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Coppabella Wind Farm – night time obstacle lighting

1 Introduction

Green Bean Design Pty Ltd (GBD) prepared a Visual Impact Assessment (VIA Modification) for the Coppabella Wind Farm Modification (September 2017).

The GBD VIA Modification stated that ‘the Yass Valley Wind Farm Consent Conditions note that the Applicant shall ensure that any aviation hazard lighting complies with the Civil Aviation Safety Authority’s (CASA) requirements’.

The GBD VIA Modification noted that no requirements had been provided by CASA at the time of the VIA Modification preparation.

The GBD VIA Modification also noted that ‘with the regard to the proposed CWF modification, no assessment has been prepared to assess potential visual impacts associated with night time obstacle lighting’.

Subsequent to the submission of the GBD VIA Modification, the New South Wales Department of Planning and Environment (DPE) requested that CASA comment with regard to the proposed Coppabella Wind Farm development.

Following their review CASA recommended that the proponent develop a lighting plan and light the wind farm with steady red medium intensity lighting at night, consistent with the provisions of National Airports Safeguarding Framework Guideline D.

CASA also commented that any decision to require or to not require lighting remains with the planning authority to determine.

Further to the provision of CASA’s comments, DPE requested Coppabella Wind Farm Pty Ltd (the Proponent) to ‘*undertake a visual assessment of the potential impacts of the obstacle lighting and/or*

an aircraft detection lighting system as a supplement to the Visual Impact Assessment prepared for the modification application, in accordance with the NSW Wind Energy Framework Visual Assessment Bulletin’.

2 The NSW Wind Energy Framework Visual Assessment Bulletin (December 2016)

The NSW Wind Energy Framework Visual Assessment Bulletin (the Bulletin) sets out guidelines for the assessment of aviation hazard lighting in Stage 2: Assessment and determination (Table 2 Visual Performance Objectives). The Visual Performance Objectives for Visual Influence Zones 1, 2 and 3 state that:

Wind turbines located in the vicinity of an aerodrome are subject to standards imposed by the National Airports Safeguarding Framework 10. CASA must be notified by the proponent if a proposed wind turbine or wind monitoring tower is greater than 150 metres in height or infringes on the Obstacle Limitation Surface (OLS) of an aerodrome. CASA may determine, and subsequently advise a proponent and relevant planning authorities, whether night-lighting is required.

If such lighting is required, the CASA guidelines recommend that to minimise visual impacts “obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously.” The lights should be fully shielded from the view of any dwelling within.

As part of the assessment of visual impacts of wind energy projects, the Department will consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.

The Aviation Hazard Lighting objective (applicable to all visual influence zones) states that:

Aviation hazard lighting (AHL) must meet the requirements of Australian Standard AS 4282 – 1997 and any prescribed or notified CASA requirement. Shield all AHL within two kilometres from any dwellings. Avoid strobe lighting.

3 With regards to the Bulletin GBD note:

The Bulletin states that ‘CASA may determine, and subsequently advise a proponent and relevant planning authorities, whether night-lighting is required’.

In their comments to DPE, CASA clearly state that any decision to require or not require lighting remains with the planning authority. CASA comments only provide recommendations. The decision to install night time obstacle lighting remains with DPE.

The Bulletin states that *'All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously'*.

In their comments to DPE, CASA has recommended a steady red medium intensity light and not flashing lights. GBD note that the majority of wind turbine obstacle lighting installed and operated in Australia utilise synchronised flashing lights rather than steady lights, including recent obstacle lighting installed at the Sapphire Wind Farm in the NSW Northern Tablelands.

The Bulletin states that *'the lights should be fully shielded from the view of any dwelling within'*.

It is unclear exactly what is intended by *'dwelling within'*.

In accordance with the Bulletin shielding can be installed to wind turbines with obstacle lighting where located within 2 kilometres of any non-associated dwelling and where shielding is not considered to compromise the operational effectiveness of the lighting.

GBD understands that the Proponent does not intend to install strobe lighting to the wind turbines or other infrastructure within the wind farm project site.

4 Australian Standard AS 4282 – 1997 Control of the obtrusive effects of outdoor lighting

GBD are familiar with AS 4282 – 1997 and have applied this Standard to a number of non-wind farm projects requiring the assessment of night time lighting impacts. GBD consider that the installation of wind turbine obstacle lighting and its potential visual impact is not addressed (directly or indirectly) in AS 4282 – 1997, and that AS 4282 – 1997 is largely irrelevant to the installation of obstacle lighting and safety lighting in general.

The Standard states that *'Public lighting has been excluded from this Standard because such lighting is provided to facilitate all-night safety and security for the public at large'*. Whilst wind turbine obstacle lighting is not strictly public lighting, it is recommended to facilitate all-night safety for aircraft.

