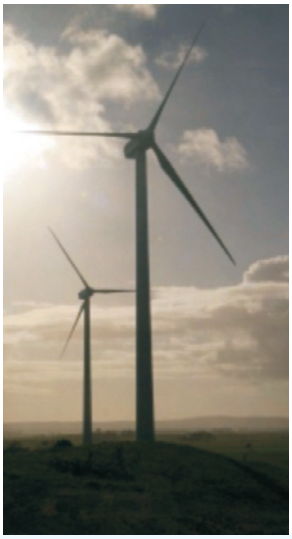
Woodlawn Wind Farm



Visual Assessment

6

6. Visual Assessment

6.1 Introduction

This chapter of the SEE provides an assessment of the proposed variations to the Woodlawn Wind Farm project in the context of the existing development consent. It addresses the visual impact of revised turbine layout, reduced number of turbines and changed dimensions for turbines as well as for the associated infrastructure including access, overhead line works and changed substation arrangement.

The key aspects of this part of the assessment include a description of the local landscape, the visual features of the proposed changes to the wind farm development, a review of the visual catchment of the amended Woodlawn Wind Farm layout and the preparation of simulated views of the wind farm with the relocated turbines from representative and potentially impacted viewpoints to enable comparison with previous simulations presented in the 2004 EIS.

6.2 Overview of assessment

A visual assessment was undertaken as part of the 2004 EIS using the following characteristics:

- 25 turbines
- 19 turbines with a hub height of 60 metres and six turbines with a hub height of 78 metres
- turbine rotor diameter of 80 metres
- consideration to be given to turbine colours including light grey
- substation located between turbines 14 and 15 and an overhead 66 kV line to an existing 66 kV line
- access tracks and cable trenches located on the ridgeline
- viewing platform adjacent to the intersection of Collector and Bungendore Road

The assessment in this SEE considers the visual impact of a reduction to 20 turbines with each turbine having a marginal increase in dimensions for hub height (all 80 metres) and rotor diameter (88 metres) as well as the changed grid connection arrangement.

The turbines will be located on the ridgeline at elevations ranging between 834 metres AHD (Australian Height Datum) at the southern end to 918 metres AHD at the northern end with the highest elevation being 930 metres. The landscape of the approved site is characterised by a series of sparsely wooded undulating hills and ridgelines with open valleys and scattered trees.

The former Woodlawn mine site, located at the northern end of the approved wind farm, is a visible element below the ridgeline. The mine site includes some revegetated overburden spoil piles of moderate height and lower elevation bare areas including tailing dams left after mining. Buildings in the locality of the approved site include rural residential properties, agricultural structures and existing communications infrastructure.

The generally north south road running between Tarago and Bungendore is located to the east of the site and is a significant regional tourist route. The Federal Highway is over 15 kilometres to the west and offers distant views to the Capital and Woodlawn Wind Farms. Collector Road is located north of the site and runs between the Federal Highway and the Tarago/Bungendore Road. It is lightly used by the local residents and to a lesser extent tourists. The Canberra to Sydney railway line is located to the east of the site and generally follows the course of the Mulwaree River with limited views to the wind farm site.

The 2004 EIS identified six landscape units from which to undertake the visibility assessment of the Woodlawn Wind Farm.

Table 6.1 – Landscape units (URS, 2004)

Landscape unit	Wind farm portion	Viewed from
1	South-west	Taylors Creek Road
2	North-west	Intersection of Taylors Creek Road and Collector Road
3	North-west	Federal Highway to the west of Lake George
4	North-east	Collector Road
5	Eastern	Bungendore Road
6	South-east	Goulburn-Bombala railway line

Site visibility was assessed for 24 viewing locations. In summary the visual catchment indicated that:

- the turbines will be visible from an area extending 21 kilometres from north to south and approximately six kilometres to the east and approximately18 kilometres to the west
- the largest group of the general public with prominent views to the wind farm will be motorists using the Bungendore Road for a distance of about 10 kilometres with generally intermittent or partly screened views to the wind farm
- turbines will be visible on the skyline from a nine kilometres section of Collector Road and a 12 kilometres section of Taylors Creek Road. The visibility from Collector Road will decline from moderate to low with increased distance from the wind farm.
- approximately 37 rural residences will be located in the visual catchment and of these:
  - Four residences are located on Woodlawn and Pylara properties, both currently owned by Veolia and regarded as wind farmer residences
  - Approximately 33 are neighbours to the wind farm with about 23 residences to the south and west of the wind farm along Taylors Creek Road

The extent of visibility from individual residences will vary greatly depending on the orientation of the residence and the position of existing trees and landform features which could potentially block or partially screen the view.

