PHOTOMONTAGE 6. BWF18- Driel Creek Road

PHOTOMONTAGE 6A: Existing view from Driel Creek Road.

PHOTOMONTAGE 6B: Proposed view from Driel Creek Road.

PHOTOMONTAGE 6C: Proposed view zoomed and cropped from Photomontage 6B.

PHOTOMONTAGE 6D: Comparison of backgrounds.

PHOTOMONTAGE 7. BWF19- Wandrona Lane

PHOTOMONTAGE 7A: Existing view from Wandrona Lane.

PHOTOMONTAGE 7B: Proposed view from Wandrona Lane.

PHOTOMONTAGE 7C: Proposed view zoomed and cropped from Photomontage 7B.

PHOTOMONTAGE 7D: Comparison of backgrounds.

PHOTOMONTAGE 8. BWF22- Mudgee Road

PHOTOMONTAGE 8A: Existing view from Mudgee Road

PHOTOMONTAGE 8B: Proposed view from Mudgee Road.

PHOTOMONTAGE 8C: Proposed view zoomed and cropped from Photomontage 8B.

PHOTOMONTAGE 8D: Comparison of backgrounds.

PHOTOMONTAGE 9. BWF24- Mudgee Road

PHOTOMONTAGE 9A: Existing view from Mudgee Road

PHOTOMONTAGE 9B: Proposed view from Mudgee Road.

PHOTOMONTAGE 9C: Proposed view zoomed and cropped from Photomontage 9B.

PHOTOMONTAGE 9D: Comparison of backgrounds.

10.1 SHADOW FLICKER

Shadow flicker is a visual effect that occurs when rotating turbines cause intermittent shadowing as the blades momentarily block the sun's path. The effect will occur under circumstances where the turbine location is such that at certain times of the day the sun's rays pass through the swept area of the rotating blades and affect the viewpoint. The effect is diminished by distance between the turbine and the viewpoint. Shadowing is reduced by increased cloud cover and is dependent on the angle of the suns rays. (Connel Wagner, 2006)

Infigen Energy engaged Aurecon Group to undertake a Shadow Flicker Assessment for the proposed Bodangora Wind Farm (Refer to Appendix A). The zones where there is potential for shadow flicker to occur have been assessed using WindFarmer software. The report was based on a proposal for Bodangora Wind Farm that consisted of 37 turbines, however the current proposal consists of 36 turbines. Whilst the Aurecon report has not been updated the Shadow Flicker diagram has been to remove the deleted turbine.

The shadow flicker study has been undertaken and depicts the worst case scenario with the proposed 36 wind turbines at a height of 150m. Variable factors which may significantly reduce the potential impact of shadow flicker include:

- the direction of the residence relative to the turbine(s);
- the distance from the turbine(s);
- the turbine hub-height and rotor diameter;
- the time of year;
- the proportion of day-light hours in which the turbines operate;
- the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon); and,
- the prevailing wind direction. (Planning NI)

Local influences including screen planting should also be considered when assessing the potential shadow flicker resulting from the proposed development.

Example of shadow intensity variation with distance & turbine blocking small proportion of sunlight. (Source: Aurecon, 2011).

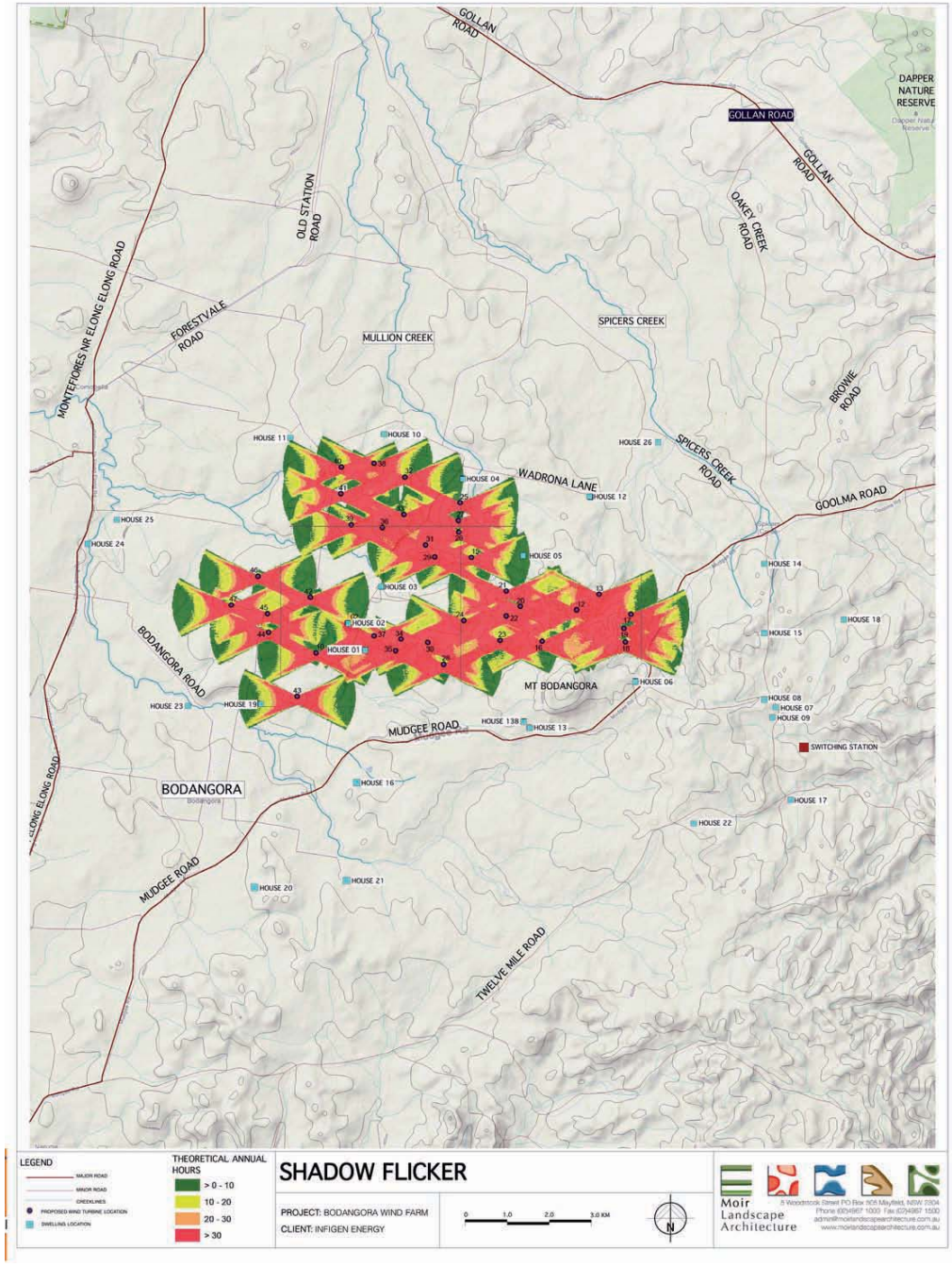

FIGURE 17: Shadow Flicker (Adapted from assessment by Aurecon, 2011).

10.1.1 Shadow Flicker Assessment Results- Homesteads

Overall the shadow flicker effects caused by the poposed Bodangora Wind Farm are minimal due to the location of the wind turbines in relation to nearby residential properties. Figure 17 shows the extent of shadow flicker as assessed by Aurecon.

