APPENDIX F LANDSCAPE AND VISUAL IMPACT ASSESSMENT

Landscape and Visual Impact Assessment

Hills of Gold Wind Farm

Prepared for: **ERM**

Project No: **1856** Issue: **Revision D** Date: **16th November 2020**

DOCUMENT HISTORY AND STATUS

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Project Name: **Hills of Gold Wind Farm Landscape and Visual Impact Assessment**

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Executive Summary

Moir Landscape Architecture have been commissioned by ERM to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Hills of Gold Wind Farm.

Hills of Gold Wind Farm (the Project) is proposed to be located approximately 8 kilometres south of Nundle, NSW. The Project consists of the installation, operation, maintenance and decommissioning of up to 70 Wind Turbine Generators (WTGs), ancillary infrastructure and temporary facilities.

SEARs were issued by the former Department of Planning and Environment (DPE), now Department of Planning, Industry and Environment (DPIE) in November 2018 for the construction, operation and decommissioning of a wind farm with a maximum of 97 turbines with a maximum height of 220 metres. During the development period, extensive community consultation, environmental assessments and iterative project design has resulted in slight increase in height (to a maximum of 230 metres) and a reduction of proposed turbines to 70. This was the result of consultation with the local community, government agencies and other stakeholders.

In addition to the wind turbines, ancillary infrastructure including access tracks, road upgrades, battery storage, underground and overhead electricity cabling, substation, switching station, operations and maintenance facility and grid connection to the 330 kV Liddell to Tamworth transmission line have been assessed in this LVIA.

Moir Landscape Architecture have utilised a quantitative study methodology with regards to the guidelines of the Wind Energy: Visual Assessment Bulletin (the Bulletin). Relevant literature and guidelines relating to large scale energy projects and Moir Landscape Architecture's previous experience on large scale infrastructure projects has also been considered in the Study Method.

The LVIA includes a comprehensive assessment of the existing landscape character, scenic quality and visibility of the Project. Visual influence zones have been established from viewpoints and sensitive receptors and assessed against visual performance objectives outlined in the Bulletin.

Extensive field work was undertaken by Moir Landscape Architecture to develop a visual baseline against which the Proposal has been assessed. The assessment determined the regional landscape character is typical of the Northern Tablelands region characterised by agricultural land predominately utilised for grazing, with some large areas of remnant vegetation. The landscape was categorised into six (6) Landscape Character Units (LCUs). A quantitative frame of reference was applied to establish the Scenic Quality Rating of these LCUs which ranged from a low to moderate - high. The Scenic Quality Ratings are utilised in defining Visual Influence Zones which are assessed against objectives outlined in the Bulletin.

The Bulletin states generally, the visual impact of a wind energy project will depend upon the characteristics and values of the existing landscape, the extent to which the existing landscape is changed by the Project and how these changes are perceived by individuals and the broader community. The assessment, in conjunction with community consultation identified the key landscape features and valued viewpoints within the Study Area. The assessment found the Project could be undertaken whilst maintaining the key visual features of the landscape.

Key factors which form a part of the existing landscape character would assist in reducing the potential for viewing the Project. These include large areas of vegetation, undulating topography, roadside vegetation and riparian vegetation associated with creek lines and rivers.

The LVIA assessed the potential visual impact of the Project for the majority of residences within the Study Area. A number of criteria were considered and assessed against the objectives of each Visual Influence Zones to determine levels of visual impact. There are a number of residences which have the potential to have visual impacts, however in the context of a project of this scale it is believed that the Project could be sufficiently mitigated and managed to an acceptable level.

The assessment identified approximately 20 non-associated dwellings within 4550 metres of the Project with potential visual impacts resulting from the Project. Mitigation methods are likely to assist in significantly reducing any negative impacts resulting from the majority of these dwellings. Mitigation measures in keeping with the existing character include off site screen planting and supplementary planting of existing vegetation. While these mitigation methods are considered appropriate to minimise the visual effects for a number of these residences, it is acknowledged that there are some residences, mitigation methods may not be suitable due to their elevated locations and expansive views over the landscape.

An evaluation of the Project against the visual performance objectives found that in the context of the scale of the Project, the impacts of the Project are considered to be acceptable.

1.0 Introduction

1.1 Introduction

Moir Landscape Architecture have been commissioned by ERM to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Hills of Gold Wind Farm (referred to hereafter as The Project).

The Project is proposed to be located at Morrisons Gap Road, Hanging Rock approximately 8 kilometres south east of Nundle, New South Wales. The Project consists of the installation, operation, maintenance and decommissioning of up to 70 Wind Turbine Generators (referred to as WTGs or turbines), ancillary infrastructure and temporary facilities.

The purpose of this report is to provide a comprehensive assessment of visibility and potential visual impacts associated with the Project on the landscape character, landscape values, landscape amenity and any scenic vistas. The report details the results of the field work, documents the assessment of the landscape character and visual setting, and makes recommendations to assist in the mitigation of any potential impacts resulting from the proposed development.

This LVIA has been prepared in accordance with the *Wind Energy: Visual Assessment Bulletin December 2016.* This LVIA forms a part of the Environmental Impact Statement (EIS) to be submitted to the Department of Planning, Industry and Environment (DPIE). This information will assist the community and the DPIE to understand and assess the likely visual impacts.

1.2 Relevant Experience

The Bulletin states *the proponent is expected to engage professionals from relevant natural resource management and design professions (for example environmental planners, geographers, landscape architects, architects, or other visual resource specialists), with demonstrated experience and capabilities in visual assessment to carry out a wind energy project visual assessment.*

Moir Landscape Architecture Pty Ltd is a professional design practice and consultancy specialising in the areas of Landscape Architecture, Landscape Planning and Landscape and Visual Impact. Our team has extensive experience in undertaking Landscape and Visual Impact Assessments for large scale infrastructure projects, including the mining industry, sustainable energy sector and commercial / residential developments in visually sensitive areas. Our capabilities include digital terrain modelling, viewshed assessment, photo montage development, landscape character assessment and community consultation.

Our team has extensive experience in undertaking Landscape and Visual Impact Assessments for wind energy projects. In the context of our experience and with guidance from the Visual Assessment Bulletin we have developed methodologies to ensure a comprehensive and qualitative assessment of the Project. Relevant experience includes the preparation of Landscape and Visual Impact Assessments for the following Wind Energy Projects:

- Crudine Ridge Wind Farm (New South Wales)
- Bodangora Wind Farm (Bodangora, New South Wales)
- Capital II Wind Farm (Bungendore, New South Wales)
- Uungula Wind Farm (Wellington, New South Wales)
- Lord Howe Island Wind Turbines (Lord Howe Island, New South Wales)
- Cherry Tree Wind Farm (Seymour, Victoria)
- Lakeland Wind Farm (Lakeland, Queensland)

2.0 Study Method

2.1 SEARs

The Project is classified as State Significant Development (SSD) and will be assessed and detemerined under the provisions of the Environmental Planning and Assessment Act 1979.

Secretary's Environmental Assessment Requirements (SEARs) issued in November 2018 for the Project state: *the EIS must include a detailed assessment of the visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure) in accordance with the Wind Energy: Visual Assessment Bulletin (DPE, 2016).*

A brief overview of the requirements of the *Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development* is outlined in ***Section 2.2***.

2.2 Wind Energy: Visual Assessment Bulletin

The *Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development* (referred to hereafter as 'the Bulletin') was adopted by the Department of Planning and Environment in December 2016. The Bulletin has been developed to guide the appropriate location of wind energy development in NSW and to establish an assessment framework for the assessment of visual impacts associated with wind energy. Visual impacts are one of a range of issues considered in the assessment and determination of wind energy projects.

The objectives of the Bulletin are to:

- provide the community, industry and decision-makers with a framework for visual impact analysis and assessment that is focused on minimising and managing the most significant impacts;
- facilitate improved wind turbine and ancillary infrastructure siting and design during the pre-lodgement phase of a project, and encourage early consideration of visual impacts to minimise conflicts and delays where possible, and provide for a better planning outcome;
- provide the community and other stakeholders with greater clarity on the process along with an opportunity to integrate community landscape values into the assessment process; and
- provide greater consistency in assessment by outlining appropriate assessment terminology and methodologies.

The visual assessment process is broken into two main stages: Preliminary Environmental Assessment and EIS (see ***Figure 1***). Stage 1: Preliminary LVIA was undertaken by Arup Pty Ltd and the findings of the assessment undertaken have been included in this report.

2.3 Overview of the Study Method

In accordance with the Visual Assessment Bulletin, the visual assessment includes:

- a baseline study that includes analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels;
- establish visual influences zones from viewpoints using data collected in the baseline study;
- assessment of the proposed layout against visual performance objectives; and
- justification for the final proposed layout and identification of mitigation and management measures.

Moir Landscape Architecture have formulated a quantitative study methodology with regards to the Visual Assessment Bulletin and with consideration of previous experience on large scale infrastructure projects and relevant literature and guidelines relating to large scale energy projects.

Extensive field work and photographic survey work for the study was undertaken in March and June 2020 from public and private property.

2.4 Report Structure

Table 1 provides an outline of the report structure, a brief overview of the objectives of the Bulletin and a summary of how these have been addressed in the LVIA. Detailed methodologies for each part of the assessment have been included in the relevant chapters of the report.

2.0 Study Method

Landscape and Visual Impact Assessment Report Structure	
Section 3.0: Project Overview	**Visual Bulletin Requirements Addressed:**
• Detailed Project Description • Wind Turbine Design • Associated Infrastructure	• The VIA is to include a full description of the proposed wind energy project design, the layout, structural elements and scenarios being considered.
Section 4.0: Community Consultation	**Visual Bulletin Requirements Addressed:**
• Community Consultation Process • Community Landscape Values • Community Perception	• The proponent is to further consult with the community to verify the community consultation findings from the scoping and design stage.
Section 5.0: Visual Baseline Study	**Visual Bulletin Requirements Addressed:**
• Detailed assessment of Landscape Character and Key Features of the Region • Landscape Character Unit Classification • Application of Scenic Quality Class Ratings	• A visual baseline study must be undertaken to establish the existing landscape and visual conditions. The baseline study is prepared and evaluated by the proponent prior to undertaking any visual analysis. • Describe, assess and map these factors in written and graphic forms supported by photographic representations of the area. • Identify Scenic Quality Classes
Section 6.0: Visual Catchment	**Visual Bulletin Requirements Addressed:**

Define the Visual Catchment of the Project:
• Preliminary Assessment Tools:
  • Visual Magnitude
  • Multiple Wind Turbine Effect
	• Visual Magnitude Assessment: Mapping the dwellings, key viewpoints and proposed turbines at scale to establish the potential visual magnitude.
	• Map into six sectors of 60º any proposed turbines and any existing or approved turbines within each dwelling or key public viewpoint.

Section 7.0 - Zone of Visual Influence	**Visual Bulletin Requirements Addressed:**
• Zone of Visual Influence	• Establish the theoretical 'zone of visual influence' of the proposal (the area from which the proposal is theoretically visible or the 'visual catchment').
Section 8.0 - Viewpoint Analysis	**Visual Bulletin Requirements Addressed:**
Assessment of viewpoints from areas identified within the visual catchment. **Refer to Appendix C - Viewpoint Analysis**	• All key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed. • The visual performance objectives form the principle framework and guide for assessing the proposed wind energy project when applied to individual viewpoints.
Section 9.0: Photomontage & WIre Frame Diagrams	**Visual Bulletin Requirements Addressed:**
• Photomontage selection process • Photomontage development process **Refer to Appendix D - Photomontages & Wire Frame Diagrams**	• Photomontages shall be prepared in accordance with the Scottish Natural Heritage Visual Representation of Wind Farms. • The visual assessment needs to include a concise description of the complete methodology used to create any photomontages presented in the visual assessment.

Landscape and Visual Impact Assessment Report Structure (continued)	
Section 10.0 Shadow Flicker & Blade Glint	**Visual Bulletin Requirements Addressed:**
• Shadow Flicker Assessment (Section 10.1) • Blade Glint Assessment (Section 10.5)	• An assessment of the number of hours of potential 'shadow flicker' • Blade Glint
Section 11.0 Night Lighting	**Visual Bulletin Requirements Addressed:**
• Night Lighting Assessment	• Consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.
Section 12.0 Cumulative Visual Impacts	**Visual Bulletin Requirements Addressed:**
• Cumulative Visual Impacts	• address potential cumulative impacts of wind energy projects in the region (the wind energy project as well as existing and approved projects).
Section 13.0 Associated Infrastructure	**Visual Bulletin Requirements Addressed:**
• Overview of impact resulting from Associated infrastructure	• the assessment of visual impacts from all ancillary facilities and infrastructure will be required.
Section 13.0 Dwelling Assessment Overview	**Visual Bulletin Requirements Addressed:**
• Summary of impact on Dwellings **Refer to Appendix E - Dwelling Assessment**	• All key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed.
Section 15.0 Visual Impact on Landscape Character	**Visual Bulletin Requirements Addressed:**
• Overview of LCUs with regards to Visual Performance Objectives • Summary of impact on Landscape Character • Summary of impact of associated infrastructure	• Assess the Project using visual performance objectives.
Section 16.0 Mitigation Methods	**Visual Bulletin Requirements Addressed:**
• Wind Farm Design • Mitigation Methods for Residences • Associated Infrastructure • Lighting	• An outline of any mitigation and management options proposed, including consultation with affected property owners regarding the proposed mitigation works
Section 17.0 Visual Performance Evaluation	**Visual Bulletin Requirements Addressed:**
• Evaluation of Visual Performance Objectives	• An assessment of the proposed wind energy project against each visual performance objective and demonstration of whether each objective is achieved and how the standard has been achieved.
Section 18.0 Conclusion	

Table 1: Landscape and Visual Impact Assessment Report Structure

2.0 Study Method

2.5 Additional Literature

In addition to the Bulletin, the following literature has assisted in the formulation of the study methodology and where relevant have been referenced in the report:

- *Scottish Natural Heritage, Visual Representation of Wind Farms - Good Practice Guidance (February, 2017)*
- *Environment Protection and Heritage Council, Draft National Wind Farm Development Guidelines (July 2010)*
- *Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment Third edition (2013)*
- *Clean Energy Council, Best Practice Guidelines for Wind Energy Development (June, 2018)*

2.6 Policy Considerations

2.6.1 Local Government Policies

As the proposal is considered a State Significant Development and will be assessed as such by the NSW DPIE, however relevant local government policies have also been considered. The Project spans across three Local Government Areas including Tamworth Regional, Liverpool Plains and Upper Hunter Shire.

2.6.2 National Parks and Wildlife Services

No land within the proposed Project Area is designated NSW National Parks and Wildlife Services Estates. However, the environmental assessment will consider the interactions of the wind turbine infrastructure on the amenity and function of the nearby NSW National Parks and Wildlife Services Estates. The proposed Hills of Gold Wind Farm development is west of Ben Halls Gap National Park (BHGNP) and east and north of Crawney Pass National Park (CPNP), in the National Parks and Wildlife Service (NPWS) Barrington Tops Area. ***Guidelines for developments adjoining land managed by the Office of Environment and Heritage*** have been considered in the preparation of this LVIA.

2.6.3 NSW Roads and Maritime Services

The assessment of shadow flicker, blade glint and reflectivity is to include an assessment of the impact on road users. This has been included in ***Section 10.0*** of this LVIA.

2.6.4 Civil Aviation Safety Authority

The LVIA includes an assessment of potential visual impact associated with night lighting in accordance with the Civil Aviation Safety Authority (CASA). Refer to ***Section 11.0*** of this LVIA.

3.0 Project Overview

3.1 The Project Area

The Project Area is located approximately 8 kilometres south of Nundle and covers approximately 7240 hectares. The Project Area is bounded to the east by Ben Halls Gap National Park, to the east by Crawney National Park and to the north by Hanging Rock.

The Site is located across the Tamworth Regional, Liverpool Plains Shire and Upper Hunter Shire Local Government Areas (LGAs).

The development corridor covers approximately 1540 hectares of the Project Area and is sited along the ridgeline associated with the Liverpool Range which forms apart of the Great Dividing Range.

For the purpose of this report, the Study Area is defined as the land surrounding the Project Site. In accordance with the Bulletin, residences and key viewpoints within 8 kilometres of the Project have been identified and assessed.

Figure 1 illustrates the Project locality and the Study Area.

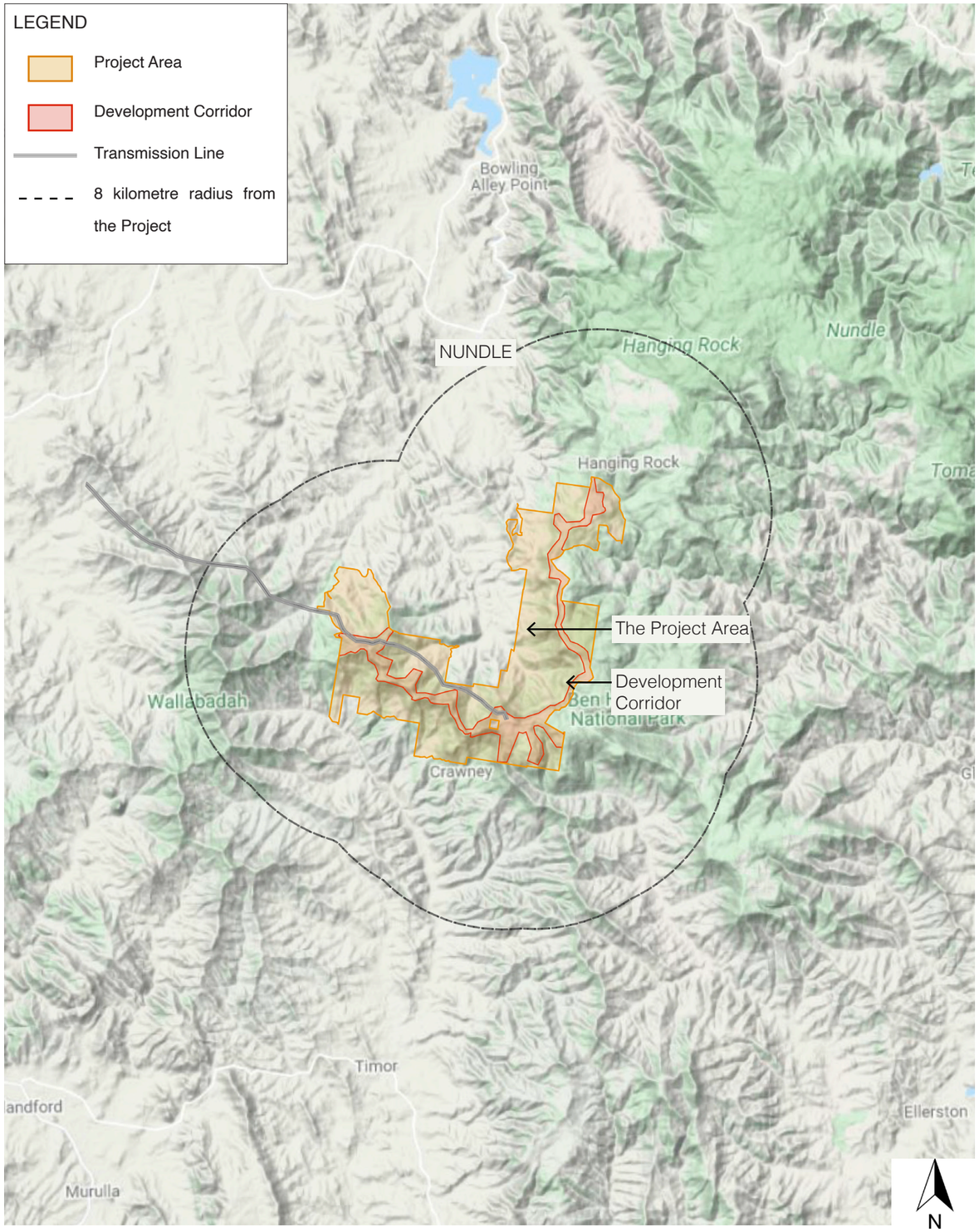


Figure 1: ***The Project Area*** *(Map Source: Google Maps)*

3.0 Project Overview

3.2 The Project

The Project involves the construction, operation and commissioning of a wind farm with up to 70 wind turbine generators (referred to as WTG or turbine), together with associated and ancillary infrastructure.

The Project has been revised and refined over time in response to design and constructibility requirements, and in consideration of environmental constraints and the outcomes of community consultation.

The following provides an overview of all aspects of the Project design to be considered in this LVIA.

3.3 Wind Turbine Design

The Wind Turbine Generator (referred to as WTG or 'turbine') model for the Project is yet to be selected, with a range of models currently under consideration. This LVIA report adopted a conservative approach by assessing the largest of the turbine model options being considered. The largest model size for the Project has been used for visual analysis to represent a worst case scenario. The proposed turbines under consideration have the following key components:

- A generating capacity of approximately 6MW;
- a 4-7 part tubular steel tower holding the nacelle;
- three blades mounted to a rotor hub on a tubular steel tower, with a combined height of blade and tower limited to a maximum tip height of 230 m AGL;
- a gearbox and generator assembly housed in a nacelle; and
- adjacent hardstands for use as crane pads and assembly and laydown areas;

Table 2 provides an overview of dimensions of the turbine components that have been used for this assessment. To best represent a worst case scenario, the maximum hub height of 150 metres has been used for modelling and visualisation purposes in this report.

Image 1 shows a typical WTG and all visual elements referred to in this report.

Wind Turbine Components		
Project Component	**Dimensions used in LVIA:**	**Quantity**
Uppermost Blade Tip	230 metres AGL	**70**
Tower (hub) height	150 metres	
Rotor Diameter	160 metres	

*Table 2: **Wind Turbine Dimensions for Visual Assessment***

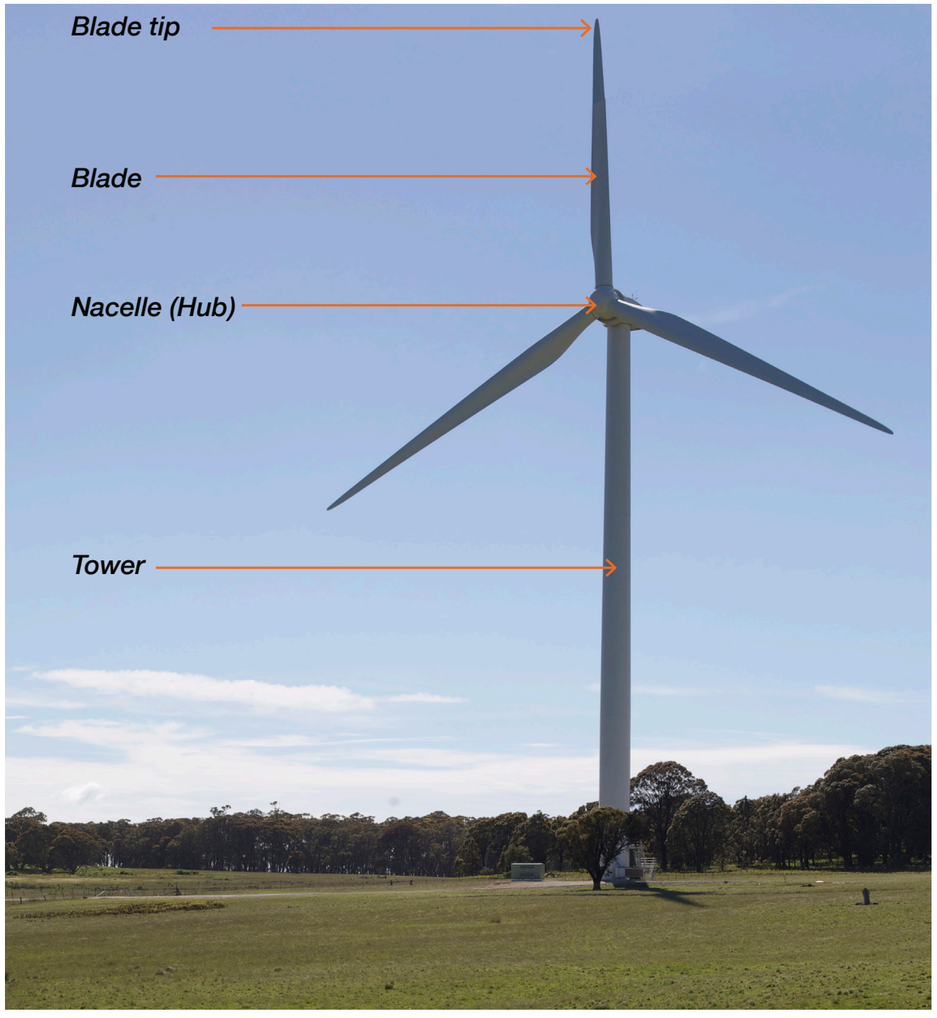
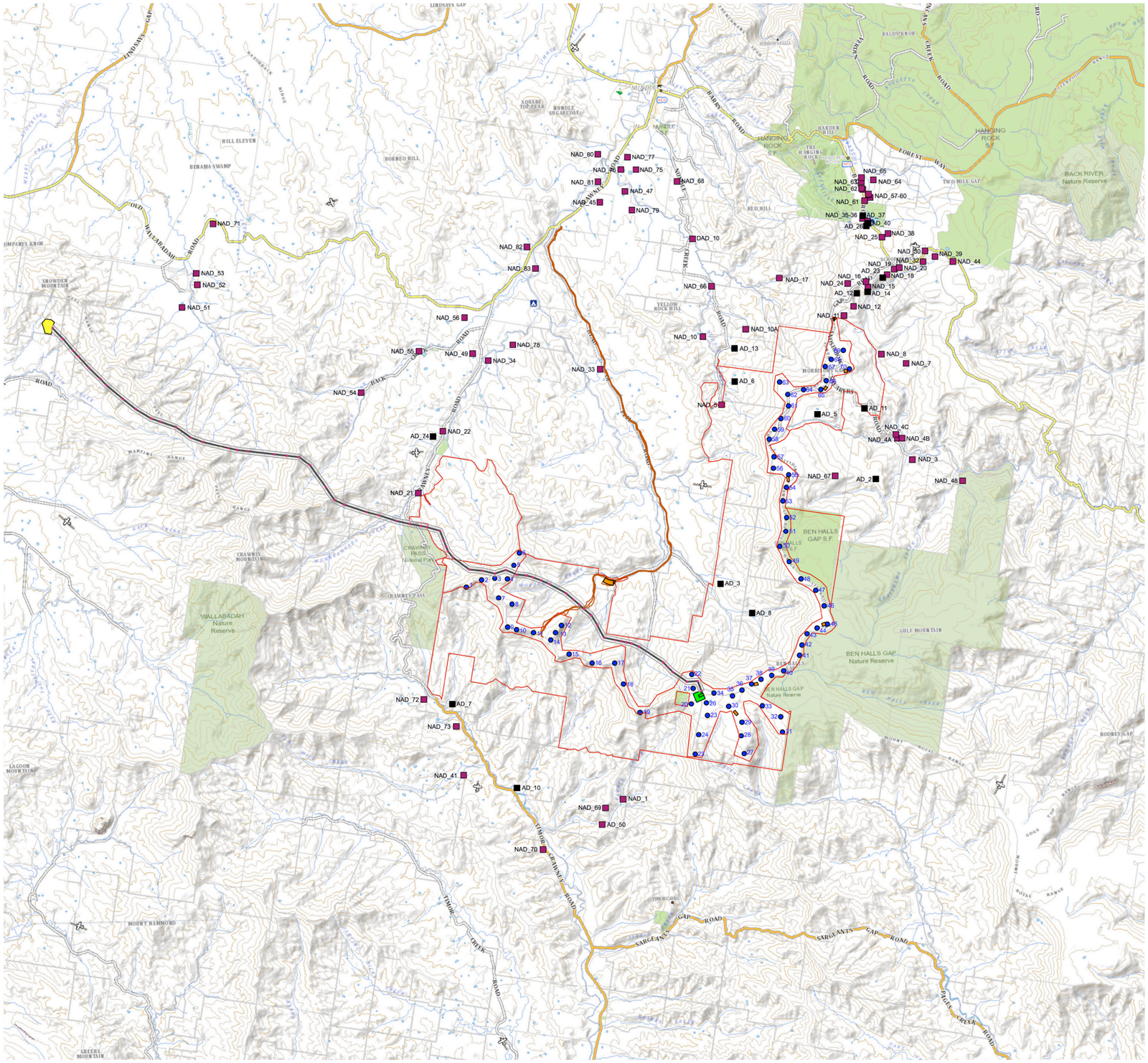


*Image 1 **Typical Wind Turbine Design (Gullen Range Wind Farm)***

3.0 Project Overview



The Project

Proposed Hills of Gold Wind Farm

LEGEND:

- Associated Dwelling
- Non- associated Dwelling
- Proposed 230m WTG Location
- Development Corridor
- Site Boundary
- 3100m from nearest turbine
- 4550m from nearest turbine
- 8000m from nearest turbine
- Switching Station
- Battery Energy Storage System and Substation
- Laydown / Batching Area
- Proposed Access Road / Internal Road
- 50m High Transmission Line Structure
- Main Road
- Minor Road

N

0 5000 m

Figure 2: The Project

3.4 Associated Infrastructure

In addition to the turbines, the following provides an overview of the permanent associated infrastructure components proposed for Hills of Gold Wind Farm which may contribute to the visual impact of the proposal. An overview of the assessment of the potential visual impacts resulting from the associated infrastructure has been provided in ***Section 13*** of this report.

