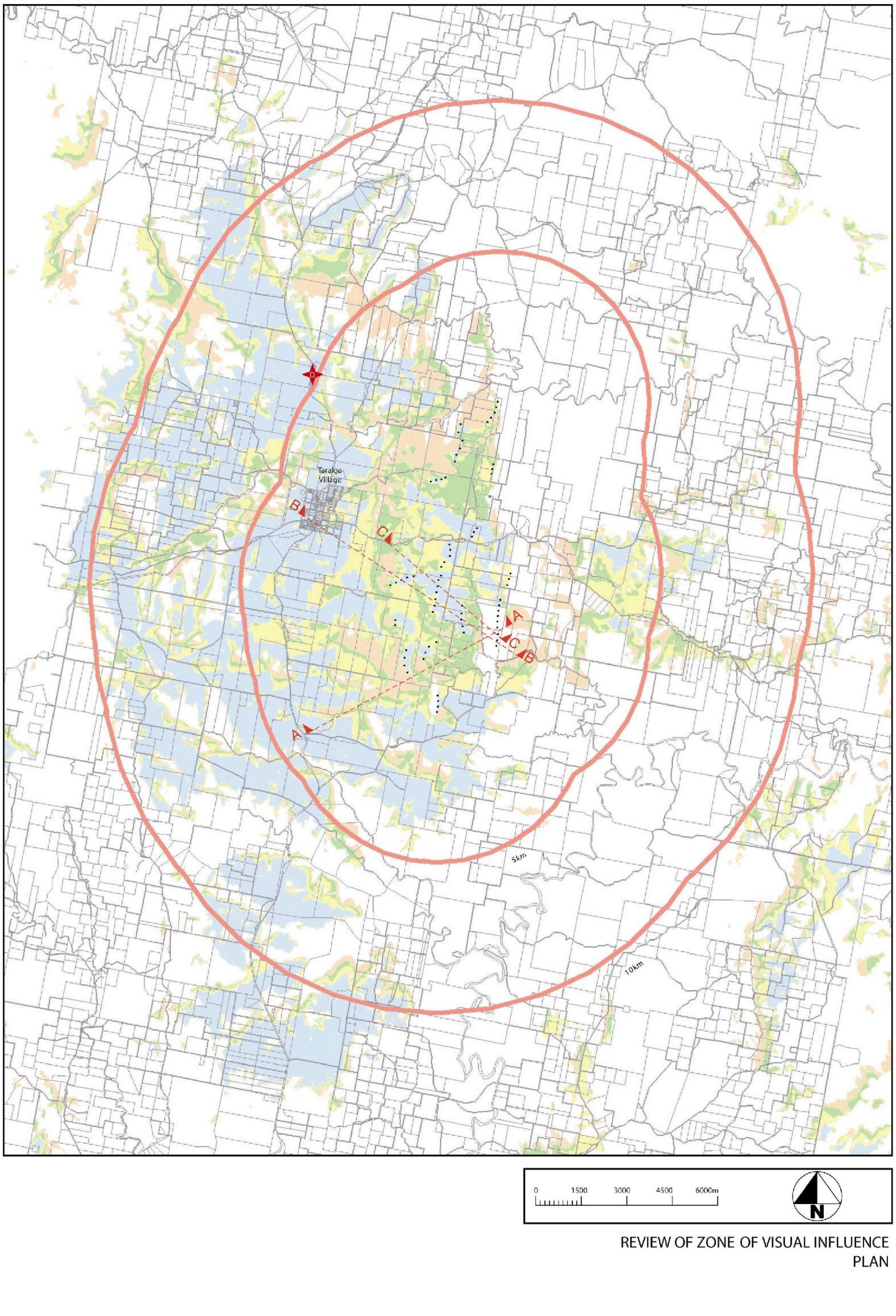
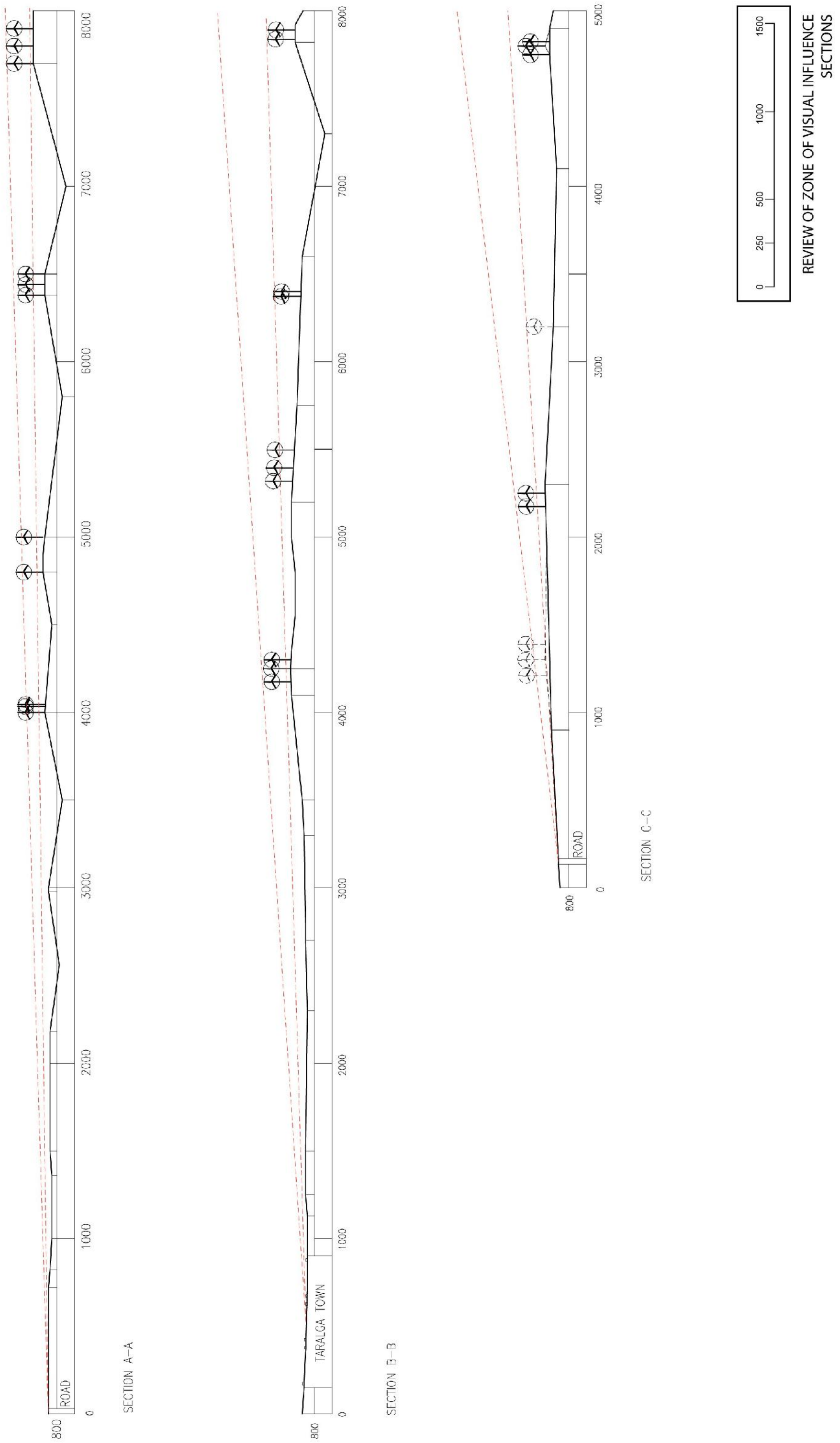
Appendix D
Analysis of Zone of Visual Influence

