8 SEQUENTIAL VIEWPOINTS

This Project Application only seeks approval for the Coppabella Hills and Marilba Hills precincts and a further application will be made for the Carrolls Ridge precinct. However this report assesses all three precincts and some viewpoints discussed in this chapter relate to the Carrols Ridge precinct for which approval is not being sought.

The following chapter discusses the possibility of sequential views for users of the local road network

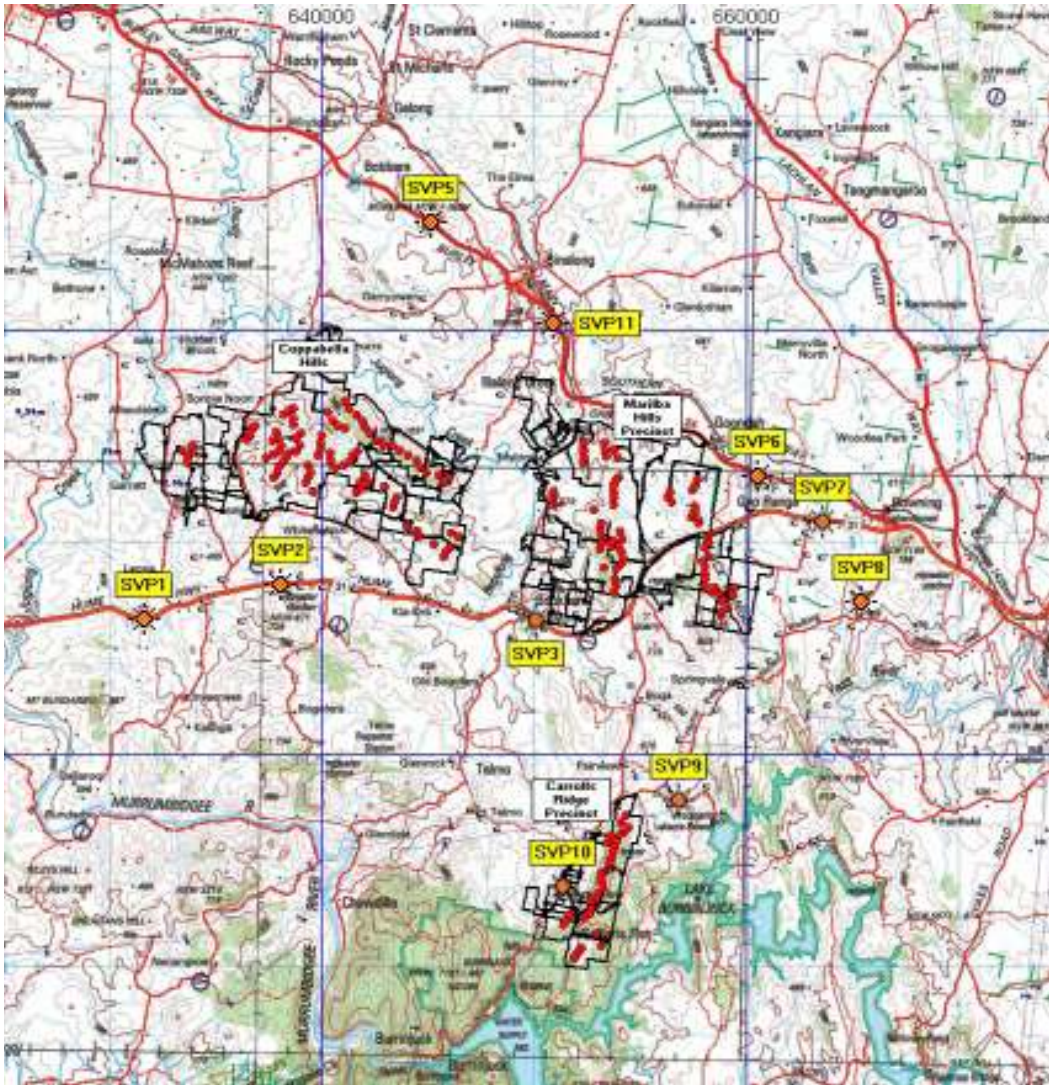


Figure 8.1 ***Sequential viewpoints around the Yass Valley Wind Farm*** ***(Map prepared using OziExplorer, based on Natmap 2008, Zone 55, Geoscience Australia)***

Sequential viewpoints (SVP's) have been selected from locations along the Hume Highway, along Burley Griffin Way and from the local road network to the south of the Hume Highway serving Lake Burrinjuck. The viewpoints are:

SVP1, SVP2, SVP3 look at the sequential views for a traveller heading east on the Hume Highway towards Yass.

SVP7 is also taken from the Hume Highway looking west.

SVP5, SVP6 and SVP11 look at the views from Burley Griffin Way for a traveller heading south towards Yass.

SVP8, SVP9 and SVP10 look at the views from near the Hume & Hovell Walking Track which parallels Black Range Road.

8.1 HUME HIGHWAY

For travellers heading east towards Yass and using the Hume Highway the wind farm will firstly appear to the north and then closer to Yass, wind turbines will be visible on both sides of the Highway. *Figure 8.2* and *Figure 8.3* shows the panoramic view from a location approximately 44km from Yass. The panorama has been shown in two figures, each of which show a field of view of approximately 60^{O}.

Figure 8.2 SVP1 – left hand side of view

The closest wind turbines visible from this location are approximately 7.6km to the north and are visible on the far left of *Figure 8.2*.

Figure 8.3 SVP1 – Right hand side of view

In *Figure 8.3* the wind turbines that are just visible on the hill in the distance are approximately 15.5 km from this location. Wind turbines to the left are more than 20 km from this location.

From this location on the Hume Highway the wind farm will be a visible element in the landscape and one which represents a further change to the landscape, however it is also a change which many viewers may find appealing.

The turbines will remain in view as a traveller moves closer to Yass. SVP2 is taken from a location on the Hume Highway approximately 37 km from Yass. From this location, for a viewer looking north through breaks in the roadside vegetation, the nearest wind turbines parallel the Highway and take up more than a 120^{O} field of view.

Figure 8.4 ***SVP2 – Left hand side of view***

At this location the nearest group of wind turbines which are visible on the left of *Figure 8.4* are approximately 7 km from the Highway.

Figure 8.5 ***SVP2 – Right hand side of view***

The wind turbines in *Figure 8.5* continue to parallel the Highway approximately 6 – 7 km from the roadway. At this distance they are a noticeable element but do not dominate the landscape. The movement of the turbine blades will attract the eye.

Figure 8.6 ***SVP3 – At a roadside stop near Bookham - right hand side of view***

No turbines are visible in *Figure 8.6* at this location looking back to the north west.

Figure 8.7 ***SVP3 – At a roadside stop near Bookham - right hand side of view***

However as a viewer looks towards the north east (the right hand side of this panorama) wind turbines are visible through a gap in the roadside vegetation approximately 4 km from this location. As can be seen in *Figure 8.7* these are very noticeable at this distance, however so too are existing elements in the landscape such as the light poles and toilet stop. This panorama highlights the fact that this landscape is one which includes many changes. Not only is it a rural landscape, but elements such as this road side stop are readily accepted by Highway users. The wind farm will provide another element in this landscape.

SVP7 is approximately 13.7 km from Yass. However from this area a viewer needs to be looking westwards along the Highway to view wind turbines.

Figure 8.8 SVP7 – Left hand side of view

From this location the nearest wind turbines are approximately 5-6 km away across the Marilba Hills. They are noticeably larger than other man made elements in the landscape, such as the sheds in the middle ground, but from this particular location the wind turbines are not larger that the power lines in the foreground.

Figure 8.9 SVP7 – Right hand side of view

The nearest wind turbines in the right hand side of this panorama are approximately 5 km from this location. As can be seen in *Figure 8.9* it doesn't require very large vegetation along the roadside to screen or filter views to wind turbines.

These views along the Hume Highway have shown that there will be a series of sequential views that users of the Highway will experience from the Highway to the west of Yass. From most locations the wind turbines will be several kilometres from the viewer, and these will be one further element in a man modified landscape. They may, for many viewers, be an appealing change in the landscape.

8.1.1 Assessment of the sequential views along the Hume Highway

These photomontages have demonstrated that the wind turbines will be noticeable for a number of kilometres along the Hume Highway, for travellers heading east or west, however the existing landscape remains relatively unchanged even with the addition of one element, namely the wind turbines. The sequential impact will not be significant.

8.2 *BURLEY GRIFFIN WAY*

Burley Griffin Way leaves the Hume Highway approximately 11 km west of Yass and heads in a north easterly direction towards Binalong. SVP6 is a location on Burley Griffin Way approximately 17 km from Yass.

Figure 8.10 SVP6 – Left hand side of view

The wind turbines within the Miralba Hills Precinct run between Burley Griffin Way and the Hume Highway to the south.

Figure 8.11 SVP6 – Right hand side of view

The nearest wind turbine in *Figure 8.11* is approximately 2.7 km from this viewpoint. At this distance the wind turbines are a dominant element in the landscape and the movement of the turbine blades will attract the eye. However for a traveller using Burley Griffin Way they may be a focus along this road, however for many they could also be an attractive focal point.

SVP11 is just south of the township of Binalong.

Figure 8.12 SVP11 – Left hand side of view

Wind turbines are not visible on the left, however they are visible on the right hand side of this panorama.

Figure 8.13 SVP11 – Right hand side of view

At this distance the nearest wind turbines are relatively small elements in the landscape. As a traveller on the Burley Griffin Way moves further to the north the wind turbines reduce in scale. This is illustrated in the views from SVP5.

Figure 8.14 SVP5 – Left hand side of view

In this view *(Figure 8.14)* the wind turbines are a small distant element in the landscape.

Figure 8.15 SVP5 – Right hand side of view

The turbines are also visible in the right hand side of this panorama, although they appear no larger.

8.2.1 Assessment of the sequential views along Burley Griffin Way

These photomontages have demonstrated that the wind turbines will be noticeable for a number of kilometres from the turn off on the Hume Highway, for travellers heading north or south along Burley Griffin Way.

However except for a short distance near the Hume Highway junction, the wind turbines will form a relatively small element in most of the views. The existing landscape remains relatively unchanged with the addition of one element, namely the wind turbines.

8.3 LOCAL ROADS AROUND LAKE BURRINJUCK

The Hume & Hovell Trial is a walking track which parallels Black Range Road. Three sequential viewpoints have had photomontages prepared to illustrate the range of views along this road, the trail and other local roads serving the tourist destinations around Lake Burrinjuck.

SVP10 is the closest viewpoint to Lake Burrinjuck.

Figure 8.16 SVP10 – Left hand side of view

In *Figure 8.16* the wind turbines can be seen on Carrols Ridge running parallel to the road.

Figure 8.17 SVP10 – Right hand side of view

In Figure 8.17 wind turbines appear on both sides of the road as a traveller looks towards the south east. At this location the nearest wind turbines are within 1.5 km and at this distance will be a dominant element in the landscape.

SVP9 is a little further away, with the nearest wind turbine approximately 2.5 km from this location.

Figure 8.18 SVP9 – Right hand side of view

At this distance the wind turbines do not dominate the landscape and are also reasdily screened by roadside vegetation.

Figure 8.19 SVP9 – Right hand side of view

Even vegetation in the middle distance reduces the visual impact of wind turbines at this distance. This is demonstrated in *Figure 8.19*.

SVP8 is some distance off the Hume & Hovell Trail at a location which has views back to the wind turbines within the Marilba Hills Precinct. The closest wind turbine is approximately 6.5 km from this location.

Figure 8.20 SVP8 – Left hand side of view

Figure 8.21 SVP8 – Right hand side of view

At this distance, even where there is a clear view, the wind turbines are noticeable but do not dominate the landscape.

8.3.1 Assessment of the sequential views on the Hume & Hovel Trail and roads serving Lake Burrinjuck

These locations were selected adjacent to or near to the Hume & Hovell Trail. They demonstrate that from these particular locations the wind turbines will be visible and will vary in their perceived scale in the landscape.

However it is stressed that from many locations along the trail and from the adjacent road network, views to all of the wind farm are screened by topography and / or vegetation. These are very conservative.

For these reasons it is considered that the sequential views from the roads and from the trail will have a very limited impact. The turbines will be a further man made element in access routes that pass many others, ranging from transmission lines to farms buildings and associated agricultural practices which also bring about changes to the landscape. In fact one of the appeals in driving through this country is the range of landscapes one passes.

9 ASSESSMENT OF VISUAL IMPACT ON RESIDENTIAL PROPERTIES

This Project Application only seeks approval for the Coppabella Hills and Marilba Hills precincts and a further application will be made for the Carrolls Ridge precinct. However this report assesses all three precincts and some viewpoints discussed in this chapter relate to the Carrols Ridge precinct for which approval is not being sought.

The major impact of wind turbines on residential properties occurs where wind turbines are within 1.5 km. However, wind turbines can be dominant out to 3 km. In this zone the greatest potential impact is on neighbouring non-participatory residential properties. That is residential properties whose owners have not elected to be part of the Yass Valley Wind Farm, as it can be assumed that those that have elected for their land to form part of the wind farm, the visual impact is acceptable.

The locations of participatory landowners' residences and non-participatory residences have been provided by Epuron Pty. Ltd. *Table 9.1* shows the number of houses that are within 1.5 km and 3 km of the nearest wind turbine. These are those properties which have the greatest potential visual impact.

Table 9.1 shows the residences that are located within three kilometres of the wind farm.. For clarity these are broken down to residences that fall within 1.5 and 3 km of each of the three precincts. Although there is an area of overlap between the Coppabella Hills and Marilba Hills precincts, there are no residences within this area and therefore there is no double counting.

Table 9.1 Residences within 3 km of the nearest wind turbine

Distance from house to the nearest wind turbine	Coppabella Hills		Marilba Hills		Carrols Ridge	
	Total houses	Non-participatory houses	Total houses	Non-participatory houses	Total houses	Non-participatory houses
Within 1.5 km	1	0	7	2	3	2
Within 1.5km to 3 km	10	5	24	19	6	5
TOTAL within 3 km	11	**5**	31	**21**	9	**7**

This table shows that of the 51 residences within 3 km of the proposed Yass Valley Wind Farm, there are only 33 non-participatory residences within this band. There are 26 houses within 3km of the Coppabella Hills and Marilba Hills and the addition of the Carrols Ridge Precinct impacts on an additional 7 houses within 3km of the nearest wind turbine. Given that the wind farm is located in an area that runs more than 25 km in an east west direction, and more than 26 km in a north south direction, then there are a relatively small number of residences that can be potentially impacted by the wind farm, even when the Carrols Ridge Precinct is included..

The following section will look at the potential impact of the proposed wind farm (including the Carrols Ridge Precinct) on a number of these residences.

During community consultation meetings and in private meetings with residents, addresses were sought of people interested in better understanding the visual impact of the wind turbines from their places of residence. Nine landowners sought or allowed Epuron Pty. Ltd. to visit their properties and undertake a visual assessment.

