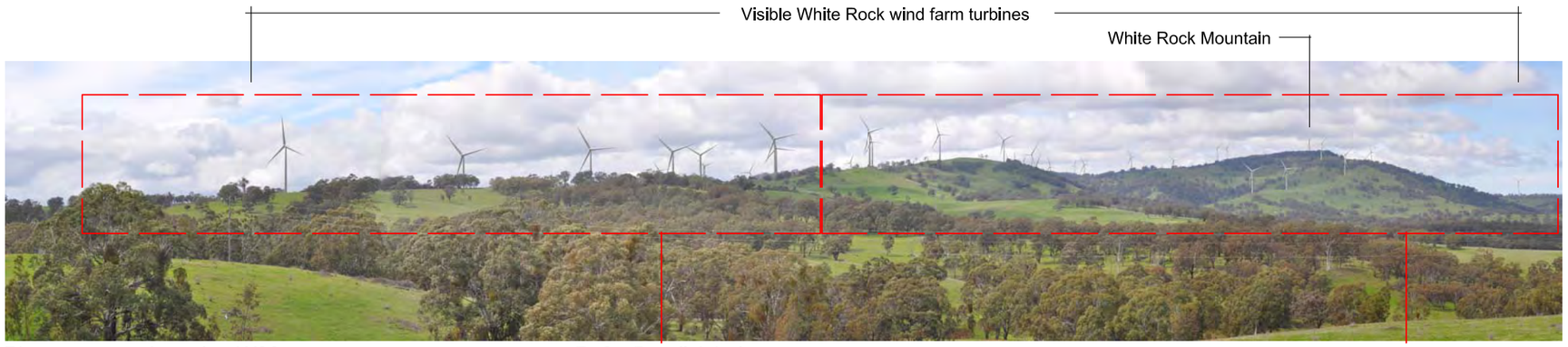

Photomontage Location W30
Gwydir Highway, Extended panorama east to south (Bearing 70° to 190°)

Photomontage Location W30 - Detail A

Photomontage Location W30 - Detail B

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 357265 Northing 6706322 (MGA Zone56)

Distance to nearest visible turbine 2km

Figure 31 Photomontage
W30 Gwydir Highway

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WHITE ROCK WIND FARM

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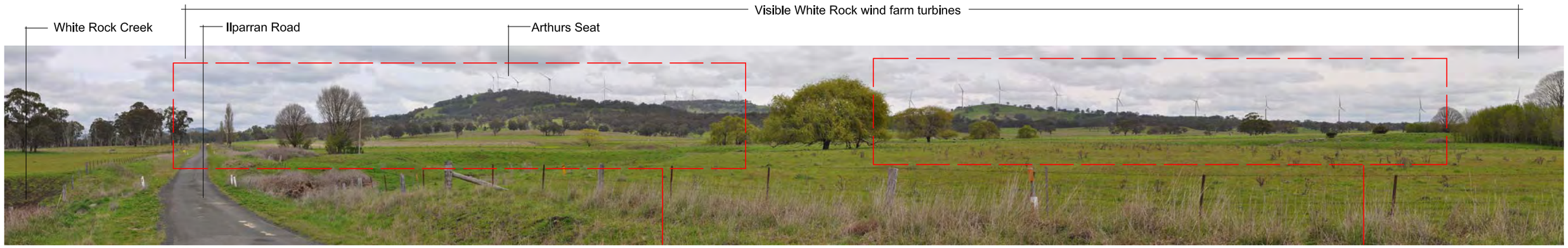

Photomontage Location W36
Ilparran Road, Extended panorama south east to west (Bearing 125° to 275°)

Refer Detail A below

Refer Detail B below

Photomontage Location W36 - Detail A

Photomontage Location W36 - Detail B

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 362430 Northing 6705863 (MGA Zone56)

Distance to nearest visible turbine 2.4km

Figure 32 Photomontage
W36 Ilparran Road

EPURON
POWER FOR PORTFOLIOS

WHITE ROCK WIND FARM

GREEN BEAN DESIGN
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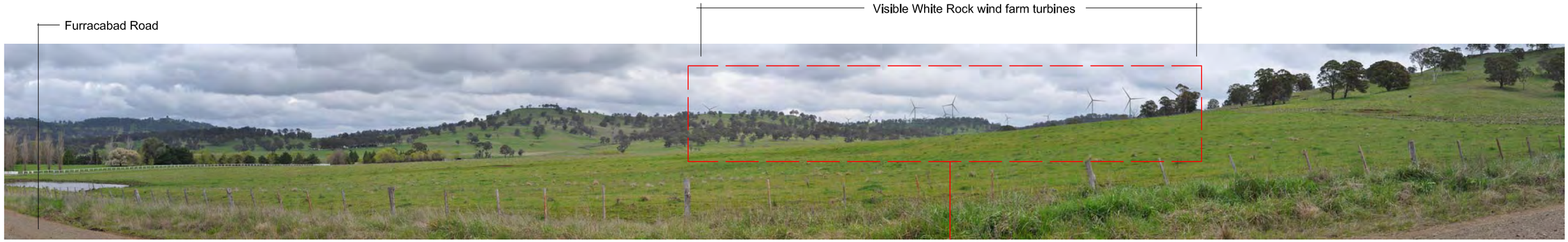


Photomontage Location W40
Furracabad Road, Extended panorama south east to south west (Bearing 155° to 255°)

Refer Detail A below

Photomontage Location W40 - Detail A

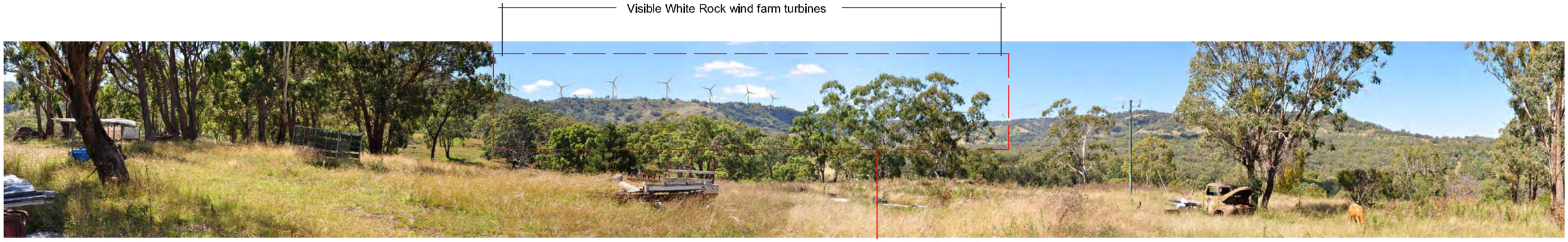
WHITE ROCK WIND FARM

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 368724 Northing 6700133 (MGA Zone56)

