



Crookwell 3 Wind Farm
Chapter 9

VISUAL IMPACTS

9.1 Introduction

An assessment on the landscape and visual impacts of the Crookwell 3 Wind Farm was undertaken by Green Bean Design Pty Ltd and a report prepared. This report was updated in June 2012 in response to the *Draft NSW Wind Farm Planning Guidelines* released in December 2011 by DoPI. The full landscape and visual impact assessment (LVIA) can be found at **Appendix 6**.

The draft guidelines set out key considerations and a framework for the assessment of landscape and visual impacts for residential dwellings within a 2km radius of proposed wind turbines. This LVIA has been prepared with regard to the draft guidelines and included the preparation of photomontages from all of the non-associated residential dwellings located within 2 km of the proposed Crookwell 3 wind turbines, apart from four residential dwellings where the residents did not agree to the production of a photomontage (refer to **Chapter 22.4.8 – Consultation with neighbours that have houses within 2km of a proposed wind turbine**).

Green Bean Design also reviewed the revised *Draft National Wind Farm Development Guidelines* (July 2010) and the *AusWind Best Practice Guidelines* as part of this updated LVIA. These guidelines offer best practice advice for assessments of landscape and visual amenity impacts, which this LVIA generally adheres to.

The LVIA analyses the potential visual impacts that may arise out of the wind farm and associated development infrastructure, and recommends mitigation measures to reduce any negative impacts.

The proponent is considering a number of alternative wind turbine models and therefore the LVIA has adopted a theoretical wind turbine 'tip' height of 157 metres in order to assess a 'hybrid' design that incorporates the maximum dimensions from each turbine model under consideration. This represents a combination of the longest blade with the tallest tower, even though no turbine combines these two components. This ensures that the LVIA has adopted a 'worst case scenario' that accounts for all possible turbines models. Therefore, the LVIA should be considered conservative in nature as the actual wind turbine 'tip' height is likely to be lower than that assessed in the LVIA.

9.2 Methodology

The LVIA methodology included the following activities:

- *desktop study addressing visual character and identification of residential and public view locations within the surrounding area;*
- *fieldwork and photography;*
- *preparation of ZVI diagrams;*
- *assessment and determination of landscape sensitivity;*
- *assessment and determination of visual impact;*
- *preparation of photomontages and illustrative figures; and*
- *preparation of shadow flicker assessment.*

A desktop study and field inspections were carried out to collect and analyse information to describe and define landscape characteristics of the area in which the Crookwell 3 Wind Farm would be constructed. Topographic maps and aerial photographs were used to identify the locations and categories of potential views that could be verified during the fieldwork component of the assessment.

The fieldwork involved:

- a total of five days of site inspections (over three separate visits) to determine and confirm the potential extent of visibility of the Crookwell 3 Wind Farm and ancillary structures;
- determination and confirmation of the various view categories and locations from which the Crookwell 3 Wind Farm and ancillary structures could potentially be visible; and
- preparation of a record for each view location inspected and assessed.

The LVIA assessed the potential visual impact of the Crookwell 3 Wind Farm for the residential view locations within the 10 km viewshed. In order to provide a representative selection of photomontage, twenty one (21) view locations (A to U) were selected. Originally, twelve (12) locations were selected. An additional nine (9) locations were selected as part of this LVIA (June 2012) for the updated EA. The selected view locations include non-associated residential dwellings and potential dwellings.

These locations were selected to represent a range of distances between the viewpoint and wind turbines between 830 metres and 5.6km to illustrate the potential influence of distance on visibility and resultant visual impact. The LVIA report has also taken into consideration the impacts for motorists travelling along highways and local roads surrounding the wind farm.

9.3 Results

Landscape Character Areas and Sensitivity Assessment

For the purpose of the LVIA, landscape character is defined as *“the distinct and recognisable pattern of elements that occur consistently in a particular type of landscape”* (The Countryside Agency and Scottish Natural Heritage 2002). The LVIA determined that the landscape surrounding the Crookwell 3 Wind Farm has an overall ‘medium sensitivity’ to accommodate change, and represents a landscape that is reasonably typical of landscape character areas that are commonly found in the surrounding regional area of the New South Wales Southern Tablelands and the NSW/ACT Border Region Renewable Energy Precinct.

