

INDEPENDENT EXPERT REVIEW



WHITE ROCK WIND FARM PROPOSAL

*Prepared for
NSW DEPARTMENT OF PLANNING
& ENVIRONMENT*

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Overview

O'Hanlon Design Pty Ltd has been engaged by the NSW Department of Planning and Environment (DP&E) to review and comment on the quality and accuracy of the Landscape and Visual Impact Assessment (LVIA) report for the proposed Modification 6 (Mod 6) of the White Rock Wind Farm (WRWF), provided as part of the Environmental Impact Statement (EIS) submitted for development approval by White Rock Wind Farm Pty Ltd (the Proponent).

The engagement specifies the provision of an independent expert review report providing advice and commentary on the:

- LVIA (including methodology, assumptions and assessment of impacts with impact ratings provided at each residence/public viewpoint related to the Stage 2 turbines; including cumulative impacts of the White Rock Wind Farm Stage 2 and if relevant, the Glen Innes Wind Farm (GIWF) and if necessary, identify gaps in the documentation to be addressed by the Applicant to ensure it accords with all relevant guidelines;
- Residences that might incur a greater impact resulting from the Stage 2 modifications – i.e. both height and distance changes, particularly of those that fall within the Level 1 and 2 viewpoints requiring detailed justification (as per Visual Assessment Bulletin); and
- suitability of the proposed mitigation and management measures, if required.

Our methodology for preparation of this review has included a two day site visit, including visits to selected individual residences. A desktop review of remaining residences and potential viewing locations, review of the DP&E Visual Bulletin, the proponent's Modification 6 Environmental Assessment (Mod 6) and Landscape & Visual Impact Assessment (LVIA), as well as previous Modification documents and other reports referenced within these documents. We have also analysed topographic maps for the study area and wider areas to identify possible local issues and potential cumulative or regional issues. The purpose of these reviews was to provide background information, a reference for the methodology and depth of assessment that could be considered reasonable for consideration of the individual impacts.

Introduction

The White Rock Wind Farm Approval dated 10th July 2012 (The 2012 Approval) permits construction and operation of up to 119 wind turbines to a maximum tip height of 150 metres. Following that Project Approval, the White Rock Wind Farm is being developed in two distinct stages, Stages One and Stage Two. Stage One is effectively complete and includes 70 of the 119 turbines constructed under the 2012 Approval with an approximate tip height of 150m.

Modification 6 of the White Rock Wind Farm project as proposed in the LVIA November 2017, proposes 48 wind turbines to be located within the Glen Innes, Severn and Inverell regions, situated approximately 15 kilometers southwest of Glen Innes. 26 of the proposed turbines remain in their 2012 approval locations whilst 22 have been relocated from the 2012 Approval locations.

Key Modification 6 Statistics:

- A total of 48 turbines for construction. Two less than the 50 remaining 2012 Approval positions after the construction of Stage 1.
- Of the 48 turbines proposed; 28 turbines remain in approved 2012 Approval locations and 20 turbines have been proposed in new or modified locations.
- Maximum Overall Height: (top of tip) 200m proposed, an increase from 150m in the 2012 Approval (25% increase).
- Hub Height: 115m or 130m (turbine model dependant) increased from 89.5m in the 2012 Approval (28% / 45% increase)
- Rotor Diameter: 140m or 170m (turbine model dependant) increased from 121m (16% / 40% increase)
- Other than the WRWF there are two existing/approved wind farms in the region. The WRWF arcs around the southern and western edges of GIWF. The GIWF is located approximately 4km to the northeast of the WRWF. The Sapphire Wind Farm (SWF) is located approximately 10 km north of the WRWF.

Conceptual Framework

In setting a conceptual framework for the review of the project we have identified 4 clusters of residences within which each residence has similar location characteristics with individual height and screening variations that result in potentially similar turbine impacts from each related group of turbines. The tables contained in the **Section 3** provide a framework that allows for:

- comment on the visual impact at each residence and comparison between this, the the 2012 Approval LVIA, and the Mod 6 LVIA by Green Bean Design;
- comment on residences or major public viewpoints with significant visual impact; and
- a summary of significant visual impacts and related issues.

