

Mount Emerald Wind Farm



Proposed view toward Mount Emerald Wind Farm

LANDSCAPE & VISUAL IMPACT ASSESSMENT

Prepared for:



Prepared by:

GREEN BEAN DESIGN
landscape architects

November 2013

Project: Mount Emerald Wind Farm

Project Number: 13-173

Report Title: Landscape and Visual Impact Assessment

Revision: V2

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Date 25 November 2013

Green Bean Design – Capability Statement

Green Bean Design (GBD) is an experienced landscape architectural consultancy specialising in landscape and visual impact assessment. As an independent consultancy GBD provide professional advice to a range of commercial and government clients involved in large infrastructure project development.

GBD owner and Principal Landscape Architect Andrew Homewood is a Registered Landscape Architect and member of the Australian Institute of Landscape Architects and the Environmental Institute of Australia and New Zealand.

Andrew has over 20 years continuous employment in landscape consultancy and has completed numerous landscape and visual impact assessments for a range of large scale and State significant infrastructure and renewable energy projects, including wind energy and solar power developments. GBD has been commissioned for over 20 wind energy projects across New South Wales, Victoria, South Australia, Queensland and Tasmania, including assessments for:

Silverton Wind Farm	Boco Rock Wind Farm	Collector Wind Farm
Crookwell 3 Wind Farm	Sapphire Wind Farm	Willatook Wind Farm
Eden Wind Farm	Birrema Wind Farm	Rye Park Wind Farm
Paling Yards Wind Farm	Port Kembla Wind Farm	Bango Wind Farm
Deepwater Wind Farm	White Rock Wind Farm	Mount Emerald Wind Farm
Conroy's Gap (Mod 4)	Granville Harbour Wind Farm	

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Glossary

This LVIA has adopted the following definitions, including those outlined in the Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment, Second Edition (2002) and Third Edition (2013).

Table 1 Glossary

Term	Meaning
Cumulative effects	<i>The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.</i>
Cultural significance	<i>The aesthetic, historic, scientific, social or spiritual value for past, present or future generations.</i>
Indirect Impacts	<i>Impacts on the environment, which are not a direct result of the development but are often produced away from it or as a result of a complex pathway.</i>
Landscape	<i>An area, as perceived by people, the character of which is the result of the action and interaction of natural and/or human factors.</i>
Landcover	<i>Combinations of land use and vegetation that cover the land surface.</i>
Landform	<i>Combinations of slope and elevation that produce the shape and form of the land.</i>
Landscape character area	<i>These are single unique areas which are the discrete geographical areas of a particular landscape type.</i>
Landscape feature	<i>A prominent eye catching feature, for example a rock outcrop or built feature.</i>
Landscape and visual sensitivity	<i>A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor.</i>
Landscape and visual significance	<i>A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.</i>
Magnitude	<i>A combination of the scale, extent and duration of an effect.</i>

Table 1 Glossary

Term	Meaning
Mitigation	<i>Measures, including any processes, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.</i>
Photomontage	<i>Computer simulation or other technique to illustrate the appearance of a development.</i>
Viewshed	<i>An area of land surrounding and beyond the project area which may be potentially affected by the Project.</i>
Visibility	<i>A relative determination at which a wind turbine or group of wind turbines can be clearly discerned and described.</i>
Visual amenity	<i>The value of a particular area or view in terms of what is seen.</i>
Visual Impact Assessment	<i>A process of applied professional and methodical techniques to assess and determine the extent and nature of change to the composition of existing views that may result from a development</i>
Visual receptor	<i>Individuals and/or defined groups of people who have the potential to be affected by a proposal.</i>
Zone Visual Influence (ZVI)	<i>A theoretical area of landscape from which the Project structures may be visible.</i>

Executive summary

Green Bean Design (GBD) was commissioned by RACL (the Proponent) to undertake a Landscape and Visual Impact Assessment (LVIA) for the Mount Emerald Wind Farm and associated development infrastructure (the project).

The project will have up to 70 wind turbines, and for the purpose of this LVIA, the proposed wind turbines have been assessed with a maximum blade tip height of 130.5 m from ground level to tip of blade and a maximum rotor diameter of up to 110 m. Associated electrical works include a proposed substation connection within the wind farm project site to the existing Chalumbin to Woree 275 kV transmission line.

This LVIA involved desktop studies and site inspections to collect and analyse information to describe and define the characteristics of the landscape in which the project will be located. This LVIA has determined that the landscape surrounding the project has an overall medium to high sensitivity to accommodate change, and represents a landscape that is reasonably typical of landscape character areas commonly found in the surrounding landscape of the Atherton Tablelands.

As a landscape with an overall medium to high sensitivity to accommodate change, some recognisable characteristics of the landscape will be altered by the project and result in the introduction of visually prominent elements that will alter some perceived landscape characteristics. Alterations to perceived characteristics may be partially mitigated by existing landscape elements and features within the landscape. The main characteristics of the landscape, patterns and combinations of landform and landcover will still be evident.

The Zone of Visual Influence (ZVI) diagrams demonstrate the influence of topography on visibility and identify areas from which the wind farm turbines will be visible.

This LVIA assessed the potential visual significance of the project for eleven uninvolved residential dwellings within 2 km of the proposed wind turbines as well as uninvolved residential dwellings and facilities between 2 km and 5 km from the proposed wind turbines.

Executive summary

This LVIA also considered impacts for motorists travelling along local roads and highways surrounding the project area. A number of criteria were considered and assessed to determine levels of visual significance.

This LVIA determined that five uninvolved residential dwellings within the Mount Emerald wind farm 2 km viewshed will have a medium to high visual significance. Two residential dwellings within the Mount Emerald wind farm 2 km viewshed have been determined to have a medium visual significance. The remaining four uninvolved residential dwellings within the project 2 km viewshed will have a nil or low/low to medium visual significance.

A cumulative visual assessment identified one existing wind farm development (the operational Windy Hill wind farm), approximately 50 km to the south south-east of the Mount Emerald project site. This LVIA determined that there is unlikely to be any 'direct' or 'indirect' visibility between the Mount Emerald wind farm and other existing wind farm development within the Atherton Tableland.

Night time obstacle lighting, if implemented, will have the potential to create a visual impact for residential view locations surrounding the Mount Emerald wind farm. This LVIA notes that in accordance with current CASA guidelines the Mount Emerald wind farm is unlikely to require obstacle lighting.

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of the elements associated with the wind farm, it is acknowledged that the degree to which the wind turbines can be visually mitigated is limited at some locations by their scale and position within the landscape relative to surrounding view locations.

Introduction

Section 1

1.1 Introduction

This LVIA addresses one of the key requirements of the Mount Emerald wind farm Environmental Impact Assessment (EIS). This LVIA methodology adopted by GBD has been applied to a number of similar LVIA for wind farm developments and large scale infrastructure projects prepared by GBD. These LVIA have been subject to formal peer reviews and assessed/approved by State Government and Local Authorities across Australia.

This LVIA addresses and responds to the Final EIS Guidelines (EPBC 22011/6288) dated April 2012 and considers potential social and cultural impacts which relate to issues of landscape and visual amenity surrounding the project area.

This LVIA involved a comprehensive evaluation of the landscape character in which the project and ancillary structures will be located, and an assessment of the potential significance of landscape and visual effects that could result from the construction and operation of the wind farm, taking into account appropriate mitigation measures. This LVIA is based on the technical and design information provided by the Proponent to GBD.

1.2 Guidelines

This LVIA has been prepared with regard to a number of existing planning and industry guidelines that relate to the assessment and determination of potential landscape and visual impacts with specific regard to wind farm developments. These guidelines include the:

- Draft National Wind Farm Development Guidelines;
- Wind Farms and Landscape Values National Assessment Framework; and
- Auswind Best Practice Guidelines.

1.2.1 Draft National Wind Farm Development Guidelines (July 2010)

The Draft National Wind Farm Development Guidelines, originally issued October 2009, were revised following a first round of public consultation and comment. The revised Guidelines were re-issued in July 2010 for a second round of comments. The Guidelines were developed to offer best practice advice, but not as a mandatory requirement for wind farm developments within Australia. In 2011 the

Environment Protection and Heritage Standing Committee decided to cease further development of the Guidelines. Whilst further development of the Guidelines has ceased, other State jurisdictions have, or are in the process of developing their own wind farm guidelines.

The advice and structure of the Guidelines are in general accordance with wind farm planning guidelines developed in Victoria and New South Wales, as well as industry best practice and have been considered in the preparation of this LVIA.

1.2.2 National Assessment Framework (June 2007)

GBD is cognisant of the Australian Wind Energy Association and Australian Council of National Trust's publication Wind Farms and Landscape Values National Assessment Framework (NAF), June 2007, and have encompassed the general assessment framework outlined in the NAF within this LVIA methodology. **Table 2** outlines the relevant requirements of the NAF and the corresponding section in which they are addressed within this LVIA report.

Table 2 NAF Recommendations

NAF Tasks (through Steps 1 to 4)	LVIA Reference/Response
Step 1 Assess the Landscape Values 1A Preliminary Landscape Assessment <ul style="list-style-type: none"> 1A.1 Desktop Review 1A.2 Seek information from Local Authority 1A.3 Identify potential community and stakeholder interests 1A.4 Site survey 1A.5 Preliminary assessment of landscape values 1B Full Landscape Assessment <ul style="list-style-type: none"> 1B.1 Define the study area for assessment, including the zone of visual influence 1B.2 Landscape Character Analysis 1B.3 Natural and cultural values analysis 1B.4 Involve communities and stakeholders in identifying landscape values 1B.5 Document values and analyse significance 	<p>This LVIA has been prepared through a comparable methodology to that outlined in the NAF and has included a desktop review (pre site inspection) to determine potential view locations as well as establishing the extent and types of landscape characteristics within the project viewshed.</p> <p>Community and stakeholder interests have been identified by an ongoing process of direct consultation between the Proponent and relevant stakeholders. The results of the consultative process are included in this LVIA as well as other relevant sections of the EIS.</p> <p>Site survey and preliminary assessment work has been undertaken and incorporated into this LVIA.</p> <p>This LVIA addresses the requirements of Step 1B and presents an analysis of key considerations included in the NAF.</p>

NAF Tasks (through Steps 1 to 4)	LVIA Reference/Response
<p>Step 2 Describe and Model the Wind Farm in the Landscape</p> <ul style="list-style-type: none"> 2.1 Describe the development 2.2 Model the development 2.3 Prepare a visual assessment report 	<p>This LVIA has described and modelled the Mount Emerald wind farm development and selected view points from a range of view locations including uninhabited residential dwellings and road corridors within the a 5 km viewshed.</p>
<p>Step 3 Assess the Impacts of the Wind Farm on Landscape Values</p> <ul style="list-style-type: none"> 3.1 Seek community input to potential impacts 3.2 Identify and describe impacts 3.3 Identify potential cumulative impacts 3.4 Identify other relevant factors 3.5 Evaluate impacts 	<p>Community and stakeholder interests have been identified by an ongoing process of direct consultation between the Proponent and relevant stakeholders. The results of the consultative process are outlined and included in this LVIA as well as other relevant sections of the EIS.</p> <p>This LVIA has identified and described potential landscape and visual impacts associated with the Mount Emerald wind farm development as well as potential cumulative impacts resulting from other wind farm projects within the Atherton Tableland.</p>
<p>Step 4 Respond to Impacts</p> <ul style="list-style-type: none"> 4.1 Changes to location or siting of the wind farm or ancillary infrastructure 4.2 Layout and design considerations 4.3 Minor changes and mitigation measures 4.4 Recommend changes to the development 	<p>The development of the Mount Emerald wind farm turbine layout has been reviewed and adjusted throughout the preparation of this LVIA. Changes to the layout have occurred as a result of stakeholder consultation and specific concerns directed toward the visual impact of the wind farm from surrounding view locations.</p> <p>Significant changes have occurred throughout the development of the preferred design layouts including the removal and repositioning of turbines within site boundary.</p>

The NAF is noted as a framework document and does not set out a detailed or prescribed method to undertake an assessment of landscape values. This LVIA has; however, followed the majority of techniques and has tested and determined outcomes for the principal issues that have been raised in the NAF.

1.2.3 Auswind Best Practice Guidelines (December 2006)

The Auswind Best Practice Guidelines were developed to assist wind farm proponents to implement best practice in regards to the location and siting of wind energy facilities and to conduct wind farm investigations and impact assessments. The guidelines have been subject to revisions following technical reviews and consultation with both industry and broader stakeholder input.

The Guidelines, developed between (the former) Auswind and the National Trust, provide a landscape assessment approach to describe, assess and evaluate the potential landscape and visual impact of a proposed wind energy project. A summary of the approach includes:

- consultation with experts in the analysis of the environments visual characteristics e.g. Landscape Architects;
- preparation of 'Zone of Visual Influence' or 'Seen Area Diagrams';
- preparation of photomontages (also referred to as Visual Simulations);
- determination of cumulative impact from existing wind energy projects;
- investigation of impacts with associated infrastructure elements, including substation, service roads and power lines; and
- assessment of shadow flicker.

The Auswind Best Practice Guidelines offer best practice advice and are not a mandatory requirement for wind farm developments within Australia and have been incorporated into this LVIA.

1.3 Methodology

This LVIA methodology included the following activities:

- desktop study addressing visual character and identification of view locations within the surrounding area;
- fieldwork and photography;
- preparation of ZVI diagrams;
- assessment and determination of landscape sensitivity;
- assessment of significance of visual impact; and

- preparation of photomontages and illustrative figures.

1.4 Desktop study

A desktop study was carried out to identify an indicative viewshed for the Mount Emerald wind farm. This was carried out by reference to 1:25,000 scale topographic maps as well as aerial photographs and satellite images of the project area and surrounding landscape. A preliminary ZVI diagram was also produced prior to the commencement of fieldwork in order to inform the likely extent and nature of areas within the project viewshed.

Topographic maps and aerial photographs were also used to identify the locations and categories of potential view locations that could be verified during the fieldwork component of the assessment. The desktop study also outlined the visual character of the surrounding landscape including features such as landform, elevation, landcover and the distribution of settlements.

1.5 Preparation of ZVI diagrams

Three ZVI Diagrams have been prepared to illustrate the potential visibility of the wind turbines within the project viewshed. ZVI Diagrams included visibility from tip of blade, hub height and whole turbine. The ZVI are illustrated in **Figures 11, 12, and 13** and detailed in **Section 7** of this LVIA.

1.6 Fieldwork and photography

The fieldwork involved:

- a four day site inspection to determine and confirm the potential extent of visibility of the project and ancillary structures;
- determination and confirmation of the various view location categories and locations from which the project structures could potentially be visible; and
- preparation of a record for each view location inspected and assessed.

1.7 Assessment of landscape sensitivity

The capability of the landscape to accommodate the wind farm will result primarily from the nature and degree of perceptual factors that can influence interpretation and appreciation of the landscape, including landform, scale, topographic features, landcover and human influence or modifications.

1.8 Significance of visual impact

The potential significance for visual impact of the project on surrounding view locations will result primarily from a combination of the potential visibility of the wind turbines and the characteristics of the landscape between, and surrounding, the view locations and the wind farm. The potential degree of visibility and resultant visual impact will be partly determined by a combination of factors such as:

- category and type of situation from which people could view the wind farm (examples of common view location categories include dwellings or roads);
- visual sensitivity of view locations surrounding the wind farm;
- potential number of people with a view toward the proposed wind farm from any one location;
- distance of visual effect (between view locations and the wind farm); and
- duration of time people could view the wind farm from any particular static or dynamic view location.

An underpinning rationale for this LVIA is that if people are not normally present at a particular location, such as agricultural areas, or they are screened by landform or vegetation, then there is likely to be a nil visual impact at that location.

If, on the other hand, a small number of people are present for a short period of time at a particular location then there is likely to be a low visual impact at that location, and conversely, if a large number of people are present then the visual impact is likely to be higher.

Although this rationale can be applied at a broad scale, this LVIA also considers, and has determined, the potential visual impact for individual view locations that will have a higher degree of sensitivity to the wind farm development, including the potential impact on individual residential dwellings situated in the surrounding landscape. The determination of a visual impact is also subject to a number of other factors which are considered in more detail in this LVIA.

Whilst this LVIA addresses a number of static elements associated with the project, the assessment acknowledges and has considered the potential visual impact associated with the movement of the wind turbine rotors.

1.9 Photomontages

The uninvolvement residential and public photomontage locations were photographed by GBD. The modelling and photomontage preparation was undertaken by GL Garrad Hassan Pty Ltd.

Photomontages have been prepared from 13 view locations to illustrate the potential visibility of the Mount Emerald wind farm following construction. The public photomontage locations were selected to provide representative views from the vicinity of residential dwellings as well as publically accessible areas and road corridors. The photomontage locations are illustrated in **Figure 16** and the photomontages in **Figures 17 to 44**. The height of the proposed turbine within the photomontages prepared by GL Garrad Hassan has been subject to verification by GBD. The photomontage methodology verification is illustrated in **Figure 45**.

1.10 Shadow flicker & blade glint

The Proponent commissioned a shadow flicker assessment and report for the Mount Emerald wind farm. None of the surrounding uninvolvement residential dwellings are expected to experience in excess of 30 hours of shadow flicker per year, with the majority experiencing no shadow flicker at all. The detailed shadow flicker assessment is included in the EIS.

Glint is a phenomenon that results from the direct reflection of sunlight (also known as specular reflection) from a reflective surface that will be visible when the sun reflects off the surface of the wind turbine at the same angle that a person is viewing the wind turbine surface. Glint may be noticeable for some distance, but usually results in a low impact. The surfaces of the wind turbines, including the towers and blades, are largely convex, which will tend to result in the divergence of light reflected from the surfaces, rather than convergence toward a particular point. This will reduce the potential for blade glint.

Blade glint can also be further mitigated through the use of matt coatings which, if applied correctly, will generally mitigate potential visual impacts caused by glint.

Location

Section 2

2.1 Location

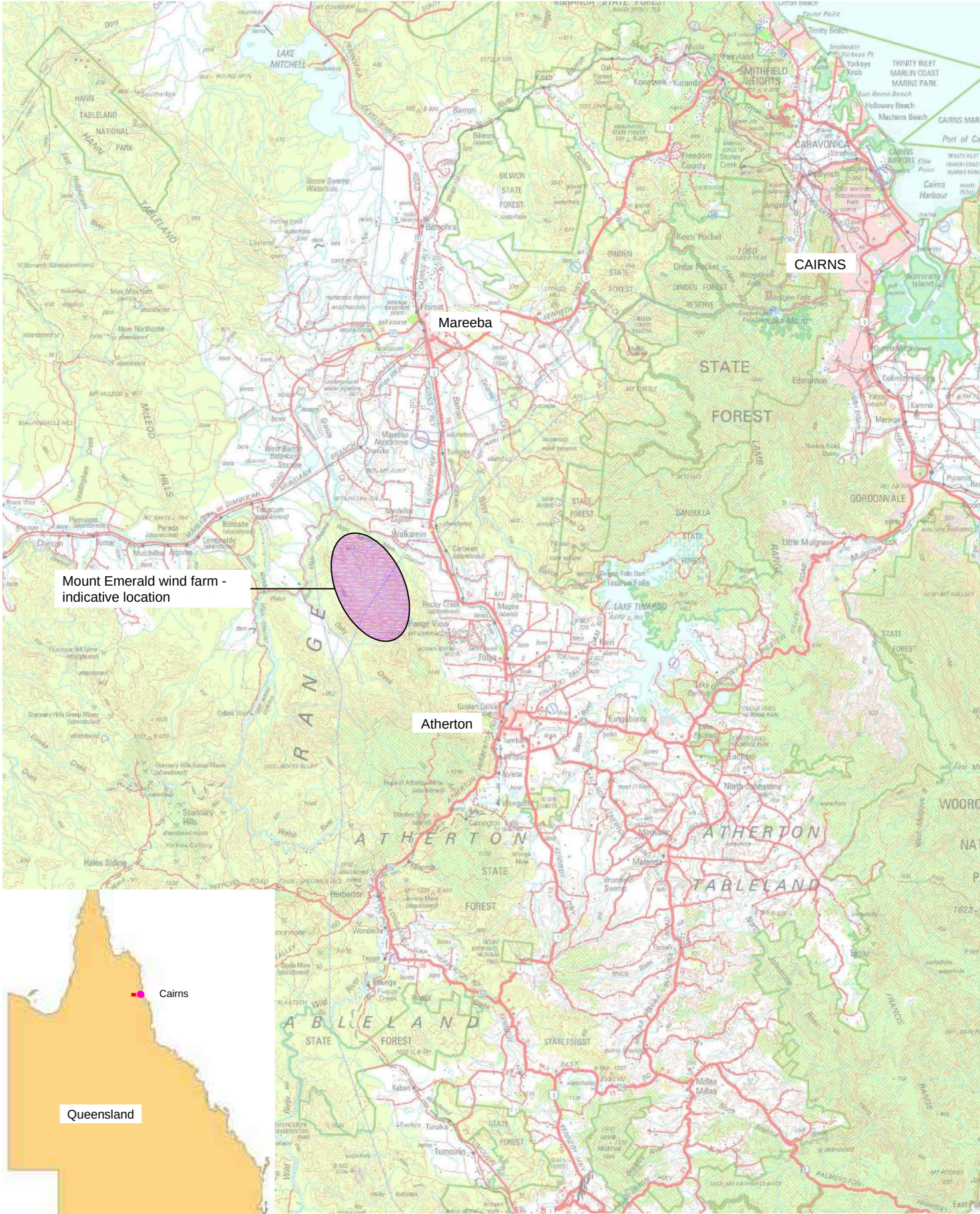
The project site (at its closest point) is approximately 3.5 km south west of Walkamin, off Springmount Road at Arriga on the Atherton Tablelands. Topographically, the site is situated at the northern most end of the Herberton Range (part of the Great Dividing Range) with the north-western section of the site being dominated by Walsh Bluff. It is characterised by rugged terrain with elevations of between 540 m up to 1089 m above sea level. The project site extends across a plateau and series of ridgelines running in an approximate north west to south east alignment from the topographic features of the Walsh Bluff in the north of the project area, to Mount Emerald in the south.

Geographically, the town centre of Mareeba is situated approximately 18 km to the north of the site, with Atherton approximately 11.5 km south east of the site. The general location of the Mount Emerald wind farm is illustrated in **Figure 1**.

A small number of towns and localities occur within and beyond the project viewshed and include:

- Mareeba (population around 7, 300 – urban centre and localities);
- Walkamin (population around 255 – urban centre and localities) ;
- Tolga (population around 878 – urban centre and localities) ; and
- Atherton (population around 6,700 – urban centre and localities).

Population figures from the 2011 Census (Australian Bureau Statistics 2011).



Not to scale



Figure 1 Location Plan



MOUNT EMERALD WIND FARM



Project description

Section 3

3.1 Project description

The key visual components of the project will comprise:

- up to 70 wind turbines;
- up to 70 individual 33kV external kiosk transformers and switchgear with associated control systems to be located in the vicinity of the wind turbine towers (in some turbine models transformer equipment will be integrated within the tower or nacelle);
- underground and overhead electrical and communication cable network linking turbines to each other within the project boundary;
- a collection/connection substation located within the wind farm project site;
- up to 4 permanent wind monitoring masts. The permanent monitoring masts may be either static guyed or un-guyed structures and will be to a minimum height of the wind turbine hubs;
- on site access tracks for construction, operation and ongoing maintenance; and
- Mount Emerald wind farm signage and maintenance facilities.

Temporary works associated with the construction of the wind farm that may be visible during construction and operational phases include:

- construction compounds;
- laydown and storage areas;
- crane hardstand areas; and
- mobile concrete batching plant and rock crushing facilities.

3.2 Wind turbines

The specific elements of the wind turbines comprise:

- concrete foundations;
- tubular tapering steel or concrete towers;
- nacelles at the top of the tower housing the gearbox and electrical generator;

- rotors comprising a hub (attached to the nacelle) with three blades; and
- three fibreglass / carbon fibre blades attached to each hub.