The analysis found that only five homesteads will experience shadow flicker as a result of the proposed wind farm (refer to Table 14). All five of the properties likely to be affected by the shadow flicker produced by Bodangora Wind Farm are involved landowners. Although there is currently no standard relating to the appropriate limits for shadow flicker effectsa commonly applied limit used around the world is 30 hours per year and 30 minutes per day, based on worst case scenario. Of these five homesteads a few houses (house 04, house 05 and house 19) have shadow flicker durations that are under the appropriate limit. Two houses (house 01 and house 02) have shadow flicker durations that exceed the appropriate limits. These calculations are based on topography and local influences such as screen planting and locations of windows would significantly reduce the affect.

The proposed limit of acceptable shadow flicker duration is aimed at protecting the public. Higher limits may be acceptable to landowners involved in the project who will potentially experience shadow flicker. In addition, local influences such as screen and foreground planting are not taken into account when developing the shadow flicker analysis. Mitigation methods including screen planting would significantly reduce any potential annoyance resulting from shadow flicker.

10.1.2 Shadow Flicker Assessment Results- Public Roads

Due to the nature of the Study Area, there are a number of unsealed minor local roads running through the Site. Driel Creek Road and Gillinghall Road will both potentially be affected by shadow flicker. A small section of Mudgee Road to the north east of Mount Bodangora will also be affected by shadow flicker.

There is a negligible risk assciated with distraction of motorists who experience shadow flicker. The effects of shadow flicker are similar to the phenomenon created when a vehicle in motion passes a static object eg. travelling along a tree lined road.

Example of shadow flicker created by shadows from trees along roads.

RESIDENT	INVOLVED LANDOWNER	SHADOW DURATION (HOURS PER YEAR)	SHADOW OCCURENCE (DAYS PER YEAR)	MAX DAILY SHADOW DURATION (MINS PER DAY)
House 01	YES	32.3	78	43.0
House 02	YES	30.7	103	30.0
House 03	YES	0.0	0	0.0
House 04	YES	2.6	20	11.0
House 05	YES	4.7	24	16.0
House 06	YES	0.0	0	0.0
House 07	YES	0.0	0	0.0
House 08	YES	0.0	0	0.0
House 09	YES	0.0	0	0.0
House 10	YES	0.0	0	0.0
House 11	NO	0.0	0	0.0
House 12	NO	0.0	0	0.0
House 13	NO	0.0	0	0.0
House 13B	NO	0.0	0	0.0
House 14	NO	0.0	0	0.0
House 15	NO	0.0	0	0.0
House 16	NO	0.0	0	0.0
House 17	NO	0.0	0	0.0
House 18	NO	0.0	0	0.0
House 19	YES	11.5	34	26.0
House 20	NO	0.0	0	0.0
House 21	NO	0.0	0	0.0
House 22	NO	0.0	0	0.0
House 23	NO	0.0	0	0.0
House 24	NO	0.0	0	0.0
House 25	NO	0.0	0	0.0
House 26	NO	0.0	0	0.0

TABLE 14: Homesteads affected by Shadown Flicker (As assessed by Aurecon, 2011)

10.2 BLADE GLINT & REFLECTIVITY

Blade Glint 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 occurrence of blade glint depends on a number of conditions including the orientation of the nacelle, angle of the blade, and the angle of the sun.
(Aurecon, 2009)

At present there are no formal regulations or guidelines in NSW pertaining to Blade Glint. However the Victorian Wind Farm Guidelines proposes the following recommendations for managing blade glint.

- Blades should be finished with a surface treatment of low reflectivity to ensure that glint is minimised.
- Blade glint can be effectively and cost effectively managed through the use of matt coatings on the turbine blades and, if so done, is not considered to be a visual impact.

Implementation of these recommendations should result in the mitigation of any actual or perceived impact.

10.3 NIGHT LIGHTING

Night lighting of the wind turbines would potentially result in the alteration of the night time landscape character of the region. The Civil Aviation Safety Authority (CASA) advisory circular provides recommends for obstacle marking and lighting of wind farms. The CASR 139.365 'requires a person proposing to construct a building or structure, the top of which will be 110m or more above ground level, to inform CASA of that intention'. Once notified of the proposal the CASA conducts an aeronautical study to determine whether the proposal will be a hazard to aviation.

Generally the minimal level for flight by civil aircraft is determined by the CASA at 152 metres above ground level. As the proposed Bodangora Wind Farm will be at a maximum height of 150 metres, there will be external night lighting of the wind turbines. Low intensity security night lighting may be required on associated infrastructure unless otherwise agreed by the Director General or required by CASA.

Existing night time illumination originates from isolated homesteads and motorists travelling along local roads. As night lighting will not be an used on the Wind Farm turbines it should not be perceived a visual issue for this development.

11.1 CUMULATIVE VISUAL IMPACT

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 (The Landscape Institute et al 2008). Cumulative effects may also affect the way a landscape is experienced and can be positive or negative. Where they compromise benefits, they may be considered to form part of the mitigation measures.

The 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."

The landscape and visual assessment for the proposed Bodangora Wind Farm needs to consider the cumulative effects on the immediate and broader regional context it is part of. The proposal needs to take into account change of landscape character and the potential for the receiving landscape to accommodate the change.

The review of the cumulative impact 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.

The cumulative visual impact can be determined by the distance of the proposal to other developments (proposed or existing). The EPHC defines the potential cumulative visual impact with the following distances:

<3 km = High Visual Impact

6 km = Medium Visual Impact

> 12 km = Low Visual Impact

These distances have been mapped on figure 15.