Distance to nearest visible turbine 2km

Figure 33 Photomontage
W40 Furracabad Road



Photomontage Location W41
Private Property, Extended panorama south to north (Bearing 20° to 210°)

Refer Detail A below

Photomontage Location W41 - Detail A

EPURON
POWER FOR PORTFOLIOS

WHITE ROCK WIND FARM

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 357262 Northing 6698558 (MGA Zone56)

Distance to nearest visible turbine 1.3km

Figure 34 Photomontage
W41 Private Property

GREEN BEAN DESIGN
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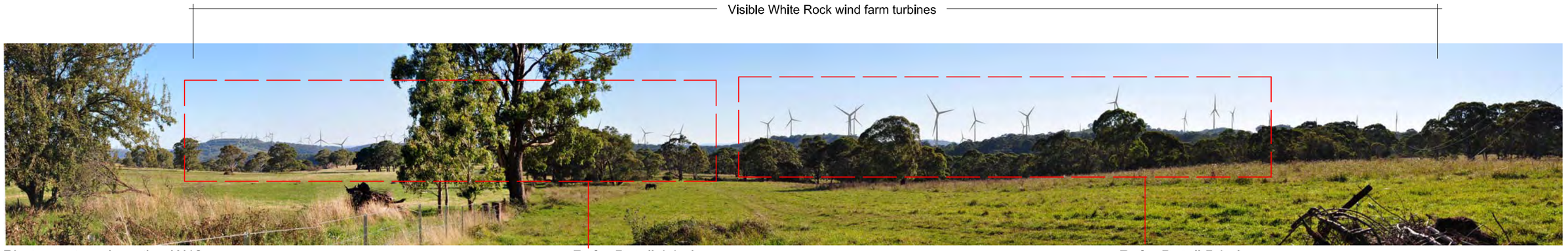
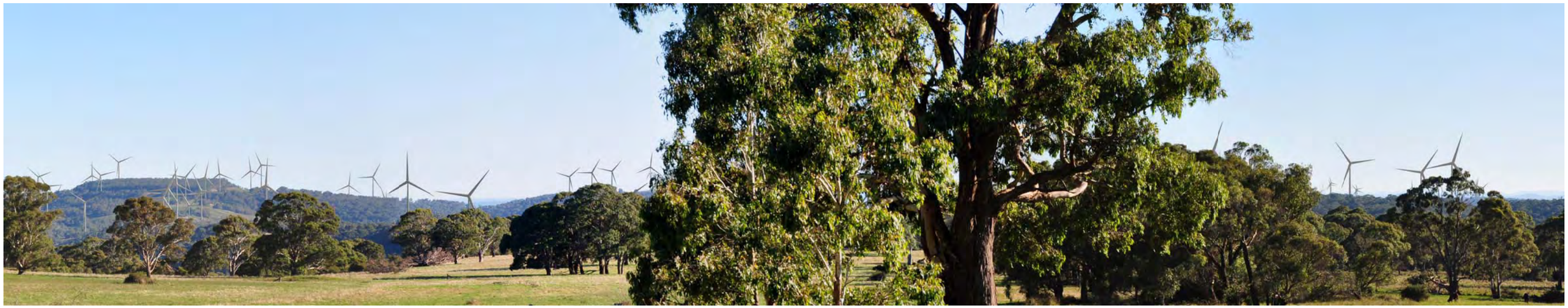


Photomontage Location W42 Refer Detail A below Refer Detail B below
Haymarket Road, Extended panorama north west to south east (Bearing 325° to 115°)



Photomontage Location W42 - Detail A

Photomontage Location W42 - Detail B

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 361125 Northing 6693997 (MGA Zone56)

Distance to nearest visible turbine 1.2km

Figure 35 Photomontage W42 Private Property

EPURON
POWER FOR PORTFOLIOS

WHITE ROCK WIND FARM

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Visible White Rock wind farm turbines

Photomontage Location W43
Private Property, Extended panorama north east to south (Bearing 215° to 65°)

Refer Detail A below

Photomontage Location W43 - Detail A

EPURON
POWER FOR PORTFOLIOS

WHITE ROCK WIND FARM

Refer Figure 25 for Photomontage Location

Photo coordinates: Easting 368435 Northing 6694266 (MGA Zone56)

Distance to nearest visible turbine 1km

Figure 36 Photomontage
W43 Private Property

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Night Time Lighting

SECTION 11

11.1 Introduction

The White Rock wind farm may require obstacle marking and lighting at night time and during periods of reduced visibility. The requirement for lighting would be subject to the advice and endorsement of the Civil Aviation Safety Authority (CASA). CASA is currently undertaking a safety study into the risk to aviation posed by wind farms to develop a new set of guidelines to replace the Advisory Circular with regard to lighting for wind turbines that was withdrawn by CASA in mid 2008.

However, in order to ensure that a full assessment was carried out, the Proponent proposes to commission an independent aviation safety expert to conduct an Aeronautical Impact Assessment, to first determine the risks posed to aviation activities by the wind farm. If recommended by the Aeronautical Impact Assessment expert, an Obstacle Lighting Assessment would be undertaken to stipulate the turbine lighting layout which would mitigate any risks to aviation. The outcomes of the Aeronautical Impact Assessment and the Obstacle Lighting Assessment would 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 New South Wales, 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 500m, 3.5km and 17km from the turbines and are illustrated in **Figures 37, 38** and **39**. 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 White Rock wind farm viewshed, and include residential and general lighting around Glen Innes.

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 provide dynamic and temporary sources of light.

Existing night time obstacle lights are located on the TV transmitter masts located on Carpenters Hill to the west of Glenn Innes. These night time obstacle lights are visible from Glen Innes as well as sections of the New England and Gwydir Highways.

11.3 Potential light sources

The main potential light sources associated with the White Rock wind farm would include:

- Night lights of control and auxiliary buildings; and
- Night time obstacle lights mounted on some wind turbines.

In accordance with the withdrawn CASA Advisory Circular two red medium intensity obstacle lights were required on specified turbines at a distance not exceeding 900m 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 would be largely contained by the surrounding landform, it is unlikely that light spill from these sources would 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 would be visible to motorists travelling along the local roads, the duration of visibility would 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 would be visible from a number of the residential view locations surrounding the White Rock wind farm; however, topography and screening by vegetation and screen planting around residential dwellings would screen or partially obscure views toward night time obstacle lighting.

Irrespective of the total number of visible lights, obstacle 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 would be obscured when curtains and blinds are closed.

