as yet undetermined, but for the purpose of this report we have assumed the capacity of the installed wind farm will be 150 Mega Watts (MW). The installed capacity could be more or less than 150MW, depending on the number and capacity of turbines installed. The Bango Wind Farm will comprise up to 75 turbines with tip height no greater than 200 metres.

The wind farm will be located across 10 farming properties and, subject to planning approval and financing, it is expected the facility will be operational by 2020.

The main findings of this EIA are summarised as follows.

<u>Regional Economic Context</u>

1 The Study Area has a resident population of around 35,470 persons in 2016, which is projected to increase to 42,030 persons by 2031.

2 The relatively low unemployment rate (4.0% compared to 5.0% for NSW) in the Study Area (ie, a relatively small pool of unemployed persons from which to draw) may have implications in terms of labour supply for the construction phase of the project, particularly with regard to seasonal labour requirements (harvesting, tourism etc) and concurrent infrastructure projects in the region.

3 The Study Area's occupational, industry and business structures indicates that a good base exists to service the needs of the project, including the needs of approximately 4,730 construction-related workers (based on occupation) and 860 construction and transport businesses.

4 The regional centre of Yass will underpin most project needs in view of the centre's reasonable supply of accommodation (150 rooms, plus cabins, power sites, B&Bs and private accommodation), trade supplies and transport services, retail services, entertainment and so on. However, the towns of Boorowa and Young would also be expected to provide project support services, including lower-cost commercial accommodation options and convenience services.

<u>Economic Impact Assessment</u>

5 The Bango Wind Farm project will involve $320 million in investment during the construction phase and will support 150 direct and 240 indirect FTE positions over the construction period. Once operational, 10 direct and 30 indirect FTE jobs will be supported by the facility.

6 Allowing for the project to be carefully managed around the region's peak times for harvesting, tourism etc and having regard for potentially concurrent infrastructure projects, accessing adequate labour supply should not present a major issue for the project. The peak local employment requirement (60 FTE positions) represents less than 2% of workers occupied in construction-related activities in the Study Region.

7 Competing projects may include the proposed Rye Park Wind Farm and a number of smaller local infrastructure projects funded through the NSW Stronger Communities Fund.

8 The Bango Wind Farm project will provide significant participation opportunities for businesses and the labour force located in the Study Area, having regard for the good match of skills and resources available. In this regard, organisations such as ICN might be involved in ensuring maximum local inputs are secured and this would be in addition to the proponent's own local sourcing initiatives.

9 The 'external' project labour requirement would be expected to generate an accommodation requirement for 90 project workers at the peak of the project. This represents only 20-25% of total commercial accommodation rooms available in the Study Area and would provide a boost to local accommodation operators, noting that room occupancy rates are around 60% across the region. Other accommodation providers such as caravan parks, B&Bs and private households will offer additional supply and may also benefit from the project.

10 Non-local construction workers living in the Study Area would be expected to inject approximately $4.1 million in additional spending to the regional economy over the construction phase, supporting around 20 jobs in the service sector.

11 Agricultural land use would only be marginally affected by the project, with existing farm activities continuing as normal.

12 Ongoing economic stimulus associated with the operation of the wind farm through the Community Fund, financial returns to host landowners, local wage spending and net rates returns to the two Councils is estimated at approximately $77 million over 25 years (adjusted for CPI @ 2.5%).

13 Additional community benefits could include construction of community legacy projects and potential for the community to directly invest in the wind farm. Host landowner properties will also benefit from the project through the construction of new internal roads which reduce bushfire risks and decrease the likelihood of loss of buildings, machinery, livestock, fencing etc.

14 The project has the capacity to supply sufficient clean energy to power approximately 90,000 homes and, in the process, to reduce $C0_2$ emissions by 0.5 million tonnes per year.

15 The project could potentially support small-scale tourism initiatives, such as viewing opportunities for visitors to the region. In the longer-term, potential exists for Bango Wind Farm to form part of organised tours to renewable facilities in the broader region as part of the SERREE Renewable Energy Trail.

Table A provides a summary of key economic benefits arising from the construction and operation of the Bango Wind Farm. These benefits apply to a facility with 150 MW installed capacity, with benefits to grow proportionally to the actual installed capacity (noting that capacity of the wind farm will depend on the number and capacity of turbines instated, which may be more or less than 150 MW).

Table A: Bango Wind Farm (150 MW) – Key Economic Benefits

Construction Phase	
Item	**Value**
Investment	$320 million (2017 dollars)
Employment (direct and indirect)	390 FTE
Local wage spending stimulus	$4.1 million (2017 dollars)
Operational Phase	
Employment (direct and indirect)	40 FTE (ongoing)
Local economic stimulus (host landowner and new wage spending)	$64.9 million (over 25 years)
Net rates returns to both Councils	$4.8 million (over 25 years)
Community Fund	$7.2 million (over 25 years)

Sources: CWP Renewables; Essential Economics Pty Ltd, ABS Input-Output Tables; ABS Average Weekly Earnings and ABS Household Expenditure Survey.
Figures rounded.

INTRODUCTION

Background

CWP Renewables on behalf of *Bango Wind Farm Pty Ltd* have commissioned Essential Economics Pty Ltd to prepare an Economic Impact Assessment for the proposed Bango Wind Farm development to be located near the townships of Boroowa and Rye Park, north of Yass in southern NSW.

The capacity of the turbines to be installed is as yet undetermined, but for the purpose of this report we have assumed the capacity of the installed wind farm will be 150 Mega Watts (MW). The installed capacity could be more or less than 150MW, depending on the number and capacity of turbines instated. The Bango Wind Farm will comprise up to 75 turbines with tip height no greater than 200 metres.

The Bango Wind Farm will be developed in an area of 5,200ha and across 10 individual farming landholdings. Subject to planning approval and financing, it is anticipated the wind farm could commence construction by 2018 and be operational by 2020.

Objectives

The objectives of this study are:

- To highlight likely local and regional economic benefits arising from the project
- To identify potential impacts associated with the project

This Report

This report contains the following chapters:

Chapter 1: **Project Context**
Presents a description of site location, project components and staging, and definition of the project Study Area.

Chapter 2: **Regional Economic Profile**
Presents an overview of population and demography, labour force, occupational structure, industry structure, business structure, and township services, including an audit of commercial accommodation capacity.

Chapter 3: **Economic Impact Assessment of Proposed Project**
Presents an assessment of the economic impacts of the proposed development, including investment, employment, business participation, local wage stimulus, impact on accommodation, impact on agricultural activities, financial returns to landowners, Council and community benefits, environmental benefits, and potential tourism-related opportunities.

1 PROJECT CONTEXT

1.1 Site Location

The proposed Bango Wind Farm is located near the towns of Boorowa and Rye Park, north of Yass in NSW. The project area is bordered by the Lachlan Valley Way to the west, Wargeila Road to the east, Boorowa-Rye Park Road to the north, and Moorbys Lane to the south.

The subject site is approximately 5,200ha in size covering 10 landholdings, with this land currently used for farming purposes (sheep grazing) under the Farming Zone (FZ). It is estimated that around 2% of the site will be utilised for permanent wind farm infrastructure.

