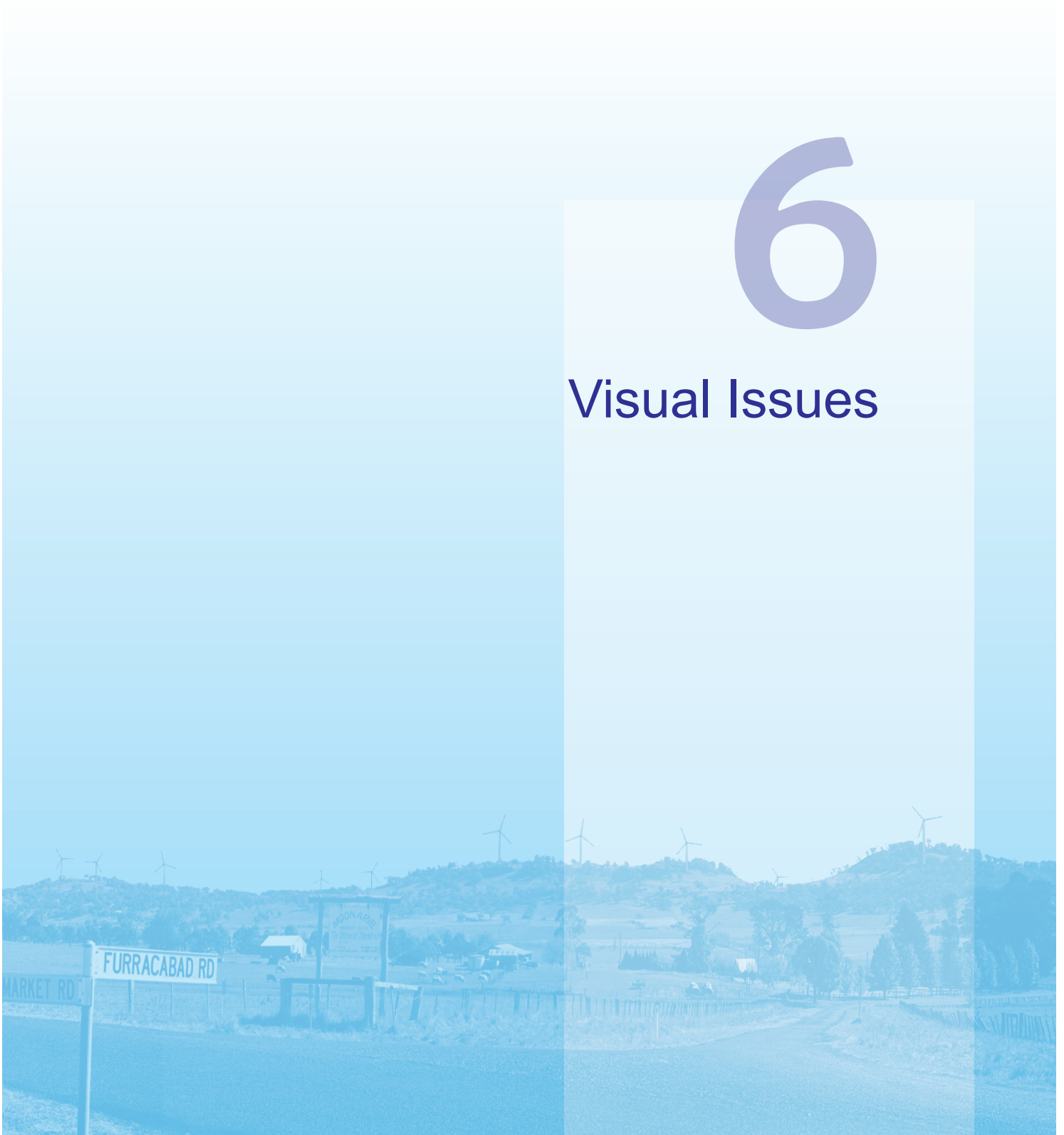


Glen Innes

6

Visual Issues



6. Visual Issues

This chapter of the Environmental Assessment outlines the key aspects of the visual impact assessment undertaken for the Glen Innes Wind Farm. A comprehensive visual impact assessment is provided as Appendix C of this Environmental Assessment.

6.1 Introduction

Wind turbines, by their nature, are usually located in elevated exposed positions and as large structures, can be highly visible. The proposed development is no exception in this regard and the wind turbines will be clearly visible from a range of viewing points. Accordingly, visual issues are recognised as being a key aspect of the environmental assessment process.

The proposed wind farm site and much of the landscape surrounding it comprises rural land that has been subject to extensive clearing. It is predominantly used for grazing and has scattered rural residences, farm buildings and associated cultural features including roads, fencing and power lines. In addition, there are areas of remnant woodland throughout the area and more intensively along the slopes of the surrounding ranges.

The topography of the wind farm locality comprises the generally north-south Waterloo Range at levels of 1160 metres in the north to 1275 metres in the south. Waterloo Range is of the order of 150 to 280 metres above the adjacent Wellingrove Valley to the west of the Range and 100 to 200 metres above the Reddestone and Furracabad Valleys to the east of the Range (Figures 1.4 and 5.1).

The western side of Waterloo Range has greater relief and presents a more distinctive feature in the locality than the eastern side of the Range. Sinclair Lookout, located on the northern end of Waterloo Range, has a westerly aspect towards Inverell (Inverell is not visible from Waterloo Range) and the significant topographic ridge referred to as Fletcher's Knob to the south west of the lookout. The land to the east has less relief and includes the river plains of Reddestone and Furracabad Creeks that are separated by a low range of hills of 50 to 150 metres above the adjacent valley floors. Glen Innes is visible from a number of locations along Waterloo Range.

The Waterloo Range, while a distinct topographic feature, forms part of a general rise in elevation of the landforms from north to south. Other topographic features in the broader area surrounding the site particularly toward the elevated Ben Lomond area are more spectacular and Waterloo Range will have the greatest visual significance for the rural population in the immediate vicinity of the Range.

The wind farm will introduce large wind turbine structures along Waterloo Range that contrast with the existing landscape. Due to the turbines being located on top of the ridgelines they will have potential to attract attention but will not obscure views of the existing rural landscape features. Viewers' opinions of the visual impact of the turbines in the landscape will vary widely and are likely to be influenced by subjective factors that are difficult to quantify.

Compared to the wind turbines, the visual impact of ancillary works will be minor and appropriate design and siting will further reduce their impact. The location of the substation, the grid connection to the existing 66,000 volt or upgraded 132,000 volt overhead transmission line and the location and design of access tracks as described in Chapter 3 have all been selected with the objective of minimising their visual impact.

The methodology adopted for the visual impact assessment provided in Appendix C included the following steps:

- review of local landscape elements
- identification of the approximate visual catchment of the wind farm

- compilation of a list of assessment sites and photography at each of the sites
- computer modelling to generate simulated perspective views of the wind farm
- photomontage compilation for selected viewpoints
- development of visibility assessment criteria
- review of photomontages using visibility assessment criteria
- review of indicative visibility for a range of other viewpoints including residences
- Review of potential visual impact of the wind farm on residences surrounding the wind farm
- review of visual aspects of ancillary works
- review of options to mitigate the visual impact of the project

A summary of assessment process and the resultant findings is provided in the following sections. The assessment delivers many of the elements described in the “Wind Farms and Landscape Values - National Assessment Framework (NAF)” developed jointly by the Australian Wind Energy Association and Australian Council of National Trusts. Each wind farm site will have its individual characteristics and visual amenity significance and assessment methodologies vary from site to site.

Because visual impact is somewhat subjective it is desirable that potentially affected landowners and the Approval Authority have access to realistic representations of the proposed wind farm from a range of vantage points to allow an appreciation of wind farm visibility within the landscape. To this end, a series of photomontages presenting simulated views of the installed wind farm from ten representative viewing points has been produced and is provided in Appendix C. Two examples (Figure 6.6 and 6.7) are included at the end of this Chapter.

6.2 Landscape analysis

Appendix C provides a review of the natural and cultural features of the local landscape for the area surrounding the proposed Glen Innes Wind Farm.