GBD specifically note that:

AS 4282 – 1997 does not apply to lighting systems which are of a cyclic or flashing nature (Section 1, part 1.1 Scope (e)).

AS 4282 - 1997 defines obtrusive light as *'spill light which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in*

the ability to see essential information e.g. signal lights' (Section 1, part 1.4 Definitions, 1.4.7 Obtrusive light).

AS 4282 - 1997 defines spill light (stray light) as *'light emitted by a lighting installation which falls outside the boundaries of the property on which the installation is sited'* (Section 1, part 1.4 Definitions, 1.4.15 Spill light (stray light)).

Wind turbine obstacle lights would be visible from areas surrounding the wind farm; however, obstacle lighting is very unlikely to result in 'spill light' (stray light) falling outside the wind farm site boundary (i.e. resulting in areas of surrounding properties or dwellings being illuminated by red light). Therefore, the wind turbine obstacle lighting cannot be considered obtrusive in accordance with the definition provided for the purpose of AS 4282 – 1997.

Given the combination of obstacle lighting design intent, distribution of luminaires, height and direction of lighting, the ability of obstacle lighting to be assessed against AS 4282 performance requirements is very limited.

A brief review of AS 4282 – 1997 would confirm that the general intent and purpose of AS 4282 - 1997 is to consider the implications of potential obtrusive lighting associated with sporting facilities, large scale commercial developments such as freight terminals and security lighting.

5 National Airports Safeguarding Framework (NASF) Guideline D – Managing the risk to aviation safety of wind turbine installations (wind farms)/wind monitoring towers.

The NASF Guideline D provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers. The Framework sets out guidelines and lighting standards for wind turbines as well as considerations for alternatives to fixed and constant aerial lighting. The following sets out information from Guideline D relevant to wind turbine obstacle lighting.

5.1 Risk assessment

The Proponent commissioned an Aviation Safety Assessment to identify potential risks to aviation safety posed by the project. The Aviation Safety Assessment, prepared by Aviation Projects Pty Ltd (Revised Final Draft 1 September 2017) considered a number of safety aspects, including the need for aviation hazard lighting.

The Aviation Safety Assessment risk analysis determined that:

If lighting is required, there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including:

- *reducing the number of wind turbines with obstacle lights*
- *specifying an obstacle light that minimises light intensity at ground level*
- *specifying an obstacle light that matches light intensity to meteorological visibility and*
- *mitigating light glare from obstacle lighting through measures such as baffling.*

The Aviation Safety Assessment further determined the residual risk of the effect of obstacle lighting on surrounding residents would be tolerable and that appropriate design would present an acceptable risk of visual impact to neighbours.

The Aviation Safety Assessment concluded **‘that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project’** (bold as per Aviation Safety Assessment report).

5.2 Lighting plan

Aviation Projects Pty Ltd have also prepared a draft Obstacle Lighting Layout plan indicating the wind turbines to be lit in the event that wind turbine obstacle lighting is required by DPE. The turbines to lit are illustrated in **Figure 30**. **Figure 30** also illustrates the removal of 4 wind turbines included in the GBD VIA (wind turbines numbers 75, 76, 77 and 36) located in the south east corner and central portions of the project site.

The draft Obstacle Lighting Layout plan indicates lights installed to 33 of the 75 wind turbines. The 42 unlit wind turbines would be generally located adjacent to, or internally to the perimeter of lit wind turbines. The obstacle lights would be located on the wind turbine nacelle, at around 100 metres above ground level.

5.3 Obstacle lighting standards for wind turbines

When lighting has been recommended by CASA to reduce risk to aviation safety, medium-intensity obstacle lights should be used. Where used, lighting on wind farms should be installed:

- (a) to identify the perimeter of the wind farm
- (b) respecting a maximum spacing of 900m between lights along the perimeter, unless an aeronautical study shows that a greater spacing can be used
- (c) where flashing lights are used, they flash simultaneously and
- (d) within a wind farm, any wind turbines of significantly higher elevation are identified wherever located.

To minimise the visual impact on the environment, obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously.

Where obstacle lighting is provided, proponents should establish a monitoring, reporting and maintenance procedure to ensure outages, including loss of synchronisation, are detected, reported and rectified. This would include making an arrangement for a recognised responsible person from the wind farm to notify the relevant CASA office, so that CASA can advise pilots of light outages.

5.4 Alternatives to fixed obstacle lighting

In some circumstances, it may be feasible to install obstacle lights that are activated by aircraft in the vicinity. This involves the use of radar to detect aircraft within a defined distance that may be at risk of colliding with the wind farm. When such an aircraft is detected, the wind farm lighting is activated. This option may allow aviation safety risks to be mitigated where obstacle lighting is recommended while minimising the visual impact of the wind farm at night.