A significant number of studies have been completed since 2009 to assess the feasibility of developing and operating a wind farm in this location, including:

- Wind monitoring assessments
- Electrical connection assessment
- Planning studies
- Environmental noise assessment
- Ecology assessment
- Socio-economic assessment
- Geology and civil engineering assessment
- Landscape and visual impact assessment
- Traffic and transport assessment
- Aviation assessment
- Communications assessment
- Fire and bushfire assessment
- Water assessment
- General environmental assessment.

An Environmental Impact Statement has been prepared for the project which has been publically exhibited, with the proponent responding to submissions received. The NSW Department of Planning and Environment are considering the Planning Application and will make a recommendation to the Planning Assessment Commission (PAC). The PAC will then determine whether the project should be granted consent. This decision could be made by the end of 2017, but more likely in early 2018.

1.2 Study Area

The Study Area for the project is defined as the Local Government Areas (LGAs) of Hilltops Council and Yass Valley Council, where the turbines are to be located and most economic benefits are likely to accrue. This Study Area is illustrated in Figure 1.2.

Benefits are also likely to be generated for the broader region, including the neighbouring Local Government Areas (LGAs) of Cowra, Goulburn and Wagga Wagga, as well as Canberra/ACT.

Figure 1.1: Bango Wind Farm Study Area

Source: Essential Economics

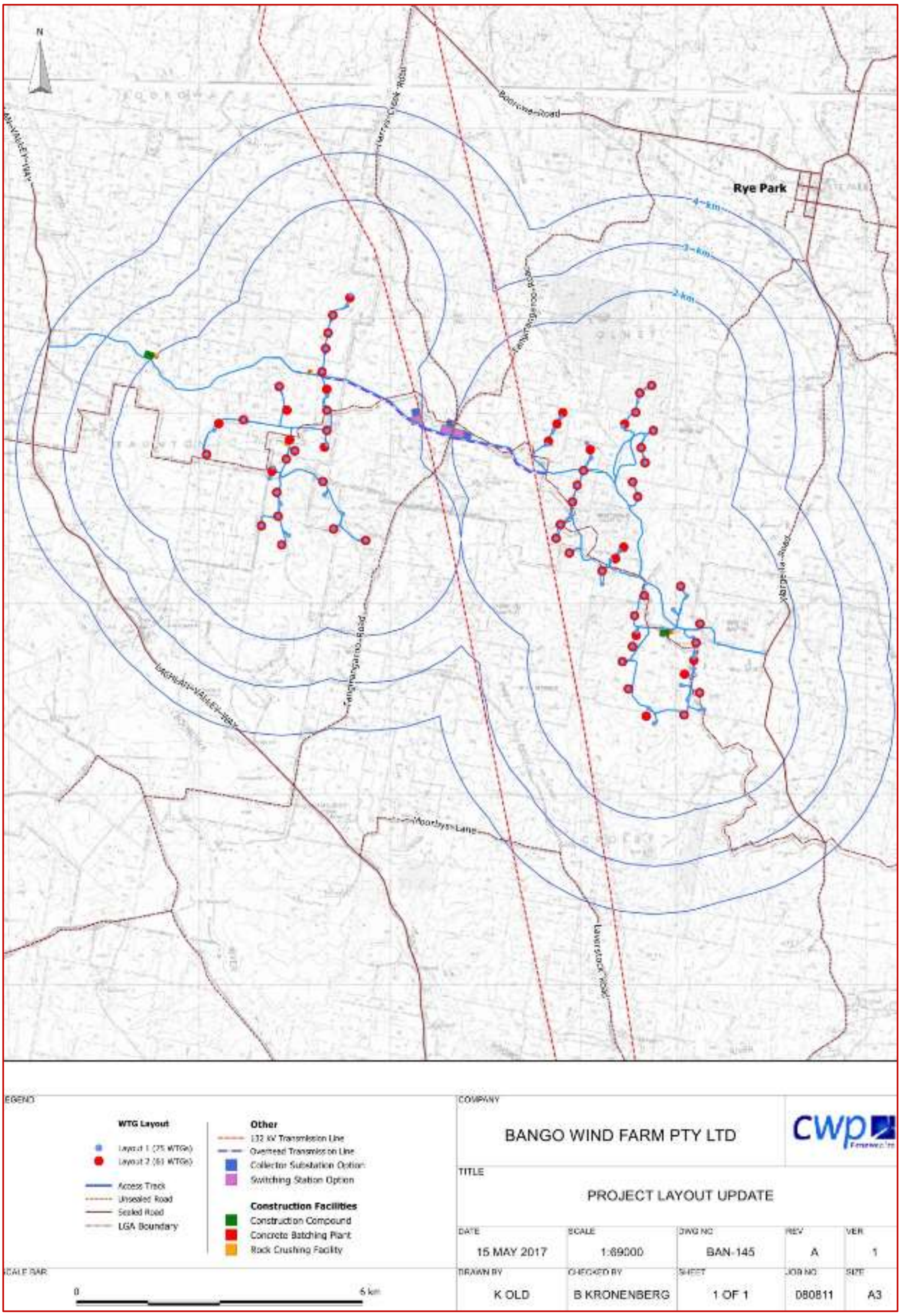
1.3 Project Description

Plans for the project include the following:

- Total installed capacity of 150 MW (assumed for the purposes of this report)
- 75 turbines, with tip heights of up to 200m
- Estimated annual output of 613,200 MWhr
- Other permanent project infrastructure will include:
  - Access tracks and hardstand areas suitable for cranes
  - Overhead and underground electrical cabling
  - Onsite substation
  - Wind monitoring masts
  - Storage compounds
  - Operational buildings
- During construction temporary infrastructure will include:
  - Temporary concrete batch plants
  - Rock crushing compounds
  - Temporary site office buildings and facilities
- Turbines to be spread across land held by 10 host farms
- Construction start date estimated 2018 (subject to planning approval and financing)
- Construction period is estimated at 12-28 months
- Wind Farm might be fully operational by 2020
- Operational lifespan estimated at 25 years.

Note, the parameters outlined above may change subject to planning approval guidelines, while project financing may also influence the final project plan.

Figure 1.2: Bango Wind Farm Preliminary Site Layout



Source: CWP Renewables

1.4 Policy Context

Federal and State policy are important factors in influencing demand and investment in the renewable energy sector, as noted below.

Paris Climate Accord

The Paris Accord is a comprehensive international climate agreement to which Australia is a party. The Accord provides a framework for participating nations to set themselves nationally determined contributions (NDCs), beginning in 2020, with review at five-year intervals. The agreement sets out a global consensus to limit temperature increases to below two degrees Celsius when compared to pre-industrial levels; an additional goal is to maintain this increase at less than one and a half degrees Celsius. NDCs do not have any set lower limit but are required to progress over time (beginning with the intended NDC pledged during the Paris conference), and to be 'ambitious'. Australia's current targets are a reduction of emissions by five percent from 2000 levels by 2020, and by 26-28 percent below 2005 levels by 2030.

Federal Renewable Energy Target

The Renewable Energy Target is an Australian Government scheme designed to reduce emissions of greenhouse gases in the electricity sector and to encourage the additional generation of electricity from sustainable and renewable sources.