The addresses of these residences are listed in Table 9.2 and their locations are mapped in *Figure 9.1.*

Table 9.2 Residential viewpoints

Ref #	*Viewpoint location*	*Epuron House Ref #*
VP R1	"Tullyvale Hall", Hume Hiughway**	G14
VP R2	"The Pines", Goondah Road, Goondah	M04
VP R3	918 Burley Griffin Way	M22
VP R4	"Gwandoban", Burley Griffin Way	C53
VP R5	"Naranghi", Garrett Road	C54
VP R6	"Farirview", Burrinjuck Road	C27
VP R7	"The Crisp Galleries", Hume Highway	C34
VP R8	"Deepwater", Hume Highway, Bookham	C41
VP R9	55 Illalong Road	C42

** ***Photomontage locations***

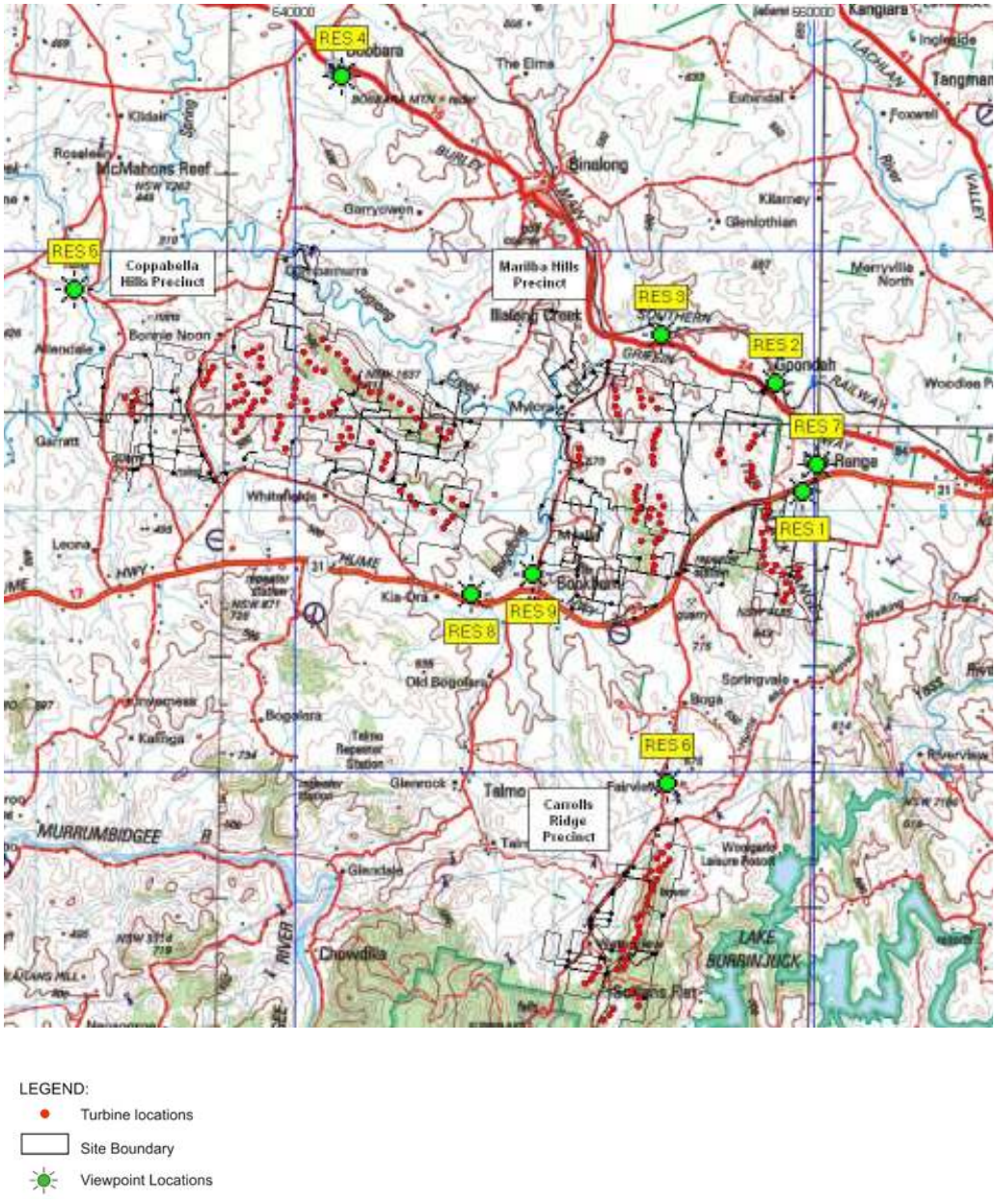


Figure 9.1 ***Selected Viewpoints around the Yass Valley Wind Farm*** ***(Map prepared using OziExplorer, based on Natmap 2008, Zone 55, Geoscience Australia)***

The following sections undertake a visual assessment of the likely impact of the Yass Valley Wind Farm on each of these nine residential properties.

GPS Coordinates

GPS Coordinates are supplied for each viewpoint. The datum used is the Australian Map Grid, GDA 94.. The GPS coordinates were recorded from a hand held GPS unit, which is typically accurate to approximately +/-10 m horizontally, while the vertical elevation may be out by a larger margin. They are included within the report to assist others in locating viewpoints or photograph locations.

In this report the GPS Coordinates are given in the format (GPS 2731865, 6090612, E43); where the first coordinate is the Easting, the second the Northing and the figure prefaced by "E" is the approximate elevation.

Sensitivity

As mentioned in the Methodology (refer Section 1.1) the assessment of visual impact from residences is different in two important aspects to one undertaken from publicly accessible viewpoints. Firstly, an assessment of visitor numbers is not applicable as the size of the household is immaterial to the impact. Secondly, the landscape sensitivity is always rated as "high", as it must be recognised that people feel most strongly about the view from their house and from their outdoor living spaces.

The major impact of wind turbines on residential properties occurs where wind turbines are within 1.5km. However wind turbines can be dominant out to 3.5km.

9.1 VIEWPOINT R1 7– "TULLYVALE HALL" (HOUSE #G14)

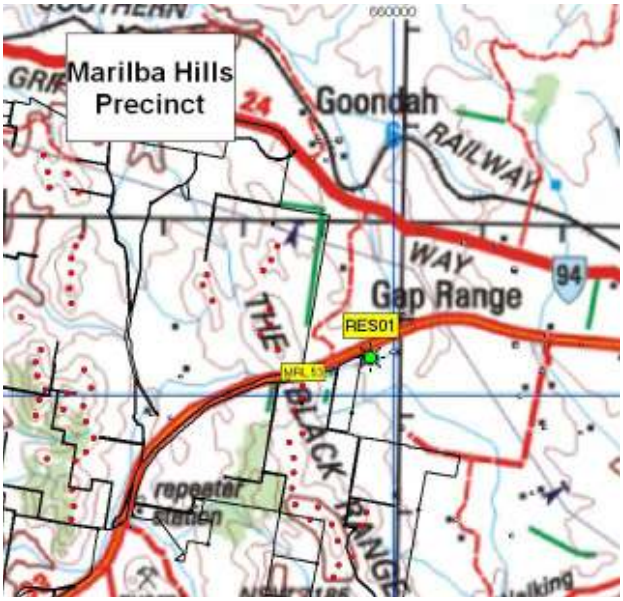
"Tullyvale Hall" (House #G14) is located

The nearest wind turbine MRL53 is 1.3 km to the south west.

The dwelling sits on a low hill located west of the township of Yass. The residence is south of the Hume Highway and the surrounding landscape is lightly vegetated.

The house is orientated to the west however views from the house are screened by existing vegetation.

Figure 9.3 shows the existing vegetation surrounding the dwelling.



VP R1 (0659544, 6150737, E605)

Figure 9.2 Aerial showing the existing vegetation around the residence

Figure 9.3 "Tullyvale Hall", view of front of house

Existing vegetation limits views from the house and its immediate surrounds, however there are views from further along the driveway.

Figure 9.4 View down driveway towards the existing house

Figure 9.4 is of a view down the driveway towards the house and shows the extensive planting around the existing house. The viewpoint below, and the photograph, was taken adjacent to the fence on the right of the driveway in *Figure 9.4*.

Figure 9.5 is taken from the driveway some distance before the house. The view is across the paddock towards the wind farm, but this view is still partially screened by existing vegetation.

Figure 9.5 View looking south-west from the driveway

The owner is not an objector. However the nearest wind turbine to this location is 1.3 km to the west. At 1.3 km the wind turbines "*will be visually dominant in the landscape from most viewing locations*". However there is extensive existing vegetation around the dwelling and for this reason the overall visual impact from this residence is assessed as low.

Summary of visual impact from Viewpoint R1

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	MRL53 - 1.3 km south west	High
Overall visual impact		Low

9.2 VIEWPOINT R2 – "THE PINES" GOONDAH ROAD, GOONDAH (HOUSE #M02)

"The Pines" (House #M02) is located on Goondah Road just to the north of Burley Griffin Way.

The nearest wind turbine MRL43 is 2.1 km to the south within the Marilba Hills Precinct.

Figure 9.6 illustrates the existing vegetation around the residence.

The dwelling is located on the hills and is orientated towards the north, away from the wind farm.

Figure 9.7 shows the existing dwelling. Goondah Road is in the front of the dwelling, towards the north, and the wind farm is located to the south.

VP R2 (0658527, 6154905, E558)

Figure 9.6 Aerial showing the existing vegetation surrounding the residence to the south west

Figure 9.7 ***"The Pines", view of house looking north*** ***(away from the wind farm)***

There is an existing shed at the south of the property from where the photograph in *Figure 9.7* was taken.

Figure 9.8 ***"The Pines", view looking south*** ***(towards the wind farm)***

This view is taken from behind the dog kennels and shed at the rear of the property towards the wind farm and the wind farm will be located on the nearby hills. However because the dwelling is orientated away from the wind farm the overall visual impact from this residence is assessed as low.

Summary of visual impact from Viewpoint R2

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	MRL43 - 2.1 km south	High
Overall visual impact		Low

9.3 VIEWPOINT R3 – 918 BURLEY GRIFFIN WAY" (HOUSE #M22)

The residence at 918 Burley Griffin Way (House #M22) is located just to the north of Burley Griffin Way.

The nearest wind turbine MRL05 is 2.2 km to the south.

The dwelling is located on the side of the hill with the main garden areas oriented towards the north and east.

The owners support the presence of wind turbines. *Figure 9.10* shows the existing dwelling and the existing garden

VP R3 (0654119, 6156776, E491)

Figure 9.9 Shows the existing vegetation around the residence

Figure 9.10 View of house from entry drive

The viewpoint discussed below is taken from the garden on the far side of this house.

Figure 9.11 View looking south

This view is taken towards the hills on which the wind farm is to be constructed. This view is obtained from a location at the western edge of the garden. As the main views are away from the wind farm the overall visual impact from this residence is assessed as low.

Summary of visual impact from Viewpoint R3

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	MRL05 - 2.2 km south	High
Overall visual impact		Low

9.4 VIEWPOINT R4 – "GWANDOBAN" (HOUSE #C53)

"Gwandoban" (House #C53) is located to the north of the Coppabella Hills precinct.

The nearest wind turbine COP01 is 10 km to the south.

The dwelling sits on a hill located to the north of the wind farm. The main garden areas and the existing tennis court is located on the north side of the house.

Figure 9.21 shows the existing vegetation surrounding the dwelling.

VP R4 (0641839, 6166696, E508)

Figure 9.12 Shows the existing vegetation around the residence

Figure 9.13 "Gwandoban", view of front of house

The front of the house is orientated away from the wind farm. . There would be no views of the wind farm from this side of the house or from the entry drive.

Figure 9.14 "Gwandoban", view of rear of the house

Figure 9.14 shows the rear of this house. There are only small windows along the rear elevation and the house is further separated by existing hedgerows. However from the rear of this garden, some 50 m or more from the rear of the house, there will be a view towards the wind farm.

Figure 9.15 View from rear garden fence on the property boundary

From this location the Coppabella Hills are visible in the distance.

However there is extensive existing vegetation around the existing dwelling and the wind farm is more than 10km from this location. For these reasons the overall visual impact from this residence is assessed as negligible.

Summary of visual impact from Viewpoint R4

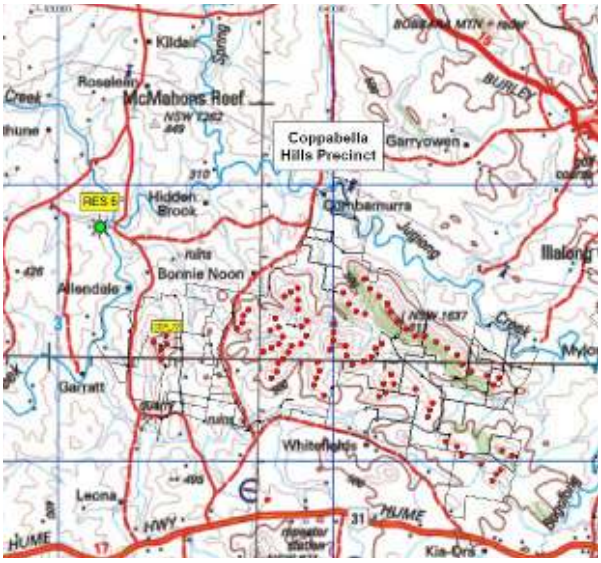
Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	COP01 - 10 km south	High
Overall visual impact		Negligible

9.5 VIEWPOINT R5 – "NARANGHI" (HOUSE #C54)

"Naranghi" (House #C54) is located north west of the Coppabella Hills.

The nearest wind turbine COP74 is 4.5 km to the south-east.

The dwelling sits on a hill located to the east of a small creek. *Figure 9.17* shows the existing dwelling with the creek visible to the right of this photograph.



VP R5 (0631542, 6158496, E313)

Figure 9.16 Shows the existing vegetation surrounding the residence

Figure 9.17 View of front of house from the entry driveway

The existing house is orientated to the east across the creek. However from the rear yard there are views to the wind turbines in the Coppabella Hills precinct to the south-east.

Figure 9.18 View from the entry driveway to the south east

Existing vegetation will filter the view to the wind turbines from some locations within this garden; however from this location the existing trees frame the Coppabella Hills.

Figure 9.19 Photomontage (60^{O} field of view)

The photomontage shows the proposed wind turbines on the Coppabella Hills.

However, even though the owner is supportive of wind farms, because of the views from the dwelling and the front verandah, the overall visual impact from this residence is assessed as medium.

Summary of visual impact from Viewpoint R5

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	COP74 – 4.5 km south-east	High
Overall visual impact		Medium

9.6 VIEWPOINT R6 – "FAIRVIEW", BURRINJUCK ROAD (HOUSE #C27)

"Fairview" (House #C27) is located just to the north of the Carrols Ridge precinct and to the south of the Marilba Hills precinct.

This is the residence closest to the Carrols Ridge Precinct.

The nearest wind turbine within the Carrols Ridge Precinct is CAR01 is 2.4 km to the south. However if the Carrols Ridge Precinct is not constructed then the nearest wind turbine to the north will be MRL39 which is 8.1 km from this location.

The dwelling sits on a low rise with sheds and ancillary farm structures located at the rear. *Figure 9.21* shows the existing house which is orientated away from the wind farm.