GBD notes Guideline D refers to the installation of flashing lights 'where flashing lights are used, they flash simultaneously'. Whilst GBD is aware of recent wind turbine night lighting being installed as simultaneously flashing red lights, we note CASA recommendations for 'steady' red medium intensity lighting at night.

6 Night time obstacle lighting – visual effect

In order to illustrate the visual effect of turbine mounted obstacle lighting a series of day and night time photographs were taken of the Cullerin Wind Farm in the New South Wales Southern Tablelands. These were taken at distances of 500 metres, 3.5 kilometres and 17 kilometres from the wind turbines and are illustrated in **Figures 31, 32 and 33**. Each night time view is presented below a corresponding day time photograph taken from the same night time photo location. It should be noted that following community consultation, and the preparation of an aviation risk assessment, the wind farm operator turned off night time obstacle lighting on the Cullerin wind turbines.

7 Existing light sources

A small number of existing night time light sources occur within the landscape surrounding the Coppabella Wind Farm project site. Localised lighting is associated with a small number of dispersed

rural homesteads and dwellings surrounding the project site, as well as localities and townships including Binalong and Bookham.

Existing lighting is not considered to be visually prominent and does not emit any significant illumination beyond immediate areas surrounding urban localities, residential and agricultural buildings. Headlights and tail-lights of vehicles travelling along the Hume Highway and local roads provide dynamic and temporary sources of light.

Overall the existing night lighting environment is considered to present a relatively dark sky. Whilst GBD are not aware of any community or scientific optical observatories within the vicinity of the wind farm, the potential for wind farm obstacle lighting to result in sky glow is considered to be minimal given the physical characteristics of the lights and as illustrated in **Figures 31, 32 and 33**.

8 Potential view locations and impact

The categories of potential view locations that could be impacted by night time lighting generally include people at residential dwellings and motorists travelling along local roads and the Hume Highway. The Bulletin identifies these view location categories as Level 2 Sensitivity (Moderate) for rural dwellings and Level 3 Sensitivity (Low) for roads. Higher sensitivity levels may occur at some residential areas or rural villages; however, these are located at some distance from the wind turbines and/or have some degree of screening through planting and topography.

Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of public view locations, including lookouts, highway rest-stops and reserves where visitation is likely to be minimal during hours of darkness.

Whilst obstacle lighting would be visible to motorists travelling along the local roads and the Hume Highway, the duration of visibility would tend to be very short and partially screened by undulating landform as well as cuttings and embankments along some sections of road corridors. The visibility of obstacle lighting would also be influenced by changes in the direction of travel and corresponding field of view. The obstacle lighting would not result in any obtrusive effect through resulting light spill and would not reduce the ability of road users to see signage and signalling systems.

Night time obstacle lighting associated with the wind farm would be visible from a number of residential dwelling view locations surrounding the Coppabella Wind Farm; however, in some instances topography and screen planting around residential dwellings would completely 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 beyond residential dwellings rather than from within residential dwellings, where internal lighting will tend to reflect and mirror interior views in windows, or where exterior views would be obscured when curtains and blinds are closed.

Whilst night time obstacle lighting would be visible from some residential dwellings assessed in the GBD VIA Modification, the distance from which night time obstacle lighting may be visible has been noted in excess of 50 kilometres for other Australian wind farm projects. As the night time obstacle lighting would be installed to wind turbines on elevated ridgeline and hilltop locations, it is likely that the obstacle lighting would be visible from middle to long distance view locations.

It is reasonable to expect that where the wind turbine obstacle lights are visible from residential dwellings, or the curtilage of dwellings that some level of annoyance and distraction may occur.

9 Mitigation measures

The Aviation Safety Assessment identified a number of mitigation measures to minimise the potential visual impact associated with night time obstacle lighting. These include:

- *reducing the number of wind turbines with obstacle lights*
- *specifying an obstacle light that minimises light intensity at ground level*
- *specifying an obstacle light that matches light intensity to meteorological visibility and*
- *mitigating light glare from obstacle lighting through measures such as baffling.*

In addition, the option for screen planting at nominated residential dwellings in the Condition of Consent would also provide some level of screening potential to the obstacle lighting as well as the wind turbines themselves.

CASA correspondence to DPE states that *'should lighting be considered a negative impact on visual amenity and result in resident objection, CASA notes the availability of Aircraft Detection Lighting Systems'*. An Aircraft Detection Lighting System (ADLS) utilises radar technology which detects the presence of aircraft in near proximity to the wind turbines and turns obstacle lighting on or off.

The likelihood of aircraft in the vicinity of the wind farm during hours of darkness is considered to be low and, subject to the installation of an ADLS, the night time obstacle lighting is likely to be turned off for relatively long periods of time.