The following diagram identifies the main components of a typical wind turbine:



Configuration and components of a typical wind turbine

Table 3 outlines the main design parameters for the proposed Mount Emerald wind turbine layout:

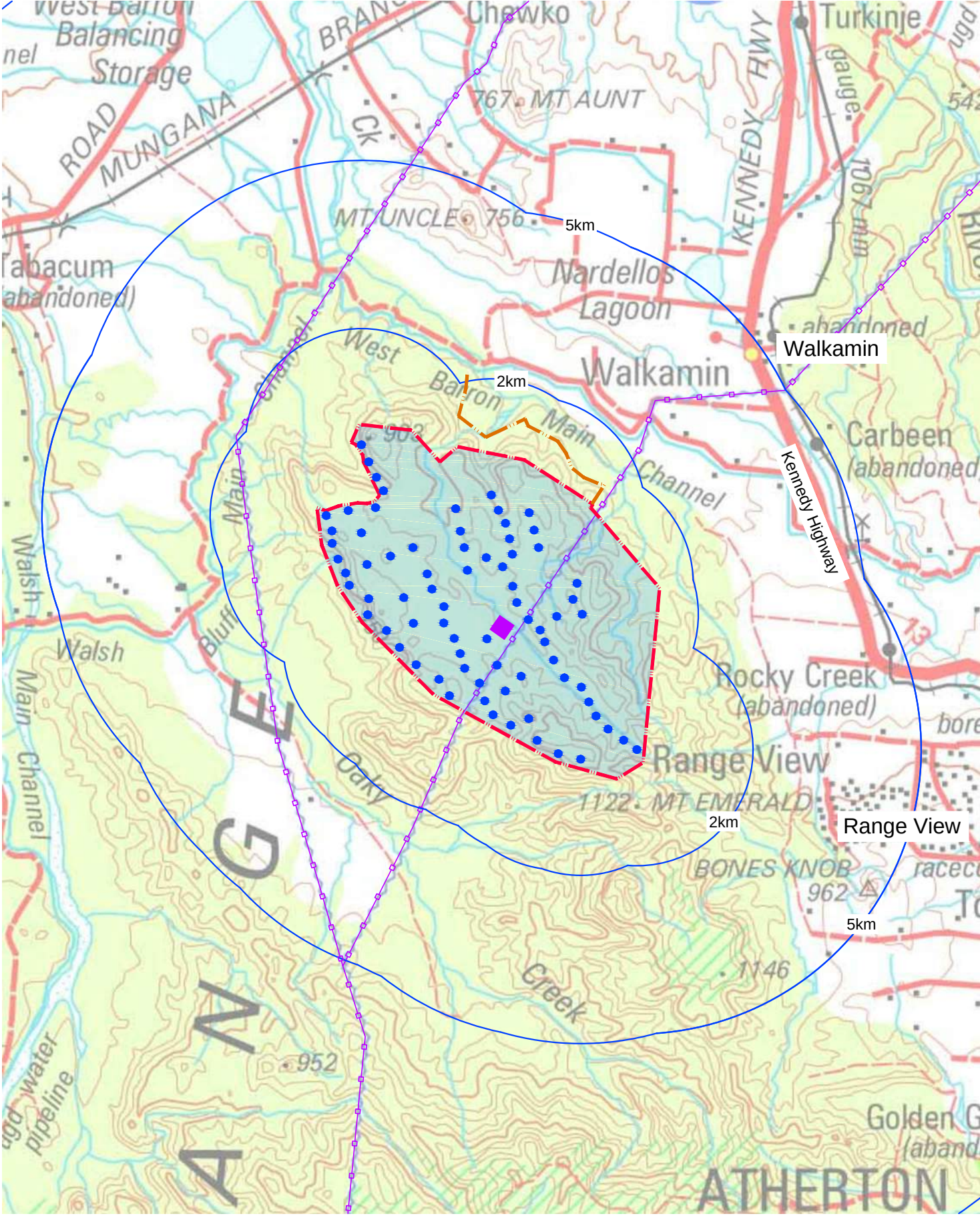
Table 3 Mount Emerald wind turbine details:

Element	Description
Tower height	80 m
Rotor Diameter	101 m
Overall height from ground level to tip of blade	130.5 m
Proposed number of Mount Emerald wind turbines	70 turbines

As new turbines come onto the market, it is possible that the final turbine selected may exceed, in minor respects, the assessed maximum turbine envelope. Minor increases in envelope size are unlikely to alter the determination of visual significance for residential view locations included in this LVIA. The indicative Mount Emerald wind farm design layout is illustrated in **Figure 2**.

3.3 Wind monitoring masts

Up to 4 permanent wind monitoring masts will be installed on-site, extending to a minimum height of the wind turbine hubs (around 80 m in height). The wind monitoring masts will be of a guyed or un-



Legend

•

Proposed Mount Emerald wind turbine (indicative layout)

(

Distance from proposed Mount Emerald wind turbine

—○—

Existing transmission line

■

Proposed substation (indicative location)

□

Indicative site boundary

—

Proposed access track

0km1km2km

Figure 2 Site layout

RATCH-Australia Corporation

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MOUNT EMERALD WIND FARM

guyed, narrow lattice or tubular steel design. The wind monitoring masts will be unlikely to create a significant visual impact, and are similar in scale, or smaller than a number of surrounding communication masts visible in the landscape surrounding the wind farm project area.

3.4 On-site access tracks

On-site access tracks will be constructed to provide access to turbine locations across the site during construction and operation. During construction the majority of access tracks will be up to 5-6 m wide (wider at bends) to allow for vehicle manoeuvring. Post construction, these access tracks will be partially rehabilitated up to 6 m width to facilitate access for maintenance vehicles during the operational phase. The final access track design will be developed on a number of environmental grounds, including minimising the potential for visual impact by considering:

- overall length and extent;
- need for clearing vegetation;
- potential for erosion;
- extent of cut and fill; and
- potential to maximise rehabilitation at the completion of the construction phase.

The proposed main access road to the wind farm plateau (starting from the junction of Springmount and Kippen Drive) will utilise the route of an existing gravel track leading up to the wind plateau. This track is partially visible from public roads and a small number of residential dwellings to the north east of the project area along Channel Drive. Works to widen the existing track will also include cut and fill operations to grade the existing track to enable access for construction and maintenance vehicles. Whilst this is likely to result in an increased level of visibility for the access road, there are a number of feasible and direct mitigation strategies which may be employed to reduce the potential level of visual significance. Strategic tree and shrub planting will provide effective screening or partial filtering of views toward the proposed access road.

3.5 Electrical works

The majority of cabling works, including the installation of control cables linking the turbines to the control building will be installed underground. For various technical, commercial and landform

reasons some cabling may be required to be installed on medium voltage overhead powerline supported by single low profile tubular poles.

Grid connection will be achieved via a connection to an existing 275 kV transmission line which spans the project site. The wind farm turbines will be connected to an on-site collection/connection substation, control room and facilities for the grid connection.

Local environmental factors

Section 4

4.1 Climatic and atmospheric conditions

Local climatic and atmospheric conditions have the potential to influence the visibility of the project from surrounding view locations, and more significantly, from distant view locations. Meteorological data collected at Mareeba Airport between 1991 and 2002 indicates that there are:

- 86 clear days (annual mean average);
- 95 cloudy days (annual mean average); and
- 68 days of rain (annual mean average).

Rainfall will tend to reduce the level of visibility from a number of view locations surrounding the project with the degree of visibility tending to decrease over distance. Rain periods will be likely to reduce the number of visitors travelling through the areas from which the project could be visible, and potentially decrease the duration of time spent at a particular public view location with a view toward the project.

Cloud cover will also tend to reduce the level of visibility of the project and lessen the degree of contrast between the wind turbine structures and the background against which the wind turbines will be visible.

On clear or partly cloudy days, the position of the sun will also have an impact on the degree of visibility of the project. The degree of impact will be largely dependent on the relationship between the position and angle of the sun relative to the view location. Late afternoon and early evening views toward the west will result in the wind turbines silhouetted above the horizon line, and with increasing distance will tend to reduce the contrast between the wind turbine structures and the surrounding landform.

The extent to which weather conditions can influence visibility toward turbine structures is illustrated in **Figure 3**.



PHOTOGRAPH A - Day time view from Hume highway toward Cullerin wind farm at around 3.5km (13th June 2010)

PHOTOGRAPH A
Illustrates the visibility of wind turbines against a clear and blue sky backdrop with sunlight from above and to the right of the wind turbines creating a shadow line along the left hand side of the towers as well as portions of the rotor blades.



PHOTOGRAPH B - Day time view from Hume highway toward Cullerin wind farm at around 3.5km (10th June 2010)

PHOTOGRAPH B
Illustrates the visibility of wind turbines against a partly cloudy and overcast backdrop. The wind turbines in cloud shadow appear off white to grey in colour.



PHOTOGRAPH C - Day time view from Hume highway toward Cullerin wind farm at around 3.5km (7th July 2010)

PHOTOGRAPH C -
Illustrates the visibility of wind turbines in fog/low cloud cover.

Figure 3
Visibility and weather



4.2 Topography and vegetation

A detailed survey of existing vegetation has been carried out as part of the biodiversity assessment for the project EIS. In general the landscape surrounding the project site contains vegetation associated with woodland, drainage lines, small ponds/dams and cleared land for pasture and agricultural crop cultivation. Stands of remnant woodland occur within the wider context of a modified landscape which continues to be managed and influenced through a variety of farming activities.

Timbered areas have some potential to provide partial or full screening toward the project area from surrounding public and residential view locations. The screening potential tends to increase when combined with the local topography of hills and undulating landform.

The topography and vegetation within the landscape surrounding the project site is illustrated in the panorama photographs presented in **Figures 5 to 9**.

Panorama photographs

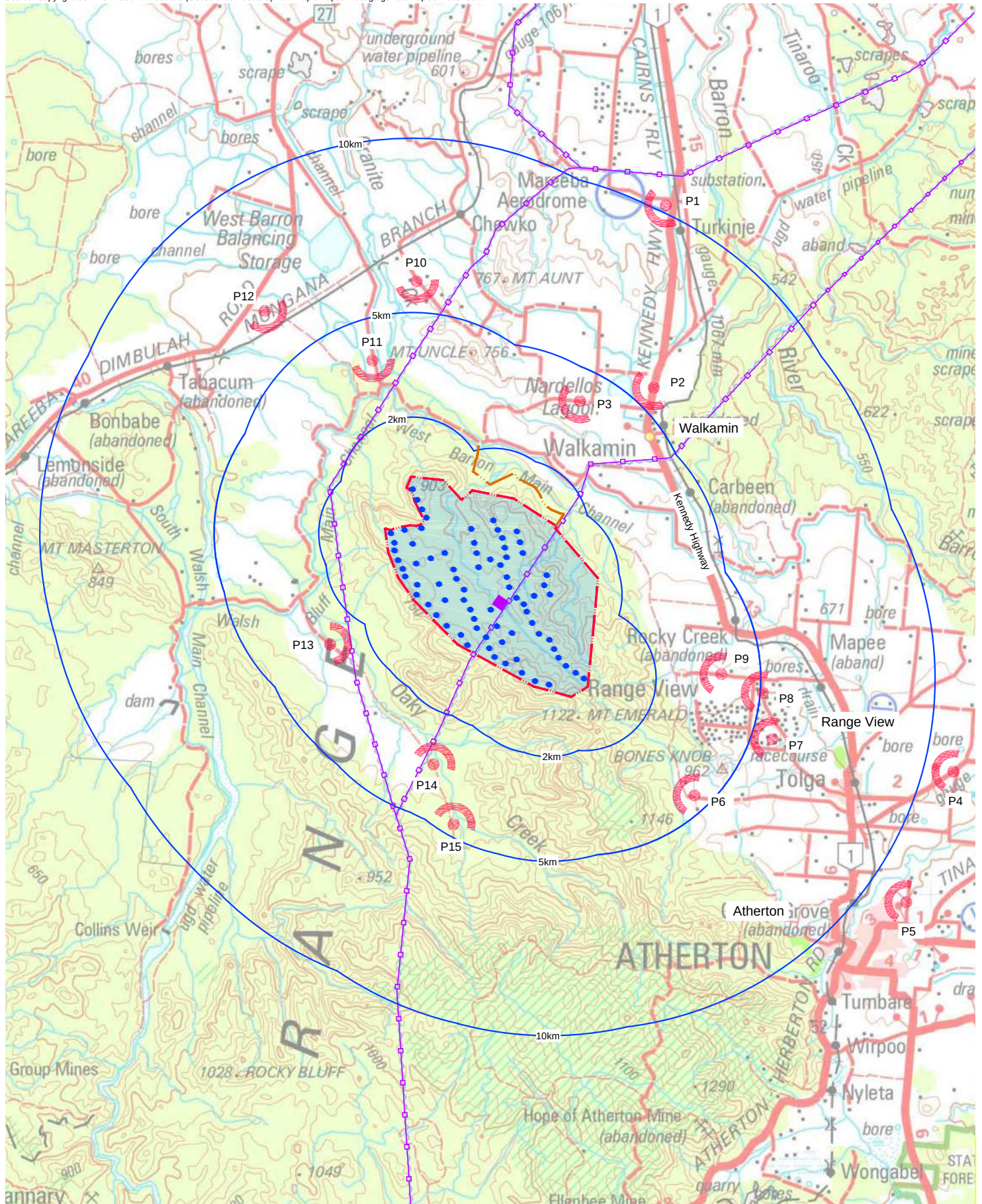
Section 5

5.1 Panorama Photographs

A series of digital photographs were taken during the course of the fieldwork to illustrate existing views in the vicinity of a number of view locations inspected and assessed as part of this LVIA. Individual photographs were digitally stitched together to form a segmented panorama image to provide a visual illustration of the existing view from each photo location.

The panorama photographs presented in this LVIA have been annotated to identify key features or structures located within the existing view. They also indicatively illustrate the general extent and location of potentially visible wind turbines or portions of turbine structures for the project.

The panorama photograph locations are illustrated in **Figure 4**, and the panorama photographs illustrated in **Figures 5 to 9**. The panorama photographs are not to be confused with the photomontages. The panorama photographs do not include a representation or model of the wind turbine structures. The photomontages are discussed in **Section 10** of this LVIA, and are illustrated in **Figures 17 to 44**.



Legend

- Proposed Mount Emerald wind turbine (indicative layout)
- (Distance from proposed Mount Emerald wind turbine
- Existing transmission line
- Proposed access track
- Proposed substation (indicative location)
- Indicative site boundary
-  Photo location

0km 2km



Figure 4
Photo locations

RAC
RATCH-Australia Corporation

GREEN BEAN DESIGN
landscape architects

MOUNT EMERALD WIND FARM

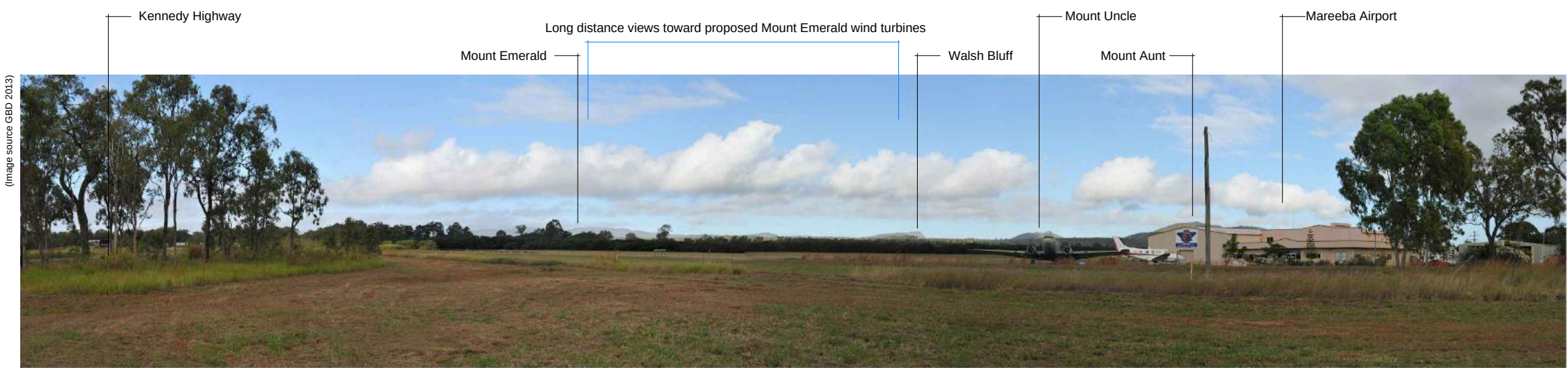


Photo Location P1- View south to south west from Kennedy Highway across Mareeba Airport



Photo Location P2 - View south to south west from the Kennedy Highway (southbound)

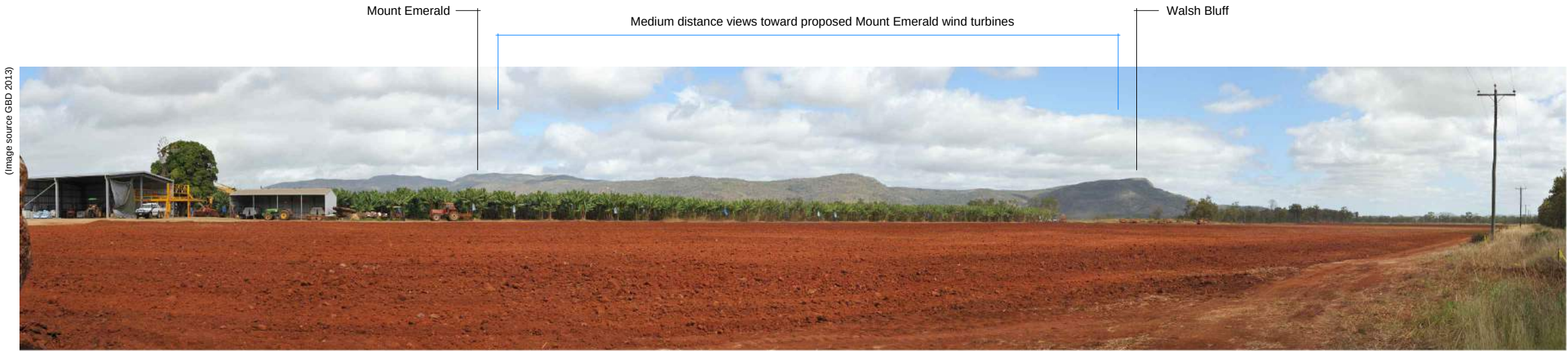


Photo Location P3 - View south to west from Hansen Road

Notes

Individual photographs taken with a Nikon D700 camera with a 50 mm prime lens. This combination of camera and lens results in a photograph equivalent to a 35mm single lens reflex camera with a 75 mm lens.

Composite digital stitching results in a panorama with an approximate view angle between 110° and 130°.

Extent of potential wind turbine visibility and illustrated on each panorama photograph is indicative only.

Figure 5
Photo Sheet 1



MOUNT EMERALD WIND FARM

(Image source GBD 2013)



Photo Location P4- View west to north west from Kairi Road

(Image source GBD 2013)



Photo Location P5 - View west to north west from Twelfth Avenue, Atherton

(Image source GBD 2013)



Photo Location P6 - View north west from Griffin Road

Notes

Individual photographs taken with a Nikon D700 camera with a 50 mm prime lens. This combination of camera and lens results in a photograph equivalent to a 35mm single lens reflex camera with a 75 mm lens.

Composite digital stitching results in a panorama with an approximate view angle between 110° and 130°.

Extent of potential wind turbine visibility and illustrated on each panorama photograph is indicative only.

Figure 6
Photo Sheet 2



MOUNT EMERALD WIND FARM

(Image source GBD 2013)

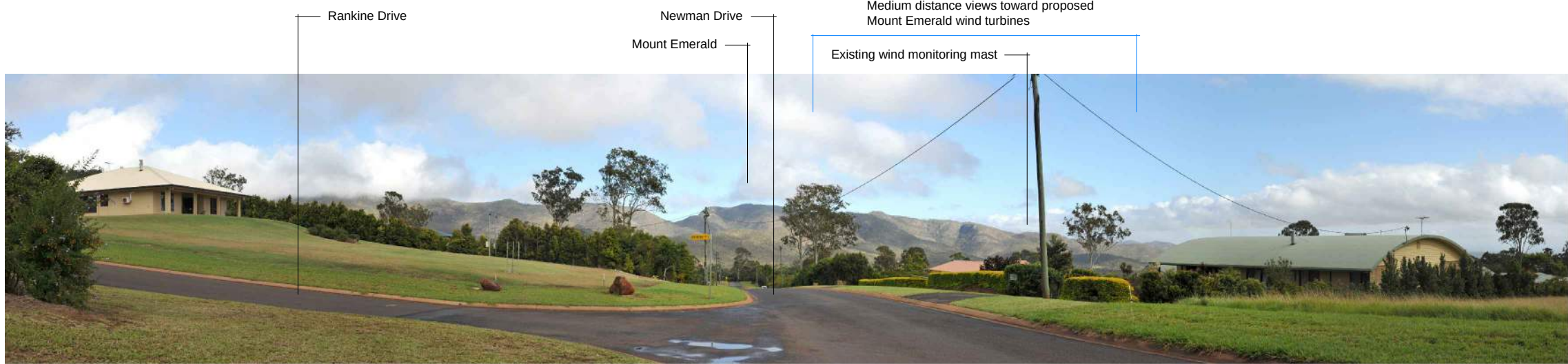


Photo Location P7- View north west from corner of Newman Road and Rankin Drive, Range View

(Image source GBD 2013)

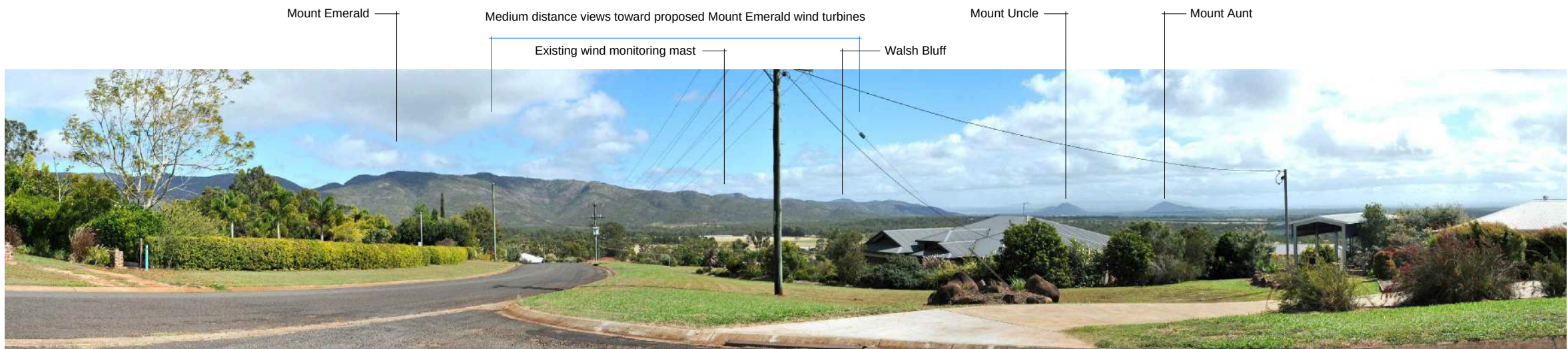


Photo Location P8 - View west to north west from Moffat Drive, Range View

(Image source GBD 2013)



Photo Location P9 - View south to west from Marnane Road

Notes

Individual photographs taken with a Nikon D700 camera with a 50 mm prime lens. This combination of camera and lens results in a photograph equivalent to a 35mm single lens reflex camera with a 75 mm lens.

Composite digital stitching results in a panorama with an approximate view angle between 110° and 130°.

Extent of potential wind turbine visibility and illustrated on each panorama photograph is indicative only.

Figure 7
Photo Sheet 3



MOUNT EMERALD WIND FARM



(Image source GBD 2013)



Photo Location P10- View south from Narcotic Creek Road

(Image source GBD 2013)

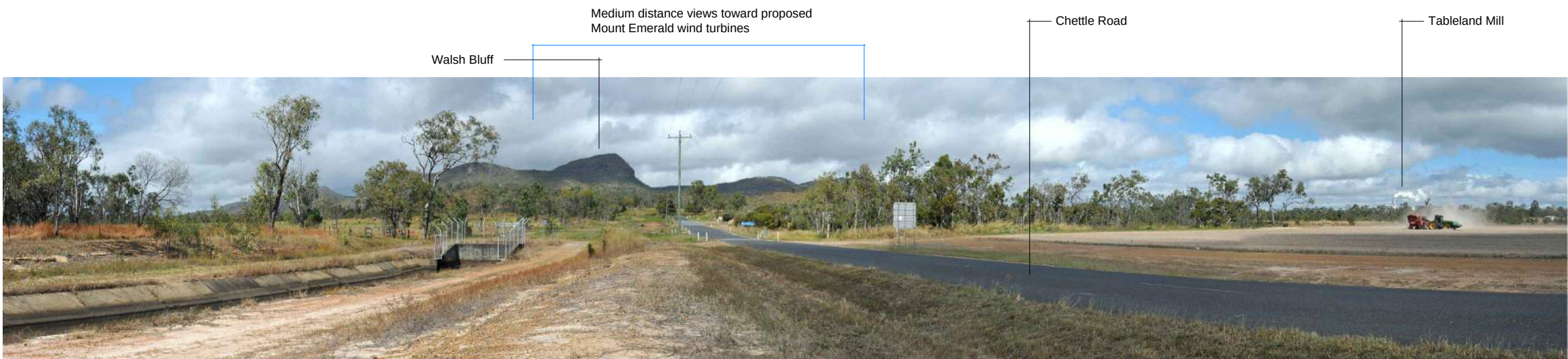


Photo Location P11 - View south from Chettle Road

(Image source GBD 2013)

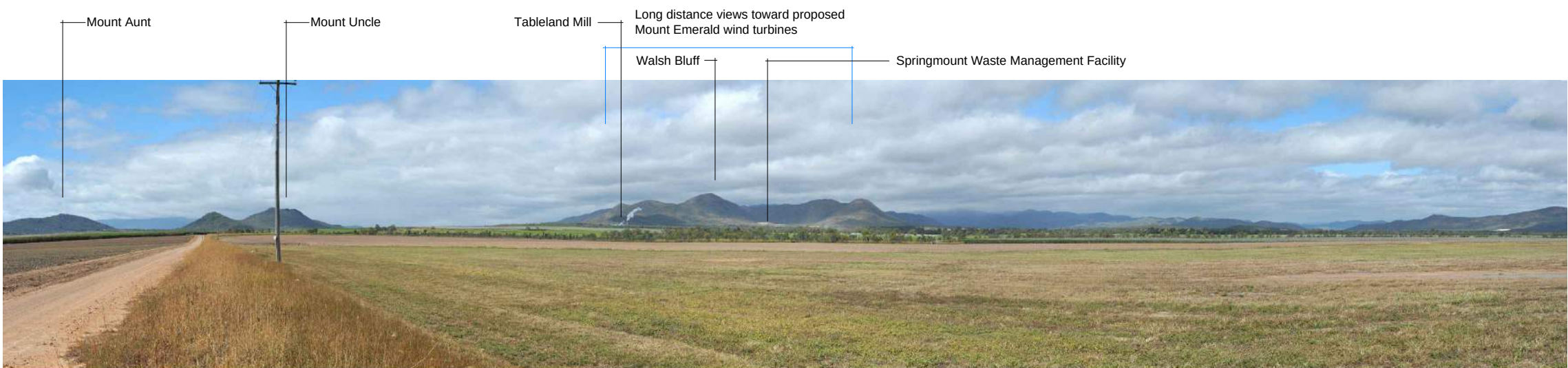


Photo Location P12 - View south to south east from farm access track (east of Burke Developmental Road)

Notes

Individual photographs taken with a Nikon D700 camera with a 50 mm prime lens. This combination of camera and lens results in a photograph equivalent to a 35mm single lens reflex camera with a 75 mm lens.