The Renewable Energy Target (RET) works by allowing both large-scale power stations and the owners of small-scale systems to create certificates for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers who sell the electricity to householders and businesses. These electricity retailers also have legal obligations under the RET to surrender certificates to the Clean Energy Regulator, in percentages set by regulation each year. This creates a market which provides financial incentives to both large-scale renewable energy power stations and to the owners of small-scale renewable energy systems.

In June 2015, the Australian Parliament passed the Renewable Energy (Electricity) Amendment Bill 2015. As part of the amendment bill, the large-scale RET was reduced from 41,000 GWh to 33,000 GWh in 2020, with interim and post-2020 targets adjusted accordingly.

Finkel Report

The Independent Review into the Future Security of the National Electricity Market, released in June 2017, is a report commissioned by the Federal Government in order to establish a framework for the development the Australian energy sector. Also known as the Finkel Report, it recommends the use of a Clean Energy Target (CET) scheme to stimulate renewable energy production throughout the National Electricity Market (NEM). This would likely replace the present federal RET scheme due to expire in 2020, and would result in a more technology-neutral allocation of renewable energy generation certificates; any generator producing energy at a level of pollution below a benchmark rate would be eligible as opposed to only specific technologies as with the RET scheme. The report modelled outcomes utilising this type of scheme to achieve the trajectory committed to by the Federal Government by 2030 and determined that renewable energy would constitute approximately 42 percent of the NEM at this time. Other policies including an Emissions Intensity Scheme and lifetime limits on coal-powered generation were considered, with the report deeming CET the most effective based on their model.

The Federal Government recently signalled its response to the Finkel Report, although the response does not include a CET. The Federal Government’s proposal is based on a National Energy Guarantee scheme involving the following main components:

- No subsidies for renewable or any other kind of energy generators
- Power companies will be forced to guarantee on-demand electricity from coal, gas, hydro, or batteries that store renewable energy
- Power companies will also be forced to keep carbon dioxide emissions below a certain level through the purchase of low emissions generated energy.

Note, implementation of the proposed National Energy Guarantee scheme will likely require Federal parliamentary legislation and will need the agreement of States and Territories.

ACT Renewable Energy Target

The Australian Capital Territory in 2016 legislated a renewable energy target of sourcing 100 percent of the territory’s electricity from renewable sources, either from within the ACT or the NEM. This is to be accomplished through an innovative reverse auction scheme, where renewable energy providers compete to supply renewable energy to the ACT. Their bids will be assessed based on price, risk, engagement with the community, and local investment benefits. These auctions are intended to be targeted towards projects located in the south-eastern region of Australia. Once an auction is won, the energy producer will essentially have their supply price guaranteed for a period of 20 years, regardless of the market price of electricity. Any renewable energy certificates associated with energy generated for the scheme will be transferred to the ACT in an effort to encourage further renewable generation outside the scheme.

NSW Renewable Energy Action Plan 2013

The NSW Renewable Energy Action Plan (2013) provides a framework to enable the State to meet the RET target, through a range of 24 actions associated with:

- Attracting investment and projects
- Building community support
- Attracting and growing expertise in renewable energy technology.

While the NSW Government does not mandate a specific renewable energy target for the State (unlike Victoria which recently set a 40 per cent renewable energy target for the State by 2025), it does have an aspirational target of zero emissions by 2050.

The NSW Renewable Energy Action Plan Annual Report monitors implementation of the Plan and reports on progress to meeting the 2020 RET target. The 2016 Annual Report notes that 17 of the 24 actions have been implemented, with the further seven substantially progressed, and notes the percentage of renewable energy in the state's electricity mix has more than doubled over the past six years, underpinned by large-scale solar and wind farm projects.

1.5 Summary

1 CWP Renewables are proposing the construction of the 150 MW Bango Wind Farm near Boorowa, in southern NSW. The facility will be located across 10 properties and is likely to provide economic benefits to businesses and communities located in Hilltops Council and Yass Valley Council (ie project Study Area). The site has the potential to accommodate a much larger facility of approximately double the size of the wind farm currently proposed.

2 Subject to planning approval by the NSW Department of Planning and Environment, it is anticipated construction of the wind farm could start in 2018, and the facility may be operational by 2020.

3 In the past 18 months, federal and state governments have updated long-term renewable energy targets and this should provide greater investment certainly within the sector in the short-term (ie 2020). However, the National Energy Plan is currently being formulated by the Federal Government and at this stage it is unclear as to the eventual impact on the renewable energy sector, noting the proposed Clean Energy Target (Finkel Report) is unlikely to feature in the Plan.

4 To obtain planning approval for the project, the proponent has undertaken a comprehensive range of studies and investigations, including a publically-exhibited Environmental Impact Statement. The Department of Planning and Environment's recommendation to the Planning Assessment Commission (PAC) is expected in late 2017. The PAC process usually takes 2-3 months, at which time the State Government approvals process will be complete.

5 The following chapters identify the potential economic impacts arising for businesses and communities located in the Study Area, should the project proceed. These impacts are described and quantified for both the construction and operational phases of the project.

2 REGIONAL ECONOMIC PROFILE

2.1 Population and Demography

The population of the Study Area totalled approximately 35,470 persons as of June 2016, with Hilltops Council accounting for 53% (18,840 persons) and Yass Valley Council 47% (16,630 persons). As Table 2.1 shows, over the period 2016-2031 population levels in the Study Area are expected to expand by 1.1% per annum (pa), driven by population expansion in Yass Valley Council of 1.9% pa, while Hilltop population growth is projected to be more modest at 0.4% pa over this period.

Table 2.1: Population – Study Area, 2016-2031

Municipality	2016	2021	2031	Change 2013-31	AAGR 2013-31
Hilltops Council	18,840	19,110	19,860	1,020	0.4%
Yass Valley Council	16,630	18,440	22,170	5,540	1.9%
Study Area	**35,470**	**37,550**	**42,030**	**6,560**	**1.1%**

Source: Profile Id
Notes: AAGR = Annual Average Growth Rate
Figures rounded

2.2 Labour Force

As of June 2017 (latest available), the Study Area had an unemployment rate of 4.0%, which is significantly below the rate for New South Wales of 5.0%; in particular, unemployment in the Yass Valley Council area is notably low at just 2.2%.

As Table 2.2 shows, in March 2017 the Study Area had a labour force totalling approximately 17,295 persons, including approximately 700 persons who were unemployed.

Table 2.2: Labour Force – Study Area, 2017

Municipality	Employed	Unemployed	Total Labour Force	Unemployment Rate
Hilltops Council	7,945	505	8,450	6.0%
Yass Valley Council	8,650	195	8,845	2.2%
Total Study Area	**16,595**	**700**	**17,295**	**4.0%**
NSW	**25,245**	**199,800**	**4,016,400**	**5.0%**

Source: Department of Employment, Small Area Labour Markets – March Quarter 2017.
Note: Figures rounded to multiples of five.

2.3 Occupational Structure

The skills base of the Study Area is reflected in its occupational structure, as shown in Table 2.3.

ABS Census data for 2011 (latest available) shows 31% of Study Area workers (4,730 workers) were occupied in activities generally associated with the types of skills required for the construction of a wind farm (ie technicians and trades workers, machinery operators, drivers and labourers).

