Perception and Public Consultation

SECTION 14

14.1 Perception

People's perception of wind farms is an important issue to consider as the attitude or opinion of individuals adds significant weight to the level of potential visual impact.

The opinions and perception of individuals from the local community and broader area were sought and provided through a range of consultation activities. These included:

- Community Open House Events;
- Community Engagement Research (Telephone Survey); and
- Individual stakeholder meetings.

The attitudes or opinions of individuals toward wind farms can be shaped or formed through a multitude of complex social and cultural values. Whilst some people would accept and support wind farms in response to global or local environmental issues, others would find the concept of wind farms completely unacceptable. Some would support the environmental ideals of wind farm development as part of a broader renewable energy strategy but do not consider them appropriate for their regional or local area. It is unlikely that wind farm projects would ever conform or be acceptable to all points of view; however, research within Australia as well as overseas consistently suggests that the majority of people who have been canvassed do support the development of wind farms.

Wind farms are generally easy to recognise in the landscape and to take advantage of available wind resources are more often located in elevated and exposed locations. The geometrical form of a wind turbine is a relatively simple one and can be visible for some distance beyond a wind farm, and the level of visibility can be accentuated by the repetitive or repeating pattern of multiple wind turbines within a local area. Wind farms do have a significant potential to alter the physical appearance of the landscape, as well as change existing landscape values.

14.2 Public Consultation

The Proponent held a number of meetings with stakeholders in the area surrounding the wind farm, including open days and individual meetings with adjoining landowners potentially impacted by the wind farm development, and carried out neighbouring consultation at all residential dwellings within a 5km radius of the Collector Wind Farm.

The Proponent commissioned Auspoll Pty Ltd to conduct a survey to better understand and measure community attitudes to wind farms projects in the Southern Highlands and the Collector Wind Farm

project in particular. The survey canvassed the opinion of 400 people residing within a 50km radius of the Collector Wind Farm project between the 10th and 14th November 2010.

The methodology and results of the survey are detailed within the EA report and the key findings presented below.

When asked which aspects of the local landscape people most enjoyed, the mountain range and hills; bush vegetation; rural and agricultural outlook; open space and Lake George were the principal elements identified. The majority of respondents to the survey indicated a preference to view these elements from residential locations as well as local roads including trips along to Federal Highway toward Goulburn and Canberra.

68% of respondents said that based on what they know about wind farms in general and the Collector Wind Farm specifically; they support the Collector Wind Farm development.

When asked what the impact of the Project would be on the aspect of the landscape they most enjoyed 60% responded no impact or minimal impact. 13% responded that the wind farm would ruin the landscape and create an eyesore.

14.3 Quantitative Research

Whilst published Australian research into the potential landscape and visual impacts of wind farms is limited, there are general corresponding results between the limited number that have been carried out when compared with those carried out overseas.

A recent survey was conducted by ARM Interactive on behalf of the NSW Department of Environment, Climate Change and Water (September 2010). The survey polled 2022 residents across the six Renewable Energy Precincts established by the NSW Government, including the NSW/ACT Border Region Renewable Energy Precinct. The key findings of the survey indicated that:

- *97% of people across the Precincts had heard about wind farms or turbines, and 81% had seen a wind farm or turbine (in person or the media);*
- *85% of people supported the construction of wind farms in New South Wales, and 80% within their local region; and*
- *79% supported wind farms being built within 10km of residences and 60% of people surveyed supported the construction of wind turbines within 1 to 2kmfrom their residences.*
- *The survey recorded an above average level of support for the construction of wind farms within the NSW/ACT Border Region Renewable Energy Precinct.*

These results are reflected in other surveys including the community perception survey commissioned by Epuron Pty Ltd for the Gullen Range Wind Farm Environmental Assessment (August 2008). The results of the survey, which targeted a number of local populations within the Southern Tablelands, suggested that around 89 % of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71 % of respondents accepting the development of a wind farm within one kilometre from their residential dwelling.

The study targeted people living in a number of small urban and rural communities located in the area immediately surrounding the proposed Gullen Range wind farm as well as other communities surrounding potential future wind farm development sites. The results of the survey suggested that almost 89% of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71% of respondents accepting the development of a wind farm within one kilometre from their residential dwelling.

These general levels of support for wind farm developments have also been recorded for a number of wind farm developments around Australia as well as overseas.

Auspoll research carried out in February 2002 on behalf of a wind farm developer for a wind farm project in Victoria included just over 200 respondents. The results indicated that:

- *Over 92% of respondents agreed that wind farms can make a difference in reducing greenhouse emissions and mitigating the effects of global warming.*
- *Over 88% disagreed with the statement that wind farms are ugly.*
- *Over 93% of respondents identified 'interesting' as a good way to describe wind farms, over 73% nominating 'graceful' and over 55% selecting attractive.*
- *Over 79% of respondents thought that the wind farm would have a good impact on tourism, with 15% of respondents believing that the wind farm would make no difference.*
- *Over 40% of respondents believed that the impact of the wind farm on the visual amenity of the area would be good, with 40% believing that it would make no difference.*

A September 2002 MORI poll of 307 tourists conducted in Argyll (United Kingdom) indicated that:

- *43% maintained that the presence of wind farms had a positive impression of Argyll as a place to visit.*
- *43% maintained that the presence of wind farms had an equally positive or negative effect.*
- *Less than 8% maintained it had a negative effect.*

- *91% of tourists maintained that the presence of wind farms in Argyll made no difference to the likelihood of them visiting the area.*

There is no published Australian research on community attitudes to the impact of wind farms on landscape and visual issues before and after construction. However, overseas research in the United Kingdom conducted by MORI in 2003 indicated that:

- *Prior to construction 27% of people polled thought problems may arise from wind farm impact on the landscape*

- *Following construction the number of people who thought the landscape has been spoiled was 12%.*

The majority of research carried out to date has focussed on public attitudes to wind farms and does not provide any indication for acceptable or agreed thresholds in relation to numbers and heights of turbines, and the potential impact of distance between turbines and view locations.

14.4 The Broader Public Good

Whilst visual perceptions and attitudes of local communities toward wind farm developments are an important issue, and need to be assessed locally in terms of potential landscape and visual impacts, there is also an issue of the greater potential public benefit provided by renewable energy production. Wind farms are expected to make a contribution toward meeting the Government's commitment that 20% of Australia's electricity supplies come from renewable energy sources by 2020.

In the 2006 Land and Environment Court decision to confirm, on an amended basis, consent for the construction of a wind farm at Taralga, Chief Judge Justice Preston said in his prologue to the judgement:

"The insertion of wind turbines into a non-industrial landscape is perceived by many as a radical change which confronts their present reality. However, those perceptions come in different hues. To residents, such as members of the Taralga Landscape Guardians Inc. (the Guardians), the change is stark and negative. It would represent a blight and the confrontation is with their enjoyment of their rural setting".

"To others; however, the change is positive. It would represent an opportunity to shift from societal dependence on high emission fossil fuels to renewable energy sources. For them, the confrontation is beneficial – being one much needed step in the policy settings confronting carbon emission and global warming".

"Resolving this conundrum – the conflict between the geographically narrower concerns of the guardians and the broader public good of increasing the supply of renewable energy – has not been easy. However, I have concluded that, on balance, the broader public good must prevail".