Associated Infrastructure	
Project Component	**Description**
33kV/330kV Electrical Substation	Including transformers, insulators, switchyard and other ancillary equipment; ***Refer to Image 2***
Switching Station	A switching station approximately 165 x 100 metres will be constructed to connect the Project to the 330kV TransGrid Liddell to Tamworth line ***Refer to Image 3***
Operations and Maintenance Facility	100 x 100 metres
Battery Energy Storage Facility	A Battery Energy Storage System (BESS) of 100/400MWh; ***Refer to Image 5***
Transmission Lines	Above and underground 33kV electrical reticulation and fibre optic cabling connecting the WTGs to the onsite substation (following site access tracks where possible).
Transmission Lines	A 330kV overhead transmission line to connect the onsite substation to the existing 330kV TransGrid Liddell to Tamworth overhead transmission line network, located approximately 21 km west of the substation. Poles are 50 metres high. ***Refer to Image 6***
Meteorological monitoring masts	Decommissioning of three current monitoring masts and installation of up to five additional monitoring masts for power testing. The five monitoring masts will be located close to a WTG location and will have same WTG hub height. The exact number and location will be defined at the detailed design stage. ***Refer to Image 7***
Internal private access road network	With a combined total length of approximately 48.65 km connecting the WTGs and other Project infrastructure to the public road network;
Off Site Road Upgrades	Upgrades to local roads and waterway crossings, as required for the delivery, installation and maintenance of WTG components and other associated materials and structures.

*Table 3: **Associated Infrastructure***

The following temporary elements will be required during construction of the Project:

- temporary site buildings and facilities for construction contractors / equipment, including site offices, car parking and amenities for the construction workforce (see ***Image 8***);
- two temporary concrete batching plants to supply concrete for WTG footings and substation construction works (see ***Image 9***);
- earthworks for access roads, WTG platforms and foundations, including blasting;
- potentially rock crushing facilities for the generation of suitable aggregates for concrete batching or sized rock for access road and hardstand construction;
- up to seven hardstand laydown areas for the temporary storage of construction materials, plant, and equipment construction;
- external water supply and aggregates / materials for concrete batching and construction activities; and
- the transport, storage and handling of fuels, oils and other materials for construction and operation of wind farm infrastructure.

3.0 Project Overview

Image 2 Typical Substation (Source: Someva)

Image 3 Typical Switching Station (Source: Someva)

Image 4 Crane Hardstand Area (Source: NGH)

Image 5 Typical Battery Energy Storage System

(Source: https://insideclimatenews.org/)

Image 6 330KV Double Suspension Pole

(Source: Aecom)

Image 7 Meteorological mast

Image 8 Operations and Maintenance Facility

(Source: Someva)

Image 9 Concrete Batching Plant

(Source: Someva)

4.0 Community Consultation

4.1 Community Consultation Process

Community consultation was undertaken in the early stages of the Project to establish landscape values, key landscape features, important viewpoints and the community's perception of the Project. It is important to note that whilst taken into consideration when undertaking the Visual Baseline Study, the landscape values of the community are considered to be subjective.

Wind Energy Partners (WEP) the Proponent and their project advisors, Someva consulted with the community on the preliminary Project boundary to gather feedback and an understanding of the key landscape features, areas of scenic quality and key public viewpoints. The community feedback was reflected in the PVIA prepared by Arup in May 2018.

The Bulletin suggests community members rate the scenic quality of the landscape character as low, medium or high. However, in the context of a proposed development this is a complex process and it is likely that the results would be highly subjective. It is best practice to utilise a objective frame of reference (***refer to Scenic Quality Rating - Section 5.5***) which can be applied by professionals. This process can be undertaken whilst also taking into account (but not being driven by) values identified by the community.

4.2 Community Perception

Landscape values are highly subjective and can differ depending on location, local context and place attachment. Understanding of the community perception towards the proposed development is an important element of the Landscape and Visual Impact Assessment.

A CSIRO study published in 2012: *Exploring community acceptance of rural wind farms in Australia* provides a snapshot of community acceptance levels regarding Australian wind farms from a variety of stakeholder perspectives. It found levels of acceptance among the public are highly subjective and can differ depending on location, local context and place attachment.

4.3 Community Landscape Values

The visual impacts associated with wind farm projects is a common underlying concern of nearby residents and the community. To address this concern, and in accordance with the Bulletin, extensive ongoing community consultation has been undertaken by WEP and Someva concurrently to establish an understanding of the key landscape features, areas of scenic quality and key public viewpoints valued by the community. To assist in gaining an understanding of the landscape values held by the local and boarder community, a survey was undertaken by Inclusive Engagement in May 2018.

Specific areas of value to the community from which the visual amenity was requested to be assessed included:

- *Sheba Dams are an important tourism destination and historically significant area.*
- *The Hanging Rock lockout and descending the road from Hanging Rock*
- *From within the town of Nundle (specifically from Jenkins St, Oakenville St, and the cemetery)*
- *From Hanging Rock*
- *From residences along Morrisons Gap Road*
- *From the New England Highway and Lindsays Gap Road near the New England Highway*
- *From the Golf Course and Bowling Club in Nundle*
- *Historic homesteads including: Woombramurra, Koobah, the DAG Sheepstation and Cottage on the Hill.*
- *The road over Crawney looking North towards the ridge*
- *The homestead on Head of the Peel Rd.*
- *Homesteads on the other side of the Crawney Pass near Timor.*

These have been considered when undertaking field work. Viewpoint analysis was undertaken (where accessible) from these locations and where possible photomontages have been prioritised for these locations to provide the community with a visual representation of the Project.

4.0 Community Consultation

4.4 General Community Comments

In addition to the locations identified through the community consultation process, general areas of concerns raised were as follows:

- *The community seeks a greater understanding of the visual impact of the project based on the likely turbine models, size and layout of the project.*
- *Visual assessment was requested to be assessed from further distances than 3km from the proposed site*
- *It was requested that visual photomontages be used to express the visual impact from area of significance.*
- *There were misconceptions to the location of the wind farm above Nundle and the visual impact if in that location.*
- *Comments were received that the forestry plantation along the ridge further to the north of the development corridor had already altered the visual amenity of the ridge in parts.*
- *A number of people living with views of the area of the site expressed it be a priority to minimise visual impact.*
- *The colour of the turbines should be such that they minimise the visual impact. It was also stated that those hills are often shrouded in clouds, particularly in the morning.*
- *Detail was requested by those living closer to the project on how shadow flicker will be assessed on residents.*

Furthermore, general concerns and request for detailed information were identified during visits to local residences when undertaking assessment from private properties. Some of these which have been addressed within the LVIA include:

- *Night lighting and the potential effects of aviation lighting on the night sky.*
- *Visual impact of transmission lines.*
- *Visual impacts resulting from removal of vegetation for access tracks.*
- *Understanding of potential shadow flicker hours at individual dwellings.*
- *Extent of vegetation clearing.*

5.0 Visual Baseline Study

5.1 Visual Baseline Study

In accordance with the Bulletin: *A visual baseline study must be undertaken to establish the existing landscape and visual conditions. This forms the basis of determining the level of impacts of a proposed wind energy project. The baseline study is prepared and evaluated by the proponent prior to undertaking any visual analysis.*

A Preliminary Landscape and Visual Impact Assessment was undertaken by Arup Pty Ltd (2018) as part of Stage 1: Preliminary Environmental Assessment (pre-lodgement). In accordance with the Bulletin a preliminary landscape baseline study was prepared. Moir LA have developed upon the baseline study undertaken in Phase 1 to provide a detailed baseline study.

The baseline study should consider the following inputs in the 'visual catchment' for the project:

- *elements of the landscape important to the community, including public and private viewpoints;*
- *the sensitivity of the viewers who use those viewpoints, and the distances at which they may view the landscape and potential wind turbines and other ancillary facilities;*
- *the character of the landscape involved, its key features and the relative scenic quality of the area; and*
- *the location of any existing operational or approved wind energy projects within both a regional and local context, including any nearby surrounding wind energy projects within eight kilometres which may have the potential to create direct or indirect visual impacts between the proposed and any other operational, approved or proposed wind energy projects.*

The purpose of the Visual Baseline Study is to establish the existing landscape and visual conditions through descriptions, mapping and photographic representations. The study method for undertaking the Visual Baseline Study has been established in accordance with ***Appendix A of the Bulletin*** where relevant and in conjunction with previous experience on large scale wind energy projects.

Table 4 provides an overview of the methodology used to establish a quantitative approach to defining and assessing the landscape character.

Visual Baseline Study Inputs:	
Sensitive Land Use Designations	
• *Map Layer identifying National and State Sensitive Land use Designations and LEP Zones.*	***Refer to Section 5.2***
Landscape Character Type	
• *Describe the broad area of land in which the wind energy project is located.*	***Refer to Section 5.3***
Key Landscape Features	
• *Identify areas of visual interest or quality that stand out visually in the landscape.*	***Refer to Section 5.4***
Landscape Character Unit Classification	
• *Landscape is categorised into Landscape Character Units (LCU) and Scenic Quality Ratings are applied to each LCU.*	***Refer to Section 5.5 and Appendix B***
Viewpoint Inventory and Sensitivity Levels	
• *Undertake a viewpoint inventory from public and private locations and establish the Visual Influence Zones for each.*	***Refer to Section 8.0***
Visibility Distance Zones	
• *Undertake visibility or view shed mapping when assessing what may be visible from a given viewpoint looking in all directions.*	***Refer to Section 7.0***

*Table 4: **Visual Baseline Study Inputs***

5.0 Visual Baseline Study

5.2 Sensitive Land Use Designations

The Project Area is located within both Tamworth Regional, Liverpool Plains and Upper Hunter Shire Local Government Areas. The following provides an overview of the land use zoning within the Study Area and its immediate surrounds as shown on ***Figure 3***.

5.2.1 RU1 Zoning

The Project Area and surrounding land is predominately zoned RU1 - Primary Production under all three LEPs. The objectives of the RU1 zoning relevant to landscape and visual impact within the Upper Hunter Shire LEP are *'to maintain the rural landscape character of the land in the long term'*. There are currently no objectives of the RU1 zoning relevant to the visual impact within the Tamworth Regional or Liverpool Plains LEP.

5.2.2 RU3 Forestry

The Ben Halls Gap State Forest borders both the Project Area and Ben Halls Gap National Park. Hanging Rock State Forest is located approximately 5km to the northeast of the Project Site. The Ben Halls Gap State Forest and Hanging Rock State Forest are zoned RU3 Forestry to enable development for forestry purposes and other development that is compatible with forestry land uses.

5.2.3 E1 National Parks and Nature Reserves

Areas of land to the north, east and west of the Project Area have been zoned as E1 - National Parks and Nature Reserves these include:

- Crawney Pass National Park (CPNP)
- Ben Halls Gap National Park (BHGNP)
- Back River Nature Reserve
- Wallabadah Nature Reserve

Land in these areas are reserved under the National Parks and Wildlife Act 1974 to protect their environmental significance. This LVIA has referred to the Guidelines for development adjoining NPWS lands for general information on NPWS's expectations in relation to development that has the potential to impact NPWS lands. All potential impacts on the conservation values of BHGNP and CPNP and NPWS management of these parks should be avoided.

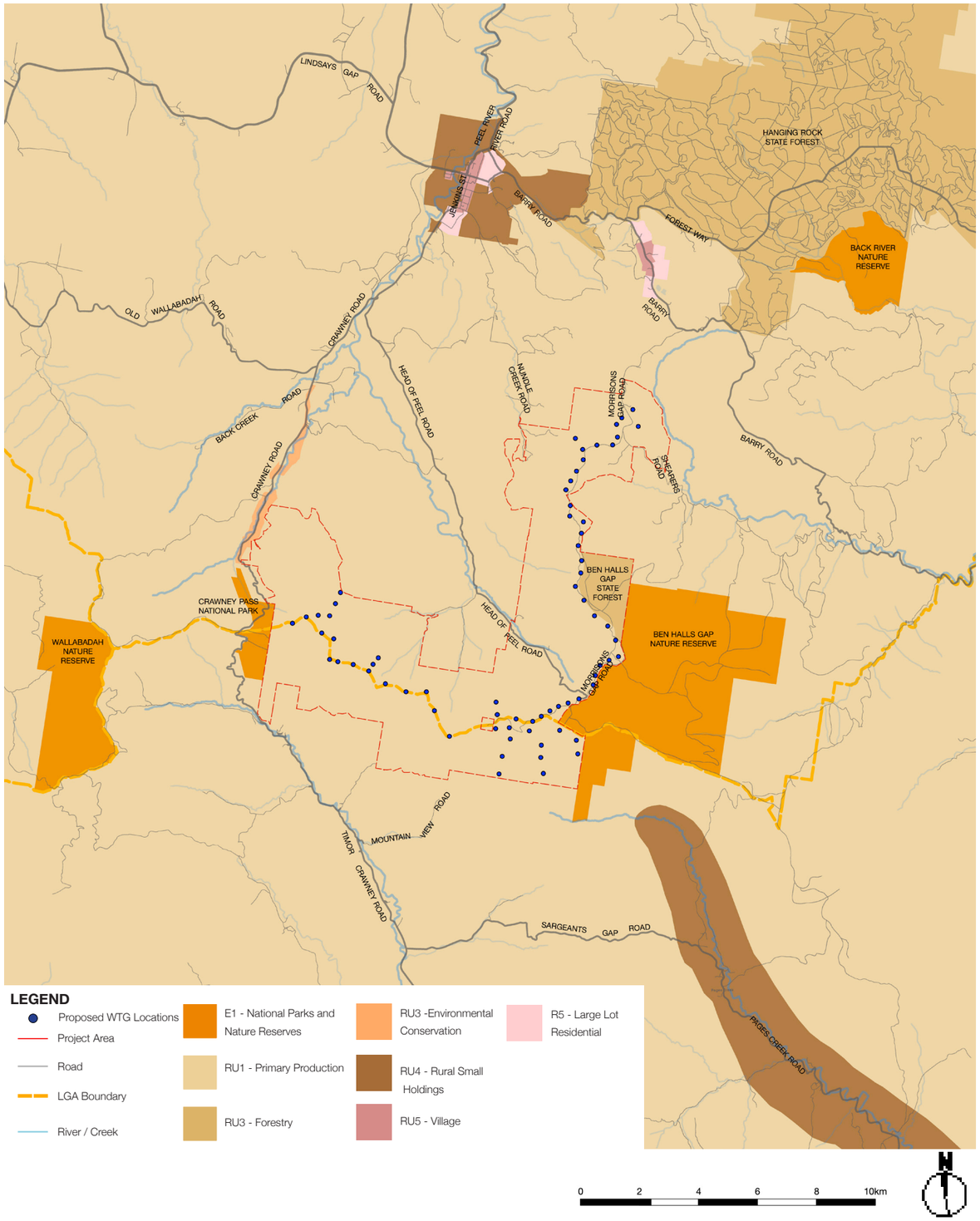


Figure 3: ***Land use Designations within the Study Area***

5.0 Visual Baseline Study

5.3 Existing Landscape Character

Generally one of the first steps in carrying out a Landscape and Visual Impact Assessment is to identify and map the landscape character of the Project Area and its surrounding area (the Study Area). The following section of the LVIA describes the typical landscape character of the Study Area.

5.3.1 Nearby Towns and Villages

The Project is located within the Tamworth, Liverpool Plains and Upper Hunter Shire LGA's. The three towns located within the Study Area include Nundle, Crawney and Hanging Rock.

Nundle:

The Project is located approximately 8km southeast of the town of Nundle. Nundle was established at the foothills of the Great Dividing Range when gold was discovered in the area in 1852. In the 2016 census, the village of Nundle had an estimated resident population of 496 people with a total of 287 dwellings (ABS, 2016). Nundle is a historic village with a number of buildings including the Nundle Woollen Mill, the Old Courthouse, The Peel Inn and the Primitive Methodist Church adding to the character of the village and ensuring a steady stream of tourists through the town each year. The presence of the ridge and rolling hillsides surrounding the village contributes to the sense of 'place' and village identity.

Hanging Rock:

Hanging Rock is located approximately 6.5 kilometres southeast of Nundle, within the Tamworth Regional Council LGA. Hanging Rock is a small but well established community with a rich history connected to gold mining. A popular look out is located within the Hanging Rock State Forest.

Crawney:

Crawney is located south of the Project Area, within the Upper Hunter Shire Council LGA, around 20km south of Nundle. It is a small community, consisting of a limited number of isolated properties accessed from Timor Crawney Road.

Image 10. *Views toward the ridge and hillsides surrounding Nundle Village*

Image 11. *Entry to Nundle via Nundle Road*

Image 12. *Old Courthouse, Nundle*

Image 13. *View from Hanging Rock Lookout across the valley*

5.0 Visual Baseline Study

5.3.2 Land use

Land use within the Project Area is predominately used for agricultural purposes, specifically cattle and sheep grazing. Cropping is also evident to occur within the Study Area. Areas of nature conservation exist within the Project Area including Crawney Pass National Park, Ben Halls Gap National Park, Back River Nature Reserve and Wallabadah Nature Reserve. Areas of forestry also occur within the Study Area with Hanging Rock State Forest and Ben Halls State Forest Area to the north and east of site, respectively.

Dwellings are mainly concentrated around the village of Nundle and Hanging Rock. Isolated dwellings exist along Sargeants Gap Road, Mountain View Road, Back Creek Road and Head of Peel Road. A cluster of rural residential dwellings are situated along Morrisons Gap Road, Shearers Road and Barry Road. There are scattered rural residential dwellings situated along Crawney Road, Timor Crawney Road, Old Wallabadah Road and Nundle Creek Road.

5.3.2 Accessibility

The village of Nundle is generally accessed via Nundle Road or Lindsays Gap Road, sealed roads providing connections to the New England Highway. Hanging Rock is accessed via Barry Road (accessed off Nundle Road) which is a sealed and winding road.

Timor Crawney / Crawney Road is a low use road running generally in a north/south direction connecting homesteads to the Village of Nundle. Old Wallabadah Road is an unsealed low use road providing an alternate link for a handful of homesteads to the New England Highway.

A small number of roads run off Timor Crawney / Crawney Road and Barry Road to provide access to a isolated dwellings (ie. Head of Peel Road, Sargeants Gap Road, Mountain View Road, Back Creek Road, Nundle Creek Road and Morrisons Gap Road.)

5.3.4 Landform

The Project Area is situated along the Liverpool Range which forms a part of the Great Dividing Range. The ridgeline runs generally north-south, bordered to the east by Ben Halls Gap National Park, and then wrapping west towards Crawney Pass National Park. The Project Area extends across the ridge reaching a height of 1400 AHD.

The undulating landform falls toward the centre of the Project Area converging at the Peel River and Nundle Creek along the Nundle valley floor. The topography surrounding the Project Area is variable and ranging from; steep/sloping in sections around Crawney Pass National Park and Hanging Rock Lookout; sloping in areas along creeklines and undulating on the foothills of the surrounding ranges.

Image 14. *Cleared grazing land with vegetation on hillsides, the ranges seen in the background*

Image 15. *Vegetated Creeklines of Nundle Valley*

Image 16. *Barry Road (Hanging Rock)*

Image 17*. Crawney Road, view to the ranges in the background and undulating landforms in the mid ground.*

5.0 Visual Baseline Study

5.3.5 Vegetation

Gentle slopes, low lying topography and sections of the ridgelines have generally been extensively cleared to increase grazing areas and make room for access roads, farming tracks and fence lines. Scattered vegetation is present within grazing lots and provides shade for stock.

The undulating foothills and steeper less fertile areas remain vegetated with grassy woodlands. Remnant stands of vegetation are generally located along creeklines, river bends, along roadsides and sloping land unsuitable for agricultural use.

There is dense canopy cover in the form of mature rainforests and Wet Sclerophyll forests on the mountain tops associated with Ben Halls Gap National Park to the east, Hanging Rock to the north and Crawney Pass National Park.

Forestry plantations located within the Hanging Rock State Forest and Ben Halls State Forest area provide visual contrast to the native vegetation occurring elsewhere in the area.

5.3.6 Water Form

The Project Area sits along the ridgelines and ranges that delineate the boundaries to three (3) catchments: the Namoi Catchment; the Hunter River Catchment; and the Manning River Catchment.

The Peel River is located within the valley floor to the northwest of the Project Area. It flows generally north, west and northwest and emerges into the Liverpool Plains near Tamworth. It is joined by thirteen tributaries before flowing through the Chaffey Dam and reaching its mouth at the confluence with the Namoi River over its course of 210 kilometres. Wombramurra, Nundle and Back Creek, to the northeast and northwest, are tributaries of the Peel River.

Pages Creek is located to the southeast of the Project Area. Pages Creek flows generally southeast before reaching its confluence with the Hunter River at Ellerston. The Isis River is located to the south of the Project Area is also a perennial river of the Hunter River Catchment. It flows generally south before reaching its confluence with the Pages River near Belltrees, northeast of Scone.

Barnard River is located to the northeast of the Project Area. It is a perennial river of the Manning River catchment, and flows generally east southeast for approximately 148km, before reaching its confluence with the Manning River.

There are a number of ephemeral creeks and streams which run through the landscape into the rivers and creek lines.

Image 18. *Crawney Pass National Park*

Image 19. *Vegetated ridge associated with the Project Site viewed south from Head of Peel Road within the Nundle Flats. Tributary of Peel River seen in the foreground.*

Image 20. *Vegetated ridge associated with the Project Site viewed northeast from Crawney Road.*

5.0 Visual Baseline Study

5.4 Key Landscape Features

The Bulletin states: *Key landscape features should be identified and shown on the baseline study map for further reference. Key landscape features may include natural features such as a distinctive mountain peak or hill top, a large rock outcrop or cliff, a waterfall, a visually distinctive stand of trees, or even a single large tree that stands out visually in the scene.*

The following provides an overview of the key features identified within the Study Area and its surrounds which contribute to the visual character of the landscape (refer to ***Figure 4***)

5.4.1 Crawney Pass National Park

Crawney Pass National Park is located west of the Project Area. It is located on the Liverpool Range and is approximately 250ha in area. The main legislation governing the management of the park is the Brigalow and Nandewar Community Conservation Area Act 2005, the Biodiversity Conservation Act 2016 and the National Parks and Wildlife Act 1974 (NPW Act) and Regulation.

The National Park is located on a saddle on the Liverpool Range at 980 metres above sea level. The topography of the park is generally rugged with steep inclines of more than 30 degrees and terraced landscapes in some sections.

Sections of the National Park were formerly Crown land and subject to some clearing and grazing activities. The travelling stock reserves adjoining the park's western and southern boundaries are well-vegetated, with tributaries feeding into the Isis River and Wombramurra Creek. The travelling stock reserve situated 150 metres north of the park is also well vegetated. The steep terrain has assisted in protecting some areas from past land clearing.

Access to the Park is via Timor Crawney Road which connect to two (2) firetrails within the boundaries of the National Park. Views to the west whilst travelling along Timor Crawney Road are highly fragmented due to the steep terrain and dense vegetation characteristic of the Park. The elevated position provides distant views to the north and east, though usually filtered by vegetation (refer to ***Image 18***).

5.4.2 Ben Halls Gap National Park

The Ben Halls Gap National Park is located to the east of the Project Site and approximately 10km southeast of Nundle. Ben Halls Gap National Park covers an area of 2500ha and is located at the junction of the Liverpool and Mount Royal Ranges. The main legislation governing the management of the Park is the National Parks and Wildlife Act 1974 (NPW Act) and Regulation and the Biodiversity Conservation Act 2016. There are no public roads providing access to the Park and no visitor facilities.

The National Park is located on the southern end of the Northern Tablelands adjoining the northern side of the Hunter Valley. It occupies a small plateau on the Great Dividing Range formed by the meeting of the Mount Royal Range and the Liverpool Range. The maximum altitude in the Park is 1400m ASL. The plateau is gently undulating but falls steeply into deep valleys cut by Brayshaws Creek, Ben Halls Creek and Pages Creek. The dense vegetation covering the slopes is a key feature of the National Park, however due to accessibility and the undulating topography of the area, views to the National Park are limited. The Park features an outstanding area of tall, high nutrient old growth eucalyptus forest. The Park has had little human disturbance and as a result it has high quality habitat and little weeds.

5.4.5 State Forests

Nundle State Forest is a small plot located on the southeast boundary of Nundle. It has been mostly cleared and is characterised by logging and hunting activity.

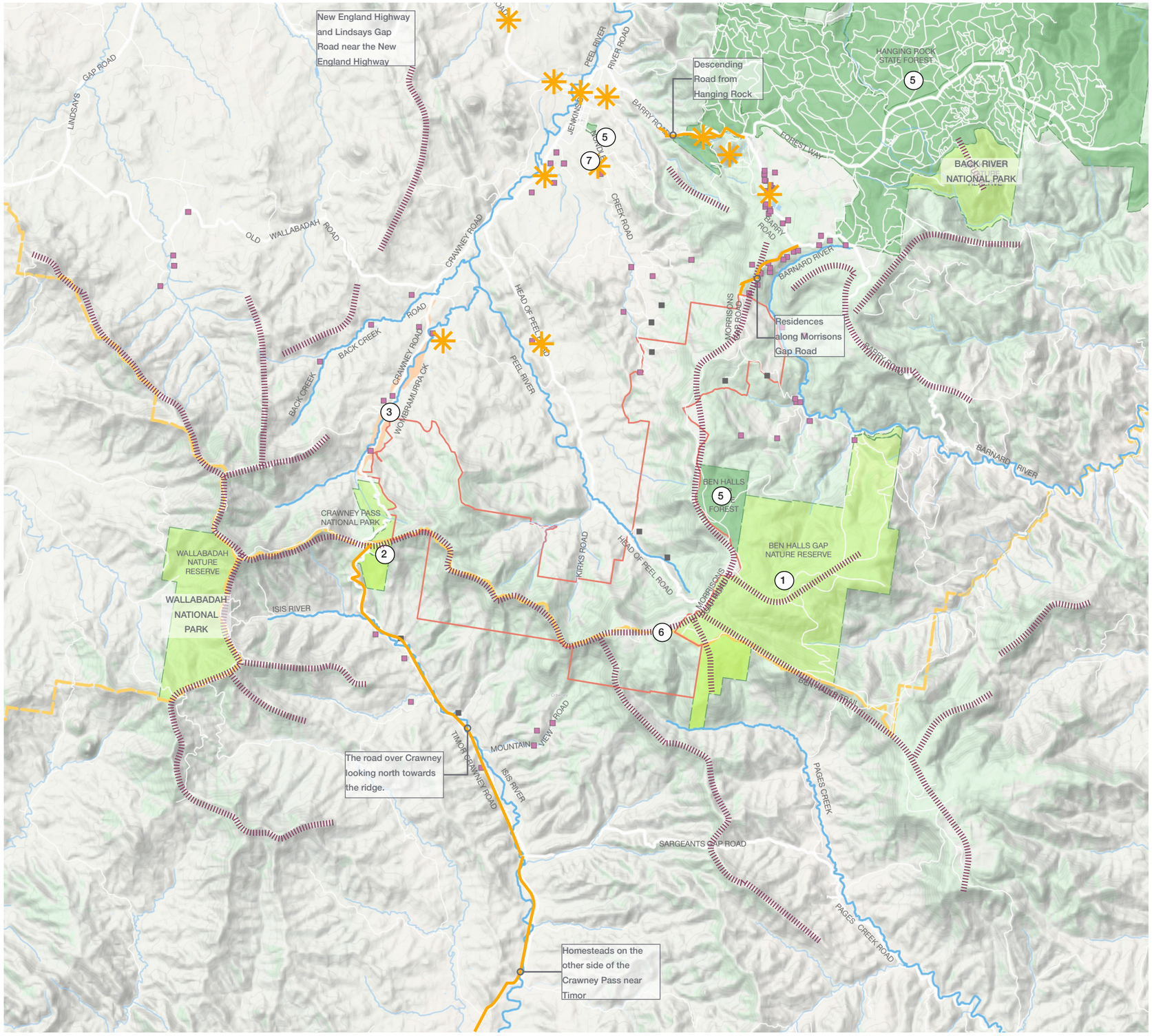
Hanging Rock State Forest is located north of the Project Area. It is an undulating landscape with steep sections that reach around 1000m AHD. It has been mostly cleared to make way for a large Conifer plantation. Due to its use as a State Forest there are numerous gravel roads that traverse the State Forest. The Ponderosa Picnic Area is located in the south of the State Forest.