10 Conclusion

GBD note that the Aviation Safety Assessment has determined that there is an acceptable level of risk associated with the potential for an aircraft collision with a wind turbine without night lighting being installed on the wind turbines.

A subsequent review by CASA has recommended that steady red medium intensity obstacle lighting be installed to the wind turbines consistent with the provisions of NASF Guideline D. CASA have commented that any decision to require or not require lighting remains with DPE.

AS 4282 – 1997 is considered to be largely irrelevant to the assessment of wind turbine obstacle lighting, which will not result in any noticeable obtrusive lighting through light spill or stray light in accordance with the definitions set out in the Standard.

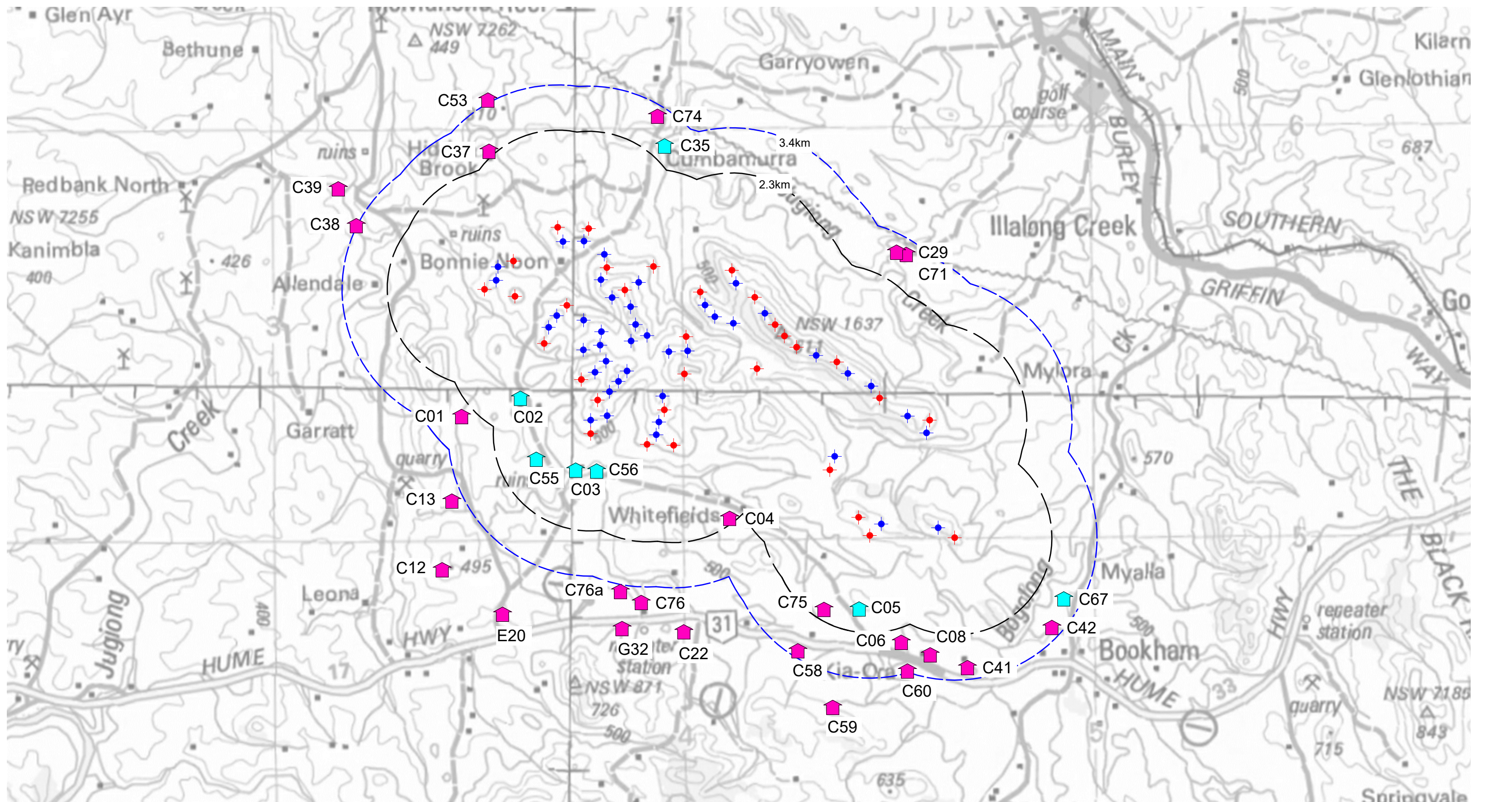
The existing night time lighting environment presents a relatively dark sky. The wind turbine obstacle lights will be visible from areas surrounding the wind farm and are likely to be visible from medium to long distance view locations. Cumulatively, the wind turbine obstacle lighting is unlikely to result in sky glow.