Response to Submissions

In addition to the Mod 6 LVA and the 2012 Approval LVIA we have received and reviewed the following documents prepared in response to submissions;

- The White Rock Wind Farm Stage 2 Obstacle Lighting Specification – Aviation Projects, dated 30 May 2018,
- The night time obstacle lighting assessment - Green Bean Design, dated 2 July 2018,
- The Response to Submissions Report – Goldwind, dated September 2018, and
- An email from Steve Neal, Section Manager GRC CASA, dated 12th February 2019.
- An email from Adrian Maddocks, Goldwind [with topographical data at 2m contours] dated 12th July 2019

The Response to Submissions Report (RtS) prepared by Goldwind highlighted a wide variety of responses on a range of matters including Landscape and Visual issues in the Table 2.2 on P14 headed *Summary of Public Submissions* the RtS notes that 41 submissions were recorded relating to Landscape and Visual of which 9 were local. Notably these numbers far exceed the number of responses to any other issue, placing Landscape and Visual as the key area of concern for both local and non-local respondents.

These submissions cover the full range of landscape and visual issues including:

- Increased impact from larger turbines,
- Ineffectiveness of landscape mitigation,
- Impact on landscape character,
- Concerns over the quality of the visual impact assessment and wireframes,
- Effect of the cumulative impact on the landscape, and
- Increased night lighting Impacts due to height increases of turbines.

Of notable significance is the response item 3.3.2, page 24 from Inverell Shire Council. This identified Council's primary focus on the effects of the navigational lighting and the cumulative effects of the increased turbine height and associated lighting over multiple wind farms in the locality. Goldwind's response acknowledged the generally negative community attitude to navigational lighting and the complaints received around the lighting at SWF to the north. There is no doubt that the request to increase turbine height increases visual impacts. The changes in daylight hours are significant however by far the greatest additional impact of the Mod 6 proposal is the addition of navigational lighting. As highlighted by the RtS and dependent on final design, the lighting potentially significantly changes the character of the night-time environment of the Study Area.

Of even greater concern, the associated cumulative impacts due to the inter-visibility of the lighting across a wide area, of conservatively 20km beyond the windfarms themselves, could have permanent and character changing impacts on the wider regional landscape character. The cumulative impact could effectively industrialise the night sky of this currently rural region.

2.0 Review of Methodology

In general, the LVIA incorporates the key elements and terminology of a standard visual assessment using a methodology specific to the proponent's landscape team. The LVIA methodology is consistent with many similar, widely used methodologies as it is based almost solely on professional opinion and assessment. However, this methodology is not a "first principles" assessment based on the derivatives of landscape values but relies more on comparison to numerical data and assessments carried out previously and adjusted for different turbine heights, locations and numbers.

The following is a summary of areas where we consider the LVIA may require more depth of consideration.

2.1 General Methodology

In Section 3.5 of the VIA it is noted that the VIA is not prepared in accordance with the NSW Planning & Environment document, *Wind Energy: Visual Assessment Bulletin 2016* (the VAB). However, Table 8 of the LVIA contains columns and references to both Sensitivity Levels and Visual Influence Zones referred to and categorised in the VAB. Further reviewing the report, it is apparent that the VIA assessment pertains only to what the proponent describes as '*residual effects*'. This term is used repeatedly throughout the assessment and refers to the difference in visual effects created by the changes proposed in Modification (Mod) 6 when compared to the previously approved effects of the 2012 Approval. The VIA is therefore not a first principles assessment and does not appear to be based on any first principles assessment in the original VIA that formed part of the 2012 Approval. This LVIA is therefore an assessment of the relative difference between the identified impacts of the 2012 Approval and the Mod 6 proposal without a first principles basis.

In section 4 of the LVIA a list of the numerical differences between the the 2012 Approval and Mod 6 turbine layout and characteristics is provided. A conclusion is then reached in section 4.4 that "*views toward additional wind turbine rotors and blade tips are not considered to result in a magnitude of visual effect which is greater than the magnitude of the visual effect associated with the WRWF Project Approval.*" This conclusion does not appear to have any analytical basis related to each individual residence or impact other than an intuitive balancing by the assessor of the numerical changes.

In our opinion, this methodology results in several steps of the visual assessment process outlined in the VAB not being properly considered. This includes use the multiple wind turbine tool, the preparation of a visual baseline study, identification of a scenic quality class and most critically; a performance evaluation based on the objectives for each zone/viewer level set out in the VAB.

2.2 Community and Stakeholder Values

When assessing the visual impact of any development it is generally recognised that the landscape values forming the basis of the assessment should reflect the values of local and regional stakeholders and should not be based solely on a professional opinion. Community consultation is documented as the first step of stage one of the VAB. The Mod 6 LVIA does not identify any research in relation to community and stakeholder values related to the local and regional visual quality but relies on past assessments based on professional opinion. The 2012 Approval does not appear to be based on any community consultation.

