structurally diverse areas of woodlands. Given the narrow linear nature of the proposal, it is considered unlikely that the proposal would create barriers to movement of Hooded Robin throughout the project site. Furthermore, given the ground-foraging habit of this species, it is considered unlikely that they would collide with turbines and hence turbines are unlikely to restrict movement across the project site.

The landscape within the study area is one of open woodland, and turbine corridors have been deliberately focussed in areas of vegetation that have already undergone some historical clearing (for agricultural uses). Therefore the narrow and linear nature of the proposal is considered unlikely to result in fragmentation of habitat for this species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Neophema pulchella* (Turquoise Parrot)**

The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.

The Turquoise Parrot lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. They are usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. This species prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds of grasses and herbaceous plants, or browsing on vegetable matter.

The species forages quietly and may be quite tolerant of disturbance. Turquoise Parrots nest in tree hollows, logs or posts, from August to December (DECCW 2011b).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Diurnal bird surveys and opportunistic surveys were conducted across the proposed study area, in areas of suitable habitat during October, November and December 2008; April and May 2009; September and October 2010, and January 2011. The Turquoise Parrot was recorded in the Swan Vale cluster.

There is potential for the Turquoise Parrot to occur within the study area with potential habitat within the study area in areas of Black Cypress Pine - Tumbledown Gum - Narrow-leaved Ironbark open forest, Blakely's Red-gum - Rough-barked Apple – Red Stringybark grassy open forest, Blakely's Red-gum – Yellow Box grassy open forest/woodland, Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest, Tenterfield Woollybutt – Silvertop Stringybark open forest, White Box grassy woodland and the associated derived grasslands. This potential habitat represents 1594.62 ha of the study area, however only a fragment of this will be disturbed by the development footprint. The proposal will require 123.64 ha of permanent habitat loss and 104.92 ha of temporary loss. The landscape within the study area is one of open woodland, and turbine corridors have been deliberately focussed in areas of vegetation that have already undergone some historical clearing (for agricultural uses).

Turquoise Parrots typically nests in tree hollows, logs or posts. The study area supports a large proportion of hollow bearing trees which are common throughout woodland areas. However, the proposal has been designed such that tree removal has been minimised wherever possible and will be further minimised during the detailed design phase. All turbines have been placed at least 30 m from hollow-bearing trees.

A risk matrix anticipating the likelihood of collision with turbines and risk of collision with overhead power lines has been prepared for those species most commonly recorded within the study area including the Turquoise Parrot. The Turquoise Parrot was found to have a moderate risk of collision with turbines – primarily when moving between sites and a low risk of collision with overhead power lines. Given the ground-foraging habit of this species it is considered unlikely that they would collide with turbines when foraging and hence turbines are unlikely to restrict movement across the project site.

Therefore, proposal is unlikely to have a significant detrimental impact on the lifecycle of the Turquoise Parrot.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Vegetation will be removed in linear strips (for turbines, access tracks and the associated ancillary structures required for the running of the wind farm). As a worst case scenario, the area of vegetation to be cleared consists of a permanent loss of 123.64 ha and a temporary impact to 104.92 ha of potential habitat, totalling 228.56 ha.

This loss of potential habitat is contiguous with other examples of the same vegetation communities in a similar condition mapped within the study area (amounting to 1,594.62 ha) and mapped within the project site (amounting to 8,930.37 ha). The amount of potential habitat proposed to be impacted represents 14.3 % of the potential habitat mapped within the study area, but only 2.6 % of potential habitat mapped within the project site. Given that vegetation removal is to occur is a narrow linear corridor, rather than one consolidated stand, it is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited in the study area.

Where the removal of habitat trees is required, a pre-clearance protocol will be developed and implemented to survey for hollow-bearing fauna and determine if roosts or nests are present in any trees proposed for clearing. An ecologist will be present during clearing to capture and re-release individuals (where appropriate).

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Turquoise Parrot's range extends from northern Victoria through to southern Queensland, from the coastal plains to the western slopes of the Great Dividing Range. The study area does not lay at the limit of the species' known distribution.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, soil disturbance and grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There have been no major fire events on the site in the last decade.

Fire regimes that impact foraging habitat are of most relevance to the Turquoise Parrot. The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Turquoise Parrot foraging habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, significant changes to the current disturbance regime that may impact the Turquoise Parrot are unlikely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the narrow linear nature of the proposal, it is considered unlikely that the proposal would create barriers to movement of Turquoise Parrot throughout the project site.

Furthermore, given the ground-foraging habit of this species, it is considered unlikely that they would collide with turbines whilst foraging and hence turbines are unlikely to restrict movement across the project site.

The landscape within the study area is one of open woodland, and turbine corridors have been deliberately focussed in areas of vegetation that have already undergone some historical clearing (for agricultural uses). Therefore the narrow and linear nature of the proposal is considered unlikely to result in fragmentation of habitat or create barriers to movement for this species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat has not been declared for this species

***Petroica boodang* (Scarlet Robin)**

The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter.

The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.

The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees.

Scarlet Robin pairs defend a breeding territory and mainly breed between the months of July and January; they may raise two or three broods in each season. This species' nest is an open cup made of plant fibres and cobwebs and is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub. The Scarlet Robin is a quiet and unobtrusive species which is often quite tame and easily approached (DECCW 2011b).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Diurnal bird surveys and opportunistic surveys were conducted across the proposed study area, in areas of suitable habitat during October, November and December 2008; April and May 2009; September and October 2010, and January 2011. Individuals were recorded just east of turbine 125a/51b of the Wellingrove Cluster.

Furthermore, potential habitat occurs within areas of Black Cypress Pine - Tumbledown Gum-Narrow-leaved Ironbark open forest, Blakely's Red-gum - Rough-barked Apple – Red Stringybark grassy open forest, Blakely's Red-gum – Yellow Box grassy open forest/woodland, Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest, Tenterfield Woollybutt – Silvertop Stringybark open forest and White Box grassy woodland. The proposal will require 75.36 ha of permanent habitat loss and 37.11 ha of temporary loss. This potential habitat represents 12.6 % of potential habitat within the study area (894.79 ha), however this represents only 1.8 % of potential habitat mapped within the project site (6,331.11 ha).

This clearance will be distributed throughout the linear development footprint, and not as one consolidated area of vegetation. Thus, the removal of any areas of potential habitat may result in the reduction of a territorial range, but is not likely to affect the entire territory. Furthermore, given tree clearance has been avoided wherever possible, it is considered unlikely that the clearance of small sections of grassy understorey for roads and turbines would impact upon the lifecycle of the species.

The Scarlet Robin is considered unlikely to fly at height as it is a woodland species that usually forages from low perches, fence-posts or on the ground (DECCW 2011b) and therefore turbine strike where turbines occur throughout open parts of woodland is unlikely. Given the flight habits of this species, the potential for this species being struck by turbines due to movement between woodland patches is considered low. Therefore the proposal is considered unlikely to affect the lifecycle of this species should it be present at the site.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Vegetation will be removed in linear strips (for turbines, access tracks and the associated ancillary structures required for the running of the wind farm). As a worst case scenario, the area of vegetation to be cleared consists of a permanent loss of 75.36 ha and a temporary impact to 37.11 ha of potential habitat, totalling 112.47 ha.