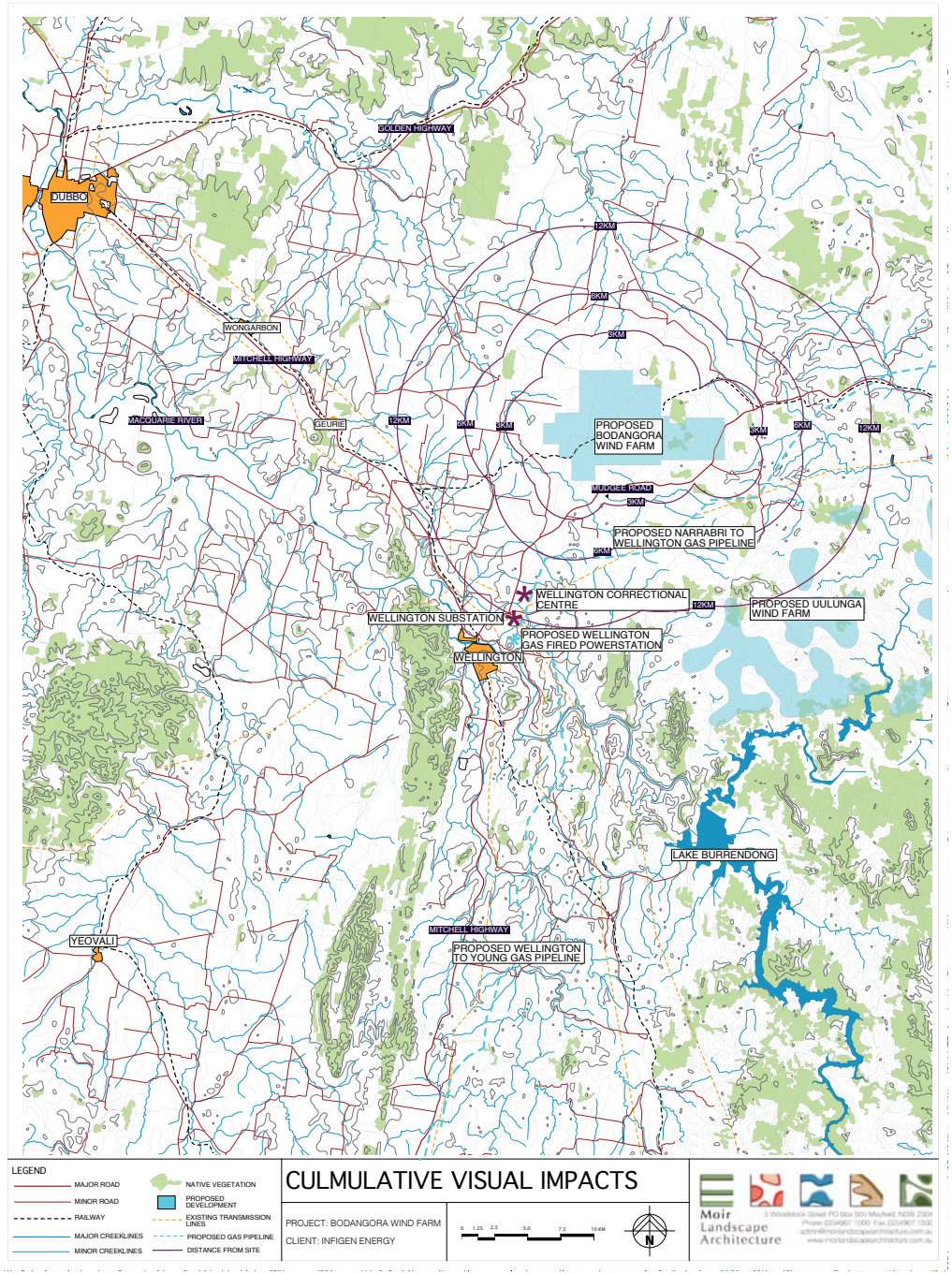

FIGURE 18: Culmulative Visual Impact

11.0 CULMULATIVE VISUAL IMPACT

11.1.1 Existing development in the region

Currently, the landscape is a predominantly rural landscape with infrastructure associated with nearby towns extending into the surrounding landscape. Travelling along Mudgee Road towards Wellington a combination of developments have altered the appearance of the natural landscape. Transgrid's Wellington Substation is a high voltage 330kV / 132kV substation located 2.4 km north east of Wellington on Mudgee Road. Associated with the Wellington Substation, a number of high voltage power lines run through the landscape servicing the region. Wellington Correctional Centre is also sited on Mudgee Road approximately 5.5 km north east of Wellington along the Mudgee Road. Both of these developments are partly concealed from view by screen planting.

11.1.2 Proposed local developments

In addition to the Bodangora Wind Farm project there are a number of projects proposed and awaiting approval, that may commence works in the near future. (As shown in figure 18)

Proposed projects in the area (as of September, 2011), include:

- Uungula Wind Farm (DGRs Issued)
- Narrabri to Wellington Gas Pipeline (DGRs Issued)
- Young to Wellington Gas Pipeline (Approved)
- Wellington Gas-Fired Power Station (Construction to commence 2012)

A plan showing the location of these proposed projects is included as Figure 18 of this report.

UUNGULA WIND FARM

An application was submitted to the Department of Planning for proposed Uungula Wind Farm in March 2011 and DGRs have since been issued to the developer. The Uungula Wind Farm proposes approximately 330 wind turbines and associated infrastructure located to the south of Mudgee Road on land surrounding Uungula.

WELLINGTON GAS FIRED POWER STATION & GAS PIPELINES

ERM Power gained approval to construct a 600 megawatt gas fired power station north of Wellington adjacent the existing Transgrid Substation. In addition to this application, ERM Power have also proposed the construction of a 219 kilometre natural gas pipeline from the Young gas hub centre to gas power station. Eastern Star Gas have also proposed to supply a natural gas pipeline from the Narrabri Coal Seam Gas Project to the Wellington Gas Fired Power Station. The cumulative visual impact resulting from these proposed developments would be insignificant.

11.1.3 Cumulative effects of existing and proposed wind farms in the region

The main cumulative impact of the multiple wind farm developments of the area is likely to be related to the visual impact. The visual impact will be greater at vantage points from which more than one development is visible.

The Uungula Wind Farm is in some areas within 12km of the proposed Bodangora Wind Farm resulting in a low cumulative visual impact. As the proposals are separated by a distance of approximately 10 km at their closest point it is unlikely that receptors will view both developments in combination.

The proposed developments may be viewed in succession as travellers move through the landscape. This may occur for motorists travelling through the landscape however this will result in what is recognised as a perceived cumulative visual impact. A perceived visual impact results from the reoccurrence of wind farms or similar scaled infrastructure / developments within a particular region that changes the perspective of the overall landscape character (EPHC).

11.1.4 Limitations on broad scale expansion

The landscape of the area allows for optimum harvest of wind energy. There are minimal obstructions in the landscape and smooth topography and easy access to the grid which is beneficial to the output of a wind farm. However it is conceivable that if wind farms in the local area where to become more prevalent, the spatial and landscape separation between the farms would decrease, resulting in limitations for continued development.

The factors which will potentially constrain wind farm development in the area include:

- Topography
- Lake Burrendgong as an area of regional significance
- National Parks
- Town centres and associated developed areas

12.0 SUMMARY OF VISUAL IMPACT

12.1 OVERVIEW OF VISUAL IMPACT

In addition to the viewpoint assessment and zone of visual influence analysis, the following provides an overview of the potential visibility from residence and roads surrounding the site. The analysis of the visibility from nearby residence has been undertaken using the receptors identified by Infigen within close distance of the project site (See figure 19).

An analysis of these individual receptors was undertaken using a combination of the zone of visual influence, aerial photography and topographic maps. This analysis has been used to provide an overview of the potential visual impact from these public and private receptors and assist in developing mitigation methods. Receptors identified as having a moderate to high visual impact were assessed in further detail during the field work and viewpoint analysis process.

12.2 NEARBY RESIDENCES

A total of 26 homesteads located within close proximity (within 6km) of the proposed wind turbines (refer to Figure 19) have been assessed as part of the visual impact assessment. These residents have been identified by Infigen as receptors for assessment due to variations in the distance and viewing direction.

Due to the predominantly rural land use of the area residential properties are generally remotely situated on unsealed minor roads from Mudgee Road and to the south of Mudgee Road. Tables 16 and 17 on the following pages assess the visual impact from these residences based on the distance from the proposed wind turbines taking into account topography, existing vegetation and screen planting. It is important to note these assessments have been undertaken with the aid of aerial photographs and topographic maps and therefore provide a general assessment. Further assessment was undertaken during field work from residences with a visual impact exceeding low.

Of the 26 receptors assessed, (of which 12 are involved landowners), the proposed wind turbines will not be visible from 9 receptors. A total of 13 residences assessed will have a low visual impact. Three residences were identified as having a moderate visual impact, however two of these were involved landowners.

Of all the receptors assessed, only one non-associated residence (house 11) is located within 2km of the proposal. Although located within close proximity to the proposed wind farm, the residence is orientated to the west and views of the wind farm will be minimal. A slight rise in topography to the south east of the homestead and an extensive group of native vegetation will reduce views of the proposal to filtered glimpses. The visual impact from this viewpoint was assessed as low - moderate, however it is likely with proposed mitigation methods, this would be significantly reduced.

Views from houses located along Mudgee / Goolma Road (Houses 16, 13, 13B and 14) are generally screened by a combination of low rises in topography and screen planting surrounding the properties. Views from houses to the south of Mudgee / Goolma Road are generally contained by the undulating topography typical of the area. Due to both the sloping topography and low fertility of soils the area remains generally uncleared and vegetation assists in screening views.