The report noted that large portions of the Southern Tablelands landscape have been heavily modified by agricultural improvement for pasture and arable production post-European settlement.

This LVIA has determined that *“the Crookwell 3 Wind Farm would not be an unacceptable development within the NSW/ACT Border Region Renewable Energy Precinct”*.

Refer to **Figures 31, 32, 33 and 34 – Photomontage Locations, Existing and Proposed Views** for Locations A (R7 Emohruo non-associated property), B2 (R8 Narangi non-associated property), D (Goulburn to Crookwell Road Corridor) and L (Crookwell to Goulburn Road Corridor) for example photomontages of the existing landscape and proposed landscape views from various locations around the proposed wind farm. Please refer to the LVIA assessment at **Appendix 6** for the full set of photomontages.

Viewshed, Zone of Visual Influence and Visibility

The viewshed for the Crookwell 3 Wind Farm has been illustrated in the LVIA (refer to **Figures 35 – Residential View Locations** and **36 – Public View Locations**) as a series of concentric bands (illustrated at 2km, 3km, 5km and 10km distance offsets) extending up to 10km from the wind turbines. Green Bean Design used a series of panoramic photographs and six Zone of Visual Influence (ZVI) diagrams, within a 10km radius of the wind farm to determine the overall visibility of the Crookwell 3 Wind Farm turbines (refer to **Figure 37 – Zone of Visual Influence Crookwell 3 – Tip of Blade**).



Photomontage Location A - 'Emohruo' non associated property, existing view



Photomontage Location A - 'Emohruo' non associated property, proposed view
Distance to closest turbine 1.2km

Figure 27 -
Photomontage Sheet A2

Crookwell 2
site compound

Pigmans Hill



Photomontage Location B - 'Narangi' non associated property, existing view (B2)

Crookwell 2
site compound

Pigmans Hill



Photomontage Location B - 'Nerangi' non associated property, proposed view (B2)
Distance to closest turbine 1.1km

Figure 29 -
Photomontage Sheet B2

Crookwell Goulburn Road



Photomontage Location D - Goulburn to Crookwell Road (view from road corridor), existing view

Crookwell Goulburn Road



Photomontage Location D - Goulburn to Crookwell Road (view from road corridor), proposed view
Distance to closest turbine 3.7km



Photomontage Location L - Crookwell to Goulburn Road (from road corridor), existing view



Photomontage Location L - Crookwell to Goulburn Road (from road corridor), proposed view
Distance to closest turbine 1.9km