Desktop review and analysis of the ZVI included cross sections to check turbine visibility from selected locations. Cross sections are included on following pages.



REVIEW OF ZONE OF VISUAL INFLUENCE PLAN


SECTION A-A
ROAD
SECTION B-B
TARALGA TOWN
SECTION C-C
ROAD
REVIEW OF ZONE OF VISUAL INFLUENCE
SECTIONS

Appendix E
HASSELL Visual Assessment Matrix

The HASSELL matrix has been developed from The Visual Management System (VMS) produced by Litton (1968) primarily used for the U.S. Forest Service (1973) and the US Bureau of Land Management (1980). These models are based on a professional consultant (Landscape Architect) quantifying potential changes to landscape composition through "forms, lines, colours and textures and their interrelationships"[1]. Other factors such as compositional qualities, dominance, variety, animation and sensitivity to potential receptors are also considered.

The visual effect of the proposed development is assessed by a number of criteria, using a photomontage (see Appendix D) to form an overall appreciation of the visual impact within the existing landscape. This assessment quantifies issues such as:

- Existing landscape character;
- Degree of visual modification;
- Horizontal visual effect (HVE);
- Vertical visual effect (VVE);
- Distance of visual effect.

Each visual aspect is rated and then an accumulative value is given for the visual effect from critical viewpoints.