The landscape elements at the locality comprise various combinations of cleared pastoral land with scattered areas of remnant woodland with different amounts of slope and relief. Built features such as buildings, roads, fences and power lines are scattered through the landscape at a low density. The larger physiographic elements of the local landscape include the Waterloo Range, more distant ranges, areas of cleared grazing land and areas of remnant woodland. In addition to the natural and cultural features that comprise the landscape, a viewer's perception of these elements and the values they assign to them will vary.

Representative views of selected landscape elements in the vicinity of the wind farm are provided in Plates 6.1 to 6.10. Some of the landscape elements reflect particular physiographic features. All of the landscape elements have been influenced by human activities, particularly clearing and settlement of the land. Despite the clearing and settlement activities having occurred relatively recently, many people viewing the landscape scenes would regard them as the natural visual state of the locality.

The installation of wind turbines on the ridges at the wind farm locality will add a new element to the landscape scenes. A viewer's perception of this addition to the landscape as either a positive or negative attribute of a scene will vary dependent on their own circumstances.

The set of representative photomontages that has been provided in Appendix C enables individuals to gain their own appreciation of the project's visual impact on the landscape. The two photomontages reproduced in this Chapter show that while the turbines are prominent they do not obscure the view of the existing landscape elements.

Plates 6.1 – 6.10 - Glen Innes Wind Farm– Landscape elements

	
Cleared ridge top pastoral land Plate 6.1 - Crest of Waterloo Range looking south	Valley grasslands Plate 6.2 - West Furracabad Valley looking north
	
River plain pastoral scene Plate 6.3 – Reddestone Creek Valley looking south from Gwydir Highway near "Rosefield"	Narrow pastoral valley with wooded slopes Plate 6.4 – Wellingrove Valley viewed from Waterloo Range looking west
	
Pastoral scene from Gwydir highway Plate 6.5 – Wellingrove Valley view looking east towards Waterloo Range	Pastoral area surrounded by low hills Plate 6.6 – Rural Settlement (West Furracabad Valley) Looking east from Waterloo Range
	
Steep wooded slopes adjacent pasture lands Plate 6.7 – Looking to the south west from the wind farm site on Waterloo Range	Cleared grassland with elevated land to the south Plate 6.8 – Southern Furracabad Valley with the Lombardy residence in mid distance and the elevated ranges to the south

	
Residence in rural setting Plate 6.9 – View to Highfields residence from Hillside Road	Urban area in rural setting Plate 6.10 – View to the west from Martins Lookout which is located to the east of Glen Innes township

6.3 Visual catchment of the Wind Farm

The visual catchment of a wind farm is the area of surrounding land from which the wind farm may be wholly or partly visible. For the proposed development the visual catchment to a distance of up to twenty kilometres was determined using a Geographic Information System (GIS) that accessed topographic data and the wind farm model (turbine location and height) to map the areas from which the wind farm will be either partially or fully visible.

The effect of screening by trees was not included in the computation of the visual catchment as data was not available for the height of tree cover across the area assessed. The degree of screening by trees may also vary in time depending on the stage of growth of the trees, extent of any clearing and from the effects of bushfire where it occurs. Due to the effect of tree screening not being taken into account, the computed visual catchment shown in this Environmental Assessment will over estimate the extent of the wind farm's visual catchment.

An inspection of areas surrounding the wind farm was also used to gain further understanding of the visual catchment. Roads, which surround the project area, were travelled and the areas from which the wind farm site could potentially be seen were noted. Many neighbouring properties were also visited to verify the visual catchment. It was found that the wind farm will be visible over a large area but local topography and vegetation will limit visibility from many locations.

Figure 6.1 provides a graphic representation of the visual catchment of the wind farm with the shaded areas representing the locations where the wind farm may be fully or partially visible. As can be seen in Figure 6.1, there will be distant views of the wind farm from Glen Innes however many of the viewpoints at lower levels within Glen Innes township will have their views of the wind farm obscured by aspect, buildings or trees. Contours represent the distance from the wind farm (distance to the nearest wind turbine) with a contour interval of 5 kilometres.

Figure 6.2 provides more detail of the visual catchment in the area closer to the wind farm. As mentioned above, trees will provide additional screening such that the visual catchment will be less than that shown in Figure 6.2.

On clear days, the wind farm will be visible at distances greater than 10 kilometres in some directions. However, the visual impact of the Glen Innes Wind Farm beyond even 5 kilometres is considered low. Accordingly, the assessment focused on viewpoints with greater visual impact and, in particular, viewpoints within about 6 kilometres from the site. A simulated view of the installed wind farm is also provided for a viewpoint at a distance of approximately 11.6 kilometres at Martin's Lookout above Glen Innes. The visual catchment of each of the turbines varies and many views to the wind farm will have only partial views of the full wind farm due to topographic and/or vegetation screening.

To demonstrate the variation in visibility of different parts of the wind farm from different viewpoints a series of visual catchments were prepared using only selected turbines for sub-parts of the wind farm. The series of figures are provided in Appendix C with two included as examples in this chapter. Figure 6.3 is the visual catchment for Turbines 1 to 9 at the northern end of the wind farm and Figure 6.4 is for the visual catchment of Turbines 15 to 19 at the southern end of the wind farm.

In addition to the series of viewpoints described above, a map depicting the wind farms zone of visual influence has been prepared and included in Appendix C and as Figure 6.5 in this chapter. It demonstrates the number of turbines for which at least the tips of the rotors are visible in the area surrounding the wind farm. The presentation does not provide details of the proportion of each turbine visible at each possible viewpoint and in some cases where a turbine has been included as being visible, only the most elevated parts of the turbine rotor may be visible. As indicated above, the computation of the zone of visual influence and its illustration in Figure 6.5 does not take into account the screening effects of trees and structures surrounding residences.

6.4 Visual Absorption Capability

The ability of the Glen Innes landscape to visually absorb the proposed wind farm project has been examined in Appendix C based on consideration of visual factors such as visual contrast, visual quality, viewer sensitivity, landscape visibility, viewer exposure, visual impact susceptibility, visual contrast, project dominance and view impairment.

Based on the topographic variations at the wind farm locality and the available landscape views, the 'visual absorption capability' of the individual landscapes appears to vary from place to place. Many of the neighbouring residences or viewpoints that are close to the range may have clear views to the turbines that are close to the residence while those turbines that are further distant in the hilly terrain may be progressively obscured with distance.

Wind farm developments are by their nature most likely to be located in rural areas on ridges where they will be prominent features in otherwise pastoral landscapes as is the case for the proposal on Waterloo Range. To a large extent the turbines add a new element in the landscape without significantly obscuring existing elements. For some observers of the landscape the turbines will represent a new point of interest and at other wind farm localities various observers have described the turbines as having aesthetic appeal. For such observers visual absorption may be less important and the turbines may be regarded as complementing the pastoral scenes and both the wind farm views and pastoral scenes may be appreciated.

The Glen Innes wind farm landscapes have low viewer exposure and have not been recognised under any planning scheme or heritage register as a zone of special visual significance. Figure 4.1 shows areas described as 'Environmentally Sensitive' by Glen Innes Severn Council. In respect of Waterloo Range the designated areas appear to relate mainly to the Wellingrove Valley including the western slopes of Waterloo Range. The special controls listed under Clause 41 of the LEP do not relate to scenic value. To limit wind farm developments in such landscapes throughout NSW would significantly reduce opportunities for the development of this form of renewable energy which appears contrary to expressed Federal and State planning objectives for expansion of renewable energy.

6.5 Visibility assessment sites

For the purposes of visual impact assessment, ten representative viewpoints within the visual catchment were selected to assess the wind farm's visibility. Figure 6.1 at the end of this Chapter shows the locations of the selected viewpoints. The chosen viewpoint locations are predominantly on public roads surrounding the wind farm site and are often close to residence locations. Viewpoints that provided direct views to the wind farm were selected in preference to viewpoints that had filtered views through vegetation. Accordingly, the viewpoints are not representative of viewpoints with restricted views to the wind farm site.

Photomontages have been prepared for each of the ten representative viewpoints (Appendix C) and the visibility of the wind farm has been classified (Table 6.1) according to the method described in Appendix C.