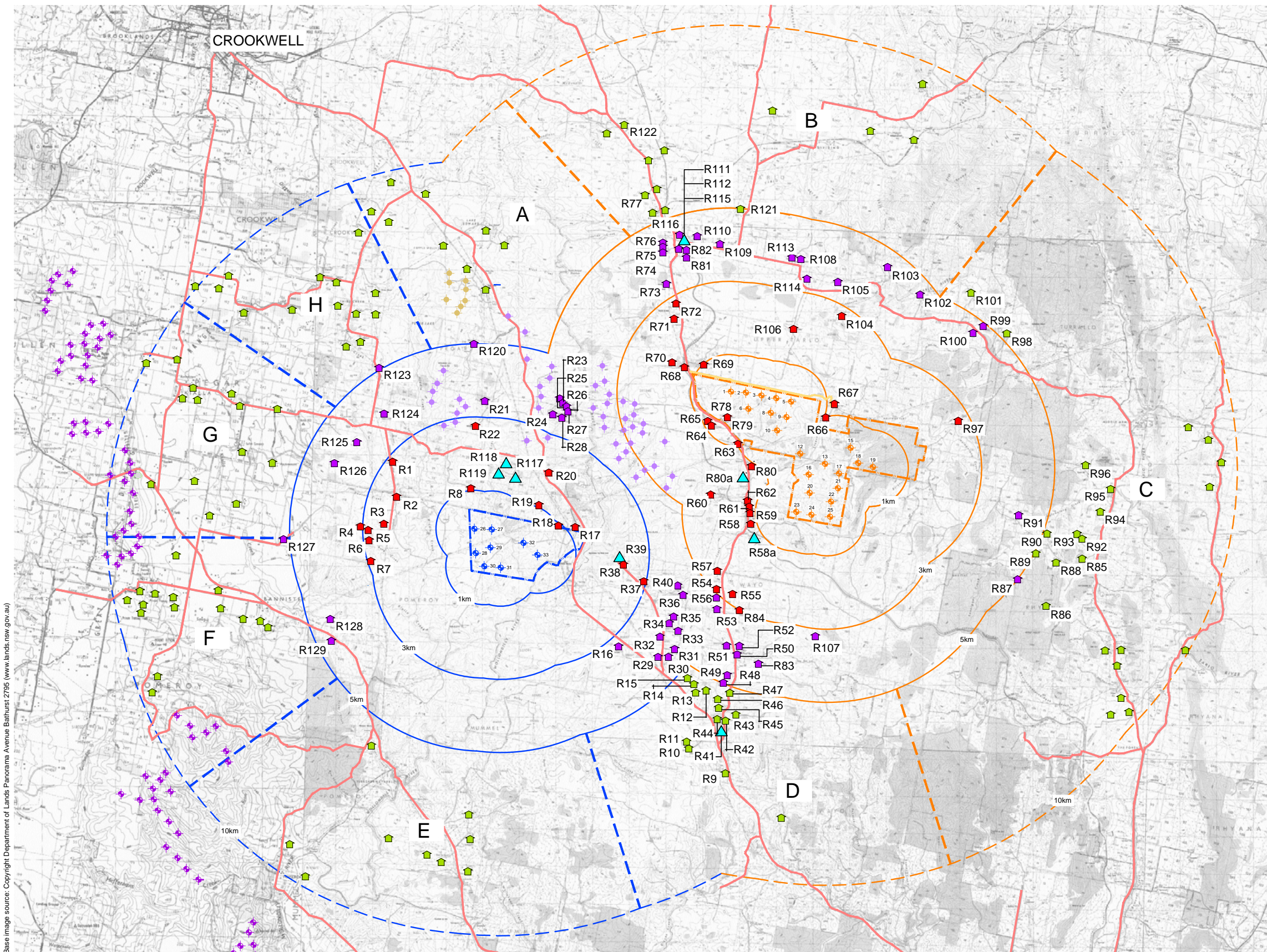
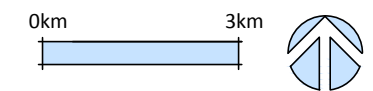