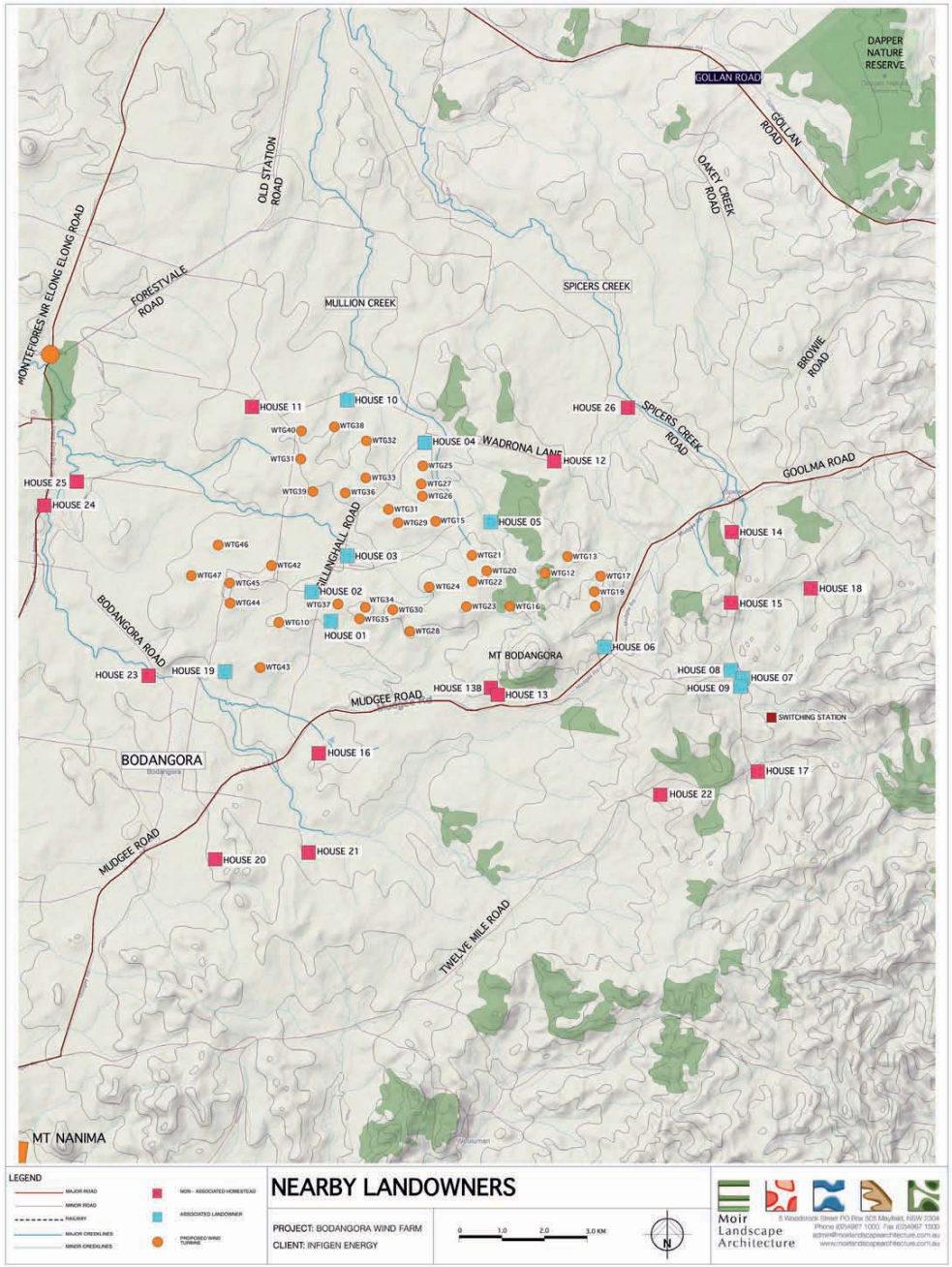

FIGURE 19: Residence within close proximity of the Site.

12.2.2 Summary of visibility from nearby residences

RESIDENT	INVOLVED LANDOWNER	ADDRESS	DISTANCE TO NEAREST WIND TURBINE	NUMBER OF VISIBLE WIND TURBINES **BASED ON TOPOGRAPHY	POTENTIAL ISUAL IMPACT	COMMENTS
House 01	YES	362 Gillinghall Road, Bodangora	0.458 km	40%	LOW	Views from House 01 are generally contained to the north by a rise in topography. Due to the close proximity of the proposed wind turbines, approximately 40% are visible to the east and west. Screen planting surrounding the house will obstruct views of the proposed wind turbines. (Note: Associated Landowner)
House 02	YES	776 Driell Creek Road, Bodangora	0.818 km	100%	LOW	Dense screen planting surrounds the property in all directions. Views of the proposed wind turbines would be significantly impeded by the dense vegetation. (Note: Associated Landowner)
House 03	YES	540 Gillinghall Road, Bodangora	1.383 km	100%	MODERATE	Roadside vegetation associated with Gillinghall Road and screen planting surrounding the homestead would obstruct views to the proposed turbines to the west. Some isolated planting to the north, south and east would reduce the visual impact from the homestead. (Note: Associated Landowner)
House 04	YES	944 Gillinghall Road, Bodangora	0.670 km	60%	LOW	Homestead is orientated to the north in the away from the proposed wind turbines. Dense screen planting surrounds the east and south of the residence in the direction of the wind turbines, significantly reducing potential views. (Note: Associated Landowner)
House 05	YES	540 Gillinghall Road, Bodangora	1.090 km	80%	MODERATE	Existing screen planting and ancillary buildings impede views to the south east. Wind turbines to the west will have a moderate visual impact, however established screen planting on the western edge of the homestead will significantly reduce the impact. (Note: Associated Landowner)
House 06	YES	4460 Goolma Road, Spicers Creek	1.098 km	40%	LOW	Homestead is sited on a local rise in topography with expansive views to the south east over Mudgee Road. Views are contained within the homestead by a combination of dense screen planting vegetation and retained native vegetation. (Note: Associated Landowner)
House 07	YES	480 Gunnegalderie Road, Spicers Creek	4.526 km	-	-	Views are contained from this homestead by retained native vegetation. Some filtered views of the proposed over head power lines may be visible to the south west. (Note: Associated Landowner)
House 08	YES	480 Gunnegalderie Road, Spicers Creek	4.196 km	-	-	Views towards the proposed wind turbines are interfered by both undulating topography and retained native vegetation surrounding the homestead. The proposed over head power line may be visible from the residence, however it will appear as a small element of the landscape. (Note: Associated Landowner)
House 09	YES	480 Gunnegalderie Road, Spicers Creek	4.581 km	-	-	A local rise to the east of the property impedes views towards the proposed wind turbine. Screen planting along the south west of the homestead will screen views of the proposed over head power lines. (Note: Associated Landowner)
House 10	YES	1460 Driell Creek Road, Bodangora	0.866 km	80%	NIL - LOW	An extensive coverage of established vegetation surrounds the homestead containing views. It is unlikely any of the proposed wind turbines would be visible from this residence. (Note: Associated Landowner)
House 11	NO	524 Runicimans Lane, Comobella	2.096 km	80%	LOW	Residence appears to be orientated away from the proposed wind farm with expansive views to the west. Woodland vegetation to the east would screen views of the proposed wind turbines.
House 12	NO	280 Wadrona Lane, Spicers Creek	2.714 km	20%	NIL - LOW	Views to the south are largely concealed by a local rise in topography densely covered by native woodland vegetation. It is unlikely the proposed wind turbines will result in a significant visual impact from this residence.
House 13	NO	5008 Goolma Road, Bodangora	2.410 km	-	-	Views to the north are contained by sloping topography associated with Mount Bodangora. Dense screen planting surrounds the property and no visual impact will result from the development from this receptor.
House 13B	NO	5008 Goolma Road, Bodangora	2.269 km	20%	NIL - LOW	Views of several of the proposed wind turbines may be available to the east, however native woodland vegetation in the foreground would significantly lower the extent of visibility. A local rise in the topography to the north east of the residence obstructs most views of the proposed wind farm.