Whilst the exact circumstances between the Taralga wind farm and the proposed Collector Wind Farm may differ, the comments provided by the Chief Judge make it clear that, in the circumstances of that case, there was a need for the broader public good to be put before the potential negative impacts on some members of the local community. Similar reasoning can be applied to the Collector Wind Farm.

15.1 Mitigation Measures

The British Landscape Institute states 'the purpose of mitigation is to avoid, reduce, or where possible remedy or offset any significant negative (adverse) effects on the environment arising from the proposed development' (2002). In general mitigation measures would reduce the potential visual impact of the Project in one of two ways:

- Firstly, by reducing the visual prominence of the wind turbines and associated structures by minimising the visual contrast between the wind turbines and the landscape in which they are viewed; and
- Secondly, by screening views toward the wind turbines from specific view locations.

In relation to the first form of mitigation, the design of the turbine structures has been highly refined over a number of years to maximise their efficiency. The height of the supporting towers and dimensions of the rotors are defined by engineering efficiency and design criteria. Consequently, modification of the turbine design to mitigate potential visual impacts is not considered a realistic option.

Colour is one aspect of the wind turbine design that does provide an opportunity to reduce visual contrast between the turbine structures and the background against which they are viewed. The white colour that is used on a majority of turbine structures provides the maximum level of visual contrast with the background. This maximum level of visual contrast could be reduced through the use of an appropriate off white or grey colour for the turbines where the visual contrast would be reduced when portions of the turbine were viewed against the sky as well as for those portions viewed against a background of landscape. The final colour selection would, however, be subject to the availability of turbine models on the market at the time of ordering and to aviation safety requirements.

The potential visual impact of the Project from specific view locations could be mitigated by planting vegetation close to the view locations. For instance, tree or large shrub planting close to a residence can screen potential views to individual or groups of turbines. Similarly roadside tree planting can screen potential views of turbines from particular sections of road provided the turbine is not located some distance from the road.

The location and design of screen planting used as a mitigation measure is very site specific and requires detailed analysis of potential views and consultation with surrounding landowners. Planting vegetation would not provide effective mitigation in all circumstances and can reduce the extent of existing views available from residences or other view locations.

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Subject to the DoPI determination, and any conditions of approval, the Proponent would consider implementing landscape treatments to screen and mitigate the potential visual impact of the wind farm for individual neighbouring properties (including those determined to have a high visual impact) within an appropriate and agreed distance from the wind farm project area. The extent and nature of appropriate mitigation measures would be subject to consultation and agreement with individual property owners.

There is greater potential to mitigate the visual prominence for some of the ancillary structures and built elements associated with the wind farm through the appropriate selection of materials and colours, together with consideration of their reflective properties.

The potential visual impacts of vehicular tracks providing access for construction and maintenance can be mitigated by:

- minimising the extent of cut and fill in the track construction;
- re-vegetating disturbed soil areas immediately after completion of construction works; and
- using local materials as much as possible in track construction to minimise colour contrast.

15.2 Summary of Mitigation Measures

A summary of the mitigation measures for the wind farm is presented in **Table 24**.

Table 24 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
Consider options for use of colour to reduce visual contrast between turbine structures and background, e.g. use of off white rather than white, and use matt finish to avoid reflected sunlight.	✓			
Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.			✓	✓
If necessary, design and construct site control building and facilities building sympathetically with nature of locality.	✓		✓	
If necessary, locate substations away from direct views from roads and residences, to minimise	✓		✓	

Table 24 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
additional line needed, and to 'blend in' with existing transmission infrastructure.				
Enforce safeguards to control and minimise fugitive dust emissions.		✓	✓	
Restrict the height of stockpiles to minimise visibility from outside the site.		✓	✓	
Minimise activities that may require night time lighting, and if necessary use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the site to minimise glare at night.			✓	✓
Minimise cut and fill for site tracks and revegetate disturbed soils as soon as possible after construction.		✓	✓	
Maximise revegetation of disturbed areas to ensure effective cover is achieved.				✓
Consider options for planting screening vegetation in vicinity of nearby residences and along roadsides to screen potential views of turbines. Such works to be considered in consultation with local residents and authorities.	✓	✓		
Undertake revegetation and off-set planting at areas around the site in consultation and agreement with landholders.	✓	✓	✓	

Conclusion

SECTION 16

16.1 Summary

In summary, this LVIA concludes that the Collector Wind Farm would have an overall low visual impact on the majority of non-associated residential and public view locations, including sections of the Hume and Federal Highways, as well as sections of the local road network identified in this LVIA.

This LVIA determined the overall landscape character sensitivity to be medium with some characteristics of the landscape likely to be altered by the wind farm development, although the landscape would have some capability to accommodate change. This capability is largely derived from the large scale and open landscape character identified in this part of the NSW Southern Tablelands, together with the relatively low density of residential view locations within the immediate area of the Collector Wind Farm 10km viewshed.

The five LCA's identified and described in this LVIA are generally well represented throughout the Upper Lachlan Shire Council area and more generally within other regions across the NSW Southern Tablelands. This LVIA has determined that the landscape surrounding the Project will have some ability to accommodate the physical changes associated with the Collector Wind Farm and its associated structures.

This LVIA determined that the Collector Wind Farm would have a high visual impact on 3 non associated and 3 associated residential dwellings within the 10km viewshed. The high visual impact would largely result from the proximity of wind turbines to the residential dwellings or orientation of dwellings relative to the wind turbines.

GBD understand that none of the associated landowners have expressed concerns with regard to the potential visual impact of the Project, including the potential visibility of wind turbines from within, or immediately surrounding their residential dwellings.

The majority of residential dwellings surrounding the Project site are strategically situated within the landscape to mitigate exposure to inclement weather, or have adopted measures to reduce these impacts by planting and maintaining windbreaks around residential dwellings. The extent of windbreak planting reduces the potential visibility of the Project from a number of residential view locations in the surrounding landscape.

This LVIA identified and assessed nine public view locations, including views from road corridors, and determined that the Project would have a low visual impact on all nine of the public view locations. The low visual impact would be largely due to the proximity of the wind turbines relative to the view location as well as the combined screening influence of undulating landform and tree cover. The majority of the public view locations are dynamic (motorists travelling along local roads) and include contextual views that would potentially change in reasonably quick succession within the spatial qualities of the surrounding landscape.

It is acknowledged that the Project has the potential to impact people engaged in predominantly farming or rural recreational activities, where views toward the Project occur from surrounding and non-associated agricultural areas. Ultimately the level of impact would depend on the type of activities engaged in as well as the location of the activities together with the degree of screening provided by local landform or vegetation within individual properties. Whilst views toward the turbines would occur from a wide area of surrounding rural agricultural land, this LVIA has determined that the sensitivity of visual impacts is less for those employed or carrying out work in rural areas compared to potential views from residential dwellings.

This LVIA has determined that the majority of non-associated landowners within the wind farm 10km viewshed are unlikely to have direct and open views toward the wind farm from their residential dwellings largely due to undulating landform, timbered areas and scattered tree cover.

The Collector wind farm would not have a significant impact on the urban character of the Collector village, where views toward the wind farm from a number of residential view locations would be screened by adjoining residences/structures, tree cover and landform.