Figure 17
Residential View Locations

Legend

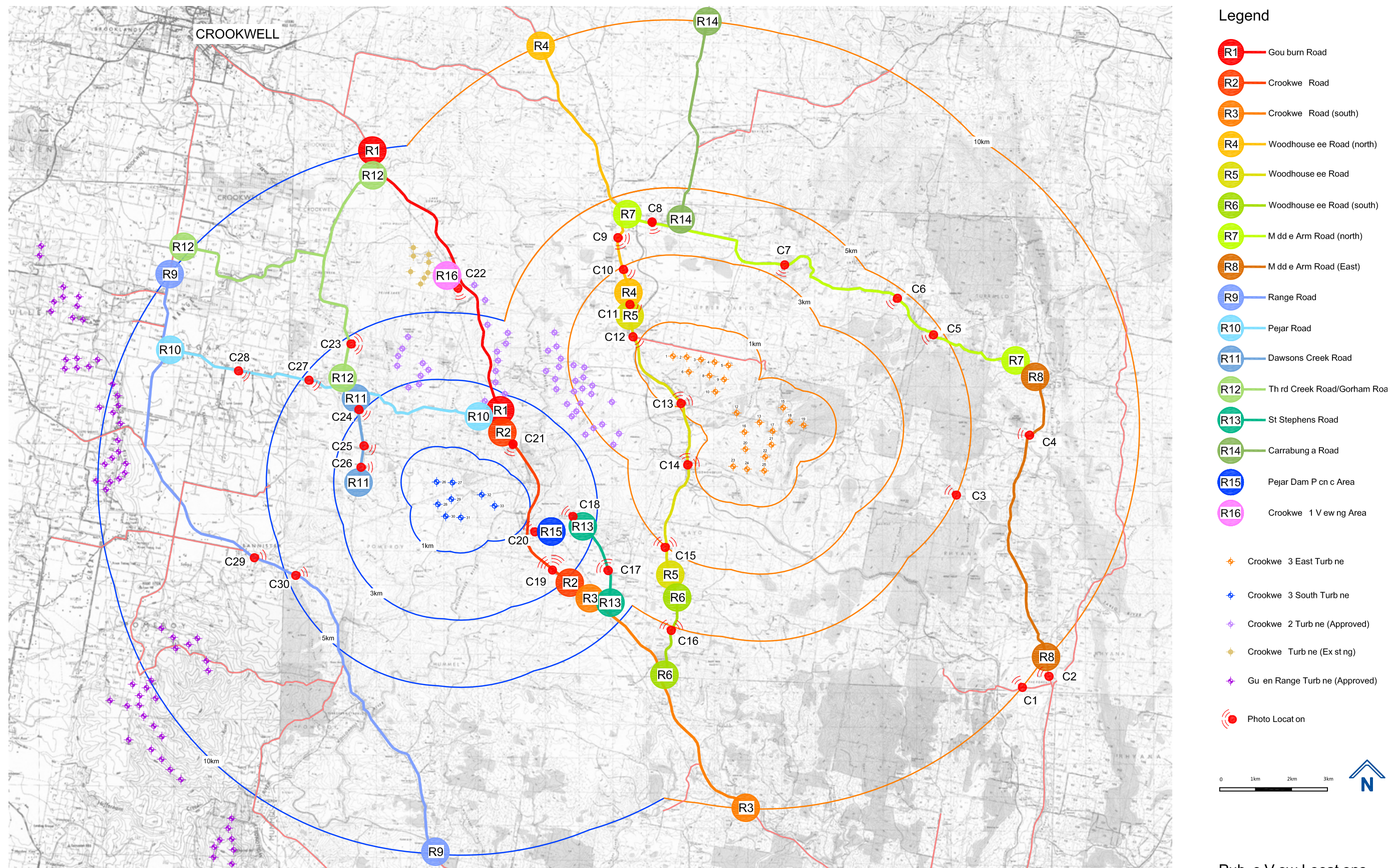
- Residence - within 3km of proposed Crookwell 3 turbines
- Residence - between 3km and 5km of proposed Crookwell 3 turbines
- Residence - between 5km and 10km of proposed Crookwell 3 turbines
- ▲ Potential future or non-residential structure (included in Table 16 - Residential View Location Matrix)
- ★ Proposed Crookwell 3 East Turbine
- ★ Proposed Crookwell 3 South Turbine
- ★ Approved Crookwell 2 Turbine
- ★ Crookwell Turbine (Existing)
- ★ Approved Gullen Range Turbine