Existing Landscape Visual Character

This is an assessment of the visual character of the existing landscape. The probable change caused by the development is assessed against the existing degree of change caused through development or agricultural practice.

Table 1

Description	Value	Typical Character/Use
Unmodified landscape/natural	5	No or minimal impact associated with the actions of man. National parks, coastlines, native forest areas.
Natural transition landscape	4	A changing landscape character associated with the interface between natural areas and modified rural, pastoral or agricultural zones.
Modified rural landscape, agricultural, pastoral areas	3	Typical character is rural landscape, defined by field patterns, forestry plantations, and agricultural areas and associated small-scale roads and buildings.
Rural transition landscape	2	Transitional landscape associated with the interface between rural, agricultural areas and more developed suburban or urban zones.

[1] *Daniel, T C & Vining, J (1980) p49*

Description	Value	Typical Character/Use
Highly modified landscape, urban/industrial	1	Substantially developed landscape. High level of visual impact associated with buildings, factories, roads and other related infrastructure.

Degree of Visual Modification

This is an assessment of the degree of visual change that will occur within the context of the existing landscape due to the proposed development, and the existing landscape's ability to absorb or mitigate visual effect or change.

Table 2

Degree of Visual Modification (expressed as percentage of change)	Value	Description of Visual Modification
80-100%	5	Substantial visual impact. The existing landscape character is completely changed or modified to accommodate the development.
60-79%	4	Increasing visual impact. The landscape is seen as changed permanently with the development dominating the existing landscape.
40-59%	3	Moderate visual impact. Medium level of change to the landscape character. The landscape is less able to mitigate or absorb change due to the scale, frequency or extent of the development.
20-39%	2	Limited impact. The development is noticeable within the landscape, however the capacity for the landscape to absorb the development through vegetation growth, landform is high.
0-19%	1	No or minor visual impact within the landscape. The development is considered in keeping with the existing landscape character.

Horizontal Visual Effect (HVE)

The field of vision (FOV) experienced by the human eye is described as an angle of 200° horizontally. Using this fixed visual reference, an assessment of the possible impact of development within this measurable area is undertaken. The centre of the development is established and an angle of 100° each side is defined. The extent of visual effect within this zone is then measured. The overall assessment is made of the entire development, rather than of the individual objects that may form the proposal. This measurement of effect is then described as a percentage of the panorama.

Table 3

Degree of Horizontal Visual Impact (expressed as an angle of impact and percentage of change)	Value	Description of Visual Modification
161-200° (80-100% of the panorama measure at 200ºFOV)	5	Substantial horizontal visual impact. Visual impact throughout the whole panorama.
121-160° (60-80% of the panorama measure at 200ºFOV)	4	Increasing visual impact.
81-120° (40-60% of the panorama measure at 200ºFOV)	3	Moderate visual impact.
41-80° (20-40% of the panorama measure at 200ºFOV)	2	Limited impact.
0-40° (0-20% of the panorama measure at 200ºFOV)	1	No or minor visual impact

Vertical Visual Effect (VVE)

The vertical visual effect measures in a similar way to the assessment of horizontal visual effect, but the field of view is described as 150°. This assessment ensures that the visual effect in relation to proximity is considered.

Table 4

Degree of Vertical Visual Impact (expressed as an angle of impact and percentage of change)	Value	Description of Visual Modification
121-150° (80-100% of the panorama measure at 150ºFOV)	5	Substantial visual impact.
91-120° (60-80% of the panorama measure at 150ºFOV)	4	Increasing visual impact
61-90º (40-60% of the panorama measure at 150ºFOV)	3	Moderate visual impact.
31-60° (20-40% of the panorama measure at 150ºFOV)	2	Limited impact
0-30° (0-20% of the panorama measure at 150ºFOV)	1	No or minor visual impact within the landscape

Distance of Visual Effect

This is a measurement of how visual impact is modified by distance. The effect of scale, topography, vegetation and weather, changes with distance, and in turn changes the degree of visual effect.