The RtS identifies that both Inverell Shire Council and Goldwind acknowledge the general community attitude to navigational lighting is negative based on community perceptions of the intrusive and distracting nature of the SWF to the north.

2.3 Landscape Character

While the LVIA states that the Landscape Character of the project area and surrounds is "*pastoral with agricultural improvements*" it does not clearly identify where this landscape sits in the Scenic Quality Class scale of High, Medium, or Low. With no assessed Scenic Quality Class it is difficult to proceed further with the assessment process outlined in the VAB as this rating forms part of the calculation that produces the VIZ rating, which in turn identifies the objectives that should be met. It is therefore unclear how the LVIA assessed the VIZ ratings identified in Table 8.

OHD has assessed that the Scenic Quality of the project area and its surrounds are of a Moderate rating. As a result a number of the residences fall into a VIZ1 rating (see tables of Section 3 for details) and the remaining fall into a VIZ2 rating. The VAB provides the following objectives under Landscape Scenic integrity:

"VIZ1 - Wind turbines should not cause more than a low level modification of the visual catchment. Turbines are seen as either very small and/ or faint, or as of a size and colour contrast (under clear, haze-free atmospheric conditions) that they would not compete with major elements of the existing visual catchment.

VIZ2 - Wind turbines should not cause significant modification of the visual catchment. Turbines may be visually apparent and could become a major element in the landscape but should not dominate the existing visual catchment. "

Following some discussion of landscape character type in Section 8, the LVIA notes in section 8.3:

"...that approvals have been granted for the Sapphire and Glen Innes Wind Farms which are located to the north west and east of the approved WRWF site. These projects, together with the approved White Rock Solar Farm have established a 'renewable energy hub' and have the potential to create a 'wind farm' and 'renewable energy' landscape character type within the broader rural and agricultural landscape setting."

In this statement the LVIA concedes that the overall landscape character is likely to change. Whilst the LVIA does not specifically identify that this change will come about as a result of the WRWF it does include the WRWF as a key influencer in this change. This change in landscape character appears to be in direct conflict with both the VIZ1 and VIZ2 scenic quality objectives noted in the VAB. This effect will be exacerbated by the potential night lighting associated with the proposed turbine height increases.

2.4 Night Lighting

The 2012 Approval LVIA was based on proposed turbines with a maximum height of 150m. At the proposed height the proponent's aviation assessment concluded that without aircraft hazard lighting (AHL) the aviation safety risk was within an acceptable range. AHL was therefore not required as part of the 2012 Approval.

The WRWF Night Lighting Assessment of July 2018 notes that subsequent to preparation of the Mod 6 VIA and as a result of the increased maximum tip height of the WRWF Mod 6 to 200m, the Civil Aviation Authority (CASA) have recommended that AHL be installed to operate at night and times of reduced visibility. The performance requirements for the AHL are set by CASA and the determination of impacts is identified in the VAB.

The AHL objectives and performance requirements in the VAB states that AHL must;

- meet the requirements of Australian Standard AS 4282-1997 and any prescribed or notified CASA requirement,
- fully shield all AHL within two kilometres from any dwellings, and
- avoid strobe lighting.

In reviewing these requirements, the Proponent's Night Lighting Assessment (NLA) discusses Australian Standard AS 4282-1997 including the definition of both obtrusive lighting and spill lighting, coming to a conclusion in Section 4 that the ability of AHL to be assessed against AS 4282 performance requirements is very limited. The intent of AS 4282 and the VAB are both to manage obtrusive light. AS 4282 notes that spill lighting is obtrusive if, because of directional or spectral attributes in a given context, it gives rise to annoyance, discomfort or distraction. The WRWF night lighting environment is a context of highly identifiable lighting placed into a dark sky with few other night light sources. In Section 8 of the NLA the final paragraph then concedes that

It is reasonable to expect that where the wind turbine obstacle lights are visible from residential dwellings, or the curtilage of dwellings that some level of annoyance or distraction may occur.

thereby identifying the AHL light as obtrusive as defined in AS 4282. We consider that the lighting should therefore be assessed against the performance requirements of AS 4282.

The VAB requirement of shielding all sources within two kilometres appears likely to meet the standard set by AS 4282. For the purpose of visual impact assessment this objective can be considered to constitute an impact assessment of Moderate or Low depending on the number, distance and level of visibility of the AHL at an individual residence. Impacts that do not meet the VAB objectives are likely to create impacts higher than Moderate when assessed at an individual viewing location.