VP R6 (0654371, 6139497, E589)

Figure 9.20 Shows the existing vegetation surrounding the residence

Figure 9.21 "Fairview", view of front of house

The panorama in is taken from the rear of the sheds, at a farm gate leading into the paddocks.

Figure 9.22 View of Carrols Ridge from the rear paddock gate

The wind farm will be visible on the hills from this location. However there is extensive existing vegetation around the dwelling separating the garden areas from views to the ridge. For this reason the overall visual impact from this residence is assessed as low.

Summary of visual impact from Viewpoint R6

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	CAR01 - 2.4 km south MRL39 - 8.1 km north	High
Overall visual impact		Low

9.7 VIEWPOINT R7 – THE CRISP GALLERIES, HUME HIGHWAY (HOUSE #C34)

The Crisp Galleries (House #C34) is located on the Hume Highway.

The nearest wind turbine MRL53 is 2.4 km to the south west.

The gallery and dwelling is a tourist destination which not only contains a gallery, but is also a venue for weddings and other functions in which the extensive gardens are used as external entertainment areas.

Figure 9.24 shows the existing vegetation in a lavender garden behind the gallery.

VP R7 (GPS 0660018, 6151762, E571)

Figure 9.23 Shows the existing vegetation around the residence

Figure 9.24 The Crisp Gallery – lavender garden

This gravel area has views towards the Marilba Hills precinct to the west. On the left of this photo, behind the existing vegetation, the owners are establishing a bamboo garden, which is approximately 90m closer to the proposed wind farm, and as vegetation is not yet established, has a greater visual impact than from this location.

Figure 9.25 View from the bamboo garden

The bamboo garden is being established on the edge of a dam and is orientated towards the low hills to the west. This will be a pleasure garden which is proposed to augment the existing lavender garden. A photomontage has been prepared from this location as this was the closest viewing location to the proposed wind farm on this property.

Figure 9.26 Photomontage (60^{O} field of view)

The photomontage shows that the wind turbines, at a distance of less than 3 km, will be a dominant element in the landscape. However foreground vegetation will be able to screen or filter views if these are seen as inappropriate from this location.

The landscape that has been undertaken at this property to date, has established a series of external "rooms". If such a landscape theme was continued around this location, then the wind turbines could easily be screened from view. It is realised that such screen vegetation will take some time to establish and that this vegetation will screen the view to the hills. However as mentioned previously, this has been the case in the treatment of other external areas around the gallery.

The gallery owners also plan to develop a n eco-village on the hills some 1km further to the east of the bamboo and lavender gardens. The view from this location is shown in *Figure 9.27*

Figure 9.27 View from the site of the future eco village

A photomontage has been prepared from this location.

Figure 9.28 Photomontage (60^{O} field of view)

The photomontage of a section of this panorama shows both the existing high voltage lines as well as the proposed wind turbines. The owners have advised that they are planning to underground the high voltage line; however the cost may be prohibitive. In which case screen planting that screened both the overhead transmission lines in the foreground, as well as the wind turbines in the distance, may be an appropriate landscape response for the design of this eco-village. The suitability of such a response is difficult to determine as no plans of the layout have been provided.

As mentioned previously, there is extensive existing vegetation around the gallery and along the entry driveway and from these areas the overall visual impact would be negligible and in most locations, as the wind farm would be fully screened by existing vegetation, the visual impact would be nil.

However there are views from the rear lavender and bamboo gardens and for some people attending functions, it is likely that they would find the presence of wind turbines to be an unacceptable juxtaposition. Therefore for these reasons the overall visual impact from these gardens within the gallery demesne is assessed as medium. However this could be addressed by additional landscape planting.

The impact from the proposed Eco-village is assessed as low as responsive layout options as well as landscape of an unconstructed facility could alleviate visual impact issues.

Summary of visual impact from Viewpoint R7

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	MRL53 – 2.4 km south west	High
Overall visual impact		Bamboo garden – Medium Eco village - Low

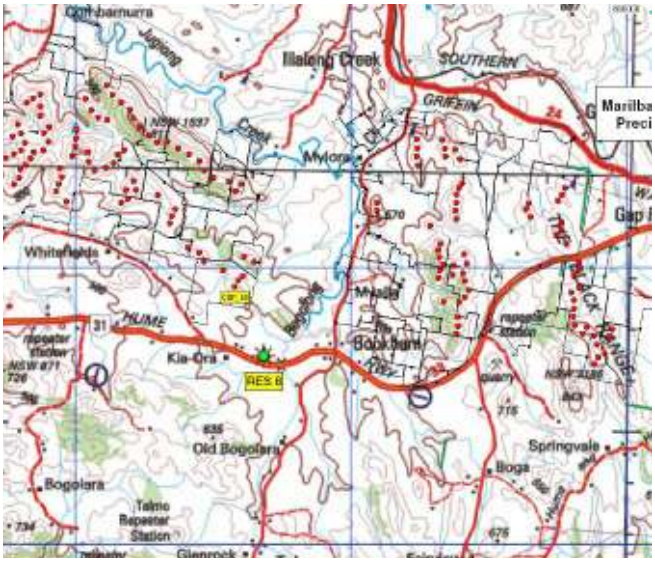
9.8 VIEWPOINT R8 – "DEEPWATER", HUME HIGHWAY, BOOKHAM (HOUSE #C41)

"Deepwater" (House #C41) is located on the Hume Highway.

The nearest wind turbine COP68 is 2.7 km to the north west, however the hill behind the residence screens views in this direction to the nearest wind turbine.

The closest wind turbine that are visible are part of the Carrols Ride Precinct some 12 km to the south east.

The dwelling is surrounded by vegetation; however there is a clear view towards the proposed wind farm from the rear veranda.



VP R8 (0646835, 6146817)

Figure 9.34 shows the existing vegetation surrounding the dwelling.

Figure 9.29 Shows the existing vegetation around the residence

The land rises behind the house (to the north) and vegetation also screens views to the east. The nearest wind turbines that are visible lie to the south east.

Figure 9.30 "Deepwater", view of front of house

Whilst from this garden and from the front of the house the wind farm would be well screened, there is a potential view from the rear veranda which is shown in *Figure 9.31*.

Figure 9.31 View from veranda at rear of house

From the veranda there is a view towards the hills to the south east.

Figure 9.32 Photomontage (60^{O} field of view)

Although the wind turbines are visible from this location, there is extensive existing vegetation around the dwelling and for this reason the overall visual impact from this residence is assessed as low.

Summary of visual impact from Viewpoint R8

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	2.7 km north west	High
	12 km south east	Low
Overall visual impact		Low

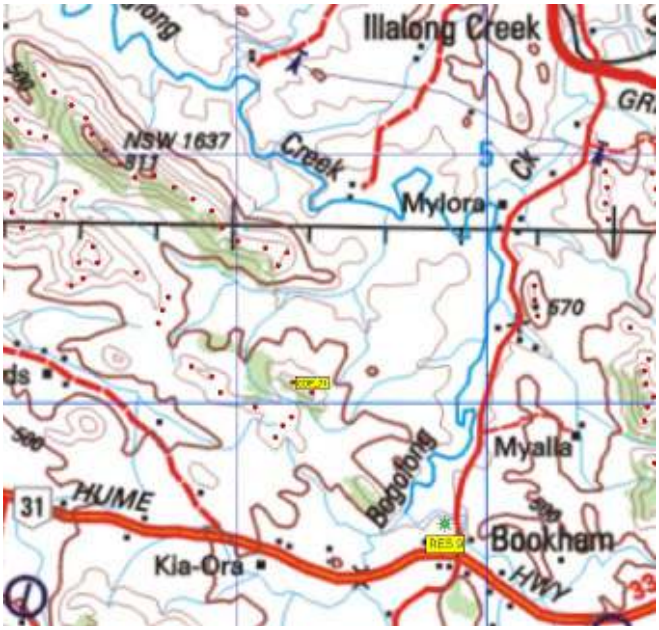
Such impact that does occur could be easily mitigated by appropriate landscape treatment.

9.9 VIEWPOINT R9 – 55 ILLALAONG ROAD (HOUSE #C42)

The residence at 55 Illalong Road (House #C42) is located near the Humne Highway between the Coppabella Hills precinct and the Marilba Hills precinct.

The nearest wind turbine COP71 is 3.7 km to the north west.

The dwelling is located on a hill with views towards the wind farm from the rear yard. *Figure 9.34* shows the existing dwelling.



VP R9 (0649167, 6147567, E478)

Figure 9.33 Shows the existing vegetation around the house

Figure 9.34 The rear of the house

There is a view towards the hills from the rear yard which is shown in the panorama in *Figure 9.36*.

Figure 9.35 Panorama from the rear yard

There is extensive existing vegetation around the dwelling however the nearest wind turbines would be visible and would be just over 3 km away. For this reason the overall visual impact from this residence is assessed as medium without additional landscape mitigation. However additional planting, supplementing that which the owner has commenced, could readily screen the turbines from view, if the owner felt this was desirable.

Summary of visual impact from Viewpoint R9

Item	Description	Evaluation
Landscape sensitivity	Residential	High
Distance to nearest turbine	COP71 – 3.7 km north west	High
Overall visual impact		Medium – without landscape mitigation

9.10 LANDSCAPE MITIGATION FOR RESIDENTIAL PROPERTIES

Landscaping is a mitigation option for residential properties. As the viewing location is relatively fixed, therefore planting may be designed to either screen the wind turbines from view, or significantly reduce the visual dominance of wind turbines through filtering.

Landscape mitigation is possible and desirable for houses located to the north of the wind farm. This screening vegetation on the southern boundaries will protect these properties from southern winds and will not affect solar access. Many properties already have substantial wind break planting along their southern boundaries.

However, it is recognised that the landholder may not wish to establish boundary planting, due to the decrease in viable farmland, or for aesthetic reasons.

The desirability of landscape mitigation measures for houses to the south is lower than for properties to the north. Such measures could affect the solar access to living areas or courtyards. Landscape mitigation measures should be determined on a case by case basis in consultation with landholders to minimise adverse impacts.

Such a process has occurred in past projects, after approval of the wind farm with advice and funding being supplied by the proponent. For example, the Portland Wind Energy Project (Pacific Hydro) involved negotiation with affected landowners to mitigate the visual impacts of the proposed wind farm by landscaping on or adjacent to residences within 2km of the proposed wind farm. This involved a site visit to affected residences and creation of a landscape concept to be implemented by the proponent.

Similarly, the Panel decision for the Bald Hills Wind Farm in Victoria also required the proponent (Wind Power Pty Ltd) to undertake "*specific off-site landscape program works to address residential amenity impacts….subject to agreement with the landowners"*. A similar process could occur on affected residences within 3km of the Yass Valley Wind Farm.

Figure 9.36 shows an example of landscape remediation for a dwelling. This example is based on a particular owner's desire that the views to the wind turbines should be screened or filtered.

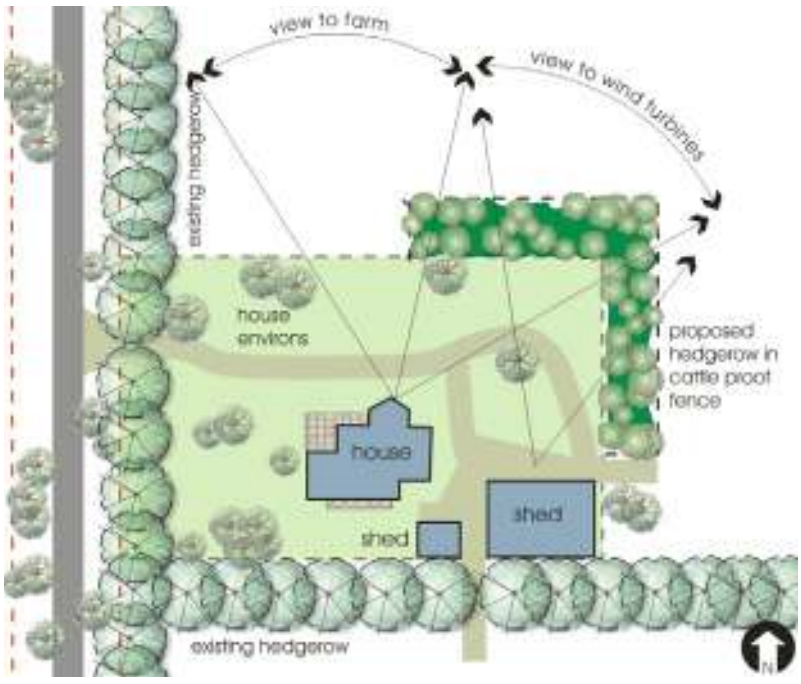


Figure 9.36 Potential Landscape mitigation measures

A site visit would determine the extent of planting between the proponent and the resident. Species selection would be determined in consultation with landholders using advice from the local Landcare group. This example used a mixture of Eucalyptus and Acacia species which was designed to filter the views to the north and to the wind farm.

Planting can be undertaken on residential properties within 3 km of the wind farm, after consultation and agreement with affected landowners. Any such offer should remain in place for a period of 1 year after construction, to allow people time to either adjust or to decide that landscape filtering or screening is warranted.

9.11 SUMMARY OF THE VISUAL IMPACT FROM RESIDENTIAL PROPERTIES

The preceding analysis has examined the potential impact on a number of residences within the viewshed, with the majority being within 3 km of the nearest wind turbine.

Table 9.3 summarises the overall visual impact of all the residential viewpoints discussed in this Chapter.

Table 9.3 Summary of the assessment of the visual impact on residential properties

VP #	Distance to nearest wind turbine	Direction to nearest wind turbine	Overall visual impact
R1	1.3 km	S	**Low** – without screening Existing screening
R2	2.1 km	S	**Low** – without landscape mitigation Screening may not be appropriate
R3	2.2 km	S	**Low** – without landscape mitigation Screening may not be appropriate
R4	10 km	S	**Negligible** – without landscape mitigation Extensive existing screening
R5	4.5 km	SE	**Medium** - without landscape mitigation
R6	2.4 km to the South 8.1 km to the north	S & N	**Low** – without screening Existing screening
R7	2.3 km	S	**Negligible** – Existing vegetation around gallery **Medium** – Bamboo garden without mitigation **Low** – Eco village site
R8	2.7 km	N	**Low** - without landscape mitigation
R9	3.8 km	NW	**Medium** - without landscape mitigation

In these assessments of residential viewpoints the overall visual impact was often assessed as being moderate to low when the wind turbines were visible and there was no existing screening.

The addition of the Carrols Ridge Precinct has only effected a single residence (R6). Should Carrols Ridge not proceed the overall visual impact would still be assessed as low, because of the presence of the northern wind turbines within the Marilba Hills Precinct.

10 CUMULATIVE VISUAL IMPACT

The presence of multiple wind farms in an area can create a cumulative visual impact. This can occur when either sequential and /or simultaneous views to wind turbines from publicly accessible viewpoints or from private viewing locations lead to a change in a community's, resident's or visitor's perception of a region.

Sequential views are those that occur when a viewer at one location observes a wind farm and then from a different location another wind farm. If for example multiple wind farms are located along a highway, then a series of sequential views can occur as a vehicle travels along the highway.