Ben Halls Gap State Forest is located directly to the east of the Project Area and north of Ben Halls Gap National Park. It is approximately 350ha is size and is primarily used for hardwood forestry activities.

5.4.6 Liverpool Range

The Liverpool/Mount Royal Ranges are part of the Great Dividing Range. The Project is located on the ridge associated with the Ranges. The rise in topography is densely vegetated and provides a visual backdrop to views from areas within the Study Area.

5.0 Visual Baseline Study



Existing Landscape Character

LEGEND

- Project Area
- Road
- Non-Associated Dwelling
- Associated Dwelling
- River / Creek
- 10m Contour
- Indicative Ridge line
- LGA Boundary
- Key locations identified through community consultation
- National Park
- State Forest
- Environmental Conservation Area

Key Landscape Features

1. Ben Halls Gap National Park
2. Crawney Pass National Park
3. Teamsters Rest Camp Ground
4. Hanging Rock Lookout
5. Hanging Rock State Forest, Nundle State Forest *and* Ben Halls Gap State Forest
6. Liverpool Ranges (Great Dividing Range)
7. Nundle Cemetery

0 2 4 6 8 10km

N

Figure 4: ***Existing Landscape Character and Key Features***

5.0 Visual Baseline Study

5.5 Scenic Quality Class Rating

The Bulletin states: *the baseline study inputs, including key landscape features and sensitive land use designations, should lead to the identification of Scenic Quality Classes. Scenic quality refers to the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. It is both a subjective and complex process undertaken by experts in visual impact assessment, taking into account community values identified in early community consultation.*

In accordance with the Bulletin, a Scenic Quality 'frame of reference' has been formulated by Moir Landscape Architecture (***Table 5***) utilising *An approach to landscape sensitivity assessment* by Natural England. The frame of reference developed for the Hills of Gold Wind Farm is in keeping with the example frame of reference provided in the Bulletin.

Each category of the 'frame of reference' has been quantified for each Landscape Character Unit (summarised in ***Section 5.6*** and overviews provided in ***Appendix B***) to determine a Scenic Quality Rating of **low**, **moderate** or **high.** The resulting *Scenic Quality Rating* is used to assist in defining the Visual Influence Zones in accordance with the Bulletin (refer to matrix in ***Appendix A***).

SCENIC QUALITY RATING		
Description	**LOW** ← **MODERATE** → **HIGH**	
Landform	- Flat Topography - Absence of Landscape Features - Open, broad extents of spaces	- Diversity in Topographical Range - Unique Landscape Features - Intimate spaces
Waterforms	- Absence of Water	- Presence of Water - Visually prominent lakes, reservoirs, rivers streams and swamps.
Vegetation	- Absence of vegetation - Lack of diversity - Land cleared of endemic vegetation - Low level of connection between vegetation and landscape / topography	- Abundant vegetation - High diversity - High retention of endemic vegetation. - High level of connectivity between natural landscape and landforms.
Human Influence	- High population. - High density in settlement - High presence of Infrastructure - High levels of landscape modification	- Low / dispersed population - No settlement - Absence of infrastructure - Landscape in natural state
Activity	- High levels of traffic movement - Presence of freight and passenger transport networks - Presence of production or industry.	- Low traffic movement - Absence of freight and passenger transport - Absence of production or industry
Rarity	- Typical landscape within a local and regional context	- Unique combination of landscape features in a local and regional context
Relationship with Adjoining Landscapes	- Low visible connection with adjoining landscapes - Low variability between adjoining landscapes. - Landscape features do not contribute to amenity from adjoining landscapes	- High visibility with adjoining landscapes. - High variability and contrast with adjoining landscapes - Landscape features contribute significantly to amenity of adjoining landscapes

Table 5 ***Scenic Quality Class Rating Frame of Reference***

5.0 Visual Baseline Study

5.6 Landscape Character Unit Classification

Due to the large scale of the Study Area and varying landscape character the Study Area has been categorised into seven (7), *Landscape Character Units* to assist in the assessment.

The Landscape Character Units (LCU) are classified by slight variations in the landscapes geology, topography, land use and vegetation which create distinct character areas within the Study Area. The LCUs have been informed by the *Preliminary Landscape and Visual Assessment by ARUP*, land use patterns, vegetation coverage, topographical maps, site images and site inspection.

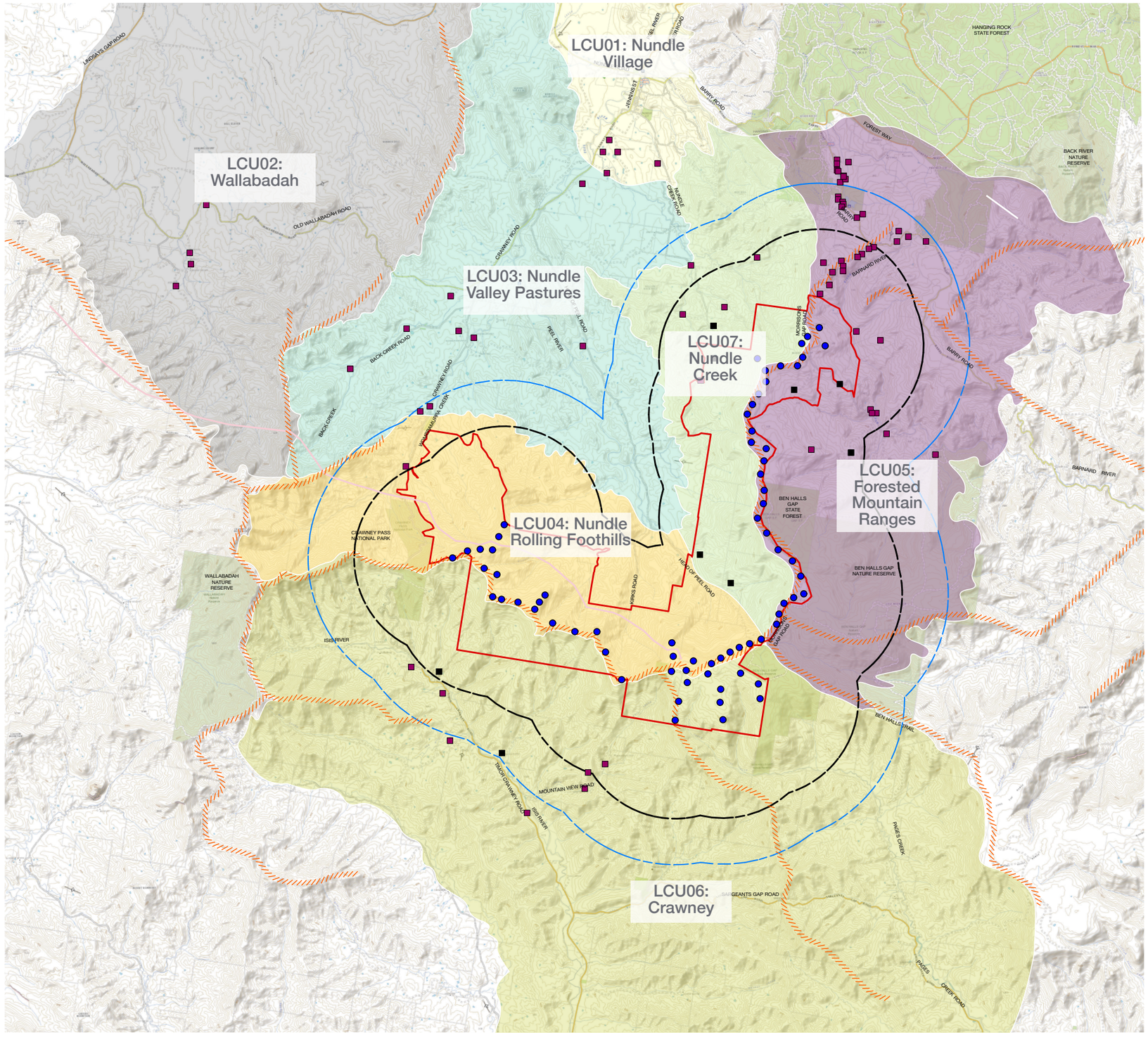
The general extent of the LCUs are shown on ***Figure 5*** on the following page and detailed description of each Landscape Character Unit has been included in ***Appendix B*** of this report.

The Scenic Quality 'frame of reference' has been applied to each LCU (refer to ***Appendix B*** and ***Table 6***).

Overview of Landscape Character Units		
LCU:	**Overview:**	**Scenic Quality Rating:**
LCU 01 Nundle Village	Gently undulating land making up the Village of Nundle.	**Low - Moderate** ***Refer to Appendix B1***
LCU 02 Wallabadah	Mostly cleared grazing land bounded to the north and west by Lindsays Gap Road and to the south and east by foothills associated with the Liverpool Range.	**Moderate** ***Refer to Appendix B2***
LCU 03 Nundle Valley Pastures	Grazing land to the north of the Project Site which is generally associated with the valley of the Liverpool/Mount Royal Ranges.	**Moderate** ***Refer to Appendix B3***
LCU 04 Nundle Rolling Foothills	Undulating land form associated with the transition topography of the elevated ridge lines and crests of the Liverpool Range and Nundle Valley.	**Moderate** ***Refer to Appendix B4***
LCU 05 Forested Mountain Ranges	Densely vegetated land to the eastern slopes of the Dividing Range, north to the Hanging Rock area, wrapping to the south Ben Halls Gap National Park.	**Moderate - High** ***Refer to Appendix B5***
LCU 06 Crawney	Cleared grazing land to the south- southwest of the ridge line.	**Moderate** ***Refer to Appendix B6***
LCU 07 Nundle Creek	Undulating, cleared grazing land to the north west of the Project area	**Moderate** ***Refer to Appendix B7***

Table 6. ***Overview of Landscape Character Units***

5.0 Visual Baseline Study



Landscape Character Units

LEGEND

- Project Boundary
- Proposed Turbine Location
- Associated Dwelling (AD)
- Non-associated Dwelling (NAD)
- 3100m from turbine
- 4550m from turbine
- Main Road
- Minor Road
- Indicative Ridgeline
- Transmission Line

LANDSCAPE CHARACTER UNITS

- LCU01: Nundle Village
- LCU02: Wallabadah
- LCU03: Nundle Valley Pastures
- LCU04: Nundle Rolling Foothills
- LCU05: Forested Mountain Ranges
- LCU06: Crawney
- LCU07: Nundle Creek

0 2 4 6 8 10km

N

Figure 5. ***Landscape Character Units***

6.0 Preliminary Assessment Tools

6.1 Overview of Preliminary Assessment Tools

To assist in defining the visual catchment, preliminary assessment tools have been developed in the Bulletin. In accordance with the Bulletin, the purpose of the preliminary assessment tools are: *to provide an early indication of where turbines require careful consideration because of potential visual impacts. The tools apply to both dwellings and key public viewpoints in the study area. The tools provide an early indication of where placement of turbines will require further assessment and justification, and where consultation with potentially affected landowners needs to be focused – including discussions for landholder agreements.*

The preliminary assessment tools involve analysis of two key visual parameters:

1. Visual Magnitude (***Refer to Section 6.2***)
2. Multiple Wind Turbine Tool (***Refer to Section 6.4***)

Once defined, the Bulletin states: *Further assessment and justification for placement of turbines located in these sensitive areas in the EIS will be required, along with a description of mitigation and management measures being employed to reduce impacts. This assessment may identify that factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project.*

Dwellings identified through the application of the Preliminary Assessment tools have been assessed in detail in ***Appendix E*** of this LVIA.

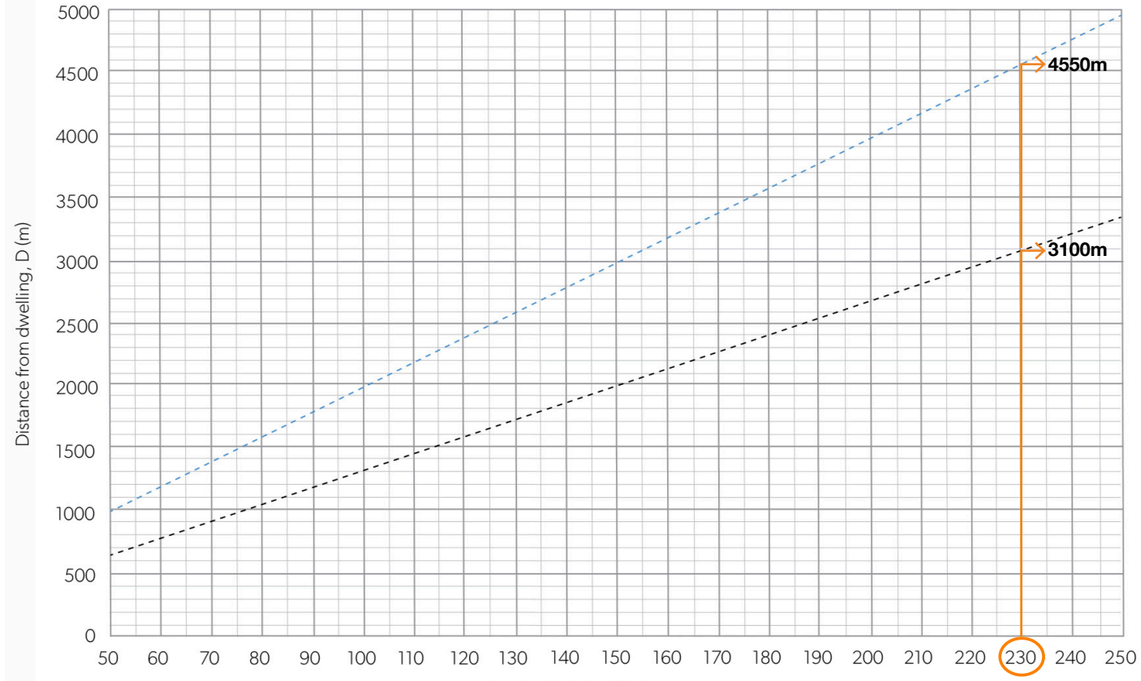


Figure 6 ***Visual Magnitude thresholds for Project Layouts***

(Source: Visual Assessment Bulletin)

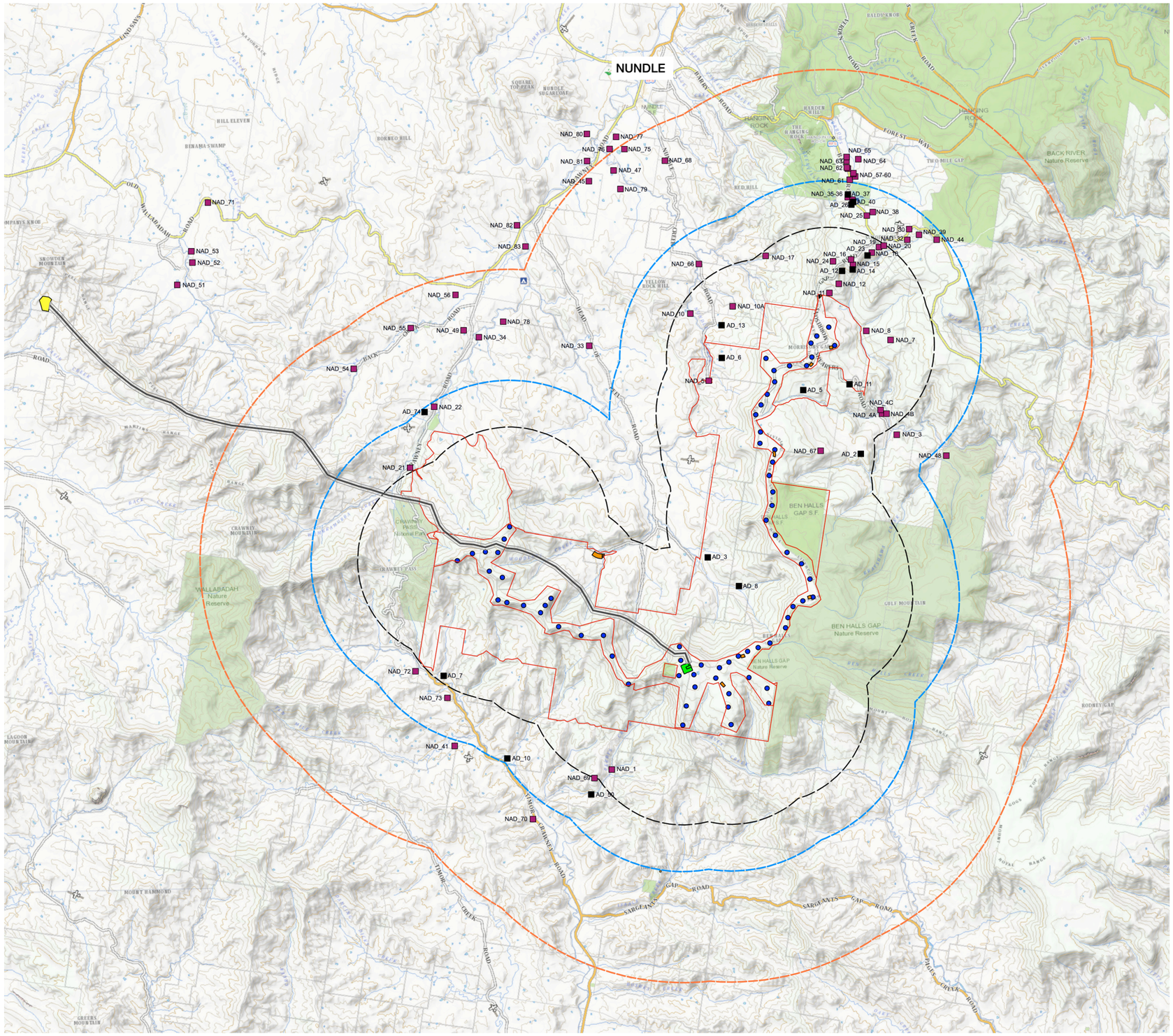
6.2 Preliminary Assessment Tool 1: Visual Magnitude

The Visual Magnitude Threshold is based on the height of the proposed wind turbines to the tip of the blade and distance from dwellings or key public viewpoints as shown in ***Figure 7***.

In accordance with the Bulletin: ***proposed turbines below the black line must be identified along with the dwellings or key public viewpoints as part of the request for SEARs.*** The proposed wind turbines are based on a worst case scenario with a tip height of ***230 metres***. The 'black line 'intersects at a distance of ***3100 metres*** and the 'blue line' intersects at ***4550 metres***.

For the purpose of the Preliminary Assessment, the Visual Magnitude thresholds are based on a 2D assessment of the Project alone. Further assessment indicates factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project from residences.

6.0 Preliminary Assessment Tools



Visual Magnitude

Hills of Gold Wind Farm

Black Line = 3100m

Blue Line = 4550m

LEGEND

- Associated Dwelling
- Non- associated Dwelling
- Proposed 230m WTG Location
- Project Area
- Main Road
- Minor Road
- 3100m from nearest turbine
- 4550m from nearest turbine
- 8000m from nearest turbine
- 50m High Transmission Line Structure

Note:

Preliminary Assessment Tool 1: Visual Magnitude is based on a 2D Assessment alone and does not take into account topography, vegetation or other screening factors which may reduce the potential for viewing turbines.

For detailed assessment of Non-associated Dwellings identified refer to ***Appendix E.***

N

0 5000 m

Figure 7 ***Preliminary Assessment Tool 1: Visual Magnitude - Hills of Gold Wind Farm*** *(Map Source: Six Maps)*

6.0 Preliminary Assessment Tools

6.3 Results of Preliminary Assessment Tool 1: Visual Magnitude

Application of the Preliminary Assessment Tools to the Hills of Gold Wind Farm Project identified dwellings which require further assessment in accordance with the Bulletin. Non-associated dwellings identified within 3100m and between 3100 - 4550 metres of the nearest proposed turbine are shown on ***Figure 7*** and listed in ***Tables 7 and 8.***

- 23 dwellings (including one (1) dwelling location with a DA lodged) have been identified within 3100 metres of a proposed wind turbine location (within the black line). Detailed assessment of these dwellings has been undertaken in ***Appendix E.***

- 20 dwellings were identified within 3100 - 4550 metres of a proposed wind turbine (within the blue line). Seven (7) of the dwellings identified will have no visibility of the proposed development due to topography (NAD_25, AD_26, NAD_35, NAD_36, AD_37 NAD_38 and AD_40).

Non-associated Dwellings within 3100 (Black Line)		
ID	**Location**	**Distance to nearest WTG**
NAD_01	*Mountain View Road*	**2.58 km**
NAD_4A	*Shearers Road*	**2.79 km**
NAD_4B	*Shearers Road*	**2.89 km**
NAD_4C	*Shearers Road*	**2.66 km**
NAD_5	*Nundle Creek Road*	**1.79 km**
NAD_7	*Morrisons Gap Road*	**1.74 km**
NAD_8	*Morrisons Gap Road*	**1.16 km**
NAD_10	*Nundle Creek Road*	**2.27 km**
NAD_10A	*Nundle Creek Road*	**1.93 km**
NAD_11	*Morrisons Gap Road*	**1.05 km**
NAD_12	*Morrisons Gap Road*	**1.38 km**
AD_12	*Morrisons Gap Road*	**1.79 km**
AD_14	*Morrisons Gap Road*	**1.94 km**
NAD_15	*Morrisons Gap Road*	**2.08 km**
NAD_16	*Morrisons Gap Road*	**2.20 km**
NAD_17	*Nundle Creek Road*	**2.94 km**
NAD_18	*Morrisons Gap Road*	**2.69 km**
NAD_19	*Morrisons Gap Road*	**2.93 km**
NAD_20	*Morrisons Gap Road*	**3.05 km**
AD_23	*Morrisons Gap Road*	**2.52 km**
NAD_67	*Morrisons Gap Road*	**1.45 km**
NAD_69	*Mountain View Road*	**3.10 km**
Potential DA Locations:		
NAD_24*	*Morrisons Gap Road*	**2.06**

Table 7 ***Non-associated Dwellings within 3100m of WTG***

Non-associated Dwellings within 3100 - 4550m (Blue Line)		
ID	**Location**	**Distance to nearest WTG**
NAD_03	*Shearers Road*	**3.52 km**
NAD_21	*Crawney Road*	**3.23 km**
NAD_22	*Crawney Road*	**4.40 km**
NAD_25*	*Barry Road*	**3.87 km**
AD_26*	*Barry Road*	**3.87 km**
NAD_30	*Barry Road*	**3.95 km**
NAD_32	*Barry Road*	**3.65 km**
NAD_35*	*Barry Road*	**4.08 km**
NAD_36*	*Barry Road*	**4.03 km**
AD_37*	*Barry Road*	**4.16 km**
NAD_38*	*Barry Road*	**3.85 km**
NAD_39	*Barry Road*	**4.00 km**
AD_40*	*Barry Road*	**3.96 km**
NAD_44	*Barry Road*	**4.32 km**
NAD_48	*Shearers Road*	**4.50 km**
AD_50	*Mountain View Road*	**3.52 km**
NAD_66	*Nundle Creek Road*	**3.65 km**
NAD_72	*Timor Crawney Road*	**3.37 km**
NAD_73	*Timor Crawney Road*	**3.41 km**
AD_74	*Crawney Road*	**4.44 km**

Table 8 ***Non-associated Dwellings between 3100 - 4550 metres of nearest WTG***

**** Project not visible due to topography***

6.0 Preliminary Assessment Tools

6.4 Preliminary Assessment Tool 2: Multiple Wind Turbine Tool

The Multiple Wind Turbine Tool provides a preliminary indication of potential cumulative impacts arising from the proposed wind energy project. To establish whether the degree to which dwellings or key public viewpoints may be impacted by multiple wind turbines, the proponent must map into six sectors of 60° any proposed turbines, and any existing or approved turbines within eight kilometres of each dwelling or key public viewpoint. ***Figure 8*** below provides examples of where a dwelling or key public viewpoint may have views to turbines in multiple 60° sectors.

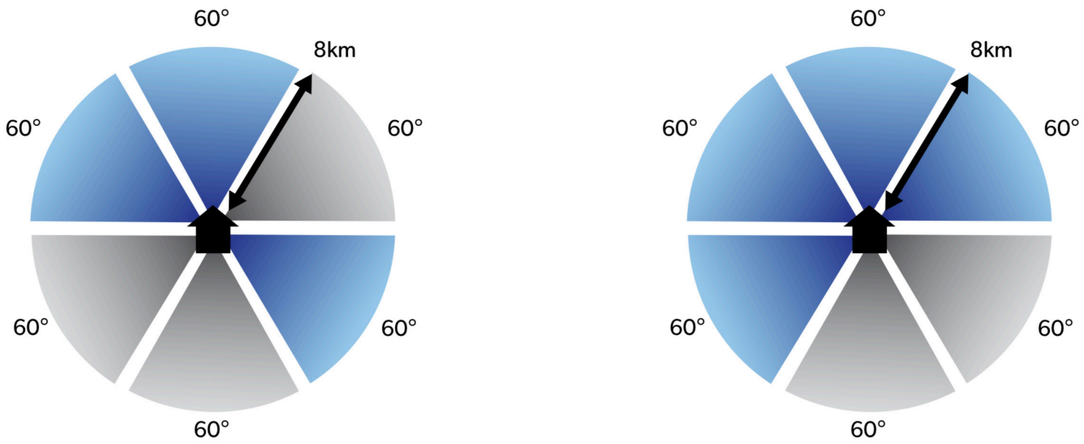


Figure 8 ***Preliminary Assessment Tool: Multiple Wind Turbines***

(Source: Visual Assessment Bulletin)

In accordance with the Bulletin *Where wind turbines are visible within the horizontal views of the dwelling or key public viewpoints in three or more 60° sectors, the proponents must identify the turbines, relative dwelling and key public viewpoint, along with the relative distance and submit these to the Department as part of the request for SEARs.* These turbines will become a focus for assessment in the EIS.

Figure 9 provides an overview of the number of 60° sectors visible from each of the dwellings identified within 8 kilometres.

6.5 Results of Preliminary Assessment Tool 2: Multiple Wind Turbine Tool

When applied to the Project, the 2D Multiple Wind Turbine Tool (see ***Figure 9***) identified seven (7) non-associated dwellings with more than two sectors of turbines within 8000 metres (see ***Table 9***). Of the seven (7) dwellings identified, further assessment determined topography would screen views to turbines reducing the number of turbines visible to an acceptable number of 60° sectors from six (6) dwellings (refer to ***Appendix E***).