Existing view locations would principally comprise residential dwellings, local roads and the Hume Highway. Views toward obstacle lighting from local roads and the Hume Highway would be influenced by direction of travel, the screening potential of planting and local landform (cuttings and embankments) alongside road/highway corridors, as well as the transitory nature of views from moving vehicles.

Views will extend toward the obstacle lights from a range of residential dwellings within the landscape surrounding the wind farm. The density of residential dwellings is generally very low throughout the agricultural landscape, with clusters of dwellings present in the Binalong and Bookham localities. Whilst the wind turbine obstacle lights would not result in any obtrusive lighting effects, some degree of annoyance and distraction would likely occur at some residential view locations where views extend toward the lights.

There are a range of potential mitigation measures that may be considered individually or as combined treatments to minimise the potential visual impact of night time obstacle lighting. These include screening views through soft landscape works, installation of directional shielding at the light source, regulation of lighting intensity and or implementation of aircraft detection systems.

In this case the potential for wind turbine obstacle lighting to result in a significant visual effect is considered to be low for views from vehicles and moderate for views from residential dwellings.



Coppabella wind turbine modification layout and residential dwelling locations

- Approved wind turbine location (unlit)
- Approved wind turbine location (lit)
- Non associated dwelling
- Associated dwelling
- 2.3 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 171 metre tip height
- 3.4 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 171 metre tip height

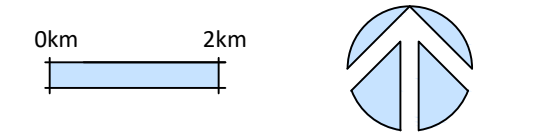
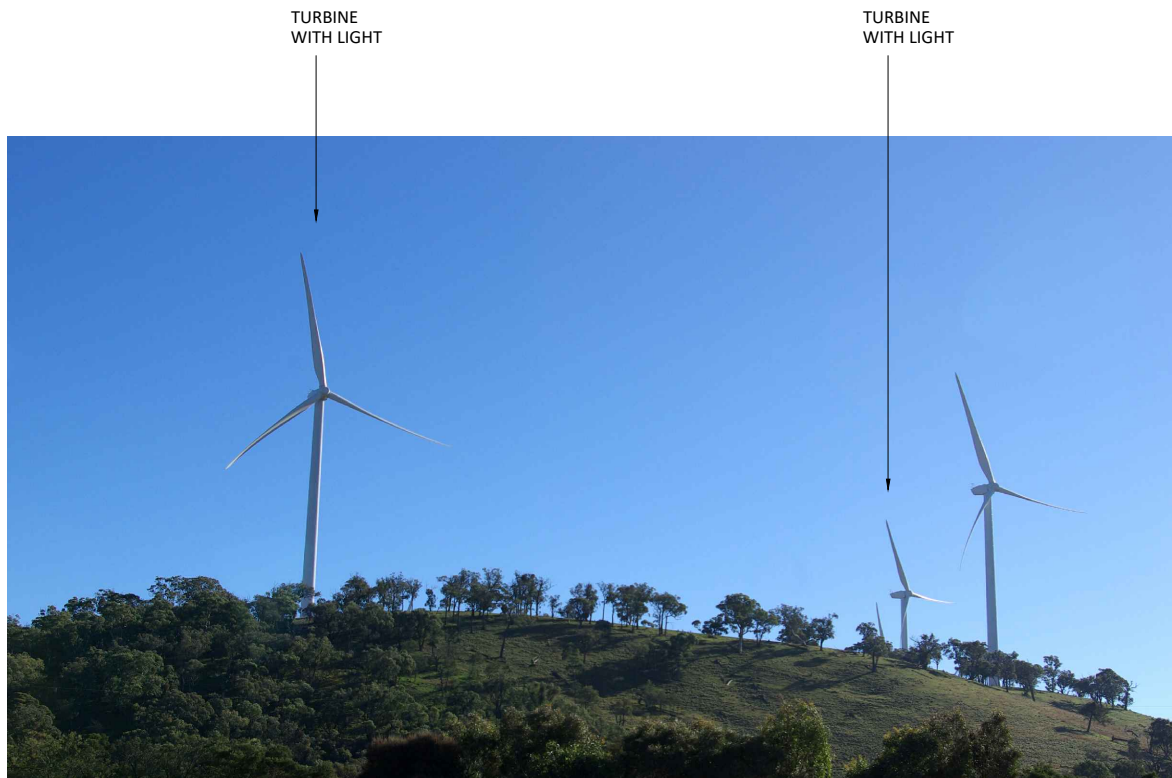
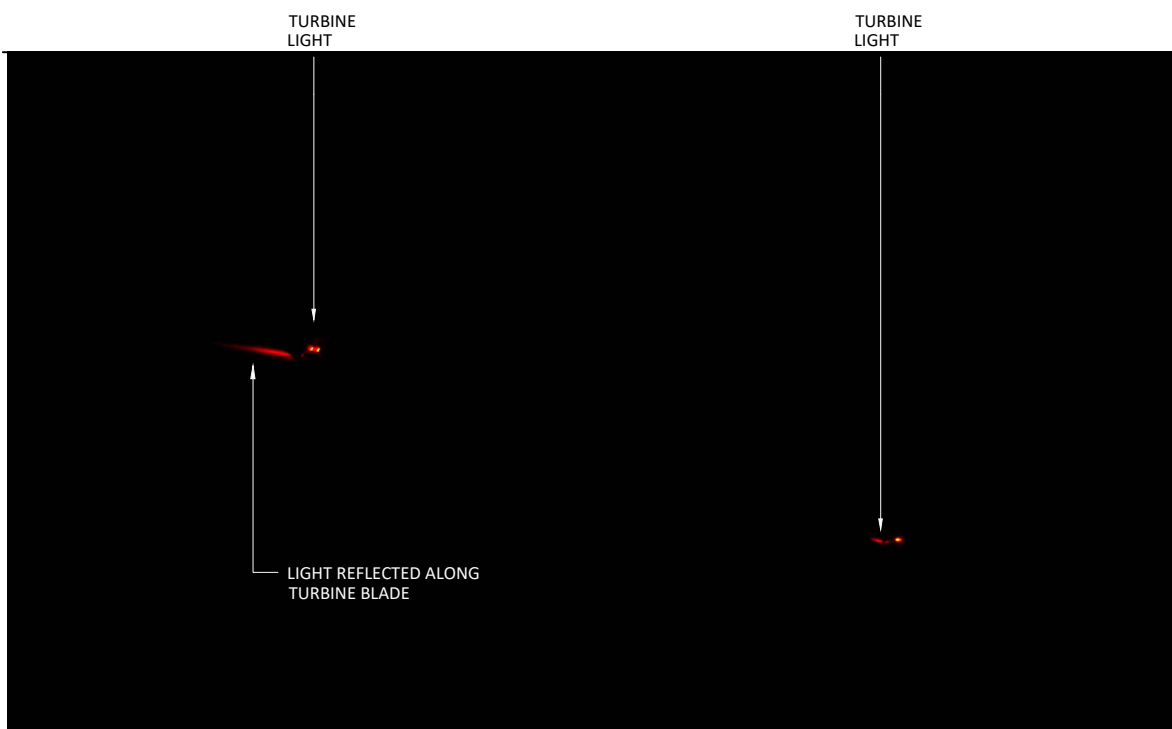