Simultaneous views are those where more than one wind farm is visible from the same location. This usually is defined as views within the same cone of view that is multiple wind farms visible within say a 60^{O} or 90^{O} cone of view. However, a simultaneous view can also occur where a viewer needs to turn their head to see more than one wind farm from a single location

10.1 WIND FARMS IN THE SOUTHERN TABLELANDS

Crookwell Wind Farm, which comprises eight wind turbines is the only constructed wind farm in the vicinity of the Yass Valley Wind Farm. There is an approval to extend this wind farm by a further forty-six wind turbines. The new wind farm boundary can be seen in *Figure 10.1.*

Other approved wind farms in the vicinity of the Yass Valley Wind Farm include the Gunning Wind Farm, which comprises 46 wind turbines and the Cullerin Range Wind Farm which comprises 15 wind turbines are located to the south west of the Yass Valley Wind Farm.

Table 10.1 shows the existing and proposed wind farms in the vicinity of the Yass Valley Wind Farm and their location is shown in *Figure 10.1.*

Table 10.1 Existing and proposed wind farms in the area

Project and Location	Proponent	Project Capacity	No. of Turbines	Status
Crookwell 1 WF, near Crookwell	Delta Electricity	4.8 MW Built 1997	8	(Operational)
Cullerin WF, near Goulburn	Origin Energy	30 MW	15	(Under construction)
Conroys Gap WF	Origon Energy	30 MW	15	(DA approved)
Capital WF, Bungendore	Renewable Power Ventures	126 MW	63	(Under Construction)
Woodlawn WF, near Tarago	Wind Energy JV	50 MW	25	(DA approved)
Taralga WF, near Taralga	RES Southern Cross	186 MW	62	(DA approved)
Gunning WF, near Gunning	Delta Electricity	64 MW	32	(DA approved)
Crookwell 2 WF, near Crookwell	TME	92 MW	46	(DA approved)
Gullen Range WF, near Gunning	Gullen Range Wind Farm P/L	Up to 278 MW	84	(proposed)

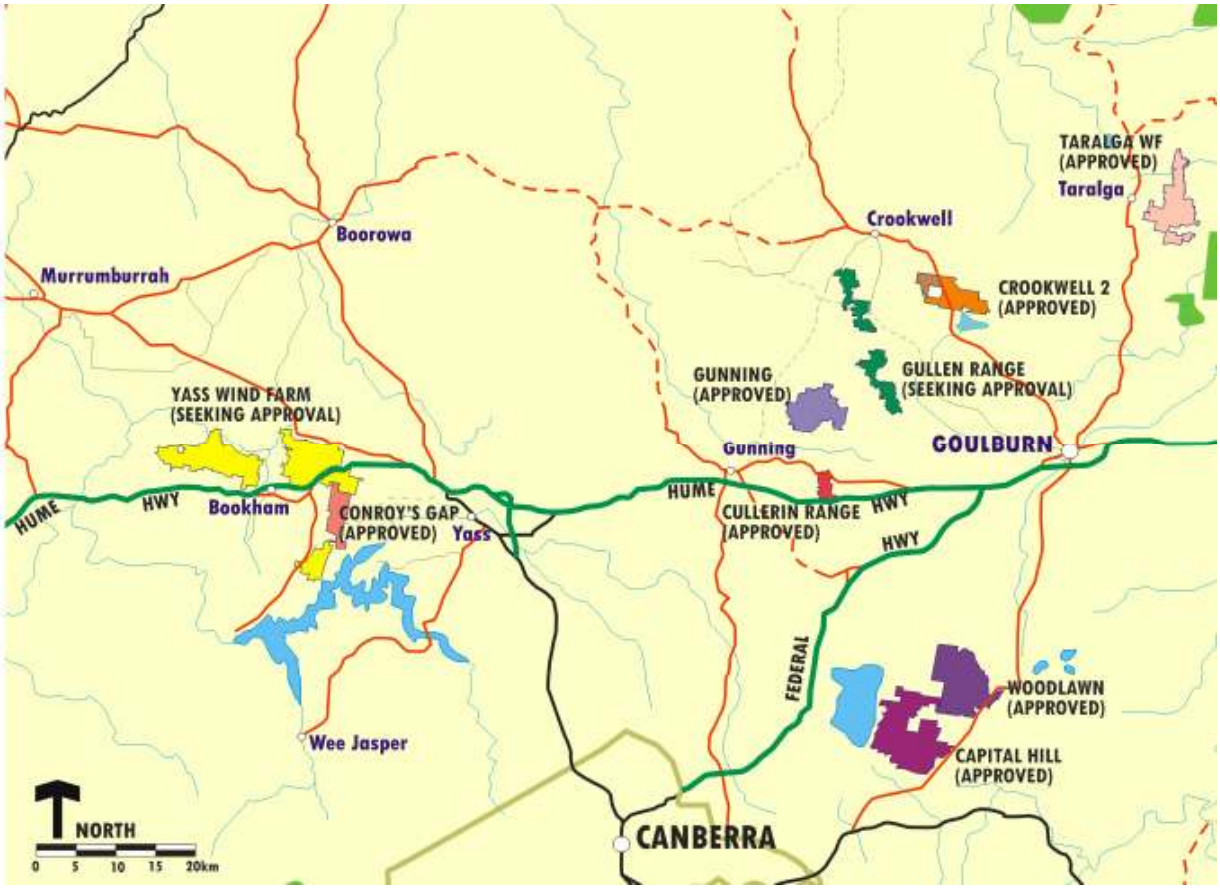


Figure 10.1 Existing and proposed wind farms

Figure 10.1 shows the approved and existing wind farms in the vicinity of the Yass Valley Wind Farm.

Conroy's Gap Wind Farm is the closest approved wind farm to the Yass Valley Wind Farm. The Carrols Ridge Precinct (which will be part of a future Development Application, is immediately adjacent and to the south of Conroy's Gap Wind Farm and this relationship is illustrated in *Figure 10.1*. Other existing and approved wind farms lie more than 50 km further to the east.

10.2 CHANGE IN PERCEPTION

The main cumulative visual impact is that which changes a visitor's or residents perception of an area through which they are travelling.

This is bought about by sequential and/or simultaneous views of multiple wind farms. The greatest chance of changing a viewer's perception of an area is when these views are available from the highways and roads that people use.

Views from towns and regional centres

There are no locations within the township of Yass where one can perceive the Yass Valley Wind Farm. Therefore as there are no views to multiple wind farms from Yass there would be no direct cumulative impact on the township of Yass.

The Yass Valley Wind Farm would be visible from the townships of Bookham and Bowning and there are limited views from Binalong. However there would be no township location where the proposed Conroy's Gap wind farms would add to the impact of the Yass Valley Wind Farm. Therefore there would ne no cumulative impact on the townships in the viewshed of the Yass Valley Wind Farm.

Views from residential dwellings

There will be simultaneous and sequential views of the proposed Yass Valley Wind Farm and the approved Conroy's Gap Wind Farm. The most effected residential properties will be those that are located to the east and west of the Conroy's Gap Wind Farms as illustrated in *Figure 10.2*.

Figure 10.2 Residential Impacts Cumulative

Simultaneous views of both the Yass Valley and Conroy's Gap Wind Farms may be possible from certain locations to the east and west of the Conroy's Gap Wind Farm. In areas south of the Hume Highway the main simultaneous views will be towards the Carrols Ridge Precinct and the Conroy's gap Wind Farm. Carrols Ridge does not form part of this Project Application, however where these two components are seen side by side they will read as a single wind farm.

Residential locations to the east and west of the Conroy's Gap wind turbines could potentially have views of the Conroy's Gap wind turbines. With the construction of the Yass Valley Wind Farm these views could potentially include wind turbines located within the Marilba Hills and Carrols Ridge precincts of the Yass Valley Wind Farm which would increase the level of visual impact. The extent to which this change would be apparent could only be assessed on a case by case basis, however it appears that there are few houses within this zone as seen in *Figure 10.3*.

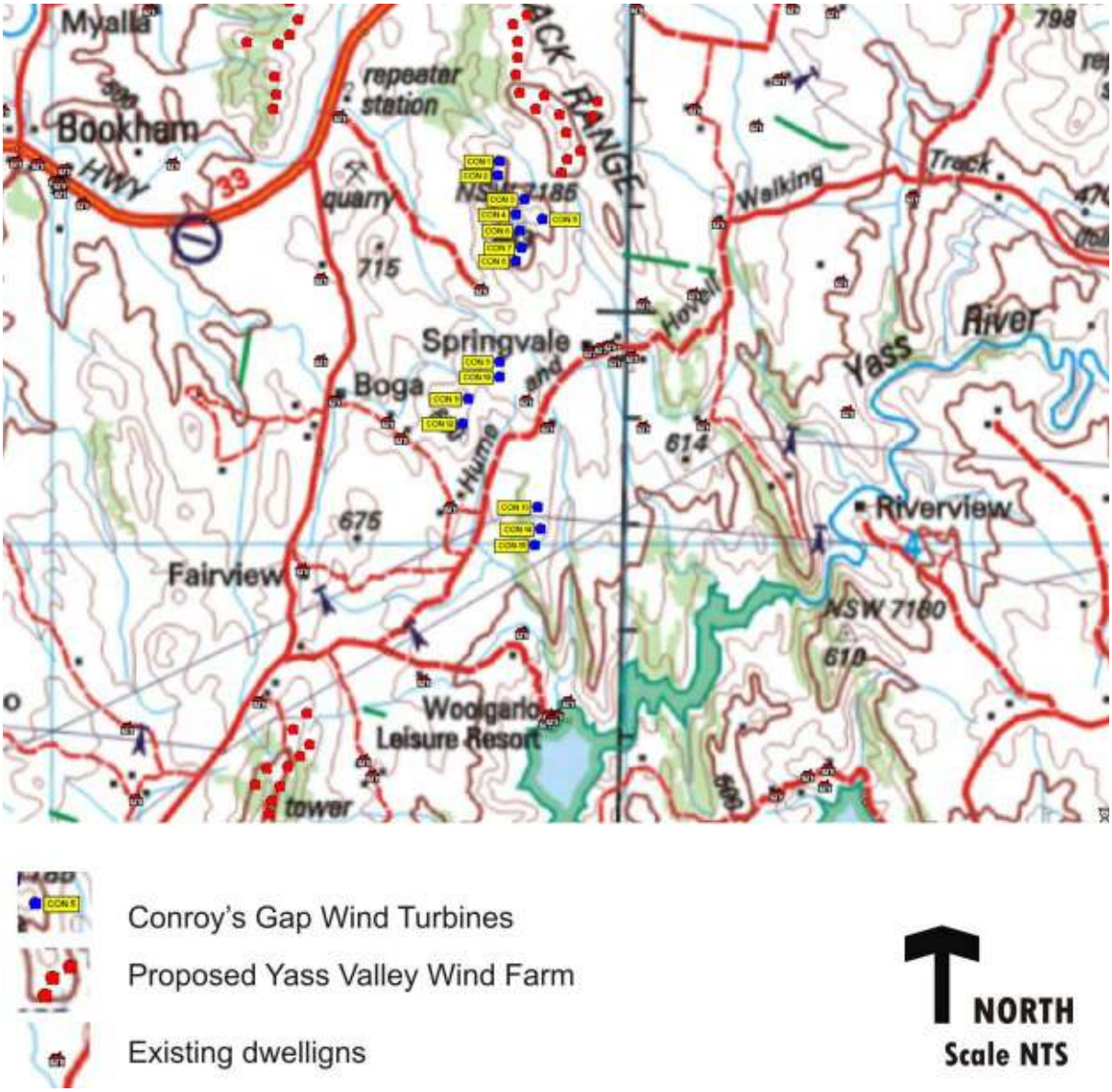


Figure 10.3 Residential Dwellings near to Conroy's Gap

An initial assessment has also shown that many of these houses are well screened by existing vegetation. Therefore the combination of few locations and this existing vegetation would lead to the assumption that the likely cumulative visual impact is probably low.

Residents to the north and south of Conroy's Gap Wind Farm will be potentially more affected by the proposed Yass Wind Farm and Conroy's Gap. From these locations turbines from both wind farms may be silhouetted against each other. However where this where to occur, it would be difficult to differentiate the Conroy's Gap and Yass Valley wind turbines and they would therefore appear as the one wind farm.

Therefore the additional visual impact will be relatively low in comparison to the level of impact that these properties will incur from the presence of the nearest wind turbines.

View from main highways

Travellers along the Hume Highway will pass by the Gullen and Cullerin Range Wind Farm more than 50km to the east of the Yass Valley Wind Farm site once they are constructed.

However as has been demonstrated previously, views from the Hume Highway to the Yass Valley Wind Farm are limited to the road between Bowning and some distance west of Bookham. The only wind farm with the potential to increase a viewers exposure to wind farms in this area is the Conroy's Gap Wind Farm to the south of the Carrols Ridge Precinct on the same range of hills. This would appear as part of the Yass Valley Wind Farm for viewers travelling along the Hume Highway and local roads. Therefore it would only be expected to marginally add to the visual impact of the Yass Valley Wind Farm.

For these reasons, whilst it may be possible for more than one wind farm to be viewed while travelling through the Yass Valley, the cumulative impact would be minimal.

Views from minor / local roads

There may be a cumulative visual impact for users of roads running near the Yass Valley Wind Farm and continuing past other wind farms. However these are typically small gravel roads, serving local farms and the cumulative impact would be negligible.

Overall cumulative impact

This assessment of the cumulative visual impact of the Yass Valley Wind Farm has concluded that there would be minimal cumulative visual impact and that the changes to peoples' perception of the surrounding area would not be significantly changed by the presence of multiple wind farms in the locality. This conclusion that there would be minimal cumulative visual impact has been assessed with the assumption that the wind turbines within the Carrols Ridge Precinct are also constructed.

However there would be no change to the assessment if these were not constructed as any impact that does occur, is present because of the adjacent location of the Marilba Hills Precinct and the Conroy's Gap Wind Farm. The presence of both the Coppabella Precinct and the Carrols Ridge Precinct adds little to the (minimal) cumulative impact of the wind turbines at these two locations.

11 NIGHT LIGHTING ASSESSMENT

Wind farms are generally located away from major population centres and in areas where there are few roads. The assessment of the viewshed of the Yass Valley Wind Farm has identified the low density of occupants within the surrounding area as well as the relatively low usage of the local road network. In essence this has highlighted the fact that the wind farm is located in an area with little night time lighting – albeit with few night time viewers.

There have been no trials of night lighting undertaken in NSW. However some trials have been undertaken in Victoria and night lighting is installed at the Mount Millar Wind Farm in South Australia. These Victorian trials and the existing night lighting at Mt Millar are used to benchmark the impact of night lighting at the Yass Valley Wind Farm.

11.1 PREVIOUS TRIALS

The visual impact of hazard identification lights erected on wind turbines is little tested in NSW while some trials have been undertaken in Victoria to assess the possible impact of various forms of night lighting. Hazard identification lights have been temporarily erected at two Victorian wind farms to assess their visual implications.