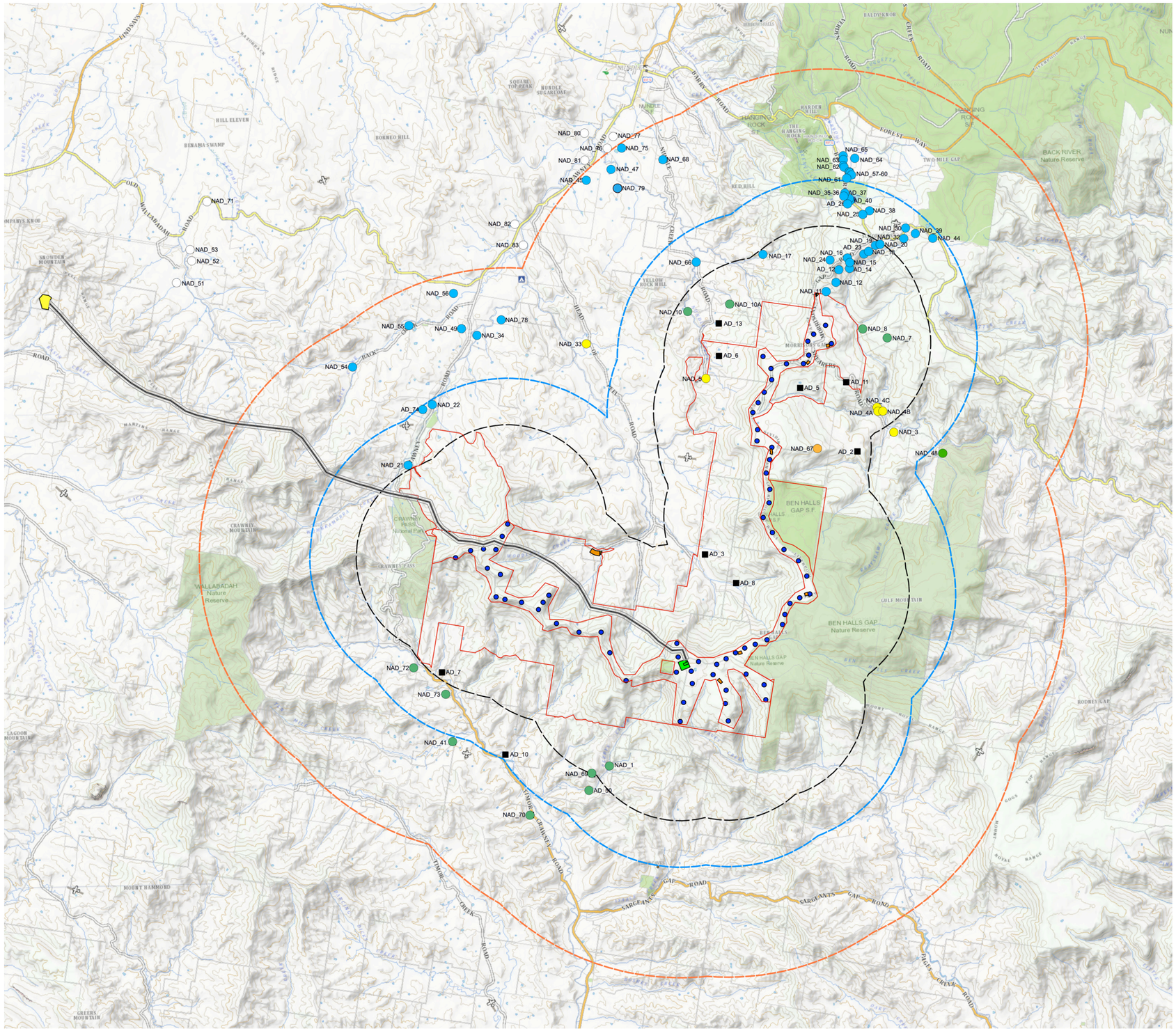
The remaining dwelling ***NAD_33*** is likely to have views of proposed turbines in up to three (3) 60° sectors. It is worth noting this dwelling is in excess of the blue line of visual magnitude, located approximately 5.62 kilometres from the nearest turbine. Detailed assessment of NAD_33 has been included in ***Appendix E.***

ID	Location	Distance to nearest WTG	Number of Sectors (2D Assessment)	Number of sectors (3D Assessment)
Non-associated dwellings within 3100m				
NAD_4A	*Shearers Road*	2.73km	3	1
NAD_4B	*Shearers Road*	2.89km	3	2
NAD_4C	*Shearers Road*	2.69km	3	1
NAD_5	*Nundle Creek Road*	1.79km	3	2
NAD_67	*Morrisons Gap Road*	1.45km	4	1
Non-associated Dwellings within 3100 - 4550m				
NAD_3	*Shearers Road*	3.52	3	2
Non-associated Dwellings in excess of 4550m				
NAD_33*	*Head of Peel Road*	5.62km	3	3

Table 9 ***Multiple Wind Turbine Tool***

**** Dwelling will have visibility of turbines in up to three (3) 60º sectors***

6.0 Preliminary Assessment Tools



Multiple Wind Turbine Tool

Hills of Gold Wind Farm

LEGEND

- Proposed 230m WTG Location
- Project Area
- 3100m from nearest turbine
- 4550m from nearest turbine
- 8000m from nearest turbine
- 50m High Transmission Line Structure
- Main Road
- Minor Road
- In excess of 8 kilometres
- One (1) 60° Sectors
- Two (2) 60° Sectors (120°)
- Three (3) 60° Sectors (180°)
- Four (4) 60° Sectors (240°)

Note:

Preliminary Assessment Tool 2: Multiple Wind Turbine Tool is based on a 2D Assessment alone and does not take into account topography, vegetation or other screening factors which may reduce the potential for viewing multiple turbines.

For detailed assessment of Non-associated Dwellings identified refer to ***Appendix E.***

N

0 5000 m

Figure 9 ***Preliminary Assessment Tool 2: Multiple Wind Turbine Tool*** *(Map Source: Six Maps)*

7.0 Zone of Visual Influence

7.1 Zone of Visual Influence

The Bulletin states *'the use of Geographic Information Systems (GIS) to facilitate the application of the tools will streamline the evaluation phase of the evaluation phase of a project during the pre-lodgement stage. This can also assist in refining the number of turbines and viewpoints that will ultimately need more detailed assessment.'*

Two Zone of Visual Influence (ZVI) diagrams have been prepared for Hills of Gold Wind Farm to illustrate the theoretical visibility of the proposed project one from hub height, and one from blade tip.

- ***Figure 10*** depicts the areas of land from which the proposed development may be visible and provides an indicative number of wind turbines based on the tip height of 230 metres.
- ***Figure 11*** illustrates the areas of land from which the proposed development would be visible at hub height (maximum height of 150 metres for this project).

The ZVI (also known as a Zone of Theoretical Influence Model) represents the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM). The ZVI usually presents a bare ground scenario - ie. A landscape without screening, structures or vegetation, and is usually presented on a base map. (Scottish Natural Heritage, 2017)

The ZVI has been determined through the use of digital topographic information and 3D modelling software *WindPro*. The ZVI has been assessed to approximately 10km from the project. Although it is possible for the development to be visible from further than 10km away, it is generally accepted that beyond 10km visibility is diminished.

7.2 Overview of Zone of Visual Influence

Due the elevated locations of the proposed wind turbines and the blade tip height of 230m above ground level, the ZVI depicts a large percentage of land immediately surrounding the proposed development from which wind turbines would theoretically be visible.

The undulating topography that characterises the region results in large areas of land from which views of all or most of the Project would be obstructed. From the east of the Project (Shearers Road and surrounding land) views towards the Project are largely screened by the steep escarpments and ridges.

The ZVI illustrates some of the WTGs would be screened by topography on land to the north and north east (including a handful of dwellings along Barrys Road).

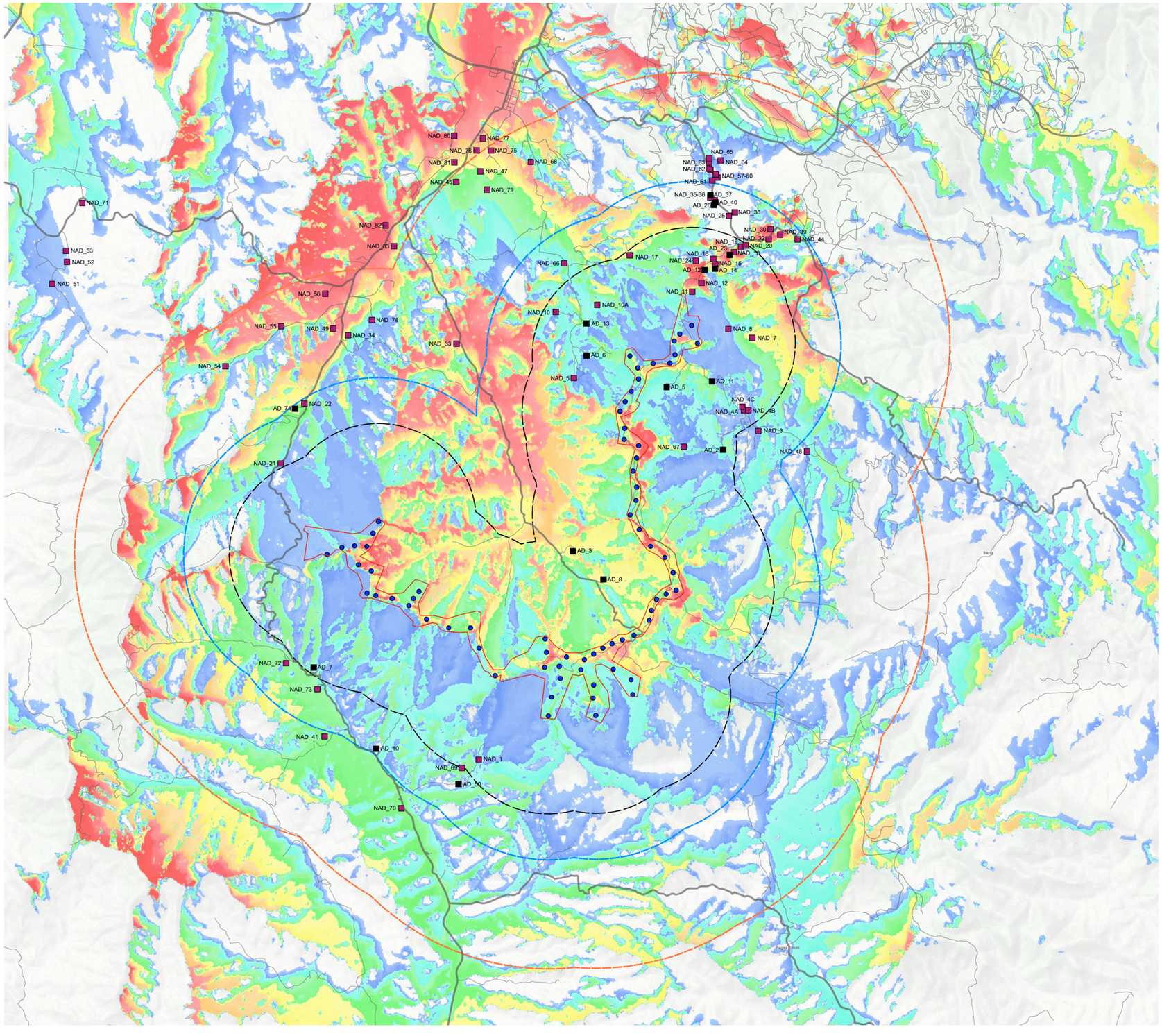
The ZVI indicates the highest level of visibility is likely to be experienced from land which surrounds the Peel River / Head of Peel Road. Land in this area is largely uninhabited, with the exception of one non-involved dwelling (NAD_33).

The ZVI identifies a small yet populated area of land associated with the northern end of Morrisons Gap Road which is likely to have the potential to view a large percentage of turbines associated with the Project. With the exception of this area along Morrisons Gap Road, the ZVI indicates limited opportunities to view the project in its entirety from land within the black line of visual magnitude (3100m).

Views towards the Project are likely to be available from large areas of land to the north west of the Project, surrounding Crawney Road and further north to Nundle. Land in this area is in excess of 8 kilometres.

Following the development of the ZVI, detailed site investigations (in the form of a viewpoint analysis inventory and dwelling assessments) were undertaken to ground truth the preliminary assessment (see ***Section 8.0***).

7.0 Zone of Visual Influence



Zone of Visual Influence Blade Tip Height 230m

Hills of Gold Wind Farm

LEGEND

- Road
- Proposed 230m WTG Location
- Project Area
- 3100m from nearest turbine
- 4550m from nearest turbine
- 8000m from nearest turbine

ZVI Legend:

- 1 - 14
- 14 - 27
- 27 - 40
- 40 - 50
- 50 - 60
- 60 - 70

Note:

The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario.

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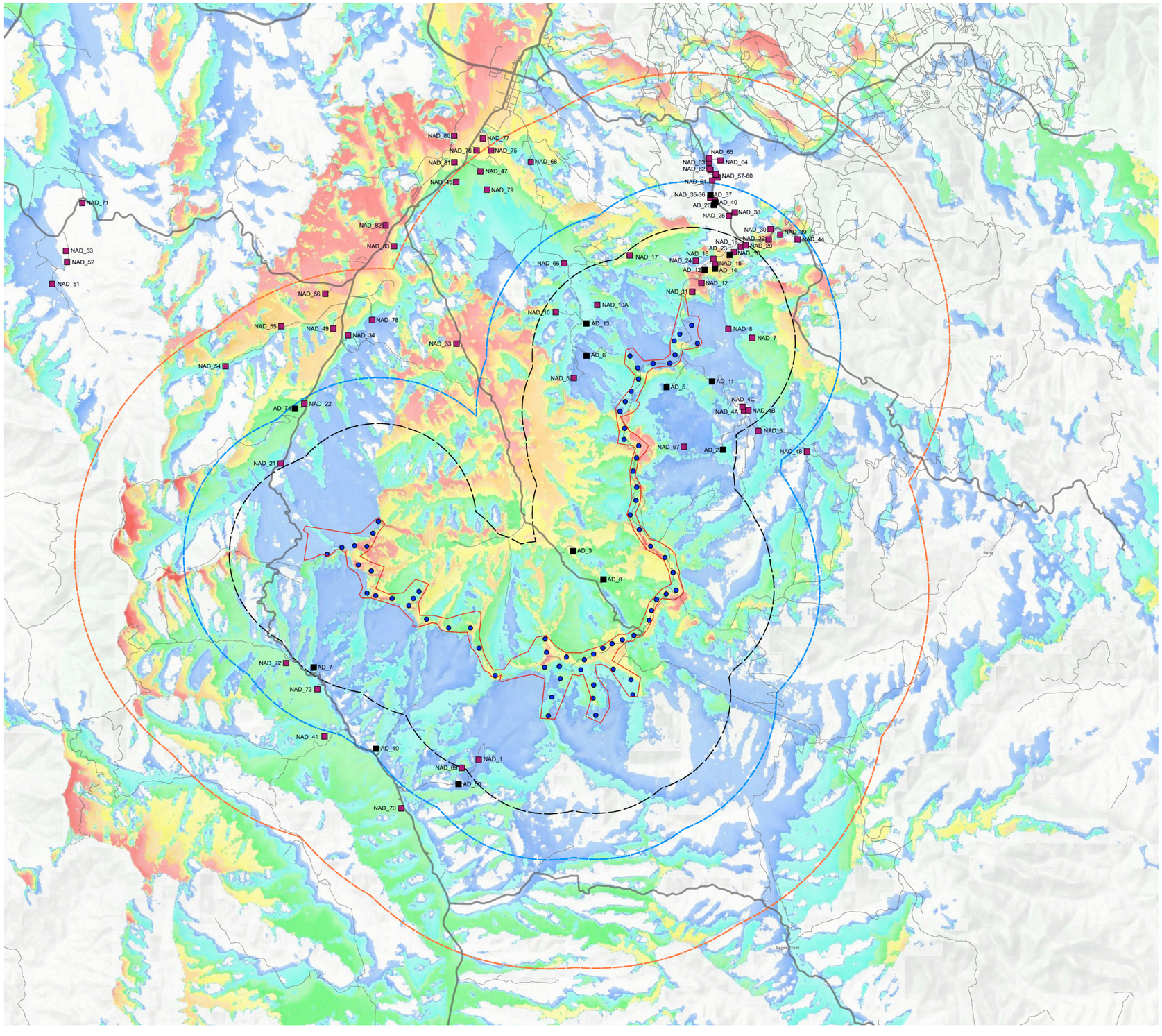
0 5000 m

Figure 10 Zone of Visual Influence - Blade tip (230 metres)

7.0 Zone of Visual Influence



Zone of Visual Influence Hub Height 150m

Hills of Gold Wind Farm

LEGEND

- Road
- Proposed 230m WTG Location
- Project Area
- 3100m from nearest turbine
- 4550m from nearest turbine
- 8000m from nearest turbine

ZVI Legend:

- 1 - 14
- 14 - 27
- 27 - 40
- 40 - 50
- 50 - 60
- 60 - 70

Note:

The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario.

N

0 5000 m

Figure 11 Zone of Visual Influence - Hub Height (150m)

8.0 Viewpoint Analysis

8.1 Overview of Viewpoint Analysis

In accordance with the Bulletin 'all key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed'.

A total of ***45*** viewpoints were taken during the field work process. Viewpoints have been carefully selected to be representative of the range of views within the Study Area. The selection of viewpoints is generally informed by the topographical maps, field work observations and other relevant influences such as access, residences, landscape character and the popularity of vantage points. Viewpoints are selected to illustrate a combination of the following;

- viewpoints identified by the community in community consultation phase of scoping paper,
- present landscape character types,
- areas of potentially high landscape or scenic value,
- range of distances,
- varying aspects and elevations,
- varying extent of wind farm visibility (full and partial visibility), and
- sequential views along specific routes.

It is important to note that viewpoints for this LVIA study have been taken predominantly accessible public land (typically walking tracks, roads and lookouts) which were identified as having a potentially high visual impact through the desktop review process. Some viewpoints were recorded from private property with consent from landowners.

The viewpoint locations assessed for the Hills of Gold Wind Farm have included key viewpoints identified through the extensive community engagement throughout the development, most of which were recorded in the PVIA prepared in 2018 by Arup.

The Bulletin states: *where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling in the following types of areas:*

- rural residential clusters;
- rural villages; and
- urban residential and commercial areas.

Selected viewpoint assessment locations are shown on ***Figure 12***.

8.2 Viewpoint Analysis Methodology

Once the viewpoints had been selected, panoramic photographs are taken in accordance with the standards outlined in the *Scottish Natural Heritage Visual Representation of Wind Farms Guidance Version 2.2.*

Photographs used for viewpoints are taken on a level tripod at a height of 150cm (to represent eye level). Photographs were taken with a Canon EOS 5D Mark III Full Frame digital SLR through a 50mm fixed focal lens which closely represents the central field of vision of the human eye. Parameters for the photography is provided in ***Table 10***.

The visual impact of the viewpoint was assessed both on site and through a desktop assessment utilising with the topographic and aerial information to ensure accuracy.

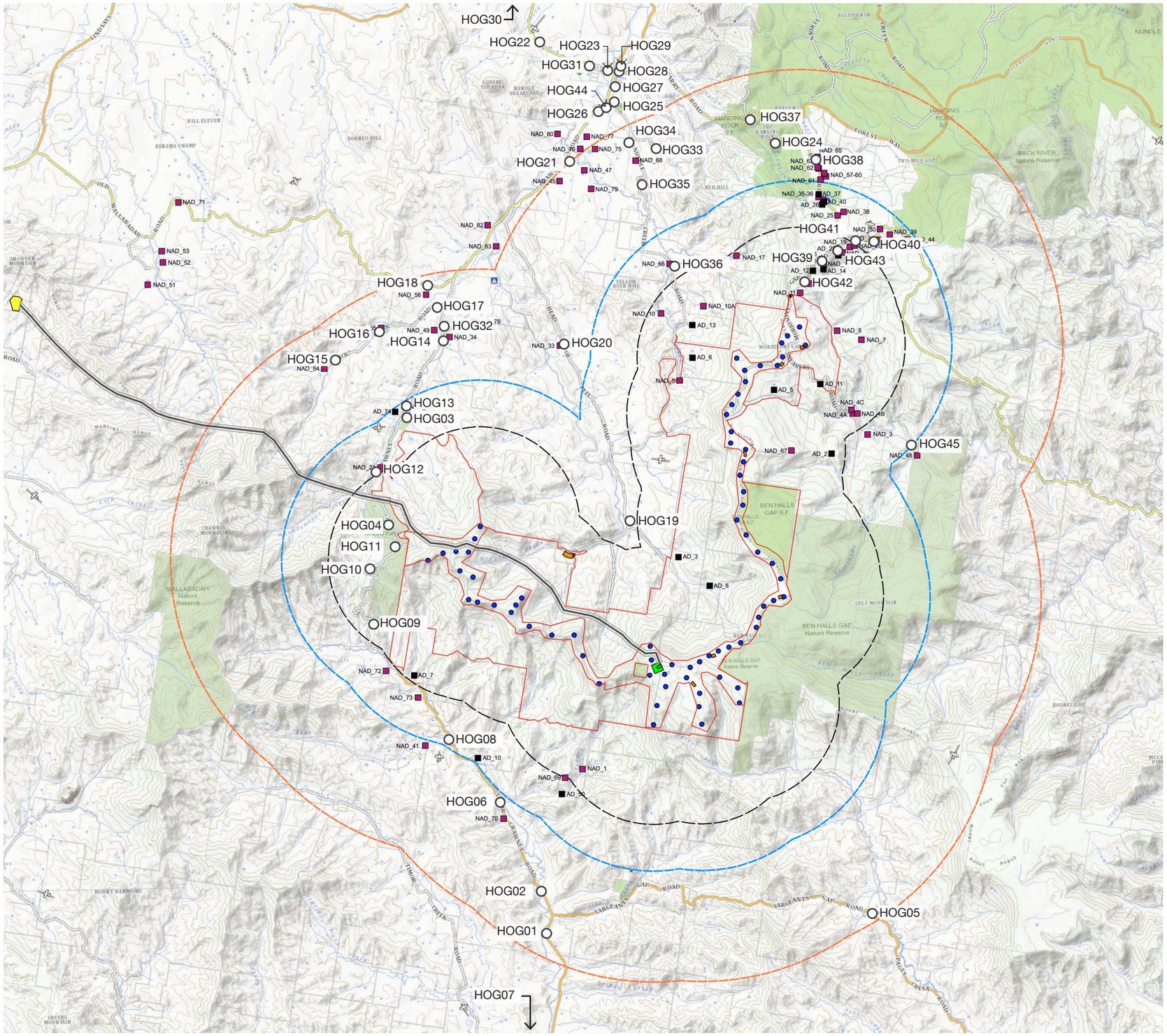
The locations of the viewpoints have been identified in ***Figure 12*** and the general viewing direction of each viewpoint is identified on the map on each viewpoint.

Viewpoint inventory prepared for the Project has been included as Appendix C.

Photography Specifications:	
Camera Make and Model:	**Canon EOS 5D Mark IV Full Frame Digital SLR**
Lens:	**EF50mm f/1.2L USM**
Focal Length:	**50mm f/0**
Aperture Setting:	**f/6.3 - 10**
Tripod Height:	**150cm**

Table 10. ***Photography Specifications***

8.0 Viewpoint Analysis



Viewpoint Analysis Locations

Hills of Gold Wind Farm

LEGEND

- Project Area
- Proposed Turbine Location
- Associated Dwelling (AD)
- Non-associated Dwelling (NAD)
- 3100m from turbine
- 4550m from turbine
- Main Road
- Minor Road
- HOG01 Viewpoint Analysis Location
- **50m High Transmission Line Structure**

Note:

Refer to Appendix C for Viewpoint Analysis.

Detailed location plans are provided for each viewpoint.

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Figure 12 ***Viewpoint Analysis Locations*** *(Map Source: Six Maps)*

8.0 Viewpoint Analysis

8.3 Visual Influence Zone (VIZ)

Visual Influence Zones have been established from the Project Area from dwellings and key viewpoints. This establishes the relative landscape significance against which the potential impacts of wind turbines may be assessed. The Visibility Distance Zone, Viewer Sensitivity Level and Scenic Quality Class of each viewpoint have been assessed which, when combined, result in an overall Visual Influence Zone (see ***Figure 13*** below and refer to tables in ***Appendix A***). An evaluation using the corresponding visual performance objectives *(Table 2 of the Visual Assessment Bulletin)* has been included for each viewpoint.

For each viewpoint, the potential visual impact was analysed through the use of a combination of the 3D terrain modelling, topographic maps and on site analysis.

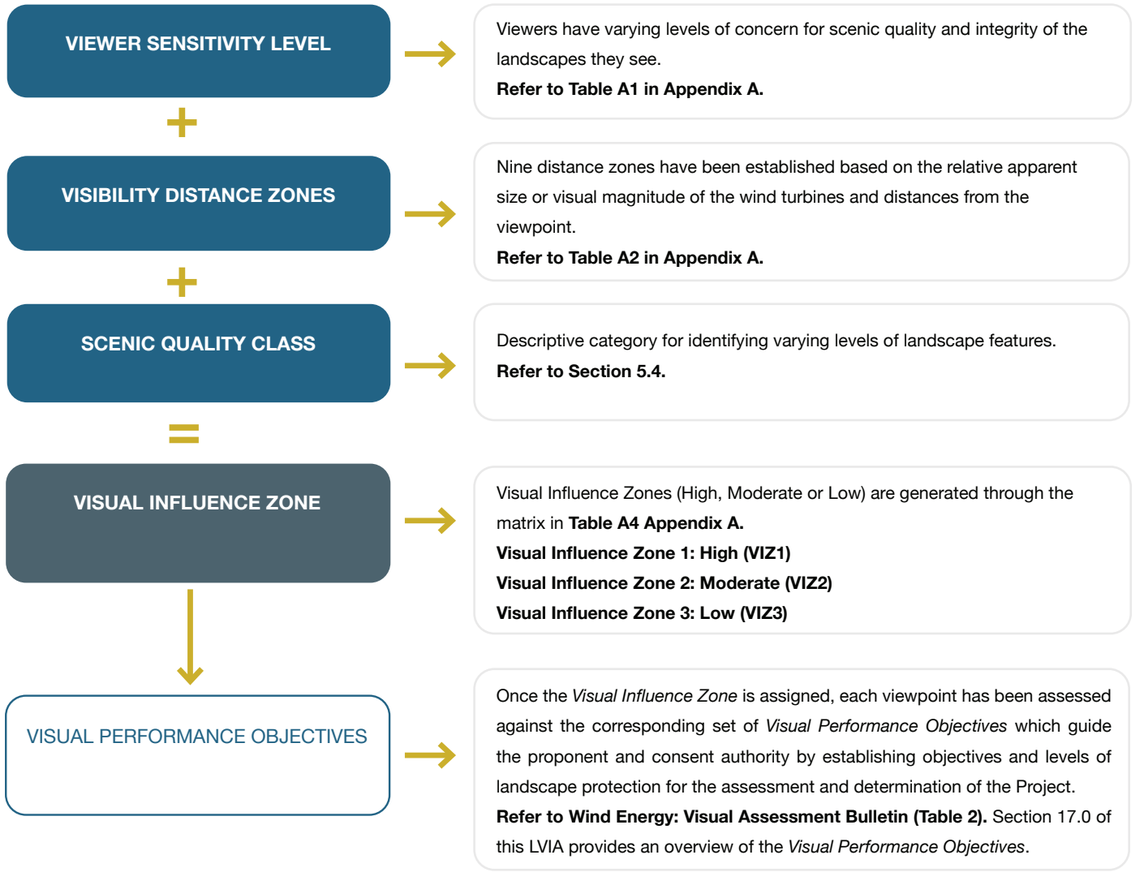


Figure 13: ***Methodology for determining Visual Influence Zone (VIZ)***

8.4 Summary of Viewpoint Analysis

The 45 viewpoints assessed for the purpose of this LVIA were taken from varying distances and locations surrounding the Project. Each viewpoint was assigned a Visual Influence Zone (VIZ) based on their view sensitivity level, distance zone and scenic quality class combinations (refer to the methodology in ***Section 8.3 and Appendix A***). In accordance with the objectives of the Bulletin, each viewpoint was assessed against the objectives for the VIZ. The following provides a brief overview of the viewpoint analysis which is located in ***Appendix C***. Photomontages have been undertaken from 10 public viewpoints to illustrate the potential visual impacts refer to ***Section 9.0*** and ***Appendix D***.

Visual Influence Zone 1 (VIZ1):

In accordance with the methodology, two (2) public viewpoints were identified as VIZ1. These viewpoints were located in Crawney National Park. The Project is unlikely to be visible from these viewpoints and will therefore not impact upon the existing visual features.