Due to the proposed variations for the existing approved wind farm, Aurecon undertook a further visual assessment predominantly to identify any differences in visual impact. The methodology adopted for the visual impact assessment included the following steps:

- landscape analysis for the wind farm site and surrounding area
- identification of the changes to the approximate visual catchment of the wind farm
- use of recent photography for existing assessment site
- computer modelling to generate simulated perspective view of the modified wind farm layout
- photomontage compilation for revised layout
- comparison of photomontages for current array and approved array
- development of visibility assessment criteria
- review of photomontage using visibility assessment criteria
- review of indicative visibility for a range of other potentially relevant viewpoints including residences
- review of visual aspects of ancillary works particularly the 33 kV overhead line from Woodlawn Wind Farm to Capital Wind Farm substation
- review of mitigation options for the amended project

The key aspects of the visual impact review are summarised in the following sections.

6.3 Wind farm visual characteristics

The general location and extent of the wind farm and the associated landscape characteristics remain unchanged. The number of turbines has decreased to 20 and turbine hub height has increased to 80 metres for all 20 turbines (previously 19 at 60 metres and six at 78 metres). The variation of hub height from 78 metres to 80 metres is negligible in terms of visual impact. The locations of the turbines have marginally changed with the distance between the turbines in some areas of the wind farm site being increased. Generator transformers are also to be located close to the base of the wind turbine towers but with low overall height and colour selection to blend in with the local landscape will have low visibility. Ancillary works include access tracks and underground power and control cables between turbines (Figure 1.3).

The 33 kV overhead line will generally have low visibility apart from locations in the vicinity of its crossing of Taylors Creek Road. This area is distant from rural residences and this section of Taylors Creek Road has low levels of usage.

Of the project elements, the wind turbines will be the most visible elements of the project. The key characteristics affecting visual impact are shown in Table 6.1 below. The proposed wind turbine structures are the Suzlon S88 2.1 MW turbines which have the general form illustrated in Figure 3.1. This turbine model will be used for each of the 20 turbine sites and its dimensions have been used in this assessment.

Table 6.2 – Wind farm components and key visual characteristics

Wind farm component	Visual characteristic
Turbines	
Number of turbines	• 20
Tower and hub height	• Steel tubular supporting towers • 80 metres hub height • Tower 4.5 metres at base and 2.5 metres at top
Turbine	• Three bladed • Rotor diameter of 88 metres (44 metres blades)
Turbine rotation (rpm)	• 15.5 revolutions per minute
Colour	• Matt white colour or similar light neutral colour
Generator transformer	• To be located near the base of each turbine – green / tan
Electrical works	
Electrical connection	• Underground power and control cables will interconnect the individual turbines and have minimum visibility once easements are revegetated
Grid connection	• Proposed 33 kV overhead double circuit transmission line supported on single poles, which will be mainly visible to the public where it crosses Taylors Creek Road.
Access works	
Site entrance	• Signposted, gate setback from the Collector Road
Access tracks	• Up to 10 metres wide and unsealed

Existing access tracks are at ground level and are mostly not visible from surrounding viewpoints. The turbine sites are generally adjacent to existing access tracks that will need to be upgraded and in places the formed tracks may have increased visibility from surrounding areas. Where practical, the works will be designed and constructed to minimise visibility through positioning, earthworks formation and revegetation of disturbed ground.

6.4 Landscape analysis

The approved wind farm location is on a visually prominent north-south ridgeline elevated above the adjacent rural lands. The revised wind turbine array is located on the same section of ridgeline as for the approved array. The maximum height of the ridgeline is 930 metres with the highest wind turbine having its footing at a height of about 924 metres.

A broad valley associated with Taylors Creek catchment extends approximately six kilometres to the west of the ridgeline. It is a subdued topographic feature with rolling hills and patchy areas of trees. The 33 kV transmission line passes through this valley and into Dry Creek Valley at its southern end.

The landscape to the east of the ridge is more variable in elevation. It is characterised by valleys and ridges associated with the Mulwaree River and Crisps Creek Catchments. Views of the ridgeline where the wind farm is to be located are in places screened because of the undulating landform and due to the presence of trees either remnant natives or rows of pines and other exotics.

The Woodlawn site reflects long term agricultural use with most of the original woodland vegetation cleared and pasture established for grazing. Fencing divides the area into regular shaped paddocks. Farm tracks provide access from public roads to scattered homesteads throughout the area with most of the homesteads having shelter trees planted around them. Sheds and stockyards are common. Remnant trees occur along sections of creek lines, road sides and as isolated patches.

There are rows of planted generally exotic species such as pines forming wind breaks that are visually prominent elements in parts of the landscape particularly to the south and west of the site. Exotic trees are also generally associated with homesteads.