TABLE 16: Summary of nearby residences (Houses 01- 13B)

**Note: Number of visible turbines is based on topographic mapping alone and is worst case scenario. Views are based on the height of the wind farmand does not allow for existing screening by vegetation or buildings.

12.2.2 Summary of visibility from nearby residents (continued)

RESIDENT	INVOLVED LANDOWNER	ADDRESS	DISTANCE TO NEAREST WIND TURBINE	NUMBER OF VISIBLE WIND TURBINES **BASED ON TOPOGRAPHY	POTENTIAL VISUAL IMPACT	COMMENTS
House 14	NO	430 Budgalong Road, Spicers Creek	3.891 km	-	-	In addition to dense screen planting surrounding the house, an extensive coverage of vegetation dominates the local rise in topography to the east of the property, containing views to the east towards the proposed wind farm.
House 15	NO	165 Budgalong Road, Spicers Creek	3.704 km	-	-	Homestead is surrounded by a large extent of native woodland vegetation, containing views from the homestead. Combined with the topography, the proposed wind farm will have no visual impact from this receptor.
House 16	NO	5609 Goolma Road, Bodangora	2.774 km	80%	NIL - LOW	Views of the proposed win turbines are significantly obstructed by native vegetation. Some filtered views of the proposed wind turbines may be visible to the north, however for the most part the wind turbines will not be noticable.
House 17	NO	2204 Twelve Mile Road, Spicers Creek	6.372 km	-	-	Views are contained by a small ridge line to the east of the property. There will be no visual impact resulting from the proposed wind turbines from this receptor.
House 18	NO	3931 Goolma Road, Goolma	5.866 km	-	-	A large ridge in the foreground screens views to the west from this residence, completely obstructing views to the proposed wind farm.
House 19	YES	530 Driell Creek Road, Bodangora	1.034 km	20%	NIL - LOW	Topography obstructs views to the majority of proposed wind turbines. In addition, extensive retained vegetation surrounding the homestead would screen views of the wind turbines. (Note: Associated Landowner)
House 20	NO	1021 Twelve Mile Road, Wuuluman	5.388 km	20%	NIL - LOW	Homestead is orientated in a northern direction and views from the property are screened by a band of dense screening vegetation. Some filtered views may be available from the property.
House 21	NO	182 Inverness Lane, Bodangora	5.139 km	80%	LOW	Homestead is located on an elevated slope and orientated to the north looking towards the proposed wind turbines. A number of filtered views would be available through screen planting surrounding the residence. Due to the distance from the site visible turbines would form only a small visual element of the landscape.
House 22	NO	2077 Twelve Mile Road, Spicers Creek	5.422 km	-	-	Views towards the proposed wind turbines are interfered by both undulating topography and retained native vegetation surrounding the homestead. There will be no visual alteration to the landscape from this viewpoint.
House 23	NO	1198 Bodangora Road, Bodangora	2.913 km	-	-	Homestead is located within close proximity to the proposed wind turbines, however due to the dense screening vegetation surrounding the hosue, it is unlikely there will be any significant visual alteration to the landscape from this house.
House 24	NO	1556 Cobbora Road, Comobella	4.742 km	-	-	Dense vegetation surrounds the homestead, containing views to the surrounding landscape. The proposed wind turbines will not be visible from this house.
House 25	NO	1632 Cobbora Road, Comobella	4.264 km	10%	NIL - LOW	Homestead appears to be orientated towards the proposed wind turbines, however dense vegetation would obstruct most views. Some filtered views may be available, however these would be limited.
House 26	NO	397 Spicers Creek Road, Spicers Creek	4.451 km	-	-	From this homestead it is unlikely any of the wind turbines would be visible due to the dense vegetation that surrounds the house.

TABLE 17: Summary of nearby residents (Houses 14 - 26)

**Note: Number of visible turbines is based on topographic mapping alone and is worst case scenario. Views are based on the height of the wind farmand does not allow for existing screening by vegetation or buildings.

12.3 NEARBY ROADS

12.3.1 Summary of visibility from nearby roads

MAJOR TRAVEL CORRIDORS

There are four major travel corridors within the study area, including Mudgee Road, Mitchell Highway, Gollan Road and Montefiores Nr Elong Elong Road. Of these four roads the proposed wind turbines would have glimpse views from Mudgee Road and Monte Fiores Nr Elong Elong Road. The proposed wind turbines have the potential to be noticed travelling along these roads due to the close proximity and potential number of visible turbines. However due to the speed of travel along both Mudgee Road and Monte Fiores Nr Elong Elong Road, direction of travel, and local influences including roadside vegetation the proposed wind turbines are likely to have a very low visual impact.

LOCAL ROADS

Local roads within the Study Area have been identified as Bodangora Road, Comobella Road, Gillinghall Road and Forestvale Road. These roads have a low frequency of use, and are generally utilised by local residents and agricultural vehicles. Of the local roads assessed, Gillinghall Road had the highest potential visual impact (moderate) as the road runs through the centre of the proposed wind farm. The potential visual impact from Bodangora road was assessed as low as the period of view was short term due to the direction of travel, distance of travel and local influences such as roadside planting.

UNSEALED MINOR ROADS

A number of unsealed minor roads run through the study area. As there is a low frequency of use and short period of view from these roads, visual impact from these roads is predominately low. Unsealed minor roads that were assessed include: Spicers Creek Road, Oakey Creek Road, Driel Creek Road, Old Station Road and Gunnegalderie Road. Of these road, Driel Creek Road had the highest visual impact (moderate).

12.4 SUMMARY OF VISUAL IMPACT

Wind turbines create a strong contrast in the landscape as a result of their large scale and lack of visual integration. The visual effects of the wind turbines are lessened as the distance of the vantage point from the Site is lengthened.

The proposed wind turbines are located within rural land occupied by a small number of isolated properties. Due to the large scale and significant contrast to the rural landscape, the proposed turbines become a dominant feature of the landscape when viewed within a close proximity. However, as the distance between the viewer and the proposed development increases the visual impact decreases.

The highest visual impact of the proposed development is felt within a 2km radius of the wind farm. There are a number of homesteads located within 2km of the wind farm, however all except one of these residents are associated landowners. The visual impact from each homestead varies depending on the orientation of the house, and local landscape features (eg. screen planting, small rises in topography).

The topography surrounding the wind turbines significantly alters the visibility of the proposed development from many vantage points. There are limited areas within the local area from which the proposed wind farm can be viewed from a short range in its entirety. As the viewer distance is extended (eg. from Mitchell Highway, Forestvale Road) the entire project is visible, however it becomes smaller in scale and hence becoming a less significant visual element within the landscape.

Land to the south of Mudgee Road is generally undulating and views tend to be limited by rises in topography. Retained vegetation is a character of the landscape in this area and when planting occurs in the foreground of the viewing location the vegetation screens views.