6.6 Production of photomontages for selected viewpoints

To assist the assessment of visibility at each of the selected assessment sites, photographic simulations of the installed wind turbines in the existing landscape (photomontages) were prepared. The objective of the photomontages was to provide a realistic representation of the appearance and scale of the wind farm in the landscape. While considerable effort has been directed to achieving this objective, the process involves several stages that can each introduce small errors and the resulting photomontage may not be a precise representation of the installed wind farm. Accordingly checks were made to ensure that the photomontages are sufficiently accurate for the purpose.

The process for production of photomontages involved three primary stages as follows:

- Photographs were taken at each of the visual impact assessment sites. The photographs were taken with a 35mm single lens reflex camera with its lens set to 65mm focal length. Due to the focal length used, it was necessary, for many of the viewpoints, to join several photographs to produce a panoramic view of the wind farm. As far as possible the photography was taken with fine weather and with blue sky but this was not possible for all viewpoints. Where the turbines are silhouetted against the sky they are likely to be more prominent against the blue background than for a white or grey cloudy background. This enhances their visibility in the photomontages.
- Computer modelling 'WindFarmer' software was used to produce perspective diagrams from each viewpoint and provide accurate representations of the proposed turbines in relation to the topography.
- The photomontages were prepared using a computer based graphics system that enabled incorporation of scaled images of the turbines into the respective photographic images. The appearance of the turbines has generally been enhanced in the photomontage to improve the contrast of the turbine against the background. Typically the background for the turbines is the sky due to the elevated positions of the turbines relative to the viewpoints.

A complete collection of photomontages showing views from all ten of the selected assessment sites around the area is included in the detailed Visual Impact Assessment Report (Appendix C). As mentioned in Section 6.1 the photomontages from the ten representative viewpoints form a key reference by which the Approval Authority and the community can gain an appreciation of the visibility of the wind farm in the representative views. Two examples of the photomontages are supplied in this document. The two representative views from Viewpoints 3 and 6 are provided in Figures 6.6 and 6.7. Locations of these viewpoints are outlined below.

- Viewpoint Location 3 – Gwydir Highway at intersection with Illparran Road
- Viewpoint Location 6 – West Furracabad Road near Mayfield residence

The orientation of the wind turbines will vary with the wind direction and, for most of the time, they are likely to be facing east or west into the predominant wind directions. The views of the wind turbines will look different, depending on the orientation of the turbine relative to the viewpoint. To maximise the impact of the turbines in the individual photomontages they have been shown generally facing the viewpoint.

6.7 Visibility and visual impact assessment

The visibility of the proposed development from the ten representative viewpoints was reviewed against the following assessment criteria and as described in more detail in Appendix C.

- the distance from the wind farm (from the viewpoint to the nearest wind turbine)
- the spatial extent of visible turbines (referred to here as the wind farm view angle)
- the number of turbines visible

The key visibility criteria and the resulting classifications for each site are shown in Table 6.1. Of the sites assessed, two of the viewpoints were rated as being subject to high visibility, six views were rated as having moderate visibility, and two views rated as low visibility.

The views of the wind farm from the more distant sites (Viewpoint 5 at 6.3 km and Viewpoint 10 at 11.6 km) were assessed as being subject to low visibility. It can be seen from the relevant photomontages in Appendix C that, due to the effects of distance, the visibility from Viewpoints 5 and 10 is indeed low, but nevertheless the wind turbines are discernible within the landscape.

Table 6.1 – Visibility assessment results – representative viewpoints

Ref No.	Viewpoint Location (see also Figure 6.1)	Number of visible turbines			Visibility criteria		
		Mid-ground	Background		Distance to Nearest Turbine	View Angle	Visibility Class
		1 – 3 km	3 - 5 km	> 5 km	km	degrees	
1	Jenkins Road, adjacent to Caloola Property	0	16	11	3.2	74	M
2	Intersection of Waterloo Road and Camerons Road	2	19	6	2.7	107	H
3	Intersection of Gwydir Highway and Illparran Road	0	10	17	3.6	73	M
4	Gwydir Highway, adjacent to "Rosefields"	0	5	21	3.7	67	M
5	Gwydir Highway, eastern Reddestone Valley	0	0	24	6.3	62	L
6	West Furracabad Road, near Mayfield residence	0	8	9	3.1	63	M
7	Intersection of East Furracabad Road and Haymarket Road	0	13	12	3.4	82	M
8	Intersection of Hillside Road and Cherry Tree Road	10	5	0	1.8	98	H
9	Haymarket Road (south end)	0	5	11	3.7	39	M
10	Martins Lookout, Glen Innes	0	0	27	11.6	35	L
		Substation – Low visibility due to low height and tree screening					

Viewpoints 2 and 8 are the only viewpoints assessed as having high visibility of the wind farm and have a significant proportion of the wind turbines in the view at a distance of less than three kilometres. All other viewpoints have the distance to the nearest turbine being in excess of three kilometres.

There are few trees on the ridges on which the wind farm is located and, therefore, little to reduce or soften its image. Other objects in the line of sight between the wind farm and the viewpoint such as residences, trees, topography or other features may reduce the visible portion of the wind farm. Many local residences are surrounded by trees to provide a degree of shelter. These trees may partially or completely obstruct views of the wind farm from the residence. In most of these cases, more expansive views of the wind farm will generally be available beyond these tree screens, often within short distances from the residences.

A qualitative review of the indicative visibility at a range of other locations, particularly residences, was also undertaken to assist stakeholders to evaluate the wind farm's visibility and visual impact at locations of interest to them. The results of that review are provided in Section 7.3 and Tables 7.2 and 7.3 of Appendix C. Table 6.2 summaries the qualitative visual impact assessment for residences within 3 kilometres of the wind farm.

For many of the viewpoints, the wind turbines are silhouetted against sky and when cloud cover is present it may reduce the level of visual impact when compared to that of clear sky.

Consultation with Civil Aviation Safety Authority (CASA) is underway to determine if the proposed wind farm will require lighting for aviation safety purposes. While it is believed that the wind farm without lighting will have a reduced visual impact, if required by CASA, Glen Innes Wind Power will install the required lighting. Mitigation measures such as shielding is an available option to partly reduce the impact if lighting is required (Refer to section 7.4 of Appendix C).

Overall, the development will be a prominent addition to the local landscape with its visual impact being primarily dependent on the distance of the viewpoint from the wind farm and also the proportion of the viewfield occupied by the wind farm.

Even though the wind turbines are prominent features they will not significantly mask the elements of the various scenes although they may change the scene's character. Furthermore, there will be large areas of the adjoining landscape that will remain unchanged by the development. In short, a significant part of the existing landscape will remain unchanged.

Table 6.2 – Summary of Visual Impact Assessment for residences within 3 km of the Wind Farm

Residence	Distance km	View Angle	Elevation Angle	Visual Impact	Basis of Visual Impact Assessment Rating
0 to 1km distance from Wind Farm					
Highfields	0.96	136	12	High	High due to closest turbine at less than 1 km and elevation above the residence. Discussion with the landowner indicates concern as to the visual impact. Some screening by mature trees is present.
Mayvona	0.85	128	14	High	High due to turbines being at close distance and at elevation above the residence. The residence is vacant and in poor state.
1 to 2 km distance from Wind Farm					
Cherry Tree (Eungai)	1.6	112	9	High	High due to close distance, view angle and elevation of turbines above residence. Tree screening could be used to reduce the visual impact. Landowners have expressed concern regarding impact for their residence location
Illparran A, B	1.4	85	12, 11	High	Potentially high due to distance and elevation of turbines above residences. Proximity to base of slope and trees may provide substantive screening.
Lombardy	1.9	90	7	Moderate	Moderate, reduced by thick tree screening
Rivoli	1.9	17	7	Low	Low due to topographic and tree screening
Wattle Vale	1.9	57	4	Moderate	Moderate due to existing view to monitoring tower, near turbine sites T1 and T2 and landowner's expressed concern.
Girrahween	2.0	95	6	Moderate	Moderate based on distance and view angle. Existing tree screening at residence is likely to significantly reduce visual impact.
2 to 3 km distance from Wind Farm					
Balaclava A, B	2.9	110	6	Moderate	Moderate based on tree screening. High without screening. Residence not visited.
Glengarry	2.1	20	6	Moderate	Moderate, limited views to wind farm and tree screening can reduce the impact
Kalanga A,B,C	2.2	106	7	Moderate	Moderate. Waterloo Sugarloaf will provide topographic screening for some turbines
Klossie	2.3	39	6	Low	Low due to limited view angle and potential for screening
Minamurra A,B,C	2.3	98	7	Moderate	Moderate but land owner may regard as Low based on consultation and indicated position in respect of renewable energy developments
Moonarie	3.0	67	4	Moderate	Moderate due to distance, indicated concern
Nullagai	2.1	53	7	Low	Low due to topographic and tree screening
Oakes	2.5	55	8	Moderate	Moderate due to topographic and tree screening, view angle for visible turbines may be less than indicated here
Wandsworth	2.3	75	6	Moderate	Moderate due to unscreened views. Potential for tree screening at residence