The Civil Aviation Safety Authority (CASA) is currently undertaking a safety study into the risk to aviation posed by wind farms and is planning develop a new set of guidelines to replace a previous wind farm lighting advisory circular that was withdrawn in 2008. Below is an excerpt from the withdrawn document. Whilst withdrawn it is relevant to understanding the limitations of what may constitute acceptable shielding.

10.4 To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness.

(a) Shielding may be provided to restrict the downward component of light to either, or both, of the following:

(i) Such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and Aeronautical Impact and Night Lighting Assessment – Crookwell 3 Wind Farm Page 37

(ii) Such that no light is emitted at or below 10 degrees below horizontal.

Roughly calculated, on a property located at the same elevation as the base of a turbine, these mitigation measures would approximately provide for a turbine with a 130m hub height (200m tip):

- (i) Partial shielding of any properties within 1.8km of the turbine (95% shielding of the nominal intensity).
- (ii) Full shielding of properties within 900m of that turbine.

As a result of the likely day time visual dominance effects addressed by the VAB most of the properties fall outside of these distances and by the definition of the VAB those properties would have acceptable effects. It is evident that light shielding, to the original CASA angles would be highly unlikely to reduce to a reasonable level the visual impact of the AHL in locations where the viewer is between 900m and two kilometres of the light source. This places a significant impact on the closest residences verifying the parameters set in the VAB.

In recent advice dated 12th February 2019, CASA has advised that a lighting intensity of 200 candelas would be sufficient for the WRWF to achieve the mitigation required to enable see and avoid action by a pilot. This would bring the WRWF in line with the adjacent sapphire Wind farm with night lighting of the same intensity.

It is agreed that the first conclusion reached in the NLA Section 10 that the impacts at night on public viewpoints, rural roads and highways, assuming low travel numbers and the transitory nature of the viewers, due to the WRWF will be low and of no significant concern. Of much greater concern is the cumulative impact of the night lighting on a regional basis, this assessment is not covered in the Mod 6 visual assessment.

The second conclusion reached in the NLA Section 10 that impacts on residential dwellings will be Moderate is appears overly simplistic and does not constitute an assessment of the actual visual impacts. It is our opinion that from individual residences the impacts will vary greatly depending on the aspect, number of lit turbines and the distance of the turbine from the viewer. Aviation Projects Pty Ltd has now prepared an obstacle lighting layout plan indicating the turbines to be lit if AHL is required. Using that as a base and using the visual parameters outlined above, we have assessed the residences individually in **Section 3** of our report.

In the wider context, it is generally accepted that in order to maintain scenic integrity of the desired landscape character the landscape alterations must remain visually subordinate to the landscape character. As night lighting is now required at WRWF it is difficult to envisage a scenario where those lights remain subordinate to the existing evening/ night-time landscape character of the area. Thus, it can be reasonably concluded that at night, obstacle lights would change the overall landscape character from the existing dark pastoral landscape to that of a wind farm/industrial landscape. Obstacle lighting is likely to be considered as significantly obtrusive in the night environment and would further contribute to a higher level of cumulative effects for most viewers.

Overall, it is our opinion that the addition of AHL in any form would significantly increase the visual impacts of the Project and that even limited AHL would significantly increase the impact levels assessed in the context of an unlit project as described in the tables in **Section 3** of our report.

2.5 Cumulative Impacts

The LVIA has made no attempt to consider the potential cumulative impacts of the White Rock Wind Farm, nor has the previous assessment of the 2012 Approval. The LVIA statement regarding cumulative impacts is:

"The modified WRWF Stage 2 would not introduce elements that are any more prominent or out of character with the approved WRWF Project, and the potential for the modified Stage 2 wind turbines to result in any additional significant cumulative visual effects is considered to be low." The author of this statement cannot have considered the potential individual and /or cumulative effects of the required navigational lighting.

It should be noted that this statement only refers to any "additional significant cumulative visual effects". This is not a measure of the complete cumulative impact of the project and any surrounding projects. This statement also makes no allowance for any rating of cumulative impacts for individual residences. As the previous the 2012 Approval LVIA also makes no attempt to quantify cumulative impacts, there seems to be no data to act as a baseline from which this statement can be validated.

The 2012 Approval LVIA does attempt to assess the cumulative impacts, however this assessment of 'cumulative impacts' refers only to the intervisibility of multiple farms and makes no attempt to assess the angle of view or affected sectors within WRWF itself. In addition, the assessment of intervisibility is based on 2011 heights and layouts. Below is a summary of the heights in 2011 and a comparison to their 2017 heights

Wind Farm	Approved Tip Height 2011	Tip Height July 2017
Glen Innes	129m	Proposed 180m
Sapphire	146m/157m	200m
White Rock	150m	Proposed 200m

The VAB clearly indicates and describes the correct use of the multiple wind farm tool as a key step in assessing the overall visual impacts of a wind farm and the omission of this step in the LVIA results in no preparation of sector analysis or angle of view analysis that would provide an analytical basis upon which to base a conclusion.