12.2.2 Summary of visibility from nearby roads

LOCATION	DISTANCE TO NEAREST WIND TURBINE	PERIOD OF VIEW	POTENTIAL VISUAL IMPACT	VIEWING CONTEXT / SCREENING FACTORS
MAJOR TRAVEL CORRIDORS				
MUDGEE ROAD	0.66 km	Very Short Term	LOW	A combination of dense roadside vegetation, topography and the direction of travel screen views for the majority of Mudgee Road. In addition the period of view is very short term due to the speed of travel along Mudgee Road. Glimpse views may be available, however they will be fleeting and typically out of the drivers sight.
MITCHELL HIGHWAY	11.88 km	-	-	It is unlikely views of the proposed wind turbines will be noticeable from the Mitchell Highway. A combination of distance from the site, speed of travel and the direction of travel will prevent views.
GOLLAN ROAD	13.20 km	-	-	Dense roadside vegetation along the majority of Gollan Road will obstruct views of the proposed wind turbine.
MONTE FIORES NR ELONG ELONG ROAD	4.27 km	Very Short Term	NIL - LOW	Some glimpse views of the proposed wind farm may be available from Monte Fiores Elong Elong Road however these will be very short term and potentially unnoticeable to motorists travelling along the road at the permissible speed limit.
LOCAL ROADS				
BODANGORA ROAD	2.49 km	Short Term	LOW	Travelling south east along Bodangora Road the proposed wind turbines will be visible beyond the topography to the east. The short distance of travel along the road combined with the roadside planting associated with Mitchell Creek results in a short term period of view. The visual impact for motorists travelling along Bodangora Road has been assessed as low.
COMOBELLA ROAD	5.30 km	Very Short Term	NIL - LOW	Comobella Road runs in an east - west direction towards the proposed wind farm. Travelling west away from the wind farm the direction of travel prevents views of the site. Travelling east towards the site, vegetation becomes dense and any potential views would be limited to glimpses.
GILLINGHALL ROAD	0.45 km	Short Term	MODERATE	Gillinghall Road is a local road servicing isolated homesteads and providing access to unsealed minor farm roads. Gillinghall Road runs through the centre of the proposed wind farm, however the period of view is short term due to the short distance. The potential visual impact has been assessed as moderate.
FORESTVALE ROAD	5.48	Very Short Term	NIL - LOW	A combination of the speed of travel, direction of travel and period of view results in a minimal visual impact from Forestvale Road.
UNSEALED MINOR ROADS				
SPICERS CREEK ROAD	4.79	Short Term	LOW	Spicers Creek Road roughly follows Spicers creek to the north east of the site. Views of the proposed wind farm would be limited to glimpses due to distance and the direction of travel. The road is used intermittently by local residents and farm vehicles. Some riparian vegetation towards the southern end of the road screens views of the site.
OAKEY CREEK ROAD	8.42 km	Very Short Term	NIL - LOW	The proposed wind turbines would be unnoticeable from Oakey Creek Road due to distance and existing roadside planting. The road is isolated used very infrequently. The visual impact for the road has been assessed as nil to low.
DRIEL CREEK ROAD	0.15 km	Short Term	MODERATE	Driel Creek Road runs through the centre of the proposed wind farm and is used intermittently by local residents. The wind turbines are located as close as 150m from the road, however as the period of view would be short term fro motorists travelling along the road and some existing woodland vegetation would obstruct some views, the potential visual impact has been assessed as moderate.
OLD STATION ROAD	7.22 km	Very Short Term	NIL - LOW	It is unlikely views to the proposed wind turbines will be available from Old Station Road. Dense roadside vegetation, direction of travel and distance from the site result in a nil to low visual impact.
GUNNEGALDERIE ROAD	1.57 km	Very Short Term	NIL - LOW	Travelling in a northern direction along Gunnegalderie Road glimpses of several of the proposed wind turbines may be visible, however a combination of the roadside vegetation and short period of view result in a nil - low visual impact.

TABLE 18: Summary of nearby roads

13.0 COMMUNITY PERCEPTION

13.1 COMMUNITY PERCEPTION

Research from previous projects, both national and international has found that community perceptions and general acceptance of wind farms varies greatly. Viewers perception to cultural and natural elements is difficult to define and can differ on the basis of a variety of elements eg. whether the viewer is a resident or a visitor.

According to Gipe (1995) 'People unconsciously realise that opposition on aesthetic grounds is subjective, and is therefore, often dismissed by public officials. Opinion shapes policy and aesthetics or how the public views the wind industry, shapes opinion. Stanton (1995) puts forward that wind farms should not be judged solely on their visual properties ; indeed, they may be greatly valued for other qualities, such as what they symbolise.

As visual resources belong to the public it is of upmost importance to utilize guidelines derived from background research and past experience to ensure the outcomes contribute positively to the evolving landscape character of the area.

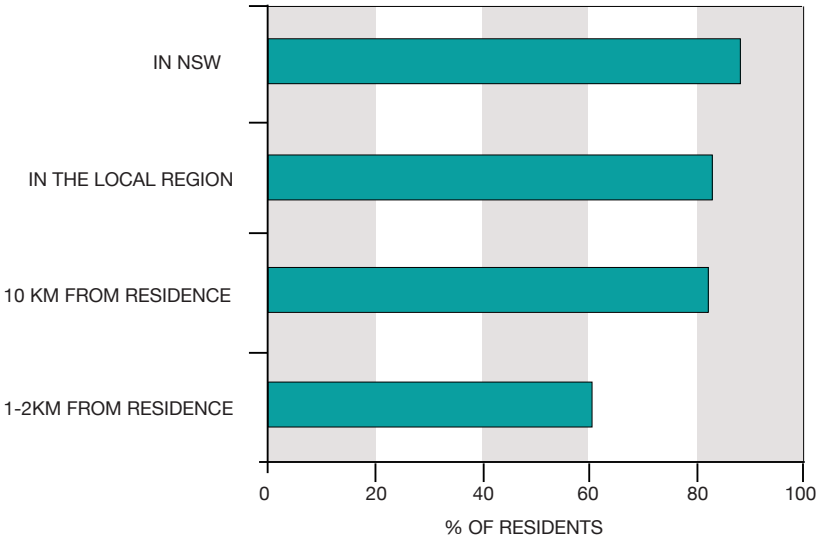

FIGURE 20: Support for wind farms in NSW (EPHC)

13.2 COMMUNITY CONSULTATION

Community consultation and engagement is key to the success and acceptance of large infrastructure projects. Since the project was announced Infigen has received a high degree of support for the proposed project both informally through conversations with community members and formally through responses to surveys.

Community information open days were held on Friday the 2nd and Saturday 3rd of September 2011, at the Comobella Hall. During the open days, community members had the opportunity to discuss their concerns with members of the project team. Infigen also provided a questionnaire to attendees with general questions regarding the proposal. A total of 17 questionnaires were submitted to Infigen. Generally, community members supported the proposal and felt the proposal would be beneficial for the local area.

Visual impact was not raised as a major concern during the open day. General comments submitted were positive providing the construction and operation benefitted the local community and businesses.