Composite digital stitching results in a panorama with an approximate view angle between 110° and 130°.

Extent of potential wind turbine visibility and illustrated on each panorama photograph is indicative only.

Figure 8
Photo Sheet 4



MOUNT EMERALD WIND FARM



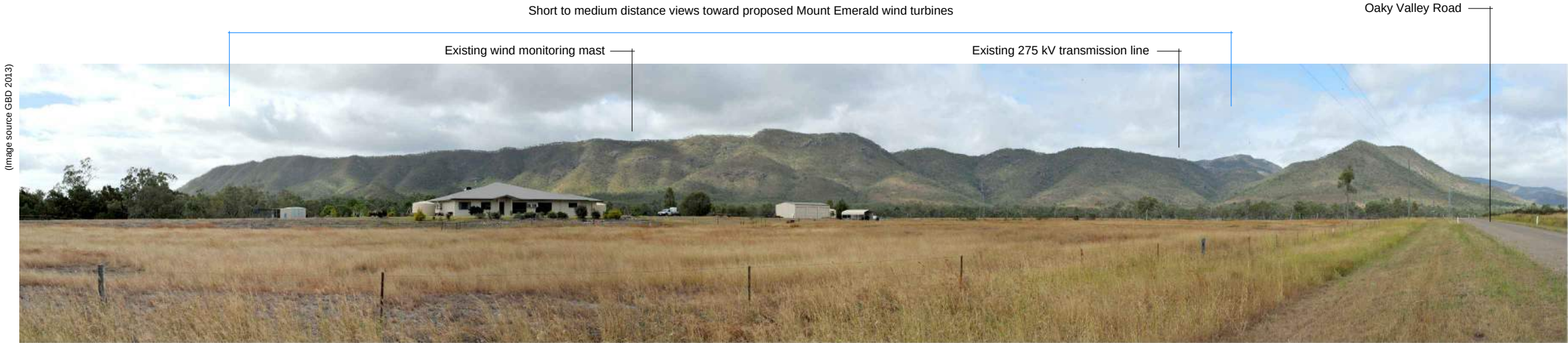


Photo Location P13- View north east to south east from Oaky Valley Road



Photo Location P14 - View north west to east from Oaky Valley Road

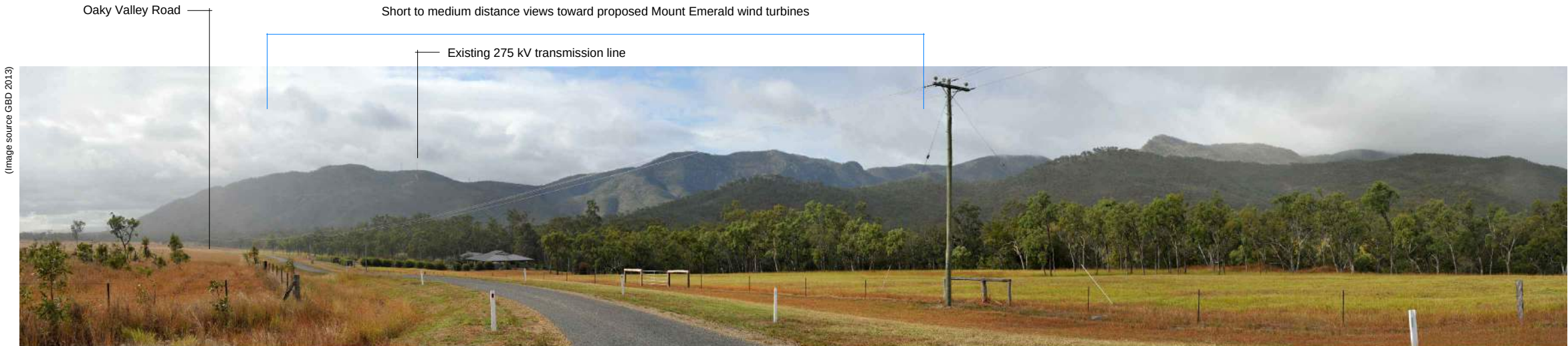


Photo Location P15 - View north west to east from Oaky Valley Road

Notes

Individual photographs taken with a Nikon D700 camera with a 50 mm prime lens. This combination of camera and lens results in a photograph equivalent to a 35mm single lens reflex camera with a 75 mm lens.

Composite digital stitching results in a panorama with an approximate view angle between 110° and 130°.

Extent of potential wind turbine visibility and illustrated on each panorama photograph is indicative only.

Figure 9
Photo Sheet 5



MOUNT EMERALD WIND FARM



Landscape character areas

Section 6

6.1 Landscape character areas

A fundamental part of this LVIA is to understand and describe the nature and sensitivity of different components of the landscape within the project viewshed, and to assess the landscape character in a clear and consistent process. For the purpose of this LVIA, landscape character is defined as *‘the distinct and recognisable pattern of elements that occur consistently in a particular type of landscape’* (The Countryside Agency and Scottish Natural Heritage 2002).

This LVIA has identified five Landscape Character Areas (LCA’s), which occur within the project viewshed. The five LCA’s represent areas that are relatively consistent and recognisable in terms of their key visual elements and physical attributes; which include a combination of topography/landform, vegetation/landcover, land use and built structures (including settlements and local road corridors).

The five LCA’s have been identified through a desk top assessment and described during the landscape assessment fieldwork carried out for the LVIA. The LCA’s are not considered to be discrete areas, and characteristics within one LCA may occur within adjoining or surrounding LCA’s. For the purpose of this LVIA the five LCA include:

- LCA 1 – Plateau;
- LCA 2 – Slopes and hills;
- LCA 3 – Cultivated agricultural land;
- LCA 4 – Timbered areas; and
- LCA 5 – Settlement.

6.2 Landscape sensitivity assessment

The British Landscape Institute describes landscape sensitivity as *‘the degree to which a particular LCA can accommodate change arising from a particular development, without detrimental effects on its character’*.

The assessment of landscape sensitivity is based upon an evaluation of the physical attributes identified within each LCA, both singularly and as a combination that gives rise to the landscape’s

overall robustness and the extent to which it could accommodate the wind farm development. The criteria used to determine landscape sensitivity are outlined in **Table 4** and based on current good practice employed in the assessment of wind farm developments. This LVIA draws on the Land Use Consultants report on landscape sensitivity for wind farm developments on the Shetland Islands (March 2009) as well as the Western Australian Planning Commission manual for Visual Landscape Planning (2007). Landscape sensitivity is a relative term, and the intrinsic landscape values of the surrounding landscape could be considered of a higher or lower sensitivity than other areas in the Atherton Tableland region.

Whilst the assessment of landscape sensitivity is largely based on a systematic description and analysis of landscape characteristics, this LVIA acknowledges that some individuals and other members of the local community will place higher values on the local landscape. These values could transcend preferences (likes and dislikes) and include personal, cultural as well as other parameters.

Table 4 – Landscape Sensitivity Criteria

Landscape Sensitivity Assessment Criteria			
Characteristic	Aspects indicating lower sensitivity to the wind farm development	↔	Aspects indicating higher sensitivity to the wind farm development
Landform and scale: patterns, complexity and consistency	<ul style="list-style-type: none"> • Large scale landform • Simple • Featureless • Absence of strong topographical variety 	↔	<ul style="list-style-type: none"> • Small scale landform • Distinctive and complex • Human scale indicators • Presence of strong topographical variety
Landcover: patterns, complexity and consistency	<ul style="list-style-type: none"> • Simple • Predictable • Smooth, regular and uniform 	↔	<ul style="list-style-type: none"> • Complex • Unpredictable • Rugged and irregular
Settlement and human influence	<ul style="list-style-type: none"> • Concentrated settlement pattern • Presence of contemporary structures (e.g. utility, infrastructure or industrial elements) 	↔	<ul style="list-style-type: none"> • Dispersed settlement pattern • Absence of modern development, presence of small scale, historic or vernacular settlement
Movement	<ul style="list-style-type: none"> • Prominent movement, busy 	↔	<ul style="list-style-type: none"> • No evident movement, still

Landscape Sensitivity Assessment Criteria			
Characteristic	Aspects indicating lower sensitivity to the wind farm development	↔	Aspects indicating higher sensitivity to the wind farm development
Rarity	<ul style="list-style-type: none"> Common or widely distributed example of landscape character area within a regional context 	↔	<ul style="list-style-type: none"> Unique or limited example of landscape character area within a regional context
Intervisibility with adjacent landscapes	<ul style="list-style-type: none"> Limited views into or out of landscape Neighbouring landscapes of low sensitivity Weak connections, self contained area and views Simple large scale backdrops 	↔	<ul style="list-style-type: none"> Prospects into and out from high ground or open landscape Neighbouring landscapes of high sensitivity Contributes to wider landscape Complex or distinctive backdrops

The landscape sensitivity assessment criteria set out in **Table 4** have been evaluated for each of the five LCA's by applying a professionally determined judgement on a sliding scale between 1 and 5.

A scale of 1 indicates a landscape characteristic with a lower sensitivity to the wind farm development (and will be more likely to accommodate the wind farm development). A scale of 5 indicates a landscape characteristic with a high level of sensitivity to the wind farm development (and less likely to accommodate the wind farm development).

The scale of sensitivity for each LCA is outlined in **Tables 5 to 9** and is set out against each characteristic identified in **Table 4**.

The overall landscape sensitivity for each LCA is a summation of the scale for each characteristic identified in **Tables 5 to 9**. The overall scale is expressed as a total out of 30 (i.e. 6 characteristics for each LCA with a potential top scale of 5). Each characteristic is assessed separately and the criteria set out in **Table 4** are not ranked in equal significance. The overall landscape sensitivity for each of the five LCA has been determined as either:

High (Scale of 24 to 30) – key characteristics of the LCA will be impacted by the proposed project, and will result in major and visually dominant alterations to perceived characteristics of the LCA which may not be fully mitigated by existing landscape elements and features. The degree to which the

landscape may accommodate the proposed project development will result in a number of perceived uncharacteristic and significant changes.

Medium to High (Scale of 16 to 23) – recognisable characteristics of the LCA will be altered by the proposed project, and result in the introduction of visually prominent elements that will alter the perceived characteristics of the LCA but may be partially mitigated by existing landscape elements and features within the LCA. The main characteristics of the LCA, patterns and combinations of landform and landcover will still be evident.

Medium (Scale 11 to 15) – distinguishable characteristics of the LCA may be altered by the proposed project, although the LCA may have the capability to absorb some change. The degree to which the LCA may accommodate the proposed project will potentially result in the introduction of prominent elements to the LCA, but may be accommodated to some degree.

Low Rating (Scale of 6 to 10) – the majority of the LCA characteristics are generally robust, and will be less affected by the proposed project. The degree to which the landscape may accommodate the wind farm will not significantly alter existing landscape character.

Very Low or Negligible Rating (Less than 6) the characteristics of the LCA will not be impacted or visibly altered by the proposed project.

6.3 Analysis of landscape sensitivity

The following section of this LVIA provides an analysis of landscape sensitivity within the viewshed of the wind farm development and considers characteristics within each of the LCA.

6.3.1 LCA 1 Plateau



Plate 1 – Typical view toward plateau LCA

Table 5 – LCA 1 – Plateau -Landscape Sensitivity

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale					
	The plateau area is a medium to large scale landscapes with a gentle to moderate undulating landform. The structure of the landform is simple containing few distinct features and has limited topographical elements.				
Landcover					
	Landcover across the plateau is predominantly simple and predictable with scattered tree and shrub cover forming the predominant visual backdrop.				
Settlement and human influence					
	There is an overall absence of modern development across the plateau landscape, excluding the existing transmission line and access tracks.				
Movement					
	There is very limited movement within the plateau LCA with very occasional traffic.				
Rarity					
	Areas of plateau occur within limited areas of the Atherton Tableland; however, the project site plateau is limited landscape type with a local area.				
Intervisibility					
	The plateau LCA appears as a simple backdrop in views from surrounding areas. Undulating landform within the LCA can retain and constrict views within the landscape, but generally contributes to views across the wider landscape.				
Overall Sensitivity Rating	Medium to High (Score 19 out of 30)				

6.3.2 LCA 2 Slopes and hills

**Plate 2** – Typical view across slopes and hills LCA**Table 6** – LCA 2 – Slopes and hills – Landscape Sensitivity

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale					
	Slopes and hills are represented by a generally open and large scale landform with distant views available from elevated areas within this landscape. The landform is simple containing few distinct features and has a general absence of any strong topographical elements.				
Landcover					
	Landcover is predominantly simple and predictable within the context of similar areas across the Atherton Tableland. The overall landscape pattern within this landscape is smooth, regular and uniform, although mosaics of timbered areas on surrounding slopes and cultural planting surrounding dwellings create some diversity and contrast in pattern.				
Settlement and human influence					
	Settlement is occasional and dispersed within this landscape and does not generally occur along the top of ridgelines or on elevated and exposed slopes. The main influences of human activity are the effects of agricultural improvement within the landscape.				
Movement					
	A lack of any significant movement gives this landscape an overall still character.				
Rarity					
	Simple slopes and hills are generally well represented and a common feature across the broader regional area of the Atherton Tableland.				
Intervisibility					
	Intervisibility is limited as views from within this landscape are often contained by undulating or sloping landform rising to ridgelines, however, potential distant views do occur from elevated landform to provide links to adjoining landscape areas.				
Overall Sensitivity Rating	Medium to High (Score 17 out of 30)				

6.3.3 LCA 3 Cultivated agricultural land

**Plate 3** – Typical views across cultivated agricultural land LCA**Table 7** – LCA 3 – Cultivated agricultural land - Landscape Sensitivity

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale					
	Cultivated agricultural land is generally located across gently sloping and level landform resulting in a moderate scale landform. The landform is simple containing few distinct features and has an absence of any strong topographical elements.				
Landcover					
	Landcover is predominantly simple and predictable within the context of widespread cultivated landscapes across the broader regional area of the Atherton Tableland. The overall landscape pattern created by farming within this landscape is smooth, regular and uniform, although occasional timbered stands along natural drainage lines create some diversity and contrast in pattern.				
Settlement and human influence					
	There is low density settlement within this landscape with a small and dispersed number of agricultural structures (some abandoned), minor access tracks and fences occurring throughout.				
Movement					
	Movement is generally limited to local roads and access tracks as well as agricultural activities across plantations and cultivated cropping areas.				
Rarity					
	Cultivated agricultural land is generally well represented and a common feature across the broader regional area of the Atherton Tableland landscape.				
Intervisibility					
	Intervisibility is limited as views from within this landscape are often contained by sloping landform and established tree cover surrounding and beyond cultivated areas.				
Overall Sensitivity Rating	Medium (Score 15 out of 30)				

6.3.4 LCA 4 Timbered areas

**Plate 4** – Typical view toward timbered LCA**Table 8** – LCA 4 – Timbered areas - Landscape Sensitivity

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale					
	Timbered areas occur across a range of landform types that are generally defined by gently sloping or undulating landform resulting in a moderate scale landform.				
Landcover					
	Landcover is predominantly simple and predictable within the context of similar timbered areas across the Atherton Tableland. The overall landscape pattern created by timbered areas creates diversity and contrast to the smooth, regular and uniform cultivated areas within the landscape. The darker coloured foliage of timbered areas contrast against the surrounding backdrop of lighter toned pasture and cultivated areas.				
Settlement and human influence					
	Settlement is occasional and dispersed within timbered areas with the majority of dwellings visually screened from surrounding landscape areas. The main influences of human activity are the effects of agricultural improvement within the landscape.				
Movement					
	Movement is generally limited to local roads and access tracks.				
Rarity					
	Timbered areas are reasonably well represented and an established feature across broader regional areas of the Atherton Tableland.				
Intervisibility					
	The level of intervisibility between this landscape and adjoining areas is generally determined by the location and extent of timbered area relative to view locations, but on the whole is limited as views from within this landscape are constrained by vegetation, combined with sloping landform. Views from scattered or lightly timbered areas provide links to adjoining landscape areas.				
Overall Sensitivity Rating	Medium to High (Score 16 out of 30)				

6.3.5 LCA 5 Settlement

**Plate 5** – Typical view along local road Walkamin**Table 9** – LCA 5 – Settlement - Landscape Sensitivity

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale					
	Settlement extends across a range of landform types which include gently sloping and low undulating landform to steeper hills and slopes resulting in an overall small to moderate scale rural urban environment.				
Landcover					
	The overall landscape pattern is defined by human scale indicators including houses, shops and roads together with a variety of urban structures which create some diversity and contrast in pattern. There are generally no elements that result in the presence of strong topographical variety.				
Settlement and human influence					
	Dwellings are dispersed beyond town and village settlement areas and are generally associated with individual farms and rural structures.				
Movement					
	Movement is generally limited to local roads and access tracks.				
Rarity					
	Urban settlements are dispersed across the landscape, as well as the broader regional area of the Atherton Tableland.				
Intervisibility					
	Intervisibility is limited where views are partially contained by buildings and structures, although views from elevated areas of the settlement extend beyond and across adjoining landscape areas.				
Overall Sensitivity Rating	Medium to High (Score 17 out of 30)				

6.4 Summary

In terms of overall landscape sensitivity, this LVIA has determined that the landscape within the viewshed of the proposed Mount Emerald wind farm has a medium to high sensitivity to accommodate change, and represents a landscape that is reasonably typical of landscape types found in surrounding areas of the Atherton Tablelands.

As a landscape with an overall medium to high sensitivity to accommodate change, recognisable characteristics of the LCA will be altered by the proposed project, and result in the introduction of visually prominent elements that will alter the perceived characteristics of the LCA but may be partially mitigated by existing landscape elements and features within the LCA.

The main characteristics of the LCA, patterns and combinations of landform and landcover will still be evident. This capability is largely derived from the presence of predominantly large scale landscape across portions of the wind farm, together with the relatively low settlement density within the Mount Emerald viewshed.

Despite being 'naturalistic' in appearance large portions of the landscape have been heavily modified by agricultural improvement. Irrespective of the extent and nature of modifications to the landscape, it is not correct to assume that the landscape surrounding the wind farm should be any less valued as a result of modification. Physical change in the appearance of the landscape is an ongoing and constant process from both human and environmental influences and can result in both positive and negative effects.

Viewshed, zone of visual influence and visibility

Section 7

7.1 Introduction

A key component of this LVIA is defined by the description, assessment and determination of the viewshed, zone of visual influence and visibility associated with the wind farm. It is a combination of these issues that sets out the framework for determining the significance and magnitude of potential visual impact of the wind farm on view locations within the landscape.

In order to clarify and explain this component of this LVIA, the relationship between viewshed, zone of visual influence and visibility is outlined and defined in **Table 10**.

Table 10 – Definitions

	Definition	Relationship
Viewshed	An area of land surrounding and beyond the project area which may be potentially affected by the wind farm.	Identifies the majority of this LVIA study area that incorporates view locations that may be subject to a degree of visual impact.
Zone of Visual Influence (ZVI)	A theoretical area of landscape from which the wind farm structures may be visible.	Determines areas within a viewshed from which the wind turbines may be visible.
Visibility	A relative determination at which a wind turbine or cluster of wind turbines can be clearly discerned and described.	Describes the likely number and relative scale of wind turbines visible from a view location.

An overview of viewshed, zone of visual influence and visibility is discussed in the following sections.

7.2 Viewshed

For the purpose of this LVIA viewshed is defined as the area of land surrounding and beyond the project area which could be potentially affected by the wind farm. In essence, the viewshed defines this LVIA study area. The viewshed for the project has been divided into a series of concentric bands (at 2 km, 5 km and 10 km distance offsets) extending across the landscape from the wind turbines. The viewshed extent can vary between wind farm projects, and be influenced or informed by a number of criteria including the height of the wind turbines together with the nature, location and height of landform that could limit visibility.

It is important to note that the wind turbines will be visible from some areas of the landscape beyond the project viewshed; however, within the general parameters of normal human vision, a wind

turbine at around 130.5 m to the tip of the rotor blade will occupy a relatively small proportion of a person's field of view from distances in excess of 10 km.

The viewshed is used as a framework and guide for visibility assessment, as the degree of visual significance will tend to be gradated with distance although there are unlikely to be any distinct or abrupt noticeable changes between the nominated distances.

7.3 Zone of Visual Influence

The ZVI diagrams are used to identify theoretical areas of the landscape from which a defined number of wind turbines, or portions of turbines, could be visible within the viewshed. They are useful for providing an overview as to the extent to which the project could be visible from surrounding areas.

ZVI diagrams have been prepared to include:

- ZVI Diagram 1 from tip of blade;
- ZVI Diagram 2 from hub height; and
- ZVI Diagram 3 toward the whole turbine.

The extent to which the wind turbines may be visible within the 'tip', 'hub height' and 'whole turbine' ZVI are illustrated in **Figure 10**, and the ZVI Diagrams in **Figures 11 to 13**.

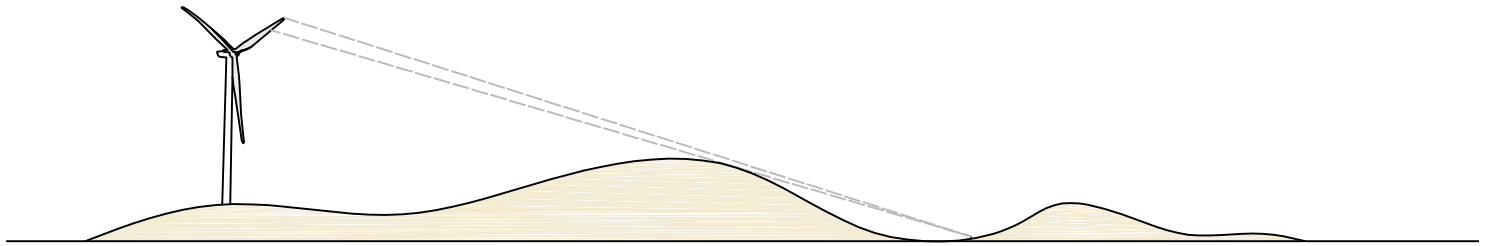
7.4 ZVI methodology

The methodology adopted for the ZVI is a purely geometric assessment where the visibility of the project is determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

Calculations have been made to determine the visibility of the wind turbines:

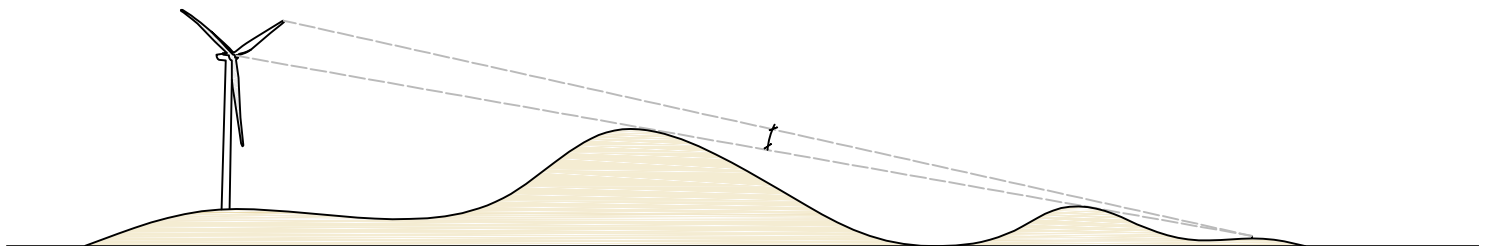
- to blade tips (essentially a view toward any part of the wind turbine rotor, including views toward the tips of blades above ridgelines);
- to hub height (essentially a view toward half the swept path of the wind turbine blades); and
- to the whole turbine (essentially a view toward the whole turbine).

The calculations also take into account the terrain relief and earth curvature.