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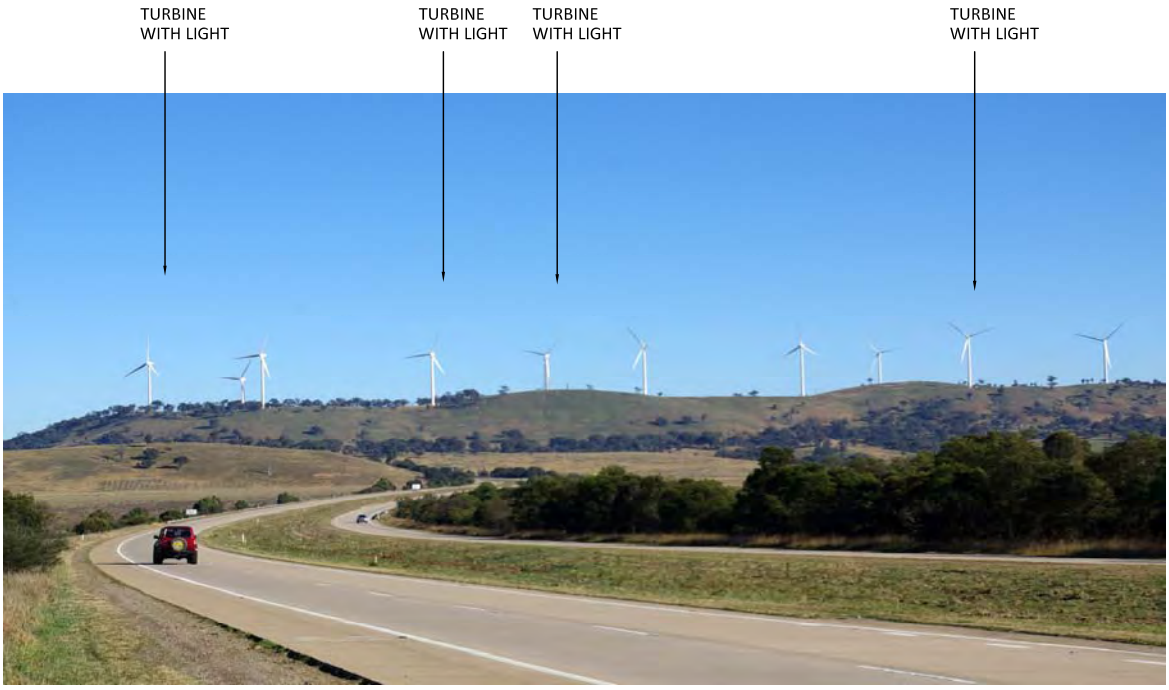
Figure 37
Night Lighting Cullerin
Wind Farm at 500m

DAY TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 500M

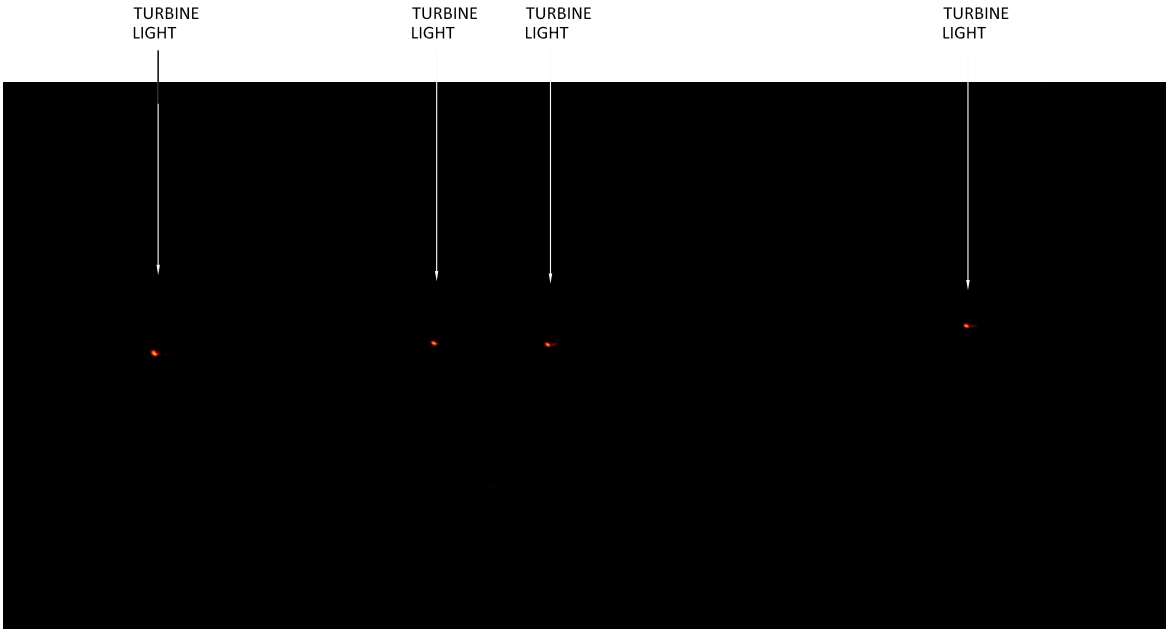
NIGHT TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 500M

CULLERIN WIND FARM NIGHT TIME LIGHTING .
VIEW WEST FROM HUME HIGHWAY AT AROUND
500M DISTANCE.

Figure 38
Night Lighting Cullerin
Wind Farm at 3.5km



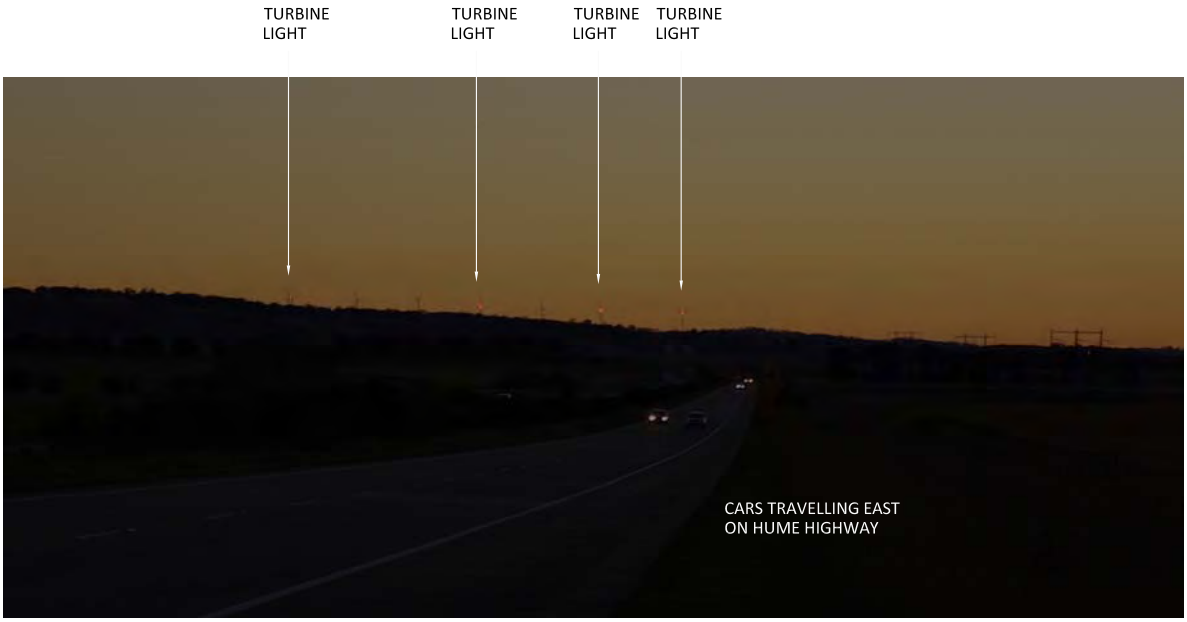
DAY TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 3.5KM