However, various options have been trialled in Victoria. Hazard identification lights had been temporarily erected at two Victorian wind farms to assess their visual implications. As well as these trials there have been permanent aviation hazard identification lighting installed at the Mount Millar Wind Farm in South Australia, south of Whyalla. Recently aviation hazard identification lighting was also installed at the Hallett and Snowtown Wind Farms, also in South Australia. A recent trial light installation was also installed on a wind turbine on Cape Bridgewater. This installation and its visual impact are discussed in the following section.

11.1.1 Trial at PWEP (II)

Pacific Hydro erected aviation hazard identification lights on a turbine adjacent to Blowholes Road on Cape Bridgewater for the trial. The installation was inspected on the 9th October 2008. Figure 11.1 shows the locations (VP1–VP4) from which the following photographs of the lit wind turbine were taken and the location of the lit wind turbine (Lit W/T).

Figure 11.1 ***Lit turbine and viewpoint locations*** *(Map Source: Spatial Vision Map Book, Victoria, South west 2007)*

VP1 is taken on Bridgewater Road from a location approximately 5.55km west of the lit turbine at a bearing of 246.5O The photo was taken with a 120mm lens on a Nikon D2X digital camera (0.5sec, F5.6). This lens is the equivalent of a 180mm telephoto lens on a 35mm film camera and it is a low telephoto lens which increases the apparent sizes of objects in the distance.

Figure 11.2 VP1 (GPS S38O 21′ 32.1″, E 141O 25′ 59.7″)

From this location, even when the photo is taken with a telephoto lens, the many other lights in the surrounding area are obvious, however the wind turbine light is elevated in the night sky and after dusk when taken against a black sky, the lit wind turbine will be more visible. On black nights the horizon line will not be visible and the wind turbine light will be one of many lights seen against a black background.

VP2 is taken on Bridgewater Road at a location approximately 2.12km from the lit wind turbine at a bearing of 261.4O. This photograph was taken with an 80mm lens (film equivalent 120mm) with an exposure time of 1sec at F5.3.

Figure 11.3 VP2 (GPS S38O 22′ 32.1″, E 141O 23′ 55.1″)

As one moves closer to the lit wind turbine the apparent size of the light does not dramatically change. Although slightly telephoto this photograph clearly shows the silhouette of the existing unlit wind turbines on the horizon at dusk as well as the visibility of the lit turbine against the sky, even at dusk. At this exposure length the turbine blades are blurred however at this distance there is no apparent flaring along the blades.

VP3 is taken from Blowholes Road at a location approximately 1km from the lit wind turbine at a bearing of 271O. This photograph was taken with a 60mm lens (film equivalent 90mm) with an exposure time of 2sec at F5.

Figure 11.4 VP3 (GPS S38O 22' 44.1", 141O 23' 7")

This longer exposure time from a closer distance allows the slight reflection along a blade to be captured, however this is a very small element above the light source and the reflection only extends a little way along a blade.

VP4 is taken from a location on Blowholes Road directly opposite the lit wind turbine at a bearing of 9O. The lit wind turbine is approximately 100m from this location to the north. This photograph was taken with a 60mm lens (film equivalent 90mm) with an exposure time of 2sec at F4.8.

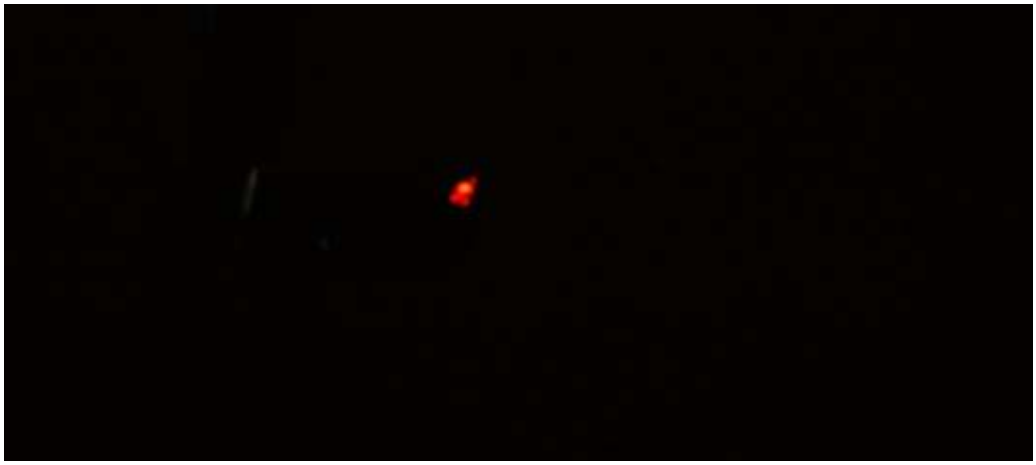


Figure 11.5 VP4 (GPS S38O 22' 42.2, 141O 22' 28.6")

The hazard identification lights, while very visible against the black sky, were a small element in the night sky.

These photographs from a range of locations between 5.5km to directly opposite the lit turbine have demonstrated that the lighting will be visible; however the impact is not great. Especially where there are other lights in the vicinity of the wind farm the impact will be minimal.

11.1.2 *Trial At Challicum Hills Wind Farm*

Trial hazard identification lights were installed at the Challicum Hills Wind Farm by Pacific Hydro in 2005 to assess the potential loss of visual amenity caused by hazard identification lighting during the assessment of the proposed Yaloak Wind Farm. The lights trialled were red flashing incandescent medium-intensity lights (2000cd). Challicum Hills Wind Farm is located on low lying cleared hills south of Ararat in central Victoria.

This trial demonstrated that the impact of this lighting configuration was high at ground level immediately adjacent to the tower on which the lights were installed particularly because of the light spill along the turbine blades which created a "strobing" effect which could be seen from some distance in the surrounding areas. There was little apparent diminution of visibility due to the horizontal baffles, which were fitted to the incandescent lights. The red glow was still visible against the darkened sky, even from immediately below the lights.

In a recent decision of Planning Panels Victoria, the Yaloak Panel came to the following conclusions after viewing a test site at Challicum Hills Wind farm:

> *A night-time inspection of the operating lights revealed that the obstacle lights are highly visible from distances of up to 25 kilometres with impact occurring from both the primary light source, and from reflection off the rear of the generator blades (thus increasing their impact). There was generally agreement at the site inspection that the amenity impacts of the lights is unacceptable and that the lights would have significant impacts on residents of the Parwan Creek valley.* (Yaloak Planning Panel 2005)

However, this assessment was primarily based on an inspection immediately adjacent to the installed lights and more emphasis should have been placed on assessing the potential visual impact from greater distances where residents and travellers on the local road network were more likely to be located.

Since the trial at Challicum Hills Wind farm other lighting options have been trialled to assess if they can reduce visual impact. One option was to replace the incandescent lights with light-emitting diodes (LED). LED's are a semiconductor device that emits coherent narrow-spectrum light. These can be in any colour, including red.

It is considered that LED's provide several advantages from a visual perspective over incandescent lights as they are easier to baffle and can be programmed to light to their peak intensity more slowly than incandescent lights.

11.1.3 Trials at Wonthaggi Wind Farm

Hazard identification lights of low-intensity (170cd) LED blinking type were erected at Wonthaggi Wind farm in December 2005 and again in April 2006. Wonthaggi Wind Farm is on the Victorian coast approximately 100km south east of Melbourne.

Trial #1 – Wednesday 14th December 2005

In December 2005, a blinking light was installed at the top of a single wind turbine on the Wonthaggi Wind Farm with photographs taken to record the visual impact from various distances.

These lights blink in intervals in an irregular cycle. (ON for 1sec, OFF for 0.5sec, ON for 1sec, OFF for 1.5sec). The irregular cycles are considered best for safety and act as a deterrent to birds. These low-intensity lights currently meet air safety standards in some European countries.

Figure 11.6 Low-intensity hazard identification lights and car lights at Wonthaggi Wind farm

Figure 11.6 illustrates the view from approximately 7.6km from the hazard identification lights. On the right of Figure 11.6 one can just discern the hazard identification lights visible in the distance. Although indistinct in this photo they were still quite clear when viewed against the night sky. In fact their visibility at this distance was a little surprising. The diminution of clarity of the lighting did not reduce with distance to the same extent that objects do during daylight. To the left of Figure 11.6 one can easily discern tail lights of moving traffic along the Bass Highway. It is evident that these car lights are much more prominent against the night sky than the aviation hazard identification lights at this distance.

This trial demonstrated that the visual impact on the surrounding areas of the low-intensity hazard identification lights was low. While the red glow of the light was visible against the dark sky, its intensity was comparable (and in many cases far less than) than lights on rural properties and on streetlights or vehicles.

Unlike the visual impact of the incandescent medium-intensity hazard identification lights seen at the Challicum Hills Wind Farm, the W-Red lights of 170cd trialled at Wonthaggi Wind Farm had reduced the visual impact and completely removed the "strobing effect" that was apparent in close proximity to the wind turbines seen at the earlier demonstration at Challicum Hills.

Trial #2, Wednesday 19th April 2006

CASA requires medium intensity lighting in Australia. A second trial at Wonthaggi Wind farm was undertaken in April 2006. In this trial two different hazard identification lights were erected. One was a MB80 medium intensity obstacle marker (2000cd), while the other was a Sealite AV 200 low intensity obstacle marker (170cd).

Whilst the low intensity light had less visual impact than the medium intensity light, both remained less visible than local display lighting, street lighting and the lighting spill from domestic locations (*Wonthaggi Windfarm Obstacle Marker Light Evaluation for Sustainability Victoria, Robert J Showers and Associates, Lighting Consultants, May 17, 2006*).

This report also commented on the narrow beam distribution and the lack of illuminance at ground level, which also agrees with the observations later in this report of medium intensity lights.

11.2 *INSTALLATION AT THE MOUNT MILLAR WIND FARM, SOUTH AUSTRALIA*

The Mount Millar Wind Farm is located on the Eyre Peninsula in South Australia, near the township of Cowell, which lies approximately 100 km south of Whyalla. The hazard identification lights at the Mount Millar Wind Farm are medium intensity lights (2000cd).

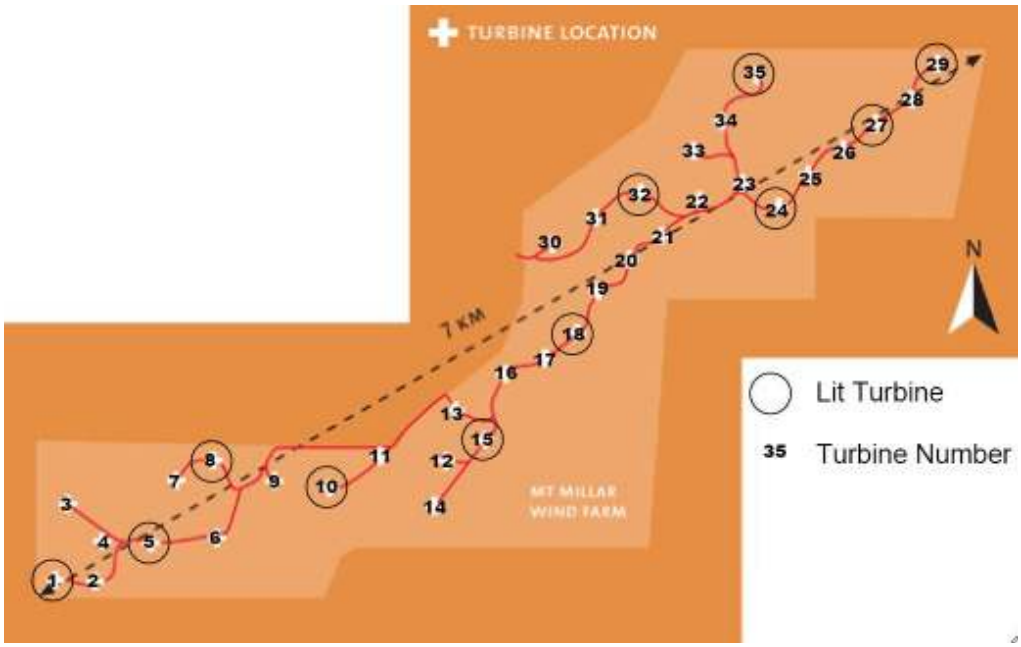


Figure 11.7 ***The layout of the 35 turbines and the lit turbines at the Mt Millar Wind Farm***

The 35 wind turbines are laid out along a ridge running from the north east to the south west. At the time of the site visit 9 wind turbines were lit with flashing red medium-intensity LED hazard identification lights. The lights were not synchronised. Subsequently two additional lights became operational, bringing the total number of wind turbines with hazard identification lighting to eleven.

The wind turbines are 2 MW Enercon turbines, with a blade diameter of 71 m and a turbine hub height of 85 m giving an overall height of 120m.

The hazard identification lights are medium intensity lights (2000cd). However, unlike the medium intensity lights trialled at Challicum Hills Wind Farm, these are LED lights are designed to restrict the light spill to 3O as shown in **Error! Reference source not found.**.

The Mount Millar Wind Farm was visited in the evening of the 20th July 2006. It was a clear night, initially with some cloud cover on the horizon, and with very good visibility.

Figure 11.8 ***Mt Millar Wind Farm at dusk***

When standing close to a lit wind turbine the difference between these lights and those used at the Challicum Hills trial was immediately obvious. At a distance of 350-400m there was a glow around the lights and only the faintest strobing effect along the moving blades.

Figure 11.9 Lighting on a Turbine at a distance of 250m

The strobing effect is indistinct and much less than was observed at Challicum Hills.

A comparison with the security lighting at the substation also revealed that the lighting used at this facility was of a much greater intensity than that used on the wind turbines.

Figure 11.10 Lighting on the substation and a turbine in the background

The substation is in the foreground of Figure 11.6, with the two hazard warning lights on a turbine immediately behind the substation. The hazard identification lights are less of a visual impact than this facility that has no more lights than many houses, dairies or farm working areas. At a distance of 1 km to 1.5 km the similarities between the Mt Millar aviation hazard identification lighting and the trial lights at the Wonthaggi Wind Farm became obvious.

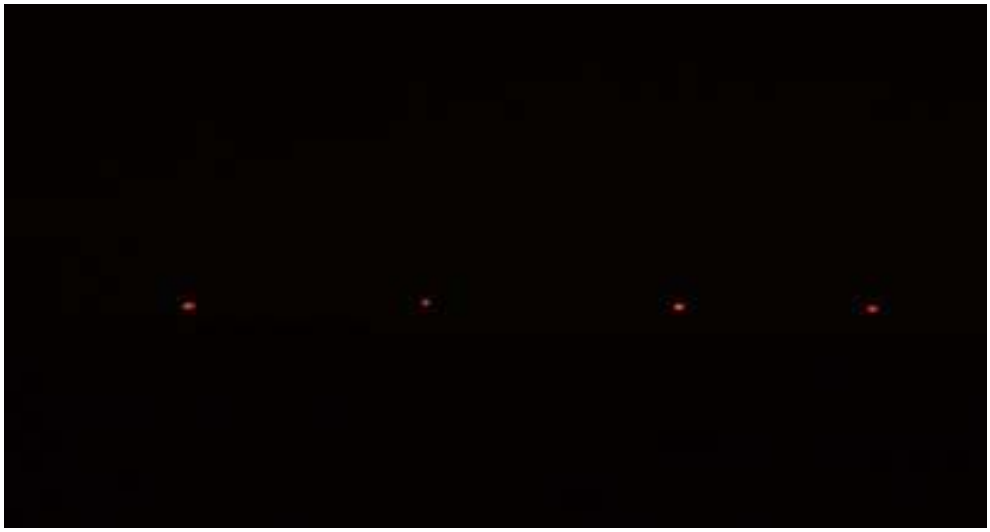


Figure 11.11 Lighting on the wind turbines from a distance of 2.0km

Although the Mt Millar lights are 2000cd medium-intensity hazard identification lights, at these distances there was no sign of any strobing along the blades and the visual impact was identical to that observed at Wonthaggi with W-Red lights of 170cd intensity at a similar distance. That is, the lights were visible, but they had none of the eerie character of the Challicum Hill lights at a similar distance.