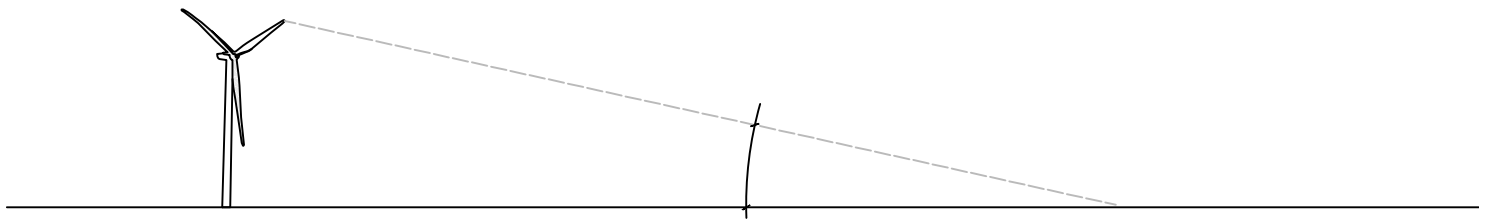
'Tip of blade'

View toward 'tip of blade' - where views extend toward the tip of blades above hill and ridgelines.



'Hub height'

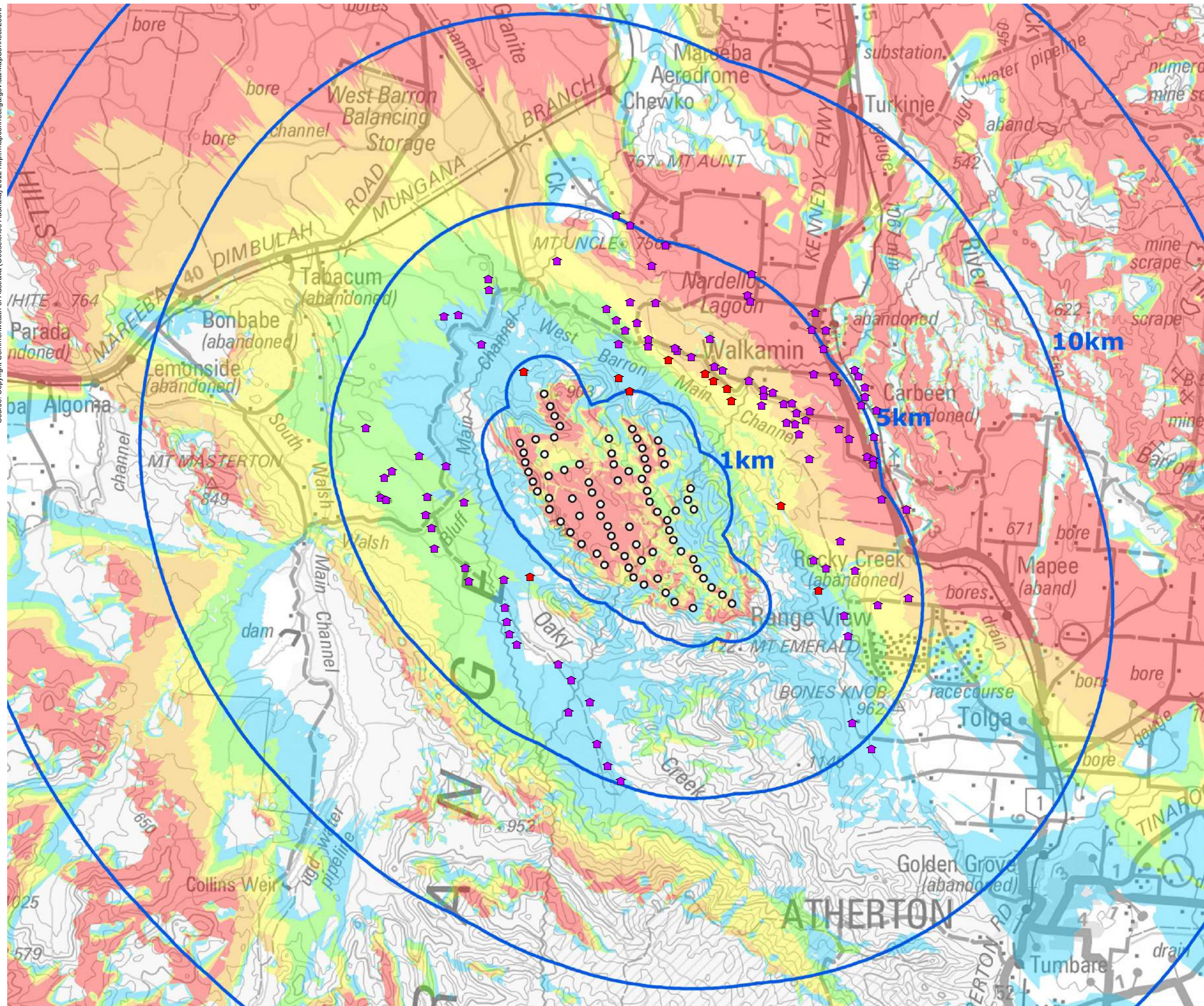
View toward 'hub height' - where views extend toward the upper half of the wind turbine rotor with views toward the lower half of the rotor face and tower screened by landform.



'Whole turbine'

View toward 'whole turbine' - where views extend from the base of the tower to the tip of the rotor blade.

Figure 10
ZVI visibility zones



NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed Mount Emerald wind farm is determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening affects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

Number of wind turbine tip of blade visible

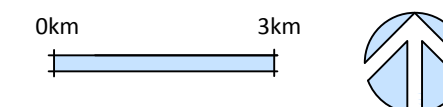


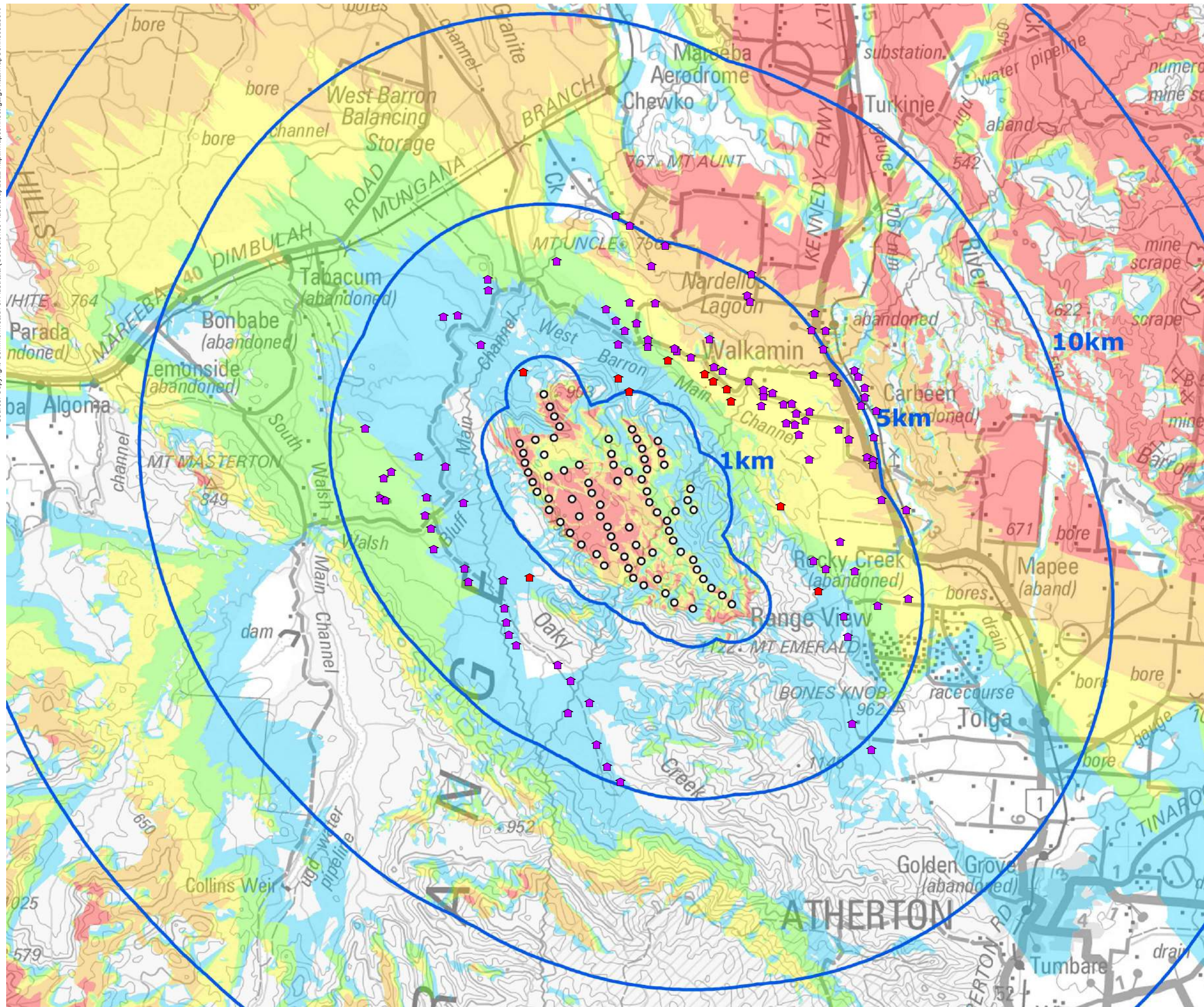
- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine

ZVI prepared by Truescape Visual Communication (based on a 75 wind turbine layout)

Figure 11
ZVI Diagram 1 Tip of blade

MOUNT EMERALD WIND FARM





NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed Mount Emerald wind farm is determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening affects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

Number of wind turbine tip of blade visible

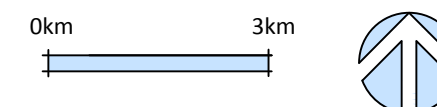


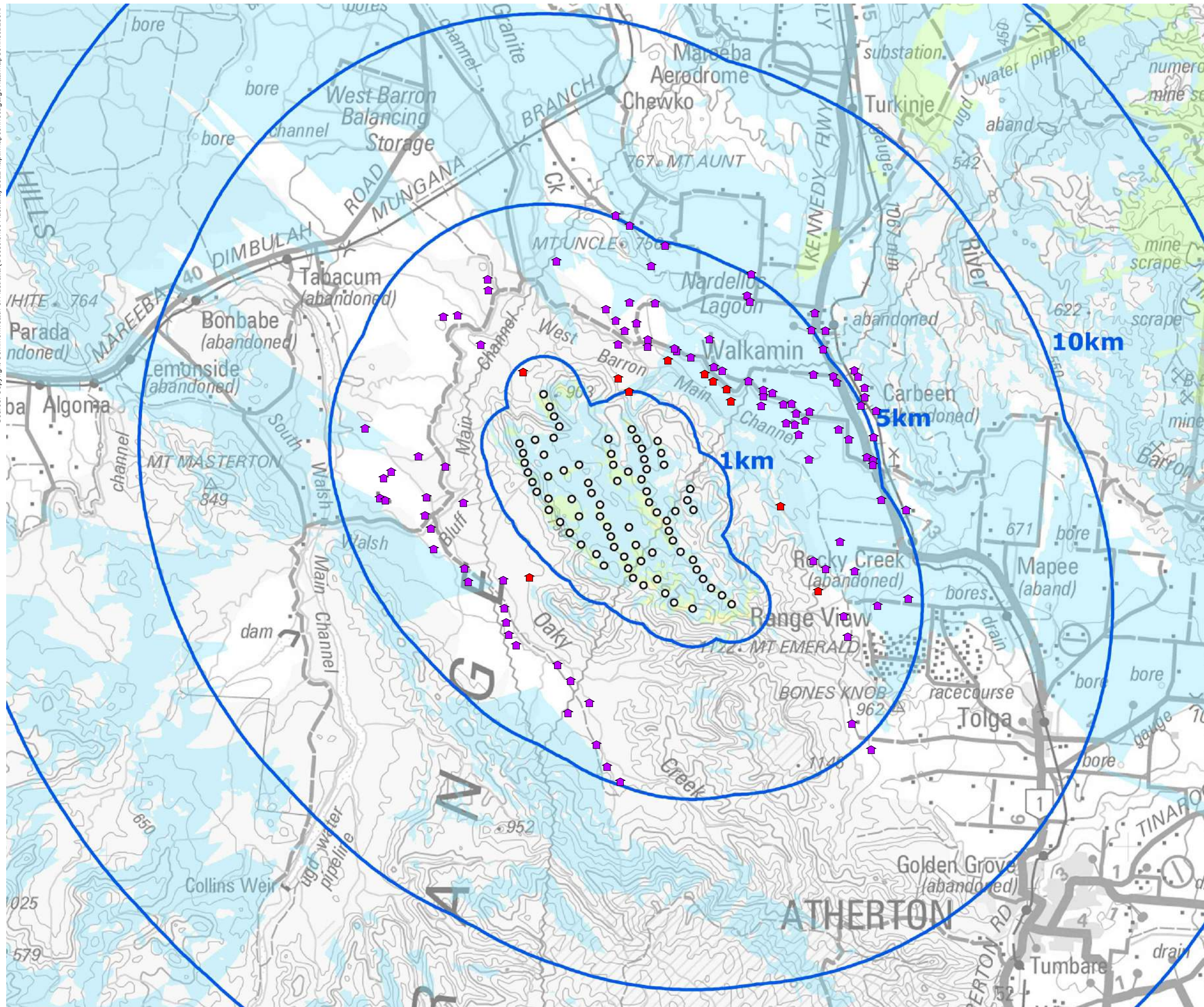
- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine

ZVI prepared by Truescape Visual Communication (based on a 75 wind turbine layout)

Figure 12
ZVI Diagram 2 Hub height

MOUNT EMERALD WIND FARM





NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed Mount Emerald wind farm is determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening affects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

Number of wind turbine tip of blade visible



- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine

ZVI prepared by Truescape Visual Communication (based on a 75 wind turbine layout)

Figure 13
ZVI Diagram 3 Whole turbine

MOUNT EMERALD WIND FARM

This assessment methodology is conservative as:

- the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI diagrams due to the local presence of trees or other screening materials.
- additionally, the number of turbines visible is also affected by the weather conditions at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

Accordingly, while ZVI diagrams are a useful visualisation tool, they are very conservative in nature.

7.5 ZVI summary

The most extensive and continuous area of visibility toward the project turbines will generally occur where the tips of the wind turbine rotor blades are visible above surrounding ridgelines or vegetation; however, views toward the tips and upper portions of the wind turbine rotors are likely to become less noticeable at reasonably short distances from the wind farm due to the screening influence of topography and dense tree cover. Views toward tip of blade are visually negligible from medium to longer distance view locations.

The ZVI diagrams for 'tip' and 'hub height' cover similar extents of landscape surrounding the wind farm, and extend toward isolated pockets of rural landscape beyond 10 km of the nearest wind turbine. The number and distribution of turbines visible between 'tip', 'hub' and 'whole' turbine height is influenced by ridgelines and surrounding hills for a number of areas between the 2 km, 5 km and 10 km distance offsets.

The ZVI diagrams illustrate areas of landscape which are likely to offer views toward the wind turbines and demonstrate that the majority of views generally occur within private property and across tracts of unoccupied rural landscape.

The ZVI diagrams also illustrate a number of discrete pockets within portions of the 2 km to 10 km distance offset from which the wind turbines will not be visible, although this band of the viewshed also represents areas from which a greater number of turbines will also be visible.

The ZVI diagrams illustrate that the influence of surrounding landform begins to disperse visibility from beyond 5 km, although opportunities to view turbines from elevated, but moderately distant and generally unoccupied areas occur from areas beyond 5 km.

It should be noted that the wind turbines, when viewed from distances of around, or greater than 10 km, will generally be less distinct from other distant elements within the same field of view, and that the majority of land within the viewshed comprises rural agricultural land and areas of dense timber growth.

7.6 Visibility

The level of wind turbine visibility within the Mount Emerald wind farm 10 km viewshed can result from a number of factors such as:

- distance effect;
- movement;
- relative position; and
- weather.

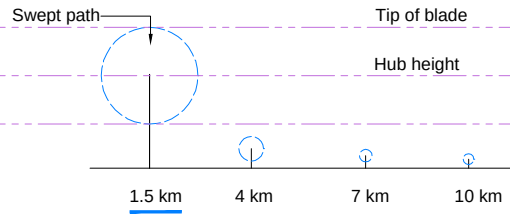
7.6.1 Distance effect

With an increase in distance the proportion of a person's horizontal and vertical view cone occupied by a visible turbine structure, or group of turbine structures, will decline. In order to demonstrate this a series of single frame photographs have been taken from pre-set distances (1.5 km, 4 km, 7 km and 10 km) toward wind turbines at the operational Capital wind farm in New South Wales. The photographs, illustrated in **Figure 14**, demonstrate the degree to which the apparent visible height of a wind turbine decreases with increasing distance (in a negative exponential relationship), and the increasing amount of horizontal skyline visible with an increasing distance.

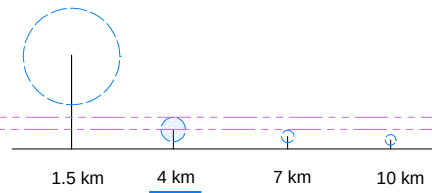
As the view distance increases so do the atmospheric effects resulting from dust particles and moisture in the atmosphere, which makes the turbines appear to be grey thus potentially reducing the contrast between the wind turbines and the background against which they are viewed.



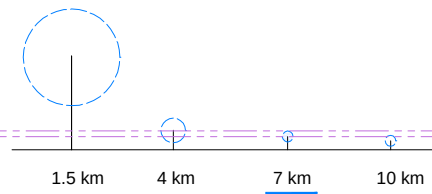
Capital Wind Farm - View distance 1.5 km



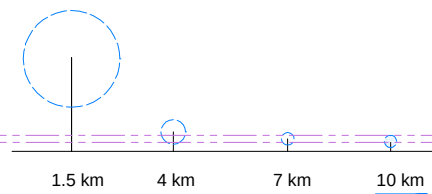
Capital Wind Farm - View distance 4 km



Capital Wind Farm - View distance 7 km



Capital Wind Farm - View distance 10 km



Capital Wind Farm turbines: Suzlon88,
80 m hub height, 88 m rotor diameter

Photographs: Pentax K10D, 50mm lens

Figure 14
Distance effect



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Whilst the distance between a view location and the wind turbines is a significant factor to consider when determining potential visibility, there are other issues which may also affect the degree of visibility. **Table 11** outlines the relative effect of distance on visibility and has been based on empirical research conducted by the University of Newcastle (2002) as well as direct observations made during wind farm site inspections.

Table 11 – Distance effect

Distance from turbine	Distance effect
>20 km	<p>Wind turbines become indistinct with increasing distance. Rotor movement may be visible but rotor structures are usually not discernible.</p> <p>Turbines may be discernible but generally indistinct within viewshed resulting in Low level visibility and Nil where influenced or screened by surrounding topography and vegetation.</p>
10 km – 20 km	<p>Wind turbines noticeable but tending to become less distinct with increasing distance. Blade movement may be visible but becomes less discernible with increasing distance.</p> <p>Turbines discernible but generally less distinct within viewshed (potentially resulting in Low level visibility).</p>
5 km – 10 km	<p>Wind turbines visible but tending to become less distinct depending on the overall extent of view available from the potential view location. Movement of blades discernible where visible against the skyline.</p> <p>Turbines potentially noticeable within viewshed (potentially resulting in Low to Moderate level visibility).</p>
3 – 5 km	<p>Wind turbines clearly visible in the landscape but tending to become less dominant with increasing distance. Movement of blades discernible.</p> <p>Turbines noticeable but less dominant within viewshed (potentially resulting in Moderate level visibility).</p>
1 – 3 km	<p>Wind turbines will generally dominate the landscape in which the wind turbine is situated. Potential for high visibility depending on the category of view location, their location, sensitivity and subject to other visibility factors.</p> <p>Turbines potentially dominant within viewshed (potentially resulting in Moderate to High level visibility).</p>
<1 km	<p>Wind turbines will dominate the landscape in which they are situated due to large scale, movement and proximity.</p> <p>Turbines dominant and significant within viewshed (potentially resulting in High level visibility).</p>

7.6.2 Movement

The visibility of the wind turbines will vary between the categories of static and dynamic view locations. In the case of static views the relationship between a wind turbine and the landscape will not tend to vary greatly. The extent of vision will be relatively wide as a person tends to scan back and forth across the landscape.

In contrast views from a moving vehicle are dynamic as the visual relationship between wind turbines is constantly changing, as is the visual relationship between the wind turbines and the landscape in which they are seen. The extent of vision can be partially constrained by the available view from within a vehicle at proximate distances.

7.6.3 Relative position

In situations where the view location is located at a lower elevation than the wind turbine, most of the turbine will be viewed against the sky. The degree of visual contrast between a white coloured turbine and the sky will depend on the presence of background clouds and their colour. For example, dark grey clouds will contrast more strongly with white turbines than a background of white clouds.

The level of visual contrast can also be influenced by the position of the sun relative to individual wind turbines and the view location. Where the sun is located in front of the viewer some visible portions of the wind turbine will be seen in shadow. If the background to the wind turbine is dark toned then visual contrast will tend to be reduced. Conversely where the sun is located behind the view location then the visible portion of the wind turbine will be in full sun.

Significance of visual impact

Section 8

8.1 Introduction

The significance of visual impact resulting from the construction and operation of the Mount Emerald wind farm will result primarily from a combination of:

- the overall sensitivity of visual receptors in the surrounding landscape; and
- the scale or magnitude of visual effects presented by the wind farm development.

The sensitivity of visual receptors has been determined and described in this LVIA by reference to:

- the location and context of the view point;
- the occupation or activity of the receptor; and
- the overall number of people affected.

This LVIA notes that although a large number of viewers in a category that will otherwise be of low or moderate sensitivity may increase the sensitivity of the receptor, it is also the case that a small number of people (such as residents) with a high sensitivity may increase the significance of visual impact.

Table 12 – View Location Sensitivity

View Category	Sensitivity
Residential Properties	<i>Highest Sensitivity</i>
Pedestrians (recreational)	▽
Public Recreational Space	▽
Rural employment/farming	▽
Motorists	▽
Business (commercial)	▽
Industry	<i>Lower Sensitivity</i>

Table 13 – Numbers of viewers

Criteria	Definition
Number of viewers	
High	> 500 people per day
Medium to high	100 - 499 people per day
Medium	50 - 99 people per day
Low	10 - 25 people per day
Very low	< 10 people per day

The scale or magnitude of visual effects associated with the project have been determined and described by reference to:

- the distance between the view location and the wind farm turbines;
- the duration of effect;
- the extent of the area over which the wind farm could be theoretically visible (ZVI hub height)
- the degree of visibility subject to existing landscape elements (such as forested areas or tree cover).

An overall determination of visual impact at each view location has also been assessed and determined against the criteria outlined in **Table 14** below:

Table 14 – Sensitivity and magnitude assessment criteria

Criteria	Definition
Distance	
Very short	<1 km
Short	1 – 3 km
Medium	3 km – 5 km
Long	5 km - 10 km +
Duration of effect	
High	> 2 hours
Medium	30 - 120 minutes
Low	10 – 30 minutes
Very low	< 10 minutes
Extent of visibility	
High	46 – 75 wind turbines visible from hub height

Table 14 – Sensitivity and magnitude assessment criteria

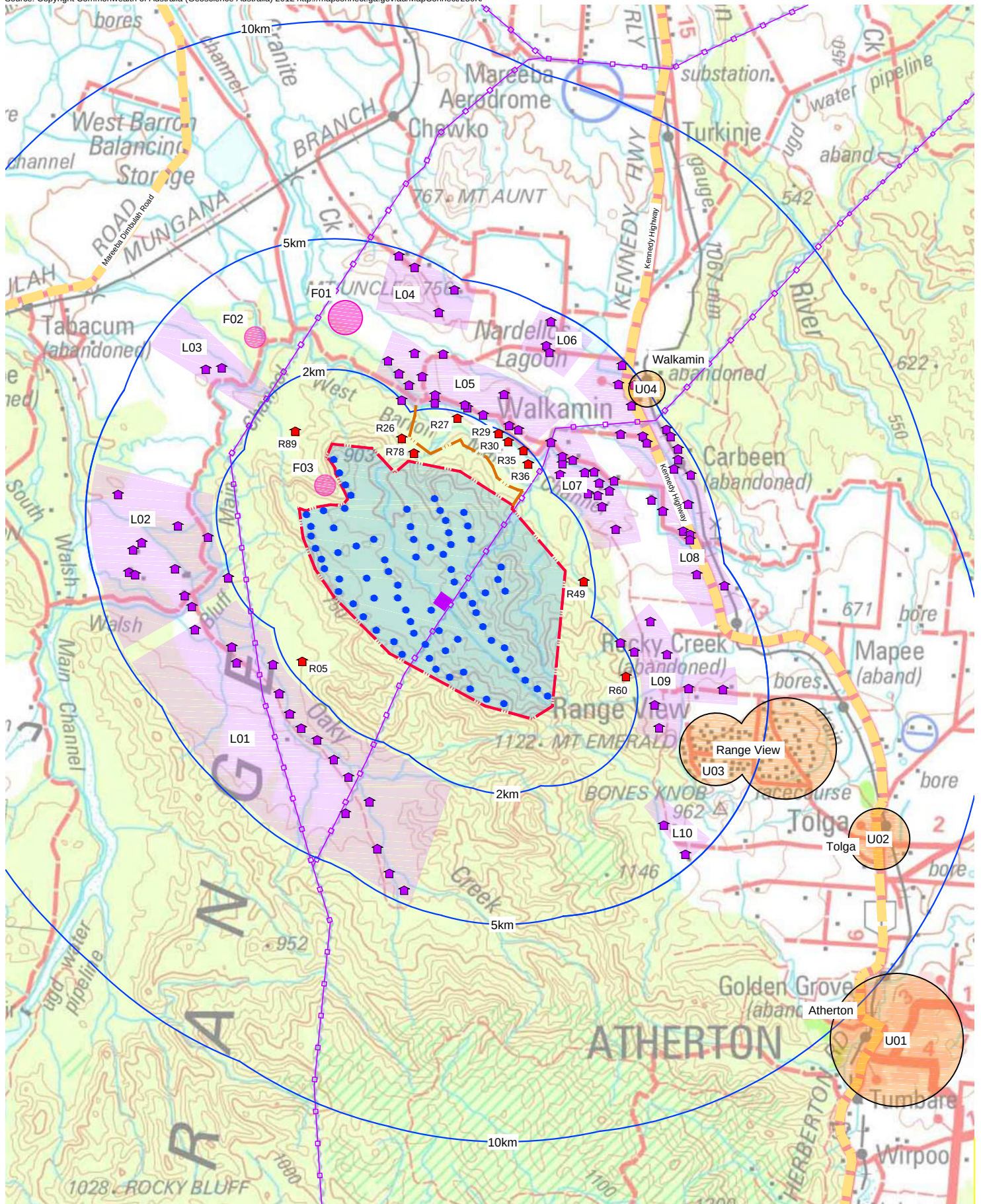
Criteria	Definition
Medium	31 – 45 wind turbines visible from hub height
Low	16 – 30 wind turbines visible from hub height
Very low	1 – 15 wind turbines visible from hub height

The levels of view sensitivity and scale or magnitude of change outlined in **Table 15** is used **as a guide** to determine levels of visual significance.