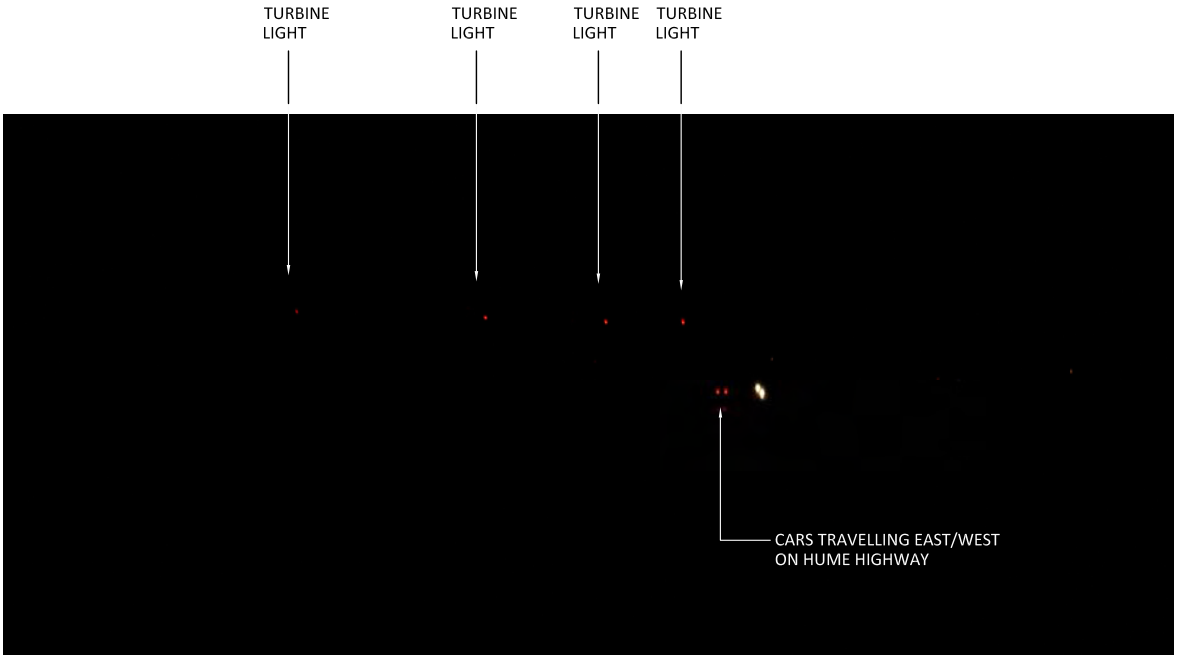
NIGHT TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 3.5KM

CULLERIN WIND FARM NIGHT TIME LIGHTING .
VIEW WEST FROM HUME HIGHWAY AT AROUND
3.5KM DISTANCE.

Figure 39
Night Lighting Cullerin
Wind Farm at 17km



VIEW WEST AT DUSK FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 17.5KM



VIEW WEST AFTER DARK FROM HUME HIGHWAY
TOWARD CULLERIN WIND FARM AT AROUND 17.5KM

CULLERIN WIND FARM NIGHT TIME LIGHTING .
VIEW WEST FROM HUME HIGHWAY AT AROUND
17KM DISTANCE.

Electrical works

SECTION 12

12.1 Introduction

The White Rock wind farm would include a range of electrical infrastructure to collect and distribute electricity generated by the wind turbines. Electrical works would include:

- Substation (2 location options) and a Switching Station;
- 132kV transmission line (7.5km);
- Generator transformer; and
- Underground and overhead 33kV and control cables.

A typical arrangement for a wind farm substation is illustrated in **Plate 7** and demonstrates the relatively small scale development required for this component of the electrical infrastructure.

The majority of electrical connections between the wind turbines would be via underground cabling, including areas along ridgelines within the project boundary. Small sections of 33kV overhead reticulation could be required within the site boundary; however, the scale of these structures would be similar to existing domestic distribution utility infrastructure found throughout the landscape.

The potential substation sites, switching station location and indicative alignment for the 132kV transmission line are illustrated in **Figure 40.**

Plate 7 – Typical wind farm substation

Plate 8 – Typical 132kV supporting structure

12.2 Substation

There are two potential substation locations illustrated in **Figure 40**. A final location would be selected subject to detail engineering design; however each option is located on the west portion of the project area and slightly below the White Rock ridgeline. Both substation locations would not be

visible from areas to the east of the ridgeline, and would be largely screened by landform and scattered tree cover to the west. Views from residential dwellings on Spring Mountain Road would also be partially screened by landform, including Spring Mountain hill between the dwellings and the north substation site. A substation at either potential location would not be expected to result in any significant visual impact from surrounding view locations.

12.3 132kV Transmission Line

Electricity generated by the White Rock wind farm would be connected to the grid via an overhead 132kV transmission line extending up to 7.5km to connect to the existing 132kV Country Energy transmission line alongside the Gwydir Highway north of the White Rock wind farm.

The key visual components of the 132kV transmission line would comprise:

- Single tapered concrete poles up to 26m high;
- Aluminium alloy 132kV conductors; and
- An aerial earth wire and communications link.

A typical pole design for a 132kV transmission line supporting structure is illustrated in **Plate 8**.

The photograph in **Plate 9** illustrates an alternative 132kV transmission line design and the direct influence of distance on visibility.