11.3 ASSESSMENT OF VISUAL IMPACT OF THE PROPOSED NIGHT LIGHTING

These trials and inspection of an operating facility have clearly identified that the type of lights do make a difference to the visual impact.

The night lighting trialled at Wonthaggi gave an acceptable level of visual impact. The planet Venus in the night sky and car lights at similar distances, were both of greater intensity than the proposed hazard identification lighting.

The hazard identification lights at Mt Millar have also supported the assessment that there are forms of hazard identification lighting that do not create such a degree of visual impact as that exhibited in the Challicum Hills trial.

That being said the hazard identification lights are still an obvious element in the landscape. There are few light sources in the proposed location of the Yass Valley Wind Farm. Wind turbines will therefore be an obvious addition to the night panorama. However, as stated earlier, few light sources are also an indication of few viewers.

For locations both in the centre and on the edges of Crookwell there are many light sources. These include street lights, shop fronts, residential dwellings and vehicles.

If lights are required by CASA, it is considered that the solution constructed at Mt Millar provides an acceptable level of visual impact while providing the required level of night time hazard identification.

11.4 CUMULATIVE IMPACT OF HAZARD IDENTIFICATION LIGHTING

A cumulative impact can potentially be envisaged for travellers on the Hume Highway, passing multiple Wind Farms where hazard identification lighting may be visible. However, whilst the lighting may be visible, it will only be one further element in a traveller's experience which

obviously includes the frequent presence of rear tail lights, headlights and lights from nearby houses and farms. As such the cumulative visual impact for these road users will be minimal.

There would also be some residents located in the area around the Yass Valley Wind Farm which may also be able to see the hazard identification lighting from other wind farms. However, although residents may be able to see hazard identification lighting of multiple wind farms such impact would effect few houses, and be a relatively small visual impact because when people are at home at night and when inside lights are on, windows become mirrors, reflecting the interior of the house and not allowing views to the low level lights in the distance. Obviously when curtains or blinds are closed, there is also no visibility to the proposed lights in the surrounding area. Therefore at night in most situations, a viewer needs to be outside to even see the proposed hazard identification lights.

For these reasons there would be negligible cumulative impact from the proposed hazard identification lighting if they were installed both at the Yass Valley Wind Farm and other wind farms in the vicinity.

12 CONCLUSION

In summary, this landscape and visual impact assessment demonstrates that the proposed Yass Valley Wind Farm will have a generally low visual impact on its surrounds, and the site is a suitable landscape for the construction of a wind farm.

This conclusion was based on a landscape and visual assessment which included the Carrols Ridge Precinct (up to an additional 30 wind turbines) which is not part of this Project Application for Development Approval, but will be part of a future application.

This conclusion is supported by:

- Perception studies which continually show that the majority of viewers do not object to the construction of wind turbines on any but the most sensitive and localised landscapes. This is supported by the social research undertaken not only for the Yass Valley Wind Farm but also for other wind farms.
- Targeted social research on perception was also undertaken by the proponent and has clearly demonstrated that there is a very high level of support for wind farms amongst local residents in the area with 89% supporting wind farms on the Southern Tablelands and 71% supporting wind farms within 1km of their residence.
- The proposed Yass Valley Wind Farm site is located in a man-modified landscape. The landscape units in the viewshed are well represented across this area. Agricultural activity, associated structures and other signs of human intervention have also created a landscape that can absorb other changes.
- There is low visual impact on townships. There are limited locations from which long distance views are available from the townships of Yass to the east and the villages of Bowning and Binalong to the east and north-east. The visual impact from these towns would be negligible. There is also minimal to no visibility of the wind turbines from other smaller settlements in the area.
- The main visibility is from major roads. The Hume Highway, to the south and the Burley Griffith Way to the north are two major roads within the region. Although there will be views from these two highways the overall impact is expected to be medium due to the predominately medium landscape sensitivity.
- There will be a visual impact on viewers using the minor roads within the locality especially where these run along the wind farm precincts. These un-made roads run along and through the different precincts within the Yass Valley Wind Farm. Visibility from these minor roads, which have far fewer users than the highways and main roads, is sometimes, but not always, restricted by roadside vegetation, however there is no doubt that there will be extensive views from this road network. It is considered that the visual impact will be minor from these locations predominately because the viewer numbers are low. The addition (or removal) of the Carrols Ridge Precinct will make no difference to the impact from these minor roads, except from roads that run adjacent to the Carrols Ridge Precinct wind turbines..
- The zone of greatest potential visual impact for residential properties lies within three kilometres of the nearest wind turbine. There are 26 non-participatory residences within 3 km of the two precincts within the current Project Application for Development Approval. This increases by a further 7 houses to a total of 33 non-participatory residences, when the wind turbines within the Carrols Ridge Precinct are also included. However many of these existing residences have screening in the form of wind breaks. Landscape mitigation can be effective in lessening the visual impact on residential properties without existing screening.
- The cumulative visual impact of the proposed Yass Valley Wind Farm with other wind farms in the area is expected to be no greater than the visual impact of the Yass Valley Wind Farm by itself. Users of the Hume Highway and Burley Griffin Way will, in the future, pass other sites, and there is the probability that the acceptance levels will reduce. There is no doubt that this will be the case for users of the Hume Highway to the south, where there is the potential for sequential views to be afforded by the Yass Valley Wind

Farm and the proposed Conroy's Gap Wind farm.. Further away travellers will pass the Cullerin Range Wind Farm. The addition (or removal) of the wind turbines within the Carrols Ridge Precinct, will make little difference to the cumulative impact on Highway users as these additional wind turbines, should they be approved within a future Development Approval, will be read as part of the Conroy's Gap Wind Farm.

- The level of cumulative visual impact for users of Burley Griffin Way would be less as there are few opportunities for sequential wind farm views. It is therefore assessed as being a low adverse visual impact. The presence of the Carrols Ridge Precinct would make no difference to any assessment of the cumulative visual impact from this Highway.
- There are few local roads where multiple wind farms become visible, either sequentially or simultaneously and as it is these viewing experiences that can change peoples' perception of an area. Therefore the visual impact is no greater than that assessed from individual viewpoints and that the cumulative visual impact is considered to be low.
- If obstacle identification lighting is required by CASA the visual impact would be low. In part this assessment is based on the type of lights now used and also on the night time environment of the area which already contains multiple existing light sources, including lights from traffic using the Highways.

Annex A

Community Perception Studies

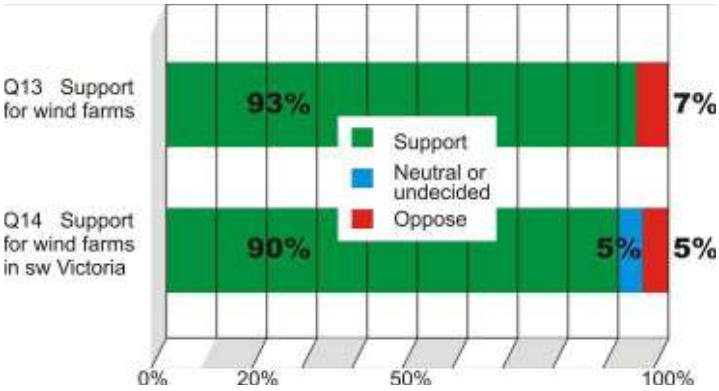
Annex A Community Perception Studies

The results summarised in 'Chapter 3 – Community Perception Studies' are also supported by many other studies undertaken in Australia, NZ, the UK and the USA. Some of these studies are summarised below.

A.1 LAL LAL WIND FARM – COMMUNITY PERCEPTION TOWARDS WIND FARMS

A study was undertaken in an area surrounding a proposed wind farm at Lal Lal. Lal Lal is located to the south east of Ballarat, between the Midland Highway and the Western Freeway. This study (*Lal Lal Wind Farm, Report on Community Perceptions towards Wind Farms in Victoria for West Wind Pty Ltd*, prepared by ERM & Reark Pty Ltd, September 2007) has shown that there is a high degree of acceptance of wind energy by residents within the area surrounding the Lal Lal Wind Farm.

Results show an approval rating of more than 9 in 10 (93%) despite the visibility of wind turbines, most people felt that "*we need to use wind power as a source of energy even if it means changing the appearance of some landscapes*".



FigureA.12.1 Lal Lal area: Support for Wind Farms

In fact most respondents (82% favour, 8% opposed) were accepting of a wind farm that was set back 5 or 10 km from the coast on flat or undulating grazing land (82% favour; 8% opposed). These acceptance figures are greater than those found in past Victorian and overseas studies; however they are very similar to the figures for the Ararat Wind Farm.

Similarly, the level of acceptance of a wind farms was also high when the proposed wind farm was near to a respondent's place of residence. This is summarised in *Figure A.12.2*.

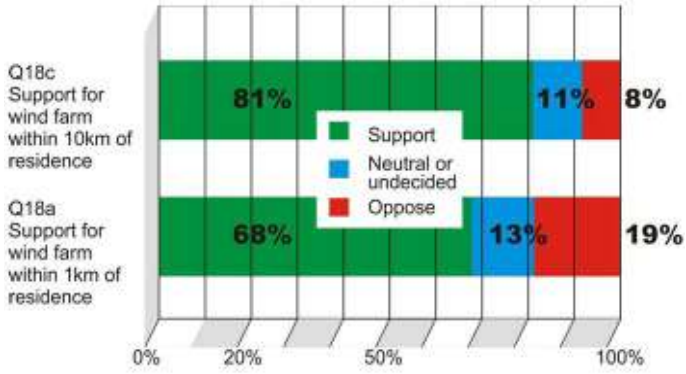


Figure A.12.2 Lal Lal area: Support for Wind Farms near Residence

This research has demonstrated an increase in acceptability of wind farms to previous studies although it may be hypothesised that the increasing political and community awareness of global warming and its impact on the environment has also increased the level of acceptance within this community.

A.2 ARARAT AREA – COMMUNITY PERCEPTION TOWARDS WIND FARMS

A similar study of community perceptions of wind farms in the Ararat area has been undertaken *(Report on Community Perceptions towards Wind Farms in the Ararat Region, Victoria* for RES Australia Pty Ltd, prepared by Environmental Resources Management Pty Ltd & Reark Pty Ltd, *November 2007*). This study has shown there is a high degree of acceptance of wind energy by respondents within Ararat and the surrounding area. While the entire perception study has been appended to the notification documentation, relevant sections are also included in this 'Preliminary Landscape and Visual Assessment' as appropriate.

Results have also shown an approval rating of over 9 in 10 (94%, 2% opposed) respondents in favour of wind farm projects being developed in south-western Victoria. With over 9 in 10 (96%) of respondents agreeing that '*wind energy is a good alterative energy source*', see *Figure A.12.3.*

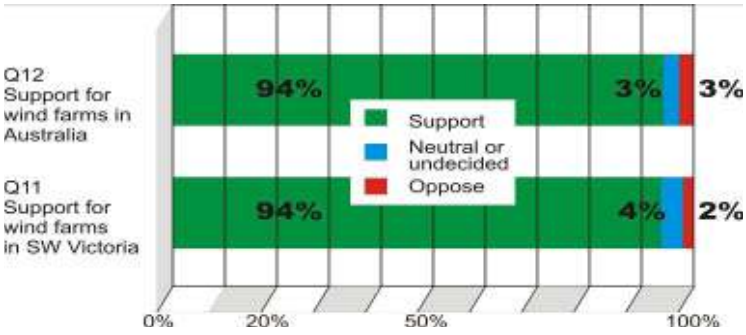


Figure A.12.3 Ararat area: Support for wind farms

Further to this, most respondents (82% favour, 2% opposed) were accepting of a wind farm set back 10 kilometres from their home, with a slight decrease to 7 in 10 respondents (71% Favour, 15% opposed) accepting a wind farm set 1 kilometre from their home, see *Figure A.12.4.*

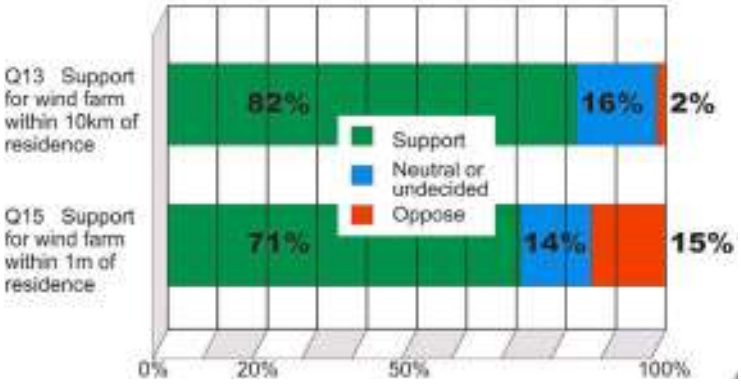


Figure A.12.4 Ararat area: Support for wind farms near respondents' residence

In response to introducing the concept of multiple 'typical' (30 to 40 turbines) wind farms in the local rural area, 87% respondents accepted (7% opposed) one typical wind farm, with three typical wind farms accepted by 71% (18% opposed), see *Figure A.12.5*.

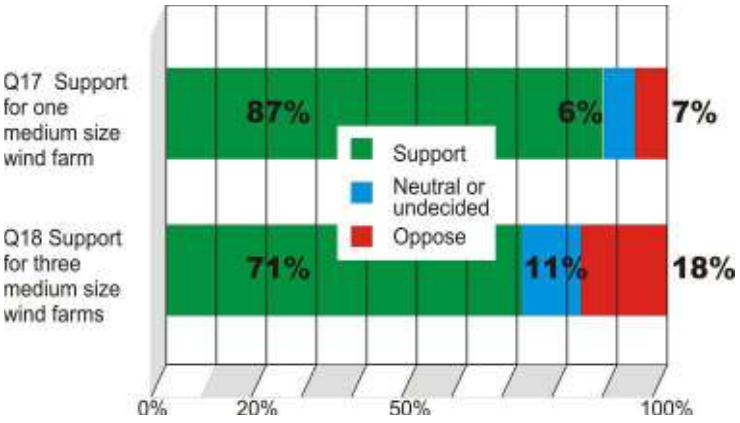


Figure A.12.5 Ararat area: Support for multiple wind farms

These results again highlight the remarkably consistent levels of approval for one or more wind farms in the area. The lowest level of acceptance at 71% for three wind farms is again very similar to the levels of support shown for the most sensitive of locations, whether within one kilometre of the respondent's house or on coastal headlands along Victoria's coast.