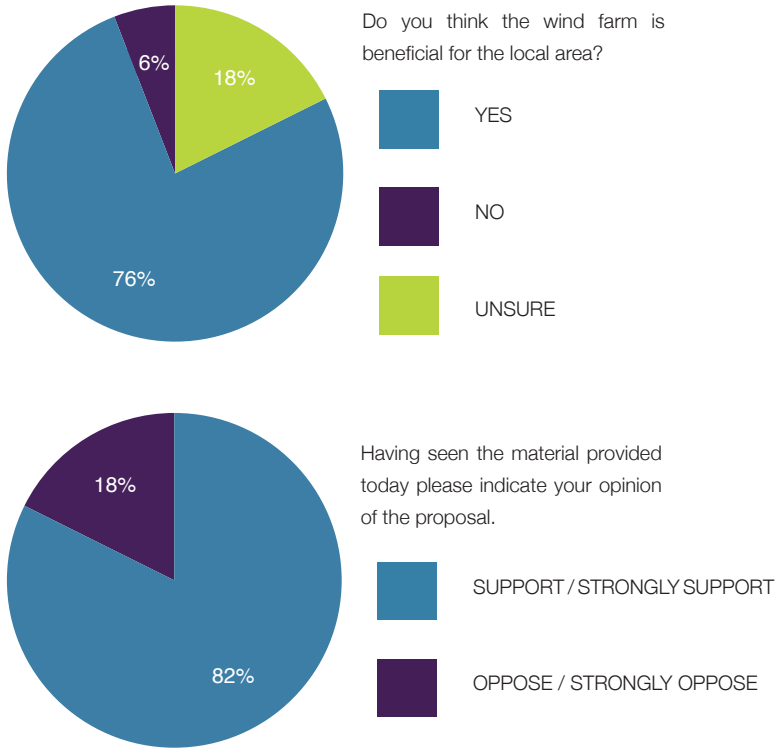

FIGURE 21: Support for Bodangora Wind Farm (Results from community open day- Infigen)

14.0 MITIGATION METHODS

14.1 SUMMARY OF MITIGATION METHODS

These recommendations 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 extension 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 design through an interactive process;
- secondary measures designed to specifically address the remaining (residual) negative (adverse) effects of the final development proposal. (The Landscape Institute et al 2008)

A range of methods for mitigating the visual impact of the proposed Bodangora Wind Farm have been identified and are outlined in this section of the VIA. The recommendations seek to achieve a better visual integration of the proposed Bodangora Wind Farm and retention of existing landscape character at both local, and regional scales.

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.) When site planning the wind farm the design should consider some or all of the following mitigation strategies 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.

Exsiting Homestead foreground planting.

Existing roadside planting.

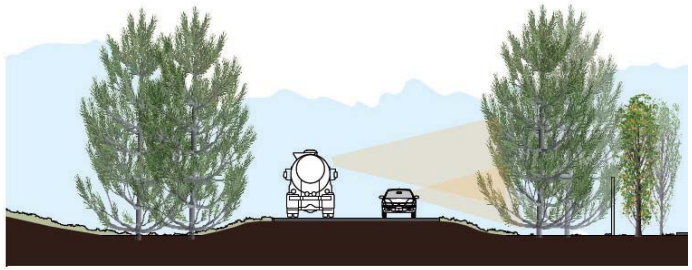

FIGURE 22: Roadside Screen Planting

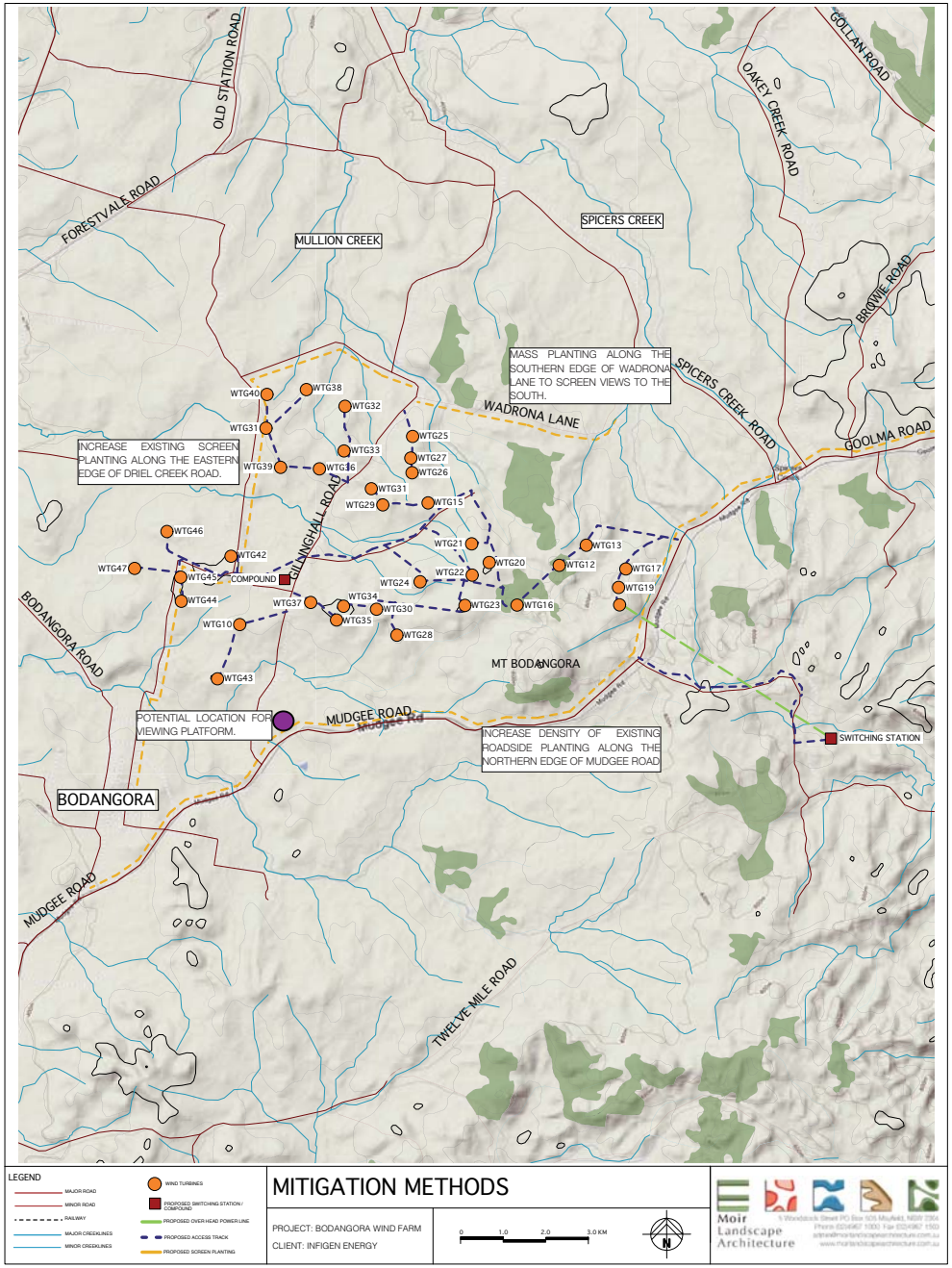

FIGURE 23: Mitigation Method Plan

14.2 WIND FARM DESIGN CONSIDERATIONS

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 the siting principles, access, layout and other principles which directly impact the appearance of the proposed development. General guidelines for the design development of the proposed wind farm have been outlined in the following section.

14.2.1 Wind Turbines Layout and Size

The layout and size of the wind farm is the significant factor in the visual impact on the landscape. According to Stanton (1995) the intrusiveness of a wind plant is not directly proportional to the number of turbines in an array, and instead, more a factor of design feature. For example, large wind plants (defined as more than 70 turbines) may appear less dominating than a smaller project when the large wind plant 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.

14.2.2 Wind Turbine Design and Colouring

Turbine design and colouring are an important factor. The proposed wind turbines have a matte white finish and consist of three blades which is consistent with the existing turbines. It is understood that wind turbines with three blades are generally more balanced than turbines with only two blades (Arkesteijn and Westra, 1991).

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 nonreflective materials to reduce distant visibility and avoid drawing the eye.
- Blades, nacelle and tower to appear as the same colour.
- Prohibit lighting except where required for the safety of aircraft to minimise the contrast between the wind farm and existing night time landscape of the area.

14.2.3 Associated Infrastructure

The following section outlines principles to assist in reducing the visual impact of the associated infrastructure.