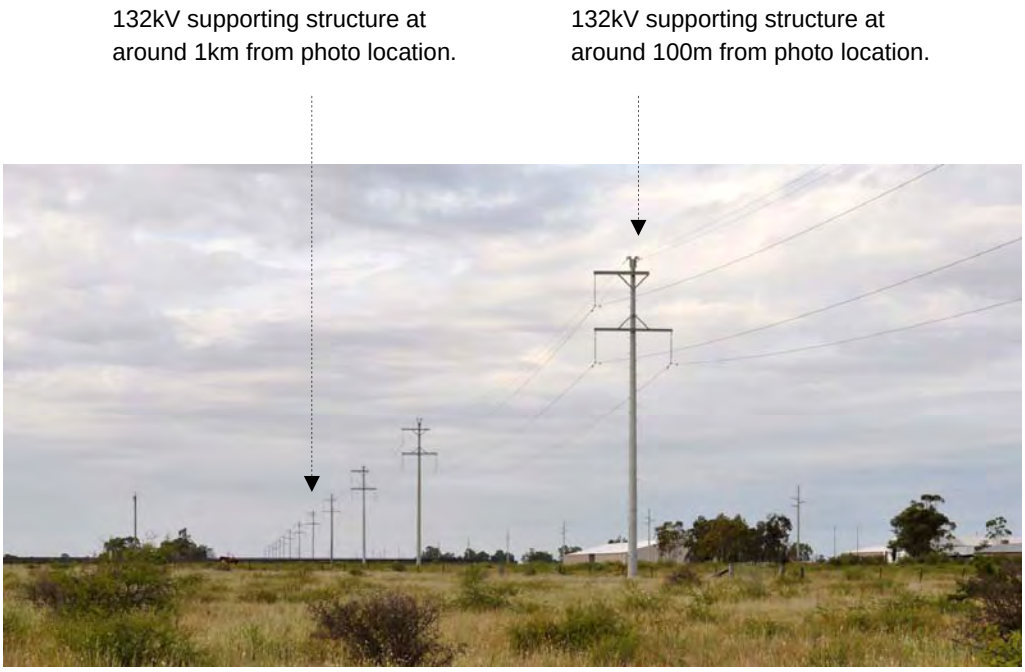


Plate 9 **-** Existing typical 132kV single pole supporting structure

The viewshed for the 132kVtransmission line has been determined within a 3 kilometre offset from either side of the transmission line. Beyond 3 kilometres views toward the transmission line would

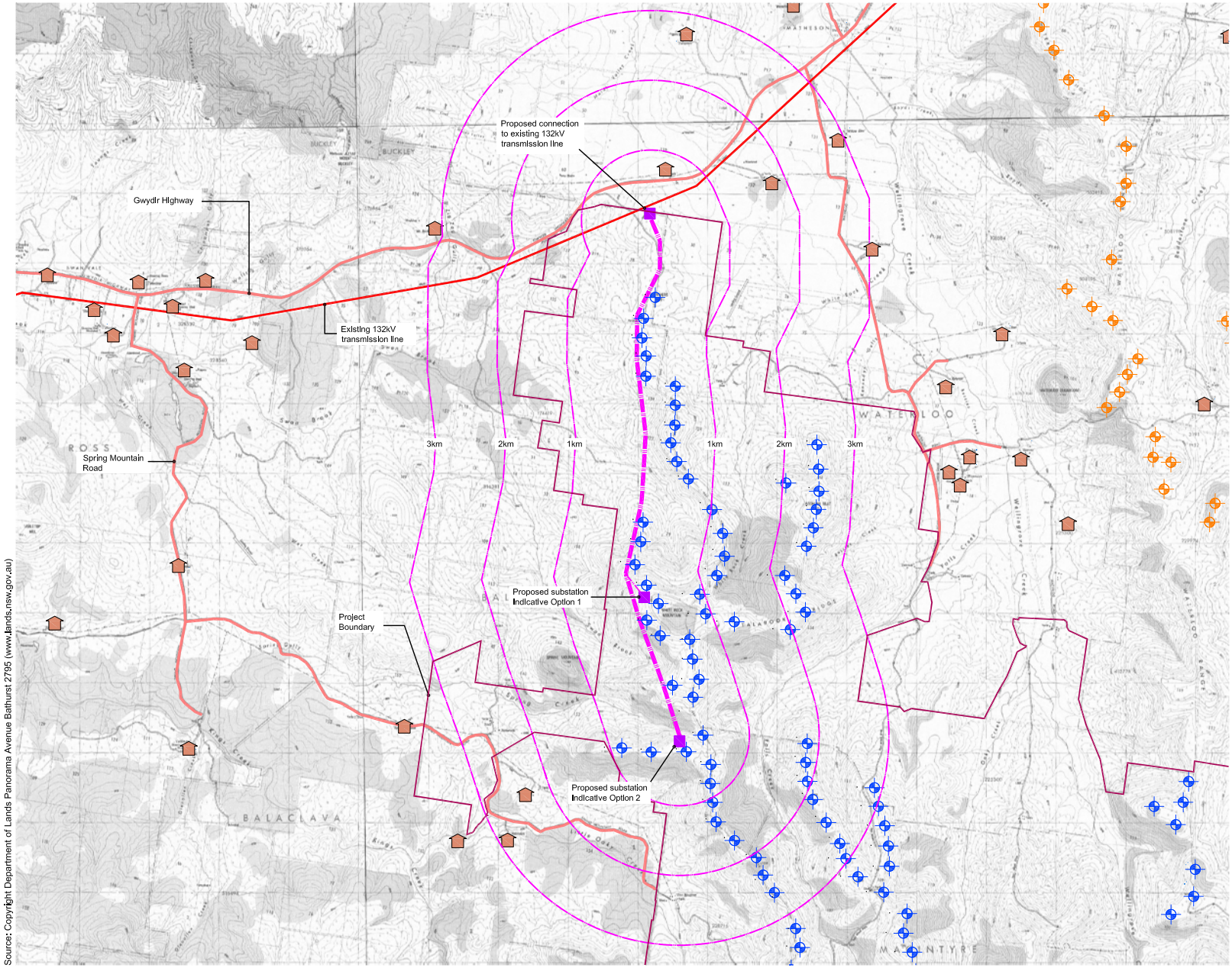
have a greater tendency to be screened by vegetation and landform for portions of the alignment. It is also considered that whilst some components of the transmission line would be noticeable from areas beyond 3 kilometres, they are unlikely to appear as a dominant visual element within the landscape at this distance.

The transmission line route would follow the White Rock ridgeline and be located between 30m to 60m below the ridgeline for around 5km in length. The final alignment of the proposed 132kV transmission line is subject to ongoing site assessment and detailed engineering design.