Below are the objectives presented in the Bulletin regarding cumulative impacts or 'Multiple Wind Turbine Effects':

"Avoid views to the proposed, existing and approved turbines within eight kilometers from Level 1 and Level 2 viewpoints, exceeding the following thresholds, or provide detailed justification:

- Level 1 (high sensitivity) – wind turbines visible within the effective horizontal views of two or more 60° sectors.*
- Level 2 (moderate sensitivity) – wind turbines visible within the effective horizontal views in three or more 60° sectors."*

As all the residences covered in the LVIA assessment sit within the Level 2 viewer sensitivity classification it would be reasonable to expect that the LVIA would provide justification for any residence with 3 or more affected sectors.

As cumulative effects are not discussed or documented within the Mod 6 assessment it is not possible to review the potential for cumulative impacts at any one view point or residence.

2.6 Mitigation Measures

The Conditions of Consent for the Consolidated Project Approval 2012 relating to the Visual Impact include amongst other items the following conditions:

"Condition C23 - All residents, business owners or public authorities, whose dwelling, business or public area respectively, may be subject to moderate to high visual impact, as defined in the EA, shall be consulted regarding impact minimisation measures. The outcomes of this consultation process shall be used to inform the Design and Landscape Plan, required under condition C30."

"Condition C24 - At the request of any owners of residential dwellings or businesses with views of a turbine(s) located within five kilometres of their dwellings, the Proponent shall provide and bear the full cost of reasonable landscaping treatments to visually screen these dwellings. Such a request may be made in writing by the owner of the dwelling or business within 6 months from the commencement of operation of the project, and landscaping treatments agreed between the parties shall be implemented and completed within 12 months of such an agreement. Should the parties not be able to reach agreement on the scope of landscaping treatments, then either party may refer the matter to the Secretary for resolution. The Secretary's decision on such a referral shall be final and binding on the parties"

"Condition C30 - A Design and Landscaping Plan shall be prepared to outline measures to ensure appropriate development and maintenance of landscaping on the site to achieve adequate landscape buffers and address the visual impacts arising from the project, including turbines, site access roads and associated above ground infrastructure, as far as is reasonable and feasible. The Plan shall be prepared by a qualified landscape architect and where relevant meet any requirements of the Councils. The Plan shall include design treatments for the turbines and ancillary infrastructure, including, but not necessarily limited to:

- (a) the landscape screening measures at residences in close proximity to the project site and along nearby roadsides to screen potential moderate to significant views of the project, including an outline of additional measures available for requested landscaping treatments, as permitted under condition C24;*
- (b) landscape elements and built elements, including proposed treatments, finishes and materials of exposed surfaces (including colour specifications);*
- (c) lighting;*
- (d) a schedule of species to be used in landscaping;*
- (e) details of the timing and progressive implementation of landscape works; and*
- (f) procedures and methods to monitor and maintain landscaped areas. The Plan shall be submitted for the approval of the Secretary prior to the commencement of permanent built works and/or landscaping, unless otherwise agreed by the Secretary. The Plan may be submitted in stages to suit the staged construction program of the project."*

It is evident from the above that Conditions that the proponent is and will continue to be responsible for the design, creation and maintenance of the vegetative screening that could be used to address the visual impacts of many residences. At this stage it is not clear whether Condition 30 items (a), (b), (c), (d), (e), and (f) have been finalised. As such, the potential reduction of impact, feasibility, effectiveness and reliability of proposed mitigation measures cannot be determined.

Importantly, the successful visual mitigation of any wind farm relies heavily on the individual location of residences and turbines as well as the surrounding topography. Whilst mitigation has often been considered possible in the past, it has become increasingly difficult to shield turbine structures that have significantly increased height due to technological advancement. The optimal conditions for successful mitigation are created when closely clustered turbines, placed at similar relative levels are viewable at a reasonable distance. Due to the geography, layout and location of the GIWF, the increased turbine heights and resultant spacing, it is unlikely that mitigation will be successful for many of the residences.

Whilst some properties have considerable effects from turbines within WRWF, a small number of residences within the project area (e.g. Q110) are likely to have significant cumulative effects when GIWF is considered in conjunction with WRWF. Areas with high cumulative effects are unlikely to achieve meaningful screening without heavy planting along much of the residential curtilage.