The Collector wind farm would be visible from a number of local roads including the Hume and Federal Highway, the Gunning Collector Road, Lerida Road South and Collector Road. This LVIA has determined that views toward the Collector turbines would generally result in a Low impact for the majority of motorists travelling through the area.

This LVIA has determined that the construction of the Collector Wind Farm would not result in significant 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any known existing or proposed wind farm developments, including the Cullerin, Capital and Gunning Wind Farm projects. Intervisibility between approved and proposed wind farms is influenced by undulating landform and tree cover within and beyond the Collector Wind Farm 10km viewshed.

The potential substation location is unlikely to result in a significant visual impact for surrounding residential or public view locations. A combination of distance between substation and transmission line components to surrounding view locations and the presence of scattered and grouped tree vegetation would tend to reduce visibility.

Both pre-construction and construction activities are unlikely to result in an unacceptable level of visual impact due to the temporary nature of these activities together with proposed restoration and rehabilitation strategies. The preferred location for some of the construction activities, including the on-site concrete batch plant, would generally be located away from publicly accessible areas, with the closest residential view locations generally comprising associated landowners.

Night time obstacle lighting would have the potential to be visible from surrounding view locations, as well as areas beyond the Collector Wind Farm 10km viewshed. The level of visual impact would diminish when viewed from more distant view locations, with a greater probability of night time

lighting being screened by landform and/or tree cover. It should also be noted that the night time lighting installed on the Cullerin Wind Farm (as illustrated in this LVIA) has been decommissioned by Origin Energy following a risk based aviation assessment. A number of recent wind farm developments in New South Wales have also been approved without a requirement for night time lighting, including the Gullen Range and Glen Innes Wind Farms.

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of the elements associated with the Project, it is acknowledged that the degree to which the wind turbines would be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations. Despite this, the Proponent has engaged in ongoing consultation with local residents and made a number of adjustments to the location of individual turbines to minimise visual impacts where possible.

Subject to DoPI determination, and any conditions of approval, the Proponent would consider implementing landscape treatments to screen and mitigate the potential visual impact of the wind farm for individual neighbouring properties (including those determined to have a high visual impact) within an appropriate and agreed distance from the wind farm project area. The extent and nature of appropriate mitigation measures would be subject to consultation and agreement with individual property owners.

Appendix A – NSW Draft Planning Guidelines (December 2011). Meeting Assessment Requirements: Landscape and Visual Amenity

Where a wind farm application is State significant development (SDD), specific assessment requirements are specified in the Director Generals Requirements (DGRs). This appendix includes information to assist applicants with assessing particular impacts from a wind farm proposal in cases where DGRs require particular impacts to be assessed. The assessment must be detailed in the proponents EIS.

Landscape and visual amenity

The visual impact of a wind farm depends on the extent of the change to the landscape caused by the development, taking into account:

- The visibility of the development
- The locations and distances from which the development can be viewed
- Landscape values and their significance
- The sensitivity of the landscape features to change

The visual impact of the development relates to:

- The number, height, scale, spacing, colour, and surface reflectivity of the wind turbines
- The quantity and characteristics of lighting, including aviation obstacle lighting (subject to CASA requirements and advice)
- Potential for visual clutter caused by turbine layout and ability to view through a cluster or array (visually well ordered series) of turbines in an orderly manner
- The removal or planting of vegetation
- The location and scale of other buildings and works including transmission lines and associated access roads
- Proximity to sensitive areas
- Proximity to an existing or proposed wind farm, having regard to cumulative visual effects

The features of the landscape include:

- The topography of the land
- The amount and type of vegetation
- Natural features such as waterways, cliffs, escarpments, hills, gullies and valleys
- Visual boundaries between major landscape types

- The type, pattern, built form, scale and character of development, including roads and walking tracks
- Flora and fauna habitat
- Cultural heritage sites
- The skyline

Assessing landscape and visual amenity impacts

DGRs typically require a comprehensive assessment of the impact of a proposed wind farm on the landscape character, landscape values, visual amenity and any scenic or significant vistas to be undertaken. There should be a particular focus on any neighbours' houses within 2km of a proposed wind turbine that do not host the wind farm facility. The assessment should include:

- A description of the assessment methodology and a clear justification of it including discrete justification of the methodology for assessing impacts at neighbours houses within 2km of a proposed wind turbine
- A description of all relevant components of the project, including turbine heights and layout – where micro siting or a range of turbines is proposed, the assessment should be based on the 'worst case' layout and turbine height
- A description of the landscape including key features
- A description of the visibility of the development
- Photomontages of the project and associated transmission lines taken from:
    - Potentially affected residences (including approved but not yet developed dwellings or subdivisions with residential rights) within 2km of a proposed wind turbine or other associated infrastructure (note that the number of photomontages may be reduced in less sensitive landscapes such as industrial areas),
    - Urban settlements, and
    - Significant public view points including roads, lookout points and walkways.
- Identification of the zone of visual influence of the wind farm (no less than 10km)
- A description of the significance of the landscape values and character in a local and regional context

- A description of community and stakeholder values of the local and regional visual amenity and quality and perceptions of the project based on surveys and consultation
- Assessment of cumulative impacts on the landscape ad any cumulative visual impacts from transmission line infrastructure and any surrounding approved or operational wind farms in the locality

Mitigating landscape and visual amenity impacts

The feasibility, effectiveness and reliability of proposed mitigation measures should be assessed. The extent of any residual impacts leftover after mitigation measures have been implements should also be described. Examples of mitigation measures that proponents can use to reduce the visual impact of a proposed wind farm include:

- Where possible locate turbines:
    - Away from areas of high scenic value
    - Away from areas with high visibility from local residents
- Select turbines that:
    - Look the same, have the same height and rotate the same way
    - Are off white or grey colouring
- Minimise the removal of vegetation
- Plant vegetation to provide a visual screen
- Reduce impacts of night and obstacle lighting by:
    - Limiting lighting on towers to that required for safe operation and aviation safety and
    - Use of lighting design which minimises glare
- Underground electricity wires where practicable
- Use alternative transmission line pole designs to minimise visual impact.

Appendix B – Truescape Photomontage Methodology

TRUESCAPE
VISUAL COMMUNICATION

RATCH Australia Corporation
Statement of Methodology

Collector Wind Farm Simulations

TRUESCAPE CREDENTIALS

Truescape has over 16 years' experience working in the 3D Photo and Video Simulation industry. Truescape has completed a wide range of different visualisation projects from Photo Simulations for simple projects to full computer generated 3D video simulations for complex projects. Truescape's client base spans many industries, from Landscape Architecture and Engineering firms through to major New Zealand and Australian and US corporates.

Truescape adopts a team approach for project completion as each type and phase of a project calls for a different mix of specialised skill sets. This expertise spans many disciplines including photography, engineering, architecture, surveying, landscape architecture, 3D computer modelling, evidence preparation and presenting evidence as expert witnesses. All members of our staff have either formal qualifications or have undergone professional training and have direct experience working in each these specialised areas.

Truescape simulations have been produced as evidence in forums such as the New Zealand Environment and High Courts, Australia's Victorian Civil and Administrative Tribunal and the Supreme Court. Members of Truescape's staff have presented evidence as expert witnesses in these Courts, where our work has been subjected to cross-examination and accepted as evidence.