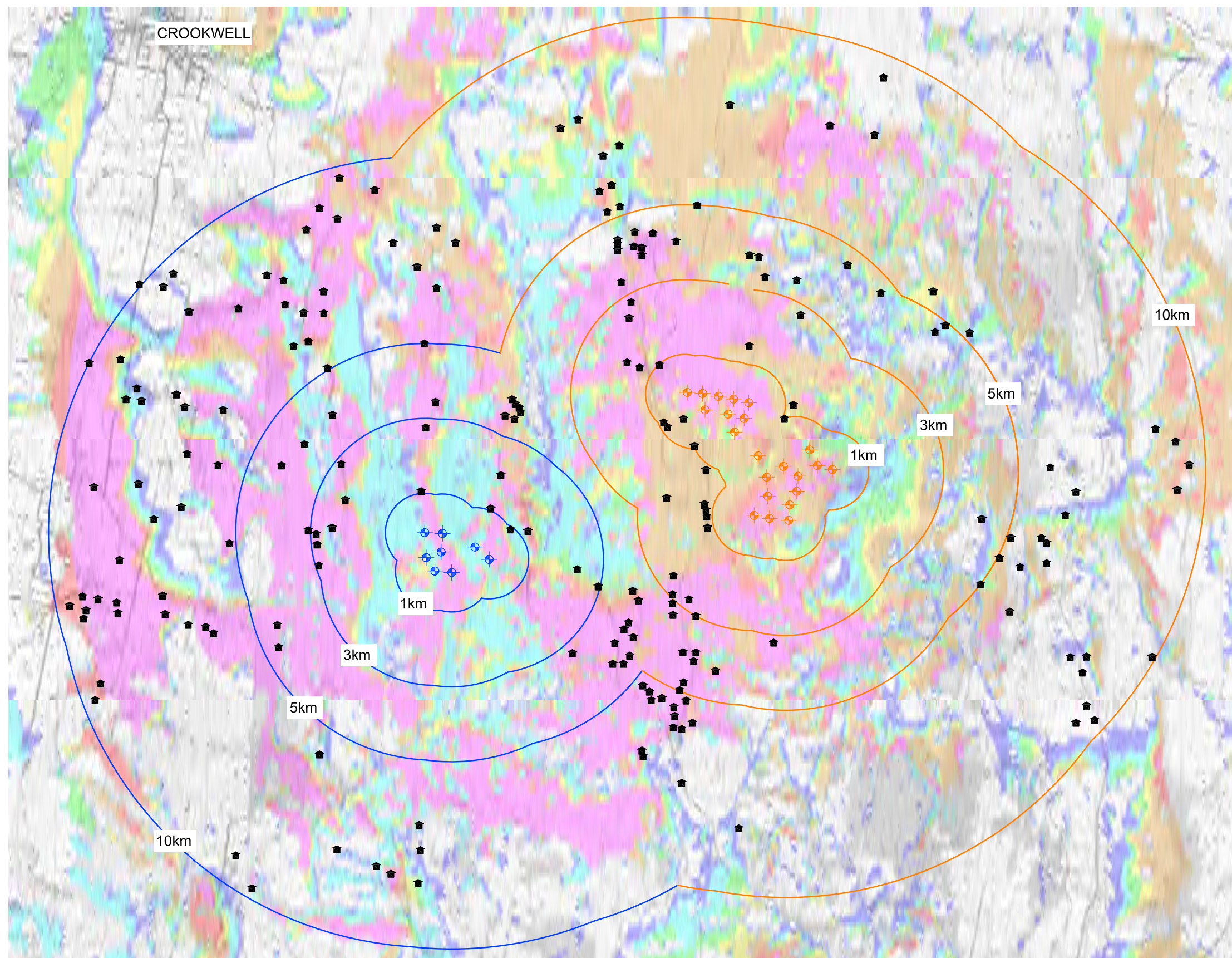


CROOKWELL DEVELOPMENT
PTY LTD



CROOKWELL 3 WIND FARM

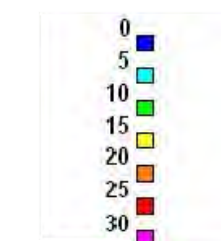




Legend

- Crookwell 3 East Turbine
- Crookwell 3 South Turbine
- Distance offset from Crookwell 3 South
- Distance offset from Crookwell 3 East
- Residence

Legend (ZVI Tips visible)



ZVI Diagram 1
Crookwell 3 - Tip of blade

GREEN BEAN DESIGN
landscape architects

The ZVI diagrams demonstrate the influence of topography on the visibility of the wind farm, and identify areas from which the wind farm would, and would not be visible. The ZVI diagrams and the photomontages also illustrate the extent of intervisibility on the landscape between the proposed Crookwell 3 Wind Farm turbines and the turbines of surrounding wind farms (existing and approved).

The LVIA identified a total of 131 residential view locations within the 5km Crookwell 3 viewshed. However, seven (7) of these view locations were determined to be non-residential structures such as meeting halls, rural fire stations and agricultural structures. An additional 87 residential view locations were identified within the 5km to 10km Crookwell 3 viewshed and were grouped into areas A to H as illustrated in the report (refer to **Figures 35** and **36**).

Table 14 outlines the assessment of residential view locations within the Crookwell 3 wind farm 5km viewshed, and **Table 15** outlines the assessment of residential view locations within the Crookwell 3 Wind Farm 5km to 10km viewshed.