Visual Influence Zone 2 (VIZ2):

A total of 20 viewpoints were rated as Visual Influence Zone 2 (VIZ2). Each of these were assessed against the performance objectives outlined in the Bulletin.

Visual Influence Zone 3 (VIZ3):

23 viewpoints were rated as VIZ3 in accordance with the methodology in the Bulletin. There are no performance objectives for VIZ3.

9.0 Photomontages & Wire Frame Diagrams

9.1 Overview of Photomontags and Wire Frame Diagrams

9.1.1 Photomontages

The Bulletin states: *Photomontages shall be prepared in accordance with the Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.1 December 2014 guidelines, noting they are generally consistent with the Land and Environment Court's Photomontage Policy. The visual assessment needs to include a concise description of the complete methodology used to create any photomontages presented in the visual assessment.*

A photomontage combines a photograph of an existing view with a computer-rendered image of a proposed development. Photomontages are used to illustrate the likely view of a proposed development as it would be seen in a photograph (not as it would appear to the human eye in the field).

Although photomontages are based on a photograph of the existing landscape, it is important to stress that they are not a substitute to visiting a viewpoint in the field. They are only one tool to aid assessment. They provide a two-dimensional image that can be compared with an actual view of the landscape to provide information, such as the scale and potential appearance of a proposed development.

Photomontages prepared for the Project have been included as Appendix D.

9.1.2 Wire Frame Diagrams

A wire frame is a computed generated image based on a digital terrain model, that indicate the 3D shape of the landscape in combination with additional elements. They are a valuable tool in the wind farm LVIA process as they allow the assessor to compare the position and scale of the turbines to the existing view of a landscape (Scottish Natural Heritage, 2017). Wire frame images can be seen as a worst case scenario as they do not take into account factors such as vegetation, building structures.

Wire frame diagrams have been utilised in this LVIA to assist in the assessment of the Project from inaccessible locations. In instances where access to a private property was not granted, wire frame diagrams have been utilised as an assessment tool to provide a worst case scenario view of the proposal.

Wire frame images have also been utilised as a substitute for photomontages in areas where dense vegetation limits the capacity to align photographs accurately (ie. due to dense vegetation).

9.2 Photomontage Limitations

Visualisations in themselves can never provide the full picture in terms of potential impacts; they only inform the assessment process by which judgements are made. Visualisations of wind farms have a number of limitations which you should be aware of when using them to form a judgement on a wind farm proposal.

These include:

- A visualisation can never show exactly what the wind farm will look like in reality due to factors such as: different lighting, weather and seasonal conditions which vary through time and the resolution of the image;
- The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate;
- A static image cannot convey turbine movement, or flicker or reflection from the sun on the turbine blades as they move.

Source: Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017.

9.3 Photomontage Selection Process

28 indicative viewpoints have been selected for the preparation of photomontages and wire frame diagrams to best illustrate the potential appearance of the proposed wind farm from varying distances and locations with differing views (refer to ***Figure 15***).

Public Photomontage Locations:

A total of ***11*** public viewpoint locations selected for the preparation of visual photomontages are based on feedback received from the community. Exact photomontage locations were selected on site to represent a worst case scenario for the viewpoint location. Localised screening factors such as vegetation were avoided (where possible) to ensure maximum exposure to the Project. The public viewpoint locations selected for the preparation of photomontages are consistent with viewpoints identified in the *2018 ARUP Hills of Gold Energy Project Preliminary Landscape and Visual Impact Assessment*.

Private Photomontage Locations:

17 photomontages and wire frame diagrams have been prepared from private properties. The locations selected were based on those within close proximity to the Project. Although effort was made to undertake site assessments from all dwellings within 3100 metres, access to some properties was not granted. In some cases, wire frame diagrams have been utilised to illustrate potential visual impacts from dwellings with no access.

9.0 Photomontages & Wire Frame Diagrams

9.4 Photomontage Development Methodology

The process for generating the photomontages involves computer generation of a wire frame perspective view of the Wind Turbines and the topography from each viewpoint. As per the requirements of the *Wind Energy: Visual Assessment Bulletin*, photomontages have been prepared in accordance with the *Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017*. The process for photomontage development is demonstrated in ***Figure 14***.

The photomontages are based on a worst case scenario of a maximum turbine height dimension of 230m with a hub height of 150m and rotor diameter of 160m, without the inclusion of the proposed mitigation methods.

Moir Landscape Architecture have prepared the photomontages using the most current available version of *Wind Pro* software using the following process:

Step 1: Develop 3D Model

Detailed 3D model of the Site is developed in *Wind Pro*. The wind turbines and associated infrastructure (substations, transmission lines, wind masts etc.) are modelled and sited in the 3D model to scale.

Step 2: Align Photograph and Model

The digital panorama is imported into Wind Pro and EXIF properties of the file are inserted automatically defining all relevant visualization information as e.g. type of camera lens used, field of view for panoramas, the position and direction. Topography, control points, obstacle objects, existing wind masts can be used as reference to calibrate the camera model very precisely.

Step 3: Render Photomontage

The software calculates the position of the sun based on the time and date of photograph and renders the wind turbines in accordance with the specific weather conditions and position of the sun. Once rendered, detailed removal of intervening elements (such as vegetation) is undertaken to provide an accurate representation of the Project.

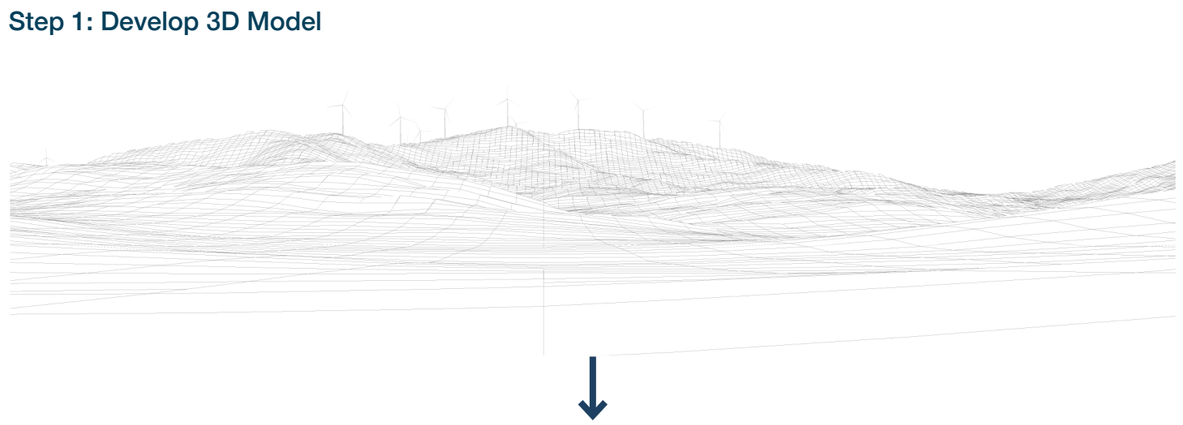
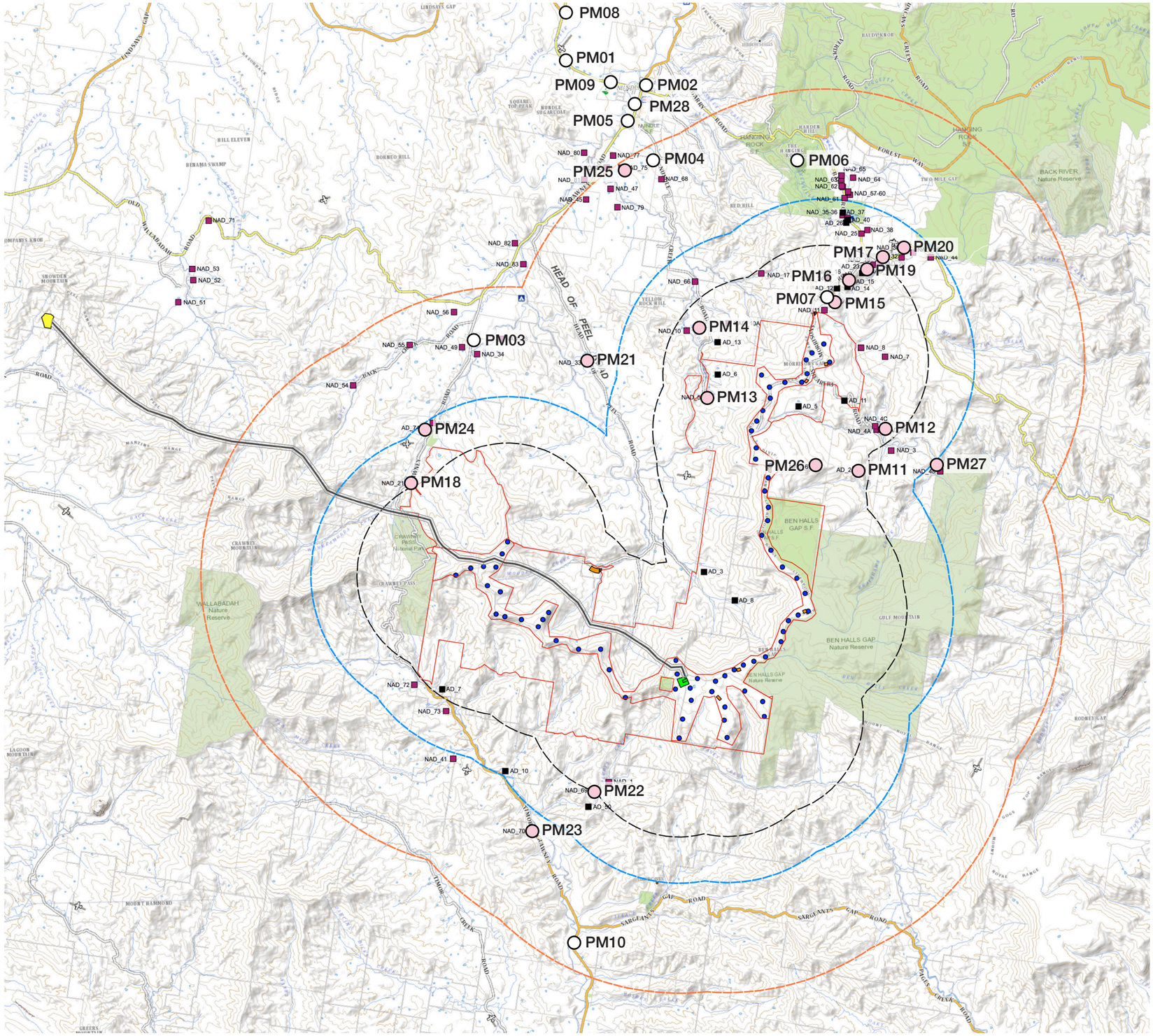


Figure 14 ***Photomontage Development Process***

9.0 Photomontages & Wire Frame Diagrams



Photomontage & Wire Frame Diagram Assessment Locations
Hills of Gold Wind Farm

LEGEND

- Project Area
- Proposed Turbine Location
- Associated Dwelling (AD)
- Non-associated Dwelling (NAD)
- 3100m from turbine
- 4550m from turbine
- Main Road
- Minor Road
- Photomontage from Public Location
- Photomontage / Wireframe from Private Location
- 50m High Transmission Line Structure

Refer to Appendix D:

Photomontage & Wire Frame Diagrams

N

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Figure 15 ***Photomontage and Wire frame Assessment Locations*** *(Map Source: Six Maps)*

10.0 Shadow Flicker & Blade Glint Assessment

10.1 Overview of Shadow Flicker

Shadow flicker is defined as the visual effect that occurs when rotating turbines cause moving shadows as the blades pass in front of the sun. The effect will occur under circumstances where the turbine is located such that at certain times of day the sun's rays pass through the swept area of the rotating blades, potentially affecting the viewpoint. The effect is diminished by the distance of the viewpoint from the turbine. Shadowing is also influenced by increased cloud cover, and is dependent on the angle of the sun's rays (Draft National Wind Farm Development Guidelines, 2016).

The Bulletin states: *The shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation measures such as amended siting and design of turbines to minimise the amount of shadow flicker.*

10.2 Shadow Flicker Assessment Methodology

As there is no methodology for the assessment of shadow flicker in the Bulletin, Moir LA have referred to the Draft National Wind Energy Guidelines (2010) to define the parameters for the assessment.

Modelling of the shadow flicker was conducted using specialist industry software (Wind Pro), assessing the largest turbine (based on a 230m maximum tip height) proposed for the project to represent the worst case impact scenario.

The parameters used for the Shadow Flicker Assessment are as follows:

Model Parameter	Setting Used:
Zone of Visual Influence of Shadows	265 x Maximum blade chord
Minimum angle of sun	3 degrees
Shape of the sun	Disk
Time and duration of modelling	One full year
Orientation of the rotor	The rotor plane is always perpendicular to the line from the WTG to the sun
Time step	1 minute
Effects of topography	Included
Receptor Height	1.7 meters
Grid size	1 meter

Table 11 Shadow Flicker Assessment Parameters

It is important to note the shadow flicker modelling undertaken for Hills of Gold Wind Farm is based on topography alone and therefore the extent of impact may be decreased by a number of variables including:

- the aspect of the residence relative to the turbine(s) (window locations, living area locations etc);
- the extent of natural or screening vegetation between the turbine(s) and the receptor;
- the existence of other screening elements (buildings, structures etc) between the turbine(s) and the receptor;
- the time of year;
- the proportion of daylight hours in which the turbines operate, and;
- the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon).

Image 21. Example of shadow intensity variation with distance.

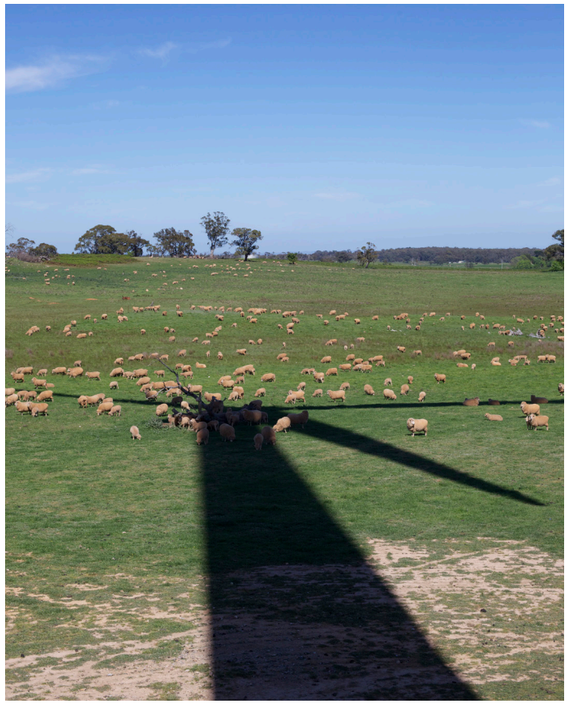
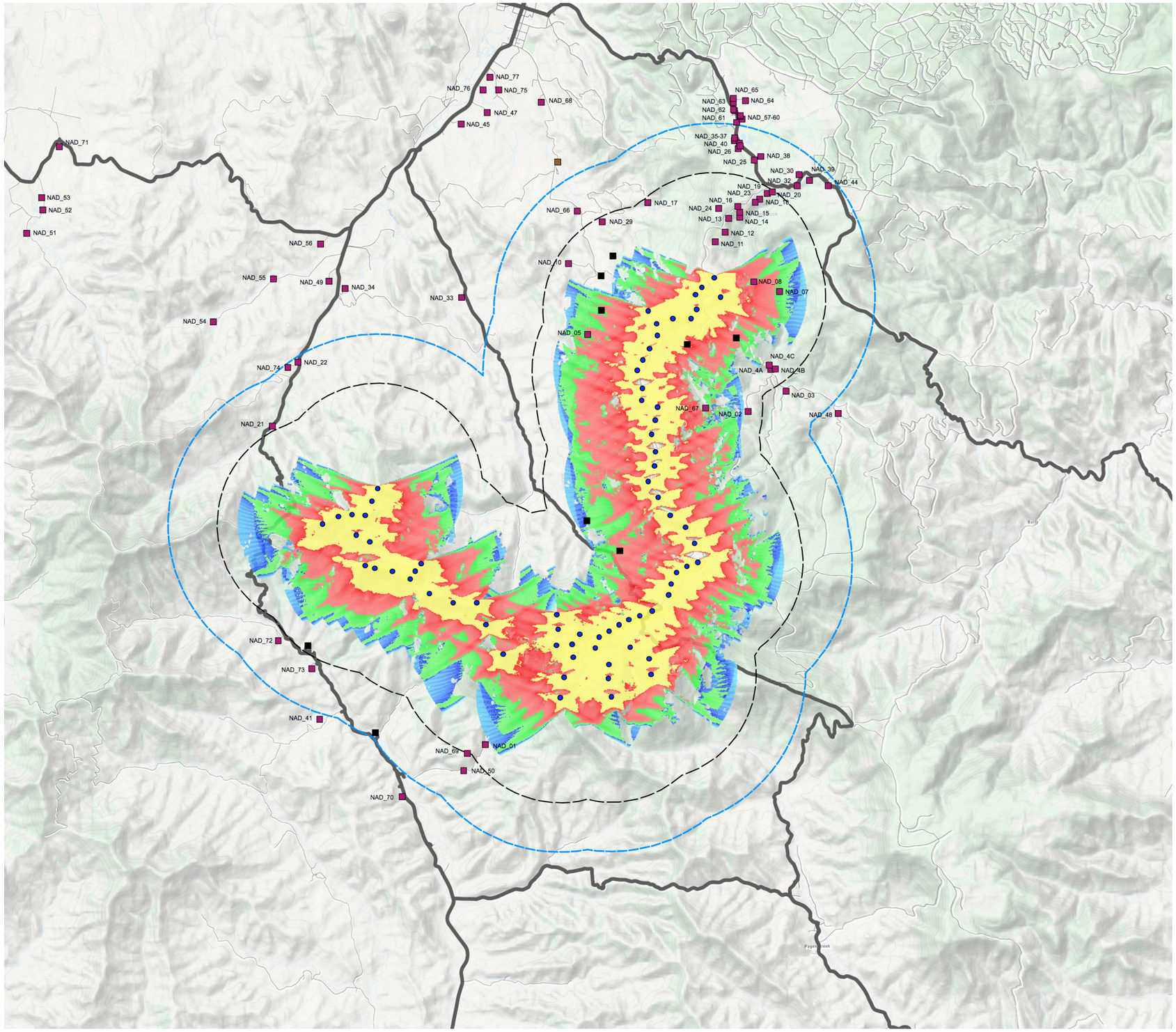


Image 22. Example of shadow flicker from base of turbine.

10.0 Shadow Flicker & Blade Glint Assessment



Shadow Flicker Assessment
Hills of Gold Wind Farm

LEGEND

- Proposed Turbine Location
- Associated Dwelling (AD)
- Non-associated Dwelling (NAD)
- 3100m from turbine
- 4550m from turbine
- Main Road
- Minor Road

Number of Hours Per Year:

- 0.1-10.0 Hours
- 10.0 - 30.0 Hours
- 30.0 - 100.0 Hours
- 100.00 - 1000.0 Hours

Assumptions for shadow calculations :

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values.

The calculated times are “worst case” given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset.
- The rotor plane is always perpendicular to the line from the WTG to the sun.
- The WTG is always operating.

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Figure 16 ***Shadow Flicker Assessment Diagram***

10.0 Shadow Flicker & Blade Glint Assessment

10.3 Results of Shadow Flicker Assessment

A total of (9) dwellings were identified with potential shadow flicker hours, five (5) of these are associated dwellings (*AD_3, AD_5, AD_6, AD_8, AD_11*). Refer to ***Table 12***.

The Bulletin states: *the shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation methods such as amend siting and design of turbines to minimise the amount of shadow flicker.*

Of the four (4) non-associated dwelling with potential shadow flicker, only one (NAD_8) has the potential to experience slightly more than 30 hours per year. The assessment is based on a worst case scenario considering topography alone. NAD_8 is surrounded by dense vegetation which would be likely to reduce any potentially unacceptable limits of shadow flicker effects.

In addition to the impact on residences, shadow flicker has the potential to cause annoyance to road users. The shadow flicker assessment identified a small extent of Crawney Pass Road which may experience shadow flicker. Dense vegetation through the national park would be likely to limit potential to experience shadow flicker.

10.4 Shadow Flicker Mitigation

Detailed desktop assessment of all four non-associated dwellings with potential to experience shadow flicker (*NAD_5, NAD_7, NAD_8 and NAD_67*) has been included in ***Appendix E***. This includes the identification of mitigation methods which (where possible) seek to reduce any potential shadow flicker impacts.

ID	Location	Associated?	Shadow Hours per year:	Shadow Days per year:	Max Shadow Hours per day:
AD_3	*151.144674° E 31.596901° S*	*Associated*	13:32	67	0:17
AD_5	*151.176841° E 31.550514° S*	*Associated*	113:58	262	0:37
AD_6	*151.150323° E 31.541134° S*	*Associated*	36:39	119	0:35
AD_8	*151.154746° E 31.605083° S*	*Associated*	33:49	153	0:19
AD_11	*151.192024° E 31.549091° S*	*Associated*	49:23	153	0:33
NAD_5	*151.145919° E 31.547445°S*	*Non-associated*	27:55	117	0:19
NAD_7	*151.205732° E 31.536877° S*	*Non-associated*	20:52	87	0:21
NAD_8	*151.197785° E 31.534211° S*	*Non-associated*	33:56	103	0:29
NAD_67	*151.182212° E 31.567576° S*	*Non-associated*	14:11	68	0:17

Table 12. ***Shadow Flicker Assessment Parameters***

10.0 Shadow Flicker & Blade Glint Assessment

10.5 Overview of Blade Glint

Blade Glint (also referred to as blade reflectivity) refers to the regular reflection off one or more rotating blades. This can be a temporary effect at any particular location, though the vast bulk of any glint occurs where the viewer is located above the altitude of the turbine hub.

The Bulletin recommends: *turbine blades be finished with a low reflectivity surface treatment to ensure any actual or perceived blade glint impact is minimised.*

All major wind turbine blade manufacturers currently finish their blades with a low reflectivity treatment. This prevents a potentially annoying reflective glint from the surface of the blades and the possibility of a strobing reflection when the turbine blades are spinning. Therefore the risk of blade glint from a new development is considered to be very low (Draft National Guidelines, 2010).

The turbines selected for the Project will be finished with a low reflectivity surface treatment in accordance with the requirements of the Bulletin.

11.0 Night Lighting Assessment

11.1 Overview of Night Lighting

The following section of the report provides an assessment of the visual impacts of potential night lighting of the Project. Night lighting has the potential to result in the alteration of the night time landscape character of the region. Potential light sources include:

- Aviation Hazard Lighting (AHL) on nacelle of wind turbines (height of up to 150 metres AGL)
- Night lighting for safety and security on ancillary structures.

11.2 Aviation Hazard Lighting

The requirement of aviation hazard lighting (AHL) on wind turbines for the proposed Hills of Gold Wind Farm is subject to the advice of the Civil Aviation Safety Authority (CASA). It is noted that the turbines proposed for the Hills of Gold Wind Farm will possibly be up to 230m in height and CASA generally recommends night lighting if an obstacle exceeds 150 metres above ground level.

Although this is to future detail, the potential CASA requirements for lighting could include:

- Two flashing red medium intensity obstacle lights should be provided per turbine where required.
- The light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and are at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction.
- Sufficient individual wind turbines should be lit to indicate the extent of the group of turbines.
- The interval between obstacle lighted turbines should not exceed 900m, and the most prominent (highest for the terrain) turbine(s) should be lit. (CASA, 2004).

As the intensity and location of proposed obstacle lights are relatively unknown at this stage, representative photomontages of the proposed obstacle lighting of Hills of Gold Wind Farm have not been included in this report.

Representative images of aviation lighting (installed in August 2020) on turbines at Biala Wind Farm have been included to best illustrate the potential visual appearance of aviation lighting. Photographs of the aviation lighting at varying distances and times have been included in this report.

Images 23 - 25 illustrate the effect of night lighting on a dark rural landscape at intervals after sunset.

Image 23. ***View towards Biala Wind Farm - 2.0 Kilometres from turbine at 6:20pm (30 minutes after sunset)***

Image 24. ***View towards Biala Wind Farm - 1.75 Kilometres from turbine at 6:35pm (45 minutes after sunset)***

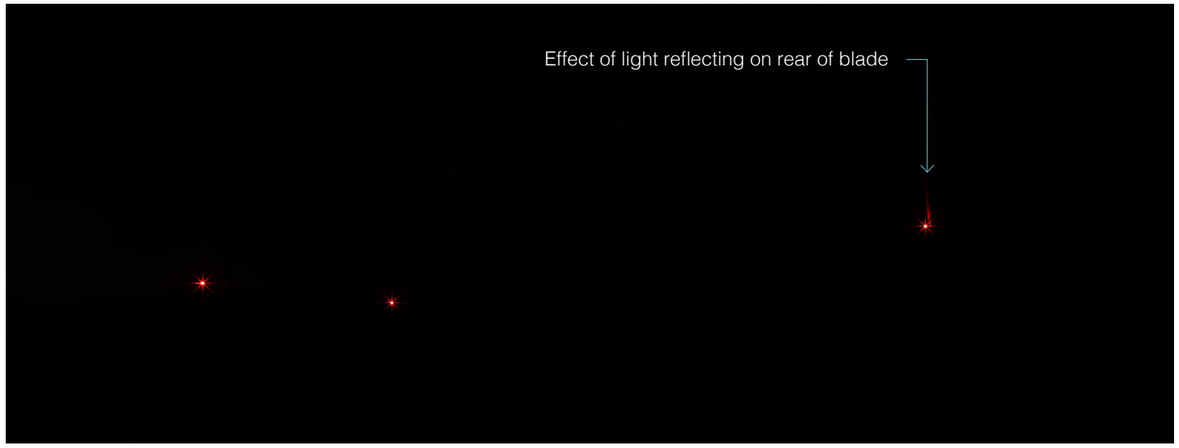


Image 25. ***View towards Biala Wind Farm - 1.85 Kilometres from turbine at 6:50pm (60 minutes after sunset)***

11.0 Night Lighting Assessment

Image 27. View towards Biala Wind Farm - 3.5 Kilometres from turbine

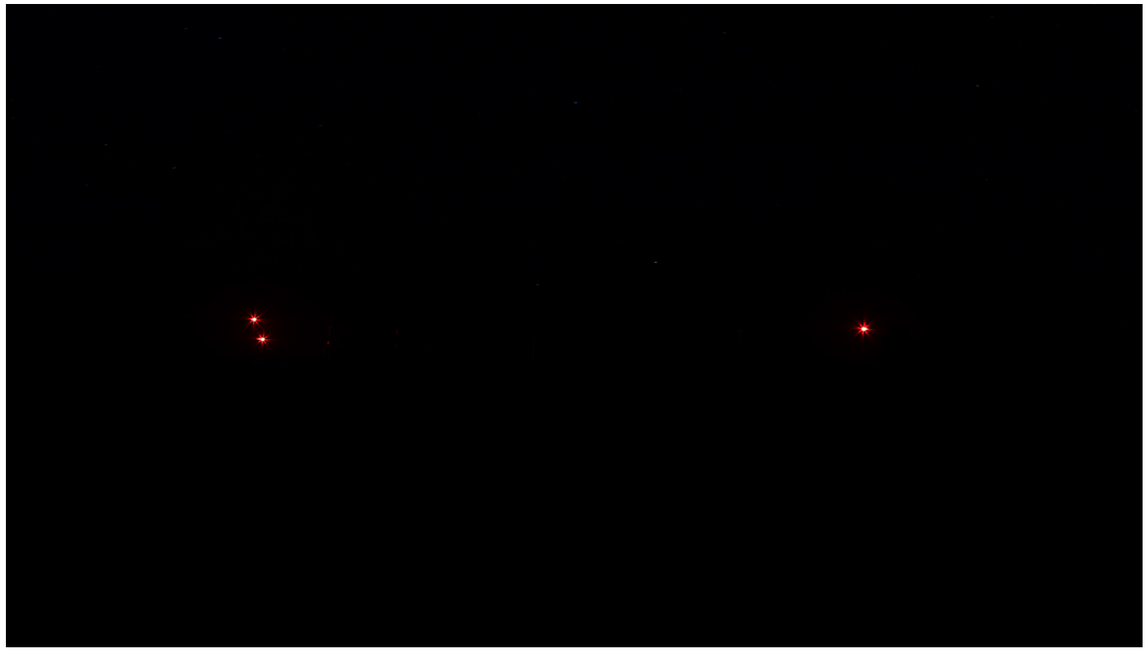


Image 28. View at night towards Biala Wind Farm - 3.5 Kilometres from turbine

Image 29. View towards Biala Wind Farm - 8.5 Kilometres from turbine

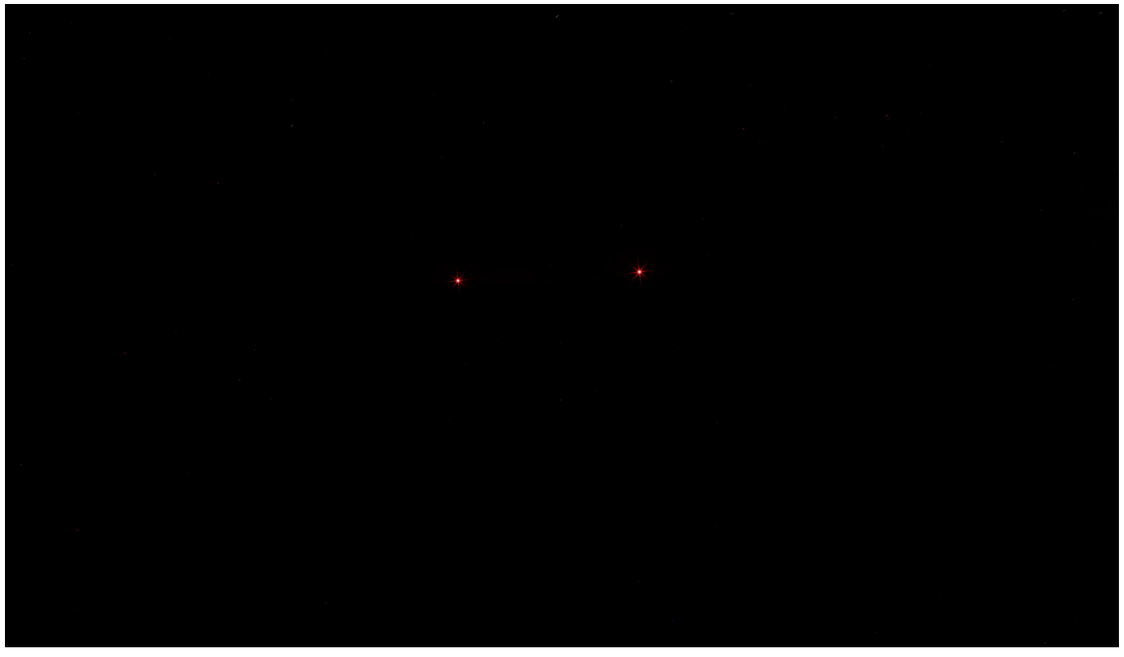


Image 30. View at night towards Biala Wind Farm - 8.5 Kilometres from turbine

11.0 Night Lighting Assessment

11.3 Overview of potential visual impacts from Night lighting

Night lighting of turbines and associated infrastructure has the potential to extend the visual effect into the night time. Aviation hazard lighting has the potential to be visible from distances in excess of 20 kilometres (Scottish Natural Heritage).