The Study Area's representation in these occupations is slightly higher than the State average of 28%, indicating a generally suitable occupational base for the proposed project.

Table 2.3: Occupational Structure – Study Area, 2011

Occupation	Hilltops Council		Yass Valley Council		Study Area		NSW
	No.	*Share*	*No.*	*Share*	*No.*	*Share*	*Share*
Managers	1,625	21.7%	1,505	19.4%	3,130	20.5%	13.3%
Professionals	950	12.7%	1,580	20.4%	2,525	16.6%	22.7%
Technicians and trades workers	**1,105**	**14.8%**	**1,065**	**13.7%**	**2,170**	**14.2%**	**13.2%**
Clerical and administrative workers	610	8.1%	715	9.2%	1,325	8.7%	9.5%
Community and personal service workers	795	10.6%	1,195	15.4%	1,990	13.0%	15.1%
Sales workers	720	9.6%	515	6.6%	1,230	8.1%	9.3%
Machinery operators and drivers	**455**	**6.1%**	**355**	**4.6%**	**810**	**5.3%**	**6.4%**
Labourers	**1,085**	**14.5%**	**665**	**8.6%**	**1,750**	**11.5%**	**8.7%**
Not stated	140	1.9%	175	2.3%	315	2.1%	1.8%
Total	**7,490**	**100%**	**7,760**	**100%**	**15,250**	**100%**	**100%**

Source: Profile Id

Note: Census employment data for 2016 is pending release
Figures rounded to multiples of five.

2.4 Industry Structure

ABS Industry structure data for 2011 (latest available) shows, the Study Area has 1,290 workers directly employed in the construction sector and a further 525 workers employed in transport, postal and warehousing sector. In total, these two sectors employ 1,815 workers or approximately 12% of the labour force (the same proportion as for New South Wales).

As with occupational structure, this industry structure indicates the Study Area provides a good labour force base upon which to service the Bango Wind Farm project.

Industry Structure data is shown in Table 2.4.

Table 2.4: Industry Structure – Study Area, 2011

Industry Structure	Hilltops Council		Yass Valley Council		Study Area		NSW
	No.	*Share*	*No.*	*Share*	*No.*	*Share*	*Share*
Agriculture, forestry and fishing	1,645	22.1%	680	8.8%	2,325	15.3%	2.2%
Mining	35	0.5%	5	0.1%	40	0.3%	1.0%
Manufacturing	525	7.0%	220	2.8%	745	4.9%	8.4%
Electricity, gas, water and waste services	70	0.9%	170	2.2%	240	1.6%	1.1%
Construction	**485**	**6.5%**	**805**	**10.4%**	**1,290**	**8.5%**	**7.3%**
Wholesale trade	245	3.3%	175	2.3%	420	2.8%	4.4%
Retail trade	980	13.1%	640	8.2%	1,620	10.6%	10.3%
Accommodation and food services	445	6.0%	505	6.5%	950	6.2%	6.7%
Transport, postal and warehousing	**315**	**4.2%**	**210**	**2.7%**	**525**	**3.4%**	**4.9%**
Information media and telecommunications	15	0.2%	110	1.4%	125	0.8%	2.3%
Financial and insurance services	135	1.8%	85	1.1%	220	1.4%	5.0%
Rental, hiring and real estate services	45	0.6%	85	1.1%	130	0.9%	1.6%
Professional, scientific and technical services	180	2.4%	650	8.4%	830	5.5%	7.9%
Administrative and support services	125	1.7%	155	2.0%	280	1.8%	3.3%
Public administration and safety	370	5.0%	1,480	19.1%	1,850	12.2%	6.1%
Education and training	565	7.6%	635	8.2%	1,200	7.9%	7.9%
Health care and social assistance	805	10.8%	650	8.4%	1,455	9.6%	11.6%
Arts and recreation services	25	0.3%	100	1.3%	125	0.8%	1.5%
Other services	275	3.7%	250	3.2%	525	3.4%	3.7%
Inadequately described/Not stated	170	2.3%	155	2.0%	325	2.1%	2.5%
Total	**7,460**	**100%**	**7,760**	**100%**	**15,220**	**100%**	**100%**

Source: Profile Id
Note: Census employment data for 2016 is pending release
Figures rounded to multiples of five.

2.5 Business Structure

One of the more tangible benefits of an investment project is the extent to which local businesses can participate in the project, through project contracts and other service provision opportunities. ABS Business Count data for 2016 (latest available at the LGA level) shows the Study Area included 590 construction businesses and a further 270 businesses associated with transport, postal and warehousing service, with these two sectors contributing 860 businesses or 13% of all businesses located in the Study Area.

This data is included in Table 2.5 and indicates a good presence of the types of firms that may be well-placed to service aspects of the project. This opportunity is explored in more detail in the following Chapter.

Table 2.5: Business Structure – Study Area, 2016

Business Types	Hilltops Council		Yass Valley Council		Study Area	
	No.	*Share*	*No.*	*Share*	*No.*	*Share*
Agriculture, Forestry and Fishing	1,855	41.2%	715	37.3%	2,570	40.1%
Mining	20	0.4%	5	0.3%	25	0.4%
Manufacturing	140	3.1%	50	2.6%	190	3.0%
Electricity, Gas, Water and Waste Services	30	0.7%	5	0.3%	35	0.5%
Construction	**590**	**13.1%**	**305**	**15.9%**	**895**	**14.0%**
Wholesale Trade	125	2.8%	40	2.1%	165	2.6%
Retail Trade	235	5.2%	85	4.4%	320	5.0%
Accommodation and Food Services	120	2.7%	70	3.7%	190	3.0%
Transport, Postal and Warehousing	**270**	**6.0%**	**90**	**4.7%**	**360**	**5.6%**
Information Media and Telecommunications	5	0.1%	5	0.3%	10	0.2%
Financial and Insurance Services	245	5.4%	80	4.2%	325	5.1%
Rental, Hiring and Real Estate Services	275	6.1%	90	4.7%	365	5.7%
Professional, Scientific and Technical Services	170	3.8%	180	9.4%	350	5.5%
Administrative and Support Services	85	1.9%	45	2.3%	130	2.0%
Public Administration and Safety	-	0.0%	-	0.0%	-	0.0%
Education and Training	30	0.7%	15	0.8%	45	0.7%
Health Care and Social Assistance	120	2.7%	40	2.1%	160	2.5%
Arts and Recreation Services	30	0.7%	25	1.3%	55	0.9%
Other Services	110	2.4%	55	2.9%	165	2.6%
Not Classified	45	1.0%	15	0.8%	60	0.9%
Total	**4,500**	**100%**	**1,915**	**100%**	**6,415**	**100%**

Source: ABS Business Counts, 2016

2.6 Township Services Capacity

Commercial Accommodation

The ability to accommodate non-local workers (ie those who are not resident in the Study Area or not living within a daily commutable distance) is a key consideration for major construction projects, especially in regional and rural areas underpinned by agricultural activity and tourism that are subject to seasonal demand for labour.