Table 14 – Summary of Visual Impact rating within 5km viewshed

| | Visual Impact Rating within 5km Crookwell 3 viewshed (Total from 124 residential dwellings) | | | | | |
|-------------------|--|------------|-----------------|----------|------------------|----------|
| | Nil | Low | Low to Moderate | Moderate | Moderate to High | High |
| Crookwell 3 South | 71 (57%) | 31 (24.5%) | 5 (4.5%) | 8 (6%) | 7 (5.5%) | 3 (2.5%) |
| Crookwell 3 East | 32 (26%) | 55 (45%) | 10 (8%) | 8 (6%) | 4 (3%) | 15 (12%) |

Table 15 – Summary of Visual Impact rating between the 5km to 10km viewshed

| | Visual Impact Rating within 5km to 10km Crookwell 3 viewshed (Total from 87 residential dwellings) | | | | | |
|-------------------|---|----------|-----------------|----------|------------------|------|
| Areas A to H | Nil | Low | Low to Moderate | Moderate | Moderate to High | High |
| Crookwell 3 South | 30 (34%) | 57 (66%) | - | - | - | - |
| Crookwell 3 East | 87 (100%) | - | - | - | - | - |

The LVIA report concluded that:

- Crookwell 3 East site would have a potential *High* or *Moderate to High* visual impact on 19 residential view locations within the Crookwell 3 Wind Farm 5km viewshed; and
- Crookwell 3 South site would have a potential *High* or *Moderate to High* visual impact on 10 residential view locations within the Crookwell 3 Wind Farm 5km viewshed.

The LVIA found that *“The majority of residential view locations between the Crookwell 3 wind farm 5km and 10km viewshed would experience a Nil to Low visual impact”*.

In terms of potential visual impacts from public locations, the LVIA identified a total of 16 public view locations. Considering the layout options for Crookwell 3 South and East, it was found that:

- *None of the 16 public view locations have been determined to have a High visual impact;*
- *None of the 16 public view locations have been determined to have a Moderate visual impact;*
- *11 of the 16 public view locations have been determined to have a Low visual impact; and*
- *5 of the 16 public view locations have been determined to have a nil visual impact.*

Refer to **Chapter 13 – Shadow Flicker** for further details on potential visual amenity impacts from the Crookwell 3 Wind Farm.

Cumulative Impact Assessment

It is acknowledged that a cumulative landscape and visual impact may result from a wind farm being constructed in conjunction with other wind farm developments in the same area (existing and proposed).

A cumulative visual assessment undertaken by Green Bean Design as part of the LVIA identified three additional current and approved wind farms within the locality of the Crookwell 3 Wind Farm (Crookwell 1, 2 and Gullen Range Wind Farms). The LVIA determined that there would be some intervisibility between proposed Crookwell 3 Wind Farm, and other existing and proposed wind farm turbines within the 10km viewshed (refer to **Figure 38 – Zone of Visual Influence Cumulative Crookwell 1, 2, 3 and Gullen Range – Tip of blade**).