Extensive curtilage planting may screen views to surrounding turbines, however it may also screen many of the views from that property. This type of screening can lead to a sense of enclosure in or around the residence as views to the immediate and distant landscapes become significantly reduced. While this type of planting is unlikely to influence the broader landscape character, it does restrict established views to that landscape. Residences within the Wester Cluster (**Section 3.4**) would likely require heavy screening along much of their curtilage to create meaningful mitigation and this is likely to considerably affect the visual amenity.

An exception to this general assessment is L200. The combination of existing topography and vegetation provides a significant screen to the West of the residence and in combination with the garage structures creates a visual curtilage that varies from the existing fence line. The topography to the west of the residence creates opportunities for further intensification of the vegetation screen if required.

Turbines situated close to residences and/or elevated above residences are generally difficult to successfully mitigate. Depending on the proximity to the viewer and the related topography, the height of the vegetation that would be required to screen a 200m tip height turbine is likely to be difficult to attain and may take decades to achieve. Added to this, tall 'one off' screening' is only relevant to one given viewing point on the property and the effect of the screen may be negated by the repositioning of the viewer within the site.

In accordance with the VAB it is an appropriate mitigation measure to reduce night lighting impacts that shielding be required for AHL on all turbines within 2km of a residence. A further measure would be the installation of an Aircraft Detection Lighting System. In this instance the use of an Aircraft Detection Lighting System as noted in Section 1.10 of the Obstacle Lighting Specification would reduce the impacts identified however the reduction cannot be easily quantified as it relates to aircraft operational times and flight paths. This option should be encouraged as overall changes to the landscape character would be significantly mitigated for all viewers at a wide range of distances by the installation of such a system.

3.0 Residential Review

This review includes assessment of impacts at residences compiled from a variety of data and site information. A number residence, identified in the proponent's VIA and considered as significantly impacted, were visited and individually assessed. The VIA assessed impacts for many of the remaining residences were reviewed from viewpoints on adjacent public roads. A lesser number of residences were considered with only a desktop review.

By our assessment there are 50 residences within 4km of a Stage 2 WRWF turbine. The proponent has reached agreement with the owners of 38 properties leaving 11 non-associated properties. Of these 4 properties (N180, N190, L220 and L230) are anticipated to have Mod-High or High impacts. Of the remaining 6 properties, 5 properties (S180, P190, Q191, L200 and N230) would have no increased impacts or reduced impacts due to the Mod 6 adjustments to layouts and 2 properties (Q110 and S160) would experience some increased impacts from WRWF and most properties would have collateral cumulative impacts from any continuous night lighting proposal. For full details refer to the following tables.

As a background to any review of visual impacts using the VAB, an assessment of the Scenic Quality of the overall landscape is an important building block. In accordance with the methodology of the VAB we have rated the Scenic Quality of the Study Area as **Moderate**. A more refined assessment could perhaps identify specific areas of higher Scenic Quality.

When reviewing the tables set out below it is important to note:

- Four of the five residences that received a High rating in the 2012 Approval have remained unchanged in the LVIA Modification 6 assessment. This creates the impression that the overall impacts of these residences have not significantly changed. In fact, in most cases an increase of 20% in turbine height would increase the impacts at these residences and result in an increase in number of viewable tips and hubs from these residences. However, as these residences are already rated as High and the rating system does not allow for any rating in excess of High, their ratings have remained unchanged. Were the rating system used more finely grained, it could be expected that at least some of these residences would see an increase in their overall visual impact rating.
- An example of this lack of refinement in the rating system can be demonstrated in the Maybole Rd Cluster of our assessment table (**Section 3.1**). N190 was previously rated as High in the 2012 Approval assessment. In Mod 6 the height of turbines has increased by 25% (50m). This has resulted in an increase from 14 to 22 visible hubs whilst the Mod 6 LVIA rating for this property remains at High as there is no potential to increase past this rating.
- The number of affected sectors in our review of potential cumulative impacts have been measured to 8km as described in the *Wind Energy: Visual Assessment Bulletin (2016)*. To standardize the review of cumulative effects across the project we have used a methodology predicated on the assumption that the start of the first sector falls upon the first viewable turbine clockwise from north.
- The VAB indicates a Visual Influence Zone 1 (VIZ1) limit at 2.7km for 200m turbines and states that for VIZ1, *turbines should be avoided or justification should be provided* for turbines in this area. The Mod 6 LVIA identifies several residences as falling within the VIZ1 but makes no justification to demonstrate why the turbines influencing the VIZ1 categorisation should be retained, nor any justification of the proposed increase in height.
- Our assessment of the night lighting impacts is based on the parameters derived from the objectives of the VAB and AS 2428 as noted in Section 3 above.
- The assessment of the night lighting impacts noted for each residence in the Section 3 tables below assumes a lighting layout as shown in Section 1.12 of the *White Rock Wind Farm Stage 2 Obstacle Lighting Specification – Aviation Projects* dated 30 May 2018. The assessment also assumes that the lighting will be in operation as a continuous red light visible between dawn and dusk or at times of low visibility. The use of an Aircraft Detection Lighting System as noted in Section 1.10 of the Obstacle Lighting Specification would reduce the impacts identified however the reduction cannot be easily quantified as it relates to aircraft operational times and flight paths.