Figure 30 - Wind turbine modification layout with residential dwelling and lit wind turbine locations

Coppabella Wind Farm Modification

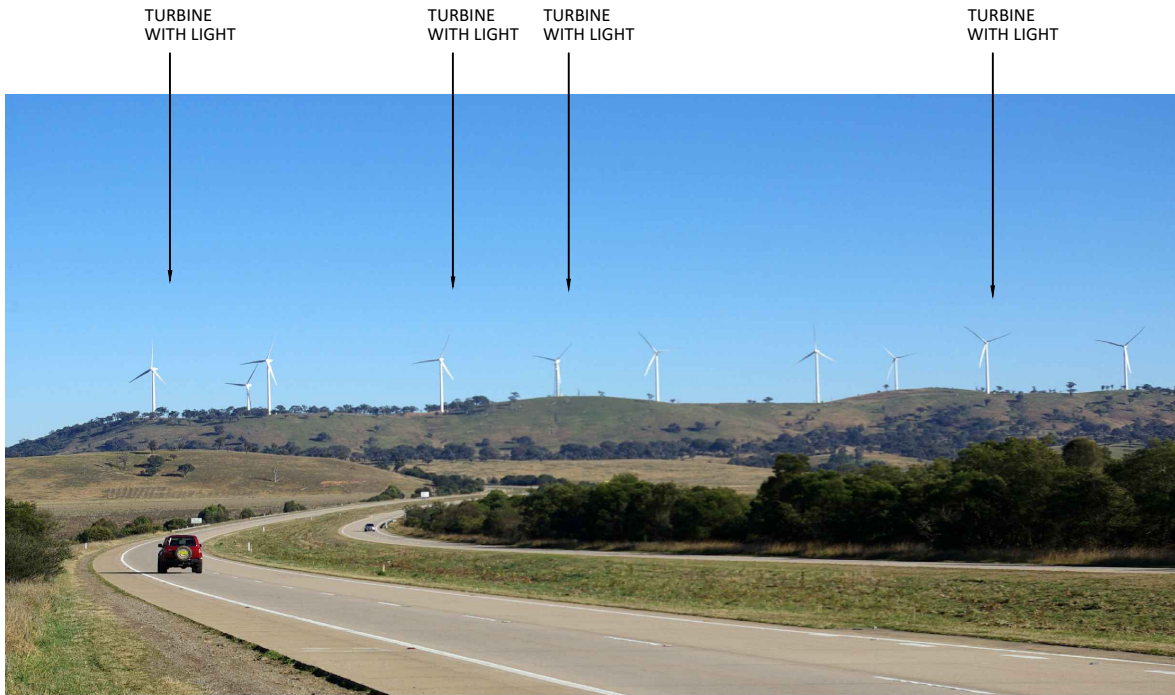


Cullerin Wind Farm - Day time view
View west from Hume Highway at around 500 metre distance

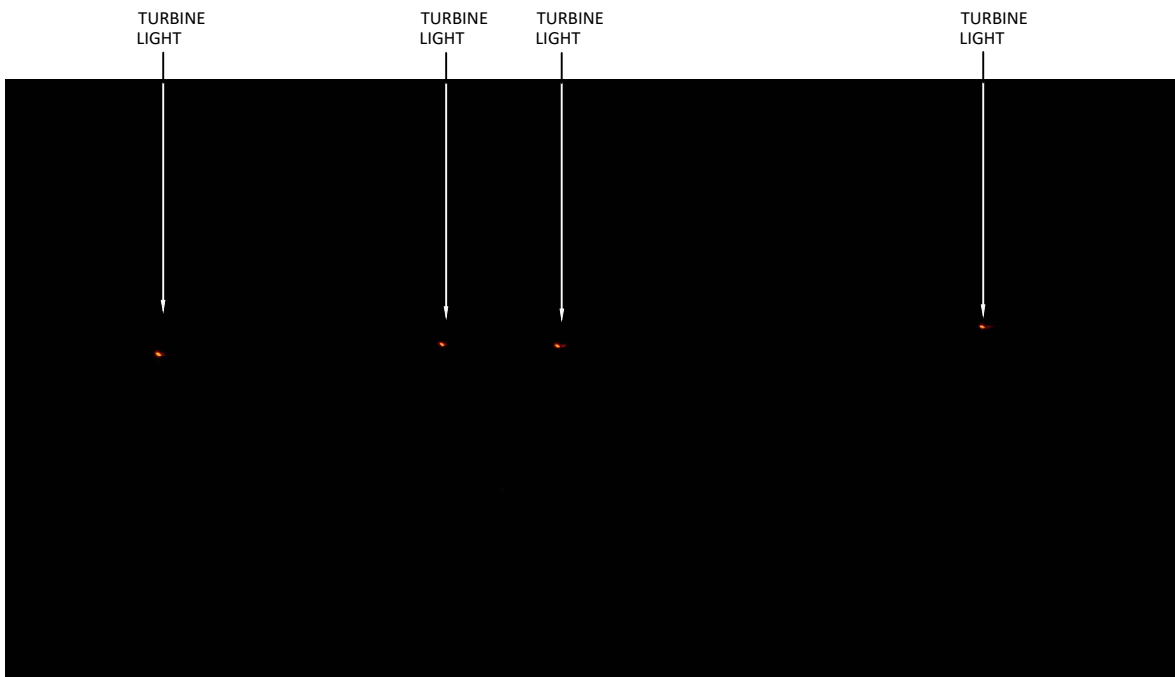


Cullerin Wind Farm - Obstacle lighting
View west from Hume Highway at around 500 metre distance