Views toward the transmission line from view locations to the east and south of the wind farm site would be largely blocked by the White Rock ridgeline, undulating landform and timbered areas. Views from residential dwellings along Spring Mountain Road would be partially screened by landform and vegetation between the transmission line and the dwellings. Where visible views toward the transmission line would not be significant due to the influence of distance where in excess of 3km. Views toward the transmission line would also be seen against the backdrop of the hillside when viewed from the north west through to south west, which would assist in visually absorbing the key elements of the transmission line and further reducing the overall level of visibility.

Views toward the transmission line from a very small number of residential dwellings as well as vehicles travelling along the Gwydir Highway to the north of the wind farm site would be screened by tree cover alongside the road corridor.

Overall, this LVIA has determined that the electrical infrastructure associated with the White Rock wind farm project would be unlikely to have a significant visual impact on surrounding view locations.



Legend

- Residential dwelling
- White Rock Wind Turbine
- Glen Innes Wind Turbine
- White Rock site boundary
- Existing 132kV transmission line
- Proposed 132kV transmission line
- Substation or Switching Station
- Road
- Distance offset from proposed transmission line

N

0km 1km 2km 3km

Figure 40
Proposed 132kV Transmission Line

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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 18 to 24 months, although the extent and nature of pre-construction and construction activities would vary at different locations within the project area.

Plate 10 **-** Illustrating general construction activities at the Capital Hill wind farm site, including views toward cranes, partial construction of towers and laydown areas.

The key pre-construction and construction activities that would 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 facilities, including portable structures and laydown areas;
- Various construction and directional signage;
- Mobilisation of rock crushing 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 would result in physical changes to the landscape (which have been assessed elsewhere 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 would be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature.

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 individuals 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 Day;
- Leaflet drops and local media presentations; 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 would accept and support wind farms in response to global or local environmental issues, others would find the concept of wind farms completely unacceptable. Some would 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 would 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 can 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

The White Rock design layout is the culmination of several meetings with residents in the local community, and has taken into account a number of issues and concerns relating to potential visual impacts from individual view locations.

The Proponent held a number of meetings with stakeholders in the area surrounding the wind farm, including individual meetings with adjoining landowners potentially impacted by the wind farm development, and carried out neighbouring consultation at all residential dwellings within a 5km radius of the White Rock wind farm.

A public consultation 'open day' was held on the 3rd November 2010 which provided a notably positive response from the estimated 40 people that attended the event. Details of the proposed wind farm project were on placed on display and included maps showing the planned locations of wind turbines and other associated infrastructure including substations, power lines and access tracks. A small number of photomontages illustrating the likely view of the completed wind farm from a number of locations around the site were on display.

14.3 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 2022 residents across the six Renewable Energy Precincts established by the NSW Government, including the New England Tablelands. The 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;*
- *79% supported wind farms being built within 10km of residences and 60% of people surveyed supported the construction of wind turbines within 1 to 2kmfrom their residences. This level of support for wind farms within 1 to 2km dropped to 54% in the New England Precinct.*

These results are reflected in other surveys including the community perception survey commissioned by Epuron for the Gullen Range Wind Farm Environmental Assessment (August 2008). The results of the survey, which targeted a number of local populations within the Southern Tablelands, suggested that around 89 % of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71 % of respondents accepting the development of a wind farm within one kilometre from their residential dwelling.

The study targeted people living in a number of small urban and rural communities located in the area immediately surrounding the proposed Gullen Range wind farm as well as other communities surrounding potential future wind farm development sites. The results of the survey suggested that almost 89% of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71% of respondents accepting the development of a wind farm within one kilometre from their residential dwelling.

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 would have a good impact on tourism, with 15% of respondents believing that the wind farm would make no difference.*
- *Over 40% of respondents believed that the impact of the wind farm on the visual amenity of the area would be good, with 40% believing that it would make no difference.*

A September 2002 MORI poll of 307 tourists conducted in Argyll (United Kingdom) indicated that:

- *43% maintained that the presence of wind farms had a positive impression of Argyll as a place to visit.*
- *43% maintained that the presence of wind farms had an equally positive or negative effect.*
- *Less than 8% maintained it had a negative effect.*
- *91% of tourists maintained that the presence of wind farms in Argyll made no difference to the likelihood of them visiting the area.*

There is no published Australian research on community attitudes to the impact of wind farms on landscape and visual issues before and after construction. However, overseas research in the United Kingdom conducted by MORI in 2003 indicated that:

- *Prior to construction 27% of people polled thought problems may arise from wind farm impact on the landscape*
- *Following construction the number of people who thought the landscape has been spoiled was 12%.*

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.

14.4 The Broader Public Good

Whilst visual perceptions and attitudes of local communities toward wind farm developments are an important issue, and need to be assessed locally in terms of potential landscape and visual impacts, there is also an issue of the greater potential public benefit provided by renewable energy production. Wind farms are expected to make a contribution toward meeting the Government's commitment that 20% of Australia's electricity supply comes from renewable energy sources by 2020.

In the 2006 Land and Environment Court decision to confirm, on an amended basis, consent for the construction of a wind farm at Taralga, Chief Judge Justice Preston said in his prologue to the judgement:

"The insertion of wind turbines into a non-industrial landscape is perceived by many as a radical change which confronts their present reality. However, those perceptions come in different hues. To residents, such as members of the Taralga Landscape Guardians Inc. (the Guardians), the change is stark and negative. It would represent a blight and the confrontation is with their enjoyment of their rural setting".

"To others; however, the change is positive. It would represent an opportunity to shift from societal dependence on high emission fossil fuels to renewable energy sources. For them, the confrontation is beneficial – being one much needed step in the policy settings confronting carbon emission and global warming".

"Resolving this conundrum – the conflict between the geographically narrower concerns of the guardians and the broader public good of increasing the supply of renewable energy – has not been easy. However, I have concluded that, on balance, the broader public good must prevail".

Whilst the exact circumstances between the Taralga wind farm and the proposed White Rock wind farm may differ, the comments provided by the Chief Judge make it clear that, in the circumstances of that case, there was a need for the broader public good to be put before the potential negative impacts on some members of the local community. Similar reasoning can be applied to the White Rock wind farm.

15.1 Mitigation Measures

The purpose of mitigation, where reasonable and feasible, is to avoid, reduce, or where possible remedy or offset any significant negative impact arising from the White Rock wind farm development. In general mitigation measures would reduce the potential visual impact of the White Rock wind farm 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 would 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 would, 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 White Rock wind farm 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 groups of turbines. Similarly roadside tree planting can screen potential views of turbines from particular sections of road provided the turbine is not located some distance from the road.

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 would 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 for the wind farm and transmission line is presented in **Tables 21** and **22**.