Truescape has assisted in providing survey controlled Photo Simulations for the following Wind Farm developments:

- 2003 – Meridian Energy, Te Apiti Farm, Council Hearing;
- 2004 – Meridian Energy, White Hill Farm, Council Hearing;
- 2004 – Southern Hydro, Dollar Wind Farm South Australia, Panel Hearing;
- 2005 – Genesis Energy, Awhitu Wind Farm, Environment Court;
- 2005 – Unison Energy, Hawkes Bay Wind Farm, Environment Court;
- 2006 – Meridian Energy, Project West Wind, Environment Court;
- 2006 – Acciona Energy, Wind Farm South Australia, Panel Hearing;
- 2007 – Invenergy, Moresville Wind Energy Park, New York; USA Permitting Hearing;
- 2008 – Bluewater Wind, Offshore Wind Farm, Maryland, USA; Permitting Hearing;

- 2008 – Bluewater Wind, Offshore Wind Farm, New Jersey, USA; Permitting Hearing
- 2008 – BP Alternative Energy – White Pines Project, Michigan, USA; Permitting
- 2008 - Meridian Energy, Project Mill Creek, Council Hearing
- 2008 – Meridian Energy, Project Hayes, Environment Court;
- 2008 – Shell Wind Energy Inc, New York State, USA; Preliminary Planning;
- 2009 – Roaring 40s, Sidonia Hills Wind Farm; Australia, Consultation;
- 2009 – Acciona, Allendale Wind Farm; Australia, Planning Application;
- 2009 – Meridian Energy, Project Central Wind, Council Hearing;
- 2009 – Meridian Energy, Project Central Wind; Environment Court;
- 2010 – West Wind Energy, Australia, Permit Application;
- 2010 – Meridian Energy Limited, Project Mill Creek, Environment Court Hearing;
- 2010 – Pacific Hydro; Australia, Panel Hearing;

SCOPE OF WORK

RATCH Australia Corporation engaged Truescape in September 2011 to produce computer simulated visual aids to assist with consultation and communication to the public, for the Collector Wind Farm. To this end, the following was generated:

- 5 TrueView™ photo simulations showing the proposed wind farm

VIEWPOINT LOCATIONS

Location map referencing publically accessible TrueView™ simulations

Viewpoint 01	Federal Hwy South of Collector
Viewpoint 02	View from Bushrangers Hotel
Viewpoint 03	Breadalbane Road
Viewpoint 04	Hume Highway
Viewpoint 05	Federal Highway North of Collector

VALIDATION OF METHODOLOGY

We have attached below some post construction analysis of the "Project West Wind" wind farm that compared a simulation built using the construction layout plan against the completed project. This comparison of the photograph to the simulation demonstrates the accuracy of the TrueView™ simulations.

In particular, it can be seen that the size and placement of the turbines in this simulation is identical to the wind farm that was constructed. It should be noted that the turbines in the simulation seem more obvious than the actual turbines in the photograph due to the atmospheric conditions experienced on the day the photograph was taken.

The simulation and photograph were produced 2 years and 7 days apart and both are taken at the same time of day so as to produce the same lighting and shadow conditions.

SIMULATION OF PROJECT WEST WIND PRE CONSTRUCTION (February 2008)

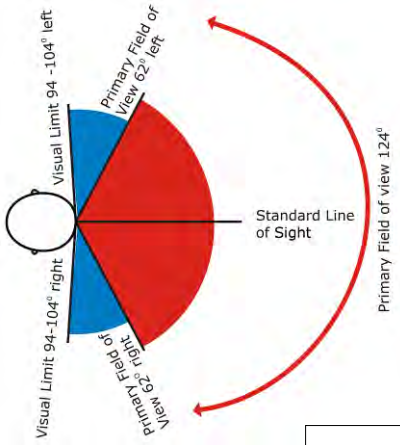
PHOTOGRAPH OF PROJECT WEST WIND POST CONSTRUCTION (February 2010)

TrueView™ PHOTO SIMULATION

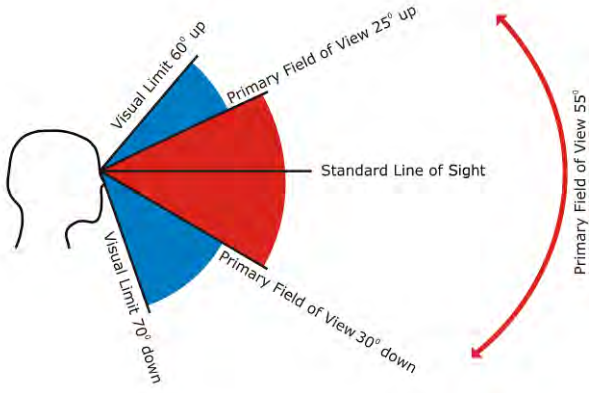
A TrueView™ Photo Simulation is a high resolution, true scale format Photo Simulation that represents **The Primary Human Field of View** that would be seen if standing 500 mm back from actual viewpoint position at the same time of day and reflecting the same climatic conditions as those experienced on the day the photograph was taken.

PRIMARY HUMAN FIELD OF VIEW

Primary Human Horizontal Field of View



Primary Human Vertical Field of View



Reference: Panero J. and Zelnick M. (1979) *Human dimension and interior space: A source book of design reference standards,* London: The Architectural Press Ltd

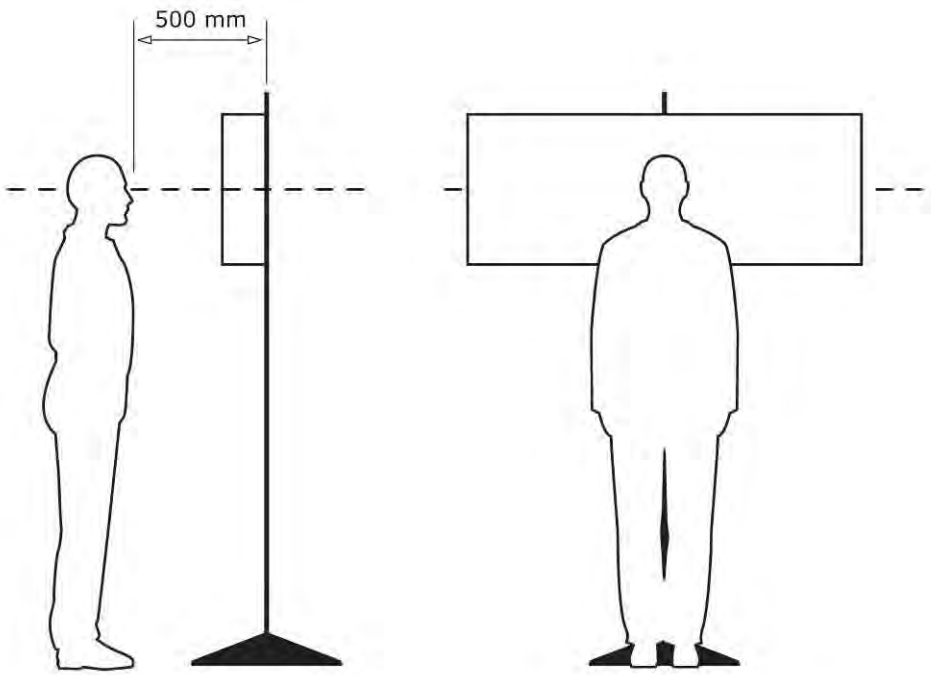
TrueView™ PHOTO SIMULATION

Correct Viewing of TrueView™ Photo Simulations

The TrueView™ Photo Simulation when viewed at the correct height and from a distance of 500 mm from the centre of the image completely fills your field of view with the same view you would see at the viewpoint position.