This loss of potential habitat is contiguous with other examples of the same vegetation communities in a similar condition mapped within the study area (amounting to 894.79) and mapped within the project site (amounting to 6,331.11 ha). The amount of potential habitat proposed to be impacted represents 12.6 % of the potential habitat mapped within the study area, but only 1.8 % of potential habitat mapped within the project site. For these reasons, the proposal is unlikely to substantially reduce the amount of potential habitat for this species present within the project site.

Nonetheless, control measures will be implemented to ensure that impacts to habitat for the threatened species are minimised. Weed control measures will be implemented in areas disturbed by proposed works for a period of three years after the completion of construction works, thereby reducing potential impacts of the proposal to potential habitat for this species.

Where the removal of habitat trees is required, a pre-clearance protocol will be developed and implemented to survey for hollow-bearing fauna and determine if roosts or nests are present in any trees proposed for clearing. An ecologist will be present during clearing to capture and re-release individuals (where appropriate).

Given the areas of woodland habitat present across the study area, comparative to the area of habitat to be removed is very small, and that vegetation removal is to occur is a narrow linear corridor, rather than one consolidated stand, it is unlikely that the proposed vegetation clearance would impact on this species such that foraging and nesting resources would become limited within the study area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes (DECCW 2011b). As it disperses to only the inland slopes during non breeding periods, this species is close to the limit of its known distribution in the study area.

How is the proposal likely to affect current disturbance regimes?

The fire regime of the study area is not expected to change as a result of the proposal, as the risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing

occurring in transmission and distribution facilities (CFA 2007). Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires.

The site is grazed primarily by sheep, and cattle are present in some areas. Over-grazing from stock changes the vegetation structure of the understorey which may reduce the availability of invertebrate taxa as a food source for Scarlet Robin. Grazing pressure and management varies across the landscape, and the proposal is considered unlikely to exacerbate over-grazing at the site, but may, in fact, contribute to a more sustainable grazing regime through the mitigation and offset measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

Feral animals can have a detrimental impact on Scarlet Robin habitat. In the case of grasslands and grassy woodlands, grazing by feral animals such as the European Rabbit can result in loss of species diversity and tussock structure which in turn impacts the presence of insects as a food source for Scarlet Robin.

Feral animals can also have a detrimental impact on Scarlet Robin through predation by species such as feral Cats and the European Red Fox. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. For the following reasons it is considered unlikely that the proposal would affect habitat connectivity for this species:

- the linear nature of the proposal;
- the extent of potential habitat across the project site;
- this species will forage across disturbed environments;
- tree clearance has been minimised; and
- this species is unlikely to fly at height.

The landscape within the study area is one of open woodland and, therefore, the proposal is considered unlikely to result in fragmentation of habitat for this species.

The landscape within the study area is one of open woodland and, therefore, the proposal is considered unlikely to result in fragmentation of habitat for this species.

How is the proposal likely to affect critical habitat?

Not applicable – critical habitat has not been declared for this species

***Pyrrholaemus sagittatus* (Speckled Warbler)**

The Speckled Warbler lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area (DECCW 2011b).

There is potential for the Speckled Warbler to occur within the study area with potential habitat within the study area in areas of Black Cypress Pine - Tumbledown Gum-Narrow-leaved Ironbark open forest, Blakely's Red-gum - Rough-barked Apple – Red Stringybark grassy open forest, Blakely's Red-gum – Yellow Box grassy open forest/woodland, Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest, Tenterfield Woollybutt – Silvertop Stringybark open forest and White Box grassy woodland.

Speckled Warbler is listed as Vulnerable under the TSC Act.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Diurnal bird surveys and opportunistic surveys were conducted across the proposed study area, in areas of suitable habitat during October, November and December 2008; April and May 2009; September and October 2010, and January 2011. The Speckled Warbler was recorded in a patch of woodland 800 m east of the Eastern Feeder road, within two kilometres of the Wellingrove cluster. Territories for this species range from around 10 ha during the breeding season and are slightly larger outside the breeding season.

The proposal will require 75.36 ha of permanent habitat loss and 37.11 ha of temporary loss. This potential habitat represents 12.6 % of potential habitat within the study area (894.79 ha), however this represents only 1.8 % of potential habitat mapped within the project site (6,331.11 ha). This clearance will be distributed throughout the linear development footprint, and not as one consolidated area of vegetation. Thus, the removal of any areas of potential habitat may result in the reduction of a territorial range, but is not likely to affect the entire territory. Furthermore, given tree clearance has been avoided wherever possible, it is considered unlikely that the clearance of small sections of grassy understorey for roads and turbines would impact upon the lifecycle of the species.

The Speckled Warbler is considered unlikely to fly at height as it is a woodland foraging species and therefore turbine strike where turbines occur throughout open parts of woodland is unlikely. Therefore, the proposal is considered unlikely to affect the lifecycle of this species should it be present at the site.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Vegetation will be removed in linear strips (for turbines, access tracks and the associated ancillary structures required for the running of the wind farm). As a worst case scenario, the area of vegetation to be cleared consists of a permanent loss of 75.36 ha and a temporary impact to 37.11 ha of potential habitat, totalling 112.47 ha.

This loss of potential habitat is contiguous with other examples of the same vegetation communities in a similar condition mapped within the study area (amounting to 894.79 ha) and mapped within the project site (amounting to 6,331.11 ha). The amount of potential habitat proposed to be impacted represents

12.6 % of the potential habitat mapped within the study area and only 1.8 % of potential habitat mapped within the project site.

Given the areas of woodland habitat present across the study area, comparatively the area of habitat to be removed is very small, and that vegetation removal is to occur is a narrow linear corridor, rather than one consolidated stand, it is unlikely that the proposed vegetation clearance would impact on this species such that foraging and nesting resources would become limited in the study area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast (DECCW 2011b). The project site does not lay at limit of this species' distribution.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, predation by feral animals, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There have been no major fire events on the site in the last decade.

A high intensity fire would result in a temporary loss of foraging habitat for the Speckled Warbler and place the species at greater risk from predation by raptors during breeding. However the risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Speckled Warbler habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

As the Speckled Warbler builds nests on or close to the ground, it is at high risk of predation by feral animals such as feral Cats and the European Red Fox. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

The site is grazed primarily by sheep, and cattle are present in some areas. Over-grazing from stock changes the vegetation structure of the understorey and will limit regeneration of woodland trees, which may reduce the availability of insects as a food source for Speckled Warbler. Grazing pressure and management varies across the landscape, and the proposal is considered unlikely to exacerbate over-grazing at the site, but may, in fact, contribute to a more sustainable grazing regime through the mitigation and offset measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that tree clearance has been minimised it is considered unlikely that the proposal would create barriers to movement of Speckled Warblers throughout the project site. Furthermore, given the flight characteristics of this species, it is considered unlikely that they would collide with turbines and hence turbines are unlikely to restrict movement across the project site.