Maybole Rd: Central South-Eastern Cluster (M)

This cluster of residences sits at the south-eastern edge of the development with residences located at levels between RL 1150 and RL 1330, having views north/northwest toward the proposed turbine layout.

		Green Bean Assessments					OHD Turbine Review			PM/ WF
		2011 LVIA		Mod 6 LVIA						
Residence	Dist. [km]	2011 Ass.	Hubs [Tips] Vis.	VIZ	Stage 2 Ass. [Mod 6]	Hubs [Tips] Vis.	VIZ	Assess [Mod 6 Impact]	Comments	
S160*	1.9	Nil	0 (4)	2	Nil	0 (1)	1	Nil – Low	- T135 is the only turbine visible, however this would be mitigated by the vegetation. 2 Sectors affected by WRWF turbines but screened by residential vegetation. - Reduced angle of view from previous approval. Improved outcome. - No view to GIWF within 8km. - No impact due to Aviation Hazard Lighting.	WF3
S180	3.2	Low	5 (9)	2	Low	5 (6)	2	Low (Reduced daytime)	- No views to Turbines within 8km - Filtered views to WR turbines past 8km. No effected sectors. - Slightly decreased daytime visual impacts within the Low range. - Moderate impact due to Aviation Hazard Lighting	WF7
Q191	3.4	Not Assessed	-		Not Assessed	-	2	Low - Moderate (Reduced daytime)	2 affected sectors of WRWF turbines. No views to GIWF - The removal/re-positioning of several turbines has created a better outcome for this property compared to the previous approval. We would assess the previous rating as Low- Moderate. - Mod-High impact due to Aviation Hazard Lighting.	
P190	3	Moderate	6 (9)	2	Low	0 (7)	2	Low (Reduced daytime)	2 affected sectors - T92, T93, T95, T134, T135, T136, T138 are below the blue line (4km), Tips only. Screening should be considered. - Unlikely to experience slightly reduced daytime visual impacts. - Minimal impact due to Aviation Hazard Lighting	PM4 WF10
N190*	1.7	High	23 (35)	2	High	18 (34)	1	High (Reduced daytime)	2 turbines in the VIZ 1 area. 70° view of WR Stage 2 turbines 2 affected sectors - T93 (1.7km), T95 (1.9km) are in full view under the Black line. No justification has been provided - Under Black Line: T91, T92, T93, T95. Justification required. - Under Blue line: T49 (3.5km), T50 (3,8km), T86, T87, T88, T89,	PM4 WF9

									T90, T114, T120, T132, T133, T134, T138. Justification required. • Approved turbines (T96-100) have been removed. • The closest turbines in the new layout is at an increased distance. This may be justification for some of the turbines. • The most densely affected area is North of the residence (roughly T85-95) a large amount of clutter will be produced by turbines behind each other from this residence. • The magnitude of this cluster to the north is also high with the closest turbine [T95] 1.7kms away. • The removal of T92, T93 and T95 would reduce the angle of view to approx. 60° and reduce the magnitude effects significantly, bringing the overall rating much closer to moderate. • High impact due to Aviation Hazard Lighting	
N180	1.6	High	39 (53)	2	High	40 (54)	1	High	• 4 turbines in the VIZ 1 area. • Approx. 100° view of just WR stage 2 turbines • 2 affected sectors • T93 (1.6km), T95 (1.9km) are in full view under the Black line. No justification has been provided This does not meet the bulletin. • Under Black Line: T91, T92, T93, T95. Justification required. • T49 (3.5km), T50 (3.8km), T86, T87, T88, T89, T90, T120, T132, T133, T134, T137, T138 all within 4km: Justification required. • Approved turbines (T96-100) have been removed from nearby. The closest turbines in the new layout is at an increased distance. This may be justification for some of the turbines. • The cluster of turbines to the North of this property are causing the majority of the impacts for this residence (roughly T85-95) a large amount of clutter will be produced by turbines behind each other from this residence. • The magnitude of this cluster to the north is also high with the closest turbine [T95] 1.6kms away. • The removal of T92, T93 and T95 would reduce the angle of view to approx. 90° and reduce the magnitude effects significantly, bringing the overall rating much closer to moderate. • High impact due to Aviation Hazard Lighting	PM4 WF8