Table 21 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
Consider options for use of colour to reduce visual contrast between turbine structures and background, e.g. use of off white rather than white, and use matt finish to avoid reflected sunlight.	✓			
Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.			✓	✓
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 residences, to minimise additional line needed, and to 'blend in' with existing transmission infrastructure.	✓		✓	
Enforce safeguards to control and minimise fugitive dust emissions.		✓	✓	
Restrict the height of stockpiles to minimise		✓	✓	

Table 21 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
visibility from outside the site.				
Minimise 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 in consultation and agreement with landholders.	✓	✓	✓	

Table 22 – 132kV transmission line summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
A careful and considered route selection process to avoid sensitive view locations and loss of existing vegetation where possible.	✓		✓	✓
Wherever possible, select angle positions in strategic locations to minimise potential visual impact (e.g. avoiding, where possible, skyline views) and to provide a maximum setback from residential dwellings and road corridors.	✓		✓	

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
Selection of suitable component materials with low reflective properties.	✓		✓	✓
Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.			✓	
Design for strategic tree or shrub planting between view locations and the transmission line.			✓	✓

Conclusion

SECTION 16

16.1 Summary

In summary, this LVIA concludes that the White Rock wind farm would have an overall low visual impact on the majority of non-associated residential view locations as well public view locations, including the New England and Gwydir Highways as well as sections of the local road network identified in this LVIA.

This LVIA determined the overall landscape character sensitivity to be medium with some characteristics of the landscape likely to be altered by the wind farm development, although the landscape would have some capability to accommodate change. This capability is largely derived from the large scale and open landscape character identified in this part of the New England Tablelands, together with the relatively low density of residential view locations within the immediate area of the White Rock wind farm viewshed.

The LCA's identified and described in this LVIA are generally well represented throughout the Glen Innes Severn and Inverell Shire Council areas and more generally within other regions across the New England Tablelands. This LVIA has determined that the landscape surrounding the White Rock wind farm will have some ability to accommodate the physical changes associated with the wind farm and its associated structures.

This LVIA determined that the White Rock wind farm would have a high visual impact on eight of the 142 residential view locations within the 10km viewshed. The high visual impact would largely result from the proximity of wind turbines to the residential dwellings or orientation of dwellings relative to the wind turbines. From the eight residential view locations with a high visual impact seven would be associated landowners and three non-associated.

GBD understand that none of the associated landowners have expressed concerns with regard to the potential visual impact of the proposed wind farm, including the potential visibility of wind turbines from within, or immediately surrounding their residential dwellings.

The majority of residential dwellings surrounding the wind farm are strategically situated 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 identified and assessed 19 public view locations, including road corridors and public lookouts, and determined that the White Rock wind farm would have a low visual impact on thirteen of the public view locations and nil on the remaining six. The low visual impact would be largely due to the proximity of the wind turbines relative to the view location as well as the combined screening influence of undulating landform and tree cover. The majority of the public view locations are

dynamic (motorists travelling along local roads) and include contextual views that would potentially change in reasonably quick succession within the spatial qualities of the surrounding landscape.

It is acknowledged that the wind farm will have the potential to impact people engaged in predominantly farming or recreational activities, where views toward wind turbines occur from surrounding and non-associated agricultural areas. Ultimately the level of impact would depend on the type of activities engaged in as well as the location of the activities together with the degree of screening provided by local landform or vegetation within individual properties. Whilst views toward the turbines would occur from a wide area of surrounding rural agricultural land, this LVIA has determined that the sensitivity of visual impacts is less for those employed or carrying out work in rural areas compared to potential views from residential dwellings.

This LVIA has determined that the large majority of non-associated landowners adjoining the wind farm project area are unlikely to have views toward the wind farm from their residential dwellings.

The White Rock wind farm would not have a significant impact on the urban character of the Glen Innes, where views toward the wind farm from the majority of residential view locations would be screened by adjoining residences, tree cover and landform.

The White Rock wind farm would be visible from a number of local roads including the Gwydir Highway. This LVIA has determined that views toward the White Rock turbines would generally result in a Low impact for the majority of motorists travelling through the area.

This LVIA has determined that the construction of the White Rock wind farm would not result in significant 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any known existing or proposed wind farm developments, including the Glen Innes, Sapphire and Ben Lomond wind farm projects. Intervisibility between approved and proposed wind farms is influenced by undulating landform and tree cover within and beyond the White Rock 10km viewshed.

The potential substation locations and 132kV transmission line are unlikely to result in a significant visual impact for surrounding residential or public view locations. A combination of distance between substation and transmission line components to surrounding view locations, together with the position of the substation and transmission line below the White Rock Mountain ridgeline would tend to reduce visibility.

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 crusher, would generally be located away from publicly accessible areas, with the closest residential view locations generally comprising associated landowners.

Night time obstacle lighting would have the potential to be visible from surrounding view locations, as well as areas beyond the White Rock wind farm 10km viewshed. The level of visual impact would diminish when viewed from more distant view locations, with a greater probability of night time lighting being screened by landform and/or tree cover. It should also be noted that the night time lighting installed on the Cullerin wind farm (as illustrated in this LVIA) has been decommissioned by Origin Energy following a risk based aviation assessment. A number of recent wind farm developments in New South Wales have also been approved without a requirement for night time lighting, including the Gullen Range and Glen Innes wind farms.

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 would be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations. Despite this, the Proponent has engaged in ongoing consultation with local residents and made a number of adjustments to the location of individual turbines to minimise visual impacts where possible.

Subject to Department of Planning determination, and any conditions of approval, the proponent would consider implementing landscape treatments to screen and mitigate the potential visual impact of the wind farm for individual neighbouring properties within an appropriate and agreed distance from the wind farm project area, subject to consultation and agreement with individual property owners.

Appendix A – Civil Aviation Safety Authority Advisory Circular AC139-18(0) July 2007 (Withdrawn)

Australian Government
Civil Aviation Safety Authority

Advisory Circular

AC 139-18(0) SEPTEMBER 2004

OBSTACLE MARKING AND LIGHTING OF WIND FARMS

CONTENTS

1. REFERENCES

- CASR Part 139, Subpart 139.E, and in particular
  - ◊ 139.365 Structures 110 metres or more above ground level.
  - ◊ 139.370 Hazardous objects etc.
- MOS-Part 139 Chapter 7 – Obstacle Restrictions and Limitations.
- MOS-Part 139 Section 8.10 – Obstacle Marking.
- MOS-Part 139 Section 9.4 – Obstacle Lighting.