The landscape within the study area is one of open woodland and, therefore, the proposal is considered unlikely to result in fragmentation of habitat for this species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Stagonopleura guttata* (Diamond Firetail)**

The Diamond Firetail is found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. This species also occurs in open forest, mallee, Natural Temperate Grassland, and in derived grassland derived from other communities. It is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland (DECCW 2011b).

The Diamond Firetail has been recorded throughout the locality on a number of occasions including within Kings Plains National Park and south of the site along the Gwydir Highway (DECCW 2011a, Birds Australia 2009). This species was also recorded along the eastern feeder during the current survey.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Diamond Firetail has the potential to occur within the study area with potential habitat within areas of Black Cypress Pine - Tumbledown Gum-Narrow-leaved Ironbark open forest, Blakely's Red-gum - Rough-barked Apple – Red Stringybark grassy open forest, Blakely's Red-gum – Yellow Box grassy open forest/woodland, Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest, Tenterfield Woollybutt – Silvertop Stringybark open forest, White Box grassy woodland and associated derived grassland. This potential habitat represents 1,594.62 ha of the study area. However, the proposal will require 123.64 ha of permanent potential habitat loss and 104.92 ha of temporary removal of potential habitat. This loss represents 14.3 % of potential habitat within the study area and only 2.6 % of potential habitat mapped within the project site (8,930.37 ha).

The Diamond Firetail has been recorded in a patch of woodland 800 m east of the Eastern Feeder road, within two kilometres of the Wellingrove cluster. There is also the potential for this species to inhabit the majority of the site although woodland areas are likely to be preferred habitat. Although the proposal will result in the removal of 228.56 ha of potential nesting and foraging habitat for this species, vegetation clearance is linear in nature and therefore will not result in large consolidated patches of vegetation clearance. Furthermore, given tree clearance has been avoided wherever possible and the understorey in most areas across the site is absent, it is considered unlikely that the clearance of small sections of grassy understorey for roads and turbines would impact upon the lifecycle of the species. Furthermore, extensive areas of potential habitat will remain within the project site.

The Diamond Firetail is considered unlikely to fly at height as it is a woodland, ground foraging species and therefore turbine strike where turbines occur throughout open parts of woodland is unlikely. Although flight heights may increase between woodland patches, given this species appears to be sedentary, though some populations move locally, especially those in the south (DECCW 2011b), the potential for this species to be struck by turbines due to movement between woodland patches is considered low. Therefore, the proposal is considered unlikely to affect the lifecycle of this species at the site.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Vegetation will be removed in linear strips (for turbines, access tracks and the associated ancillary structures required for the running of the wind farm). As a worst case scenario, the area of vegetation to be cleared consists of a permanent loss of 123.64 ha and a temporary impact to 104.92 ha of potential habitat, totalling 228.56 ha.

This loss of potential habitat is contiguous with other examples of the same vegetation communities in a similar condition mapped within the study area (amounting to 1,594.62 ha) and mapped within the project site (amounting to 8,930.37 ha). The amount of potential habitat proposed to be impacted represents 14.3 % of the potential habitat mapped within the study area and 2.6 % of potential habitat mapped within the project site.

Given that vegetation removal is to occur is a narrow linear corridor, rather than one consolidated stand, it is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited in the study area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Diamond Firetail is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. This species is not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW and is also found in the Australian Capital Territory, Queensland, Victoria and South Australia (DECCW 2011b). The project site does not lay at the limit of the species' known distribution.

How is the proposal likely to affect current disturbance regimes?

The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires.

The site is grazed primarily by sheep, but cattle are present in some areas. Grazing pressure and management varies across the landscape, and the proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation and offset measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire providing a food source to the Diamond Firetail.

Feral animals can have a detrimental impact on threatened species and their habitat. In the case of grasslands and grassy woodlands, grazing by feral animals such as the European Rabbit impact on species diversity, seed availability and tussock structure which in turn impacts of potential prey / foraging resources for this species.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats and the European Red Fox. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management

of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. For the following reasons it is considered unlikely that the proposal would affect habitat connectivity for this species: the linear nature of the proposal; the extent of potential habitat across the project site; the landscape is one of open woodland with large canopy gaps, this species will forage across disturbed environments; tree clearance has been minimised; and, this species is unlikely to fly at height.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Mammals

***Dasyurus maculatus* (Spotted-tailed Quoll)**

The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECCW 2011b), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECCW 2011b). Maternal den sites include logs with cryptic entrances, rock outcrops, windrows and burrows (Environment Australia 2000).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Targeted surveys were undertaken for the Spotted-tailed Quoll (*Dasyurus maculatus*) as this species has been recorded within the locality south of the Gwydir Highway (DECCW 2011a). This species was not recorded within the study area and there is only one historical record (2006) of this species within the locality. The species is predicted to occur within the Glenn Innes-Guyra Basalts CMA subregion (SEWPAC 2011a) and there is potential for this species to utilise the study area.

Spotted-tailed Quoll is recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. The species is mostly nocturnal, although will hunt during the day. They spend most of the time on the ground, but are excellent climbers and may raid possum and glider dens and prey on roosting birds (DECCW 2011b).

Spotted-tailed Quoll consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects, and also eats carrion and takes domestic fowl. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. They usually traverse their ranges along densely vegetated creeklines.

At the Sapphire site, the lifecycle of the Spotted-tailed Quoll may be impacted by the loss of potential foraging habitat and breeding sites.

The area of woodland within the study area that could form potential habitat for Spotted-tailed Quoll is 894.79 ha. Assuming the highest degree of impact (the 80m turbine layout), the proposal requires permanent removal of 75.36 ha of woodland habitat (8.4 % of the study area) and the temporary loss of 37.11 ha of woodland habitat (4.1 %) within the study area. Given this is a relatively small impact within the study area, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

Hollow-bearing tree clearance has been avoided where possible and will be further avoided where practical during the detailed design phase. To minimise the disturbance to potential den sites a pre-clearance protocol will be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing. These surveys will be undertaken to determine if dens are present in any areas proposed for clearing and an Ecologist will be present on site during clearing to capture and re-release fauna. Therefore, the disturbance to breeding Spotted-tailed Quoll will be minimised and managed during the clearing of potential habitat.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Spotted-tailed Quoll is a threatened species in NSW. The proposed project will result in the permanent removal of 75.36 ha of woodland habitat (8.4 % of the study area) and the temporary loss of 37.11 ha of woodland habitat. However this potential habitat removal is unlikely to result in resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat is to be removed (8.4 %);
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible;
- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand;
- retention of hollow-bearing trees where possible;
- this species is known to forage over a wide area of up to 750 hectares for females and 3,500 hectares for males; and
- Preferred habitat for the species includes large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understorey or dense vegetation along drainage lines. The habitat at Sapphire is considered to be marginal for the species given the drainage lines are largely cleared of vegetation and the understorey is relatively sparse.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common (DECCW 2011b). At Sapphire, this species is not at the limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.