Lake George is located about 10 kilometres to the west of the site and is a major visual feature of the landscape. Views from the section of the Federal Highway running along the western edge of Lake George towards the wind farm are approximately 18 kilometres distant from the Woodlawn ridgeline. This section of the Federal Highway also includes views of the Groses Hill, Ellenden and Hammonds Hill Groups of turbines which form the Capital Wind Farm.

Views towards to the proposed wind farm from public roads vary from open, filtered and screened. Screening elements adjacent roads include planted trees, remnant native vegetation and elevated areas of landform which reduces the overall visibility of the project for travellers on the surrounding roads.

Representative views of selected landscape elements in the vicinity of Woodlawn Wind Farm are provided in Plates 5.1 to 5.14. Some of the landscape elements reflect particular physiographic features of the locality. All of the landscape elements have been influenced by human activities, particularly clearing and settlement of the land. Features remaining after mining are also evident in the landscape. Despite the clearing, settlement and mining activities having occurred relatively recently, many people viewing the landscape scenes would regard them as the natural visual state of the locality.

The representative photomontages included in this Chapter enable individuals to gain their own appreciation of the landscape elements and the visual impact of the currently proposed project layout relative to the approved project as indicated by photomontages included in the 2004 EIS.

6.5 Landowner consultation

It is possible that some people within the visual catchment may feel a degree of concern regarding the visual impact of the wind farm development on their longer term enjoyment of the locality. Such concern tends to heightened by any uncertainty regarding the extent of actual visual impact.

Woodlawn WindEnergy Joint Venture undertook extensive consultation with the local community during the preparation of the 2004 EIS. Further to the original consultation and following acquisition of the project by Woodlawn Wind Pty Ltd, consultation activities have been conducted to provide relevant stakeholders with information regarding the proposed variations to the development, the potential

impacts of the proposed variations, including visual impact, and new contact details for the proponent (Woodlawn Wind Pty Ltd). Overall, neighbouring residences are likely to have a decreased visual impact arising from a lesser number of turbines being installed although in some cases individual turbines may be slightly more visible due to an increase in hub height and rotor diameter.

This chapter aims to assist stakeholders to gauge the visual impact of the project variations relative to the approved project with the provision of photomontages that provided a realistic representation of the amended wind farm from relevant viewpoints. It also aims to provide a relative ranking of visibility of the wind farm from other selected viewpoints and a description of the changes to the scenes at representative viewpoints.

6.6 Visual Catchment of the wind farm

The visual catchment of a wind farm is the area of surrounding land from which the wind turbines may be wholly or partly visible. The visual catchment of Woodlawn Wind Farm was determined to a distance in excess of 20 kilometres 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 extent of visibility for the new turbine specifications and the reduced number of turbines has been determined and illustrated in Figure 6.1. The primary visual catchment demonstrated in the 2004 EIS is also shown in Figure 6.1. It is evident that there is little variation in visual catchment between the approved and amended layout.