The study also found that the community has no clear preference between a few clusters, close together, or spread out at reasonable intervals along the highway. Therefore, it would seem that this landscape can absorb future wind farm developments, as the community has not a strong preference.

This is a very similar level of acceptance that has been identified in the recent Lal Lal Wind Farm study. Lal Lal Wind Farm was located in central Victoria in a landscape that was not dissimilar to that of the Ararat site.

A.3 OTHER AUSTRALIAN COMMUNITY PERCEPTION STUDIES

The following section builds upon ERM's discussion of perception issues in past visual assessments of other wind farms and is pertinent to the visual and landscape assessment of the proposed Ararat Wind Farm.

A.3.1 Coastal Headlands

In 2000, a study was undertaken for the Department of Natural Resources and Environment (Kantos & Quint, 2000) on the many issues concerning the Victorian Coastline including the construction of wind farms on coastal headlands.

Figure A.12.6 summarises the results of this particular component. The study involved a series of nine workshops as well as telephone interviews (n = 700).

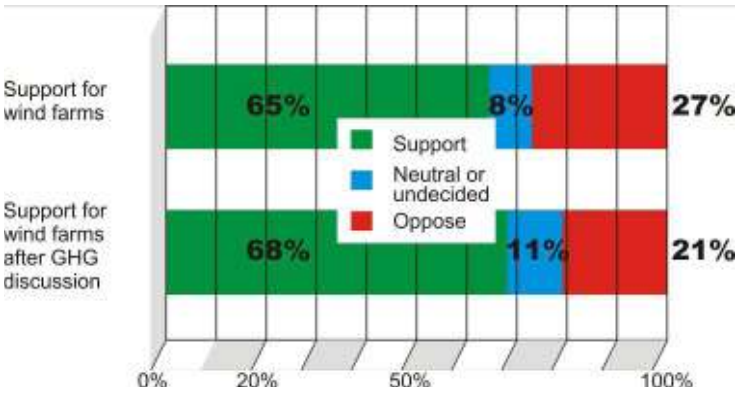


Figure A.12.6 Wind farms on Coastal Headlands – Participant Responses

Study participants initial support or opposition to the construction of wind farms on coastal headlands was measured. After being exposed to arguments on renewable energy, greenhouse gas emissions and climate change issues their responses were measured again. This study found that there was only a slight increase in participants' acceptance of wind farms on coastal headlands, from a 65% acceptance level before arguments on greenhouse gas emissions to 68% acceptance after these arguments were presented. However opposition reduced from 27% to 21%.

A.3.2 Nirranda Wind Farm

Similar figures have been found in a 2002 visitor survey undertaken for Stanwell Corporation Limited (Offer Sharp & Associates 2002) on the possible visual impacts of the proposed wind farm on the Bay of Islands viewing platform that is located adjacent to the Nirranda site, in the Shire of Moyne approximately 250km west of Melbourne.

Approximately 80% of people were generally in support of wind farms, however when presented with a proposal for a wind farm visible from a scenic coastal lookout (the Bay of Islands) the support for a wind farm at this location reduced to approximately 71%, whilst opposition to the presence of a wind farm at this location increased from 3% to 12%.

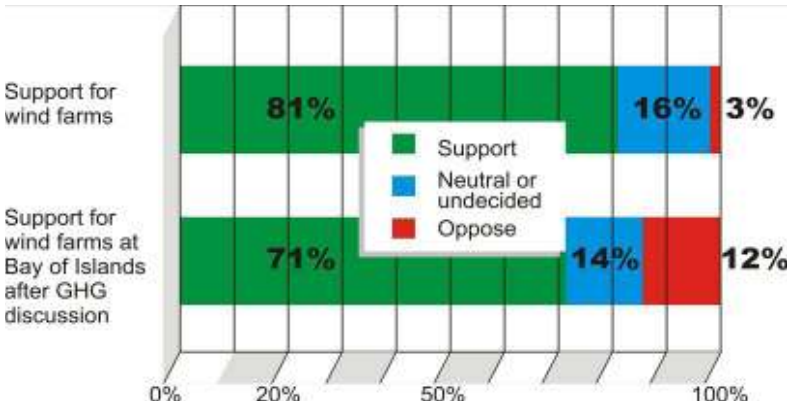


Figure A.12.7 Nirranda Wind Farm Respondents Attitudes to Wind Farms

This figure of 71% support for wind farms is similar to the Kantos & Quint result of 68% reported previously for wind farms on exposed coastal headlands (refer Figure A.12.6 Wind farms on Coastal Headlands – Participant Responses).

A.3.3 Yaloak Wind Farm

Research undertaken by Offer Sharp & Associates, 2004 presented at the Yaloak Wind Farm panel hearing in 2005 showed a similar level of community acceptance to wind farms on this inland site near Ballan, Victoria.

The study assessed community reaction to images of a wind farm in the Yaloak landscape as well as at another site at Crowlands in Western Victoria. Neither location was identified, however the Yaloak proposal had been publicised for some time before the survey and the landscape may have been recognised by some, and particularly local, respondents. Community reaction to the siting of wind turbines in these landscapes was based on interviews with 200 respondents from each of Melbourne, Bacchus Marsh and Ballarat.

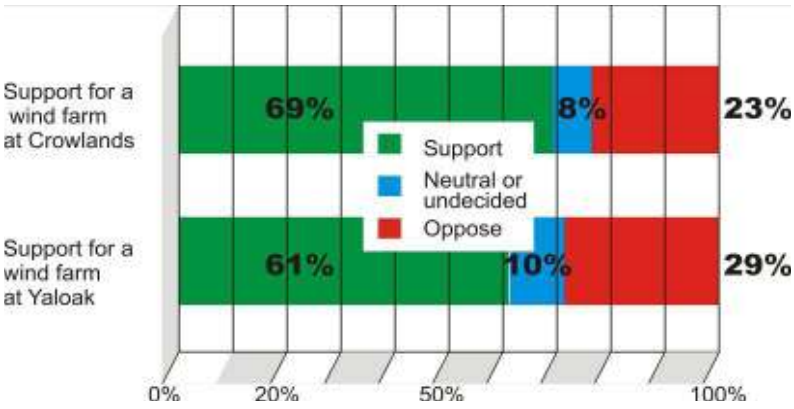


Figure A.12.8 Level of Support for Potential Wind Farms at Yaloak and Crowland

This data has been extracted from *Table 15 Crowlands* and *Table 19 Yaloak* in the Offer Sharp & Associates 2004 report and illustrates the acceptance levels for wind farms of each of these sites. The study also found slight differences in levels of support at Crowlands (67%, 66% and 73%) for respondents from Melbourne, Bacchus Marsh and Ballarat respectively, and slightly larger differences (61%, 55% and 68%) in support for the proposed wind farm at Yaloak.

However, the overall findings are similar of the earlier studies from the earlier Kantos & Quinn 2000 and Offer, Sharp 2002. All these Australian studies continually show a level of acceptance greater than 60%. Overseas studies show similar results.

A.4 OVERSEAS STUDIES

Community perception studies have also been undertaken overseas to gauge levels of community support and opposition to wind farms.

A.4.1 United Kingdom

A paper presented at the 20th British Wind Energy Association Conference (Anne Marie Simon Planning, 1996) gives an overview of thirteen studies undertaken between 1990 and 1996 by wind power proponents, opposition groups, the BBC, statutory authorities and a Liverpool University dissertation found that in all these studies:

- The overwhelming majority of respondents support the principal of development of wind power in the UK, and they also support their local wind farm;
- Those with direct experience of an operating wind farm are more supportive and positive than those without experience;
- Once wind farms are in operation, concerns about noise and visual impact decrease;
- The majority of people find the wind farms acceptable in the landscape and more find the wind turbines graceful than ugly; and
- A strong majority support and a small minority oppose wind farms, with more expressing no opinion than opposition (Freris 1998).

A summary of the results for eleven of these studies, which is taken from this paper (*Anne Marie Simon Planning, 1996*), are reproduced below.

Table A.1 Summary of Eleven Studies Conducted in the United Kingdom into Attitudes to Wind Power from 1990-96

Location	Sponsor/Organiser	Date	In favour	Against	Don't know
Delabole, England	DTI	1992/3	84%	4%	11%
Cemmaes, Wales	DTI	1992/3	86%	1%	13%
Llandinam & Llangwyryfon, Wales	CCW	1992/3	83% 78%	3% 8%	14% 14%
Llandinam Rhyd-y-Groes Taff Ely, Wales	BBC	1994	76% 61% 74%	17% 32% 9%	8% 7% 17%
Kirkby Moor, England	National Wind Power	1994	82%	9%	9%
Bryn Titli, Wales	NWP (pre construction) NWP (open day)	1996	68% 94%	14% 3%	19% 3%
Trysglwyn, Wales	NWP (open day)	1996	96%	4%	-
Coal Clough, England	Liverpool University Dissertation	1996	96%	4%	-

Notes
NWP = National Wind Power (a wind farm developer).
CCW = Countryside Council for Wales (a statutory body)
BBC = BBC (Wales) and the University of Wales

In all these studies between 61% and 96% of survey respondents were supportive of wind power.

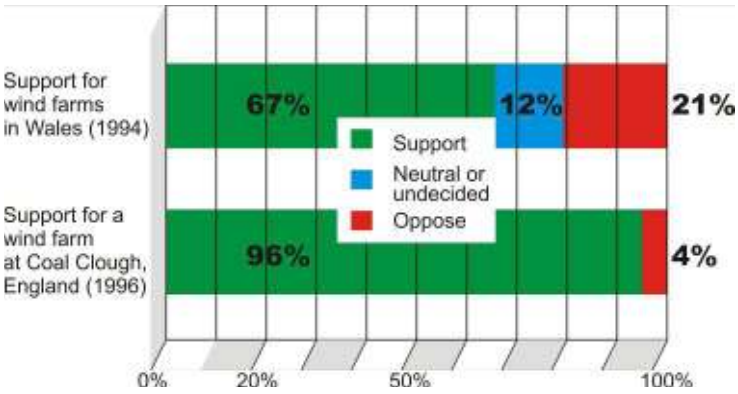


Figure A.12.9 ***Comparison of Selected Wind Farm Community Perception Studies in the United Kingdom***

The lowest level of acceptance was one area within the BBC 1994 study which looked at attitudes towards wind farms in Wales (Interviews with 268 respondents, conducted in two stages; stage one being just after the wind farm was built and stage two one year later). The BBC study also looked at three locations, Llandinam, Rhyd-y-Groes and Taff Ely) with the lowest support for the wind farm at Rhyd-y-Groes with 61% support and 32% against, whilst overall the BBC study found that 67% of respondents were in favour of the development of wind power in Wales, and 21% were opposed.

The highest approval was that reported in the Coal Clough (Lancashire, England) study (Questionnaire completed by face to face interviews, sample of 50) with 96% approval and 4% opposition.

These figures are similar to those reported in the Australian studies.

A.4.2 Scotland & Ireland

A recent study (November 2005) on community perception of wind farms in Scotland and Ireland also has similar, but higher approval ratings. (found at http://www.your-energy.co.uk/pdf/windfarmpaper121205.pdf).

Table A.2 Comparison of levels of acceptance between wind farms in Scotland and Ireland

	Strongly support		Support		Neutral		Oppose		Strongly oppose	
	DL (%)	BH (%)	DL (%)	BH (%)	DL (%)	BH (%)	DL (%)	BH (%)	DL (%)	BH (%)
A. Wind power is Scotland	55	55	35	22	6	16	2	0	2	7
B. Local wind farm	63	47	25	16	3	20	3	4	5	13

DL = Dun Law (operational site). BH = Black Hill (proposed site).

Table compiled from data from *Public Perceptions of Wind Power in Scotland and Ireland*, Charles R. Warren, Carolyn Lumsden, Simone O'Dowd & Richard V. Birnie, Journal of Environmental Planning and Management, Vol. 48, No. 6, 853 – 875, November 2005, Table 4, p862.

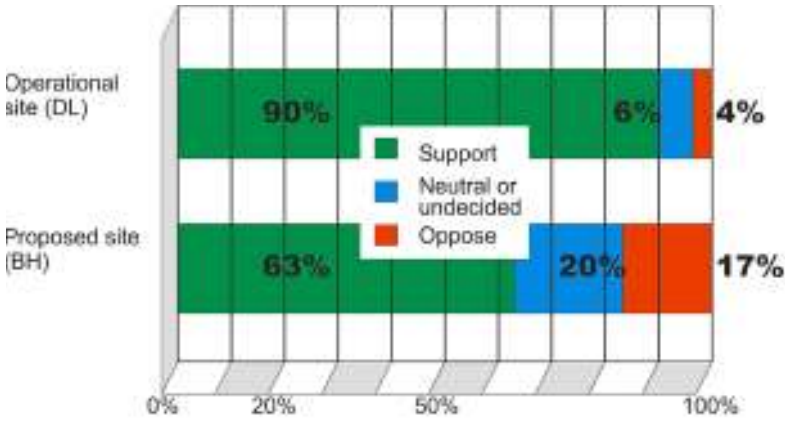


Figure A.12.10 Acceptance levels - Scotland and Ireland

Once again this reconfirms that the high level of acceptance, and this report also goes further and shows the increased level of acceptance within a community following construction. This is discussed in the next section of this report.

A.4.3 North Carolina, USA

Reported attitudes in a study from North Carolina (NC) in the USA are also similar. A paper prepared on public attitudes (Grady 2004) towards wind energy in eastern NC, which included coastal areas, and western NC, which includes mountainous areas, presented to the 'Efficient NC Conference' also found similar degrees of approval. Note: There was no information in this paper on the sample size.

Table A.3 Public Attitude to Placement of Wind Farms in Eastern NC

Placement	% Prohibited	% Not prohibited	% Don't know
Mainland	11.9	72.8	15.3
Mainland clustered	14.1	69.6	15.1
Sounds	16.6	63.6	19.8
Sounds clustered	28.0	50.2	20.5
Offshore	13.9	68.6	17.6
Offshore clustered	14.4	68.6	15.8

Table A.3 shows the level of acceptance for clusters of wind turbines reduced to 50% for the Sounds which are the coastal areas along the eastern seaboard of North Carolina. The level of acceptance for clustered groups of wind turbines in the mainland area rose to 69.6%.

This paper (Grady, 2004) also presented levels of acceptance within the more mountainous areas of Western NC.

Table A.4 Public Attitudes to Wind Farm Placement – Western NC

Placement	% Prohibited	% Not prohibited	% Don't know
Ridgetops	20	64	17
Ridgetops clustered	28	57	15
Ridgetops with other towers	16	75	10

The western area of Northern Carolina is mountainous; many parts are uncleared and show few signs of human intervention. The level of acceptance for clustered groups of wind turbines on ridge tops in this area is less (57%) than the level of acceptance reported for the mainland areas of Eastern NC (69%), however if there are other towers on the ridge tops (ie there are obvious signs of human intervention) then the level of acceptance rises to 75%.