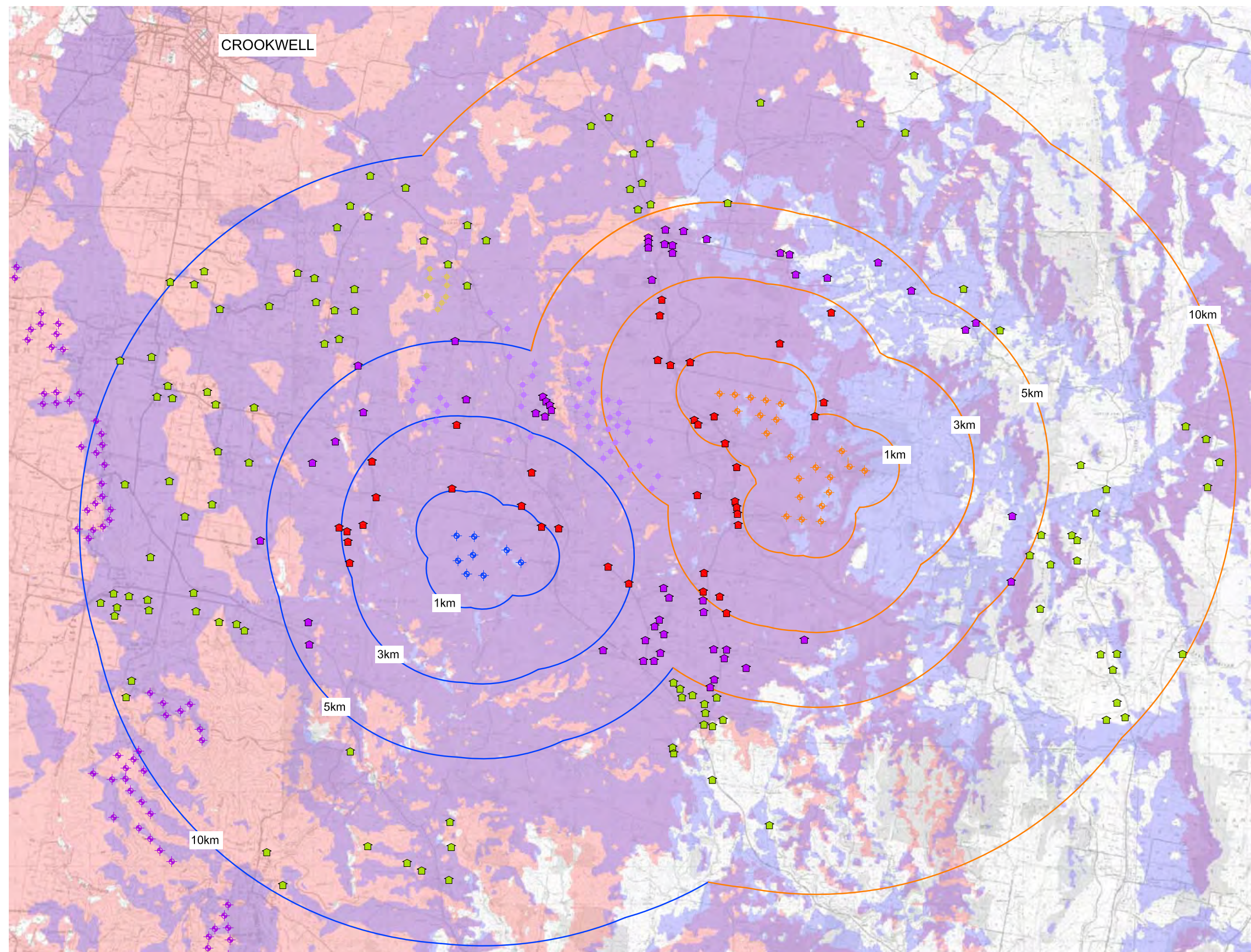
The LVIA notes that:

- *‘Direct’ cumulative visual impacts may occur where two or more wind farms have been constructed within the same locality, and may be viewed from the same view location simultaneously.*
- *‘Indirect’ cumulative visual impacts may occur where two or more wind farms have been constructed within the same locality, and may be viewed from the same view location but not within the same field of view (i.e. the viewer has to turn their head in order to view both wind farms).*
- *‘Sequential’ cumulative visual impacts may arise as a result of multiple wind farms being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which may form an impression of greater magnitude within the construct of short term memory.*

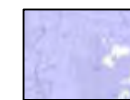
The report found that there are opportunities for ‘direct’ and ‘indirect’ views from residential dwellings, and ‘sequential’ views from some surrounding road corridors between Crookwell 3 and other wind farms, but that *“there is unlikely to be a significant increase in visual impact arising from cumulative impacts”*.

The LVIA report concluded that;

- *Overall, the Crookwell 3 Wind Farm is not considered to significantly increase the magnitude of visual impact for the majority of residential view locations within the Crookwell 3 wind farm 10km viewshed.*
- *The potential for the occurrence of ‘direct’ and ‘indirect’ cumulative visual impact is mitigated to a degree by the screening or partial filtering of views toward approved and existing wind farms.*



Legend



Crookwell 3 South and East ZVI - Tip of blade



Crookwell 1, 2 and Gullen Range Cumulative ZVI - Tip of blade



Crookwell 1, 2, 3 and Gullen Range Cumulative ZVI - Tip of blade

Residence - within 3km of Crookwell 3 turbines

Residence - between 3km and 5km of Crookwell 3 turbines

Residence - between 5km and 10km of Crookwell 3 turbines

Crookwell 3 East Turbine

Crookwell 3 South Turbine

Crookwell 2 Turbine (Approved)

Crookwell Turbine (Existing)

Gullen Range Turbine (Approved)



ZVI Diagram 6
Cumulative Crookwell 1,
2, 3 and Gullen Range

- *Sequential views from local roads would be mitigated to some extent by undulating landform and tree cover alongside road corridors.*

Refer to **Chapter 13 – Shadow Flicker** for further details on potential cumulative visual impacts from the Crookwell 3 Wind Farm and surrounding wind farms.