The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No adverse impacts to potential Spotted-tailed Quoll habitat is expected to result from a reduction in grazing pressure from livestock and feral animals. Feral animal control at the site involving poison-baiting techniques for cat and fox must consult with DECCW and use techniques least likely to affect quolls.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Spotted-tailed Quoll foraging and roosting habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, changes to the current disturbance regime as a result of the proposal that may impact the Spotted-tailed Quoll are not considered likely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey, which forms marginal habitat for the quoll, which prefer a dense understorey. Given the linear nature of the proposal and that tree clearance has been minimised, it is considered unlikely that the proposal would create barriers to movement of the Spotted-tailed Quoll which is a highly mobile species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Phascolarctos cinereus* (Koala)**

Koalas are arboreal marsupials, spending most of their time inactive in trees, feeding and moving around between trees (along the ground) at night. They are a generally solitary species with complex social hierarchies regarding the territory of males and females. They inhabit eucalypt woodlands and forests, and have specific preferences regarding eucalypt species as feed trees (DECCW 2011b).

Historical distribution of Koalas covered much of NSW, however this range has become more fragmented with clearing of timbered potential habitat, and they are now thought to occur as sparse (and possibly genetically disjunct) populations.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Koala was not recorded at the site during the surveys, although there are nearby historical records and six species of Koala feed tree are present across the study area. The primary koala feed tree species within the study area is *Eucalyptus viminalis* (Manna Gum). Additional secondary feed tree species are: *E. dealbata*; *E. blakelyi, E. melliodora, E. albens* and *E. banksii*.

For these reasons, the study area is thought to comprise potential habitat for Koalas. Approximately 860.44 ha of potential habitat is present within the study area and 5,934.64 ha within the project site. It is anticipated that the proposal would impact approximately 76.55 ha of potential habitat for this species (1.3 % of the habitat within the project site). Given this is a relatively small impact comparative to the amount of habitat present within the study area and project site, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

The loss of potential habitat will be distributed around the linear study area, it is expected that vegetation removal will only affect part of any individual's territory (if at all). Koalas are a highly mobile species, and given the large amounts of potential habitat that extend throughout the project site (5,934.64 ha) - of which only 1.3 % will be impacted - it is not expected that the partial loss of an individual's territory is likely to disrupt the lifecycle of the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Koala is a threatened species in NSW. The proposed project will result in the removal of 8.9 % of potential habitat within the study area and 1.3 % of habitat mapped within the project site. However this potential habitat removal is unlikely to result in resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat is to be removed, relative to potential habitat present within the project site;
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible; and
- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The species is widely though sparsely distributed in eastern Australia, from north-east Queensland to the Eyre Peninsula in South Australia. Sapphire is not at the limit of the known distribution for the species.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Koala habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures and recruitment of eucalypts in the absence of fire.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No adverse impacts to potential Koala habitat is expected to result from a reduction in grazing pressure from livestock and feral animals.

Therefore, changes to the current disturbance regime as a result of the proposal that may impact the Koala are not considered likely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that tree clearance has been minimised, it is considered unlikely that the proposal would create barriers to movement of the Koala which is a mobile species and able to cross the road corridors to be installed within the study area.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Petaurus norfolcensis* (Squirrel Glider)**
Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas (DECCW 2011b). The presence of hollow bearing eucalypts is a critical habitat value (Quinn 1995), as are trees and shrubs that provide a winter source of nectar (DECCW 2011b).

Diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. Reliably available food is considered to be an important determinant of habitat suitability (Van Dyck & Strahan, 2008). They typically live in social camps and shelter in tree hollows with groups occupying multiple hollows over time and can glide up to 80 m between trees (Van Dyck & Strahan, 2008). Breeding occurs between April and November with a peak during winter. The major threat to Squirrel Glider is the loss of suitable habitat containing hollow-bearing trees (Van Dyck & Strahan, 2008).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Squirrel Glider has been recorded within Kings Plain National Park to the north east of the study area and it is possible that this species utilises the site as suitable habitat based on the presence of hollow-bearing trees and winter flowering gums. At the Sapphire site, the lifecycle of the Squirrel Glider may be impacted by the loss of potential foraging habitat and shelter sites.

Extensive areas of potential habitat for the Squirrel Glider are present across the study area. It is anticipated that up to 880.63 ha of potential habitat is present within the study area and 6,176.22 ha within the project site. Approximately 111.36 ha is likely to be impacted by the proposal. This represents 1.8 % of the habitat within the project site. Given that this is a relatively small impact comparative to the amount of habitat present within the study area and project site, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

Hollow-bearing tree clearance has been avoided where possible and will be further avoided where practical during the detailed design phase. To minimise the disturbance to potential shelter sites of Squirrel Gliders, a pre-clearance protocol will be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing. These surveys will be undertaken to determine if shelters are present in any areas proposed for clearing and an ecologist will be present on site during clearing to capture and re-release fauna. Squirrel Gliders insulate their hollows with a nest of leaves and they will readily occupy nest boxes when natural hollows are scarce (Van Dyck & Strahan 2008).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?
The Squirrel Glider is a threatened species in NSW. The proposed project will result in the permanent removal of 74.79 ha (8.4 %) of potential habitat within the study area. However this potential habitat removal is unlikely to result in foraging and sheltering resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat is to be removed (12.6 %) within the study area;
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible;

- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand;
- retention of hollow-bearing trees where possible; and
- mitigation measures should include the provision of nest boxes, in any areas where hollow-bearing tree densities are low.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. The site at Sapphire is not at the limit of the known distribution for the species.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.

The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No adverse impacts to potential Squirrel Glider habitat is expected to result from a reduction in grazing pressure from livestock and feral animals.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Squirrel Glider habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, significant changes to the current disturbance regime as a result of the proposal that may impact the Squirrel Glider are unlikely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that tree clearance has been minimised it is considered unlikely that the proposal would create barriers to movement of the Squirrel Glider which is a mobile species, able to glide 80 m between trees.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Microchiropteran Bats

***Falsistrellus tasmaniensis* (Eastern False Pipistrelle)**

The Eastern False Pipistrelle prefers moist habitats, with trees taller than 20 m. This species generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings (DECCW 2011b). This species was recorded within the study area on the edge of MGRAYB / derived grassland. It is known to forage over large distances and its limited manoeuvrability means that it forages below or near the canopy and usually in forest with an open structure (Law *et al*. 2008).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Eastern False Pipistrelle is a threatened species listed under the TSC Act. This species was recorded at three different locations within the study area via Anabat analysis. These were: 2.5 kms west of Polhill Rd east of the Wellingrove cluster, along the ridge of the Wellingrove cluster; north of Waterloo Road on the eastern side of the Swan Vale cluster; and approximately 1 km north of Wellingrove cluster along Kings Plain Road.

The Eastern False Pipistrelle flies within or just below the canopy in gaps, along tracks and also in open areas. It is highly mobile with a large foraging range up to 136 ha. Where the removal of habitat trees is required, a pre-clearance protocol will be developed and implemented to survey for hollow-bearing fauna and determine if roosts are present in any trees proposed for clearing. An ecologist will be present during clearing to capture and re-release individuals (where appropriate).