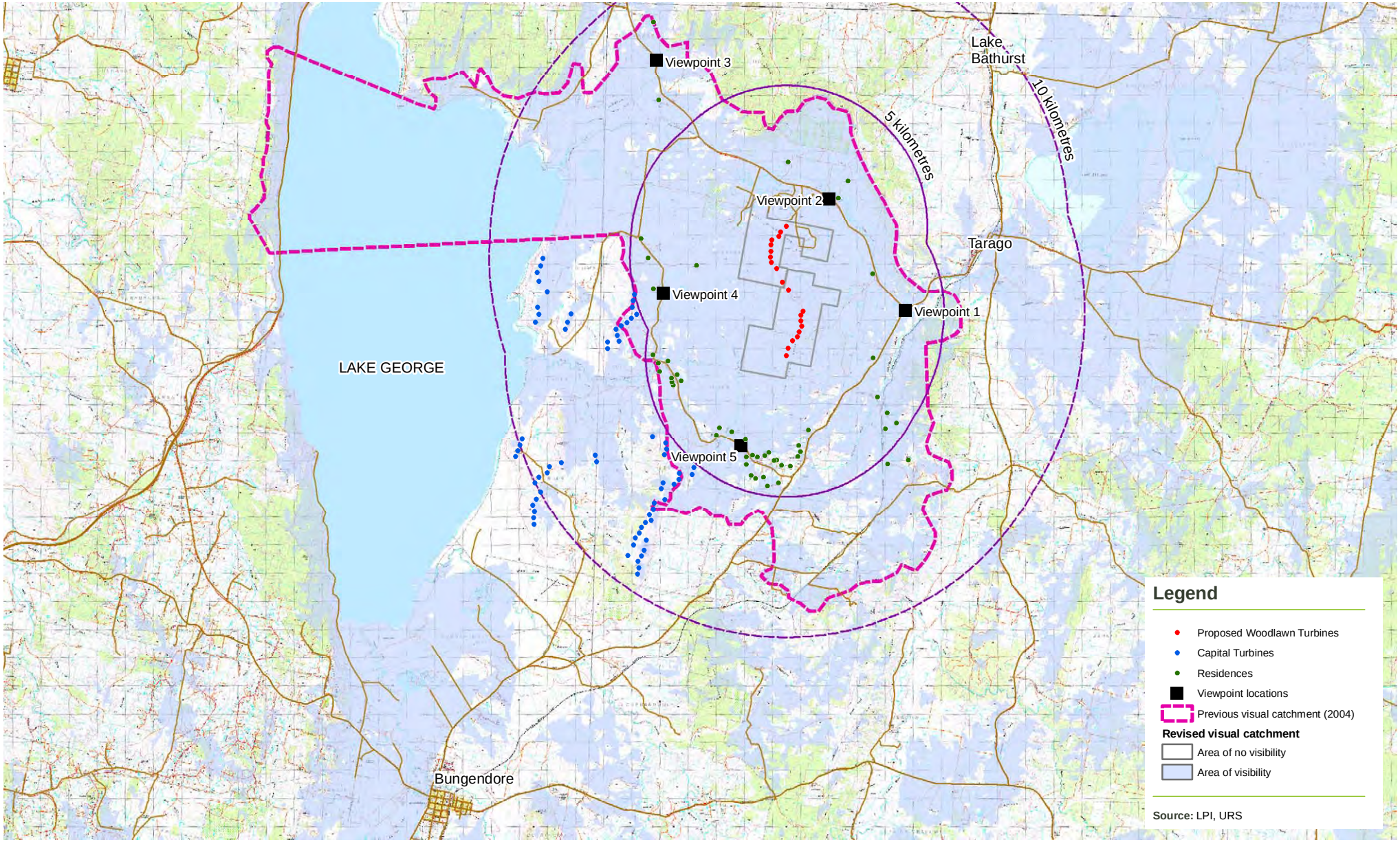
The effect of screening by trees or built structures was not included in the computation of the visual catchment as data was not available for the relevant heights. Accordingly, the computed visual catchment will overestimate the extent of the wind farm's visual catchment.

A site inspection was conducted to gain further understanding of the visual catchment of the modified turbine layout. Roads which surround the project area were travelled and the areas from which the turbine sites could potentially be seen were noted. It was found that the turbines will be visible over a large area but that local topography and vegetation will limit visibility from many locations. In particular, localised ridges will limit views of the proposed wind farm from some residences immediately to the west of Tarago-Bungendore Road and along Taylors Creek Road to the south.

The turbines will be visible at distances greater than 10 kilometres in some directions. However, the visual impact of the overall Woodlawn Wind Farm beyond about 10 kilometres will be minor but nevertheless noticeable. For many viewpoints at distance, the distinction between the Capital and Woodlawn Wind Farms may not be evident.

6.7 Visual impact assessment sites

Five representative viewpoints were used to prepare photomontages for this assessment with the objective of providing comparative material for the current form of the wind farm and that described in the 2004 EIS and for which consent was granted. Figure 6.1 shows the locations of the viewpoints.



U:\GIS\Project-2\project\Woodlawn Wind Farm\wlwf_fig6-1_Visual catchment_V2.mxd\200636\16-12-09\KAD\Rev 1

SCALE 1:185,000 @ A4

0 3 6km

Projection: MGA
Note: The viewshed analysis is taken from top of blade (124m) and is indicative only. Screening by trees and others structures has not been taken into account

FIGURE 6.1: Visual catchment - Woodlawn Wind Farm only

Table 6.3 – Representative viewpoints for photomontage preparation

Viewing location (2010 SEE)	Viewing location (2004 EIS)	Description of viewing location for 2009 photomontages
Site 1	Viewing situation 2	View from the crest of Bungendore Road at intersection with Collector Road looking west towards the site on the skyline
Site 2	Viewing situation 11	View from Collector Road looking south-west towards the site on the skyline with a tree covered spur partially blocking views of the site
Site 3	Viewing situation 19	Elevated valley view from Collector Road looking south-east towards the site with open paddocks extending from foreground to mid-distance and clumps of remnant trees partially blocking distant ridgeline
Site 4	Viewing situation 6	View from Taylors Creek Road looking south to east across grazing paddocks scattered with bands of trees in the mid distance and the site forming on the skyline
Site 5	Viewing situation 4 (no photomontage prepared for this view)	View to north from Taylors Creek Road near RFS Shed with rural distance in the mid ground and ridgeline in the far distance.
No photomontage prepared – About 18 kilometres from Woodland Wind Farm	Viewing situation 20	View from Badcoe VC Rest Area on Federal Highway looking east across Lake George toward site forming part of ridgeline.