To assess the potential visual impacts on the Study Area, a Zone of Visual Influence (ZVI) has been prepared up to 20kms from the Project to illustrate the areas from which aviation lighting has the potential to be seen. As the number of turbines which may require aviation lighting is unknown, the ZVI has been prepared on the assumption that all turbines would have AHL installed. The ZVI is based on having AHL installed at the highest hub height of 150 metres. The ZVI does not take into account screening factors such as vegetation.

The ZVI illustrate large areas of land from which aviation lighting would have the potential to be visible. If required, aviation lighting is likely to be visible to motorists travelling towards the Project Area, in particular Crawney Road, Timor Crawney Road and Nundle Road. Generally due to headlights reflecting on elements in the foreground, although visible, night lighting is not likely to cause major visual impacts to motorists travelling throughout the Study Area.

Nundle is located 8 kilometres from the Project Area. The aviation lighting has the potential to be a noticeable element in the night time landscape from areas around Nundle Village that have exposure to the views towards the Project Area. It is important to note the effect of night lighting is reduced when existing light pollution surrounds the viewer. Due to Nundle Village being a populated area, existing light sources from dwellings, buildings and street lights exist in the village. ***Image 30*** illustrates the visual appearance of night lighting at a distance of 8.5 kilometres (with no light pollution influence), which is representative of the potential visual appearance from areas around Nundle.

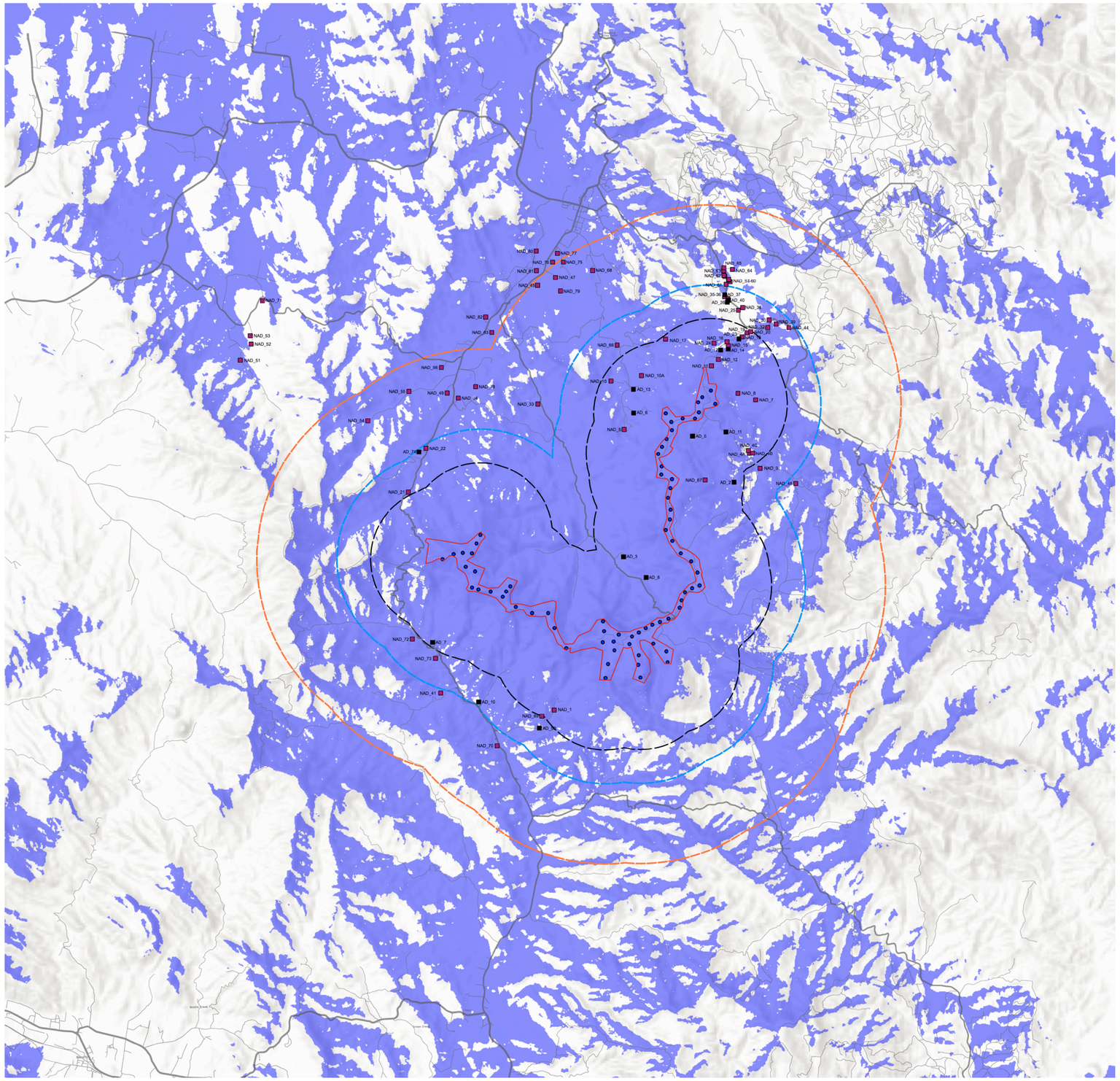
Due to the relatively isolated location of the Project, very little existing sources of lighting are present in the night time landscape of the Study Area. Some existing lighting associated with homesteads and motor vehicles is dispersed around the Study Area. Isolated receptors within the Study Area experience a dark night sky with minimal light sources. The impact of night lighting is unlikely to be experienced from inside of a dwelling as internal lights reflect on windows and limit views to the exterior at night time.

The highest visual impact is likely to be people who experience the night landscape outdoors. Dark sky is a valued quality of the rural landscape, due to the lack of light pollution. Aviation lighting has the potential to impact on receptors who view the landscape at night, in particular night-sky enthusiasts, photographers, star gazers, campers and some land owners with potential visibility of the turbines hub.

Considering the high elevation of the turbines and the implementation of shields, the source of visible light is likely to be reduced to ambient lighting as opposed to direct visibility of the light itself when viewed from a close proximity.

The visual impact of potential aviation lighting could be reduced by employing mitigation methods outlined in ***Section 11.4***.

11.0 Night Lighting Assessment



Zone of Visual Influence Night Lighting

Hills of Gold Wind Farm

LEGEND

- Project Area
- Proposed Turbine Location
- Associated Dwelling (AD)
- Non-associated Dwelling (NAD)
- Aviation lighting installed on hub height (150m) visible

Note:

The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. The ZVI makes an assumption that aviation lighting is installed on all 70 WTGs on a hub height of 150 metres AGL. Therefore this form of mapping should be acknowledged as representing the absolute worst case scenario.

N

0 5000 m

Figure 17 Zone of Visual Influence - Hub Height (150m)

11.0 Night Lighting Assessment

11.4 Recommendations to reduce the potential visual impacts

The Bulletin states: *If such lighting is required, the CASA guidelines recommend that to minimise visual impacts "obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously." The lights should be fully shielded from the view of any dwelling within. As part of the assessment of visual impacts of wind energy projects, the Department will consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.*

To assist in the amelioration of the effect of Aviation Hazards Lighting on wind turbines the following should be applied:

- If used, air navigation lights is required to be spaced over the array, particularly at the extremities. They are not required on every tower. Where possible, careful consideration of turbines upon which aviation lighting is installed to avoid unnecessary impact upon residences.
- Treatment of the rear of blades with a non-reflective coating to reduce reflection off the rotating blade at night.
- Use of the lowest candela intensity allowed by CASA.
- According to the CASA requirements, shielding may be provided to restrict the downward spill of light to the ground plane by ensuring that no more than 5% of the nominal light intensity should be emitted at or below 5° below horizontal (Refer to Figure 18).
- No light should be emitted at or below 10° below horizontal.

Technology in both aviation and wind farm development is constantly evolving. One example of evolving technology is Air Detection Lighting System (ADLS). Although these haven't been utilised in New South Wales, an ADLS has recently been installed at the Lal Lal Wind Farm just east of Ballarat in Victoria. An ADLS is an effective measure to reduce visual impacts, save electricity and improve aviation safety. Aviation lighting is activated when an aircraft approaches within four to six kilometres.

As this technology such as Air Detection Lighting Systems become more cost effective and readily available, it may become viable option for the Project.

Overtime as wind farm development has occurred throughout New South Wales, there are precedents for the review of the requirement of aviation lightings on a number of wind farms post-construction. In the Upper Lachlan Shire, on November 1, 2010 Cullerin Wind Farm, owned by Origin Energy, switched off turbine aviation lighting after guidelines set out by CASA were withdrawn. Requirement of aviation lighting for Crookwell 2 Wind Farm was reviewed by CASA in 2019 and allowed to be turned off (Crookwell Gazette, 2019).

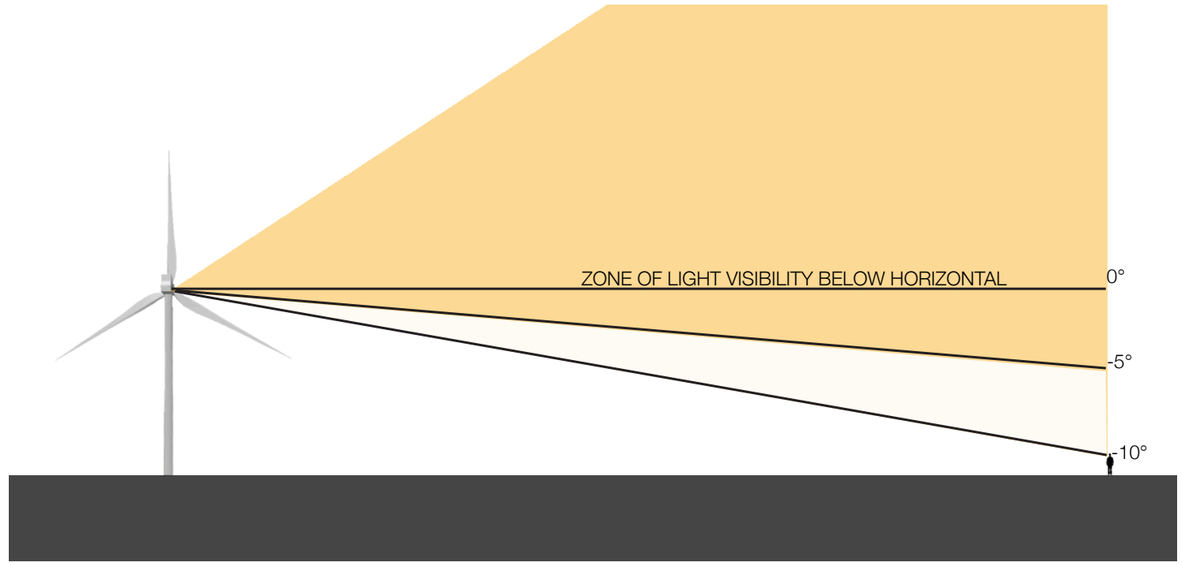


Figure 18: ***CASA Recommended Obstacle Lighting Spread*** *(Image adapted from Urbis 2009)*

11.0 Night Lighting Assessment

11.5 Potential Impacts of Lighting Associated with Ancillary Infrastructure

In addition to aviation hazard lighting on wind turbines, night lighting is likely to be required on ancillary infrastructure including switching stations, collector substations and facilities buildings. At this stage of the Project, the location and type of lighting required on the proposed substations and facilities buildings is to be confirmed.

The proposed ancillary infrastructures have been carefully sited to minimise visibility from existing residences and publicly accessible viewpoints. It is unlikely the proposed night lighting associated with the ancillary infrastructure would create a noticeable impact on the existing night time landscape.

To assist in the amelioration of the effect of night lighting on ancillary structures the following should be applied:

- Security lighting throughout the wind farm, switching station and the substation should be minimised to decrease the contrast between the wind farm and the night time landscape of the area.
- Motion detectors should be used to activate night time security lighting when required.
- Lighting is to be designed to ensure it does not spill onto nearby roads or residences.

12.0 Cumulative Visual Impact Assessment

12.1 Overview of Cumulative Visual Impacts

The Bulletin states: *The visual assessment must assess, in accordance with the SEARs, the overall and broader landscape impacts of the proposed wind energy project. It will also address potential cumulative impacts of wind energy projects in the region (the proposed wind energy project, as well as existing and approved projects).*

Cumulative landscape and visual effects result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it) or actions that occurred in the past, present or are likely to occur in the foreseeable future (Landscape Institute et al, 2008). Cumulative effects may also affect the way a landscape is experienced and can be positive or negative. Where they comprise benefits, they may be considered to form part of the mitigation measures.

The Draft Planning NSW Guidelines state that *"Cumulative impacts may result from a number of activities with similar impacts interacting with the environment in a region. They may also be caused by the synergistic and antagonistic effects of different individual impacts interacting with each other and may be due to temporal or spatial characteristics of the activities impacts."*

It is important the proposed Hills of Gold Wind Farm considers the potential cumulative effects on the immediate and broader regional context it forms part of.

A cumulative impact assessment has several dimensions:

- The impact of the wind farm, when added to the combined impacts of all other existing developments and environmental characteristics of the area.
- The impact of this development in the context of the potential for development of wind energy developments in the local, regional and national context.
- The impact of developments which are ancillary to or otherwise associated with the proposed wind farm eg. the development of transmission lines.
- The potential for future development of wind farms in the region.

12.2 Nearby Wind Farm Projects

The nearest constructed and operating wind farm to the Project is the White Rock Wind Farm, which is located in excess of 190 kilometres from the Project Area. The nearest approved wind farm to the Project is the Liverpool Range Wind Farm which is located over 100 kilometres south east of the Hills of Gold Project.

Several proposed wind farms within the wider regional context include:

- *Bowmans Creek Wind Farm* (70 kilometres south)
- *Winterbourne Wind Farm* (75 kilometres to the north)
- *Valley of the Winds* (in excess of 100 kilometres south east)

Due to distance there are no opportunities to view any additional wind farms simultaneously from a static viewpoint in the foreseeable future.

The potential cumulative visual impact must also be assessed in relation to the potential visual impact when viewed sequentially. If a number of wind farms are viewed in succession as a traveller moves through the landscape (eg. motorist travel routes or walking tracks) this may result in a change in the overall perception of the landscape character. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (EPHC, 2010).

Due to the relatively isolated location, the Project is set back from major travel routes which prevents any opportunities to view wind farms in succession along travel routes.

12.0 Cumulative Visual Impact Assessment

12.3 Visual Impact on the Broader Landscape Character

The re-occurrence of wind farms within a region has the potential to alter the perception of the overall landscape character irrespective of being viewed in a single viewshed. As wind farm developments prevail it is important to determine whether the cumulative effect of wind farms and other major infrastructure within the region would combine to become the dominant visual element, altering the perception of the general landscape character.

The existing landscape character of the region allows for optimum harvest of wind energy due to elevated topography, expanses of uninhabited land and minimal obstructions in the landscape. These characteristics are beneficial to the output of wind energy and it is inevitable that overtime this will be utilised.

The New South Wales Government have identified three key Renewable Energy Zones (REZ) in the State's Central-West Orana, New England and South-West regions. Whilst the Project is not located within the New England REZ it is located within proximity to it. The development of wind farms is likely to be focused in these three key regions in the future and as the Project Area is a relative distance wind farms as an element would not emerge as a dominant feature to visitors of the Study Area. Therefore it is unlikely the perceptions of the regions broad landscape character would be altered as a result of the Hills of Gold Project.

13.0 Associated Infrastructure Assessment

13.1 Overview of Associated Infrastructure

In addition to the proposed wind turbines, the associated infrastructure (as described in ***Section 3.4*** of this report) is likely to contrast with the existing visual landscape. Due to the large scale and elevated siting of the proposed wind farm, access roads, transmission lines and other ancillary structures have the potential to alter the existing visual landscape. An overview of the potential visual impact resulting from associated infrastructure and project components is provided in this section of the report.

13.2 Access Roads

Access roads are proposed off site connecting to existing arterial roads, and on site between the wind turbines. Access to the Project Area is proposed via Morrisons Gap Road or Head of Peel Road. It is likely some upgrades to these roads would be completed to accommodate the Project.

The construction and maintenance of the Project will require construction of approximately 48.5 kilometres of private access roads. Civil engineering concept designs identified the most suitable location for roads and hardstands to avoid earth works where practicable. The benefits this brings to the Project is that the ancillary infrastructure is integrated into the existing contours where possible. Where possible, the internal road network will be aligned on the route of existing farm or other access roads. The internal roads will be up to 5.5 metres wide with localised widening where required to support transportation of the WTG components.

Generally, the internal roads have been sited to reduce potential vegetation loss and limit earth work requirements. Due to the existing agricultural land use of the Study Area, farm roads traversing the landscape form a significant part of the existing landscape character. The proposed access roads are likely to be viewed as part of the existing character of the landscape and therefore visual impact would be low.

Mitigation measures for reducing residual visual impact resulting from the construction of access roads include:

- *Where possible utilise or upgrade existing roads, trails or tracks to provide access to the proposed turbines to reduce the need for new roads.*
- *Allow for the provision for down sizing roads or restoring roads to existing condition following construction where possible.*
- *Any new roads must minimise cut and fill and avoid the loss of vegetation.*
- *Utilise local materials where possible and practical.*

13.3 Transmission Lines

13.3.1 Internal 33kV Transmission lines

Each of the 70 WTGs will be connected to an onsite substation via a 33kV electrical cable and fibre network which (subject to detailed design) will comprise a mix of underground and overhead transmission lines connecting to an onsite substation. If required, any overhead transmission lines are likely to be located adjacent to the footprint of internal access roads. The proposed internal 33kV transmission lines are in keeping with the scale and appearance of existing powerlines which are a common element throughout the existing rural landscape.

13.3.2 External 330kV Transmission lines

A 330kV single circuit overhead transmission line connection is proposed to connect the on site substation to the existing overhead 330kV transmission line network to the north west of the Project Area. The proposed 330kV transmission line will include a steel pole structure, typically 50 metres high and spaced up to 100-900 metres apart.

A 60 metre cleared easement will be required underneath the transmission line. ***Figure 19*** provides an overview of the potential visual impacts resulting from the construction of the 330kV transmission line. Where they have been identified for individual dwellings, potential visual impacts have been discussed in further detail in ***Appendix E***.

Generally the above ground transmission lines transverse an large area of uninhabited land surrounded by undulating topography. Opportunities to view the transmission lines are limited due to distance, topography and vegetation.

Proposed mitigation methods to be considered during detailed design phase include:

- *Where possible underground cabling is to be used to connect wind turbines to the electricity grid.*
- *Utilise existing transmission lines where possible.*
- *The route for any proposed overhead transmission lines should be chosen to reduce visibility from surrounding areas.*
- *Plan route to minimise vegetation loss.*
- *Use of subtle colours and a low reflectivity surface treatment on power poles to ensure that glint is minimised.*

13.0 Associated Infrastructure Assessment

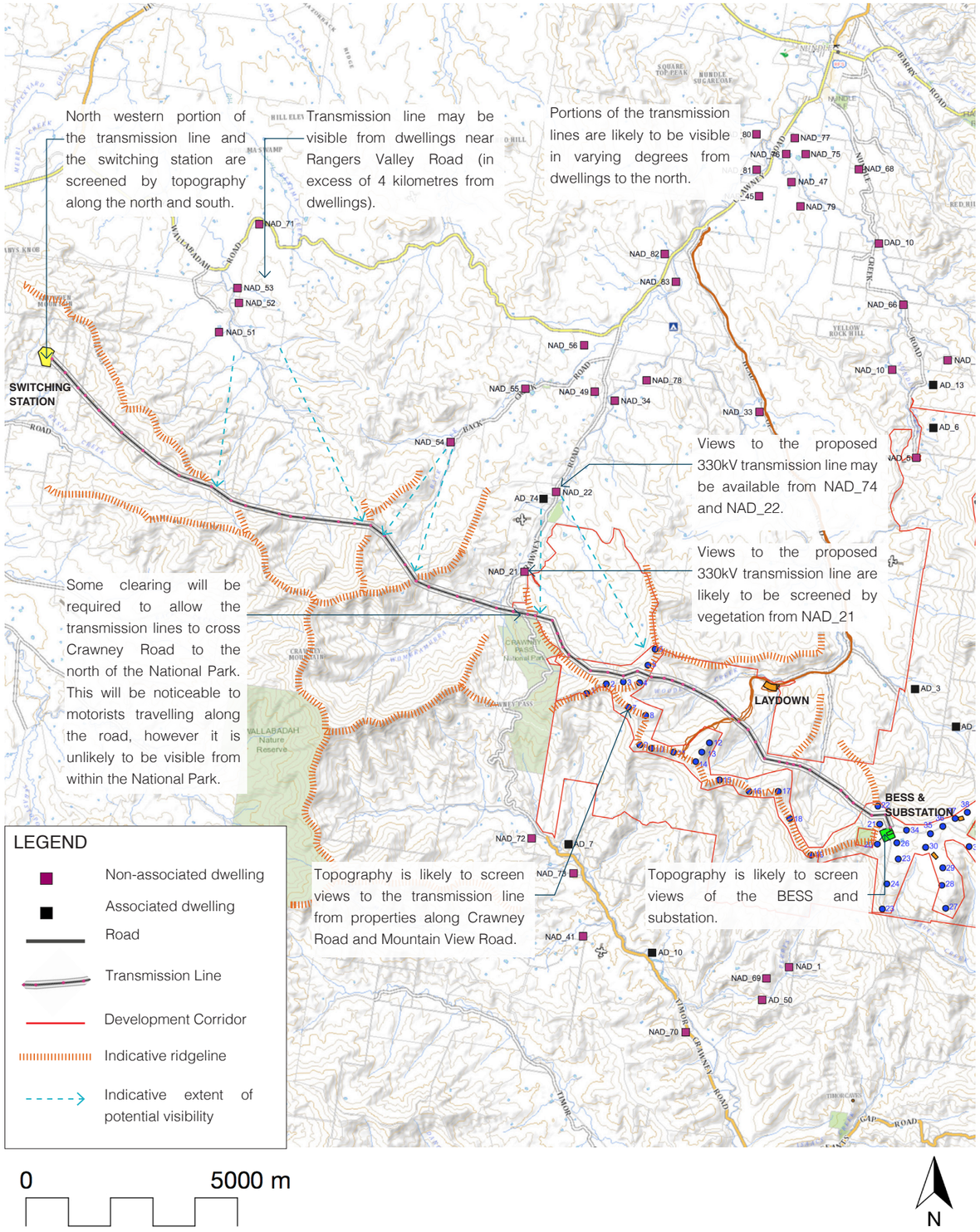


Figure 19 ***Overview of Potential Visual Impacts - Transmission Line***

13.4 Switching Station

The proposed switching station location is approximately 12.5 kilometres west of the Project, connecting to the existing 330kV Transgrid Liddell to Tamworth overhead transmission line network. The switching station is located on a valley floor to the north of Basin Creek Road. Basin Creek Road is an isolated road which is accessed off Wallabadah Creek Road, providing access to one dwelling. Existing transmission lines are an element in the landscape. Opportunities to view the switching station are limited to receptors travelling along Basin Creek Road.

13.5 Ancillary Structures

13.5.1 BESS and Substation

The proposed Battery Energy Storage System (BESS) and substation are located in an area of cleared land near the centre (southern end) of the Site. The BESS and substation are likely to be screened by topography and vegetation. If deemed necessary during the detailed design phase, mitigation methods such as screen planting could be employed to reduce any potential visual impacts.

13.5.2 Site Operations and Maintenance Facility (O&M)

A permanent site operations and maintenance (O&M) facility will be constructed to provide for all operations and maintenance activities associated with the Project. Car parking facilities will also be provided for employee and service vehicles. The O&M facility is proposed adjacent to the substation and BESS. It is unlikely the O&M facility would be visible from any nearby dwellings. The nearest dwelling with visibility of the ridge is NAD_69, although the O&M facility is situated in excess of 4 kilometres from the dwelling. The O&M is set back and screened by vegetation to the south west and it is therefore unlikely to be visible.

The operations and maintenance (O&M) facility is proposed at the entry to the Project Area off Morrisons Gap Road. There would be limited opportunities to view the O&M facility at close proximity. It is suggested screen planting and finishing the building in an appropriate colour scheme to reduce potential visibility from Nundle Creek Road.