Impacts from the proposal on this species are likely to be greater during operation than construction. Based on the risk matrix included in Appendix F, the collision potential for this species was considered moderate as this species forages widely and roosts in hollows. Hollow-bearing trees are extensive throughout woodland and open forest areas of the site. Although it is not realistic to completely remove the threat of collisions with turbines, a commitment to placing turbines at least 30 m away from hollow-bearing trees has been made in an attempt to reduce the likelihood of collisions at or near potential roost sites. Furthermore, the open nature of the landscape is such that it is unlikely that the turbines would create cleared areas that would be used as fly ways by this species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 15, 934 HBT are estimated to be present across the study area and it is anticipated that up to 1,816 HBT (11.4 %) may be removed for the proposal (as a worst-case scenario). The distribution of HBT across the study area in not uniform and therefore this estimate is indicative only and is likely to be an over-estimate given many could be avoided through micro-siting. Areas of woodland and grassland provide potential foraging habitat for the Eastern False Pipistrelle. Of the 1,883 ha of habitat present across the study site, up to 140.72 ha of this will be permanently removed and 148.05 ha will be temporarily cleared. Combined, the proposed 288.77 ha of impact represents 15.3 % of the habitat within the study area and approximately 2.9 % of the potential habitat within the project site (9955.20 ha). Furthermore, the proposed habitat removal occurs over a large linear area and not in one consolidated block. Therefore, it is unlikely that the habitat loss due to the proposal would significantly reduce the available habitat for this species within the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (DECCW 2011b). The project site does not represent the limit of this species' distribution.

How is the proposal likely to affect current disturbance regimes?

The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. Given the linear nature of the proposal, the large home range of the species and that tree clearance has been minimised, it is considered unlikely that the proposal would affect habitat connectivity it terms of use by the Eastern False Pipistrelle.

The landscape within the study area is one of open woodland and therefore the proposal is considered unlikely to result in fragmentation of habitat for this species which forages through open areas and fly ways.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)**

The Eastern Bentwing-bat hunts in forested areas and roost primarily in caves although derelict mines, storm-water tunnels, buildings and other man-made structures are also used. This species forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Breeding or roosting colonies can number from 100 to 150,000 individuals (DECCW 2011b). Females leave the maternity roost in February and juveniles depart a month later. Both may travel long distances to over-wintering sites, with juveniles known to travel up to several hundred kilometres. Roost sites outside the breeding period depend on the sex and age of individuals. This species has a fast direct flight, foraging in open areas and above the tree canopy as well as along tracks and waterways (Hoye and Hall 2008).

The Eastern Benwting-bat is a threatened species listed under the TSC Act. This species was recorded in fourteen different locations throughout the study area via Anabat analysis primarily in woodland areas or on the fringes of woodland.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Eastern Bentwing-bat flies high, from just above to many times above the canopy and in open areas. It is highly mobile and can travel up to 65 km in one night and will travel several hundred kilometres to over-wintering roosts. It has a fast flight and typically level with shallow dives foraging in forested areas, open areas, and around waterways, street lights and tracks.

Impacts from the proposal on this species are likely to be greater during operation than construction. Based on the risk matrix included in Appendix F, the collision potential for this species was considered moderate as this species forages widely and roosts in caves (although no caves are present within the project site).

This species is known to be attracted to lighting and therefore measures such as turbines without lighting, where safety requirements permits, and the use of lighting that minimises insect attraction in any areas where they are required for safety reasons will assist in reducing the likelihood of collisions.

Given the Eastern Bentwing-bat does not roost in hollows, collisions when leaving roost sites is unlikely as they would be a distance from the study area. However, given this species forages above the canopy and is migratory there is the potential for strike during these activities. Whilst it is not possible to completely prevent potential strikes, the following factors reduce the likelihood that strikes will occur:

- The open nature of the landscape means that species are not funnelled through the fly ways as they would be in a landscape where turbine construction has created breaks in woodlands;
- The proposal is involves linear clusters of turbines rather than one long string of turbines and therefore the number of turbines potentially occurring along a flight path are reduced; and
- Unless required for safety reasons, turbine lighting will not be used. Where it is required for safety reasons, lighting that minimises insect attraction will be used.

Furthermore, the open nature of the landscape is such that it is unlikely that the turbines would create cleared areas that would be used as fly ways by this species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Areas of woodland and grassland provide potential foraging habitat for the Eastern Bentwing-bat. Of the 1,883 ha of habitat present across the study site, up to approximately 140.72 ha of this will be permanently removed and 148.05 ha will be temporarily cleared. Combined, the proposed 288.77 ha of impact represents 15.3 % of the habitat within the study area and 2.9 % of the potential habitat within the project site. Extensive areas of potential habitat are present in the areas around the project site (9,955.20 ha) and throughout the locality. Furthermore, the proposed habitat removal occurs over a large linear area and not in one consolidated block. Therefore, it is unlikely that the habitat loss due to the proposal would significantly reduce the available habitat for this species within the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Eastern Bent-wing Bats occur along the east and north-west coasts of Australia (DECCW 2011b). The project site does not represent the limit of this species' distribution.

How is the proposal likely to affect current disturbance regimes?

The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats and the European Red Fox. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. Given the linear nature of the proposal, the large home range of the species and that tree clearance has been minimised, it is considered unlikely that the proposal would affect habitat connectivity it terms of use by the Eastern Bentwing-bat.

The landscape within the study area is one of open woodland and therefore the proposal is considered unlikely to result in fragmentation of habitat for this species which forages through open areas and fly ways.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Mormopterus norfolkensis* (Eastern Freetail-Bat)**

The Eastern Freetail-bat weighs up to 10 grams, with a bare tail protruding from the tail membrane. Freetail-bats are also known as mastiff-bats, having hairless faces with wrinkled lips and triangular ears (DECCW 2011b).

The Eastern Freetail-bat occurs east of the Great Dividing Range from southern NSW to south-east Queensland. This species occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range (DECCW 2011b).

The Eastern Freetail-bat is a fast flier in natural and artificial openings within dry eucalypt forest and woodland foraging within a few kilometres from roost sites, although individuals have been recorded foraging on flying insects up to 6 kilometres from roost sites. The Eastern Freetail-bat roosts in hollows in mature eucalypts and will utilise paddock trees and remnant vegetation in farmland where there is proximity to larger forest remnants.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Eastern Freetail-bat is a threatened species listed as Vulnerable under the TSC Act. This species was recorded approximately 2 km west of the south end of the Swan Vale cluster and in the north of the Sapphire cluster. However, habitat for this species is available throughout the study area.

During construction, where the removal of habitat trees is required, a pre-clearance protocol will be developed and implemented to survey for hollow-bearing fauna and determine if roosts are present in any trees proposed for clearing. An ecologist will be present during clearing to capture and re-release individuals (where appropriate). Therefore, the disturbance to roosting microbats will be minimised and managed during the clearing of potential habitat.

Impacts from the proposal on this species are likely to be greater during operation than construction. Based on the risk matrix included in Appendix F, the collision potential for this species was considered moderate as this species forages widely and roosts in hollows. Hollow-bearing tree clearance has been avoided where possible to date and will be further avoided where practical during the detailed design phase through the maintenance of a buffer of 30 m between all turbines and hollow-bearing trees where practical following construction.