As Table 2.6 highlights, the Study Area has a reasonable supply of commercial accommodation as measured by the ABS Tourism Accommodation series for the March Quarter 2016. This data, which identifies supply for hotels, motels and apartments with 15 rooms or more, shows the Study Area has 15 establishments, 385 rooms and 1,120 beds, reflecting the high level of tourism associated with this general region. Yass, which would be the most convenient location to house project workers, has 6 establishments, 150 rooms and 460 beds.

Room and bed occupancy rates, 61% and 31% respectively, can be considered modest (noting that this data relates to the peak summer period), indicating the wind farm project will boost the commercial accommodation sector, especially during off-peak periods. This factor is further discussed in section 3.5.

Table 2.6: Hotel, Motel and Apartments Accommodation (with 15 Rooms or more) – Study Area, March Quarter 2016

	Establishments	Rooms	Beds	Room Occupancy Rate	Bed Occupancy Rate
Yass	6	150	460	69%	38%
Yass Region	4	100	270	n/a	n/a
Young	4	110	320	60%	25%
Young Region	1	25	70	n/a	n/a
Study Area	**15**	**385**	**1,120**	**61%**	**31%**

Source: ABS Tourism Accommodation, Australia 2015-16

In addition to commercial accommodation outlined above, Boorowa provides a range of smaller facilities (which are not included in the ABS data), such as the Court House Hotel and Boorowa Hotel.

The Study Area also provides a range of additional options which could be used for worker accommodation, including the following:

- Caravan/ Holiday parks providing cabins, such as:
  - Boorowa Caravan Park
  - Yass Caravan Park
  - Young Caravan Park
- Bed and Breakfast
- Guest houses.

Private Accommodation

Private accommodation is often used to support construction worker needs and this could be through leasing of holiday homes and investment properties, either privately or through real estate agents. ABS Census data for 2016 indicates the Study Area has an above-average level of unoccupied dwellings; this is consistent with a tourist region that includes many holiday homes.

As Table 2.7 shows, 13.5% of Study Area dwellings (1,970 dwellings) were unoccupied at the 2016 Census, which is well above the average for NSW at 9.9%. Shared private housing accommodation is one potential option for the wind farm project workers, and this is further explored in section 3.5.

Table 2.7: Unoccupied Dwellings – Study Area, June 2016

	Occupied Dwellings	Unoccupied Dwellings	Total Dwellings	Unoccupied Dwelling Share
Hilltops Council	7,080	1,340	8,420	15.9%
Yass Valley Council	5,520	630	6,140	10.3%
Study Area	**12,590**	**1,970**	**14,560**	**13.5%**
New South Wales	**2,604,320**	**284,740**	**2,889,060**	**9.9%**

Source: ABS Census of Population and Housing, 2016

Township Services

In addition to accommodation, workers locating temporarily to the Study Area will require a wide range of other convenience services, and the project will also need to source trade and other services from businesses located in the immediate region. The following paragraphs provide an overview of the services located in the main townships in the Study Area.

Yass

Figure 2.1: Images of Yass Town Centre

Source: www.bing.com

The Yass Township is a strategically important settlement located in the southern NSW area north of Canberra, accommodating approximately 6,500 residents (2016 Census, Yass State Suburb). Yass provides significant access to services for surrounding smaller towns, and as such has a multitude of stores and amenities available. Yass is located approximately 70 kilometres from the subject site (or an hour's drive) and will therefore be an important base for non-local workers, as well as providing construction and other support services to the project.

Key services available in Yass include:

- Range of commercial accommodation options (see above)
- Large range of retail service (Woolworths, Aldi, IGA etc)
- Construction services (Yass Valley Hire – builders and contractors equipment)
- Trade Supplies (Home Timber & Hardware, B & G Hardware)

- Transport and freight services (Roche's Transport, Muscat Haulage, Jones Transport etc)
- Automotive Mechanics
- Cafes, bakeries, restaurants and take-away
- Entertainment (parks, hotels, clubs, sports and recreational activities)
- Most major financial institution branches
- Fuel supplies (Caltex, United Petroleum)
- Postal Services
- Employment Service (Campbell Page, Employment Plus etc)
- Medical and Emergency Services (Yass District Hospital with 24-hour emergency centre, NSW Ambulance Service, Yass Medical Centre, Yass Fire Station, Yass Police Station).

<u>Boorowa</u>

Figure 2.2: Images of Boorowa Town Centre

Source: www.bing.com

Boorowa is a township with a population at approximately 1,640 people (2016 Census, Boorowa State Suburb). The township provides convenience services, particularly for local residents, businesses and agricultural producers. Boorowa is located within 20 km (or a 20-minute drive) from the subject site and, as such, will provide an ideal base for non-local workers while providing local labour and some support services to the project. The township has a limited range of stores and other services, including:

- Accommodation (two hotels and a caravan park)
- IGA Supermarket
- Construction services (Hurley's Excavation Hire)
- Local Hardware stores (Boorowa Hardware, JD's Hardware & Rural Supplies)
- Fuel supplies (Caltex)

- Automotive mechanics
- Cafes, bakeries, restaurants and take-away
- Bendigo Bank Branch; Third party ATM
- Entertainment (clubs, hotels, recreation and sport)
- Postal Services
- Health and Emergency Services (Boorowa Medical Centre, Boorowa Fire Station, Boorowa Police Station).

Young

Figure 2.3: Images of Young Town Centre

Source: www.bing.com

Young has a population of approximately 10,295 people (2016 Census, Young State Suburb). The township provides convenience services particularly for the local community and agricultural producers. Young is located within 70 km (or a 75 minute drive) from the subject site and as such will provide an potential base for non-local workers, while providing local labour and some support services to the project. The township has a reasonable range of stores and other services, including:

- Accommodation (see above)
- Woolworths and IGA supermarkets
- Construction services (Everdell Construction, Hardy Brothers Earth Moving)
- Local Hardware stores (Mitre 10, Home Timber & Hardware)
- Fuel supplies (BP, Caltex, Mobile)
- Automotive mechanics
- Cafes, bakeries, restaurants and take-away
- Most major financial institution branches

- Entertainment (clubs, hotels, recreation and sport)
- Postal Services
- Health and Emergency Services (Young District Hospital – with 24 hour emergency department, Young Fire Station, Young Police Station).

2.7 Conclusions

The key findings of this Regional Economic Profile are as follows:

1 The Study Area has a resident population of around 35,470 persons in 2016, which is projected to increase to 42,030 persons by 2031.

2 The relatively low unemployment rate (4.0% compared to 5.0% for NSW) in the Study Area (ie, a relatively small pool of unemployed persons from which to draw) may have implications in terms of labour supply for the construction phase of the project, particularly with regard to competing seasonal labour requirements (harvesting, tourism etc) and concurrent infrastructure projects in the region.

3 The Study Area's occupational, industry and business structures indicates that a good base exists to service the needs of the project, including the needs of approximately 4,730 construction-related workers (based on occupation) and 860 construction and transport businesses.

4 The regional centre of Yass will underpin most project needs in view of town's reasonable supply of accommodation (150 rooms, plus cabins, power sites, B&B's and private accommodation), trade supplies and transport services, retail services, entertainment and so on. However, the towns of Boorowa and Young would also be expected to provide project support services, including lower-cost commercial accommodation options and convenience services.