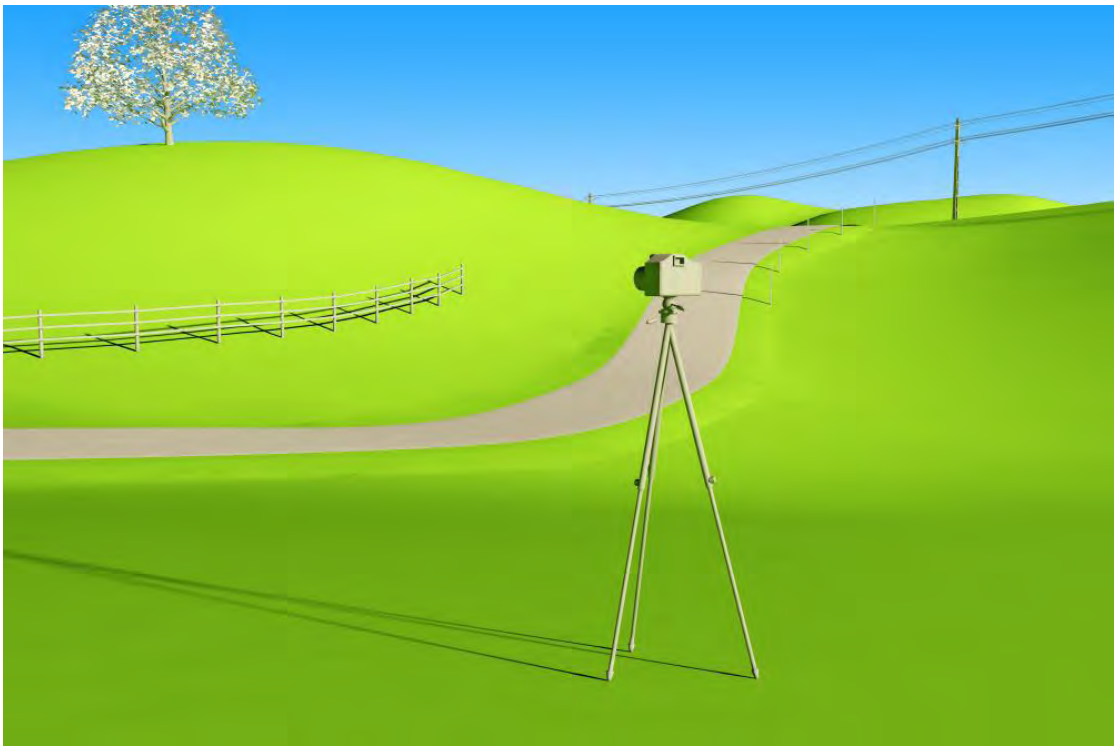
The image should be displayed level at such a height to allow the viewer's line of sight to be directly at the centre of the image.

The viewer should be looking forward at the centre of the image at all times to ensure correct viewing as shown below.



METHODOLOGY

The Site Visit



The site visit is undertaken to take the necessary photographs and ground mark the viewpoint position and identify additional reference points to enable the surveyor to survey fix the exact location of the camera.

A digital SLR 1:1 16 mega pixel camera is used to take the photography. This camera produces photographs at a resolution and clarity as good as current technology will allow when generating photo-montages.

METHODOLOGY

Creating the Primary Human Field of View Image

The photographs are taken so that they overlap precisely to allow both the Primary Human Vertical and Horizontal Field of View to be recreated into a single primary human field of view image.

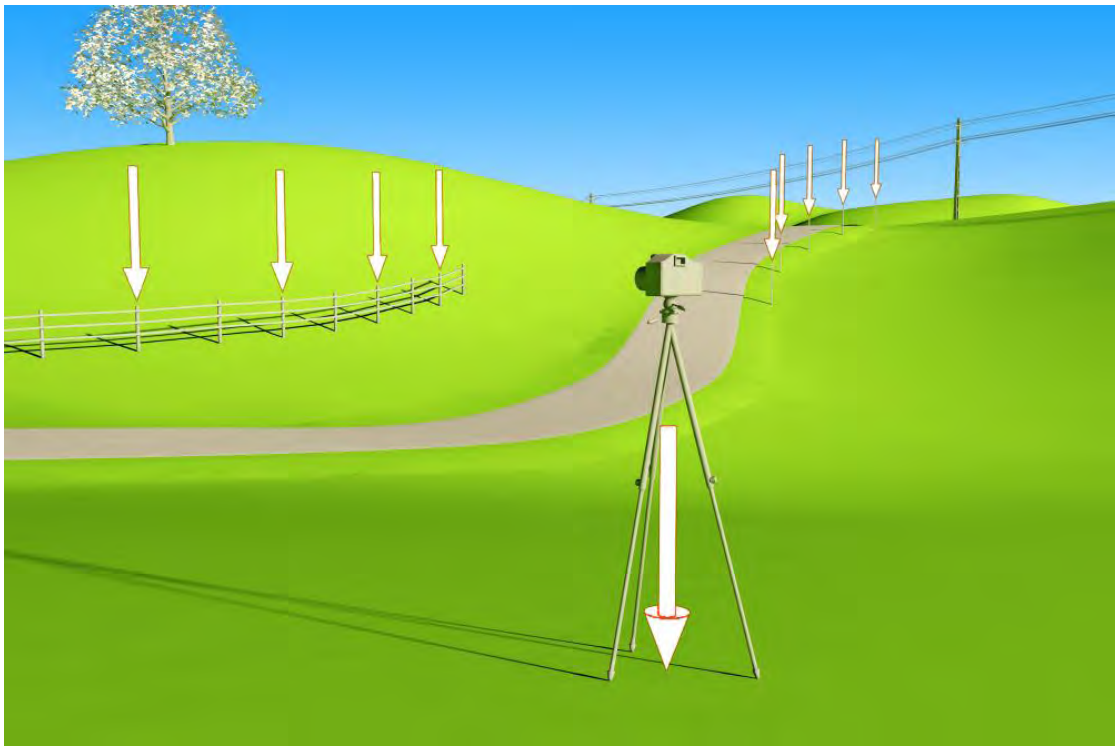
METHODOLOGY

The Final Colour Adjusted TrueView™ Photograhy

Using the middle photographs as the benchmark, each of the adjoining photographs are colour adjusted to ensure consistency throughout the image. The TrueView™ photograph is now complete.