Given the open nature of the landscape it is unlikely that the string of turbines would create cleared areas that would be used as fly ways by this species. Furthermore, the location of a wind farm in primarily open areas means that bats have large unobstructed areas through which to move throughout the study area and are therefore less likely to come in contact with turbines than they would be in cluttered landscapes.

Should the turbines require lighting, selection of lighting that minimises the likelihood of attracting insects and foraging bats will be reduce the risk of bat collision. Monitoring bat strike will be undertaken and an adaptive management approach implemented whereby additional measures are implemented should significant bat strike at certain turbines be recorded.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Areas of woodland and grassland provide potential foraging habitat for the Eastern Freetail-bat. Of the 1,883 ha of habitat present across the study site, up to approximately 140.72 ha of this will be permanently removed and 148.05 ha will be temporarily cleared. Combined, the proposed 288.77 ha of impact represents 15.3 % of the fauna habitat within the study area and approximately 2.9 % of the potential habitat within the project site. Extensive areas of potential habitat are present in the areas around the study area (eg. project site 9955.2 ha) and throughout the locality. Furthermore, the proposed habitat removal occurs over a large linear area and not in one consolidated block. Therefore, it is unlikely that the habitat loss due to the proposal would significantly reduce the available habitat for this species within the locality.

As a worst-case scenario, approximately 15, 934 HBT are estimated to be present across the study area and it is anticipated that up to 1,816 HBT (11.4 %) may be removed for the proposal. The distribution of HBT across the study area in not uniform and therefore this estimate is indicative only and is likely to be an over-estimate given many hollow-bearing trees will be avoided during micro-siting.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Eastern Freetail-bat occurs east of the Great Dividing Range from Southern New South Wales to south-east Queensland. The study area does not fall at the edge of its known range.

How is the proposal likely to affect current disturbance regimes?

The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires, and in the case of fire, access across the site will be improved for firefighting appliances.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. Given the linear nature of the proposal, the large home range of the species and that tree clearance has been minimised, it is considered unlikely that the proposal would affect habitat connectivity it terms of use by the Eastern Freetail-bat.

The landscape within the study area is one of open woodland and therefore the proposal is considered unlikely to result in fragmentation of habitat for this species which forages through open areas and fly ways.

How is the proposal likely to affect critical habitat?

Not applicable – critical habitat has not been declared for this species

***Nyctophilus corbeni* (South-eastern Long-eared Bat)**

The species has a preference for semi-arid areas. However, they have been recorded in the high rainfall areas of south-western Australia (Churchill 1998). In South Australia this species has been associated with a range of mallee species, and found to the fringes of the treeless Nullarbor Plain (Duncan et al. 1999). In northern NSW, this species is thought to prefer structurally complex forest as foraging habitat, and breeding and sheltering is in tree hollows (Environment Australia 2000). The species has had a recent name change from *N. timoriensis* to *N. corbeni*.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Nyctophilus spp. calls were detected on the site at three locations within the study area. It is difficult to identify difference species of *Nyctophilus* spp. from their echolocation calls. In some cases calls were identified as 'possible' calls to species level. However, in most cases, they were identified as *Nyctophilus* spp. which may include *N. geoffroyi*, *N. gouldi* or *N. corbeni*. Thus, *N. corbeni* has been included as a precautionary measure and its presence assumed for the purposes of the impact assessment.

Nyctophilus corbeni inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland (DECCW 2011b).

The species roosts in tree hollows, crevices, and under loose bark. Mating takes place in autumn with one or two young born in late spring to early summer (DECCW 2011b). Threats to the species include loss of remnant semi-arid woodland and mallee habitat, loss of hollow-bearing trees and application of pesticides in or adjacent to foraging areas (DECCW 2011b).

At the Sapphire site, the lifecycle of *N. corbeni* may be impacted by:

a) loss of potential foraging habitat and breeding sites;

b) a disruption to breeding if clearing of potential habitat occurs during the breeding season of late spring to early summer; and

c) casualties caused by accidental strike with the wind turbines.

In terms of loss of habitat, the area of woodland within the study area that could form potential habitat for *N. corbeni* is 882.33 ha. Assuming the highest degree of impact (the 80m turbine layout), the proposal requires permanent removal of 74.79 ha (8.48%) of woodland habitat and the temporary loss of 36.57 ha of woodland habitat. Given this is a relatively small impact within the study area, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

Hollow-bearing tree clearance has been avoided where possible to date and will be further avoided where practical during the detailed design phase through the provision of a buffer of 30 m between all turbines and hollow-bearing trees where practical following construction. To minimise the disturbance to roosting and breeding microbats, a pre-clearance protocol will be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing. These surveys will be undertaken to

determine if roosts are present in any trees proposed for clearing. Ecologist will be present on site during clearing to capture and re-release fauna. Therefore, the disturbance to roosting microbats will be minimised and managed during the clearing of potential habitat.

N. corbeni is a slow flying agile bat, utilising the understorey to hunt non-flying prey, especially caterpillars and beetles, and will even hunt on the ground. Based on the risk matrix included in Appendix F, the collision potential for this species was considered to be low, as this species forages below the canopy close to the ground.

Should the turbines require lighting, selection of lighting that minimises the likelihood of attracting insects and foraging bats will be reduce the risk of bat collision. Monitoring bat strike will be undertaken and an adaptive management approach implemented whereby additional measures are implemented should significant bat strike at certain turbines be recorded.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

N. corbeni is a threatened species in NSW. The proposed project will result in the permanent removal of 74.79 ha of woodland habitat (8.48 % of that in the study area) and the temporary loss of 36.57 ha of woodland habitat. However this potential habitat removal is unlikely to result in foraging and roosting resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat to be permanently removed (8.48 % of the study area);
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible;
- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand;
- retention of hollow-bearing trees where possible; and
- this species is known to forage over a wide area of up to 12 km from roosting sites.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Overall, the distribution of the south-eastern form of *Nyctophilus corbeni* coincides approximately with the Murray Darling Basin, with the Pilliga Scrub region being the distinct stronghold for this species (DECCW 2011b). At Sapphire, this species is not at the limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.

The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in

some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No adverse impacts to potential *Nyctophilus corbeni* habitat is expected to result from a reduction in grazing pressure from livestock and feral animals.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on *Nyctophilus corbeni* foraging and roosting habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, changes to the current disturbance regime as a result of the proposal that may impact *Nyctophilus corbeni* are not considered likely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that limited tree clearance is required it is considered unlikely that the proposal would create barriers to movement of the *Nyctophilus corbeni*, which is a highly mobile species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat)**

The Yellow-bellied Sheathtail-bat forages in most habitats across its very wide range, with and without trees and appears to defend an aerial territory. When foraging for insects, this species flies high and fast over the forest canopy, but lower in more open country. This species roosts singularly or in groups of up to six, in tree hollows and buildings and in treeless areas they are known to utilise mammal burrows. Seasonal movements are unknown but there is speculation about a migration to southern Australia in late summer and autumn (DECCW 2011b).