For the 2009 visual assessment

- current photographs were obtained from five viewing situations that were used in the 2004 EIS and numbered 2, 6, 11 and 19.
- photographs were also obtained from an additional view point (Site 5 of the 2009 assessment) with a view of the southern part of Woodlawn Wind Farm site. The viewpoint is at an area of rural residences between the Capital and Woodlawn Wind Farms and adjacent Taylors Creek Road (referred to as viewing situation 4 in the 2004 EIS).
- Viewing situation 20 (2004 EIS) was not repeated for the 2009 assessment as the viewpoint is about 18 kilometres from the Woodlawn Wind Farm site and as the skyline from this view is dominated by the closer Groses Hill and Ellenden groups of turbines of Capital Wind Farm. A photomontage of the Capital Wind Farm from the western side of Lake George was provided in the Capital Wind Farm Environmental Assessment 2006.

The new photographs have been used to prepare the photomontages shown in Plates 6.1 to 6.5. These photomontages were used to determine the visual impact of the proposed variations relative to the approved project.

The viewfield figure includes reference contours showing approximate distances of five kilometres and 10 kilometres respectively from the wind farm (distance to nearest turbine). The co-ordinates of the viewpoints are provided in Table 6.4 below together with the distance for the nearest turbine.

Photomontages have been prepared for the representative viewpoints (Table 6.4) and visibility of the wind farm classified (Table 6.5). The photomontage for the various locations will assist the neighbouring residents to visualise the changes arising from the relocated turbines relative to their property.

Table 6.4 – Details of viewpoint assessment sites

Ref site #	Viewpoint location (see Figure 6.2)			Viewpoint details	
	Easting MGA (m)	Northing MGA (m)	Description of location and plate number	Dist. nearest turbine (km)	Direction of view
1	738755	6113349	Intersection of Collector and Tarago to Bungendore Roads – Plate 6.1	3.6	west
2	736047	6117312	Collector Road, near Cowley Hills residence – Plate 6.2	1.8	south-west
3	729888	6122218	Collector Road near Willeroo residence – Plate 6.3	7.5	south-east
4	730134	6113964	Taylors Creek Road, between Euroka and Sunnybrook residences – Plate 6.4	4	east
5	732893	6108527	Taylors Creek Road near Bonnie Doon Residence and RFS shed – Plate 6.5	3.6	north

The Tarago township is at an elevation of about 700 metres and approximately 6.5 kilometres north-east of the Woodlawn Wind Farm. As there are intervening hills of over 800 metres height between Tarago and the wind farm the bulk of locations within the township will not provide views of Woodlawn Wind Farm as evident in Figure 6.2.

The Lake Bathurst township (nine kilometres to the north-east) and the Bungendore township (19 kilometres to the south west) also have topographic screening and will not have views to the Woodlawn Wind Farm.

6.8 Production of photomontages for selected viewpoints

To assist the assessment of visual impact at the selected assessment sites, a photographic representation (photomontage) of the landscape with the wind turbines superimposed was prepared. The objective of the photomontage was to provide an accurate simulation of the appearance and scale of the modified wind farm in comparison to the approved wind farm layout in the landscape.

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

- The relevant viewpoints and the photomontages produced for the 2004 Woodlawn Wind Farm Visual Impact Assessment were used as a guide for taking a new set of photographs. The photographs were taken with a 35 mm single lens reflex camera with its lens set to 65 mm focal length. Due to the focal length used it was necessary 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. 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 generally 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 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 photomontages to aid recognition of the respective turbines.

The photomontages form a principal reference by which the Approval Authority and the community can gain an appreciation of the likely visual impact of the proposed modification for the closest neighbouring residences.

The orientation of the wind turbines will vary with the wind direction however, 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 photomontage they have been shown generally facing the viewpoint even though that situation will be uncommon. The photomontages are shown in Plates 6.1 to 6.5 at the end of this chapter.

6.9 Visibility assessment

The visibility of the development was reviewed against the following assessment criteria:

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

For the purpose of this assessment, the following descriptors were adopted.

High Visibility: Scenes having high visibility include viewpoints within one kilometre and viewpoints up to three kilometres depending on the wind farm view field angle.

Low Visibility: Low visibility is assigned to all viewpoints beyond five kilometres and viewpoints between three kilometres and five kilometres depending on the wind farm view field angle. It should be noted, however, that low visibility does not necessarily correspond to low visual impact.

Moderate Visibility: This classification is applied to viewpoints intermediate between the low and high classes.

While the above classification scheme is somewhat arbitrary, it does serve to rank visibility for the respective viewpoints. It is stressed that visibility rankings do not represent the visual impact which is subject to a range of other considerations. Similarly, the visibility ranking does not indicate whether the visibility is adverse or favourable.