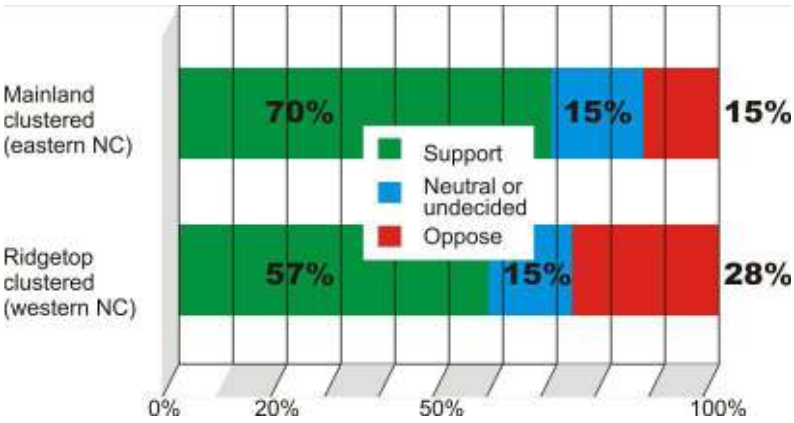


Figure A.12.11 Acceptance Levels - Northern Carolina, USA

In summary this paper reported that:

- *"within groups of middle aged, middle class, pragmatic, year round residents of the mountain and coastal regions of NC, there is support for developing renewable energy as a future source of fuel for electricity generation.*
- *More than 3 out of 4 would prefer to see more future electricity derived from solar and wind*
- *Less support for turbines in sounds or national forests*
- *2 out of 3 support turbines visible from home*
- *Over 80% support turbines for residential use."*(Grady, 2004)

The degree to which the respondents believe that wind farms on mainland sites should not be prohibited is very similar to the previously cited United Kingdom and Australian studies; with between 69-73% believing that wind farms should not be prohibited.

A.5 PERCEPTION ALTERATION AFTER CONSTRUCTION

There has been no research done on the visual impact of wind farms in Australia after construction, however overseas studies suggest greater acceptance levels by people who live in the vicinity of wind farms after their construction (Gipe n.d.)

Anne Marie Simon Planning and Research in the previously cited study also found that all studies that looked at perceptions before and after construction, reported an increase in acceptance after the Wind Farm was completed.

It is also interesting to note that the study on Scotland and Ireland (cited above) also shows a 27% increase in acceptance following construction, although the greatest proportion of people who changed their mind were in the "neutral or undecided" group, there was still a significant reduction from 17% to 4% in the group that opposed the wind farms.

This study supports the view that familiarity does not increase opposition to a wind farm, but rather increases acceptance and support for wind turbines in the landscape.

Annex B

Parameters Of Human Vision

Annex B Parameters Of Human Vision

The viewshed for the Yass Valley Wind Farm can be determined by determining the extent to which an object is part of an observer's static field of view. The viewshed in a man-modified landscape has in past projects been delineated to that area in which an object takes up at least 5% of the field of view.

The measurement of the field of view is based upon the parameters of human vision outlined below. These provide a basis for assessing and interpreting the impact of a development by comparing the extent to which the development will intrude into the central field of vision (both horizontally and vertically).

HORIZONTAL FIELD OF VIEW

The central field of vision for most people covers an angle of between 50^{O} to 60^{O}. Within this angle, both eyes observe an object simultaneously. This creates a central field of greater magnitude than that possible by each eye separately.

This central field of vision is termed the 'binocular field' and within this field images are sharp, depth perception occurs and colour discrimination is possible.

These physical parameters are illustrated *in* ***Figure B.1***.

The visual impact of a development will vary according to the proportion in which a development impacts on the central field of vision.

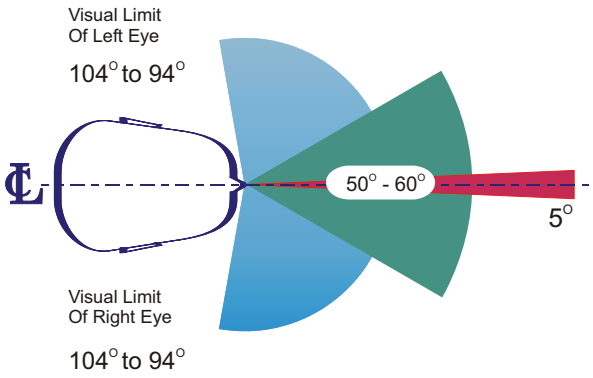


Figure B.1 Horizontal Field of View

Developments, which take up less that 5% of the central binocular field, are usually insignificant in most man-modified landscapes (5% of 50^{O} = 2.5^{O}).

Viewshed Based on the Horizontal Field of View

The viewshed of a single wind turbine is calculated on the extent to which a single wind turbine (in this example the widest section is the swept path of the rotor) would intrude into the 60^{O} central field of vision.

The table below analyses' the extent to which a swept path of a single rotor would interrupt the horizontal field of view.

Table B.1 *Viewshed based on the degree a swept path of a single rotor would take up in the horizontal field of view*

Horizontal Field of View	Visual Impact	Distance from an observer to a rotor with 100m diameter
<2.5° of view (5% of 50° = 2.5°)	Insignificant The swept path of the rotor would take up less than 5% of the central field of view. The rotor, unless particularly conspicuous against the background, will not intrude significantly into the view. The extent of the vertical angle will also affect the visual impact.	> 2290m
2.5° – 30° of view (60% of 50° = 30°)	Potentially Noticeable The swept path of the rotor may be noticeable and its degree of visual intrusion will depend greatly on its ability to blend in with its surroundings and particularly the sky.	173m-2290m
>30° of view	Potentially Visually Dominant At this distance the swept path of a single rotor will fill more than 50 percent of the central field of vision and will always be noticed and sympathetic treatments, such as paint colours to blend against a sky, will only be able to partially mitigate visual effects.	< 173 m

These calculations suggest that the impact of a 100m wide rotor would reduce to insignificance at approximately 2,290m, as the swept path of the rotor would, at this distance, form less than 5% or 2.5° of the horizontal field of view. At distances less than 173m, a 92m wide rotor, would be visually dominant.

These calculations do not take into account the height of the wind turbines, nor do they allow for the placement of multiple wind turbines within the landscape.

The distances suggested by the analysis based upon horizontal field of view of a single rotor are far less than experience would suggest to be reasonable. The previous calculation is based on the visual impact of a single rotor in the horizontal field of view. A single wind turbine has the same height as many wind turbines sited across several kilometres, and the intrusion into the vertical field of view may better determine the viewshed for a wind farm.

The point from which the wind farm becomes an indistinct line on the landscape, better determines the viewshed. That is the point at which the vertical size of a range of wind turbines diminishes to an imperceptible component within the vertical field of view.

Figure B.2 shows how the viewshed of a long horizontal object is determined by its height and not by its width.

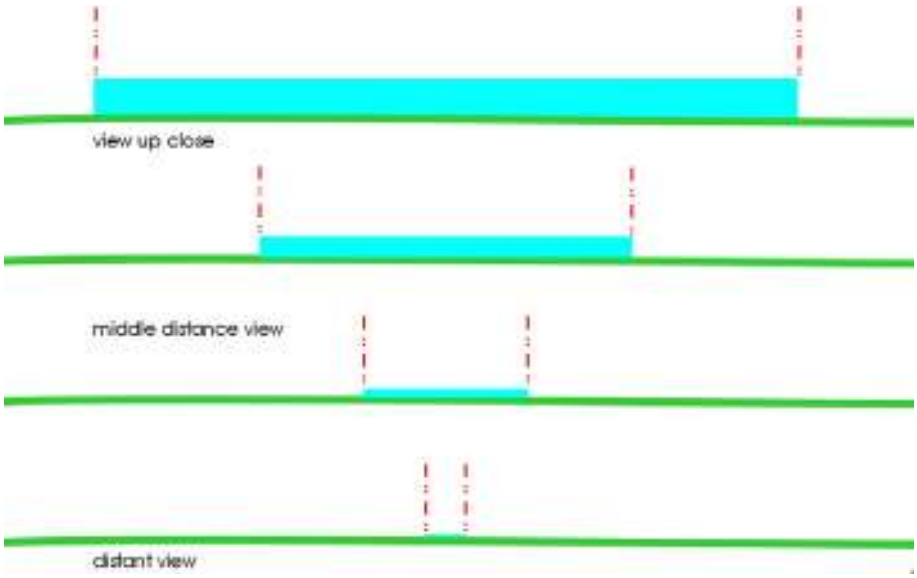


Figure B.2 The diminution in visibility with distance from a long horizontal object

As an observer moves further away from a horizontal object the width may still be apparent, however the vertical dimension reduces to insignificance

This effect can also be demonstrated by the example of a farm fence that may be several kilometres in width, yet as one moves further away, it becomes less apparent, until at some distance it is not possible to separate this element from the horizontal plane of the landscape. Similarly, the viewshed of a long horizontal object such as a wind farm can also be determined by its height.

As wind farms are comprised of many tall slim towers with rotating blades, wind farms are different to a solid structural mass such as buildings. At greater distances, the rotating blade becomes the most visible element and at closer distances, it is the overall height of the wind turbine that becomes most apparent.

For these reasons the extent of the viewshed is to be based on an analysis of the extent to which wind turbines extend into the vertical field of view.

VERTICAL FIELD OF VIEW

A similar analysis can be undertaken based upon the vertical line of sight for human vision.

These physical parameters are illustrated in ***Figure B.3***.

As can be seen in ***Figure B.3*** the typical line of sight is considered to be horizontal or 0O. A person's natural or normal line of sight is normally a 10O cone of view below the horizontal and, if sitting, approximately 15O.

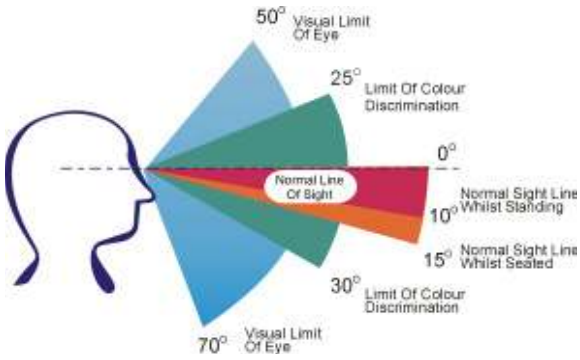


Figure B.3 Vertical Field of View

Objects, which take up 5% of this cone of view (5% of 10O = 0.5O) will only take up a small proportion of the vertical field of view, and are only visible when one focuses on them directly. However, they are not dominant, nor do they create a significant change to the existing environment when such short objects are placed within a disturbed or man-modified landscape.

Viewshed based on the vertical field of view

Objects that take up 5% of this cone of view (5% of 10O = 0.5O) are considered visually insignificant. That is not to imply that the objects become invisible at this distance, rather they become such a minor element in an already man modified landscape that their visual impact can be considered to be insignificant.

Once objects take up at least 10% of the vertical field of view, they can be more readily discernible (10% of 10O = 1O) and this visibility increases as the wind turbines increasingly take up a greater proportion of the vertical field of view.

When the wind turbines take up 25% of the vertical field of view, they become visually evident and when they take up 50% of the vertical field of view, they will dominate the view.

Table B.2 *Visual impact based on the vertical field of view to a wind turbine*

Vertical Line of Sight	**Visual Impact**	**Distance from an observer to a 135m high wind turbine**
< 0.5^{O} of vertical angle (5% of 10^{O} = 0.5^{O})	Insignificant A thin line in the landscape.	17,188m
0.5°-2.5°of vertical angle	Potentially noticeable The degree of visual intrusion will depend on the development's ability to blend in with the surroundings.	3,435 – 17,188
2.5^{O} – 5^{O} of vertical angle	Visually evident Usually visible, however the degree of visual intrusion will depend of the width of the object and its placement within the landscape.	<3,435m

The table above shows the distance at which a wind turbine approximately 150m high with a 100m diameter swept path of a rotor diminishes with distance within a vertical field of view.

In some lighting conditions, the rotor stands out in distant views and for this reason it is calculated separately for the outer edge of the viewpoint. As this calculation is intended as only a guide to setting the viewshed, all figures have been rounded to the nearest appropriate kilometre).

Proposed Viewshed & Zones of Visual Influence

The preceding analysis shows that a 150m high built form recedes into an insignificant element in the landscape at approximately 17.2km. It is proposed that the viewshed extend out to 17km and that the zones of visual influence are also set out *in Table B.3.*

Table B.3 *Viewshed and zones of visual influence*

Distance from an observer to the nearest wind turbine	Zones of visual influence
>17km	*Outside the viewshed*
8.5-17km	*Visually insignificant –* A very small element which are difficult to discern and will be indistinct in different lighting and weather conditions.
3-8.5km	*Potentially noticeable, but will not dominate the landscape.* The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer; however the proposed wind turbines will not dominate the landscape.
1.5 – 3km	*Highly visible and will usually dominate the landscape* The degree of visual intrusion will depend on the wind turbines' placement within the landscape and factors such as foreground screening.
<1.5km	*Will be visually dominant in the landscape from most viewing locations.* The degree of visual intrusion will only be reduced by screening by nearby vegetation or buildings

Insignificant visual impact & beyond the limit of the viewshed occurs at approximately 17km, at which point a 150m high wind turbine is no longer a significant visible element in a man modified landscape except for the most sensitive of locations. The swept path of the rotor also becomes the only visible element in some lighting conditions as the supporting tower becomes imperceptible and possibly this could reduce the viewshed to 11.5km in these lighting conditions.

The 17km viewshed is based on a conservative assumption that the wind turbines are a solid mass 150m high, similar to a building. In reality the wind turbines are widely spaced and the wind farm is a far more visually transparent object than a solid building mass some 150m high and many kilometres in width. However, it is also to be noted that the turning of the rotor also attracts the eye, extending the viewshed.

It is stressed that these calculations attempt to locate the distance at which a wind farm becomes imperceptible within a man-modified landscape. This is not to say that wind turbines at 18km, or even at 27km, are invisible. Wind turbines of this height will be discernible in good lighting conditions to an observer who knows where the wind turbines are located and therefore focuses in that direction. However the visual impact within a man modified landscape is not considered significant beyond this distance, aside from exceptional circumstances.

Visually insignificant visual impact occurs between 8.5km – 17km. At these distances the wind turbines are a very small element in the landscape and are often hard to discern. In any but exceptionally clear lighting conditions they are imperceptible.

Potentially noticeable visual impact occurs between 3km to 8.5km where the entire wind turbine is visible and lighting does not alter the visibility of the tower versus that of the rotor. Foreground vegetation and intervening landform can reduce the degree to which the wind turbines are noticeable.

Visually evident occurs at distances between 1.5km and 3km where the wind turbines have increased in visibility and are evident and potentially dominant in the landscape. Landscape is less effective at screening wind turbines unless it is close to the viewer.

Visually dominant occurs at distances closer than 1.5km. Wind turbines visible at this distance dominate will always the landscape.