The Yellow-bellied Sheathtail-bat is a threatened species listed as Vulnerable under the TSC Act.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

This species was recorded in three locations including on the northern arm of the Wellingrove cluster approximately 2.5 kilometres west of Polhill Rd, at the western side of the northern arm within the Sapphire cluster and in the southern part of the Sapphire cluster adjacent to the current 330kV powerline. However, habitat for this species is available throughout the study area.

The Yellow-bellied Sheathtail-bat flies fast and straight, capable of tight lateral turns. It generally flies above the canopy but lower in open areas and at forest edges.

Impacts from the proposal on this species are likely to be greater during operation than construction. Based on the risk matrix included in Appendix F, the collision potential for this species was considered high as this species forages flies above the canopy and roosts in hollows. Hollow-bearing trees are extensive throughout woodland and open forest areas of the site. Although it is not realistic to completely remove the threat of collisions with turbines, a commitment to placing turbines at least 30 m away from hollow-bearing trees has been made in an attempt to reduce the likelihood of collisions at or near potential roost sites. Furthermore, the open nature of the landscape is such that it is unlikely that the turbines would create cleared areas that would be used as fly ways by this species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

As a worst-case scenario, approximately 15, 934 HBT are estimated to be present across the study area and it is anticipated that up to 1,816 HBT (11.4 %) may be removed for the proposal. The distribution of HBT across the study area in not uniform and therefore this estimate is indicative only. Areas of woodland and grassland provide potential foraging habitat for the Yellow-bellied Sheathtail-bat. Of the 1,883 ha of habitat present across the study site, up to approximately 140.72 ha of this will be permanently removed and 148.05 ha will be temporarily cleared. Combined, the proposed 288.77 ha of impact represents 15.3 % of the fauna habitat within the study area and approximately 2.9 % of the potential habitat within the project site. Extensive areas of potential habitat are present in the areas around the study area (eg. project site 9955.2 ha) and throughout the locality. Furthermore, the proposed habitat removal occurs over a large linear area and not in one consolidated block. Therefore, it is unlikely that the habitat loss due to the proposal would significantly reduce the available habitat for this species within the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. (DECCW 2011b). This species is close to the limit of its distribution at the project site.

How is the proposal likely to affect current disturbance regimes?

Landscape fire is relatively rare in subalpine environments in Australia (Wahren *et al.* 2002) so the threatened species potentially occurring in the study area are likely to be dependent on very low or no fire frequency. The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires.

Feral animals can also have a detrimental impact on threatened fauna through predation by species such as feral Cats and the European Red Fox. The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the project site naturally have large canopy gaps and a very open and more often absent understorey. Given the linear nature of the proposal, the large home range of the species and that tree clearance has been minimised, it is considered unlikely that the proposal would affect habitat connectivity it terms of use by the Yellow-bellied Sheath-tail Bat.

The landscape within the study area is one of open woodland and therefore the proposal is considered unlikely to result in fragmentation of habitat for this species which forages through open areas and fly ways.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

***Scoteanax rueppellii* (Greater Broad-nosed Bat)**
The Greater Broad-nosed Bat is a large powerful bat, up to 95 mm long, distinguished from other broad-nosed bats by its greater size (DECCW 2011b).

The Greater Broad-nosed Bat usually roosts in tree hollows and has been found in buildings. It utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. This species forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m (DECCW 2011b). The Greater Broad-nosed Bat is a threatened species listed as Vulnerable under the TSC Act. This species was recorded within the southern part of the Sapphire cluster adjacent to the current 330kV powerline via Anabat analysis.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Greater Broad-nosed bat flies slow and in a direct pattern with limited manoeuvrability along flyways or forest edges, at around 30 m or so in cluttered environments and low along creeks and small rivers. It forages through open woodland habitat and dry open forest which suits the direct flight of this species as it searches for beetles and other large, slow-flying insects. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young (DECCW 2011b).

This species was recorded within the southern part of the Sapphire cluster adjacent to the current 330kV powerline. At the site, the lifecycle of Greater Broad-nosed Bat may be impacted by: a loss of potential foraging habitat and breeding sites; a disruption to breeding if clearing of potential habitat occurs during the breeding season; and, casualties caused by accidental strike with the wind turbines.

In terms of loss of potential habitat, the area of woodland within the study area that could form potential habitat for Greater Broad-nosed Bat is 894.79 ha. Assuming the highest degree of impact (the 80m turbine layout), the proposal requires permanent removal of 75.36 ha (12.6 %) of woodland habitat and the temporary loss of 37.11 ha of woodland habitat. Given this is a relatively small impact within the study area, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

Hollow-bearing tree clearance has been avoided where possible to date and will be further avoided where practical during the detailed design phase. In addition, a buffer of 30 m between all turbines and hollow-bearing trees will be maintained during operation (where practical) to minimse the likelihood of bird and bat strike. To minimise the disturbance to roosting and breeding microbats, a pre-clearance protocol will be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing. These surveys will be undertaken to determine if roosts are present in any trees proposed for clearing. Ecologist will be present on site during clearing to capture and re-release fauna. Therefore, the disturbance to roosting microbats will be minimised and managed during the clearing of potential habitat.

Greater Broad-nosed Bat is a slow flying bat that hunts beetles and other flying insects. Based on the risk matrix included in Appendix F, the collision potential for this species was considered to be moderate, due to its direct flying pattern with limited manoeuvrability along flyways or forest edges and the proximity of potential roosts to the turbines.

Should the turbines require lighting, selection of lighting that minimises the likelihood of attracting insects and foraging bats will reduce the risk of bat collision. Monitoring bat strike will be undertaken and an adaptive management approach implemented whereby additional measures are implemented should significant bat strike at certain turbines be recorded.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Greater Broad-nosed Bat is a threatened species in NSW. The proposed project will result in the permanent removal of 75.36 ha of woodland habitat (12.6 % of that in the study area) and the temporary loss of 37.11 ha of woodland habitat. However this potential habitat removal is unlikely to result in foraging and roosting resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat to be removed (12.6 % of the study area);
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible;
- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand; and
- retention of hollow-bearing trees where possible.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 m (DECCW 2011b). The study area is not located at the edge of the species' known distribution.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.
The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No

adverse impacts to potential Greater Broad-nosed Bat habitat is expected to result from a reduction in grazing pressure from livestock and feral animals.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. It is unlikely that the proposal will significantly affect the fire regime such that high intensity fire would have a detrimental impact on Greater Broad-nosed Bat foraging and roosting habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, significant changes to the current disturbance regime as a result of the proposal that may impact Greater Broad-nosed Bat are considered unlikely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that limited tree clearance is required it is considered unlikely that the proposal would create barriers to movement of the Greater Broad-nosed Bat, which is a highly mobile species.

How is the proposal likely to affect critical habitat?

Not applicable – critical habitat has not been declared for this species.

***Vespadelus troughtoni* (Eastern Cave Bat)**

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. The Eastern Cave Bat flies in air space above creeks and in spaces in between trees interspersed with occasional rapid flights across paddocks foraging over a small area around 30 ha.

Very little is known about the biology of this uncommon species. It is a cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs and it has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally, it has been found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour (DECCW 2011b). .