* Denotes site visit

Durkins Rd: Southern Cluster (D)

This cluster of residences at the southern edge of the development with residences located at levels between RL 1240 and RL 1360. The residences have views predominantly north/northeast toward the proposed turbine layout.

		Proponent Assessments					OHD Turbine Review			PM/ WF
		2011 LVIA		Mod 6 LVIA						
Residence	Dist. [km]	2011 Ass.	Hubs [Tips] Vis.	VIZ	Stage 2 Ass. [Mod 6]	Hubs [Tips] Vis.	VIZ	Assess [Mod 6 Impact]	Comments	
L200*	1.6	Moderate	14 [17]	2	Moderate	8 [24]	1	Moderate	• 3 closest turbines T117, T118 and T119 removed in Mod 6. • Turbine heights have increased from 150m to 200m tip height. • T120 [1.8km], T138 [21.km], T139 [2.4km] are in new locations further removed than turbines T117, T118 and T119 and remain located in the VIZ 1 area. • T114 [2.7km], T115 [2.9km] and T116 [2.6km] remain in approved locations but with increased tip heights to 200m. • Approx. 150° view of WRWF stage 2 turbines • Residence primary outlook is East and SE • 3 sectors are affected NNE to SW. • A large amount of visual clutter will be produced NNE by turbines [T85-T95] located in a string behind each other when viewed from the residential curtilage. • Residential curtilage West to SW of residence can be defined by vegetation lines and garages. • The 2m contours to West verify the topo screening to residential curtilage is substantial. • Under Black Line: T116, T120, T138, T139 blades only visible above existing topography. T114 likely fully screened by topography. • Under Blue line: 92 [4km], 93 [3.8km] T95 [2.8km] and T115. Partially visible from the curtilage east of the residence. • Moderate impact due to Aviation Hazard Lighting	WF 12
L220	1.4	Not Assessed “Derelict Building [not assessed]”	3 [4]	2	Not Assessed	2 [9]	1	Moderate - High	• 6 turbines in the VIZ 1 zone. • Under Black Line: T114 [2.5km], T115 [2.5km], T116 [2.2km], T120 [1.9km], T138 [1.5km], T139 [1.5km]. Justification required. • 3 affected sectors • Mod- High impact due to Aviation Hazard Lighting	PM4 WF13

L230*	2.4	Low	3 (6)	2	Low	4 (6)	2	Moderate	- This is a VIZ2 property with one turbine within 2.7km. - Under Black line: T139. Justification required. - Under Blue Line: T114, T116, T120, T138. - Turbines 138(2.4km) and 139(2.5km) are within 2.7km and in relatively full view. 2 affected sectors. - Moderate impact due to Aviation Hazard Lighting and slightly increased impacts still within the Moderate rating.	PM4 WF19
N230	3.8	Moderate	25 (45)	2	Moderate	29 (48)	2	Moderate	- Under Blue Line: T138, T139. Justification required. 2 affected sectors. - Unlikely to experience increased daytime visual impacts. Rating remains unchanged. - High impacts due to Aviation Hazard Lighting	WF18

Haymarket Rd: North-Eastern Cluster [H]

This cluster of residences at the north-eastern edge of the development with residences located at levels between RL 1110 and RL 1210, having views east toward the proposed turbine layout.

		Green Bean Assessments					OHD Turbine Review			PM/ WF
		2011 LVIA		Mod 6 LVIA						
Residence	Dist. [km]	2011 Ass.		VIZ	Stage 2 Ass. (Mod 6)	Hubs (Tips) Vis.	VIZ	Assess (Mod 6 Impact)	Comments	
Q110**	3.7	Not Assessed	PM3		Not Assessed	-	2	Low	• 1 turbine within 4km. • 1 Sector of WRWF Turbines • 1 Sectors of GIWF Turbines • 2 Sectors cumulatively effected. • Minimal impact due to Aviation Hazard Lighting and no significant change to the overall impacts due to Mod 6.	PM3

** Denotes roadside assessment