Note: View angle is the lateral field of view and Elevation angle is the angle from horizontal to hub height of nearest turbine

6.8 Visual issues associated with ancillary works

Ancillary works will include the construction of new access tracks, the upgrading of existing tracks, the construction of a substation with facilities and auxiliary services buildings and the installation of underground cables and the overhead grid connection to a new 132,000 volt Glen Innes to Inverell transmission line or the existing 66,000 volt transmission line.

The visual impact of most of the ancillary works will be insignificant compared to that of the wind turbines and the ancillary works will be designed and located so as to reduce their visual impact.

Upgrading of existing tracks and construction of new access tracks will be required. Any temporary tracks not required for ongoing operation and maintenance will be removed and re-grassed after construction works have been completed. Permanent tracks will be located to achieve suitable grades on stable slopes and designed so that they will not exacerbate erosion at the site. As far as possible, the location of tracks will also be chosen to minimise visual impact from the surrounding countryside.

In most cases there will be limited visibility of tracks for the surrounding countryside. However, some access tracks may need to be located on slopes that could be visible from surrounding vantage points. It is possible with careful design to construct these tracks such that their visual impact is minimised. Earth batters on any tracks that are benched into slopes will be revegetated to prevent erosion and to reduce visibility of the constructed track.

The substation and associated buildings will be located to the north of the wind farm adjacent to the existing 66,000 volt high voltage transmission line. There will be minimal visual impact by placing the substation and associated buildings where they will be screened by vegetation and to a certain extent, topography. This will mean that they will only have limited visibility from neighbouring residences and surrounding roads. Night lighting at the substation should be minimised.

To reduce visual impact at the location of the turbines, the 33,000 volt cables linking the turbines within each group will be placed underground along the ridge tops. The 33,000 volt underground cables will also link the turbines to the substation. The location of the grid connection is close to the substation and requires only a short section of overhead line that will have a low visual impact. The location minimises clearing of remnant woodland and avoids areas of unstable ground or areas of archaeological significance. The overhead grid connection will be a minor feature of the development that will not be visible from neighbouring residences or local roads but may be visible from Sinclair Lookout.

6.9 Shadow flicker

Shadow flicker is a visual effect that occurs when rotating turbine blades cause intermittent shadowing at a viewpoint as the blades momentarily block the sun's path. For any viewpoint, it occurs only during the day when the positions of the sun, the turbine and the viewpoint are such that the sun's rays pass through the swept area of the rotating blades. At these times the sun's rays are repeatedly and intermittently interrupted which causes a flickering shadow effect at the viewpoint.

The intensity of the effect is diminished by distance between the turbine and the viewpoint, by increased cloud cover and when the turbine is facing at an angle to the rays of the sun and the blades present a narrower profile and reduced shadowing. The effect is also absent when the turbines are not operating further limiting the times when shadow flicker will be experienced.

An assessment of the potential for shadow flicker effects is provided in Appendix D and its findings are summarised here. The zones where there is potential for shadow flicker at residence locations were assessed using 'WindFarmer' software and with consideration of factors illustrated in Figure 6.9. Figure 6.8 shows a graphical analysis of the distribution of the shadow flicker effect and the duration in hours that the effect may occur over a year.

Shadow flicker effects at distances greater than 1 km were assessed as being minor or absent (at least indistinct and faint). At a distance of less than approximately 400 metres between a turbine and a residence there is the potential for the sun to be completely blocked by blades of 3.5 metres width, although only intermittently. No residences are located at distances of less than 400 metres and the nearest occupied neighbouring residence is beyond 950 metres.

The closest occupied residence, 'Highfields', a non-wind farmer residence at about 960 metres from the nearest turbine (Turbine 18), was found to have little potential for shadow flicker effects. The position of the residence relative to the closest turbines and the number of large trees surrounding the residence mean that any shadow flicker effects that may occur would be largely mitigated.

Mayvona is a vacant neighbouring residence at a distance of about 850 metres from the nearest turbine (Turbine 22B) and is within a zone potentially subject to shadow flicker. The residence has been assessed as being subject to a maximum 10 hours of the effect over a full year. However, the analysis in Appendix D indicates that at such distances, the effect will be very diffuse.

Sinclair Lookout is the nearest public place to the wind farm site. Due to the Lookout being north of the turbine site it is very unlikely to be affected by shadow flicker. If affected by shadow flicker it would only be for very short periods in the early morning in mid summer but at these times few visitors are likely to be visiting the lookout. The local roads are mostly at distances from the turbines where the impact is assessed as negligible.

6.10 Blade glint

Blade glint refers to the regular reflection of sun from one or more rotating turbine blades. This can be a temporary effect at any particular location, though the majority of any glint occurs where the viewer is located above the altitude of the turbine hub and few such viewpoints occur around the wind farm. The occurrence of blade glint depends on a number of conditions including the orientation of the nacelle, angle of the blade, and the angle of the sun. The reflectivity of the surface of the blades is also important and is influenced to some extent by colour and age of the blade.

Blade glint is an aspect that could be a potential distraction to drivers if roads are aligned towards turbines, particularly where the road is located at a higher altitude to the turbine hub and can be noticed over some distance, as much as 10 to 15 kilometres. While the effect may be noticeable at distance its impact is regarded as transient and low.

Blade glint is not expected to represent a significant issue for the Glen Innes Wind Farm project due to the altitude of the turbines relative to potential view points, low density of settlement in the areas that could be potentially affected and the low volumes of traffic on the local roads. Where it does occur it will be of short term duration. In most cases where potential for glint exists, manufacturers are able to use low reflectivity finishes for the turbine blades that will minimise any potential for glint.

6.11 Mitigation of visual impact

The three bladed turbine design and the chosen matt white colour are generally accepted as being the most visually acceptable turbine arrangement and colour. However, due to their size and prominent position the wind turbines will be difficult to screen at the site. Existing trees and other features at some surrounding locations may partially obstruct views of the wind farm.

Measures to further mitigate the visual impact that have or will be incorporated in the development will include:

- Clearing of woodland vegetation will be minimised
- Earthworks will be restored as soon as possible after construction

- Underground cables will be installed between turbines within each of the turbine groups
- Cable trenches will be backfilled so that once restored they will have no visual impact. The choice of underground cables for the ridge top turbine locations instead of above ground transmission lines has been made to minimise the visual impact of the development.
- The colour of the turbines is that commonly chosen to create a more desirable visual outcome
- If necessary, and with agreement of the relevant landowners, tree planting could be undertaken on some of the closer neighbouring properties (within three kilometres of the wind farm) to screen parts of the development. The preferred types of plants for screening are local native varieties but it may be necessary to plant non-natives that are fast growing where expediency is essential or where property owners would prefer non-natives.
- The design and location of ancillary works will incorporate measures to reduce their visual impact. Screening of certain ancillary works, if required, can utilise vegetation planting at the location of the ancillary works
- Turbine 18 has been shifted to the south of its original location to increase the setback from the Highfields residence
- Access roads have been minimised and located to limit their visibility from neighbouring public areas and to minimise clearing of woodland. The construction methods will also aim to reduce the visibility of disturbed ground
- If aircraft safety lighting is required by CASA for selected turbines then shielding of obstacle lights is permitted provided it does not compromise their operational effectiveness. Shielding can restrict the downward component of light to 5% of nominal intensity is emitted at or below 5 degrees from horizontal and no light is emitted at or below 10 degrees below horizontal (section 10.4 of CASA AC 139-18 (0))
- With two obstacle lights mounted on the nacelle, light extinction of one of the lights can occur when the blade passes in front of the light, provided that at least one light can be seen from every angle in azimuth (section 10.4 of CASA AC 139-18 (0))
- Lighting would not be used during daylight hours unless visibility is reduced

6.12 Overview of visual issues

The layout of the proposed site has been based on achieving an acceptable energy output while addressing potential visual and noise impacts and comments received from the property owners and neighbours. While minor adjustments may be made to the locations of turbines within the site, such adjustments are unlikely to alter the overall visual impact. It is also possible that not all of the 27 sites assessed will be developed.