Table 15 Visual significance matrix

			Scale or magnitude of change in view caused by proposed development			
			High	Medium	Low	Very Low
			Very short distance view over a long duration of time. A high extent of wind turbine visibility will tend to dominate the available skyline view and significantly disrupt existing views or vistas.	Short to medium distance views over a medium duration of time. A moderate extent of wind turbine visibility will have the potential to dominate available views with visibility recessing over increasing distance.	Medium to long distance views over a low to medium duration of time. Wind turbines in views, at long distances or visible for a short duration not expected to be significantly distinct in the existing view.	Visible change perceptible at a very long distance, or visible for a very short duration, and/or is expected to be less distinct within the existing view.
Sensitivity of visual receptor	High	Indicator	High	Medium to High	Medium	Low to Medium
		Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities such as residents and users or visitors to attractive and/or well-used recreational facilities. Views from a regionally important location whose interest is specifically focussed on the landscape				
	Medium	Medium numbers of residents and moderate numbers of visitors with an interest in their environment e.g. visitors to environmental areas, such as bush walkers and horse riders etc...Larger numbers of travellers with an interest in their surroundings	Medium to High	Medium	Low to medium	Low
	Low	Low numbers of visitors with a passing interest in their surroundings e.g. those travelling along principal roads. Viewers whose interest is not specifically focussed on the landscape e.g. farm workers, commuters.	Medium	Low to Medium	Low	Very low to low
Very Low	Very low numbers of viewers or those with a passing interest in their surroundings e.g. those travelling along minor roads.	Low to Medium	Low	Very low to low	Very low	

This table is used as a guide only. The descriptions of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts.



Legend

- Proposed Mount Emerald wind turbine (indicative layout)
- Proposed substation (indicative location)
- Residential dwelling within 2 km of wind turbine
- (Distance from proposed Mount Emerald wind turbine
- Indicative site boundary
- Residential dwelling between 2 km and 5 km of wind turbine
- Existing transmission line
- Proposed access track
- Residential development or urban center

0km 2km



Figure 15
View locations

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8.2 View location matrix

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
R05	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,800 m	High	Very Low	Short distance and elevated views will extend toward a very low number of wind turbines along the south west boundary of the project site. Views toward wind turbines will be restricted to upper sections of towers and rotors.	Medium
R26	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,567 m	High	Very Low	Short distance and elevated views will extend toward a very low number of wind turbines within the north east portion of the project area.	Low to Medium
R27	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,930 m	High	Very Low to Low	Short distance and elevated views will extend toward a low number of wind turbines along the north to north east boundary of the project site.	Medium
R29	Uninvolved landowner Residential dwelling	Very low	Short 1,977 m	High	Medium	Short distance and elevated views will extend toward a medium number of wind turbines along the north and north east portion of the project site.	Medium to High

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	High sensitivity						
R30	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,890 m	High	Medium	Short distance and elevated views will extend toward a medium number of wind turbines along the north and north east portion of the project site. Some screening toward turbines from internal residential views and views from house veranda will occur through tree planting surrounding and beyond dwelling.	Medium to High
R35	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,948 m	High	Medium	Short distance and elevated views will extend toward a medium number of wind turbines along the north and north east portion of the project site. Vegetation surrounding the residential dwelling will provide some degree of screening toward the wind turbines.	Medium to High
R36	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,825 m	High	Medium	Short distance and elevated views will extend toward a medium number of wind turbines along the north and north east portion of the project site.	Medium to High
R49	Uninvolved landowner Residential dwelling High	Very low	Short 1,815 m	High	Medium	Short distance elevated views will extend toward a medium number of wind turbines along the eastern portion of the project site.	Medium to High

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	sensitivity						
R60	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,846 m	High	Nil	Views toward wind turbines from main residential dwelling and cabins within the Allawah Retreat will be screened by rising landform and ridgeline topography to the west of the occupied area.	Nil
R78	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,137 m	High	Very Low	Short distance and elevated views will extend toward a very low number of wind turbines within the north east portion of the project area.	Low to Medium
R89	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,100 m	High	Low	Short distance and elevated views will extend toward a very low number of wind turbines within the north portion of the project area.	Low
Assessment of residential dwellings between 2 km and 5 km of the proposed Mount Emerald wind turbines (Refer Figure 15 for locations)							
L01	Uninvolved landowners Residential dwellings	Very low	Short to Medium 2,300 m to 4,600 m	High	Nil to Very Low	Short to medium distance and elevated views will extend toward wind turbines along the western boundary of the project area from a small number of residential dwellings along Oak Creek Road.	Low to Medium

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	High sensitivity					Views toward the wind turbines from a small number of residential dwellings located between the existing 275 kV transmission line corridors will be screened by topography. A small number of residential dwellings will have views toward the wind turbines screened by tree cover and vegetation along the Oaky Creek corridor.	
L02	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,128 m to 4,365 m	High	Very Low to Low	Short to medium distance and elevated views will extend toward a very low to low number of wind turbines within the north west portion of the project area. Some degree of screening exists through tree cover surrounding and beyond residential dwellings.	Low to Medium
L03	Uninvolved landowners Residential dwellings High sensitivity	Very low	Medium 3,328 m to 3,600 m	High	Very Low	Medium distance and elevated views will extend toward a very low number of wind turbines within the north portion of the project area.	Low
L04	Uninvolved landowners Residential dwellings High sensitivity	Very low	Medium 4,150 m to 4,918 m	High	Nil to Medium	Medium distance views toward wind turbines will be largely screened by topography (sloping ground and ridgeline of Mount Uncle) as well as established tree cover surrounding and beyond residential dwellings.	Nil to Low

Table 16 – View location matrix (Refer Figure 15 for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
L05	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,261 m to 3,483 m	High	Very Low to Medium	Short to medium distance and elevated views toward wind turbines from residential dwellings north of Channel Road will be partially screened by established tree cover surrounding and beyond a number of the residential dwellings.	Low to Medium
L06	Uninvolved landowners Residential dwellings High sensitivity	Very low	Medium 4,859 m to 4,248 m	High	Medium to High	Medium distance and elevated views will be partially screened by established tree cover surrounding and beyond residential dwellings.	Low
L07	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,363 m to 3,269 m	High	Medium	Short to medium distance and elevated views will extend toward a medium number of wind turbines within the east and south east portion of the project area.	Low to Medium
L08	Uninvolved landowners Residential dwellings High sensitivity	Very low	Medium 3,790 m to 4,969 m	High	Medium	Medium distance views toward wind turbines within the east portion of the project area from residential dwellings either side of the Kennedy Highway will be partially screened by tree cover.	Low to Medium

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
L09	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,069 m to 4,029 m	High	Very Low to Low	Short to medium distance views toward wind turbines within the east portion of the project area will be largely screened by established tree cover surrounding and beyond residential dwellings.	Low
L10	Uninvolved landowners Residential dwellings High sensitivity	Very low	Medium 3,986 m to 4,825 m	High	Very Low	Medium distance and elevated views toward wind turbines within the south portion of the project area are largely screened by topography. Views toward a very low number of wind turbines will be restricted to upper sections and tips of turbine structures.	Very Low
Assessment of developed areas and facilities between 2 km and 5 km of the proposed Mount Emerald wind turbines (Refer Figure 15 for locations)							
U01 Atherton	Uninvolved landowners Residential dwellings High sensitivity	High	Around 10 km	High	Very Low	Distant views toward the Mount Emerald wind farm turbines will be largely screened by a combination of tree cover and built structures within the urban area. Views will extend toward a small portion of the project area from elevated areas within Atherton; however, the wind turbines are unlikely to have any significant impact as a distant view.	Very Low
U02 Tolga	Uninvolved landowners Residential dwellings	High	Around 8 km	High	Very Low	Distant views toward the Mount Emerald wind farm turbines will be largely screened by a combination of tree cover and gently sloping landform which rises to the west of Tolga. The wind turbines are	Very Low

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	High sensitivity					unlikely to have any significant impact as a distant view.	
U03 Range View	Uninvolved landowners Residential dwellings High sensitivity	High	3,400 m to 6,300 m	High	Very Low to Medium	Medium to distant views toward the Mount Emerald wind farm will be screened by established tree cover for the majority of residential dwellings within Range View. Residential dwellings located within elevated and cleared areas of Range View will have medium to distant views toward wind turbines within the south portion of the project area which, due to distance, will not result in a significant level of visibility.	Very Low to Low
U04 Walkamin	Uninvolved landowners Residential dwellings High sensitivity	High	Around 5 km	High	Medium to High	Medium to distant views toward the Mount Emerald wind turbines from the majority of residential dwellings within Walkamin will be screened by established tree planting surrounding and beyond residential dwellings, as well as tree planting alongside the Kennedy Highway corridor.	Low
F01 Lotus Glen Correctional Centre	Uninvolved dwellings	High	3,250 m	High	Low	Medium distance and elevated views will extend toward wind turbines within the north portion of the project area. Some screening will occur where views are disrupted or screened by built structures within the centre. Views will more likely occur from open areas including those for recreation in the east portion of the centre.	Low
F02	Uninvolved landowners	Very Low	3,342 m	High	Very Low	Medium distance and elevated views will extend toward a very low	Nil to Low

Table 16 – View location matrix (Refer **Figure 15** for view locations)

View location (Refer to Figure 28)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
Tableland Mill	and commercial facility Residential dwellings High					number of wind turbines within the north portion of the project area. Views from within the industrial complex, as well as a small number of dwellings immediately north of the mill, will tend to be screened by mill infrastructure and established tree cover.	
F03 Springmount Waste Management Facility	Commercial facility	Very Low	Adjoining	High	Very Low	Very short distance and elevated views will extend toward a very low number of wind turbines within the north portion of the project area from the working area of the waste management facility.	Low

8.3 Summary of residential visual significance (within 2 km of wind turbines)

This LVIA identified a total of 11 uninvolved residential view locations within the Mount Emerald wind farm 2 km viewshed. Unoccupied residential dwellings have been included and assessed as part of this LVIA where structures and buildings were considered to be habitable at the time of the field work. An assessment of each potential residential view location indicated that for the Mount Emerald wind turbine design layout:

- 1 of the 11 residential view locations has been determined to have a nil visual significance;
- 1 of the 11 residential view locations has been determined to have a low visual significance;
- 2 of the 11 residential view locations have been determined to have a low to medium visual significance;
- 2 of the 11 residential view locations have been determined to have a medium visual significance;
- 5 of the 11 residential view locations have been determined to have a medium to high visual significance; and
- 0 of the 11 residential view locations has been determined to have a high visual significance.

The field assessment for the majority of residential view locations was undertaken from the closest publicly accessible location, with a conservative approach adopted where there was no opportunity to confirm the actual extent of the available view from areas within or immediately surrounding the residence. It is anticipated that some visibility ratings will be less than those determined subject to a process of verification from private property.

8.4 Summary of residential visual significance (beyond 2 km of wind turbines)

The majority of residential dwellings located beyond a 2 km distance from the wind turbines are unlikely to be significantly impacted by the wind farm development and have been determined to have an overall low to medium and medium visual significance between 2 km and 5 km of the wind turbines. The localised influence of topography, as illustrated in the ZVI diagrams, has some direct impact on the extent and nature of views between the 2 km and 5 km viewshed.

8.5 Future residential dwellings

In general existing residential dwellings in the vicinity of the wind farm are located below surrounding ridgelines and where exposed tend to include a degree of shelter from windbreak planting or tree planting around dwellings. The tendency to locate residential dwellings in sheltered situations also acts to limit the extent of available views across the surrounding landscape for the majority of residential view locations, although there are a small number of dwellings that appear to have been located on properties to take advantage of distant and panorama views.

Potential future planning considerations for residential dwellings will be able to take advantage of any approved layout design for the Mount Emerald wind farm when determining the optimal location for residential dwellings on individual portions of land to minimise views toward wind turbines if desired. In some circumstances future residential dwellings could be located to take advantage of local topographic features in order to screen views toward wind turbines or implement in advance mitigation measures such as tree planting for windbreak and/or screening purposes.

Should residential dwellings be constructed on existing portions of land immediately adjacent to the wind farm site, there is likely to be an associated visual impact not only with additional residential structures within the landscape but also a range of domestic infrastructure associated with it.

8.6 Towns and localities

There are a small number of towns and localities within the Mount Emerald wind farm viewshed. These generally occur along, or in proximity to the Kennedy Highway corridor and to the east of the wind farm project area. Views toward the Mount Emerald wind farm project site from towns and localities are partially restricted by a combination of landform, vegetation and built structures within urban areas. Overall the Mount Emerald wind farm will have a very low to low visual impact on the majority of residential dwellings within surrounding towns and localities.

8.7 Local roads and highways

There are a small number of local roads that pass through the landscape surrounding the wind farm project area including the:

- Hansen Road;

- Channel Road;
- Springmount Road;
- Chettle Road; and
- Oaky Valley Road.

Views from vehicles travelling along local road corridors surrounding the project site will include a combination of short to medium distance direct and indirect views toward wind turbines. Whilst wind turbines will be visible whilst driving through the project viewshed, it is likely that the majority of journeys will comprise very short to short duration views and not result in significant visual effects.

The Kennedy Highway extends approximately north south to the east of the project area and is approximately 4 km at its closest point to the wind turbines. Medium to long distance direct and indirect views toward wind turbines within the project site will tend to be screened by roadside tree planting, as well as larger areas of established tree cover beyond the road corridor. Views from the Kennedy Highway will tend to be short duration and unlikely to be significant in magnitude or visual effect.

Cumulative assessment

Section 9

9.1 What is cumulative assessment?

A cumulative impact can result from a proposed wind farm development being constructed in conjunction with other existing or proposed wind farm developments, and could be either associated or separate to it.

Separate wind farm developments can occur within the established viewshed of the proposed wind farm, or be located within a regional context where visibility is dependent on a journey between each site or an individual project viewshed. Cumulative impacts presented by multiple wind farm developments may be presented as 'direct', 'indirect' or 'sequential' impacts.

- 'direct' cumulative visual impacts could occur where two or more wind farms have been constructed within the same locality, and could be viewed from the same view location simultaneously.
- 'indirect' cumulative visual impacts could occur where two or more wind farms have been constructed within the same locality, and could be viewed from the same view location but not within the same field of view.
- 'sequential' cumulative visual impacts could arise as a result of multiple wind farms being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which could form an impression of greater magnitude and impact within the construct of short term memory.

9.2 Other wind farm developments

There is one operational wind farm within the regional area. The Windy Hill wind farm, commissioned in 2000, comprises 20 wind turbines and is located approximately 50 km to the south south-east of the Mount Emerald wind farm project site.

The distance between the operational Windy Hill wind farm and the proposed Mount Emerald project site will limit and exclude opportunities for any 'direct' or 'indirect' visual impacts.

‘Sequential’ visual impacts will also tend to be limited by the distance and travel time between the existing and proposed wind farm development.

GBD is not aware of any smaller wind farm developments that are currently lodged, or being assessed by the relevant local government authorities.

Photomontages

Section 10

10.1 Photomontages

A total of 13 photomontage locations were selected to represent uninvolved residential dwellings and public view locations from surrounding road corridors. The photomontages locations are illustrated in **Figure 16** and are presented in **Figures 17 to 44**.

Whilst it is possible for any residential dwelling with a view toward the project turbines to be potentially affected (with a resultant high, moderate or low impact), it is not feasible or practical to prepare a photomontage for each and every residential dwelling within the project viewshed.

The photomontages locations have been selected to represent views from:

- Residential dwellings and occupied buildings within 2 km of the wind turbine locations;
- Local road corridors;
- Residential areas and urban localities; and
- Highways.

The photomontages locations have also been selected to provide representative views from a range of varying distances which illustrates the potential influence of distance on the magnitude of visual effects.

10.2 Photomontage preparation

The photomontages have been prepared with regard to the general guidelines set out in the Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance and British Landscape Institute Advice Note 01/11 (March 2011) Photography and photomontage in landscape and visual impact assessment.

Photography for the photomontages was undertaken by GBD using tripod mounted Nikon D700 a digital single-lens reflex (SLR) camera. A 50 mm focal length prime lens was attached to the Nikon D700 SLR camera.

The Nikon D700 has a full frame image sensor (36 x 23.9 mm Nikon FX format), and when mounted with a 50mm lens results in a single photographic image with a view angle equivalent to a 35 mm SLR camera with a 50 mm lens. The 50 mm lens is commonly utilised, and cited in landscape and visual assessment manuals and guidelines, for the preparation of landscape and visual assessment photomontages. Following site photography the photomontages were generated through the following steps:

- a digital terrain model (DTM) of the project site was created from a terrain model of the surrounding area using digital contours;
- the site DTM was loaded in the G-L Garrad Hassan 'WindFarmer' software package;
- the layout of the wind farm and 3D representation of the wind turbine was configured in WindFarmer;
- the location of each viewpoint (photo location) was configured in WindFarmer – the sun position for each viewpoint was configured by using the time and date of the photographs from that viewpoint;
- the view from each photomontage location was then assessed in WindFarmer. This process requires accurate mapping of the terrain as modelled, with that as seen in the photographs. The photographs, taken from each photomontage location were loaded into WindFarmer and the visible turbines superimposed on the photographs;
- the photomontage were adjusted using Photoshop CS3 to compensate for fogging due to haze or distance, as well as screening by vegetation or obstacles; and
- the final image was converted to JPG format and imported and annotated as the final figure.

Table 17 identifies the thirteen photomontage locations, property names (where relevant), corresponding reference number identified in the residential view matrix (**Table 16**) as well as the status of each photomontage location.

Table 17 – Photomontage details

Photomontage Location	Figure Reference	Status: Residential (uninvolved) Road corridor
M4 Hibiscus Street, Walkamin	Figure 17 and 18	Local road corridor adjoining dwellings
M15 Moffat Drive, Range View	Figure 19 and 20	Local road corridor adjoining dwellings
M16 Allawah Retreat (from road)	Figure 21 and 22	Local road corridor
M16 Allawah Retreat (from road) with wireframe model	Figure 23 and 24	Local road corridor
M30 Cascade Camp	Figure 25 and 26	Local road corridor
M34 Oaky Valley Road	Figure 27 and 28	Local road corridor
M42a Residential dwelling R32	Figure 29 and 30	Residential
M44 Residential dwelling R30	Figure 31 and 32	Residential
M52 Residential dwelling R78, from wind farm access track	Figure 33 and 34	Local road corridor
M53 Springmount Waste Management Facility	Figure 35 and 36	Access road
M63 Residential dwelling from local road	Figure 37 and 38	Local road corridor
M29 Oaky Valley Road	Figure 39 and 40	Local road corridor
M3 Kennedy Highway	Figure 41 and 42	Highway corridor
M66 Burke Developmental Road	Figure 43 and 44	Highway corridor

The horizontal and vertical field of view within the majority of the photomontages exceeds the parameters of normal human vision. However, in reality the eyes, head and body can all move and, under normal conditions, the human brain will 'see' a broad area of landscape within a panorama view. Each of the Mount Emerald photomontage panoramas indicates the extent of a single photograph within the full extent of the panorama.

Whilst a photomontage can provide an image that illustrates a photo realistic representation of a wind turbine in relation to its proposed location and scale relative to the surrounding landscape, this

LVIA acknowledges that large scale objects in the landscape can appear smaller in photomontage than in real life and is partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

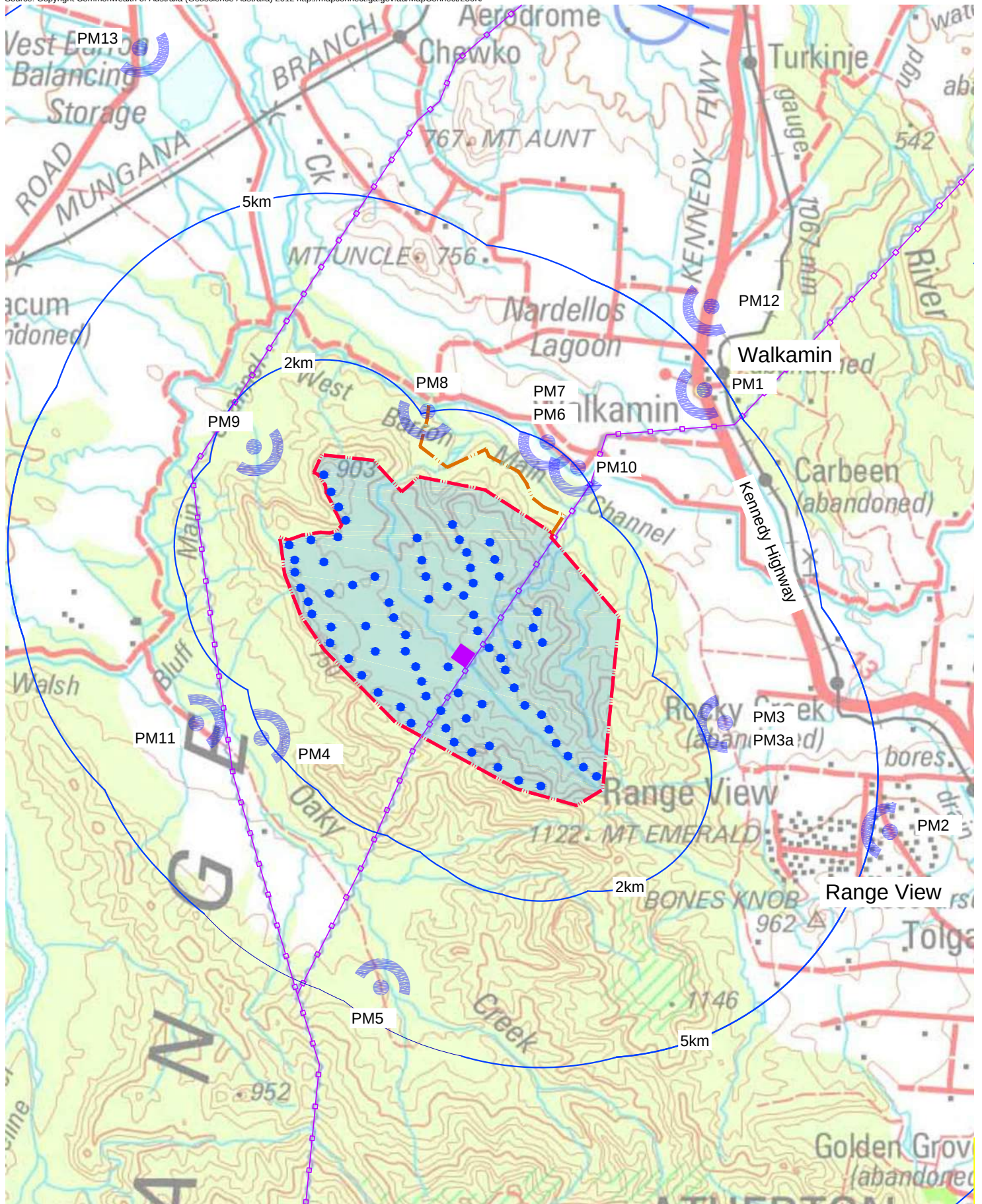
The British Landscape Institute states that *'it is also important to recognise that two-dimensional photographic images and photomontages alone cannot capture or reflect the complexity underlying the visual experience and should therefore be considered an approximate of the three-dimensional visual experiences that an observer will receive in the field'*.