13.0 Associated Infrastructure Assessment

The smaller scale of ancillary structures including the proposed substation and site compound have the ability to be screened by topography, existing vegetation or proposed screening vegetation. The following mitigation measures would assist in reducing any residual visual impacts:

- *Siting to ensure minimal vegetation loss.*
- *Screen planting to further reduce any residual visual impacts.*
- *Consideration should be given to controlling the type and colour of building materials used. Where possible a recessive colour palette is to be used which blends into the existing landscape (see example provided in* ***Image 31****).*
- *Avoidance of unnecessary lighting, signage on fences, logos etc.*
- *Any proposed buildings to be sympathetic to existing architectural elements in the landscape.*
- *Minimise cut and fill and loss of existing vegetation throughout the construction process.*
- *Boundary screen planting is an effective mitigation method which could be utilised to ameliorate potential visual impacts resulting from the construction of ancillary structures with a small vertical scale such as collector substations, switching stations and the operations facilities building. An example of the successful screening of a substation is provided in* ***Image 32****.*

Image 31. ***Example of a building colour palette sympathetic to the surroundings***

Image 32. ***Example of landscape screening along the boundary of a substation - Rothbury NSW***

13.5.3 Meteorological Monitoring Masts

The Project includes decommissioning of three current monitoring masts and installation of up to five additional monitoring masts for power testing. The five monitoring masts will be located close to a WTG location and will have same height as the WTG hub height. The exact number and location will be defined at the detailed design stage. The masts are difficult to discern from a distance and are an existing element in the landscape.

14.0 Overview of Dwelling Assessment

14.1 Overview of Dwelling Assessment

The Bulletin states: *all key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed.*

The Preliminary Assessment Tools (***Section 6.0***) defined the visual catchment and identified non-associated residences within the Study Area which require further assessment. These include:

- 23 non-associated dwellings within 3100 metres of the nearest turbine.
- 20 non-associated dwellings within 3100-4550 metres.
- One non-associated dwellings in excess of 4550 metres with potential view turbines in multiple 60° sectors.

14.2 Study Method for Dwelling Assessment

The Bulletin states: *The black and blue lines are not determinative of acceptability. Instead, they provide a basis for the assessment to be undertaken. There may be reasons why the proposed turbine will not have the impact as identified by (the visual magnitude thresholds) and detailed justification can be provided for proposed turbines... for example ground truthing may identify that existing vegetation or topography will screen views to a proposed turbine'.*

Further detailed assessment identified a number of dwellings within the visual catchment are likely to have limited or no views to the Project due to topography and / or other screening factors such as vegetation.

Table 13 provides an overview of the study method for undertaking the dwelling assessment for each dwelling identified within the visual catchment.

Study Method	Process
Step 1: Application of Preliminary Assessment Tools	Preliminary Assessment Tools were applied in accordance with the Bulletin from each dwelling to assess the following two parameters: - Visual Magnitude (identify the number of turbines within blue and black lines) - Multiple 60° Sector Assessment (identify the number of 60° sectors based on a 2D assessment).
Step 2. 3D Assessment (based on topography alone)	Using 3D modelling, Moir LA identified turbines which will not be visible from the dwelling due to topography. As a result the extent of visibility is generally decreased when compared to the 2D assessment. The application of the Preliminary Assessment Tools are updated to account for 3D modelling.
Step 3. Aerial Imagery	Information on the extent of visibility extracted from the 3D model is then overlaid onto a recent aerial image of the dwelling and its surrounds. This provides a detailed assessment of the direction and extent of potentially visible turbines and identifies any intervening elements (such as structures, wind break planting or vegetation) which may reduce the potential visibility.
Step 4. Site Inspection	Where access was granted, Moir LA attended the property to undertake a site inspection to ground truth potential screening factors that were identified on aerial imagery. This included photographic assessment from the dwelling. During the site inspection Moir LA identified potential intervening elements including vegetation and structures.
Step 5: Photomontage / Wireframe	Where potential impacts were identified, photomontages or wireframes were prepared from dwellings to represent those with potential impacts or to best represent the appearance of the Project from clusters of dwellings.
Step 6. Evaluation of VIZ Objectives	In accordance with the Bulletin, the Visual Influence Zone was defined and the relevant objectives were evaluated for each dwelling based on the assessment.
Step 7. Visual Effect Rating	A visual effect rating is applied to each dwelling with regards to the parameters outlined in ***Section 14.3***.
Step 8. Consideration of mitigation methods	For non-associated dwellings where by the Project has the potential to cause visual impact, mitigation methods have been suggested. ***Refer to Section 16.***

*Table 13. **Dwelling Assessment Process***

14.0 Overview of Dwelling Assessment

14.2.1 Dwellings within 3100 metres of the nearest turbine

With the advice of Moir LA, WEP offered on-site visual assessments from all private properties within 3100 metres of the proposed development. Access was granted by 13 of the 23 landowners, and Moir LA attended these properties between 15th - 17th June 2020 to undertake a detailed site inspection.

The purpose of the site inspections was to undertake photographic assessments from areas identified by the landowner as having concern for visual impact and ground truth information identified through the desktop assessment. Where access was not granted to the property, Moir LA have undertaken a desktop assessment utilising 3D and the most current available aerial imagery. Assumptions have been made on the height of vegetation based on character assessments.

An overview of the visual assessment for each of these dwellings has been outlined in ***Table 15*** and detailed assessments have been included in ***Appendix E*** and summarised in ***Section 14.4***.

14.2.2 Dwellings within 3100 - 4550 metres of the nearest turbine

A total of 20 dwelling were identified within 3100 - 4550 metres of a proposed turbine. WEP offered on-site visual assessments from most of these dwellings with potential visual impacts identified. Access was granted by six (6) land owners and Moir LA attended these properties between 15th - 17th June 2020 to undertake a detailed site inspection.

An overview of the visual assessment for each of these dwellings has been outlined in ***Table 16*** and summarised in ***Section 14.4***.

14.2.3 Dwellings in excess of 4550 metres of the nearest turbine

One dwelling in excess of 4550 metres was identified with the potential to view turbines in more than three 60° sectors (NAD_33). Moir LA undertook a site inspection on the 17th June 2020 and a detailed assessment is included in ***Appendix E***.

In addition to those identified through the Preliminary Assessment Tools, Moir LA undertook visual assessments from ***four (4)*** dwellings outside of the blue line of visual magnitude (4550 metres) up to 9 kilometres from the Project that raised concerns associated with potential visual impacts during community consultation.

The Bulletin states: *where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling in the following types of areas:*

- *rural residential clusters;*
- *rural villages; and*
- *urban residential and commercial areas.*

In addition to the detailed assessment of dwellings identified within the visual catchment, Moir LA undertook an extensive Viewpoint Analysis which provides representative visual assessments from dwellings in excess of 4550 metres of the Project (refer to Section 7.0).

14.0 Overview of Dwelling Assessment

14.3 Visual Effect Rating

The Bulletin states: *The Department adopts the widely accepted and commonly utilised approach that visual impact can be determined from a combination of receiver sensitivity and the magnitude of visual effect. This approach is documented in numerous Australian and international guidelines, and is considered to be industry best practice.*

In addition to assessing against the visual performance objectives outlined in the Bulletin, Moir LA have developed a framework for defining and rating the level of visual effect from each dwelling. The framework in **Table 14** has been prepared with regards to the third edition of the *Guidelines for Landscape and Visual Impact Assessment* (GLVIA3), *Residential Visual Amenity Assessment* (RVAA) and Moir LA's extensive professional experience in undertaking LVIA's for wind energy projects.

Published in 2013, the GLVIA3 is well established as providing 'best practice guidance' when undertaking Landscape and Visual Impact Assessment (LVIA). RVAA is a stage beyond LVIA and focusses exclusively on private views and private visual amenity. Considerations outlined in the RVVA which provide a framework for describing and evaluating the predicted magnitude of visual change and related visual amenity effects include:

- *Distance of property from the proposed development having regard to its size / scale and location relative to the property (e.g. on higher or lower ground);*
- *Type and nature of the available views (e.g. panoramic, open, framed, enclosed, focused etc.) and how they may be affected, having regard to seasonal and diurnal variations;*
- *Direction of view / aspect of property affected, having regard to both the main / primary and peripheral / secondary views from the property;*
- *Extent to which development / landscape changes would be visible from the property (or parts of) having regard to views from principal rooms, the domestic curtilage (i.e. garden) and the private access route, taking into account seasonal and diurnal variations;*
- *Scale of change in views having regard to such factors as the loss or addition of features and compositional changes including the proportion of view occupied by the development, taking account of seasonal and diurnal variations;*
- *Degree of contrast or integration of new features or changes in the landscape compared to the existing situation in terms of form, scale and mass, line, height, colour and texture, having regard to seasonal and diurnal variations;*
- *Duration and nature of the changes, whether temporary or permanent, intermittent or continuous, reversible or irreversible etc.; and*
- *Mitigation opportunities – consider implications of both embedded and potential further mitigation.*

(Source: RVVA, 2019).

VISUAL EFFECT RATING				
	NIL	**LOW**	**MODERATE**	**HIGH**
Distance	The project will not be visible.	Turbines may be visible in distance or very partially visible in the foreground.	Turbines maybe visible in the middle ground or a small number may be visible in the near ground.	Turbines are highly visible in the foreground.
Type of views		Views from the dwelling are not focused on the Project.	Views from the dwelling are not focused entirely on the Project.	Views are focused directly towards the Project.
Direction of view		The Project may be visible in peripheral views or form a very minor element in primary views.	The Project may be visible from, yet will not dominate primary views.	The Project will be highly visible and has the potential to be a dominant element in primary views from the property.
Extent of visibility		The Project may be partially visible or fragmented.	The Project may be visible from the dwelling yet will not significantly alter the existing visual character.	The Project has the potential to significantly alter the existing visual character when viewed from the dwelling.
Scale of change		The Project may be visible yet will not change to the existing visual character.	The Project has the potential to become a noticeable element in the view, yet will not overly diminish the existing visual character.	The Project has the potential to alter the existing visual character.
Degree of contrast		The Project will have a low level of contrast with the existing landscape.	The Project will result in a moderate level of contrast with the existing landscape.	The scale of the Project will result in a high level of contrast with the existing landscape.
Duration of change		Changes are temporary.	Changes to the landscape have the potential to be reduced over time (with the employment of. mitigation methods).	Changes to the landscape are continuous and / or irreversible.
Mitigation Options		Existing screening factors contribute to reducing the potential visibility.	Some existing screening factors may contribute to fragmenting the Project or there is opportunity to screen the Project.	Limited or no opportunity to screen the Project.

Table 14. Visual Effect Rating

14.0 Overview of Dwelling Assessment

Non-associated Dwellings within 3100m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assess-ment)**	**Number of 60º Sectors (Based on 3D Assess-ment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes:**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD 1	*Mountain View Road*	**2.58**	**2**	**1**	10	Views from the dwelling are largely contained by topography and vegetation. Up to 10 WTGs may be visible to the NNE.	Low	**Desktop Assessment: Refer to Appendix E1**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 4A	*Shearers Road*	**2.79**	3	**1**	7 blades	Views to the majority of the project is contained by topography, with the exception of up to 7 blade tips. Existing vegetation to the south west of the dwelling is likely to screen views to the blade tips.	Nil - Low	**Site Assessment: Refer to Appendix E2 and Photomontage 12 (Wireframe)**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 4B	*Shearers Road*	**2.89**	**3**	**2**	10	From this dwelling the majority of the Project is likely to be screened by topography with the exception of the tips of 1 turbine to the north west and up to nine (9) turbines to the WSW. Existing vegetation is located in this direction and is likely to screen views to the turbines.	Nil - Low	**Site Assessment: Refer to Appendix E3 and Photomontage 12 (Wireframe)**	
NAD 4C	*Shearers Road*	**2.66**	**3**	**1**	1	From this dwelling, the Project will be screened by topography with the exception of one (1) turbine located in a generally south west direction in excess of 5 kilometres from the dwelling	Nil - Low	**Site Assessment: Refer to Appendix E4 and Photomontage 12 (Wireframe)**	
NAD 5	*Nundle Creek Road*	**1.79**	**3**	**2**	10*	Views to the Project are largely screened by topography. Up to 10 proposed turbines are likely to be visible (based on topography alone) to the east of the dwelling.	Moderate	**Site Assessment: Refer to Appedix E5 and Photomontage 13**	***Consider screen planting***
NAD 7	*Morrisons Gap Road*	**1.74**	**2**	**2**	25* *Within 8kms*	Elevated position, surrounded by vegetation. 3D modelling suggests up to 40 turbines would be visible (25 of which are within 8 kms), however due to vegetation surrounding the property the reality would be much less.	Low	**Desktop Assessment: Refer to Appendix E6**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 8	*Morrisons Gap Road*	**1.16**	**2**	**1**	8*	Dwelling is located in a valley associated with Barnard River and appears to be surrounded by vegetation. 3D modelling suggests up to 8 turbines would be visible (based on topography alone). Vegetation is likely to screen views to the turbines from this dwelling.	Low	**Desktop Assessment: Refer to Appendix E7**	***Consider supplementary planting if deemed neccessary***
NAD 10	*Nundle Creek Road*	**2.27**	**2**	**1**	22	Views to approximately 22 proposed turbines are likely to be available to the south east, the nearest turbine is approximately 2.74 kilometres from the dwelling. Existing scattered vegetation located in the foreground may assist in fragmenting views of the turbines from the dwelling.	Moderate	**Desktop Assessment: Refer to Appendix E8 and Photomontage 14 (from nearby land - not representative of dwelling)**	***Consider screen planting***
NAD_10A	*Nundle Creek Road*	**1.88**	**2**	**2**	15	From this dwelling it is likely 15 turbines will be visible to the south east of the dwelling along the vegetated ridgeline. 10 of these visible turbines are located within 3100 metres of the dwelling.	High	**Desktop Assessment: Refer to Appendix E9**	***Consider screen planting***
NAD 11	*Morrisons Gap Road*	1.05	**1**	**1**	22* *Within 8kms*	Based on 3D modelling considering topography alone it is likely up to 22 turbines would be visible. However, 90 metres of vegetation is located to the south of the dwelling. It is likely views to the Project would be screened by the vegetation, however some filtered views may be available	Low	**Desktop Assessment: Refer to Appendix E10**	***Consider supplementary planting***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 15: ***Overview of non-associated dwellings located within 3100 metres of nearest turbine***

14.0 Overview of Dwelling Assessment

Non-associated Dwellings within 3100m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assess-ment)**	**Number of 60º Sectors (Based on 3D Assess-ment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes:**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD 12	*Morrisons Gap Road*	**1.38**	**1**	**1**	21* *Within 8kms*	Approximately 60-70 turbines would be visible (based on topography alone) 7 turbines are within 3100m. Limited filtered views are available through the vegetation towards the Project Area.	Low	**Site Assessment: Refer to Appendix E11 and Photomontage 15 (Wire frame)**	***Consider supplementary planting***
AD 12	*Morrisons Gap Road*	**1.79**	**1**	**1**	13* *Within 8kms*	Based on topography alone, up to 40 turbines (21 within 8 kms) would be visible to the SSW, however it is likely views to the Project will be screened by vegetation to the south	Nil - Low	**Site Assessment: Appendix E12**	***N/A existing vegetation is likely to sufficiently screen the Project.***
AD 14	*Morrisons Gap Road*	**1.94**	**1**	**1**	20* *Within 8kms*	The dwelling is surrounded by dense vegetation in the direction of the Project Site. An assessment based on topography alone indicates approximately 30 turbines would be available to the south west (10 of which are in excess of 8kms). The dense vegetation (as shown on aerial image - Figure E13b) is likely to screen views to the Project.	Nil - Low	**Site Assessment: Appendix E13**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 15	*Morrisons Gap Road*	**2.08**	**1**	**1**	20* *Within 8kms*	A wireframe diagram has been prepared from this location, and determined (based on topography alone, that up to 59 turbines would be visible from this property (only 20 of the potentially visible turbines are within 8kms). When overlaid onto the panoramic photograph from this location, it illustrates vegetation to the south west will screen the Project.	Nil - Low	**Site Assessment: Refer to Appendix E14 and Photomontage 16 (Wire frame)**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 16	*Morrisons Gap Road*	**2.20**	**1**	**1**	19* *Within 8kms*	The dwelling is located on the northern side of Morrisons Gap Road. Based on topography alone, up to 19 turbines have the potential to be visible from this dwelling within 8kms. However, dense vegetation to the south west of the property and the south west of Morrisons Gap Road is likely to screen views to the Project.	Nil - Low	**Desktop Assessment: Refer to Appendix E15**	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD 17	*Nundle Creek Road*	**2.94**	**1**	**1**	*15** *Within 8kms*	Based on topography alone, up to 15 turbines are likely to be visible (within 8 kilometres) to the south east. Approximately 20 turbines may be visible to the south and south west (in excess of 10 kilometres from the dwelling). Intervening vegetation to the south east may fragment views to the turbines. The implementation of suggested screen planting would further reduce potential visibility from this dwelling.	Moderate	**Desktop Assessment: Refer to Appendix E15**	***Consider screen planting***
NAD 18	*Morrisons Gap Road*	**2.69**	**1**	**1**	12 *Within 8kms*	An opening in the vegetation to the south west of the property with framed views of vegetated ridgeline associated with the Project Site. Approximately 30 turbines (most of which are in excess of 8 kilometres from the dwelling) will be visible in this view.	Moderate	**Site Assessment : Refer to Appendix E17**	***Consider screen planting***
NAD 19	*Morrisons Gap Road*	**2.93**	**1**	**1**	11* *Within 8kms*	Based on an assessment of topography alone, approximately 11 turbines associated with the project (within 8kms) would be visible to the SSW. Existing intervening vegetation in this direction is likely to screen views to the Project.	Moderate	**Desktop Assessment: Refer to Appendix E18**	***Consider supplementary planting***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 15 (Continued): ***Overview of non-associated dwellings located within 3100 metres of nearest turbine***

14.0 Overview of Dwelling Assessment

Non-associated Dwellings within 3100m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assess-ment)**	**Number of 60º Sectors (Based on 3D Assess-ment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes:**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD 20	*Morrisons Gap Road*	**3.05**	**1**	**1**	7* *Within 8kms*	An assessment based on topography alone identified 7 turbines visible to the south west. A combination of existing shed / structure and vegetation to the south west of the property will screen views to the Project from this dwelling. Views to the more of the Project will be available from the garden (see Photomontage 17).	Low	**Desktop Assessment: Refer to Appendix E19 and Photomontage 17**	***Consider screen planting***
AD 23	*Morrisons Gap Road*	**2.52**	**1**	**1**	3 *Within 8kms*	Vegetation to the SSE may assist in screening some turbines. Three (3) turbines are located within 3100m, however only one of these is visible. The remaining visible turbines are in excess of 8 kilometres from the dwelling.	Moderate	**Site Assessment & Refer to Appendix E20 and Photomontage 19**	***N/A - Elevated position and majority of visible turbines are in excess of 8kms.***
NAD 67	*Morrisons Gap Road*	**1.45**	**4**	**1**	10*	Although within close proximity to the Project, the majority of turbines are screened by topography. Based on topography alone it is likely 10 wind turbines will be visible to the north, the closest visible turbine is 2.39 kilometres from the dwelling	Moderate	**Desktop Assessment: Refer to Appendix E21 and Photomontage 26 (Wire frame)**	***Consider screen planting***
NAD 69	*Mountain View Road*	**3.10**	**2**	**2**	31	Moir LA attended the property and undertook a visual assessment on 17th June 2020. The dwelling is sited in an elevated position with expansive, uninterrupted views in all directions. The dwelling is orientated to the north, views to the vegetated hills associated with the Project Site. 31 turbines will be visible along the ridge to the north. A photomontage has been prepared from this dwelling to illustrate the proposal.	High	**Site Assessment: Refer to Appendix E22 and Photomontage 22**	***Consider screen planting***
NAD 24 (DA Location)	*Morrisons Gap Road*	**2.06**	**1**	**0**	0	Moir LA attended this property on June 16th 2020. The Project will not be visible from the DA location due to topography. ***No further assessment required.***	***Nil***	**Site Assessment**	***N/A topography will sufficiently screen the Project.***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 15 (Continued): ***Overview of non-associated dwellings located within 3100 metres of nearest turbine***

14.0 Overview of Dwelling Assessment

Non-involved dwellings within 3100 - 4550m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assessment)**	**Number of 60º Sectors (Based on 3D Assessment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD_03	*Shearers Road*	**3.52**	**3**	**1**	10*	Moir LA attended the property to undertake a visual assessment on 16th June 2020. Owner was not concerned about visual impacts. A desktop assessment (based on topography alone) identified 10 turbines would be visible to the north west. Existing vegetation in this direction would screen views to the Project from the dwelling.	Low	***Site Assessment undertaken***	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD_21	*Crawney Road*	**3.23**	**1**	**1**	7*	Moir LA attended the property on the 15th of June 2020 and undertook a detailed visual assessment from multiple locations on the property. The property is located in a cleared area of land between Crawney Road and Wombramurra Creek. Based on a 3D assessment (topography alone) 6 turbines and one blade would be visible to the south east of the property. Vegetation along the south eastern side boundary of the property and on the south eastern side of Crawney Road is likely to sufficiently screen views to the Project from this property, however if deemed neccessary supplementarty planting could further reduce any potential impacts. The proposed transmission line which crosses Crawney Gully to the south west of the dwelling is likely to be screened by vegetation to the south of the property.	Low	***Site Assessment undertaken*** ***Refer to Photomontage 18 (Wireframe)***	***Consider supplementary planting***
NAD_22	*Crawney Road*	4.40	**1**	**1**	8 *Within 8kms*	Moir LA attended the property on the 15th of June 2020 and undertook a detailed visual assessment. The dwelling is orientated to the east with views across land defined as 'nundle valley pastures' towards distant vegetated ranges. From this dwelling up to 8 turbines will be visible within 8 kilometres to the south west of the property. The proposed transmission line and associated vegetation clearing would be noticeable to the south west. 22 turbines will be discernible in excess of 10 kilometres to the east. ***Photomontage 24*** from NAD_74 is representative of the potential visibility from this dwelling. Screen planting may be undertake in consultation with the land owner to reduce the visibility of turbines to the south west of the dwelling.	Moderate	***Site Assessment & Photomontage 24***	***Consider Screen Planting***
NAD_25	*Barry Road*	**3.87**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***Site Assessment***	***N/A topography will sufficiently screen the Project.***
AD_26	*Barry Road*	**3.87**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
NAD_30	*Barry Road*	**3.95**	**1**		25	Moir LA attended the property on the 16th of June 2020 and undertook a detailed visual assessment. Views from the dwelling are contained by a combination of vegetation and existing sheds and greenhouse. ***Photomontage 20*** has been prepared from the back fence of the property which indicates up to 25 turbines would be visible to the south east. Views to the Project in this one particular location would occupy a very small portion of the view from this location.	Low	***Site Assessment & Photomontage 20***	***N/A existing vegetation is likely to sufficiently screen the Project from the dwelling.***
NAD_32	*Barry Road*	**3.65**	**1**		14 *Within 8kms*	A desktop assessment of NAD_32 identified up to 14 turbines are likely to be visible within 8 kms (based on topography alone). Dense vegetation surrounding the dwelling is likely to screen views to the turbines. Viewpoint HOG40 was assessed from Barrys Road near the entry to the dwelling.	Low	***Desktop Assessment & Viewpoint HOG40***	***N/A existing vegetation is likely to sufficiently screen the Project.***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 16: Overview of non-associated dwellings located between 3100 - 4550 metres

14.0 Overview of Dwelling Assessment

Non-involved dwellings within 3100 - 4550m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assessment)**	**Number of 60º Sectors (Based on 3D Assessment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD_35	*Barry Road*	**4.08**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
NAD_36	*Barry Road*	**4.03**	**1**	**0**	0	***Not visible due to topography. No further assessment required..***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
AD_37	*Barry Road*	**4.16**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
NAD_38	*Barry Road*	**3.85**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
NAD_39	*Barry Road*	**4.00**	**1**	**1**	50*	A desktop assessment identified up to 50 turbines may be visible to the south west (based on an assessment of topography alone). Aerial imagery indicates the dwelling is orientated to the north and surrounded by vegetation. Vegetation to the south west of the dwelling is likely to sufficiently screen views to the Project from this dwelling. If deemed necessary, supplementary planting to the south west could be implemented to ensure long-term screening of the Project.	Low	***Desktop Assessment***	***Consider supplementary planting***
AD_40	*Barry Road*	**3.96**	**1**	**0**	0	***Not visible due to topography. No further assessment required.***	***Nil***	***N/A***	***N/A topography will sufficiently screen the Project.***
NAD_44	*Barry Road*	**4.32**	**1**	**1**	10 *Within 8kms*	A desktop assessment identified up to 10 turbines may be visible to the south west (based on an assessment of topography alone). Aerial imagery indicates the dwelling is orientated to the north and surrounded by vegetation. Vegetation to the south west of the dwelling is likely to sufficiently screen views to the Project from this dwelling.	Nil - Low	***Desktop Assessment***	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD_48	*Shearers Road*	**4.50**	**2**	**1**	6	A desktop assessment has been undertaken from the dwelling currently under construction on Shearers Road. Based on an assessment of topography alone, it is likely up to 6 turbines may be visible to the north west. Dense vegetation to the north west of the dwelling location is likely to sufficiently screen views to these turbines from the dwelling.	Nil - Low	***Desktop Assessment Viewpoint HOG45***	***N/A existing vegetation is likely to sufficiently screen the Project.***
AD_50	*Mountain View Road*	**3.52**	**2**	**1**	9*	A desktop assessment identified up to 9 turbines may be visible to the north east (based on an assessment of topography alone). Aerial imagery indicates the dwelling is orientated to the north and surrounded by vegetation. Vegetation to the north east of the dwelling is likely to sufficiently screen views to the Project from this dwelling.	Nil - Low	***Desktop Assessment***	***N/A existing vegetation is likely to sufficiently screen the Project.***
NAD_66	*Nundle Creek Road*	**3.65**	**1**	**1**	20* *Within 8kms*	A desktop assessment identified the dwelling is located in a cleared area of land and orientated to the north east. Based on an assessment of topography alone 20 turbines associated with the Project are likely to be visible to the south east. A stand of intervening vegetation may reduce the potential to view the turbines from this dwelling. Supplementary planting along the south eastern side of the dwelling would further reduce visual impacts overtime.	Moderate	***Desktop Assessment Viewpoint HOG36***	***Consider supplementary planting***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

KEY:

Project will be screened by topography

Consider screen planting
Refer to Section 16

Consider supplementary planting
Refer to Section 16

Table 16: ***Overview of non-associated dwellings located between 3100 - 4550 metres (continued)***

14.0 Overview of Dwelling Assessment

Non-involved dwellings within 3100 - 4550m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assessment)**	**Number of 60º Sectors (Based on 3D Assessment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD_72	*Timor Crawney Road*	**3.37**	**2**	**2**	30 *Within 8kms*	A desktop assessment identified up to 30 turbines will be visible to the north east (based on an assessment of topography alone). If deemed necessary, screen planting close to the dwelling would reduce the potential visual impact from this dwelling, however it is understood the owner is not concerned about visual impacts.	Moderate	***Desktop Assessment***	***Consider Screen Planting***
NAD_73	*Timor Crawney Road*	**3.41**	**2**	**2**	25 *Within 8kms*	A desktop assessment identified up to 25 turbines will be visible to the north east (based on an assessment of topography alone). If deemed necessary, screen planting close to the dwelling would reduce the potential visual impact from this dwelling, however it is understood the owner is not concerned about visual impacts.	Moderate	***Desktop Assessment***	***Consider Screen Planting***
AD_74	*Crawney Road*	**4.44**	**1**	**1**	7 *Within 8kms*	Moir LA attended the property on the 17th of June 2020 and undertook a detailed visual assessment. The dwelling is orientated to the north. From this dwelling up to 7 turbines will be visible within 8 kilometres to the SSW of the property. The transmission line and associated vegetation clearing will be noticeable to the south of the property. Approximately 22 turbines will be discernible in excess of 10 kilometres to the east. Screen planting may be undertake in consultation with the land owner to reduce the visibility of turbines to the south of the dwelling.	Moderate	***Site Assessment & Photomontage 24***	***Consider Screen Planting***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 16: Overview of non-associated dwellings located between 3100 - 4550 metres (continued)

Non-involved dwellings in excess of 4550m									
ID	**Location**	**Closest WTG (km)**	**Number of 60º Sectors (Based on 2D Assessment)**	**Number of 60º Sectors (Based on 3D Assessment)**	**Number of Visible WTGs (*Based on topography alone)**	**Assessment Notes**	**Visual Effect Rating**	**Assessment Method:**	**Recommended Mitigation:**
NAD_33	*Head of Peel Road*	**5.62**	**3**	**3**	30 *Within 8kms*	Moir LA attended the property on the 17th of June 2020 to undertake a visual assessment. Dwelling is in excess of 4550 metres, however a detailed assessment was undertaken due to the potential to view turbines in three (3) 60º sectors. It would be reasonable to suggest the turbines would be visible in only two (2) sectors which is acceptable for a receptor with a viewer sensitivity Level 2. 30 turbines will be visible to the SE and SSW (at distance of 5.62 - 8 kilometres). Existing vegetation surrounding the dwelling may assist in fragmenting views to the turbines.	Moderate	**Site Assessment : Refer to Appendix E23 and Photomontage 21**	***Consider Supplementary Planting***

Based on an assessment of topography alone. Screening factors such as vegetation may reduce the potential visibility of the proposed turbines.