The wind farm will be noticeable from many points within its visual catchment. The photomontages provide representative views from each direction and at various distances from the wind farm. In many cases actual views will be limited partially or fully by topography and / or trees or by the aspect of the viewpoint. As far as possible, all ancillary works will be implemented with due consideration to reducing their visual impact and in most cases they will have a minor contribution to the project's visual impact.

The perceived visual impact is likely to vary between individuals depending on a range of factors. For this reason a set of photomontages has been produced showing how the wind farm will appear when

viewed from a selection of representative sites in the area. These photomontages, along with the visual impact assessment provided in Section 7.3 of Appendix C, are intended to provide stakeholders with an indication of the potential visual impact of the wind farm from key locations surrounding the wind farm site.

Based on experience with the Crookwell and Blayney Wind Farms in NSW and larger wind farms of Lake Bonney near Mt Gambier in South Australia and Alinta Wind Farm near Geraldton in Western Australia it is likely that many in the Glen Innes community will regard the visual impact of the installed wind farm as being acceptable. All of the above-mentioned developments appear to have been well received and some initial concerns about the developments, including visual impacts, appear to have dissipated after construction of the wind farms.

Consultation to date with residents in the vicinity of the Glen Innes Wind Farm has encountered a range of views including a considerable degree of support from the local community. However, some neighbours to the wind farm site have expressed concern as to the visual impact of the wind farm and have advised that they will oppose the development. This opposition has seen the formation of the Glen Innes Landscape Guardians which appears to have been initiated by neighbours to the Glen Innes Wind Farm in the Furracabad Valley.

The proponent is able to offer tree planting at affected neighbouring residence locations to reduce the visual impact at the residence location. However, the proponent is unable to significantly mitigate the visibility of the wind farm by measures at the site without removing significant parts of the wind farm array.