10.3 Photomontage verification

Photomontages prepared for wind farm developments are sometimes claimed not to represent the correct relative scale of the wind turbines within the baseline panorama or single photographic images. Whilst modern windfarm industry software, such as WindFarmer, is able to produce correctly scaled turbines within photomontages, GBD undertook to independently verify the scale of the Mount Emerald wind turbines within the photomontages.

The verification process involved the direct photographic comparison of constructed and operational wind turbines at the Capital wind farm development with those presented in the photomontages.

The results of the verification are illustrated in **Figure 45**, and demonstrate that the wind turbines in the Mount Emerald photomontages are proportional relative to distance when compared to photographs of existing and operation wind turbines photographed at a similar distance.



Legend

- Proposed Mount Emerald wind turbine (indicative layout)
- (Distance from proposed Mount Emerald wind turbine
- Existing transmission line
- Proposed substation (indicative location)
- Indicative site boundary
- Proposed access track
- C Photomontage location

0km 1km 2km

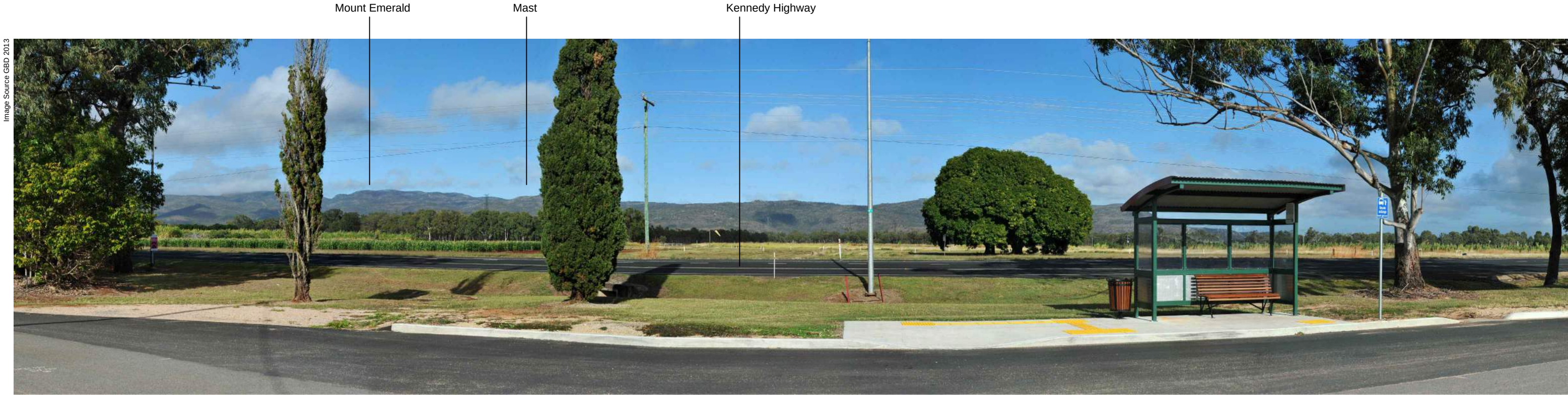


Figure 16
Photomontage locations

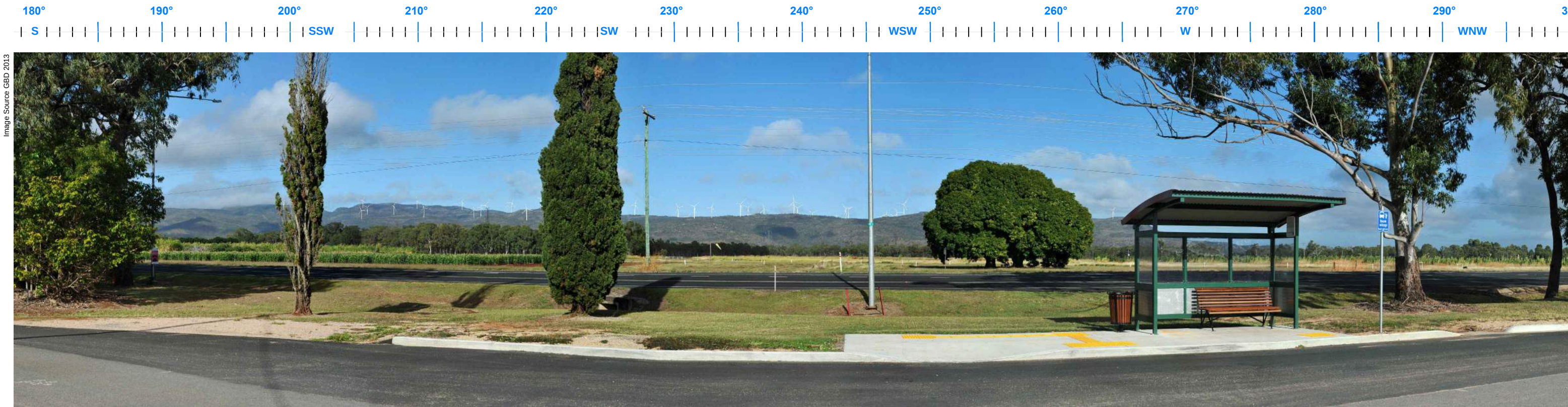
RAC
RATCH-Australia Corporation

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MOUNT EMERALD WIND FARM



Photomontage Location M4 Hibiscus Street, Walkamin. Existing view south to west north west.



Photomontage Location M4 Hibiscus Street, Walkamin. Proposed view south to west north west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 332643 Northing 8105315 (MGA 94z55H).
Approximate distance to nearest visible turbine 4.8 km

Image Source GBD 2013



Photomontage Location M4 Hibiscus Street, Walkamin

Indicative extent of single frame photo
(refer detail below)

Figure 18
Photomontage PM 1 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

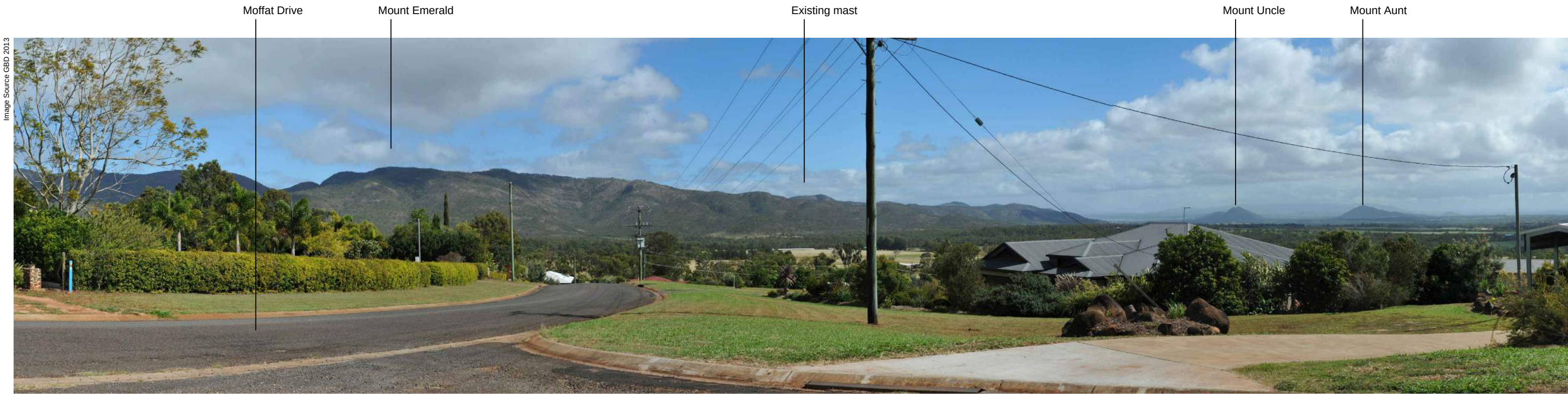
Photo coordinates:
Easting 332643
Northing 8105315 (MGA 94z55H)

Approximate distance to nearest visible
turbine 4.8 km

Image Source GBD 2013



Photomontage Location M4 - Single frame photo detail, proposed view



Photomontage Location M15 Moffat Drive, Range View. Existing view south west to north.



Photomontage Location M15 Moffat Drive, Range View. Proposed view south west to north.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 335350 Northing 8097827 (MGA 94z55H).
Approximate distance to nearest visible turbine 5.7 km

Image Source GBD 2013



Photomontage Location M15 Moffat Drive, Range View

Indicative extent of single frame photo
(refer detail below)

Figure 20
Photomontage PM 2 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 335350
Northing 8097827 (MGA 94z55H)

Approximate distance to nearest visible
turbine 5.7 km

Image Source GBD 2013

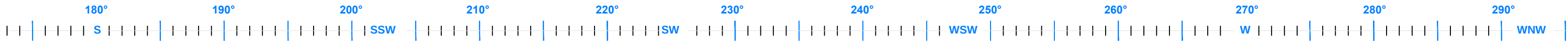


Photomontage Location M15 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M16 Allawah Retreat, Marnane Road. Existing view south south east to north west.



Photomontage Location M16 Allawah Retreat, Marnane Road. Proposed view south south east to north west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 333131 Northing 8098739 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.5 km



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MOUNT EMERALD WIND FARM

Image Source GBD 2013



Photomontage Location M16 Allawah Retreat from Marnane Road

Indicative extent of single frame photo
(refer detail below)

Figure 22
Photomontage PM 3 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 333131
Northing 8098739 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2.5 km

Image Source GBD 2013

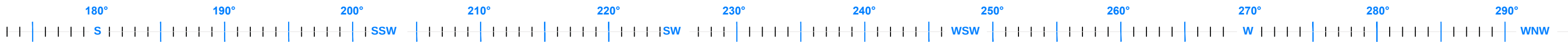


Wind turbine blade tip visible above ridgeline

Photomontage Location M16 - Single frame photo detail, proposed view



Photomontage Location M16 Allawah Retreat, Marnane Road. Existing view south south east to north west.



Photomontage Location M16 Allawah Retreat, Marnane Road. Proposed view south south east to north west.

Note - Photomontage PM 3A includes a digital terrain overlay (in green) to illustrate the location of proposed wind turbines beyond the foreground hills and ridgeline. A view would extend toward the blade tips of the southern most wind turbine, however all other wind turbines illustrated in PM 3 would not be visible from this view location.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 333131 Northing 8098739 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.5 km

Image Source GBD 2013



Photomontage Location M16 Allawah Retreat from Marnane Road

Indicative extent of single frame photo
(refer detail below)

Figure 24
Photomontage PM 3 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

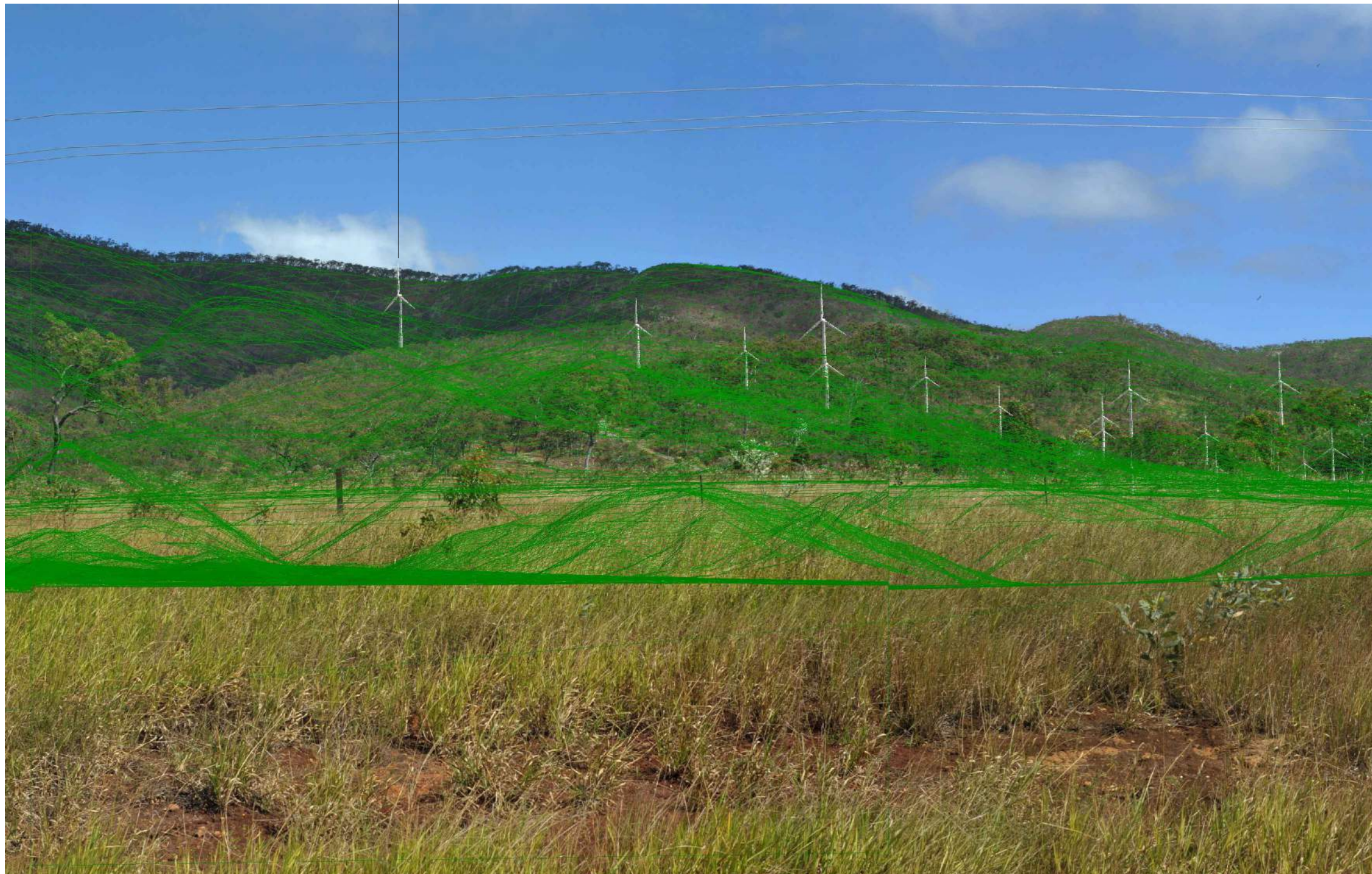
Photo coordinates:
Easting 333131
Northing 8098739 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2.5 km

Note - Photomontage PM 3A includes a
digital terrain overlay (in green) to
illustrate the location of proposed wind
turbines beyond the foreground hills
and ridgeline.

A view would extend toward the blade
tips of the southern most wind turbine,
however all other wind turbines
illustrated in PM 3A would not be visible
from this view location.

Image Source GBD 2013



Photomontage Location M16 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M30 Cascade Camp, Cascade Road. Existing view north to east south east.

Image Source GBD 2013



Photomontage Location M30 Cascade Camp, Cascade Road. Proposed view north to east south east

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 325075 Northing 8099009 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.1 km

Image Source GBD 2013



Photomontage Location M30 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M30 Cascade Camp, Cascade Road

Indicative extent of single frame photo
(refer detail below)

Figure 26
Photomontage PM 4 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 325075
Northing 8099009 (MGA 94z55H)

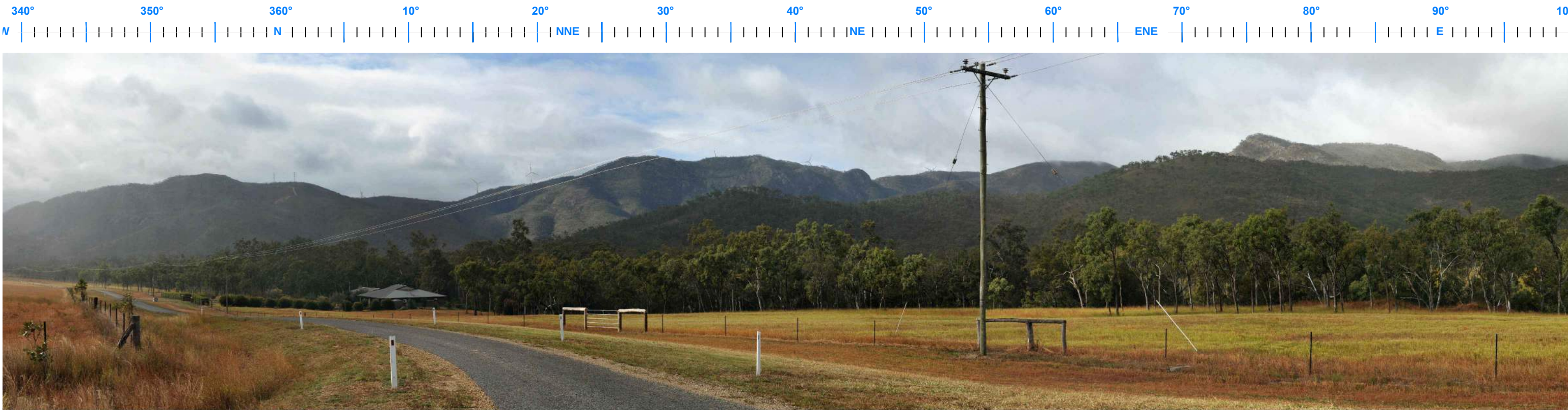
Approximate distance to nearest visible
turbine 2.1 km

Image Source GBD 2013



Photomontage Location M34 Oak Valley Road. Existing view north west to east south east.

Image Source GBD 2013



Photomontage Location M34 Oak Valley Road. Proposed view north west to east south east.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 326760 Northing 8094596 (MGA 94z55H).
Approximate distance to nearest visible turbine 4.4 km

MOUNT EMERALD WIND FARM

Image Source GBD 2013



Figure 28
Photomontage PM 5 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 326760
Northing 8094596 (MGA 94z55H)

Approximate distance to nearest visible
turbine 4.4 km

Photomontage Location M34 Oak Valley Road

Indicative extent of single frame photo
(refer detail below)

Image Source GBD 2013



Photomontage Location M34 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M42a Residential Dwelling R32. Existing view south south east to west.



Image Source GBD 2013



Photomontage Location M42a Residential Dwelling R32. Proposed view south south east to west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 329789 Northing 8104156 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.08 km

Image Source GBD 2013



Photomontage Location M42a Residential Dwelling R32

Indicative extent of single frame photo
(refer detail below)

Figure 30
Photomontage PM 6 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 329789
Northing 8104156 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2.08 km

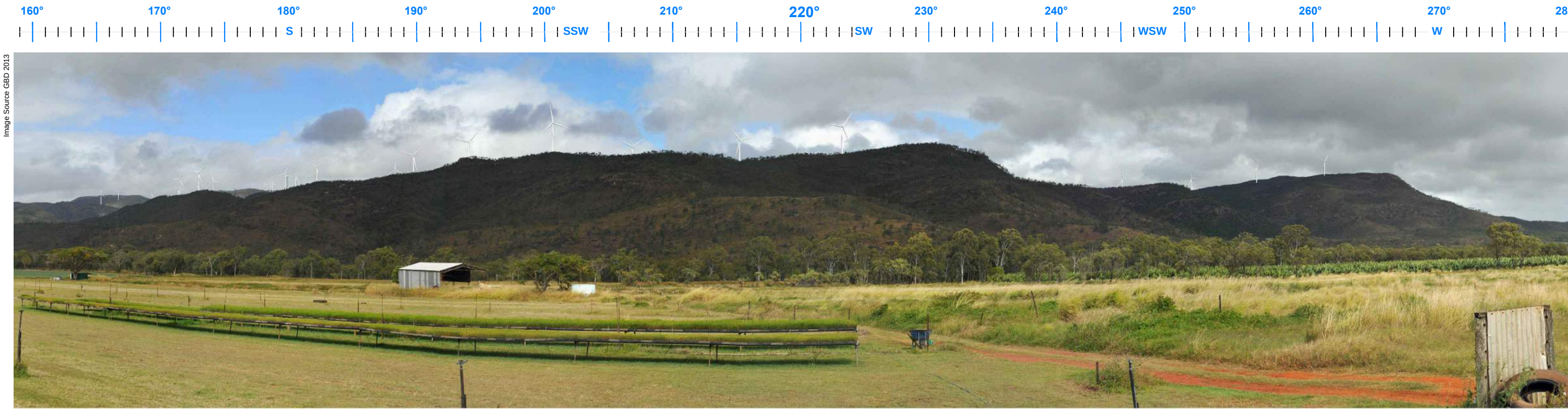
Image Source GBD 2013



Photomontage Location M42a - Single frame photo detail, proposed view



Photomontage Location M44 Residential Dwelling R30. Existing view south south east to west.



Photomontage Location M44 Residential Dwelling R30. Proposed view south south east to west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 3296639 Northing 8104307 (MGA 94z55H).
Approximate distance to nearest visible turbine 2 km

Image Source GBD 2013



Photomontage Location M44 Residential Dwelling R30

Indicative extent of single frame photo
(refer detail below)

Figure 32
Photomontage PM 7 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 3296639
Northing 8104307 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2 km

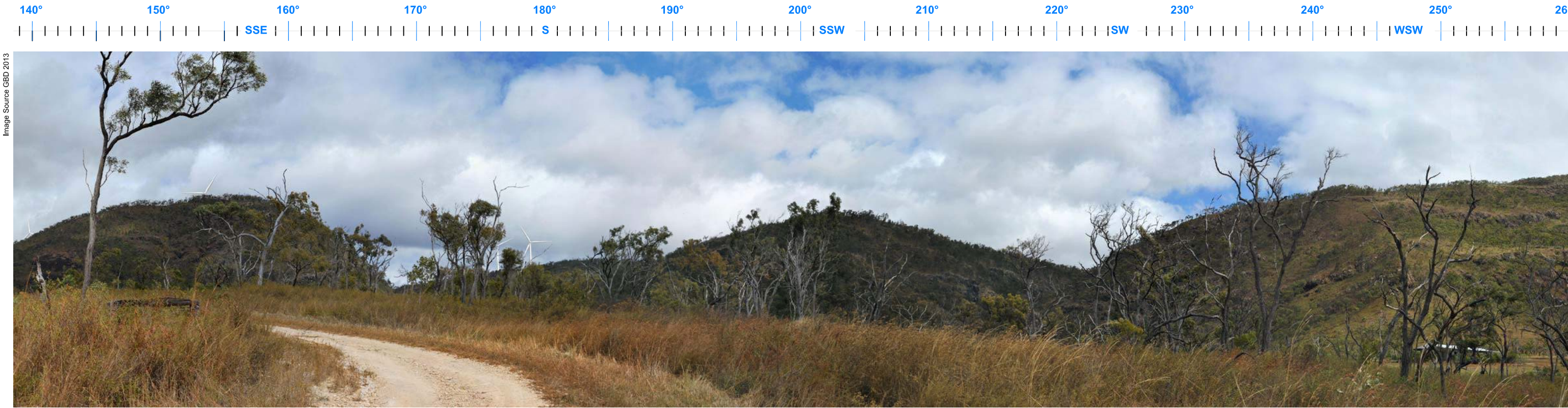
Image Source GBD 2013



Photomontage Location M44 - Single frame photo detail, proposed view



Photomontage Location M52 Residential Dwelling R78. Existing view south east to west.



Photomontage Location M52 Residential Dwelling R78. Proposed view south east to west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 327571 Northing 8104309 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.06 km

Image Source GBD 2013



Photomontage Location M52 Residential Dwelling R78

Indicative extent of single frame photo
(refer detail below)

Figure 34
Photomontage PM 8 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

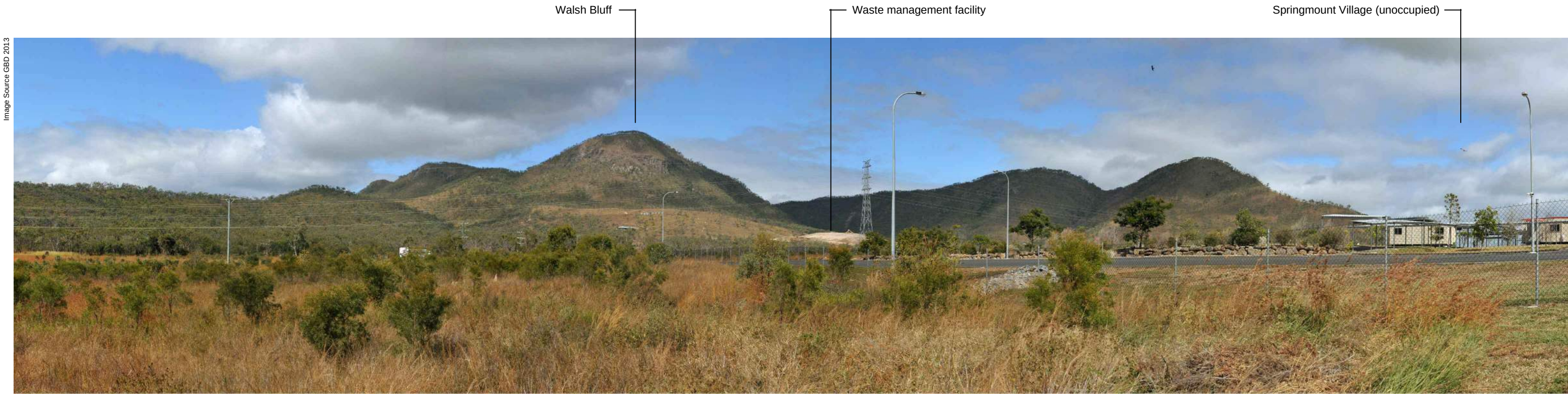
Photo coordinates:
Easting 327571
Northing 8104309 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2.06 km

Image Source GBD 2013



Photomontage Location M52 - Single frame photo detail, proposed view



Photomontage Location M53 Residential Dwelling R89 (and Spingmount Village). Existing view east to south south west.