METHODOLOGY

Capturing the Surveyed Reference Points

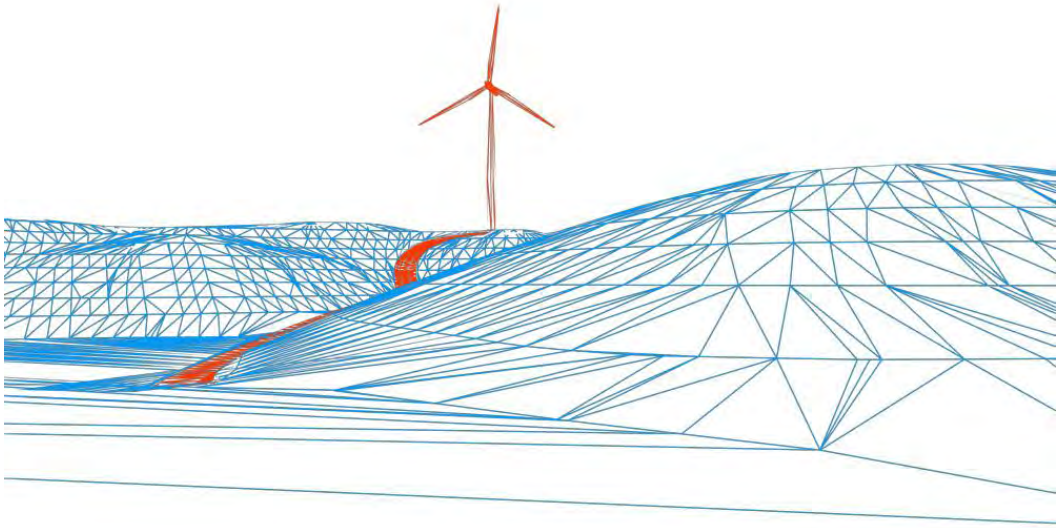


To accurately create a TrueView™ Photo Simulation the exact position of the camera is survey-fixed by a surveyor.

Additional reference points are identified during the site visit so that the 3D model can be accurately placed into the photograph. These reference points include things like fences, vegetation, houses and roads. The surveyor is directed to each of these points.

METHODOLOGY

Aligning the Surveyed Reference Points

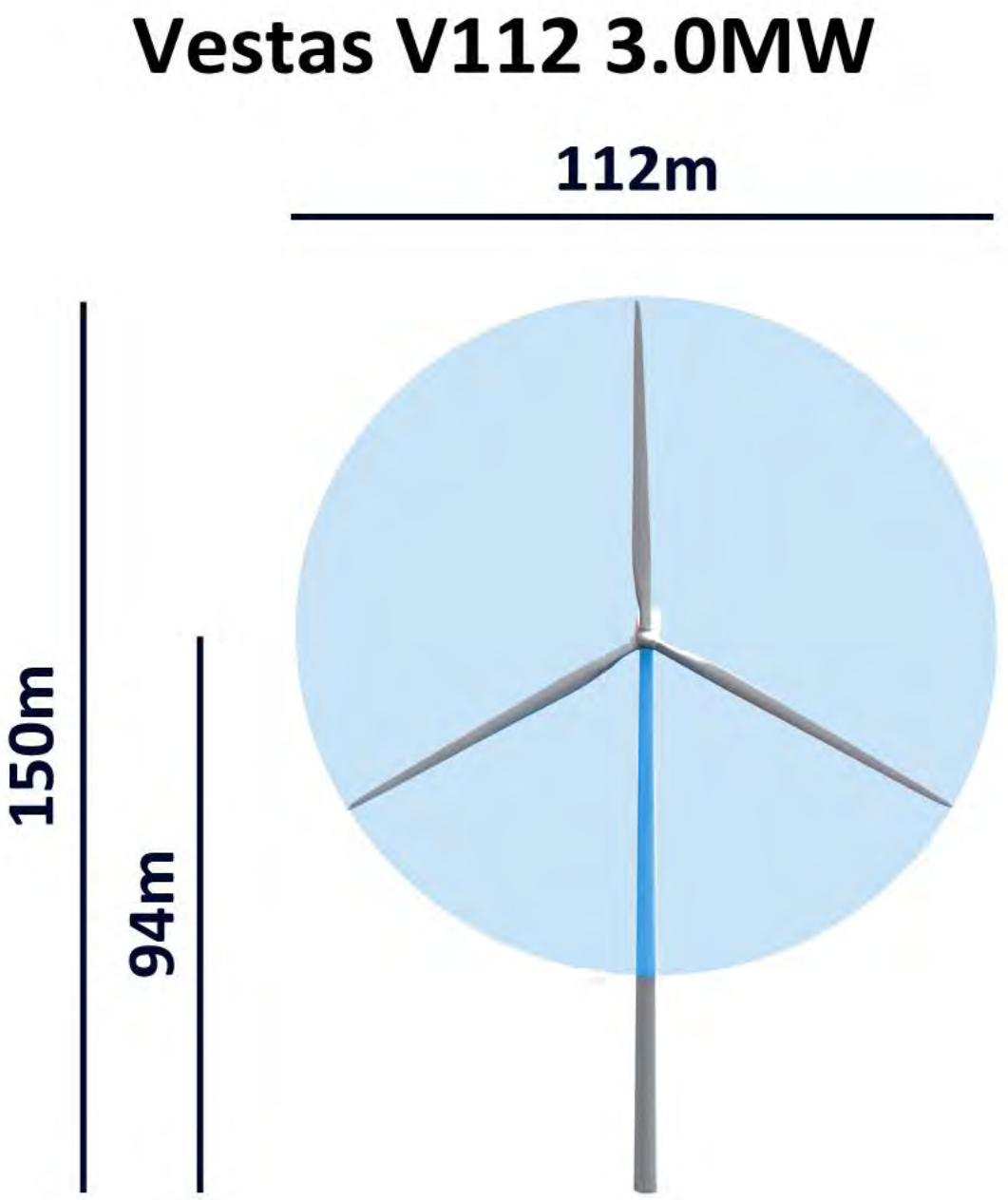


The next step is to construct the 3D computer model. Using Autodesk® 3ds Max® 3D computer simulation software the survey-fixed photo and reference points are imported into the 3D model. A "computer camera" is created to simulate the camera that captured the original photographs, including matching the focal length. The simulated "computer camera" is then positioned at the same survey coordinates as the physical viewpoint positions.

The photographs are then incorporated into the computer model. This is done by correctly aligning the "computer camera" to match the surveyed reference points to the reference objects, and to the terrain if required.