3 ECONOMIC IMPACT ASSESSMENT

3.1 Project Investment

The total construction cost for the Bango Wind Farm project is estimated to be $320 million, according to information provided by CWP Renewables. The major investment cost is associated with the purchase of wind turbines, although significant investment is also required for civil, electrical and grid connection works. Additional investment will be required with regard to project management, planning and approvals, financing, insurance and other project costs.

3.2 Project Employment

Construction Phase

Project employment is assessed in terms of **Direct** jobs (ie, site-related) and **Indirect** (or flow-on) jobs in the local and wider economies (ie, jobs that are generated by the employment multiplier as funds circulate around the economy between various industry sectors).

Direct Construction Employment

CWP Renewables estimate a workforce requirement of 150 Full Time Equivalent (FTE) jobs over the construction phase of a wind farm project.

Construction jobs are expected to be associated with a wide-range of on and off-site activities, including:

- Structural concrete foundations
- Earthworks
- Roads and access tracks
- Fencing
- Landscaping
- Vehicle and equipment hire
- Trade services
- Security
- Office cleaning
- Waste disposal
- Building maintenance

- Foundation laying
- Electrical transformer installation
- Crane works
- Cabling
- Temporary site facilities (power, water, telecommunications)
- Transport of components/workers.

Local/ regional professional services might include:

- Civil engineering
- Mechanical engineering
- Environmental engineering and specialist consultants
- Employment agencies
- Electrical engineering
- Legal and financial services.

Indirect Construction Employment

In addition to direct employment, significant employment will be generated indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the construction industry of 2.6 (based on ABS Input-Output tables), the project is estimated to generate an additional 240 FTE jobs over the construction period.

Indirect or flow-on jobs include those supported locally and in the wider economy (including metropolitan Sydney, regional NSW and interstate, such as the ACT and northern Victoria), as the economic effects of the capital investment flow through the economy. Indirect employment creation within the region would include jobs supported through catering, accommodation, trade supplies, fuel supplies, transportation, food and drink etc.

Total Construction Employment

In summary, approximately 390 FTE jobs (150 direct and 240 indirect) are expected to be generated by the Bango Wind Farm project during the construction phase.

As identified earlier, the Study Area has a relatively low unemployment rate and the labour market is subject to seasonality. The level of local employment required at the peak of the project is estimated by the proponent to be 60 FTE jobs (40% of the total project requirement).

This represents less than 2% of the Study Area's labour force who are occupied in construction-related activities (4,730 workers) and this should not present a constraint to labour supply for the project. Additionally, 675 labour force participants in the Study Area are currently unemployed; therefore, the wind farm project presents new employment opportunities for these jobseekers (subject to an appropriate skill match).

Discussions with the Boorowa Business Chamber indicate the wind farm project should not negatively impact on farmers' labourers, as there is generally an ample supply of labour for farms (oats, wheats, barley, canola, sheep shearing) which are mostly serviced by contractors who have the flexibility to switch between harvest activities and infrastructure projects.

Employment requirements for potentially competing infrastructure projects also need to be considered, and this factor is discussed in section 3.3.

Operational Phase

Direct Operational Employment

CWP Renewables indicate that around 10 FTE jobs will be supported on an ongoing basis through the operation of the Bango Wind Farm, with 70% of these jobs (7 FTE positions) expected to be supported in the Study Area, with remaining jobs located in other areas, including Head Office. Local positions would be associated with managerial and maintenance activities.

Indirect Operational Employment

A number of additional jobs will also be supported indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the electricity industry of 3.9 (based on ABS Input-Output tables) to the 10 direct operational and maintenance jobs, a further 30 permanent jobs (rounded) would be generated in the wider State and national economies, with some of these jobs generated locally through existing supply chains.

Operational-related employment is for the lifetime of the project (ie at least 25 years); therefore, while job creation is relatively small, it represents new long-term employment opportunities at a local, regional and state-wide level.

For the purposes of this assessment it is assumed that 20% of indirect FTE jobs are created in the Study Area. This equates to approximately 6 ongoing FTE positions.

Total Operational Employment

In summary, approximately 40 FTE jobs (10 direct and 30 indirect) are expected to be generated by the Bango Wind Farm through its ongoing operations, with 13 FTE positions expected to be created locally (ie within the Study Area).

3.3 Competing Projects

Discussions with Hilltops and Yass Valley councils have identified the following projects that may compete with the Bango Wind Farm projects for labour and resources. These projects are described below.

Rye Park Wind Farm

The proposed Rye Park Wind Farm is a 92-turbine facility (276 MW) to be located east of Boorowa near Rye Park Village. The project has received planning approval from the Planning Assessment Commission (May 2017).

According to the proponent, Tilt Renewables, the wind farm project will take between 18-24 months to complete from the start of construction.

The timing of the construction phase of the Rye Park Wind Farm is currently unknown, but potential exists for the facility to be constructed concurrently with the nearby Bango Wind Farm.

Coppabella Wind Farm

The Coppabella Wind Farm, to be developed by Goldwing Capital Australia Pty Ltd, will be located approximately 30km west of Yass. The wind farm site will extend 12 kilometres west to east and 10 kilometres north to south along the Coppabella Hills near the towns of Bookham and Binalong.

The NSW Government has approved construction and operation of up to 79 wind turbines and related civil and electrical infrastructure.

Construction is expected to commence in 2018.

Hilltops Council – Stronger Communities Fund Projects

The NSW Government, through the Stronger Communities Fund, has provided each newly amalgamated Council $15 million to invest in community projects and infrastructure.

Table 3.1 outlines funding allocated to major projects in the Hilltops Council area. In total, $14.1 million has been allocated to ‘major projects’, with a further $0.9 million allocated to small ‘community projects’.

Most of these projects are relatively small-scale, ranging from $100,000 to $2.0 million and will therefore not involve significant construction-related resources.

Furthermore, the terms of the Stronger Communities Fund require all projects to be completed by 30 June 2019, with many projects likely to be finalised well before the Bango Wind Farm project commences.

Table 3.1: Hilltops Council – Stronger Communities Fund, Major Projects

Project	Investment
Boorowa Caravan Park	$200,000
Harden Caravan Park	$100,000
Urban Growth Boorowa	$1,000,000
Road Network Improvement Program Boorowa	$700,000
Chinese Cemetery Murrumburrah	$50,000
Hilltops Regional Library - Young	$2,000,000
Lambing Flat Chinese Tribute Garden - Young	$300,000
Solar Power	$328,995
Burrangong Creek - Young	$1,500,000
Murrimboola Creek - Murrumburrah	$1,000,000
Pool renewals - Harden	$300,000
Swimming Pool - Young	$1,700,000
Trinity Centre Refurbishment - Harden	$100,000
Mechanics Institute	$250,000
Tennis Courts - Boorowa	$300,000
Hilltops Regional Tennis Complex	$1,000,000
Play Ground - Boorowa	$250,000
Playgrounds - Harden	$350,000
Sports Fields - Harden	$1,000,000
Sports Fields - Boorowa	$500,000
Blackguard Gully - Young	$500,000
Museum extension - Harden	$100,000
Cranfield Over Improvements	$600,000
Major Projects Total	**$14,128,995**

Source: https://www.strongercouncils.nsw.gov.au/new-councils/hilltops-council

3.4 Industry and Business Participation Opportunities

In terms of cost efficiencies (lower transport, labour costs etc), many large construction projects located in regional areas are (where possible) serviced from within the same region.