Photomontage Location M53 Residential Dwelling R89 (and Springmount Village). Proposed view east to south south west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 323902 Northing 8105214 (MGA 94z55H).
Approximate distance to nearest visible turbine 1.34 km

MOUNT EMERALD WIND FARM

Image Source GBD 2013



Photomontage Location M53 Residential Dwelling R89

Indicative extent of single frame photo
(refer detail below)

Figure 36
Photomontage PM 9 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 323902
Northing 8105214 (MGA 94z55H)

Approximate distance to nearest visible
turbine 1.34 km

Image Source GBD 2013



Photomontage Location M53 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M63 Residential Dwelling R36. Existing view south south east to west.

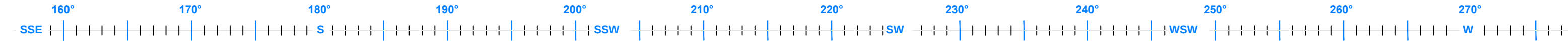


Image Source GBD 2013



Photomontage Location M63 Residential Dwelling R36. Proposed view south south east to west.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 330268 Northing 8103817 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.07 km

Image Source GBD 2013



Photomontage Location M63 Residential Dwelling R36

Indicative extent of single frame photo
(refer detail below)

Figure 38
Photomontage PM 10 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 330268
Northing 8103817 (MGA 94z55H)

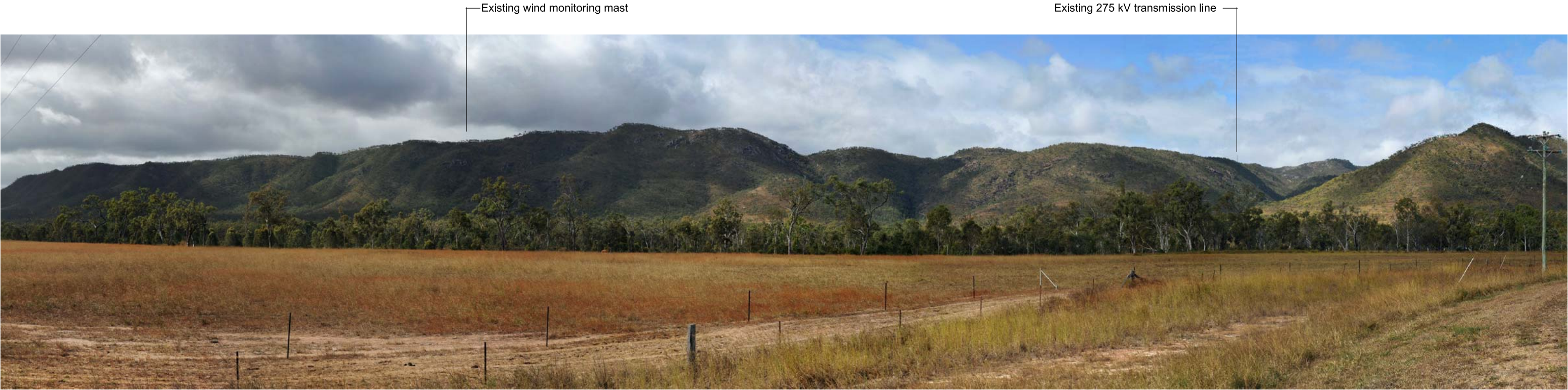
Approximate distance to nearest visible
turbine 2.07 km

Image Source GBD 2013



Photomontage Location M63 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M29 Oaky Valley Road. Existing view north to east south east.

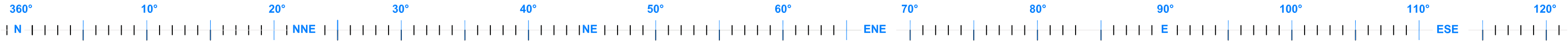


Image Source GBD 2013



Photomontage Location M29 Oaky Valley Road. Proposed view north to east south east.

MT. EMERALD WIND FARM

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 323936 Northing 8098965 (MGA 94z55H).
Approximate distance to nearest visible turbine 2.8 km

Image Source GBD 2013



Photomontage Location M29 Oaky Valley Road

Indicative extent of single frame photo
(refer detail below)

Figure 40
Photomontage PM 11 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 323936
Northing 8098965 (MGA 94z55H)

Approximate distance to nearest visible
turbine 2.8 km

Image Source GBD 2013



Photomontage Location M29 - Single frame photo detail, proposed view



Photomontage Location M3 Kennedy Highway. Existing view south to west north west.



Photomontage Location M3 Kennedy Highway. Proposed view south to west north west.

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 332665 Northing 8106499 (MGA 94z55H).
Approximate distance to nearest visible turbine 5.8 km

Image Source GBD 2013



Figure 42
Photomontage PM 12 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

Photo coordinates:
Easting 332665
Northing 8106499 (MGA 94z55H)

Approximate distance to nearest visible
turbine 5.8 km

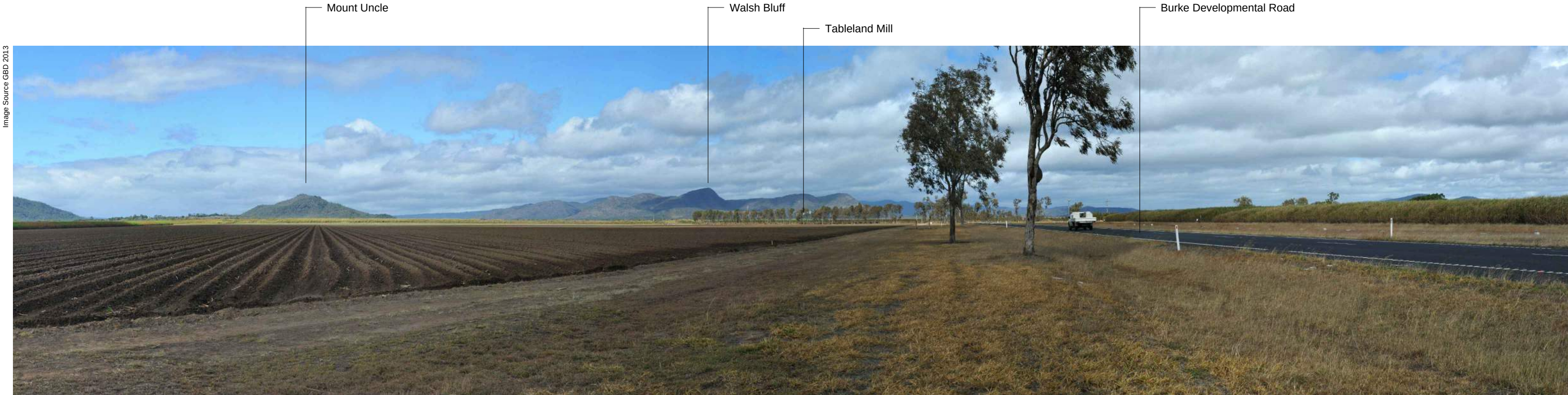
Photomontage Location M3 Kennedy Highway

Indicative extent of single frame photo
(refer detail below)

Image Source GBD 2013



Photomontage Location M3 - Single frame photo detail, proposed view



Photomontage Location M66 Burke Developmental Road. Existing view east south east to south west.



Photomontage Location M66 Burke Developmental Road. Proposed view east south east to south west.

Refer Figure 16 for Photomontage Location.

Individual panorama photos taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Photo coordinates: Easting 322452 Northing 8111537 (MGA 94z55H).
Approximate distance to nearest visible turbine 8.4 km

MT. EMERALD WIND FARM

Image Source GBD 2013



Photomontage Location M66 - Single frame photo detail, proposed view

Image Source GBD 2013



Photomontage Location M66 Burke Developmental Road

Indicative extent of single frame photo
(refer detail below)

Figure 44
Photomontage PM 13 Sheet 2

Refer Figure 16 for Photomontage
Location

Individual panorama photos taken with
a Nikon D700 digital SLR camera with
50 mm prime lens.

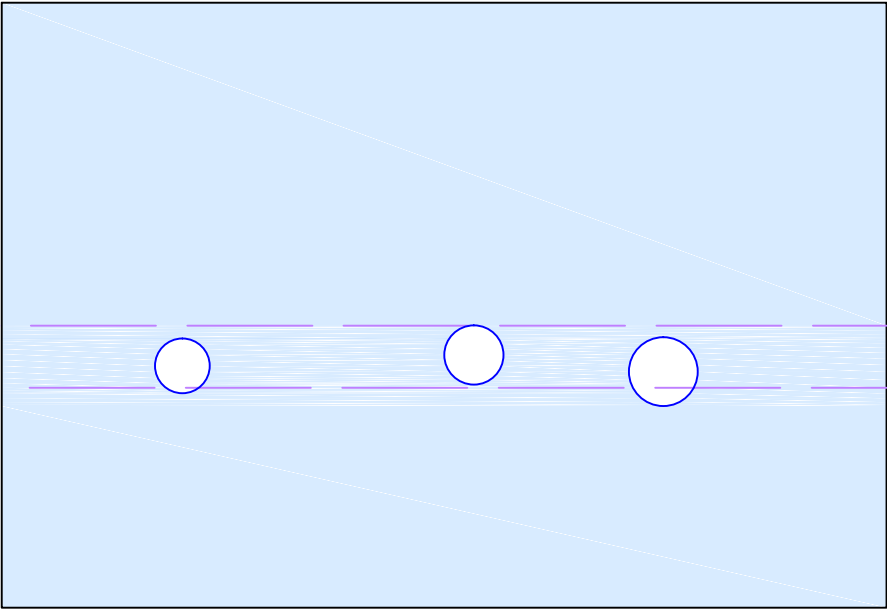
Photo coordinates:
Easting 322452
Northing 8111537 (MGA 94z55H)

Approximate distance to nearest visible
turbine 8.4 km



Proposed Mount Emerald wind farm photomontage.

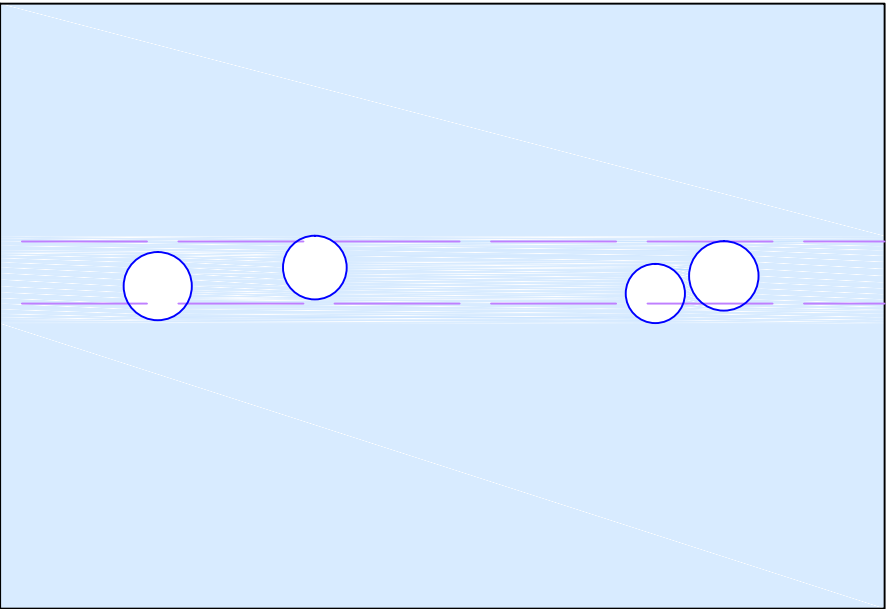
Public view location PM 1 Hibiscus Street, Walkamin - Existing view south to west north west
 Photo coordinates: Easting 332643 Northing 8105315 (MGA 94z55H). Approximate distance to nearest visible turbine 4.8 km



Mount Emerald wind turbine photomontage- comparative rotor swept area
 Wind turbine 130.5 m tip height (80 m tower with 49.5 m rotor length)



Existing view toward the operational Capital wind farm turbines from around 4.5 km



Capital wind turbine photograph- comparative rotor swept area
 Wind turbine 124 m tip height (80 m tower with 44 m rotor length)

Figure 45
Comparison of operational and
photomontage wind turbines

MOUNT EMERALD WIND FARM

Night time lighting

Section 11

11.1 Introduction

As the Mount Emerald wind turbines will be no greater than 150 m in height (to tip of blade), and in accordance with current CASA guidelines, the Mount Emerald wind turbines will not require obstacle lighting.

Should future CASA regulations require a lighting assessment; the proponent will undertake a detailed Obstacle Lighting Assessment will be undertaken by an Aeronautical Impact Assessment expert to stipulate the turbine lighting layout which will mitigate any risks to aviation. The outcomes of the Aeronautical Impact Assessment and the Obstacle Lighting Assessment will then be submitted to CASA for their comment.

Potential visual impacts associated with obstacle marking and lighting at night time have not been extensively researched or tested in Queensland, although some site investigations have been carried out at existing wind farms in Victoria. Investigations have generally concluded that although night time lighting mounted on wind turbines could be visible for a number of kilometres from the wind farm project area, the actual intensity of the lighting appears no greater than other sources of night time lighting, including vehicle head and tail lights.

Previous investigations have also suggested that replacing the more conventional incandescent lights with light emitting diodes (LED) could help to minimise the potential visual impact of the wind turbine lights (Epuron 2008).

In order to illustrate the visual effect of turbine mounted lighting a series of night time photographs were taken of the Cullerin wind farm in the New South Wales Southern Tablelands. These were taken at distances of 500 m, 3.5 km and 17 km from the turbines and are illustrated in **Figures 46, 47 and 48**. Each night time view is presented below a corresponding day time photograph taken from the same photo location. It should be noted that following community consultation, and the preparation of an aviation risk assessment, Origin Energy have removed night time obstacle lighting from the Cullerin wind turbines.

11.2 Existing light sources

A small number of existing night time light sources occur within the Mount Emerald wind farm viewshed, and include rural residential and general lighting within surrounding towns.

Localised lighting is associated with a small number of dispersed homesteads located within the project boundary, but lighting is unlikely to be visually prominent and does not emit any significant illumination beyond immediate areas surrounding residential and agricultural buildings.

Lights from vehicles travelling along the local roads and highways provide dynamic and temporary sources of light.

11.3 Potential light sources

The main potential light sources associated with the Mount Emerald wind farm will include:

- low intensity night lights for substation, control and auxiliary buildings; and
- night time obstacle lights mounted on some wind turbines (if required in the future).

In accordance with the withdrawn CASA Advisory Circular two red medium intensity obstacle lights were required on specified turbines at a distance not exceeding 900 m and all lights were to flash synchronously. To minimise visual impact some shielding of the obstacle lights below the horizontal plane was permitted. Lighting for aviation safety could also be required prior to and during the construction period, including lighting for large equipment such as cranes.

In addition to the standard level of lighting required for normal security and safety, lighting could also be required for scheduled or emergency maintenance around the control building, substation and wind turbine areas.

As the visibility of the substation and control room will be largely contained by the surrounding landform, it is unlikely that light spill from these sources will be visible from the majority of surrounding view locations including surrounding residences.

11.4 Potential view locations and impact

The categories of potential view locations that could be impacted by night time lighting generally include residents and motorists.

Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of public view locations. Whilst obstacle lighting will be visible to motorists travelling along the local roads, the duration of visibility will tend to be very short and partially screened by undulating landform along some sections of local road corridors and influenced by the direction of travel.

Night time obstacle lighting associated with the wind farm will be visible from a number of the residential view locations surrounding the Mount Emerald wind farm; however, topography and screening by vegetation and screen planting around residential dwellings will screen or partially obscure views toward night time obstacle lighting.

Irrespective of the total number of visible lights, any lighting is more likely to be noticeable from exterior areas surrounding residences rather than from within residences, where internal lighting tends to reflect and mirror views in windows, or where exterior views will be obscured when curtains and blinds are closed.

TURBINE WITH LIGHT

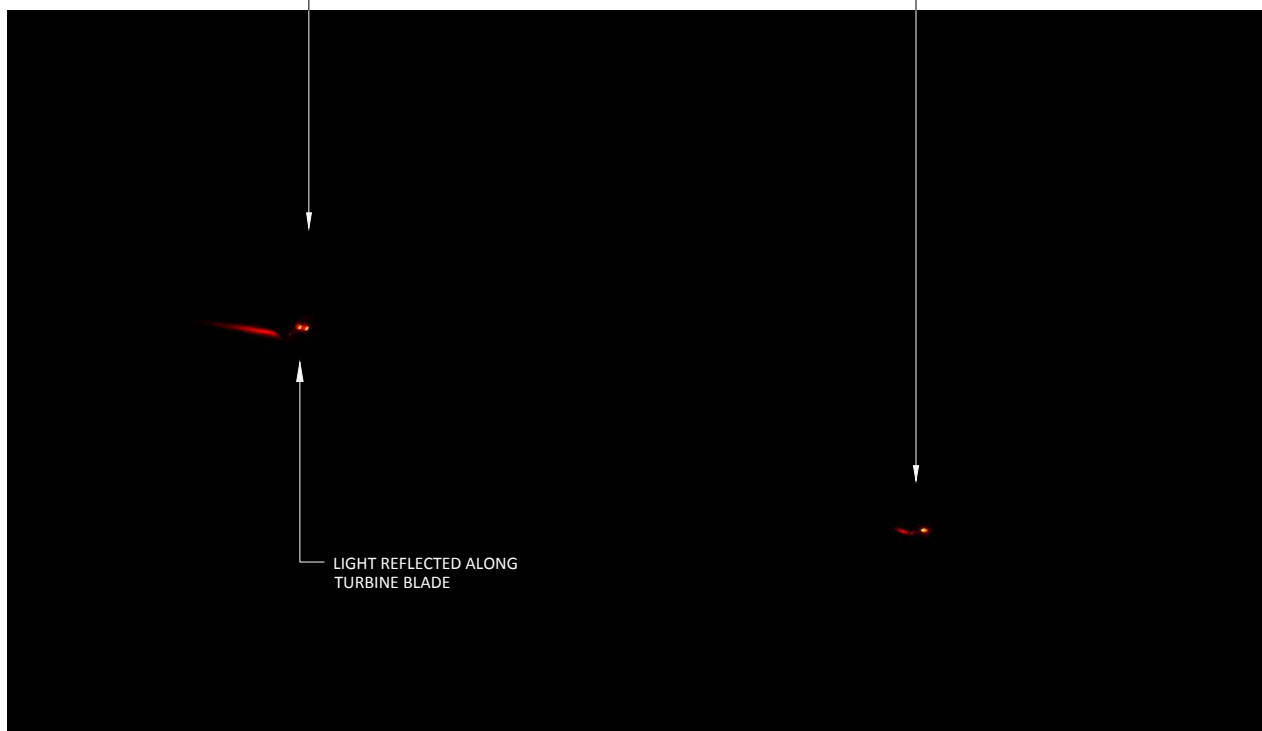
TURBINE WITH LIGHT



Day time view from Hume highway toward Cullerin wind farm at around 500m

TURBINE LIGHT

TURBINE LIGHT



Night time view from Hume highway toward Cullerin wind farm at around 500m

Cullerin wind farm night time lighting. View approximately 500 m west from Hume Highway

Figure 46
Night lighting Cullerin wind farm at 500m

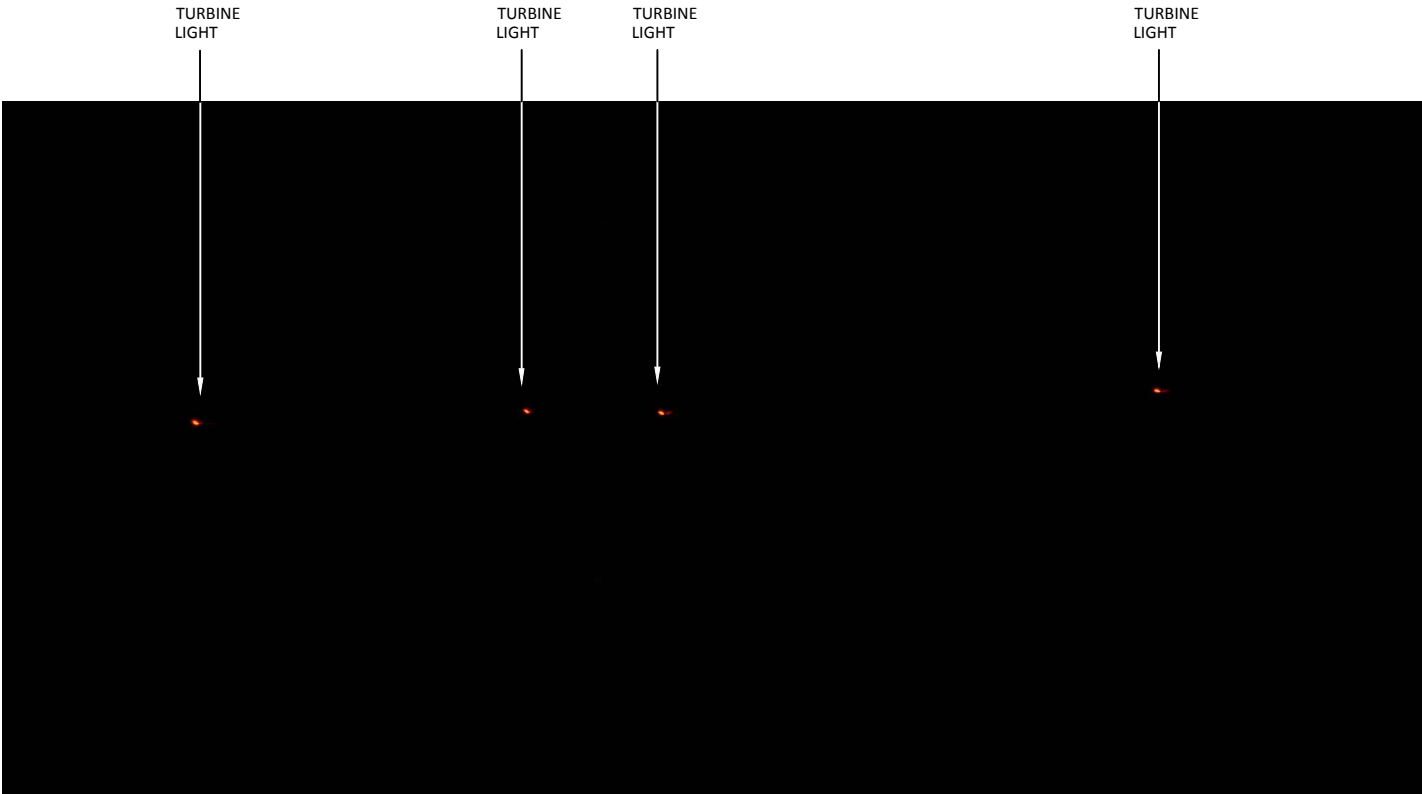


MOUNT EMERALD WIND FARM

GREEN BEAN DESIGN
landscape architects



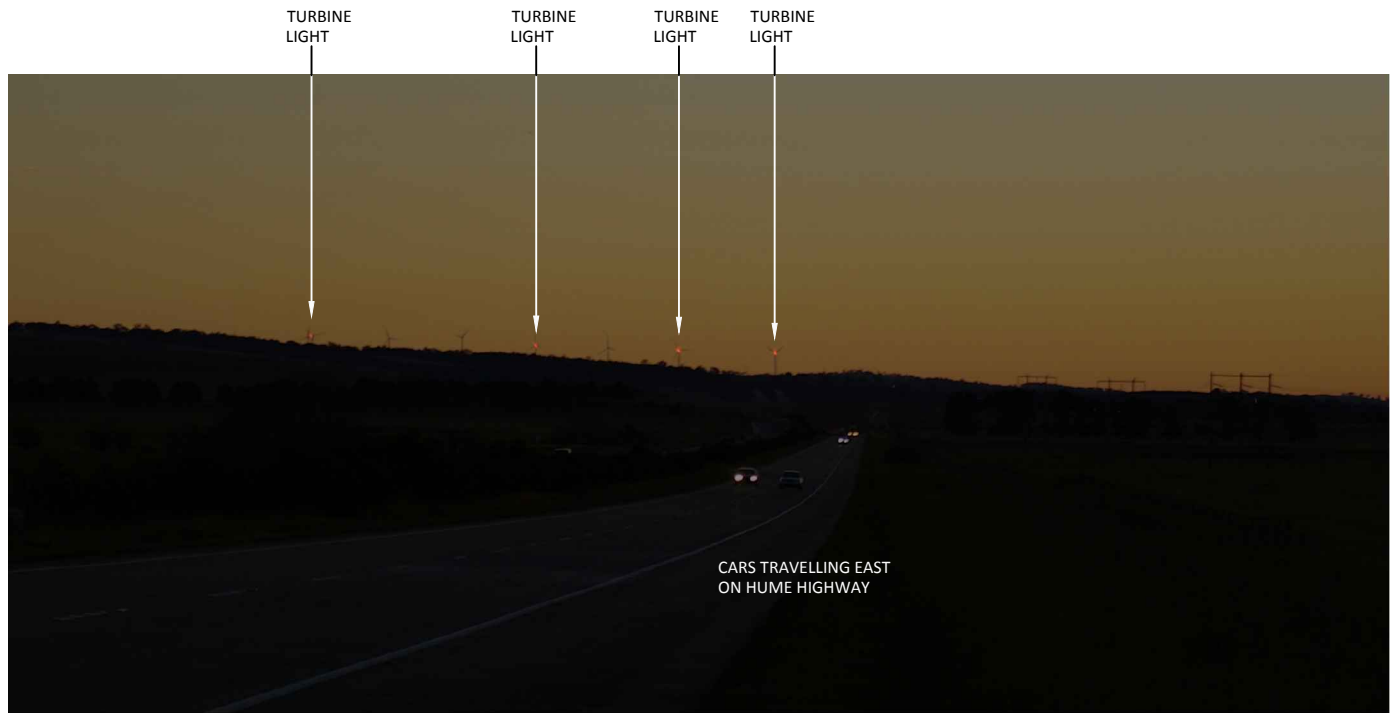
Day time view from Hume highway toward Cullerin wind farm at around 3.5km