METHODOLOGY

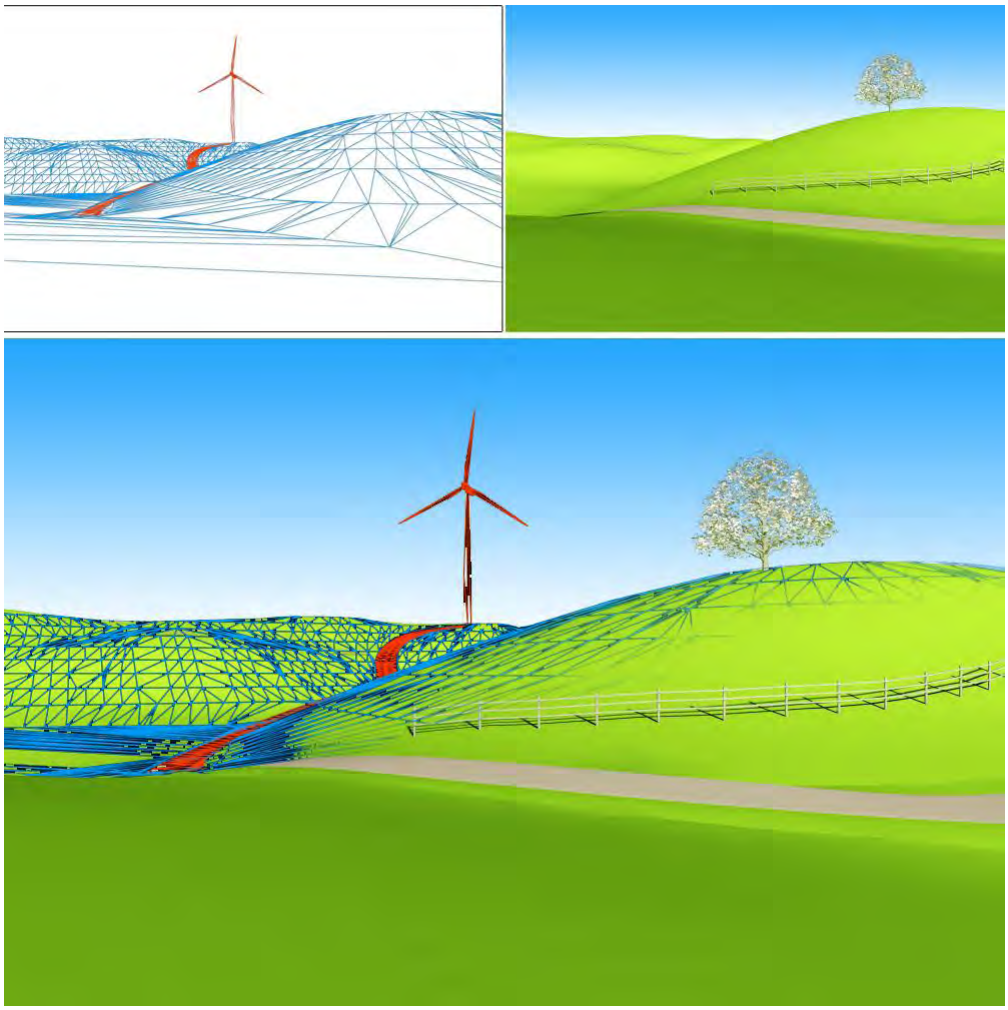
Building the Proposed Project in 3D



The proposed turbines are then modelled in 3D in accordance with all dimensions, site layouts, colours and textures

METHODOLOGY

Building the Proposed Project in 3D



The 3D terrain model of the site has been generated using the land contour data. The proposed development has now been modelled in 3D and is imported and positioned accurately into the scene.

The simulation software allows the sun to be simulated at the precise time the original photography was captured. This ensures the lighting of the turbines as well as the shadows they cast are an accurate depiction of how the Project would appear in the photograph at the same time of day and reflecting the same climatic conditions as those experienced at the time the photograph was taken.

The Final TrueView™ Photo-Montage

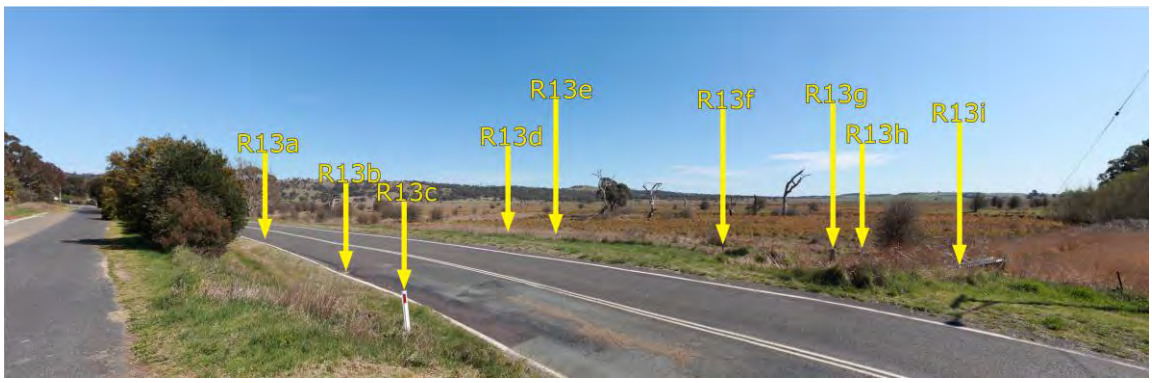
In order to correctly place existing objects that are in front of the 3D model of the development, these foreground objects are overlaid, from the original photograph, onto the computer generated image using photo shop software.

Our extensive experience in researching how to accurately simulate the "Primary Human Field of View" has determined that the lens type is irrelevant when generating such simulations. The key factors are the aligning of the raw photographs in 3D, the size that the simulations are output at, and the viewing distance.

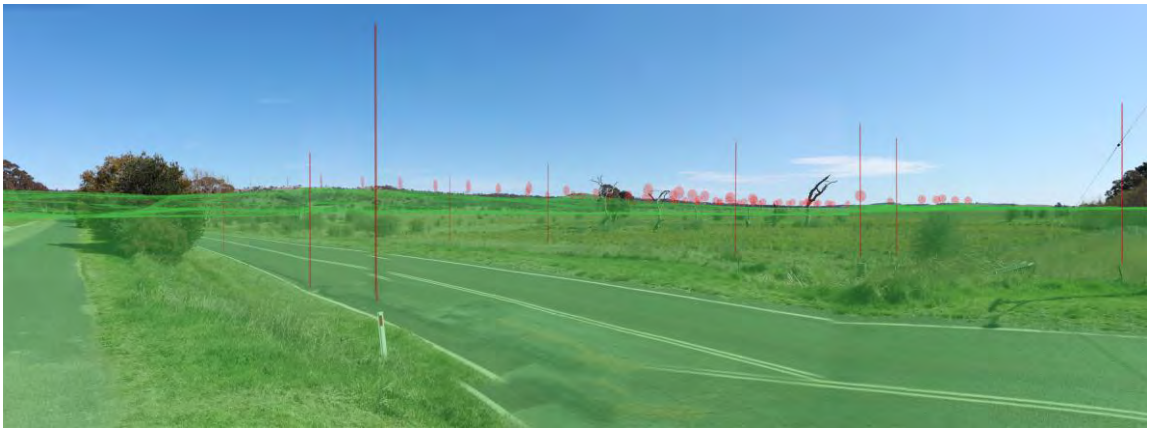
The full size TrueView™ photo-montages are printed at a size that represents the "Primary Human Field of View", being 124º horizontal field of view and 55º vertical field of view when standing 500 mm from the centre of the image.

SURVEY CONTROL

Using Viewpoint 02 as an example the images below represent the survey accurate alignment of reference points and terrain. All surveying was carried out by Southern Cross Surveying.



Reference points requested for survey



Reference points depicted by coloured lines have been survey fixed and used to Accurately position the wind turbines into the photograph.