As identified above, the Study Area comprises 895 construction firms (which include individual contractors) and many other businesses associated with activities likely to be required for the project. These include transport operators, trade suppliers, vehicle and machinery hire, and repair companies, among others.

As a regional centre, Yass is likely to have firms of sufficient scale to compete for project contracts and many smaller firms which could supply fencing, machinery hire, waste disposal, electrical services and the like.

Consultation with officers from both councils and Boorowa Business Chamber representatives confirms the potential of local businesses and contractors from across the Study Area to benefit from the project.

In order to maximise local business participation a number of strategies should be implemented, such as widespread advertising of contracts in local media and directly through the project website. CWP Renewables has already compiled a database of potential local (and non-local) suppliers who have expressed an interest in providing services to the project.

The Industry Capability Network (ICN) is another organisation that often plays an important business facilitation role for major infrastructure projects, such as the proposed wind farm. The ICN is an independent, non-profit organisation funded by the Federal Government to support business opportunities, including linking suppliers to project contracts at a local level through its ICN Gateway website where details of work packages are advertised.

3.5 Housing and Commercial Accommodation Sector Impacts

Information supplied CWP Renewables indicates that up to 90 non-local staff may need to be accommodated in the region at the project's peak. These staff will comprise a range of occupations, including managers and specialist technicians. Contracts lengths will vary. This highlights the need for a number of types of accommodation, which would be expected to range from higher-end options for professional staff on longer contracts, to convenient low-cost options for those on short-term contracts.

As highlighted in Chapter 2, the Study Area has a capacity of around 400 commercial rooms (including the small supply of rooms in Boorowa). Assuming each non-local worker requires individual accommodation, approximately 22% of total accommodation stock would be required at peak times to service the project. The actual proportion would be lower on the expectation that some workers may be accommodated in caravan parks (cabins or powered sites), B&Bs, private rentals or with family or friends – none of these categories are included in the accommodation audit. Additionally, some workers are likely to share motel rooms/cabins, private rentals etc to reduce personal costs.

ABS Tourism Accommodation data for 2015/16 shows the Study Area had a room occupancy rate of approximately 60% and a bed occupancy rate of 30% for its hotels, motels and serviced apartments in the March Quarter, 2016 (refer to Table 2.6).

This data indicates that adequate capacity exists in the region to accommodate the numbers of non-local workers expected at the peak of the wind farm project. Importantly, the influx of these workers would support higher occupancy rates and revenues for local accommodation operators over the construction period.

3.6 Local Wage Spending Stimulus

CWP Renewables estimate that 60% of jobs (90 jobs) are likely to be sourced from outside the Study Area, particularly specialist and management positions.

This level of employment would equate to $7.3 million in wages (2017 dollars) on the basis that each is employed for 12 months on the project and at an average construction wage of $80,850 including on-costs (source: ABS Average Weekly Earnings 6302.0, May 2017).

A considerable portion of these wages would be spent in Boorowa, Yass, Young and the surrounding region. An estimated $4.1 million in wages (2017 dollars) would likely be directed to local and regional businesses and service providers during the construction period (once 25% in average income taxes are removed). This estimate is based on reference to the ABS Household Expenditure Survey which indicates that approximately 75% of post-tax wages are likely to be spent by workers in the regional economy in view of the wide range of goods and services available, especially in Yass. This spending would be likely to include the following:

- <u>Housing expenditure</u>, including spending on accommodation at hotels, motels, caravan parks and private rental dwellings
- <u>Retail expenditure</u>, including spending on supermarket items, clothing, books, homewares etc
- <u>Recreation spending</u> associated with day trips and excursions, gaming (lottery, sports betting, etc), purchases in pubs and clubs (although noting that expenditures at restaurants is included in the retail category)
- <u>Personal, medical and other services</u>, such as local prescriptions and GP fees, household cleaning services, fuel, vehicle maintenance and so on.

This level of personal spending would support approximately 20 FTE jobs in the services sector (1 job allocated for every $200,000 of spending), including jobs in the Study Area associated with retail, accommodation, trade supplies, cafes and restaurants etc. These jobs are included in the 'indirect employment' estimates outlined in Section 3.2 above.

3.7 Impact on Agricultural Land

The impact of the Bango Wind Farm on agricultural activity is likely to be small, due to the following factors:

- Only a very small proportion of agricultural land, estimated at 90 ha or 2% of the 5,200ha site area, will be lost to permanent infrastructure eg internal access roads, siting of turbines and other infrastructure requirements.
- The land is principally used for sheep grazing associated with wool and lamb production, and this activity can continue as normal within the subject site (minus the 90ha required for permanent infrastructure).
- The Aviation Assessment (REHBEIN Airport Consulting) undertaken for the Bango Wind Farm Environmental Impact Statement found the wind farm would have minimal impacts on agricultural activity noting the following (p.253):

  "Agricultural aerial spraying activity for pest management and pasture top-dressing is not considered to be a common activity across the Project site. Pest management spraying is unlikely to be affected by the Project. Top-dressing activity will require care by pilots applying the material to properties along the ridgelines.

  Despite the presence of another wind farm in the vicinity of the Project, no cumulative impact on air activity in and around the Project is expected"

It is also important to recognise benefits to host landowner properties from the project through improved access facilitated by new internal roads which also reduces bushfire risks across these agricultural landholdings decreasing the likelihood of loss of buildings, machinery, livestock, fencing etc.

3.8 Ongoing Economic Stimulus

Landowners

CPW Renewables advise that turbines will be spread across 10 host landowners, providing income returns to these farming families. Payments are made on the basis of the number of turbines hosted on each property with a fixed rate per turbine linked to CPI.

These new income streams can be particularly important in supporting the financial sustainability of some farms, especially as primary agricultural activities are not impacted upon to any great extent (as outlined above).

As noted earlier, securing a guaranteed 25-year drought proofed income stream (indexed to CPI) also allows farming families more flexibility in the long-term planning for their farming operations, including succession planning. Potential exists for landowners to continue to host turbines post the initial 25-year period (assuming the wind farm is not decommissioned) and this would provide income for future generations or new landowners.

Wage Stimulus

Additionally an estimated 13 FTE permanent local jobs (direct and indirect) will be created through the project (refer to section 3.2), and wage spending associated by these jobs will benefit local businesses and communities. The extent of retained local spending has been calculated in line with the methodology outlined in section 3.6.

Over 25 years, and allowing for 2.5% CPI pa, cumulative host landowner payments and wage stimulus factors will inject an estimated $64.9 million into the Study Area’s economy.

3.9 Returns to Council and the Community

Council Rates Revenue

Unlike other states (such as Victoria), NSW does not currently have in place a legislative framework to assist in determining rates payable for electricity generating facilities.

The NSW Valuer General’s Policy No. 12 (*valuation of land used as a wind farm*) states that the value of land under lease for the purpose of a wind farm has an increased value compared to similar land without a wind farm lease – this has implications for taxes and council rates. The proponent has made a commitment to cover any increase in council rates caused by the installation of wind farm infrastructure.