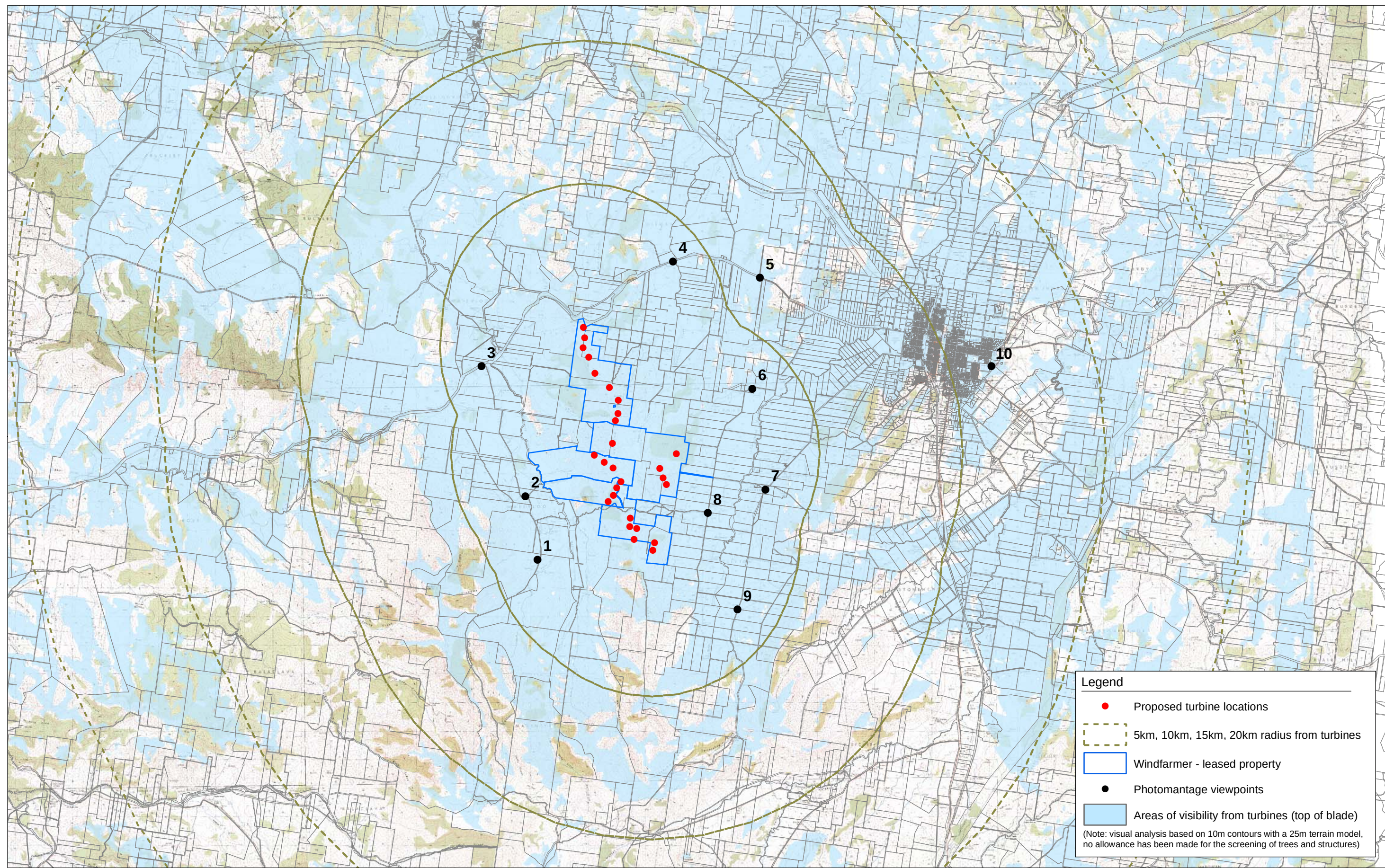


Figure 6.1
Visual Catchment and Viewpoints

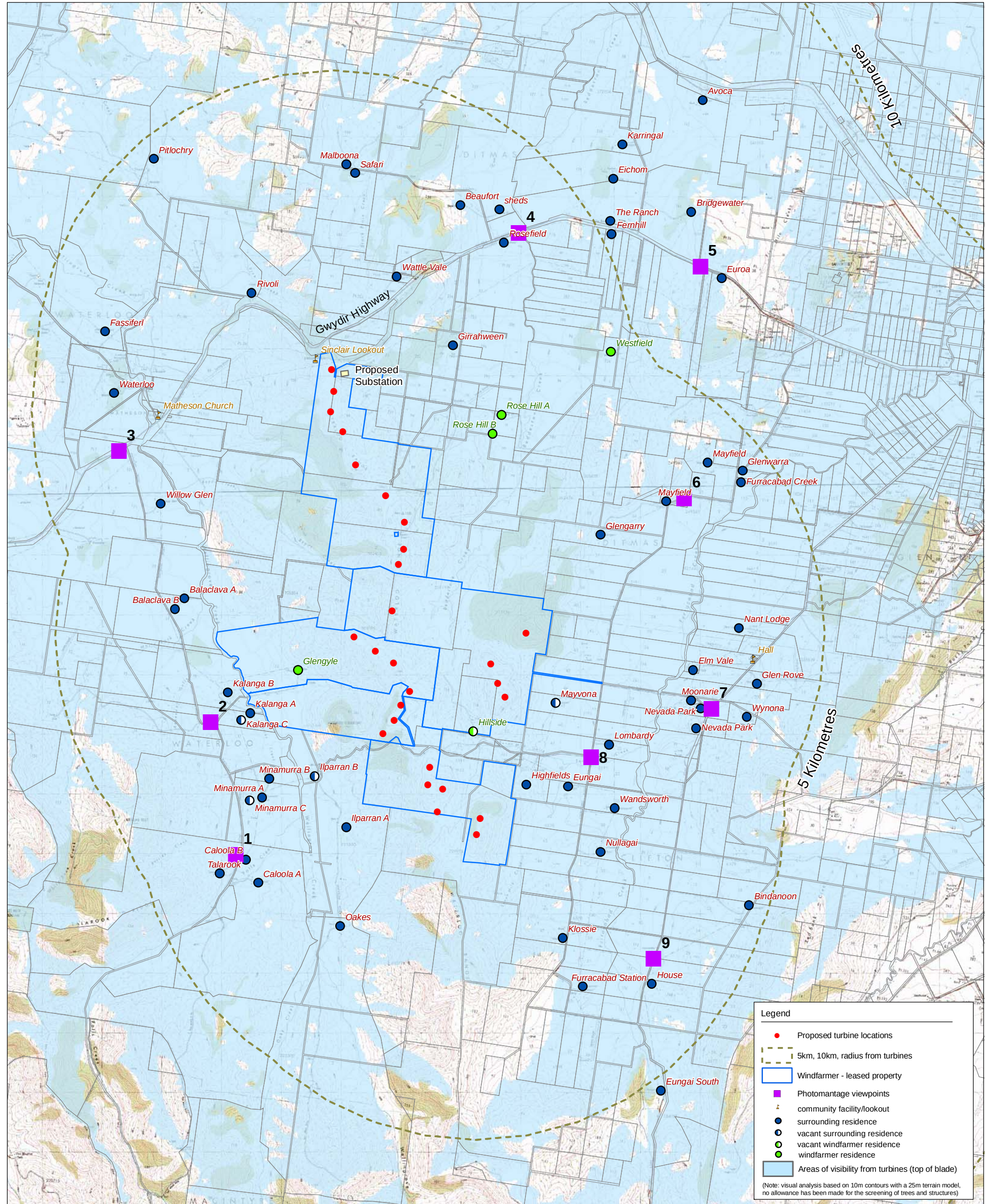
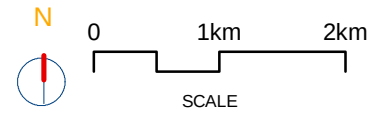


Figure 6.2

Visual Catchment and Viewpoints



Source: Lands Department

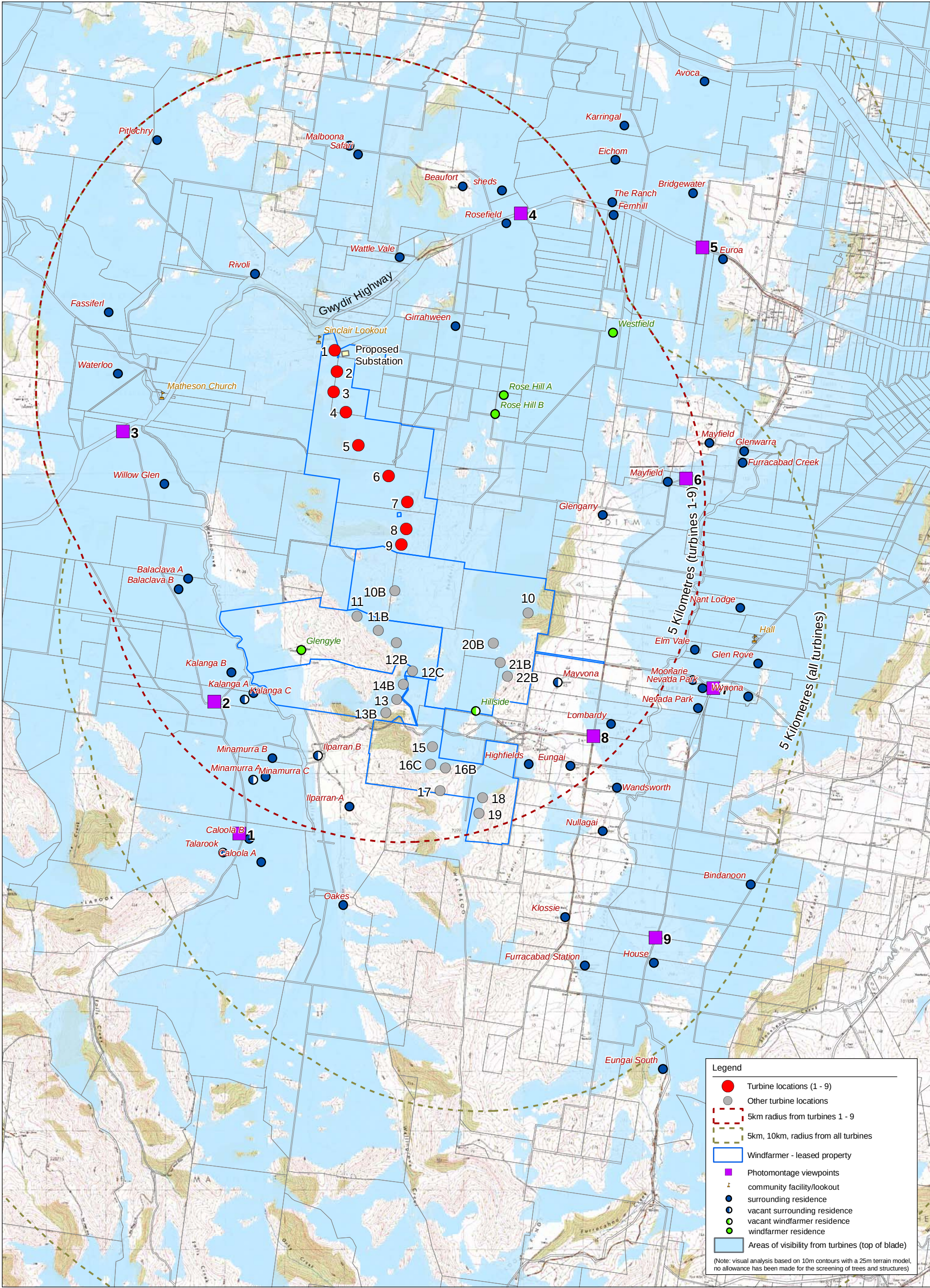
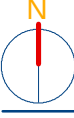