2. PURPOSE

This Advisory Circular (AC) provides general information and advice on the obstacle marking and lighting of Wind Farms (including single wind turbines), where CASA has determined that the wind farm is, or will be, a hazardous object to aviation.

3. STATUS OF THIS AC

This is the first AC to be issued on this subject.

Advisory Circulars are intended to provide recommendations and guidance to illustrate a means but not necessarily the only means of complying with the Regulations, or to explain certain regulatory requirements by providing interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations

4. GENERAL

4.1 This AC applies specifically to horizontal-axis wind turbines, which are the only type installed, or known to be proposed for installation, in Australia, at the date of issue of this document.

4.2 This AC applies to:

(a) a single wind turbine; or

(b) a group of wind turbines, referred to as a wind farm, which may be spread over a relatively large area.

4.3 The height of a wind turbine is defined to be the maximum height reached by the tip of the turbine blades.

4.4 Australian standards and recommended practices for the marking and lighting of obstacles and objects assessed as being hazardous to aviation, are consistent with international standards and recommended practices as published by the International Civil Aviation Organisation (ICAO) in Annex 14 Volume 1 (Aerodrome Design and Operations). The general requirements are:

(a) marking is used to make objects conspicuous to pilots, by day.

(b) lighting is used to make objects conspicuous to pilots, by night;

(c) lights are located as close as practicable to the top of the objects, and at other locations so as to indicate the general definition and extent of the objects.

4.5 Wind turbines pose a particular practical problem in that their highest point is not a fixed structure, and therefore lights can not be appropriately located. The highest fixed part of the turbine where lights can conveniently be located is the top of the generator housing, sometimes known as the nacelle, and this is typically of the order of 2/3 the maximum height of the turbine.

4.6 ICAO has not yet published standards and recommended practices specifically suited to wind turbines. The advice in this document has been derived by allowing some variations to standards and recommended practices to accommodate the specific practical difficulties associated with wind turbines and wind farms, and taking into consideration the practices of some overseas countries.

5. WIND TURBINES IN THE VICINITY OF AN AERODROME

5.1 CASA strongly discourages the siting of wind turbines in the vicinity of an aerodrome.

5.2 A wind turbine located sufficiently close to an aerodrome so that it penetrates an obstacle limitation surface (OLS) of the aerodrome, is defined by MOS-Part 139 Section 7.1, to be an obstacle.

5.3 If the aerodrome is to be used at night, an obstacle that penetrates an OLS should be lighted, in accordance with MOS-Part 139 Section 9.4. The top lights are required to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface. For a wind turbine, these lights may be located on a separate supporting structure adjacent to the wind turbine, to overcome the difficulty associated with the highest point of the obstacle being the (moving) blades of the turbine.

Note: Obstacle limitation surfaces are a complex of imaginary surfaces associated with an aerodrome. They vary depending on number and orientation of runways, and the instrument-approach type of the runway(s). Some surfaces can extend to 15 km from an aerodrome. Aerodrome operators can provide details for their particular aerodrome.

6. WIND TURBINES WITH A HEIGHT OF 110 m OR MORE

6.1 CASR 139.365 requires a person proposing to construct a building or structure, the top of which will be 110 m or more above ground level, to inform CASA of that intention and the proposed height and location of the proposed building or structure.

6.2 CASA will conduct an aeronautical study to determine if the wind turbine will be a hazardous object to aviation, in accordance with CASR 139.370.

6.3 If, as a result of the aeronautical study CASA finds that a proposed wind turbine will penetrate an OLS of an aerodrome, the proposal will be dealt with in accordance with 5 above.

6.4 The aeronautical study may find that even though the proposed wind turbine will not penetrate any OLS of an aerodrome, it will be a hazardous object to aviation.

6.5 The hazard that an object poses to aviation can be reduced by indicating its presence by appropriate marking and/or lighting.

Note: The marking and/or lighting does not necessarily reduce operating limitations which may be imposed by an obstacle or hazardous object.

6.6 The advice, in 7 and 8 below, on marking and lighting of wind turbines, should be suitable for wind turbines that do not penetrate an OLS, in most cases. However, because of the variations in configurations and layout of turbines in wind farms, the aeronautical study may indicate that a variation to that advice would be appropriate for a particular wind farm. In such a case, CASA may offer suggestions for variations to the normal advice provided in 7 and 8 below.

7. MARKING OF WIND TURBINES

7.1 Experience with wind turbines installed to date, indicates that they are sufficiently conspicuous by day, due to their shape, size, and colour.

7.2 Wind turbines that are of basically a single colour, and visually conspicuous against the prevailing background, do not require to be painted in obstacle marking colours and/or patterns.

8. LIGHTING OF WIND TURBINES

8.1 In the case of a single wind turbine:

(a) two flashing red medium intensity obstacle lights should be mounted on top of the generator housing;

(b) the light fixtures should be mounted at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;

(c) both lights should flash simultaneously; and

(d) the characteristics of the obstacle lights should be in accordance with MOS-Part 139 subsection 9.4.7.

8.2 In the case of a wind farm, sufficient individual wind turbines should be lighted to indicate the extent of the group of turbines:

(a) the interval between obstacle lights should not be less than the current extensive object standard of 900 metres, and at a distance that minimises the number of lighted wind turbine generators without diminishing appropriate aviation safety;

(b) in addition, the most prominent (highest for the terrain) turbine(s) should be lighted, if not included amongst the turbines lighted in accordance with (a) above; and

(c) the lighting of individual turbines should be in accordance with 8.1 above.

*Note**:*** *There is an overseas proposal that all lighting provided at a wind farm should flash simultaneously. This proposal is still to be validated and accepted. It is suggested that wind farm operators bear in mind that the simultaneous flashing of all lights at a wind farm could become accepted practice some time in the future.*

8.3 On completion of the project, CASA may choose to conduct a flight check to determine the adequacy of the obstacle lighting. This may result in a change (either more or fewer) to the number of obstacle lights required, to ensure the development remains conspicuous.

8.4 Where obstacle lighting is to be provided, it is recommended a monitoring, reporting and maintenance procedure be put in place to ensure outages are reported through the NOTAM system and repairs are implemented.

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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 Epuron Australia 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 25th August 2010.

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.

This report was prepared between September 2010 and January 2011 and is based on the conditions encountered and information reviewed at the time of preparation. GBD disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Green Bean Design Profile

Green Bean Design is an experienced landscape architectural consultancy specialising in landscape and visual impact assessment. As an independent consultant Green Bean Design provide professional advice to a range of Clients involved in large infrastructure project development.

Green Bean Design Principal Landscape Architect Andrew Homewood has over 18 years continuous employment in landscape consultancy and has participated in the preparation of LVIA for ten wind farm projects across New South Wales and Victoria.