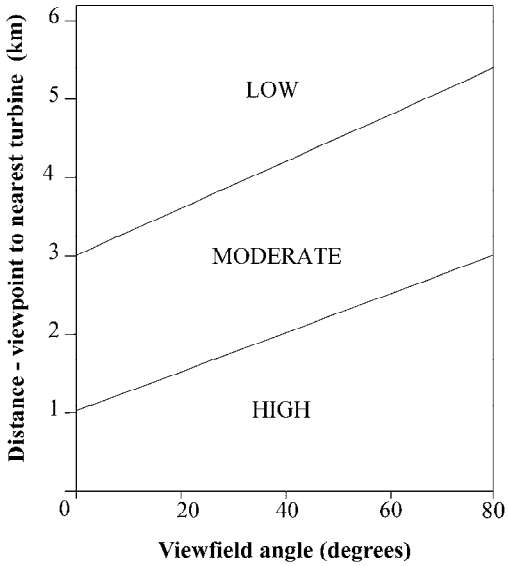


Figure 6.2 – Classification of wind farm visibility

The key visibility criteria and the resulting classifications for each viewpoint are shown in Table 6.5. One viewpoint has been rated as having a high visibility of the wind farm, three viewpoints with moderate visibility and one with low visibility.

Table 6.5 – Visibility assessment results – representative viewpoints

Ref site #	Viewpoint location	Number of visible turbines			Visibility criteria		
		Mid-ground	Back ground	Back ground	Distance to nearest turbine	Wind farm view angle	Visibility class
		1–3 km	3–5 km	> 5 km	km	degrees	
1	Intersection of Collector and Bungendore Roads	0	12	8	3.6	65	Moderate
2	Collector Road, near Cowley Hills residence	7	9	4	1.8	55	High
3	Collector Road near Willeroo residence	0	0	20	7.5	17	Low
4	Taylors Creek Road, near Sunnybrook residence	0	19	1	4	65	Moderate
5	Taylors Creek Road near Bonnie Doon Residence	0	7	13	3.6	25	Moderate

There are very few trees on the ridges where the turbines will be relocated and, therefore, little to reduce or soften their image. At other locations, 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 obstruct views of the wind farm from the residence. More expansive views of the wind farm may be available beyond these tree screens often within short distances from the residence.

For many viewpoints surrounding the wind farm, the 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.

Overall, the amended layout of the turbines will be a noticeable in the local landscape, however, the difference in visibility of the amended layout in comparison to the approved layout is marginal based on a lesser number of turbines but slight increase in dimensions of individual turbines. Turbine visibility will be primarily dependent on the distance of the viewpoint from the wind farm, the proportion of the view occupied by the wind farm and any screening that may be present for the viewpoint.

Even though the wind turbines are prominent features they will not significantly mask the elements of the various scenes, and as there are turbines in the immediate vicinity, the scene's character will not significantly change from the approved form. Furthermore, there will be large areas of the adjoining landscape that will remain unchanged by the modified development. In short, a significant part of the existing landscape will remain unchanged.

A qualitative review of the indicative visibility at a range of other locations, particularly residences, was also undertaken to assist stakeholders to evaluate the visibility of the relocated turbines at locations of interest to them. One neighbouring residence, Torokina, has been assessed as having a potentially high visibility of the wind farm. There is existing tree screening in place which will filter views of the proposed wind farm, however further screening may be provided for the residence should the landowner agree. Neighbouring residences Kildare and Glendale potentially have moderate visibility of the amended wind farm, however there also appears to be partial tree screening in place at these residences.

The review of wind farm visibility has concentrated primarily on the variations to the turbine array within the Woodlawn Wind farm and in Table 6.6 Capital Wind Farm has not been taken into account. For further information on the visibility of the approved Capital Wind Farm please refer to the Capital Wind Farm Environmental Assessment and supplementary assessments (Connell Wagner PPI, 2006; Connell Wagner, 2008; Connell Wagner, 2009).

6.10 Visual issues associated with ancillary works

Ancillary works will include variations to existing access tracks, the installation of underground cables and construction of a 33 kV overhead transmission line from the Woodlawn Wind Farm to the Capital Wind Farm substation. The visual impact of the ancillary works will be generally insignificant compared to that of the wind turbines and the ancillary works will be designed and installed so as to reduce their visual impact, where practicable.

The minor modifications to existing access tracks will be undertaken to achieve suitable grades on stable slopes and designed so that they will not exacerbate erosion at the site. As far as possible, works will be undertaken to minimise visual impact from the surrounding countryside. Any temporary tracks which are not required for ongoing operation and maintenance will be removed and re-grassed after construction works have been completed. Batters on hardstands or roads will be grassed to reduce their visibility.

To reduce visual impact at the location of the turbines, the 33 kV cables linking the turbines within the two groups will be placed underground along the ridge tops. Where practicable, the cabling route will follow the access tracks. Once the cables have been installed in trenches, the trenches will be back-filled and the disturbed area will be restored with topsoil and grass.