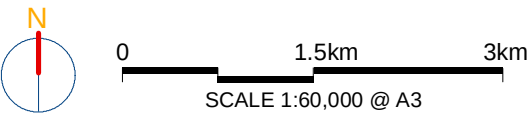
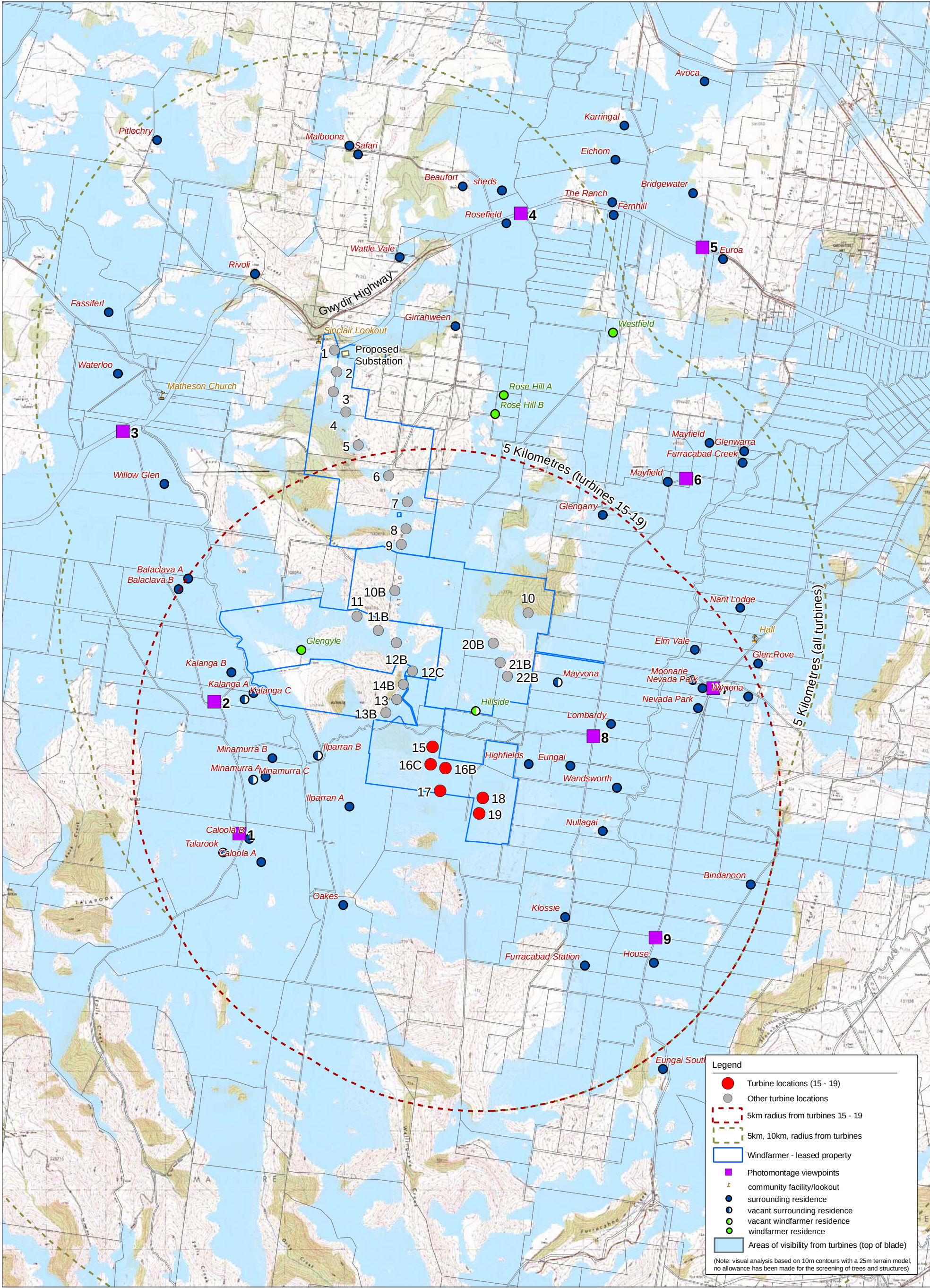
Figure 6.3

Visual Catchment for Turbines 1 - 9



0 1.5km 3km
SCALE 1:60,000 @ A3

Source: Lands Department



Source: Lands Department

Figure 6.4

Visual Catchment for Turbines 15 - 19

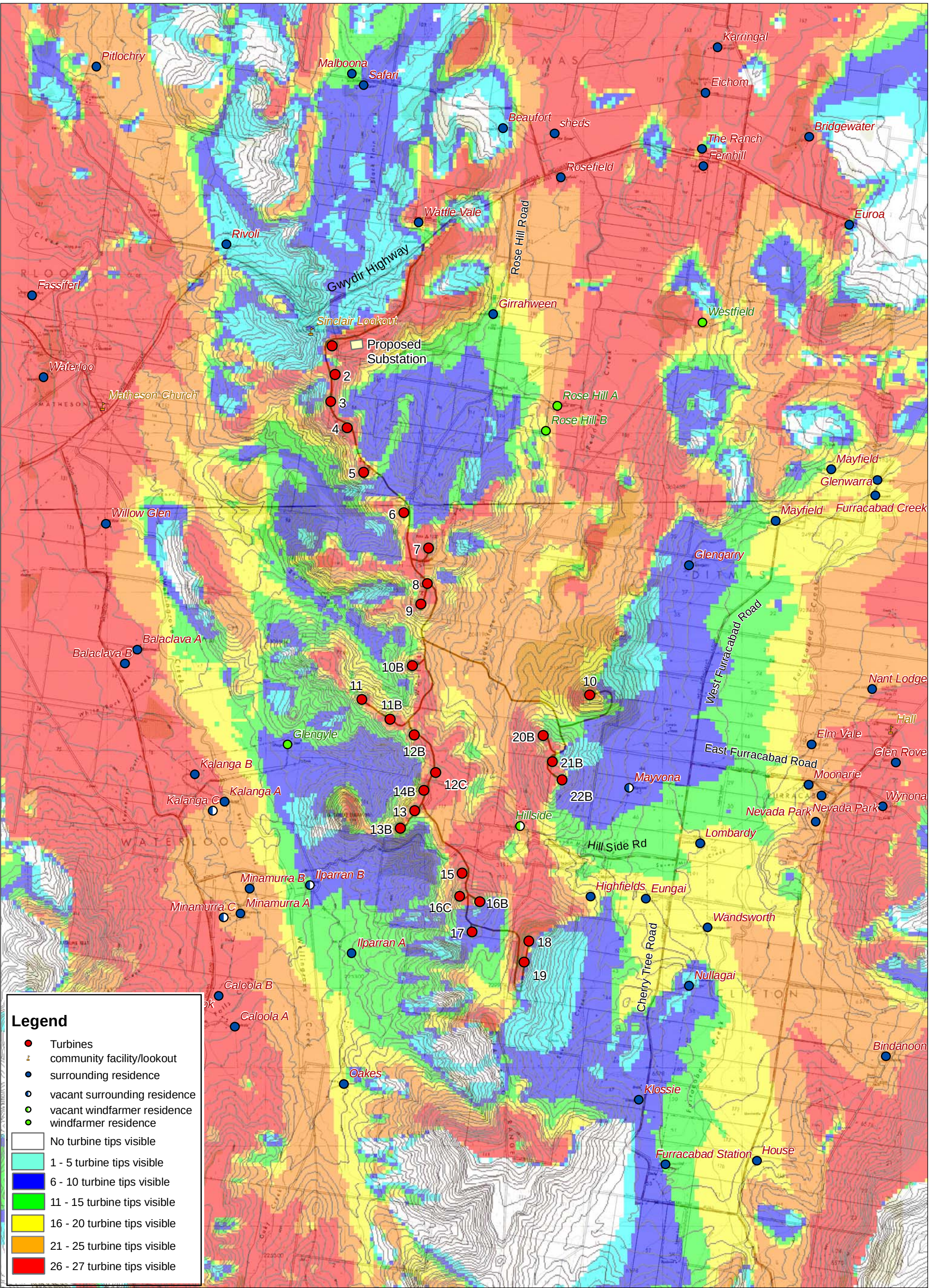
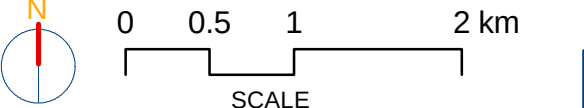