Table 5

Location of Development (from viewpoint)	Value	Description
0 to 0.5 km	5	Adjacent
0.5 to 1 km	4	Foreground
1 to 3 km	3	Middle ground
3 to 5 km	2	Distant middle ground
5 km and greater	1	Background

Final Visual Effect Value

Table 6

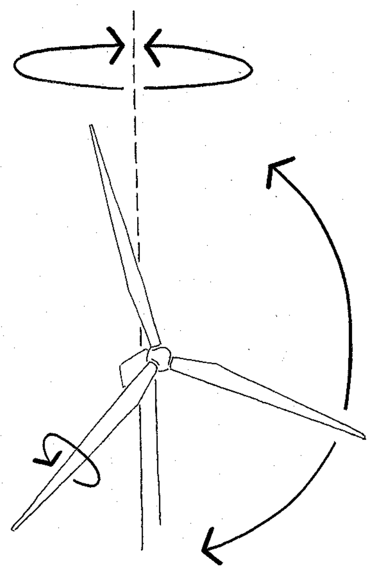
Degree of Visual Effect[2]	Value (total of previous criteria)
Severe	21 to 25
Substantial	17 to 20
Moderate	13 to 16
Slight	9 to 12
Negligible*	5 to 8

*Values between 0 and 4 cannot be expressed as part of the assessment criteria and therefore have not been considered within the final value.

[2] *Definitions of visual effect based on criteria set by Terence O'Rourke*

Appendix F
Turbine Dynamics, Glint, Shadow Flicker, Colour and Decals, Electromagnetic Interference

In assessing the visual impact of issues such as glint, flicker and shadow, an understanding of the wind turbine movement dynamics must be understood. Wind turbines, nacelles and blades are all able to adopt different pitches, rotations and orientations. This extremely complex and dynamic form of three-dimensional movement is difficult to assess and the impact of flicker or glint may vary or change, depending on turbine orientation, wind direction, wind speed, sun angle and the specific time of year.



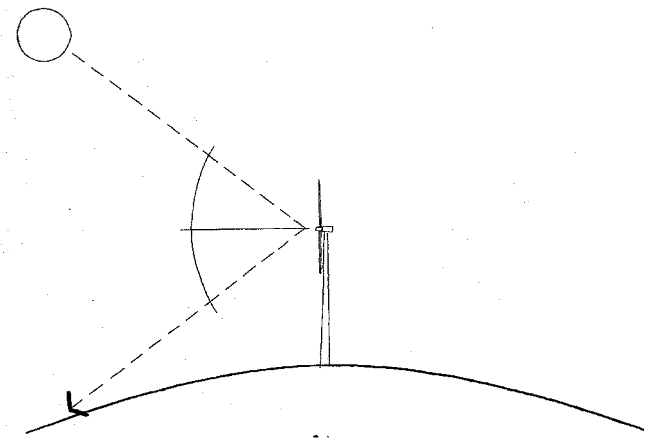
Research into the visual perception of turbine dynamics in the United States (Thayer & Freeman 1987), has established that "on one hand people find moving rotors more attractive than static ones, so that motion has been equated with lower perceived visual impact by some commentators. Whilst elsewhere there appears to be agreement that movement makes the turbines more conspicuous than they would otherwise be."

While it is difficult to model or accurately predict the impact of these issues, certain aspects can be identified and noted in order to appreciate the potential effect.

Glint

Glint is caused by the reflection of the sun's rays upon the wind turbine's blades. Research has indicated that glint from highly reflective surfaces can be observed between 10-15 km. In the case of a wind turbine, this would be dependent on the following factors, assuming the surface of the wind turbine is reflective.

- Sun angle.
- Wind turbine orientation.
- Blade pitch.
- Reflectivity of blade and nacelle surfaces.
- Rotation speed of blades.

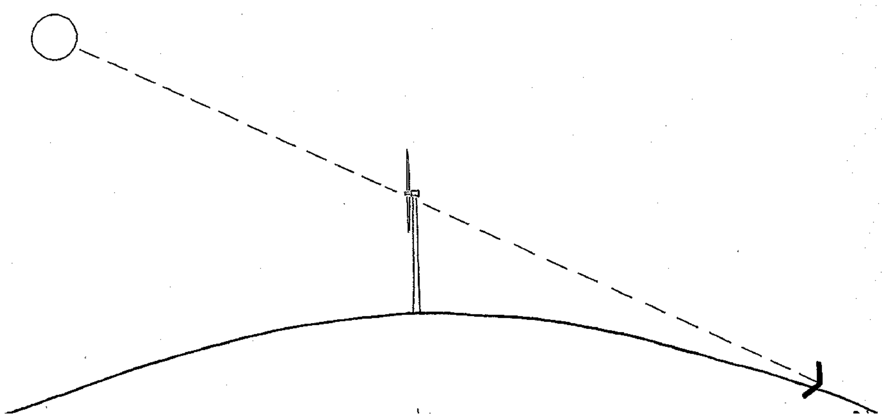


Flicker

Flicker results from the sun's rays being observed through the rotating blades of the wind turbine. This effect is dependent on a number of factors.

- Sun angle.
- Wind turbine orientation.
- Blade pitch.
- Rotation speed.