The 33 kV overhead transmission line will involve a double circuit overhead transmission line of the form indicated in Plates 6.6 and 6.7. The line route will be located in rural land distant from neighbouring residences. The route is also sited in depressed topographic features of Taylors Creek catchment and Dry Creek catchment. As can be seen in Plate 6.7 the lines are progressively less visible with distance from viewpoints.

Plate 6.6 – Double circuit 33 kV overhead line crossing Capital Wind Farm access track

Plate 6.7 – Double circuit 33 kV overhead line from Ellenden to Groses Hill. Visibility of the line reduces with distance.

Table 6.6 – Review of indicative visibility of Woodlawn Wind Farm for viewpoints from neighbouring residences within three kilometres of the wind farm site

Location	Nearest turbine	View field angle	Estimated visibility class	Screening by trees	Nearest photomontage	Comment on potential visibility factors
	number	degrees	L, M, H	Yes/No/Partial		
Kildare	15	55	M	Partial	Viewpoint 1	Partial screening by trees around homestead may reduce visibility
Glendale	20	20	M	Partial	Viewpoint 5	Partial screening by trees around homestead may reduce visibility
Torokina	7	80	H	Partial	Viewpoint 4	Partial screening by trees around homestead may reduce visibility

6.11 Shadow flicker

Shadow flicker is a visual effect that occurs when rotating turbine blades cause intermittent shadowing as the blades momentarily block the sun's path. The effect will occur under circumstances where the turbine location is such that at certain times of the day the sun's rays pass through the swept area of the rotating blades and affect the viewpoint. 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.

A full shadow flicker study was not undertaken in the 2004 EIS. However the EIS did identify that the shadow flicker frequency range based on the 9 to 19 rpm rotation speed of the three-bladed rotor was estimated to be between 0.45 Hz and 0.95 Hz. This was considered to be well below the ranges identified for potential human health effect (URS, 2004). The proposed turbines for the amended project have an estimated rotation speed 15.5 rpm which is within this range.

Shadow flicker effects at distances greater than one kilometre are also considered to be minor (ie indistinct and very faint). At a distance of less than about 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. At this distance, shadowing by the tips of the blades will be less prominent and more diffuse than for the wider section of the blade near the hub (Connell Wagner, 2006 and 2008).

The closest neighbouring residences to the Woodlawn Wind Farm are located 2.6 kilometres (Torokina) to the west, 2.8 kilometres (Kildare) to the south-east and 2.8 kilometres (Glendale) to the south, therefore the shadow impact on these residences is expected to be negligible. The closest windfarmer residence is 2.1 kilometres (Cowley Hills) to the north-east of Woodlawn wind farm.

The shadow flicker analysis conducted for the revised Woodlawn Wind Farm is illustrated in Figure 6.3. In general, neighbouring residences are beyond the distance where shadow flicker effect will extend and neighbouring residences to the south of Woodlawn Wind Farm would not be affected at all.