This increased land value is likely to result in a net increase in annual rates returns to both Councils from the subject site, but at no additional cost to the host landowners (who will also be benefiting from annual payments from the proponent for hosting the turbines). The proponent estimates the increase in rates is likely to be approximately $140,000 pa or $4.8 million over 25 years (adjusted for CPI @ 2.5% pa).

Unlike a new residential development (where Council incurs costs such as garbage collection; maintenance of parks, open space, roads, footpaths; provision of community services; etc) the cost to Council of providing resources for the wind farm site is likely to be relatively small and would be limited to road maintenance, garbage removal and the like. Therefore, an uplift in rates revenues generated from the operation of the wind farm on the subject site will represent a net return to Council.

Importantly, this revenue can be re-invested in infrastructure and services, which will benefit the community more generally.

Community Fund

The Bango Wind Farm Community Fund will be based on an annual payment by the operator of $2,825 per turbine, with this payment linked to CPI.

Based on the existing 75 turbine layout, annual payments to the Community Fund would generate approximately $212,000 in Year 1 of wind farm operations.

Over the 25-year operational period, the Community Fund is projected to generate $7.2 million (adjusted for CPI @ 2.5% pa) for local projects, infrastructure and services.

Community Legacy Projects

CWP Renewables are considering delivering a series of longer-term, legacy projects that will span the life of Bango Wind Farm. This may involve working with the project contractors to plan, fund and deliver specific community projects in areas such as construction and education.

This approach has been used by CWP Renewables during the construction phase of the Sapphire Wind Farm (northern NSW) through the Construction in the Community program.

The Construction in the Community initiative aims to facilitate small community infrastructure projects (through an application process) which can be completed in the space of a half-day or day but require manpower, specialist skills and machinery which can be readily provided by the on-the-ground contractor team.

Examples of such projects include:

- Improvements and upgrades to existing infrastructure
- Minor earthworks or excavation
- Environmental projects: rehabilitation, rejuvenation of community spaces, tree planting
- Working bee projects such as painting or clearing.

Community groups, catchment and wildlife groups, school P&C associations and non-profit organisations have submitted applications for these community projects.

Community Investment

CWP Renewables is investigating the potential for local community investment in their renewable energy projects. Depending on the outcome of these investigations, locals within the Study Area may be offered the opportunity to invest in the Bango Wind Farm.

3.10 National Grid Supply Benefits

The Bango Wind Farm has the potential to provide sufficient renewable energy to support the annual electricity needs of approximately 90,000 NSW households (rounded). This annual calculation is based on:

- 613,200 MWhrs / by average annual Australian electricity consumption per household of 6.9 MWhr = 88,870 households.

In a regional context, the Study Area currently contains 14,560 dwellings (refer to Table 2.7) and therefore the Bango Wind Farm has the potential to provide the annual electricity needs of the Study Area six times over, highlighting the importance of the facility from a clean electrical generation perspective.

3.11 Environmental Benefits

Once fully-operational, the Bango Wind Farm will result in the reduction of an estimated 515,000 tonnes in carbon dioxide (CO_2) emissions on an annual basis compared to the same level of electricity generation using fossil fuels. This annual calculation is based on:

- 613,000 MWhrs x CO_2 savings per KWhr (0.84 tonnes) = 514,920 tonnes pa

This reduction on CO_2 emissions is the equivalent of taking approximately 185,000 cars off the road annually, based on an average of 14,000km travelled with CO_2 emissions of 200g/km (or 2.8 tonnes of CO_2 emissions per car pa).

3.12 Tourism Opportunities

The Bango Wind Farm site is situated across a number of private land holdings, somewhat limiting the tourism potential of the facility. However, wind farms have traditionally attracted interest from a range of groups and interests, and longer-term opportunities might be possible if suitable arrangements can be put in place regarding access to the site.

Potential visitor types include:

- Environmentalist
- Researchers

- Eco-tourists
- Schools and educational institutions (eg Canberra Institute of Technology's *Renewable Energy Skills Centre of Excellence*).

The South East Region of Renewable Energy Excellence (SERREE) Renewable Energy Trail provides a specific tourism opportunity for the Bango Wind Farm. The Renewable Energy Trail is a self-drive guided trail that showcases the diversity of renewable energy infrastructure sites located within the ACT–south-east NSW region.

A Concept and Action Plan has recently been developed for the Trail to guide its future development, with half and full day Renewable Energy Site Tours now available as part of the Renewable Energy Trail experience.

Benefits of attracting new visitors to the region include increased expenditures on accommodation, food and beverage, fuel, retail, entertainment etc, all of which will support local businesses and employment, especially in townships such as Boorowara, Rye Park, Yass and Young.

3.13 Conclusions

1 The Bango Wind Farm project will involve $320 million in investment during the construction phase and will support 150 direct and 240 indirect FTE positions over the construction period. Once operational, 10 direct and 30 indirect FTE jobs will be supported by the facility.

2 Allowing for the project to be carefully managed around the region's peak times for harvesting, tourism etc, and having regard for potentially concurrent infrastructure projects, accessing adequate labour supply should not present a major issue for the project. The peak local employment requirement (60 FTE positions) represents less than 2% of workers occupied in construction-related activities in the Study Region.

3 Competing projects may include the proposed Rye Park and Coppabella wind farms and a number of smaller local infrastructure projects funded through the NSW Stronger Communities Fund.

4 The Bango Wind Farm project will provide significant participation opportunities for businesses and the labour force located in the Study Area, having regard for the good match of skills and resources available. In this regard, organisations such as ICN might be involved in ensuring maximum local inputs are secured, which would be in addition to the proponent's own local sourcing initiatives.

5 The 'external' project labour requirement would be expected to generate an accommodation requirement for 90 project workers at the peak of the project. This represents only 20-25% of total commercial accommodation rooms available in the Study Area and would provide a boost to local accommodation operators, noting that room occupancy rates are around 60% across the region. Other accommodation providers, such as caravan parks, B&Bs and private households, may also benefit from the project.

6 Non-local construction workers living in the Study Area would be expected to inject approximately $4.1 million in additional spending to the regional economy over the construction phase, supporting around 20 jobs in the service sector.

7 Agricultural land use will only be marginally affected by the project, with existing farm activities continuing as normal.

8 Ongoing economic stimulus associated with the operation of the wind farm through the Community Fund, financial returns to host landowners, local wage spending and net rates returns to the two Councils is estimated at approximately $77 million over 25 years (adjusted for CPI @ 2.5%).

9 Additional community benefits include construction of community legacy projects, and potential for the community to directly invest in the wind farm. Host landowner properties will also benefit from the project through the construction of new internal roads which reduce bushfire risks and decrease the likelihood of loss of buildings, machinery, livestock, fencing etc.

10 The project has the capacity to supply sufficient clean energy to power approximately 90,000 homes and, in the process, to reduce $C0_2$ emissions by 0.5 million tonnes per year.

11 The project could potentially support small-scale tourism initiatives, such as viewing opportunities for visitors to the region. In the longer-term, potential exists for Bango Wind Farm to form part of organised tours to renewable facilities in the broader region as part of the SERREE Renewable Energy Trail.