This effect is commonly experienced when the full face of the turbine blades are presented to a low sun angle over a distance of 350-500 metres when viewing through the blades.

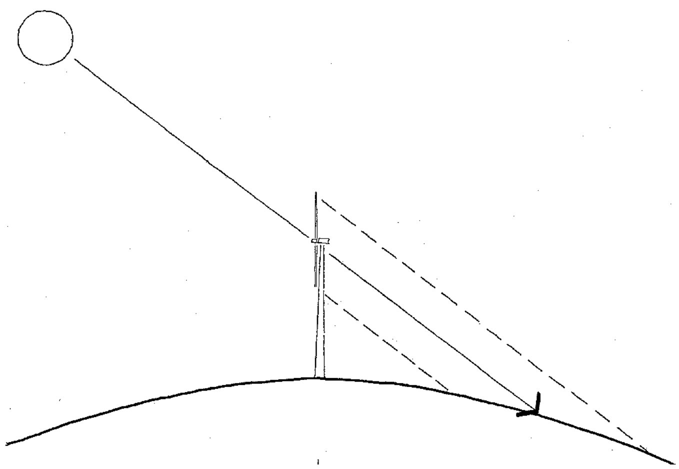


Shadow

The effect of the shadow is caused by the physical height and structure of the wind tower, nacelle and blades. Factors affecting shadow:

– Sun angle.
– Time of year.
– Wind turbine orientation.
– Topography.
– Vegetation.
– Other built forms.

Calculating the sun's lowest angle (mid June at 1630 hours), a value for the potential effect of shadow is calculated at 850-1000 metres, depending on the tower height. As described previously, the impact of this shadow will be dependent on the adjacent topography, the effect of trees and other vegetation in screening or distorting the shadow position.



It is important to note that the issues of shadow, flicker and glint are often described as causing a strobing effect that may cause nuisance to people within the adjacent area. While this effect may occur with smaller wind turbines, which operate at higher revolutions per minute, the operating speed of larger wind turbines would translate a much slower visual effect, limiting the potential nuisance.

Shadow flicker occurs when the blades of the rotor cast shadows or moving silhouettes, across the landscape or nearby dwellings. The major concern is the impact on nearby buildings and the possible psychological effects on those suffering from epilepsy (currently 2% of the population). Research in the United States and Europe have suggested that under worst case scenario the wind turbines in question would only have a shadow flicker effect for 100 minutes of the year, accounting to 20 minutes per year under normal circumstances (Gipe, 1995), and would produce a low frequency effect opposed to the higher frequency strobing required to induce an epileptic episode. These figures come from European studies where the effect may be amplified due to the latitude and low angle of the sun in winter.

Following a detailed assessment of the visual effect of the Taralga wind farm development, and a review of the Environmental Impact Statement, a number of recommendations have been made in respect to the following items:

- Colour selection.
- Wind turbines locations.
- Logos and signage.
- Revegetation.

Colour and Decals

Recommendations on the selection of colour for the wind turbines is based on a number of issues, such as the existing landscape colour, the predominant sky colour, and the perceptions associated with colour.

Research in Denmark (The Danish Wind Energy Association 2000) and in Scotland (The Scottish Natural Heritage 2001), have concluded that "experiments in blade colour have shown that pale blue, brown and grey rather than white appear to be more recessive, whilst a matt surface reduces the amount of glint". Gipe (1995) has arrived at the same conclusions, through his empirical survey work in this field of perception. However, Stanton (1996) has argued that the colour used for turbines should be white associated with purity and neutrality, rather than grey, which may represent technological fabric, linked to industrialisation.

Due to the seasonally varied colour of the existing landscape from a field colour of light sand during the summer months to a deep, fresh green during the winter months, it is not recommended that reference be drawn from either of these seasonal colours. A similar attitude should be adopted in respect to predominant sky colours. This is also affected substantially by seasonal change, varying from a pure blue, with little or no cloud impact during the summer, to a light grey sky during winter months.

Drawing on the findings of visual impact assessments from the United Kingdom and Denmark, it is recommended that the final colour selection be an off-white (slightly into the grey or cream tones) that will work well against the seasonally varied landscape and sky colour. Selections such as an obvious grey, or a galvanised finish would not be recommended, as issues of camouflage and industrialisation are associated with these alternatives. Finally, the finish should give consideration to reflectivity in order to remove potential glint. It is suggested that blades, nacelles and towers are devoid of signage and logos. Where decals are required, consideration should be given to their location in order to achieve a clear and uniform profile within the landscape.