Figure 31 -
Cullerin Wind Farm
Obstacle lighting

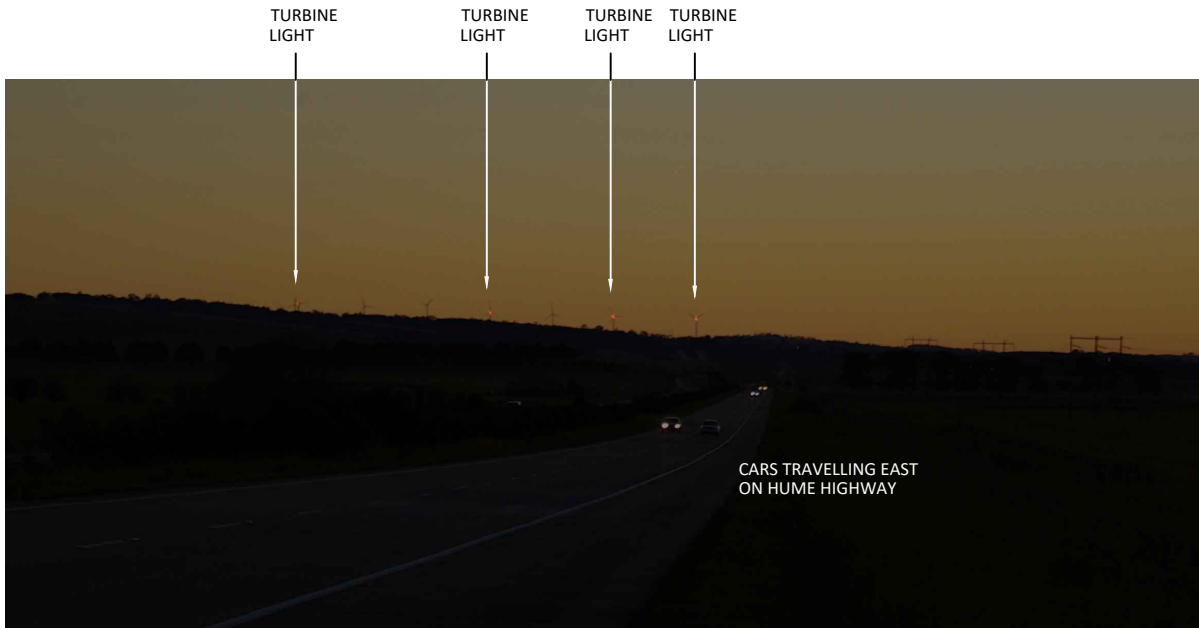


Cullerin Wind Farm - Day time view
 View west from Hume Highway at around 3.5 kilometre distance

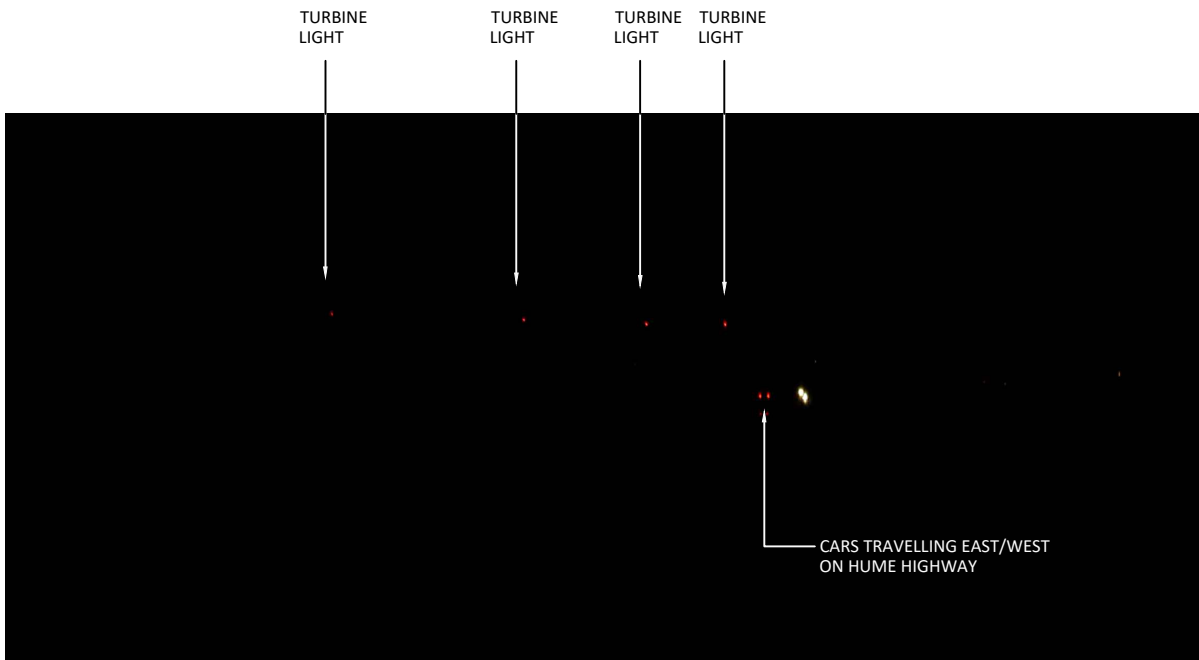


Cullerin Wind Farm - Obstacle lighting
 View west from Hume Highway at around 3.5 kilometre distance

Figure 32 -
 Cullerin Wind Farm
 Obstacle lighting



Cullerin Wind Farm - Day time view
View west from Hume Highway at around 17 kilometre distance



Cullerin Wind Farm - Obstacle lighting
View west from Hume Highway at around 17 kilometre distance

Figure 33 -
Cullerin Wind Farm
Obstacle lighting