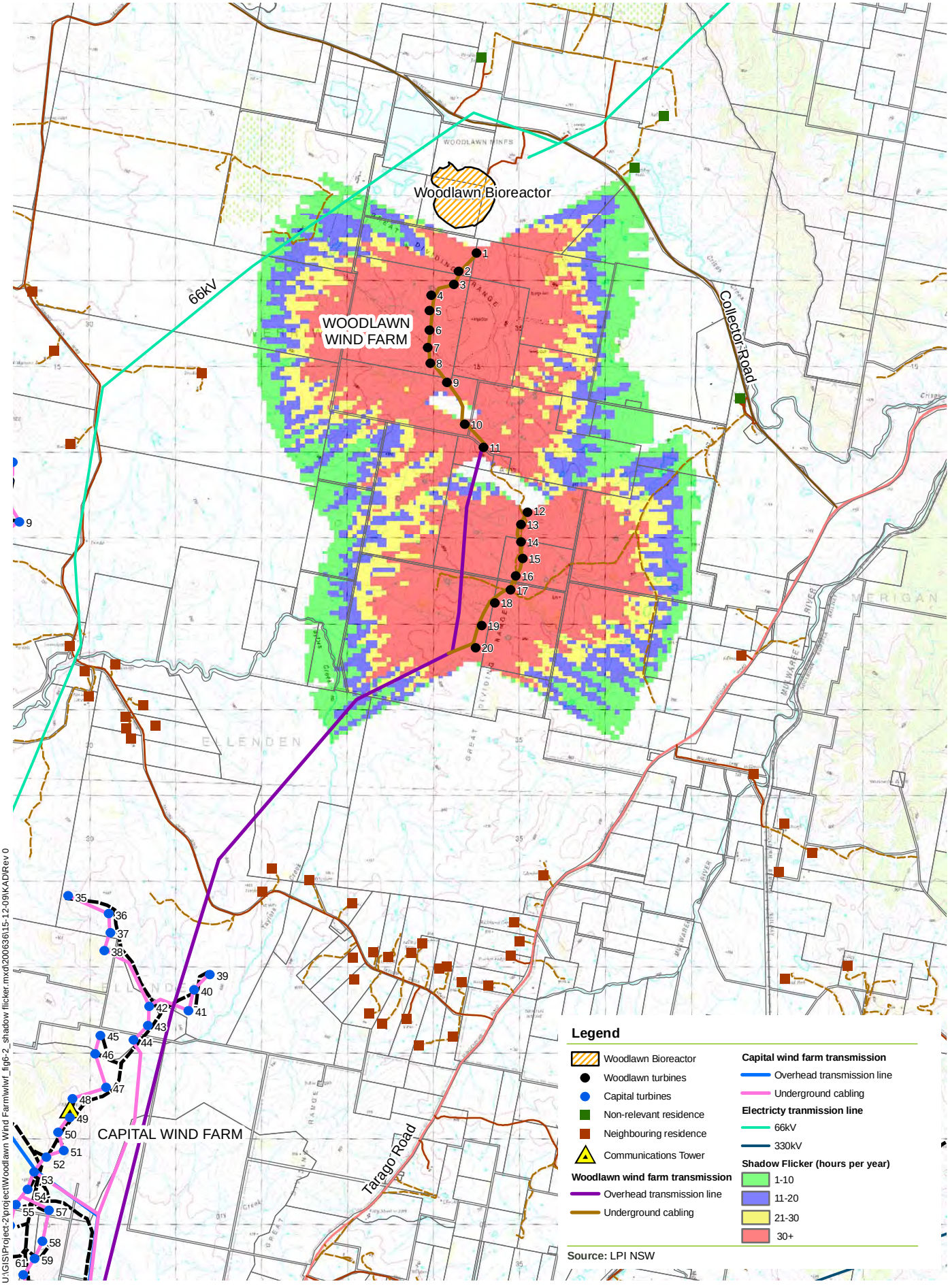
No public roads or public places will be significantly affected by shadow flicker. A small part of Collector Road may have short term impacts on passing vehicles to the magnitude of one to ten hours per annum. Due to the short period the road could be affected and the distance involved between the turbines and the roads (two kilometres) the impact is assessed as negligible.

6.12 Blade glint

Blade glint refers to the regular reflection of sun off one or more rotating turbine blades. This can be a temporary effect at any particular location, though the vast bulk of any glint occurs where the viewer is located above the altitude of the turbine hub. 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 very low.

Blade glint is not expected to represent a significant issue for the proposed modifications 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 that are near to the turbine sites. Where it does occur it will be of short term duration.



SCALE 1:60,000 @ A4

0 1 2km

Projection: MGA

FIGURE 6.3: Shadow Flicker Analysis

6.13 Mitigation of visual impact

The three bladed turbine design and the chosen off-white colour is 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 been incorporated in the wind farm development will include:

- Use of underground cabling between wind turbines
- Access roads located to limit their visibility, to the extent practicable
- Selected tree planting on site may be undertaken to reduce the visibility of certain elements of the wind farm
- Tree planting at some neighbouring properties may be undertaken
- A matt finish will be applied to blades if practicable
- An off site landscape sub plan will be developed and implemented as part of the Operational Environmental Management Plan (OEMP) as per the Woodlawn Wind Farm Project Consent DA-250-10-2001-i: Condition 40. The landscape plan will address visual impacts for any owner of an existing or approved residential dwelling within four kilometres with views of the turbines
- No external night lighting will be associated with the relocated turbines

6.14 Conclusions

The layout of the proposed modifications has been based on achieving an acceptable energy output and practical and effective implementation of the project while addressing potential visual and noise impacts and the wishes of the property owners and neighbours. While minor adjustments may be made when positioning the turbines, such adjustments are unlikely to alter the overall visual impact described in this assessment.

The wind farm will be noticeable from many points within its visual catchment. The photomontages provide a set of representative views from the neighbouring viewpoints with generally clear views to the turbines. The photomontages are intended to provide stakeholders with the means to make their own assessment of the visual impact of the amended wind farm layout.

Where practicable, 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.

To date, consultation with the neighbouring residents within three kilometres of the wind farm has not identified any specific concerns, however this SEE provides a more comprehensive basis for affected stakeholders to assess the impacts relative to the revised wind farm layout.

Based on the assessment conducted, it is concluded that the revision to the wind farm layout makes little change to the overall visual impact of Woodlawn Wind Farm described by URS in the 2004 EIS.