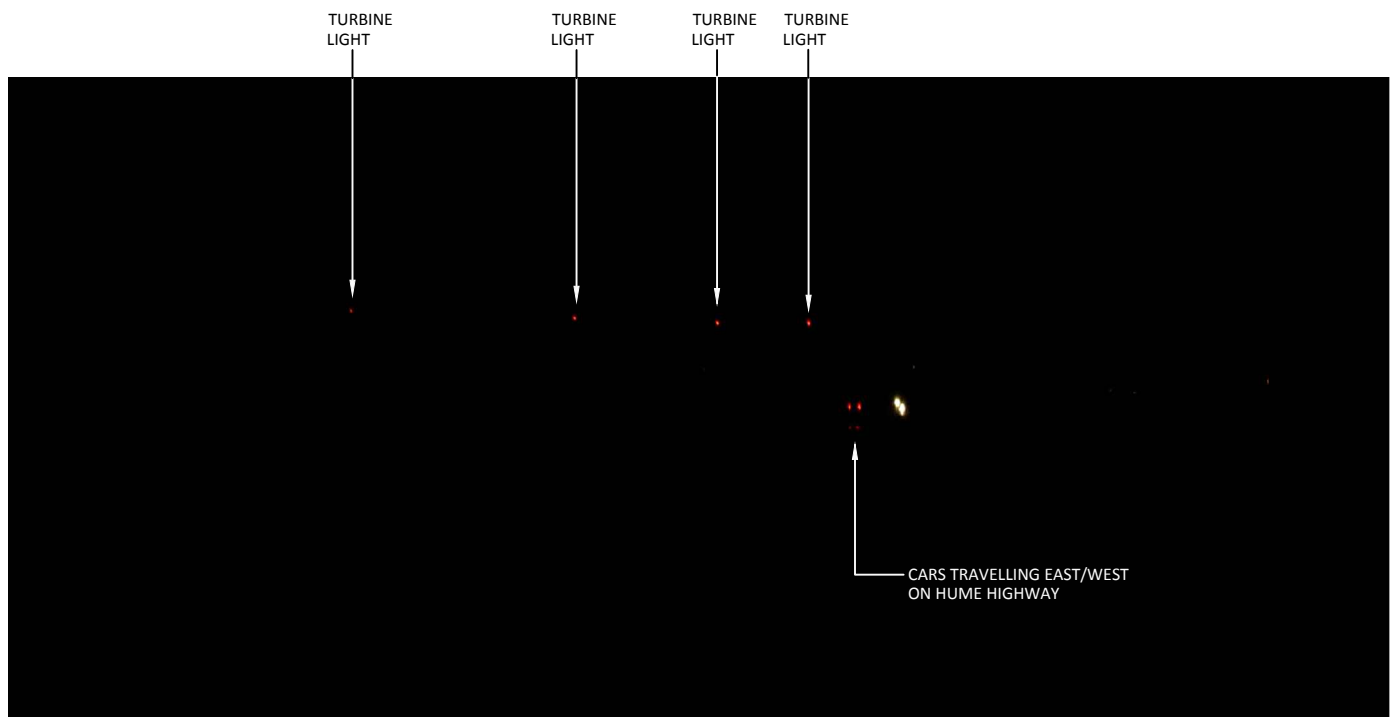
Night time view from Hume highway toward Cullerin wind farm at around 3.5km

Cullerin wind farm night time lighting . View approximately 3.5 km west from Hume highway.

Figure 47
Night lighting Cullerin wind farm at 3.5km



View west at dusk from Hume highway toward Cullerin wind farm at around 17km



View west after dark from Hume highway toward Cullerin wind farm at around 17km

Cullerin wind farm night time lighting . view west from Hume highway at around 17km distance.

Figure 48
Night lighting Cullerin wind farm at 17km

Electrical works

Section 12

12.1 Introduction

The project will include a range of electrical infrastructure to collect and distribute electricity generated by the wind turbines. Electrical works will include elements such as:

- wind turbine transformers at each turbine site located within the turbine tower;
- a wind farm substation with two 130 MVA transformers, switch gear and circuit breakers;
- approximately 40km of 33kV underground electrical and control cabling to connect each wind turbine to the substation;
- an overhead transmission line connection to the existing 275kV transmission line; and
- an operations building containing control and communications equipment.

A typical design for a wind farm substation is illustrated in **Plate 6** and demonstrates the relatively small scale development required for this component of the electrical infrastructure. The majority of electrical connections between the wind turbines will be via underground cabling wherever possible, including areas along ridgelines within the project boundary. Some sections of 33kV overhead electrical reticulation may be required within the site boundary; however, the scale of these structures will be similar to existing medium voltage electrical distribution utility infrastructure found throughout the landscape.



Plate 6 – Typical wind farm collector substation

12.2 Substation

The final location and layout of the substation will be selected subject to detail engineering design.

The main visual components of a typical wind farm collection/connection substation will likely comprise:

- incoming and outgoing overhead powerlines;
- a single storey control building;
- electrical housings and buildings
- an access road and parking (or road utilising wind turbine maintenance access track);
- various switch bays and transformers;
- a communications pole;
- lightning masts;
- water tank;
- external lighting for security and maintenance; and
- security fencing including a palisade fence and internal chainmesh fence.

The substation location and associated electrical infrastructure works will not be visible from residential or public view locations beyond the project area, and will be screened by landform extending across the project area plateau.

Pre-construction and construction

Section 13

13.1 Potential visual impacts

There are potential visual impacts that could occur during both pre-construction and construction phases of the project. The wind farm construction phase is likely to occur over a period of around 24 months, although the extent and nature of pre-construction and construction activities will vary at different locations within the project area.

The key pre-construction and construction activities that will be visible from areas surrounding the proposed wind farm include:

- ongoing detailed site assessment including sub surface geotechnical investigations;
- various civil works to upgrade local roads and access point;
- construction compound buildings and facilities;
- construction facilities, including portable structures and laydown areas;
- various construction and directional signage;
- mobilisation of rock crushing equipment and concrete batching plant (if required);
- excavation and earthworks; and
- various construction activities including erection of wind turbines, monitoring masts and substation with associated electrical infrastructure works.

The majority of pre-construction and construction activities, some of which will result in physical changes to the landscape (which have been assessed in this LVIA report), are generally temporary in nature and for the most restricted to various discrete areas within or beyond the immediate wind farm project area. The majority of pre-construction and construction activities will be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature.



Plate 7 Illustrating typical activities during wind farm construction and installation.

(Image: Wind Prospect CWP Pty Ltd).

Perception and public consultation

Section 14

14.1 Perception

People's perception of wind farms is an important issue to consider as the attitude or opinion of individual people adds significant weight to the level of potential visual impact.

The opinions and perception of individuals from the local community and broader area were sought and provided through a range of consultation activities. These included:

- public open days
- public site inspection;
- dedicated project web; and
- individual stakeholder meetings.

The attitudes or opinions of individuals toward wind farms can be shaped or formed through a multitude of complex social and cultural values. Whilst some people may accept and support wind farms in response to global or local environmental issues, others may find the concept of wind farms completely unacceptable. Some may support the environmental ideals of wind farm development as part of a broader renewable energy strategy but do not consider them appropriate for their regional or local area. It is unlikely that wind farm projects will ever conform or be acceptable to all points of view; however, research within Australia as well as overseas consistently suggests that the majority of people who have been canvassed do support the development of wind farms.

Wind farms are generally easy to recognise in the landscape and to take advantage of available wind resources are more often located in elevated and exposed locations. The geometrical form of a wind turbine is a relatively simple one and can be visible for some distance beyond a wind farm, and the level of visibility may be accentuated by the repetitive or repeating pattern of multiple wind turbines within a local area. Wind farms do have a significant potential to alter the physical appearance of the landscape, as well as change existing landscape values.

14.2 Public consultation and survey

Public open days were held at the Mareeba Heritage Centre in March 2011 and September 2012. The open days provided an opportunity for members of the local community to view preliminary photomontages as well as other maps and plans illustrating layouts and potential locations for project infrastructure. The open day also provided an opportunity for the local community to provide feedback on their experience and personal values associated with the surrounding landscape.

The Proponent commissioned a community survey in March 2012. The survey undertaken by Auspoll was carried out to identify community attitudes to the proposed Mount Emerald wind farm project. The key outcomes of the survey identified that:

- *Over 80% of respondents are aware of the proposed development.*
- *Around three quarters of respondents (76%) support the project, with only 13% opposed to it.*
- *32% of opponents say it will be an eyesore or unattractive*
- *29% of opponents say it is too close to residences*
- *Less than 30% of respondents think the wind farm will have a negative impact on their favourite aspect of the local landscape.*
- *Most respondents are not aware of any local historical or culturally significant sites, but of those that are, less than 30% think the wind farm will have a negative impact on these sites.*

14.3 Australian quantitative research

Whilst published Australian research into the potential landscape and visual impacts of wind farms is limited, there are general corresponding results between the limited number that have been carried out when compared with those carried out overseas.

A recent survey was conducted by ARM Interactive on behalf of the NSW Department of Environment, Climate Change and Water (September 2010). The survey polled 2,022 residents across the 6 Renewable Energy Precincts established by the NSW Government. Key findings of the survey indicated that:

- *97% of people across the Precincts had heard about wind farms or turbines, and 81% had seen a wind farm or turbine (in person or the media);*
- *85% of people supported the construction of wind farms in New South Wales, and 80% within their local region; and*
- *76% supported wind farms being built within 10km of residences and 47% of people surveyed supported the construction of wind turbines within 1 to 2km from their residences.*

These general levels of support for wind farm developments have also been recorded for a number of wind farm developments around Australia as well as overseas.

Auspoll research carried out in February 2002 on behalf of a wind farm developer for a wind farm project in Victoria included just over 200 respondents. The results indicated that:

- *Over 92% of respondents agreed that wind farms can make a difference in reducing greenhouse emissions and mitigating the effects of global warming;*
- *Over 88% disagreed with the statement that wind farms are ugly;*
- *Over 93% of respondents identified 'interesting' as a good way to describe wind farms, over 73% nominating 'graceful' and over 55% selecting 'attractive';*
- *Over 79% of respondents thought that the wind farm will have a good impact on tourism, with 15% of respondents believing that the wind farm will make no difference; and*
- *Over 40% of respondents believed that the impact of the wind farm on the visual amenity of the area will be good, with 40% believing that it will make no difference.*

The majority of research carried out to date has focussed on public attitudes to wind farms and does not provide any indication for acceptable or agreed thresholds in relation to numbers and heights of turbines, and the potential impact of distance between turbines and view locations.

Mitigation measures

Section 15

15.1 Mitigation measures

The British Landscape Institute states *‘the purpose of mitigation is to avoid, reduce, or where possible remedy or offset any significant negative (adverse) effects on the environment arising from the proposed development’ (2002)*. In general mitigation measures will reduce the potential visual impact of the project in one of two ways:

- firstly, by reducing the visual prominence of the wind turbines and associated structures by minimising the visual contrast between the wind turbines and the landscape in which they are viewed; and
- secondly, by screening views toward the wind turbines from specific view locations.

In relation to the first form of mitigation, the design of the turbine structures has been highly refined over a number of years to maximise their efficiency. The height of the supporting towers and dimensions of the rotors are defined by engineering efficiency and design criteria. Consequently, modification of the turbine design to mitigate potential visual impacts is not considered a realistic option.

Colour is one aspect of the wind turbine design that does provide an opportunity to reduce visual contrast between the turbine structures and the background against which they are viewed. The white colour that is used on a majority of turbine structures provides the maximum level of visual contrast with the background. This maximum level of visual contrast could be reduced through the use of an appropriate off white or grey colour for the turbines where the visual contrast will be reduced when portions of the turbine were viewed against the sky as well as for those portions viewed against a background of landscape. The final colour selection will, however, be subject to the availability of turbine models on the market at the time of ordering and to aviation safety requirements.

The potential visual impact of the project from specific view locations could be mitigated by planting vegetation close to the view locations. For instance, tree or large shrub planting close to a residence

can screen potential views to individual or clusters of turbines. Similarly roadside tree planting can screen potential views of turbines from portions of road corridors.

The location and design of screen planting used as a mitigation measure is very site specific and requires detailed analysis of potential views and consultation with surrounding landowners. Planting vegetation will not provide effective mitigation in all circumstances and can reduce the extent of existing views available from residences or other view locations.

There is greater potential to mitigate the visual prominence for some of the ancillary structures and built elements associated with the wind farm through the appropriate selection of materials and colours, together with consideration of their reflective properties.

The potential visual impacts of vehicular tracks providing access for construction and maintenance can be mitigated by:

- minimising the extent of cut and fill in the track construction;
- re-vegetating disturbed soil areas immediately after completion of construction works; and
- using local materials as much as possible in track construction to minimise colour contrast.

15.2 Summary of mitigation measures

A summary of the mitigation measures available for the wind farm and powerline infrastructure is presented in **Tables 18** and **19**.

Table 18 - Mitigation measures summary

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
Consider options for use of colour to reduce visual contrast between project structures and visible background.	✓			
Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.			✓	✓

Table 18 - Mitigation measures summary

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
If necessary, design and construct site control building and facilities building sympathetically with nature of locality.	✓		✓	
If necessary, locate substations away from direct views from roads and residential dwellings.	✓		✓	
Enforce safeguards to control and minimise fugitive dust emissions.		✓	✓	
Restrict the height of permanent stockpiles to minimise visibility from outside the site.		✓	✓	
Minimise construction activities that may require night time lighting, and if necessary use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the site to minimise glare at night.		✓	✓	
Minimise cut and fill for site tracks and revegetate disturbed soils as soon as possible after construction.		✓	✓	
Maximise revegetation of disturbed areas to ensure effective cover is achieved.			✓	
Consider options for planting screening vegetation in vicinity of nearby residences and along roadsides to screen potential views of turbines. Such works to be considered in consultation with local residents and authorities.	✓	✓	✓	
Undertake revegetation and off-set planting at areas around the site where required in consultation and agreement with landholders.	✓	✓	✓	

Conclusion

Section 16

16.1 Summary

In summary, this LVIA concludes that the Mount Emerald wind farm project will have an overall low to medium visual significance on the majority of uninvolved residential view locations within the viewshed as well public view locations (from sections of local roads and amenity areas within urban localities). This LVIA has determined that the project will have a medium to high visual significance for five uninvolved residential view locations within 2 km of the proposed Mount Emerald wind farm turbines. This LVIA has also determined that the project will have a medium significance for two residential dwellings within 2 km of the proposed turbines.

This LVIA determined the overall landscape character sensitivity to be medium to high. Some recognisable characteristics of the LCA will be altered by the proposed project, and result in the introduction of visually prominent elements that will alter the perceived characteristics of the LCA but may be partially mitigated by existing landscape elements and features within the LCA.

The main characteristics of the LCA's, patterns and combinations of landform and landcover will still be visually evident from within and beyond the project site boundary.

The LCA's identified and described in this LVIA are generally well represented throughout the surrounding local landscape and more generally within other regions across the Atherton Tablelands. This LVIA has determined that the landscape surrounding the project will have some ability to accommodate the physical changes associated with the wind farm and its associated structures.

Many of the residential dwellings surrounding the wind farm have been positioned within the landscape to mitigate exposure to inclement weather, or have adopted measures to reduce these impacts by planting and maintaining windbreaks around residential dwellings. The extent of windbreak planting reduces the potential visibility of the wind farm from a number of residential view locations in the surrounding landscape.

This LVIA has determined that views toward the Mount Emerald wind turbines will generally result in a low impact for the majority of motorists travelling through the area due to the short duration and

transitory nature of effects. This low level of impact will include tourist traffic travelling along the Kennedy Highway.

This LVIA has determined that the construction of the project will not result in any significant 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any existing or proposed wind farm developments within the planning system located in the Atherton Tablelands.

The potential substation location and associated electrical infrastructure works are unlikely to result in any visual impact for surrounding residential or public view locations.

Both pre-construction and construction activities are unlikely to result in an unacceptable level of visual impact due to the temporary nature of these activities together with proposed restoration and rehabilitation strategies. The preferred location for some of the construction activities, including the on-site concrete batch plant and rock crushing equipment, will be located away from publicly accessible areas, with the closest residential view locations generally comprising involved landowners.

The Mount Emerald wind turbines do not exceed the 150 m tip height threshold and, in accordance with current CASA guidelines, will not require night time obstacle lighting.

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of the elements associated with the wind farm, it is acknowledged that the degree to which the wind turbines will be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations.

The Proponent has engaged in ongoing consultation with local residents and made adjustments to the location of individual turbines and associated infrastructure to minimise visual impacts where possible.

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Limitations

GBD has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of RACL (Pty Ltd) and only those third parties who have been authorised in writing by GBD to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the GBD Proposal dated 17 April 2013.

The methodology adopted and sources of information used are outlined in this report. GBD has made no independent verification of this information beyond the agreed scope of works and GBD assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to GBD was false.

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Appendix A – Andrew Homewood, curriculum vitae

Areas of Expertise	Landscape and Visual Impact Assessment Landscape Design and Contract Documentation Independent Verification & Landscape Management
Education	University of Sheffield, Graduate Diploma Landscape Management, 1996 University of Sheffield, BSc (Dual Hons), Landscape Architecture & Archaeology, 1995 Writtle College, National Diploma Amenity Horticulture, 1989
Registration & Memberships	Registered Landscape Architect , Australian Institute Landscape Architects (AILA) Member Environmental Institute Australia and New Zealand (MEIANZ) Member of the Landscape Research Group (UK)
Selected Project Experience	<i>Landscape and Visual Impact Assessment</i>
<i>Wind and Solar Farms</i>	BP Moree Solar Power Station, Status: Approved LVIA for the Solar Flagship Moree Solar Farm site in northern New South Wales. Boco Rock Wind Farm EA, (Wind Prospect CWP Pty Ltd) Status: Approved LVIA for the proposed construction of up to 125 wind turbine generators in the NSW Southern Tablelands Monaro sub region, including coordination for supply of photomontage, ZVI and flicker assessment. Sapphire Wind Farm EA (Wind Prospect CWP Pty Ltd) Status: Approved LVIA for the proposed construction of up to 174 wind turbine generators in the NSW New England region, including coordination for supply of photomontage, ZVI and flicker assessment. Silverton Wind Farm EA Stages 1 & 2 (Epuron Pty Ltd) Status: Approved LVIA for a 1000MW wind farm at Silverton in the Unincorporated Area of western NSW, for up to 600 wind turbines including a 25km length of 220kV transmission line between the wind farm and Broken Hill. Conroy's Gap Wind Farm (Epuron Pty Ltd) Status: Approved LVIA for a DA modification for additional wind turbines to an approved development located in the southern highlands NSW.

Bango Wind Farm (Wind Prospect CWP Pty Ltd)

LVIA for the proposed construction of up to 100 wind turbines located in the southern highlands NSW.

Liverpool Range Wind Farm Stage 1 (Epuron Pty Ltd)

LVIA for the proposed construction of up to 200 wind turbines located in the Warrumbungle and Upper Hunter Shire Councils approximately 370 km north of Sydney, and a 60 km length of 330 kV line connecting to the Ulan mine site.

Rye Park Wind Farm, (Epuron Pty Ltd)

LVIA for the proposed construction of up to 120 wind turbines adjoining multiple wind farm sites in the New South Wales southern highlands.

Deepwater Wind Farm (Epuron Pty Ltd)

LVIA for the proposed construction of up to 7 wind turbines at Deepwater in north NSW.

Port Kembla Wind Farm (Epuron Pty Ltd)

LVIA for the proposed construction of up to 7 wind turbines within the Port Kembla industrial facility at Wollongong.

Eden Wind Farm, (Epuron Pty Ltd)

LVIA for the proposed construction of up to 7 wind turbines within the SEFE woodchip facility on the south coast of New South Wales.

Paling Yards Wind Farm EA, (Union Fenosa Pty Ltd)

LVIA for the proposed construction of up to 59 wind turbines including night lighting, cumulative impact assessment, detailed field assessment for shadow flicker and preparation of photomontages.

Collector Wind Farm EA, (APP/RATCH)

LVIA for the proposed construction of up to 68 wind turbines adjoining the operation Cullerin wind farm project including a detailed cumulative impact assessment.

Willatook Wind Farm EES Referral, (Wind Prospect WA Pty Ltd)

Preliminary LVIA for the proposed construction of up to 190 wind turbines within Moyne Shire Council (Victoria) including a detailed cumulative impact assessment, photomontage location selection and community consultation.

**Electrical
Infrastructure****Birrema Wind Farm EA (Epuron Pty Ltd)**

LVIA for the proposed construction of up to 75 wind turbines adjoining the proposed Yass Valley wind farm project development including a detailed cumulative impact assessment, photomontage location selection and community consultation.

White Rock Wind Farm EA, (Epuron Pty Ltd)

LVIA for the proposed construction of up to 100 wind turbines adjoining the proposed Sapphire and approved Glen Innes wind farm projects including a detailed cumulative impact assessment, photomontage location selection and community consultation.

Crookwell 3 Wind Farm EA, (Union Fenosa Wind Australia)

LVIA for the proposed construction of up to 35 wind turbines adjoining the approved Crookwell 2 wind farm development including a detailed cumulative impact and night time lighting assessment.

22kV transmission line (Country Energy)

LVIA for a short section of electrical distribution line through central New South Wales.

Wagga North 132kV substation (TransGrid)

LVIA for a proposed 132/66kV substation and installation of transmission line connections at Wagga Wagga New South Wales.

Lismore to Dumaresq 330kV transmission line (TransGrid)

LVIA for a proposed 330kV transmission line through northern New South Wales.

Manildra to Parkes 132kV transmission line (TransGrid)

LVIA for a proposed 132kV transmission line through central New South Wales.

Mount Macquarie Communication Tower (TransGrid)

LVIA and preparation of visual simulations for proposed 80m high microwave communication tower in rural New South Wales, adjacent to the Blayney Wind Farm.

Broken Hill to Red Cliffs 220kV transmission line duplication (Epuron Pty Ltd)

LVIA for approximately 300km of 220kV transmission line duplication for the Silverton Wind Farm Concept Approval application.

Molong to Manildra 132kV transmission line (TransGrid)

View catchment mapping and visual assessment for a 28 km section of 132kV transmission line through rural landscape in central western New South Wales.

Power Generation

Dalton Gas fired Power Plant (AGL Energy)

LVIA for gas turbine peaking power station, valve station and communication tower in rural NSW. Preparation of photomontage and 3D modelling.

Herons Creek Peaking Power Station (International Power)

LVIA for 120MW distillate-fired peaking power station in rural landscape setting. Visual assessment included preparation of visual simulations to model each of the three 40MW generating units in the existing landscape.

Parkes Peaking Power Station (International Power)

LVIA for 120MW distillate-fired peaking power station in central New South Wales, including provision of photomontages.

Buronga Peaking Power Station (International Power)

LVIA for 120MW distillate-fired peaking power station in far west New South Wales.

Leafs Gully Peaking Power Plant (AGL Energy Pty Ltd)

LVIA and landscape master plan for gas turbine peaking power station in south-west Sydney.

Bio Energy Project (SEFE)

LVIA for a 5MW bio fuel power plant located on the south of Two Fold Bay, Eden.

Professional History

Green Bean Design, Principal Landscape Architect 2006 -
URS Australia Pty Ltd, Practice Leader Landscape Architecture 2005 - 2006
URS Australia Pty Ltd, Associate Landscape Architect 2003-2005
URS Australia Pty Ltd, Senior Landscape Architect, 2002 - 2003
URS Australia Pty Ltd, Landscape Planner, 2001-2002
URS, Contract Landscape Architect, 2000-2001
Blacktown City Council, Contract Landscape Planner, 2000-2001
Knox & Partners Pty Ltd, Landscape Architect, 1996-2000
Brown & Associates, Landscape Architect, 1996
Philip Parker & Associates, Graduate Landscape Architect, 1994-1995
Rendel & Branch, Landscape Assistant, 1989-1991
National Trust, Horticulturalist, 1987-1988
English Nature, Species Protection Warden, 1985-1986
Essex Wildlife Trust, Botanist, 1984-1985
Royal Society for the Protection of Birds, Voluntary Warden, 1983-1984