Table 17: Overview of non-associated dwellings located in excess 4550 metres (continued)

14.0 Overview of Dwelling Assessment

14.4 Summary of Dwelling Assessment

Detailed assessment of the 43 dwellings identified within the visual catchment found that the majority of dwellings have limited opportunities to view the Project due to topography and or vegetation.

14.4.1 Summary of dwellings within 3100 metres

A total of 23 non-associated dwellings (including one (1) DA location) within the black line of visual magnitude were assessed in detail. Of the 23 dwellings assessed, the Project is likely to be screened by topography from one (NAD 24).

Of the 22 dwellings from which the Project will be visible, the turbines will be largely screened by vegetation from eight (8) dwellings. The visual effect rating identified 13 dwellings with a nil - low or low visual effect, seven (7) dwellings with a moderate visual effect and two (2) dwellings with a high visual effect. Mitigation methods have been identified for eleven (11) dwellings within 3100 metres of the Project and have been discussed in further detail in **Section 16**.

Morrisons Gap Road:

The majority of dwellings (14) within 3100 metres of the Project are located on Morrisons Gap Road. Morrisons Gap Road follows the ridgeline and dwellings are generally elevated. Morrisons Gap Road is apart of the Forested Mountain Ranges LCU which is characterised by high vegetation coverage. As a result, of the 14 dwelling assessed, only three (3) dwellings (AD_23, NAD_18 and NAD_67) are likely to have uninterrupted views to the proposal. Due to the undulating topography typical of the forested mountain ranges these view are likely to be to a small portion of the Project.

Nundle Creek Road:

Four dwellings associated with Nundle Creek Road are located within 3100 metres of the Project. The Project is likely to be visible from all dwellings identified and assessed on Nundle Creek road to varying degrees. Generally the Project occupies a small portion of views from these dwellings and the mitigation methods suggested for these dwellings could be employed to significantly reduce potential impacts.

Shearers Road:

Three (3) non-associated dwellings located on Shearers Road are located within 3100 metres of the nearest turbine. Detailed assessment of these dwellings identified limited opportunities to view the Project due to a combination of topography and vegetation (typical of the landscape character in this area).

Mountain View Road:

Two (2) dwellings were identified and assessed on Mountain View Road. NAD_1 is located at the base of the valley and views to the Project are limited. NAD_69 is likely to have views to a large portion of the Project which will likely occupy a large portion of the views toward which the house is orientated. The visual effect of the Project has been rated as high from NAD_69.

14.4.2 Summary of dwellings within 3100 - 4550 metres

A total of 20 non-associated dwellings were identified and assessed between 3100 to 4550 metres. Views to the Project will be screened by topography from seven (7) of the dwellings.

Of the remaining 13 dwellings from which the Project will be visible, existing vegetation is likely to screen or fragment views from seven (7) dwellings. The visual effect rating identified eight (8) dwellings with nil - low or low visual effect and five (5) dwellings with a moderate visual effect and. Mitigation methods have been outlined for seven (7) dwellings with potential views to the Project in the form of screen or supplementary planting being NAD_21, NAD_22 (Crawney Road), NAD_39 (Barry Road), NAD_66 (Nundle Creek Road), NAD_72 (Timor Crawney Road), NAD_73 (Timor Crawney Road) and AD_74 (Crawney Road).

14.4.3 Summary of dwellings in excess of 4550 metres

NAD_33 located on the Head of Peel Road was identified as having the potential to view turbines in up to three (3) 60° sectors and was assessed as having a moderate visual effect see **Table 17** and **Appendix F**. A photomontage has been prepared from this dwelling.

Dwellings in excess of 4550 metres from the Project have the potential to view the Project. The Viewpoint Analysis (refer to Section 8.0) and photomontages prepared from public viewpoints seek to assist the Department and landowners in determining potential visual impacts from dwellings in excess of 4550 metres.

15.0 Visual Impacts on Landscape Character

15.1 Overview of Visual Impacts on Landscape Character

The proposed development is to be located within a predominantly rural landscape that has not been identified as significant or rare. The broad landscape character is dominated by established rural land which consists primarily of modified undulating hills. Generally, the Scenic Quality Classes of the Landscape Character Units (LCU) within the Study Area have been rated as moderate with some areas defined as moderate to high (refer to ***Section 5.6***).

The fact that the proposed wind turbines are generally positioned within a landscape that has remained largely unchanged for decades means that the potential for contrast is significant. There is little doubt that the Hills of Gold Wind Farm, regardless of how visible it actually is, would become a feature of the area. However, the degree to which the existing landscape character and significance is altered as a result of the proposal, is determined by the dominance of the proposal in relation to the existing landscape features.

It is undeniable the proposed wind farm would become a feature of the visual landscape. However, it is likely the character of areas which are valued for their high landscape quality and utilised for recreation and tourism will remain intact. Regionally, significant landscape features identified in ***Section 5.2*** of this report, would remain dominant features of the landscape and it is unlikely the proposal would degrade the scenic value of these landscape features.

15.2 Overview of the Visual Impact on LCUs

Appendix F provides an overview of the assessment of the potential visual impacts on the existing landscape character of the local area for each Landscape Character Unit (LCU) as characterised in ***Section 5.6*** of this report. An evaluation of the potential visual impacts has been undertaken using the visual performance objectives as outlined in the Bulletin.

Table 18 provides a brief summary of the findings.

Of the seven (7) LCU's identified and assessed, the Project is likely to be visible from all, to varying degrees. Due to the undulating topography surrounding the Project Area, there are limited opportunities to view the Project in its entirety.

15.0 Visual Impacts on Landscape Character

Summary of Visual Impacts of Landscape Character Units			
LCU:	**Scenic Quality Rating:**	**Landscape Scenic Integrity:**	**Key Landscape Features:**
LCU 01 Nundle Village	**Low - Moderate** *Refer to Appendix B1*	• Visibility to the Project Area from the Nundle Village LCU is limited. • Although the proposed wind turbines are likely to be discernible from some areas within the LCU, the Project will not dominate the visual catchment of the Nundle Village LCU. • Due to the distance, the Project will form a minor element in the overall visual landscape. The landscape elements which contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal.	• The key features of this LCU include a mixture low density residential houses on large blocks, gently undulating lots used for light farming activities, the presence of the Peel River and distant views of vegetated ridgelines to the east (associated with Hanging Rock) and to the south. • Views to vegetated ranges (including the Project Area) characterise the arrival to Nundle from the north west. Although visible in the distance, the Project is likely to occupy a small portion of the vegetated ridgelines that surround Nundle Village. The key feature on arrival is the steep densely vegetated range associated with Hanging Rock which will remain unchanged.
LCU 02 Wallabadah	**Moderate** *Refer to Appendix B2*	• Visibility to the Project Area from the Wallabadah LCU is limited due to the distance, local screening factors, and topography. • The Project may be discernible from some public areas within the LCU, however it will not modify the visual catchment or scenic integrity of the Wallabadah LCU area. • The Project will form a minor element in the overall visual landscape. The landscape elements which contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal.	• The key features of this LCU include cleared undulating valleys used for grazing activities, creeklines and views to the foothills associated with the Liverpool/Mount Royal Ranges. These features will remain unchanged.. • The Project will form a minor element in the overall visual landscape and will not disrupt the key landscape features.
LCU 03 Nundle Valley Pastures	**Moderate** *Refer to Appendix B3*	• The proposed wind turbines will be a noticeable element from some areas within the LCU, they will not dominate the existing landscape character of the Nundle Valley Pastures LCU. • The landscape elements which contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal.	• Views to vegetated ranges (including the Project Area) form a visual backdrop when travelling along Crawney road toward Nundle Village. Although visible in the distance, the Project is likely to occupy a small portion of the vegetated ridgelines. • Whilst the Project will be a noticeable element in the landscape, the key features of the LCU are likely to remain undisturbed.
LCU 04 Nundle Rolling Foothills	**Moderate** *Refer to Appendix B4*	• The Project Area is likely to be noticeable from some areas within the LCU. However, for the most part the Project will not dominate the visual catchment of the Nundle Rolling Foothills LCU. • There are limited opportunities to view the Project Area within the LCU due to local screening factors and topographical undulations. • The current landscape character and scenic quality of the Nundle Rolling Foothills LCU is likely to be slightly altered in some locations due to the Project.	• The key features of this LCU include the densely vegetated and undulating terrain, cleared grazing land and fleeting views to the surrounding ridgelines. • Although the proposed wind turbines are likely to slightly alter views toward the ridge from some limited locations, the landscape features will remain the key feature of the landscape within this LCU**.**
LCU 05 Forested Mountain Ranges	**Moderate - High** *Refer to Appendix B5*	• Although the proposed wind turbines are likely to alter the existing landscape as defined in this report as the Forested Mountain Ranges LCU, the dense vegetation and topographical changes typical of the LCU will remain unchanged. • Due to the localised topographical changes and roadside vegetation the number of publicly accessible locations to view the Project from within the LCU is likely to be limited. • As the range forms apart of the visual catchment from surrounding Landscape Character Units, the level to which it has the potential to alter the scenic integrity has been assessed based on the parameters of surrounding LCUs (in particular LCU03: Nundle Valley Pastures, LCU04 Nundle Rolling Foothills, LCU06: Crawney and LCU07 Nundle Creek).	• The valued features of this LCU include the densely vegetated ridgeline which provides a backdrop from the surrounding areas. The proposed development is likely to alter the existing visual character of the ridgeline. However, the heavily wooded character of the LCU will remain unchanged. • Due to the proximity of the Project Area to this LCU, there is the possibility of the turbines being a dominant feature within the landscape. However, the dense vegetation limits opportunities for these views from within the public domain. The close proximity reduces views to include a small portion of the Project Area. • It is important to note that whilst the proposed wind turbines will be a noticeable element on top of the range, and in some areas a dominant feature, they will not disrupt central line of sight to the range. The range is likely to remain a key feature of the landscape from areas surrounding this LCU.
LCU 06 Crawney	**Moderate** *Refer to Appendix B6*	• Although the southern section of the proposed wind turbines are likely to be discernible along the ridgeline from some areas within the LCU, the Project will not cause significant modification to the visual catchment of the Crawney LCU. • Due to the existing roadside vegetation, local topographical changes and distance, the Project will form a minor element in the overall visual landscape. • The scenic quality of the LCU will be slightly altered as a result of the proposal.	• The key features of this LCU include the densely vegetated undulating terrain and intersecting creeklines, cleared grazing land and fleeting views to the surrounding ridgelines. • Although the proposed wind turbines are likely to slightly alter the views toward the ridge from some locations, the landscape features will remain the dominant feature of the landscape within this LCU.
LCU 07 Nundle Creek	**Moderate** *Refer to Appendix B7*	• The proposed wind turbines are likely to be noticeable along the ridgeline from some areas within the LCU, however due to the local topographical changes and proximity to the Project Area, the turbines will form a minor element in the overall visual landscape. • The current landscape character and scenic quality of the Nundle Creek LCU is likely to be slightly altered in some locations due to the Project as a result of the proposal.	• The key features of this LCU include the cleared, undulating grazing land and fleeting views to the surrounding ridgelines. • Although the proposed wind turbines are likely to alter the appearance of the ridge line from some locations, the Project is likely to occupy a small portion of the vegetated ridge. • The undulating rolling hills and traversing creek lines are likely to remain a dominant feature of the Nundle Creek LCU.

*Table 18. **Summary of Visual Impacts on Landscape Character Units***

16.0 Mitigation Methods

16.1 Overview of Mitigation Methods

This section of the report provides recommendations which seek to achieve a better visual integration of the proposal and the existing visual character at both local and regional scales. The mitigation measures attempt to lessen the visual impact of the proposed wind farm whilst enhancing the visual character of the surrounding environment.

Mitigation measures are best considered as two separate phases. These include:

- Primary measures that form part of the development of the wind farm design through an interactive process;
- Secondary measures designed to specifically address the remaining (residual) negative (adverse) effects of the final development proposals (The Landscape Institute et al 2008).

It is important to note that the mitigation methods proposed in this report are made notwithstanding issues raised by other consultants (eg. engineering, ecology, geology etc.). During the planning and design phase of a wind farm mitigation strategies should also be considered to lessen the visual impact of the proposal. This is by no means an exhaustive list, however the adoption of these recommendations will assist considerably in ensuring the proposal contributes positively to the visual quality and character of the area.

Mitigation methods considered for associated infrastructure has been included in ***Section 13.0***.

16.2 Project Layout and Design

The design of the proposed wind farm is a primary measure of mitigation. The general principles employed through the project design phase can significantly reduce the visual impact. These include siting, access, layout and other principles which directly impact the appearance of the proposed development. It is important to note that as a result of community consultation during the development period, the Project has undergone many changes. The resulting layout has a substantially smaller development footprint to those previously considered and increases distances between turbines along the ridgeline. General guidelines for the design development of the Project have been outlined in the following section.

16.2.1 Wind Farm Layout and Size

The layout and size of the wind farm is a significant factor in the visual impact on the landscape. According to Stanton (1995) the intrusiveness of a wind farm is not directly proportional to the number of turbines in an array, and instead, more a factor of design feature. For example, large wind farms may appear less dominating than a smaller project when the large wind farm is subdivided into several visually comprehensible units.

It is suggested that fewer and more widely spaced turbines present a more pleasing appearance than tightly packed arrays (URBIS, 2009). The following principles should guide the design process of the wind farm:

- Controlling the location of different turbine types, densities and layout geometry to minimise the visual impacts.
- The lines of turbines should reflect the contours of the natural landscape as best as possible.
- Ensure the turbines are evenly spaced to give a regular pattern creating a better balance within the landscape.

It is important to note that as a result of community consultation during the development period, the Project has undergone many changes. The resulting layout has a substantially smaller development footprint to those previously considered. The above design principles have been considered in the siting of the proposed turbines to provide a balanced appearance along the ridgeline.

16.2.2 Wind Turbine Design and Colouring

Turbine design and colouring are an important factor. The turbines will have a matte white finish and consist of three blades which is consistent with the current turbine models being considered.

The important factors to achieving a visual consistency through the landscape include:

- Uniformity in the colour, design, rotational speed, height and rotor diameter.
- The use of simple muted colours and non-reflective materials to reduce distant visibility and avoid drawing the eye.
- Blades, nacelle and tower to appear as the same colour.
- Avoidance of unnecessary lighting, signage, logos etc.

16.0 Mitigation Methods

16.3 Mitigation Methods - Residences

In accordance with the Bulletin, a detailed assessment of dwellings identified within the visual catchment has been undertaken and (where possible) mitigation methods have been recommended to assist in reducing any residual impacts.

Of the ***43*** dwellings assessed a total of ***20*** residences were identified through the visual assessment as having the potential to benefit from the application of mitigation methods as described in this section of the report. ***Table 15*** - ***Table 17 (Section 14.0)*** provide an overview of the potential mitigation options for the ***20*** residences based on an assessment of potential visual impacts and consideration of the existing landscape character.

Screen planting was identified as a potential mitigation measure for 12 dwellings and supplementary planting has been suggested for eight (8) dwellings. The principles of both methods have been outlined in the following sections.

16.3.1 Residence Screen Planting

In circumstances where residences are subject to a high level of visual impact, screen planting is an option proposed to assist in mitigating views of turbines from residential properties. As the viewing location of the proposal would be generally fixed there is opportunity to significantly reduce potential visual impact from the proposal.

In order to achieve visual screening planting between the intrusive element and the homestead, tree planting could be undertaken in consultation with the relevant landowners to ensure that desirable views are not inadvertently eroded or lost in the effort to mitigate views of the turbines.

An example of how screen planting could be used to mitigate potential views towards visible WTGs from **NAD_10** illustrated in ***Figure 20***. Note this is an example only and a detailed analysis would be required to determine the extent of visibility, existing planting and orientation of the residence. Existing scattered vegetation obstructs views towards some wind turbines from this location. Existing vegetation is scattered in the middle ground. Where screening may be required from a static position (ie. kitchen / living room window) screen planting sited away from the residence ensures desirable views across land are retained where possible, whilst selectively screening views to WTGs.

16.3.2 Residence Supplementary Planting

Due to the vegetated character of areas surrounding the site (particularly to the north along Morrisons Gap Road) the Project is likely to be screened by vegetation from a number of dwellings. Where turbines are located close to the dwelling or existing intervening vegetation is thin, supplementary planting is a mitigation method that has been identified. Supplementary planting in keeping with the existing landscape character would further reduce potential visibility and ensure longevity of the intervening vegetation.

Figure 20: ***Example of screen planting set back from residence (RES20)*** *(Image Source: Google Maps 2020)*

16.0 Mitigation Methods

16.4 Landscaping Principles

Visual screen planting is a beneficial mitigation method used to assist in reducing the visual impact of the wind farm and associated infrastructure. Landscaping and screen planting can also be utilised to significantly reduce the affect of shadow flicker on both roads and residences. The existing character of the landscape allows for a variety of methods of landscaping and visual screening which will remain in keeping with the landscape character. General guidelines to adhere to when planning for landscaping and visual screening include:

- Planting should remain in keeping with existing landscape character.
- Species selection is to be typical of the area.
- Planting layout should avoid screening views of the broader landscape.
- Avoid the clearing of existing vegetation. Where appropriate reinstate any lost vegetation.
- Allow natural vegetation to regrow over any areas of disturbance.

Locally native plant species are preferred, as they will help assist and maintain the connectivity of the area and therefore. They help preserve the landscape character and scenic quality of the area as well as building habitat for local fauna. Native species are also well-suited to local conditions (ie. soil, climate, etc.) and will build on the existing vegetation assemblages in the area.

17.0 Evaluation of Visual Performance Objectives

17.1 Overview of Visual Performance Objectives

In accordance with the Bulletin, the visual assessment requires an evaluation of the proposed wind energy project and its various components, turbines and ancillary facilities against the visual performance objectives of the Project *(refer to Table 2 of the Bulletin)*, using a combination of desktop and field evaluations. The visual performance objectives are used as a framework for evaluation that enables potential impacts and management options to be considered objectively, against the varying levels of landscape significance established by the baseline study. Application of the visual performance objectives will allow for a transparent and robust assessment process.

The following tables provide a brief summary of the evaluation of each of the visual performance objectives and identifies the relevant sections of the LVIA where detailed assessments are located.

Visual Magnitude - Visual Performance Objectives		
Visual Influence Zone 1 Objectives:	**Visual Influence Zone 2 Objectives:**	**Visual Influence Zone 3 Objectives:**
Avoid turbines or provide detailed justification of turbines below the blue line (4550m for Hills of Gold WF)	*Manage impacts as far as practicable, justify residual impacts, and describe proposed mitigation measures below the black line (3100m for Hills of Gold WF). Consider screening between the blue line and the black line.*	*Consider screening below the black line (within 3100m).*
Summary of LVIA Evaluation		
• ***Refer to Section 6.0 - Visual Magnitude***		
Dwellings within 3100 m (below the black line):		
• *22 non-associated landowner dwellings and one (1) potential DA locations were identified within 3100 metres of a proposed WTG*		
• *DA Location will be screened by topography (NAD_24).*		
• *Further Detailed Assessment found the Project is likely to be screened by vegetation from eight (8) dwellings within 3100m.*		
• *Mitigation methods proposed for the 11 remaining dwellings is likely to reduce impacts to an acceptable level.*		
Dwellings within 3100 m - 4550 m (between the blue and black line):		
• *20 non-associated dwellings were identified between 3100 - 4550 metres of the nearest proposed WTG.*		
• *Seven (7) of these dwellings have no visibility of the Project due to topography.*		
• *Vegetation is likely to screen the proposed from a further seven (7) dwellings.*		
• *Mitigation methods proposed for the six (6) remaining dwellings is likely to reduce impacts to an acceptable level.*		

*Table 19. **Visual Magnitude - Evaluation of Visual Performance Objectives***

17.0 Evaluation of Visual Performance Objectives

Landscape Scenic Integrity

Visual Influence Zone 1 Objectives:	Visual Influence Zone 2 Objectives:	Visual Influence Zone 3 Objectives:
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.	*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.*	*No Visual Performance objective applies.*

Summary of LVIA Evaluation

Assessment Notes:

- The Visual Influence Zone (VIZ) was identified for 45 viewpoints within the Study Area, where relevant for viewpoints rated as VIZ1 and VIZ2 the objectives were evaluated.
  Refer to Section 8.0 and Appendix C: Viewpoint Analysis

- The potential for the project to affect the Scenic Integrity of the existing landscape character was summarized for each Landscape Character Unit.
  Refer to Section 15 and Appendix F: Overview of LCUs

- The LVIA concluded that whilst the Project is likely to be a visible element in the landscape, the scenic integrity of the existing landscape character is likely to remain intact.

Table 20. Landscape Scenic Integrity - Evaluation of Visual Performance Objectives

Key Feature Disruption

Visual Influence Zone 1 Objectives:	Visual Influence Zone 2 Objectives:	Visual Influence Zone 3 Objectives:
Avoid wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.	*Minimise impact of wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.*	*No Visual Performance objective applies.*

Summary of LVIA Evaluation

- Key Landscape Features are identified in Section 5.0. The key features were identified through a combination of community consultation and landscape character assessment.
- The LVIA has assessed the key features of the area and it has been concluded that whilst the Project may impact views from some areas, key features identified through the landscape baseline study will remain the dominant features of the landscape. The Project is unlikely to result in major disruptions to the key landscape features.
  Refer to Section 15 and Appendix F: Overview of LCUs

Table 21. Key Feature Disruption - Evaluation of Visual Performance Objectives

17.0 Evaluation of Visual Performance Objectives

Multiple Wind Turbine Effects

Objectives (Applies to all Visual Influence Zones)

- *Avoid views to the proposed, existing and approved turbines within eight kilometres 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 60º sectors.*
- *Level 2: (Moderate Sensitivity) - Wind Turbines visible within the effective horizontal views in three or more 60º sectors.*

Summary of LVIA Evaluation

Assessment Notes:

- All viewers identified using the Multiple Effect Tool (based on 2D plan assessment) are Level 2 Sensitivity (Rural Dwelling). The Bulletin recommends further assessment to Rural Dwellings (Level 2 Sensitivity) identified as having the potential to view more than two (2) 60º sectors when using the Multiple Effect Tool.
  Refer to Section 6.0: Preliminary Assessment Tools

Summary of Assessment:

Based on a 2D Assessment:

- A total of seven (7) non-associated dwellings were identified as having the potential to view turbines in more than two (2) 60º sectors.
- Six (6) Non-associated Dwellings had turbines within three (3) 60º sectors (NAD_4A, NAD_4B, NAD_4C, NAD_5, NAD_3 and NAD_33).
- One (1) Non-associated Dwelling had turbines within up to four (4) 60º sectors (NAD_67).

3D Assessment (based on topography alone):

- A 3D assessment found the number of potential turbines was reduced to acceptable levels (one or two 60º sectors) for six (6) of the seven (7) dwellings identified.
- One dwelling have turbines in up to three (3) 60º sectors (NAD_33).
- ***NAD_33 (Head of Peel Road)*** is in excess of 5.5 kilometres from the nearest turbine and has the potential to view turbines in up to three (3) 60º sectors. The encroachment of the turbines into three sectors is marginal.
- A site assessment was undertaken from NAD_33 (refer to Appendix E23).

*Table 22. **Multiple Wind Turbine Effects - Evaluation of Visual Performance Objectives***

Shadow Flicker and Blade Glint - Visual Performance Objectives

Objectives (Applies to all Visual Influence Zones)

- *Minimise shadow flicker to not more than 30 hours per year and utilise available mitigation options to minimise shadow flicker.*
- *Finish turbine blades with a low reflectivity surface treatment to ensure that blade glint is minimised.*

Summary of LVIA Evaluation

Shadow Flicker:

- No methodology is provided for the assessment of shadow flicker. Moir LA have utilised the Draft National Guidelines to assist in formulating a methodology for assessment.
- A total of (9) dwellings were identified with potential shadow flicker hours, five (5) of these are associated dwellings (AD_3, AD_5, AD_6, AD_8, AD_11). Refer to Table 12.
- Of the four (4) non-associated dwelling with potential shadow flicker, only one (NAD_8) has the potential to experience more than 30 hours per year.
- The assessment is based on a worst case scenario considering topography alone. NAD_8 is surrounded by dense vegetation which would be likely to mitigate any potentially unacceptable limits of shadow flicker effects.

Refer to Section 10.1 Shadow Flicker

Blade Glint:

- Turbines will be finished with a low reflectivity surface treatment to ensure blade glint is minimised.

Refer to Section 10.5 Blade Glint

*Table 23. **Shadow Flicker and Blade Glint - Evaluation of Visual Performance Objectives***

17.0 Evaluation of Visual Performance Objectives

Aviation Hazard Lighting
Objectives (Applies to all Visual Influence Zones) *Objective Applies to all Visual Influence Zones* • ***Aviation Hazard Lighting (AHL) must meet the requirements of Australian Standard AS 4282 - 1997 and any prescribed or notified CASA requirement. Shield all AHL within 2 kilometres of any dwellings. Avoid strobe lighting.***
Summary of LVIA Evaluation
• The visual effect from night lighting has the potential to have a visual impact on receptors including motorists and residents in the area. • Mitigation methods have been outlined in Section 11.4. *Refer to Section 11.0 Night Lighting Assessment*

*Table 24. **Aviation Hazard Lighting - Evaluation of Visual Performance Objectives***

18.0 Conclusion

It is inevitable that the placement of wind turbines in a rural landscape will alter the existing landscape character of the area to some degree. The proposed wind farm contrasts with the existing landscape character of the region which is typically rural, pastoral land with large expanses of vegetation.

With all visual impact assessments the objective is not to determine whether the proposed impact is visible or not visible, but to determine how the proposal will impact on the existing visual amenity, landscape character and scenic quality. If there is potential for negative impact, this impact, and any mitigation methods must be investigated in order to reduce the impact to an acceptable level.

Although this LVIA quantifies the visual impact of the proposed wind turbines, the overall visual impact of the wind farm will vary greatly depending on the individual viewer's sensitivity to and acceptance of change. The sensitivity towards change varies greatly depending on the user's connection with the landscape. For example visitors to the area travelling into Nundle from the west may perceive the wind farm as an interesting feature of the landscape. This may contrast with a resident who passes the wind farm daily who may have a more critical perception of the visual presence of the wind farm.

The visual impact of the wind turbines are lessened as the distance of the vantage point from the Project Area is lengthened. The topography surrounding the wind turbines significantly alters the visibility of the proposed development from many vantage points. Within the local setting, a combination of the topography and local influences such as existing natural and introduced vegetation significantly reduce visibility towards the proposed turbine locations.

The greatest visual effect is most likely to be felt by residents in the immediate vicinity of the wind farm. Amelioration methods incorporated into the design process in conjunction with landscape and visual screening will have a positive effect on reducing any visual impact of proposed wind farm. Through mitigation methods described it will be possible to significantly reduce the visual impact to an acceptable level at sensitive viewpoints such as rural residential properties.

The landscape within the Study Area and its surrounds has evolved significantly since non-indigenous settlement and continues to evolve to reflect changing farming practices and the introduction of forestry plantations in the landscape. The landscape is continuing to change over time and has the capacity to accomodate further change as a result of the Project.

Due to their simplicity in form (especially when compared to transmission lines, towers and associated infrastructure) wind turbines can be considered a temporary installation in the landscape due to their modular construction and relatively low impact during the construction phase.

When implemented with appropriate environmental management, the development of wind farms can be undertaken with low impact on the surrounding environment whilst providing positive local, regional and national benefits. It is the professional opinion of Moir Landscape Architecture that the social, environmental and economical benefits of the proposed wind farm far outweigh the identified visual impacts associated with the proposed Hills of Gold Wind Farm.

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