The final TrueView™ Photo Simulation

Appendix C – Civil Aviation Safety Authority Advisory Circular AC139-18(0) July 2007 (Withdrawn)

Australian Government
Civil Aviation Safety Authority

Advisory Circular

AC 139-18(0) SEPTEMBER 2004

OBSTACLE MARKING AND LIGHTING OF WIND FARMS

CONTENTS

1. REFERENCES

- CASR Part 139, Subpart 139.E, and in particular
  - ◊ 139.365 Structures 110 metres or more above ground level.
  - ◊ 139.370 Hazardous objects etc.
- MOS-Part 139 Chapter 7 – Obstacle Restrictions and Limitations.
- MOS-Part 139 Section 8.10 – Obstacle Marking.
- MOS-Part 139 Section 9.4 – Obstacle Lighting.

2. PURPOSE

This Advisory Circular (AC) provides general information and advice on the obstacle marking and lighting of Wind Farms (including single wind turbines), where CASA has determined that the wind farm is, or will be, a hazardous object to aviation.

3. STATUS OF THIS AC

This is the first AC to be issued on this subject.

Advisory Circulars are intended to provide recommendations and guidance to illustrate a means but not necessarily the only means of complying with the Regulations, or to explain certain regulatory requirements by providing interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations

4. GENERAL

4.1 This AC applies specifically to horizontal-axis wind turbines, which are the only type installed, or known to be proposed for installation, in Australia, at the date of issue of this document.

4.2 This AC applies to:

(a) a single wind turbine; or

(b) a group of wind turbines, referred to as a wind farm, which may be spread over a relatively large area.

4.3 The height of a wind turbine is defined to be the maximum height reached by the tip of the turbine blades.

4.4 Australian standards and recommended practices for the marking and lighting of obstacles and objects assessed as being hazardous to aviation, are consistent with international standards and recommended practices as published by the International Civil Aviation Organisation (ICAO) in Annex 14 Volume 1 (Aerodrome Design and Operations). The general requirements are:

(a) marking is used to make objects conspicuous to pilots, by day.

(b) lighting is used to make objects conspicuous to pilots, by night;

(c) lights are located as close as practicable to the top of the objects, and at other locations so as to indicate the general definition and extent of the objects.

4.5 Wind turbines pose a particular practical problem in that their highest point is not a fixed structure, and therefore lights can not be appropriately located. The highest fixed part of the turbine where lights can conveniently be located is the top of the generator housing, sometimes known as the nacelle, and this is typically of the order of 2/3 the maximum height of the turbine.

4.6 ICAO has not yet published standards and recommended practices specifically suited to wind turbines. The advice in this document has been derived by allowing some variations to standards and recommended practices to accommodate the specific practical difficulties associated with wind turbines and wind farms, and taking into consideration the practices of some overseas countries.

5. WIND TURBINES IN THE VICINITY OF AN AERODROME

5.1 CASA strongly discourages the siting of wind turbines in the vicinity of an aerodrome.

5.2 A wind turbine located sufficiently close to an aerodrome so that it penetrates an obstacle limitation surface (OLS) of the aerodrome, is defined by MOS-Part 139 Section 7.1, to be an obstacle.

5.3 If the aerodrome is to be used at night, an obstacle that penetrates an OLS should be lighted, in accordance with MOS-Part 139 Section 9.4. The top lights are required to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface. For a wind turbine, these lights may be located on a separate supporting structure adjacent to the wind turbine, to overcome the difficulty associated with the highest point of the obstacle being the (moving) blades of the turbine.

Note: Obstacle limitation surfaces are a complex of imaginary surfaces associated with an aerodrome. They vary depending on number and orientation of runways, and the instrument-approach type of the runway(s). Some surfaces can extend to 15 km from an aerodrome. Aerodrome operators can provide details for their particular aerodrome.

6. WIND TURBINES WITH A HEIGHT OF 110 m OR MORE

6.1 CASR 139.365 requires a person proposing to construct a building or structure, the top of which will be 110 m or more above ground level, to inform CASA of that intention and the proposed height and location of the proposed building or structure.

6.2 CASA will conduct an aeronautical study to determine if the wind turbine will be a hazardous object to aviation, in accordance with CASR 139.370.

6.3 If, as a result of the aeronautical study CASA finds that a proposed wind turbine will penetrate an OLS of an aerodrome, the proposal will be dealt with in accordance with 5 above.

6.4 The aeronautical study may find that even though the proposed wind turbine will not penetrate any OLS of an aerodrome, it will be a hazardous object to aviation.

6.5 The hazard that an object poses to aviation can be reduced by indicating its presence by appropriate marking and/or lighting.

Note: The marking and/or lighting does not necessarily reduce operating limitations which may be imposed by an obstacle or hazardous object.

6.6 The advice, in 7 and 8 below, on marking and lighting of wind turbines, should be suitable for wind turbines that do not penetrate an OLS, in most cases. However, because of the variations in configurations and layout of turbines in wind farms, the aeronautical study may indicate that a variation to that advice would be appropriate for a particular wind farm. In such a case, CASA may offer suggestions for variations to the normal advice provided in 7 and 8 below.

7. MARKING OF WIND TURBINES

7.1 Experience with wind turbines installed to date, indicates that they are sufficiently conspicuous by day, due to their shape, size, and colour.

7.2 Wind turbines that are of basically a single colour, and visually conspicuous against the prevailing background, do not require to be painted in obstacle marking colours and/or patterns.

8. LIGHTING OF WIND TURBINES

8.1 In the case of a single wind turbine:

(a) two flashing red medium intensity obstacle lights should be mounted on top of the generator housing;

(b) the light fixtures should be mounted at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;

(c) both lights should flash simultaneously; and

(d) the characteristics of the obstacle lights should be in accordance with MOS-Part 139 subsection 9.4.7.

8.2 In the case of a wind farm, sufficient individual wind turbines should be lighted to indicate the extent of the group of turbines:

(a) the interval between obstacle lights should not be less than the current extensive object standard of 900 metres, and at a distance that minimises the number of lighted wind turbine generators without diminishing appropriate aviation safety;

(b) in addition, the most prominent (highest for the terrain) turbine(s) should be lighted, if not included amongst the turbines lighted in accordance with (a) above; and

(c) the lighting of individual turbines should be in accordance with 8.1 above.

*Note**:*** *There is an overseas proposal that all lighting provided at a wind farm should flash simultaneously. This proposal is still to be validated and accepted. It is suggested that wind farm operators bear in mind that the simultaneous flashing of all lights at a wind farm could become accepted practice some time in the future.*

8.3 On completion of the project, CASA may choose to conduct a flight check to determine the adequacy of the obstacle lighting. This may result in a change (either more or fewer) to the number of obstacle lights required, to ensure the development remains conspicuous.

8.4 Where obstacle lighting is to be provided, it is recommended a monitoring, reporting and maintenance procedure be put in place to ensure outages are reported through the NOTAM system and repairs are implemented.

Bill McIntyre
Executive Manager
Aviation Safety Standards

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Limitations

Green Bean Design (GBD) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of RATCH Australia Corporation Limited and only those third parties who have been authorised in writing by GBD to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the GBD Proposal dated 17th February 2011.

The methodology adopted and sources of information used are outlined in this report. GBD has made no independent verification of this information beyond the agreed scope of works and GBD assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to GBD was false.

This report was prepared between January 2011 and January 2012 and is based on the conditions encountered and information reviewed at the time of preparation. GBD disclaims responsibility for any changes that may have occurred after this time.

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