Figure 6.5

Zones of Visual Influence



Source: Lands Department



Viewpoint 3: Intersection of Gwydir Highway and Waterloo Road

Figure 6.6

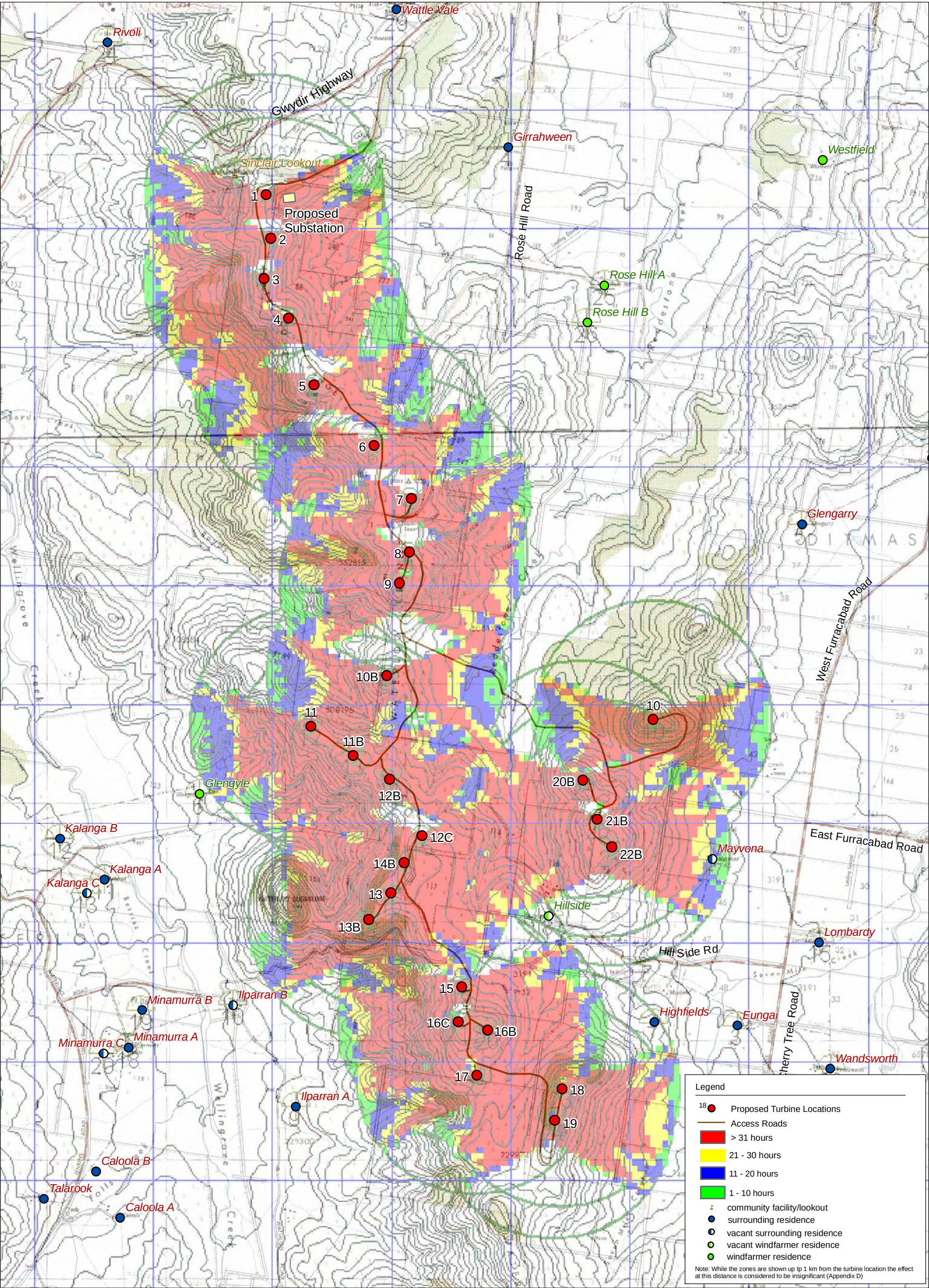
Photomontage from Viewpoint 3



Viewpoint 6: West Furracabad Road

Figure 6.7

Photomontage from Viewpoint 6



N

00.75 km1.5 km

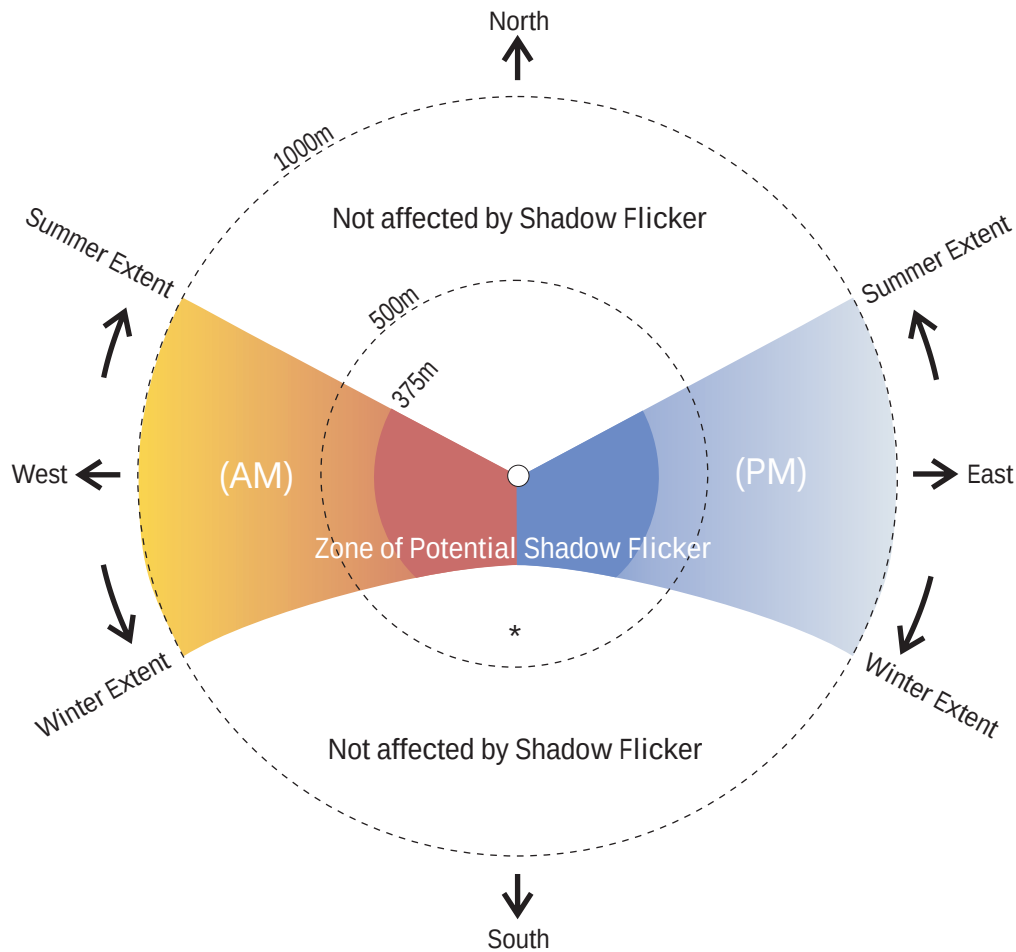
SCALE

Source: Lands Department

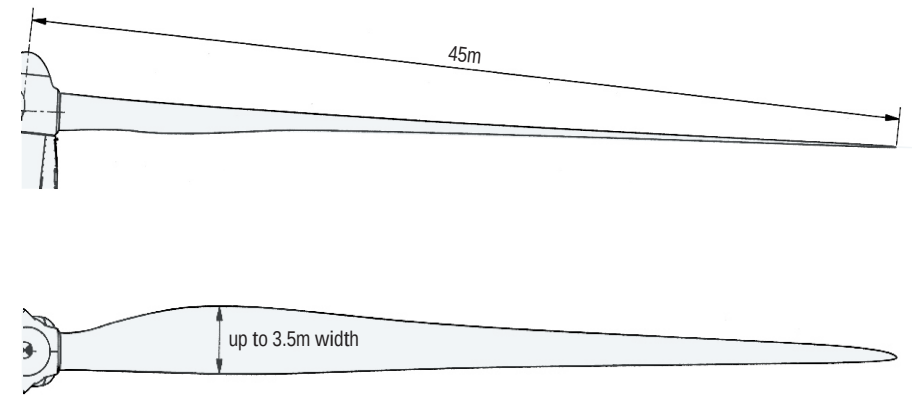
Figure 6.8

Potential Shadow Flicker Zone

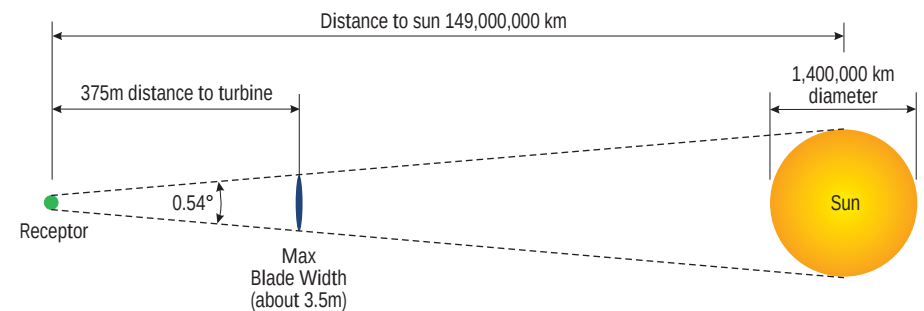
GLEN INNES\25766\29-10-07\MAR\REV-1



A – Approximate zone of potential Shadow Flicker Effect around a single Turbine
(* for turbine base 100m above receiver)



B – Blade profiles



C – Schematic illustration of shadow cast by turbine blade