Night time lighting

The LVIA found that night time obstacle lighting has the potential to create a visual impact (in the event that it was installed) for a small number of residential view locations surrounding the Crookwell 3 Wind Farm. This includes an increased cumulative impact where views extend toward night time lighting on turbines within the approved Crookwell 2 Wind Farm.

The report notes that further to the withdrawal of the CASA Advisory Circular there are no guidelines by which to define criteria for wind farm night time obstacle lighting. The report also considers that a determination has been made that night time obstacle lighting is *not required* for the Gullen Range Wind Farm, and that night time lighting has recently been removed from the Cullerin Wind Farm. These suggest that night lighting of the proposed Crookwell 3 Wind Farm may also not be required.

The categories of potential views that may be impacted by night time lighting generally include residents and motorists.

Visual impacts caused by safety lighting at night would be greater from exterior areas surrounding the residences rather than from within homes, as the LVIA highlights that room lights tend to reflect and mirror internal views in windows, or curtains and blinds tend to be drawn.

The intensity of night time lighting is considered to diminish over 3 to 4km from the lit turbines, and would be more likely to be screened by topography and vegetation surrounding individual residential dwellings.

The report concluded that:

- *Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of public view locations.*
- *The duration of visibility to motorists from local roads would tend to be very short and partially screened by undulating landform along some sections of local road corridors.*

Pre-construction and construction

Temporary works associated with the construction of the wind farm that may be visible during construction and operational phases include:

- crane hardstand areas; and
- mobile concrete batching plant and rock crushing facilities.

The majority of pre-construction and construction activities are temporary in nature and are restricted to various discrete areas within or beyond the immediate wind farm project area. Therefore, *“it is unlikely to result in an unacceptable level of visual impact for their duration and temporary nature”*.

9.4 Mitigation

The mitigation measures outlined in the LVIA are intended to reduce the potential visual impacts of the Crookwell 3 Wind Farm in one of two ways:

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

One of the options available for mitigation of visual impacts to residences is planting vegetation close to the view locations (between the viewing location and the source of intrusion). Similarly, roadside tree planting can screen potential views of turbines from particular sections of road provided the turbine is not located some distance from the road.

The location and design of screen planting used as a mitigation measure is very site specific and requires detailed analysis of potential views and arrangements to be made between an affected land holder and the proponent following the grant of project approval.

The LVIA provides a number of measures to mitigate potential visual impacts of the Crookwell 3 Wind Farm:

- *Consider options for use of colour to reduce visual contrast between turbine structures and background, e.g. use of off white rather than white, and use matt finish to avoid reflected sunlight.*
- *Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.*
- *If necessary, design and construct site control building and facilities building sympathetically with nature of locality.*
- *Consider options for planting screening vegetation in vicinity of nearby residences and along roadsides to screen potential views of turbines. Such works to be considered in consultation with local residents and authorities.*
- *Undertake revegetation and off-set planting at areas around the site in consultation and agreement with landholders.*
- *Enforce safeguards to control and minimise fugitive dust emissions.*
- *Restrict the height of stockpiles to minimise visibility from outside the site.*
- *Minimise activities that may require night time lighting, and if necessary use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the site to minimise glare at night.*
- *Minimise cut and fill for site tracks and revegetate disturbed soils as soon as possible after construction.*
- *Maximise revegetation of disturbed areas to ensure effective cover is achieved.*
- *A careful and considered transmission line route selection process to avoid sensitive view locations and loss of existing vegetation where possible.*

There are also a number of recommendations in relation to turbine characteristics and materials used. These include recommendations of colour, limits to advertising, paint types and limits to night lighting.

Where appropriate, the recommendations made to mitigate the visual impact of the proposed wind farm during the design of the project have been employed, and would continue to be employed during the detailed design of the project.