ACCESS ROADS

- Existing access roads will be utilised as much as possible 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 utilise or upgrade existing roads, trails or tracks to provide access to the proposed turbines.
- Any new roads must minimise cut and fill and avoid the loss of vegetation.

TRANSMISSION LINES

- 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.

GENERAL PRINCIPLES

- No above ground infrastructure apart from the turbine itself and the transformer at the base of the turbine.
- Avoid the use of brand names logos etc.
- Avoidance of unnecessary lighting, signage on fences logos etc.
- Consideration should be given to controlling the type and colour of building materials used especially with the use of light, highly reflective cladding and brick and tile materials which contrast dramatically with the landscape character.
- Any proposed buildings to be sympathetic to existing architectural elements in the landscape.
- Minimise cut and fill throughout the construction process

14.3 LANDSCAPING AND VISUAL SCREENING

Visual screen planting is a beneficial mitigation method used to assist in the reduction of the wind farms visual impact. Wind break screen planting around homesteads and along property boundaries and roadsides forms apart of the existing visual character of the Bodangora region. 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.

In order to achieve visual screen planting between the intrusive element visual screen planting is to be undertaken. The existing character of the landscape allows for a variety of methods of visual screening which will remain in keeping with the landscape character.

Foreground visual planting is to be undertaken in areas of high visual sensitivity, such as close to residences and other areas requiring amelioration. Due to the large scale nature of the wind turbines, the most effective method of visual mitigation is through off-site screen planting. This is best undertaken close to the viewpoint. Locations of recommended foreground visual screening are shown in Figure 23 and examples of screen planting in place are demonstrated in the Figure 24 below.

In circumstances where residences are subject to a high level of visual impact, screen planting is proposed. In order to achieve visual screening planting between the intrusive element and the homestead, tree planting should 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.

14.3.1 Mitigation Methods- Photomontage

Photomontage of proposed wind turbines from Mudgee Road.

Photomontage of proposed wind turnines from Mudgee Road with mature roadside planting.

FIGURE 24: Photomontage mitigation method- Roadside planting.

14.4 VISUAL OPPORTUNITIES

The proposed Bodangora Wind Farm is a progressive development for renewable energy which, due to the relatively large scale and new technology, is bound to be of interest to viewers. Opportunities exist for the provision of education viewing areas at various locations around the site. The integration of a viewing area where visitors would be able to safely view the wind farm as a positive attribute to the development. Combined with interpretive signage these viewing areas would provide insight into the function, output and benefits of large scale wind farms.

An indicative location is shown on Figure 23 for a proposed viewing platform.

Waubra Wind Farm Viewing Platform (Source: Joh Architects)

Informative Signage- Hopetoun WA.

Informative Signage- Starfish Hill Wind Farm

15.0 CONCLUSION

The proposed development is renewable energy source located within an area of low level of habitancy. It is undeniable that the placement of wind turbines into the rural landscape will alter the existing landscape character of the area. Wind turbines have a simplicity in form especially when compared to transmission lines, towers and associated infrastructure, and can almost be considered a temporary installation in the landscape due to their modular construction.

The Bodangora Wind Farm would result in impacts on the existing surrounding environment in terms of landscape and scenic values. The proposed wind farm contrasts with the existing landscape character of the region which is typically a combination of rural and pastoral land.

With all visual impact assessments the objective is not to determine whether the proposed impact is visible or not visible, it is to determine how the proposal will impact on the existing visual amenity, landscape character and scenic quality. If there is a potential for a negative impact on these factors it must then be investigated if and how this impact can be mitigated to the extent that the impact is reduced to an acceptable level.

Although this VIA quantifies the visual impact of the proposed wind turbines, the overall visual impact of the wind farm will vary greatly depending on the individual viewers sensitivity to and acceptance of change. The sensitivity towards change varies greatly depending on the users connection with the landscape. For example visitors of the region travelling along Mudgee Road (especially tourists) may perceive the wind farm as an interesting feature of the landscape. This may contrast with a nearby residents perception of the change who may be more critical of the development.

The greatest visual effect is most likely to be felt from residents in the immediate vicinity of the wind farm. However in most instances, the homesteads have screening vegetation protecting the house from strong winds which may assist in screening views to the wind farm.

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. Due to the undulating topography of the local area, there are limited opportunities for the proposed development to be viewed in its entirety within close proximity. Areas from which the proposal can be viewed in its entirety are predominately a long distance from the site and the proposal would be viewed as a small element of the visual landscape from these areas.

Mitigation 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.

Considering the character of existing and proposed development in the region in addition to the suggested mitigation methods, the visual landscape of the region has the capacity to absorb the proposed development.

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 considering the extent of quantified impact and community response the social, economical and environmental benefits significantly out weight any visual impact that may result from the proposal.

16.0 REFERENCES

PUBLICATIONS

Arkesteijn and Westra (1991) The Visual Impact of Wind Turbines. Elsevier Science Publications.

Australian Wind Energy Association and the Australian Council of National Trusts (2005) Wind Farms and Landscape Values Stage One Final Report Identifying Issues. Pirion Printers, Canberra, Australia.

Birk Nieslon, F. (1996) Wind Turbines and the Landscape: Architecture and Aesthetics.

British Wind Energy Association (1994) Best Practice Guidelines for Wind Energy Development. London, England.

Colleran, JR. & Gearing D., (1980) A Visual Assessment Method for Botany Bay, Landscape Asutralia, 3 August.

Connell Wagner (2005) Renewable Power Ventures Capital Wind Farm - Review of Visual Impact. Neutral Bay, Australia.

EDAW (2008), Peter Haack, Mt Bryan Wind Farm- Visual and Landscape Assessment.

EPHC (2010) National Wind Farm Development Guidelines - Draft

Aurecon (2011), Visual Effects Bodangora Wind Farm - Infigen Energy.

Gipe, P. (1995) Design as if People Matter: Aesthetic Guidelines for the Wind Industry.

Horner + Maclennan & Envision (2006) Visual Representation of Windfarms - Good Practice Guidelines. Scottish Natural Heritage, Inverness, Scotland.

Integral, (2008) Kyoto Energy Park Visual Assessment Study. Scarborough Queensland, Australia.

Land & Water Conservation, (1998), Soil Landscapes of the Dubbo 1:250 000 Sheet.

New South Wales Department of Planning, (2010) http://www.planning.nsw.gov.au/

Scottish Natural Heritage (2009) Siting and Designing windfarms in the landscape - Version 1. www.snh.org.uk Scotland.

Stanton, C. (1996) The Landscape Impact and Visual Design of Windfarms.

The Landscape Institute with the Institute of Environmental Management and Assessment (2008) Guidelines for Landscape and Visual Assessment Second Edition.

WEBSITES

About NSW (2011) http://about.nsw.gov.au/view/suburb/Goolma/

The Bodangora Website (2011) http://bodangora.com/

DOE UK, Draft PPS18: Renewable Energy (2011) http://www.planningni.gov.uk

Stuart Town (2011) http://www.stuarttown.org.au/

Wellington Council (2011) http://www.wellington.nsw.gov.au/eservice/navigation.jsp

Visit Wellington (2011) http://www.visitwellington.com.au/

MAPS

2010 Google- Map data Sciences Pty Ltd, PSMA. http://map.google.com.au

Department of Environment, Climate Change and Water (2010), Soil Landscape Series Sheet S1550-4 Edition 1

Geosciences Australia, Australian Government - http://www.ga.gov.au/

Land and Property Management Authority, Spatial Information Exchange, 2010. https://six.maps.nsw.gov.au/