The Eastern Cave Bat is a listed as a threatened species under the TSC Act. This species was recorded within the study area via Anabat analysis.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

At the site, the lifecycle of Eastern Cave Bat may be impacted by a loss of potential foraging habitat, and casualties caused by accidental strike with the wind turbines.

In terms of loss of potential habitat, the area of woodland within the study area that could form potential foraging habitat for Eastern Cave Bat is 894.79 ha. Assuming the highest degree of impact (the 80 m turbine layout), the proposal requires permanent removal of 75.36 ha (12.6 % of the study area) of woodland habitat and the temporary loss of 37.11 ha of woodland habitat. Given this is a relatively small impact within the study area, the proposal is considered unlikely to adversely affect the lifecycle of this species should it be present at the site.

Based on the risk matrix included in Appendix F, the collision potential for this species was considered to be low, due to the lack of breeding habitat within the study area. Although little is known of its biology, the species is likely to be insectivorous. Therefore, should the turbines require lighting, selection of lighting that minimises the likelihood of attracting insects and foraging bats will reduce the risk of bat collision. Monitoring bat strike will be undertaken and an adaptive management approach implemented whereby additional measures are implemented should significant bat strike at certain turbines be recorded.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposed project will result in the permanent removal of 75.36 ha of woodland habitat (12.6 % of that in the study area) and the temporary loss of 37.11 ha of woodland habitat. However this potential habitat removal is unlikely to result in foraging and roosting resources becoming limited within the project site for the following reasons:

- a relatively small area of potential habitat to be removed (12.6 % of the study area);
- a commitment to avoid tree clearance through sighting of wind turbines within previously cleared areas where possible;

- vegetation removal is to occur in linear fingers within clusters rather than one consolidated stand;
- this species is known to forage over a small area of up to 30 ha, and as potential habitat removal is distributed across the entire study area, it is likely that only part of a foraging range will be removed, if at all.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (DECCW 2011b). The study area does not lay at the limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. The proposal is considered unlikely to exacerbate over-grazing at the site. It may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire, which in turn can affect the abundance of invertebrates available as a food resource to microbats.

The risk of fire with wind farms is inherently low (CFA 2007). A low risk is associated with malfunctioning turbine bearings, inadequate crankcase lubrication, cable damage during rotation, electrical shorting or arcing occurring in transmission and distribution facilities (CFA 2007). A large portion of the study area is grassland and turbines in woodland areas have been located at least 30 m from trees wherever possible, therefore it unlikely that the proposal will dramatically alter fire patterns across the study area. Furthermore, a number of mitigation measures will be implemented during construction to prevent accidental fires and access to the study area for firefighting appliances will improve due to the construction of tracks.

The proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. No adverse impacts to potential Eastern Cave Bat habitat is expected to result from a reduction in grazing pressure from livestock and feral animals.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey. Given the linear nature of the proposal and that limited tree clearance is required it is considered unlikely that the proposal would create barriers to movement of the Eastern Cave Bat, which is a highly mobile species.

How is the proposal likely to affect critical habitat?

Not applicable – critical habitat has not been declared for this species

Reptiles

***Underwoodisaurus sphyrurus* (Border Thick-tailed Gecko)**
Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree (DECCW 2011b). They are most common in the granite country of the New England Tablelands on rocky hills with dry open eucalypt forest or woodland (DECCW 2011b). This species favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter (DECCW 2011b). These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Habitat for the Border Thick-tailed Gecko is present in isolated patches across the study area, in areas of potential and marginal potential habitat. Mapping is based on the following:

- Potential – granite or basalt, dense canopy, rocky outcrops and / or fallen timber
- Marginal potential – granite or basalt, agricultural land, limited rocky out crops fallen timber

The Border Thick-tailed Gecko shows a preference for steep rocky or scree slopes, especially granite although there are recent records from basalt and metasediment slopes and flats. This species favours forest and woodland areas with boulders, rock slabs, fallen timber, deep leaf litter and often a dense tree canopy that helps create a sparse understorey. However, they have been recorded in areas that were cleared for agriculture in the past (DECCW 2011b). It is likely that the majority of the study area is extremely marginal habitat for the Border Thick-tailed Gecko as woody debris is sparse and the understorey in most areas is grassy. Those areas mapped as potential habitat are more likely to support this species should it be present at the site as they support either rocky outcrops or fallen timber and also a dense canopy.

The majority of the habitat mapped as marginal potential is likely to be extremely marginal habitat for this species as it would primarily support a grassy understory with scattered woody debris and has been mapped as a precaution given that this species has been recorded in disturbed areas such as those cleared for agriculture in the past.

As a worst-case scenario (80 m layout), 18.73 ha of potential habitat and 49.65 ha of marginal potential habitat will be impacted, which represents 14.71 % of potential habitat (127.29 ha within the study area) and 11.26 % of marginal potential habitat (440.78 ha within the study area) within the study area respectively. Furthermore, this represents 1.6 % of total potential habitat (1,183.58 ha) and 1.2 % of total marginal potential habitat mapped (4,033.67 ha).

At the site, the lifecycle of the Border Thick-tailed Gecko may be impacted by the loss of habitat, particularly within the areas of mapped potential habitat. Habitat removal will impact the lifecycle of the species through a reduction in sheltering, foraging and breeding opportunities. However, given the relatively low amount of habitat disturbance across the study area, potential impacts to the lifecycle of the Border Thick-tailed Gecko are not considered to be significant. Targeted searches of potential habitat will be undertaken prior to clearing, with any species found relocated to undisturbed areas of adjacent potential habitat.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

While the species was not detected during the field survey, 1,183.58 ha of potential habitat and 4,033.67 ha of extremely marginal potential habitat has been mapped. As a worst-case scenario (80 m layout), 18.73 ha of potential habitat and 49.65 ha of marginal potential habitat will be impacted, which represents 14.71 % of potential habitat (127.29 ha within the study area) and 11.26 % of marginal potential habitat (440.78 ha within the study area) within the study area respectively. Furthermore, this represents 1.6 % of total potential habitat (1,183.58 ha) and 1.2 % of total marginal potential habitat mapped (4,033.67 ha). This disturbance is considered unlikely to represent a significant portion of the potential habitat for this species within the project site given the extent of habitat present.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Border Thick-tailed Gecko has a very limited distribution, only occurring on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree and is most common in the granite country of the New England Tablelands. It occurs at sites ranging from 500 to 1000 m elevation. Populations are apparently fragmented, with over 50 discrete sites currently known that are separated by at least 2 km (DECCW 2011b).

Sapphire is within the altitudinal range of the species, as the site is between 750-1100m AHD. The western limit of the species distribution is approximately 160 km to the west (Moree) and the southern limit is 160 km south at Tamworth. Therefore Sapphire is close to, but not at the limit of the species' known distribution. However, given the small distribution of the species within the cool highland granite belt of New England, any location within the species distribution is likely to be close to the edge of its range.

How is the proposal likely to affect current disturbance regimes?

Current disturbances at the site include cattle and sheep grazing, grazing by feral animals including the European Rabbit and European Hare, and periods of drought and rainfall consistent with the southern oscillation index and resultant cycles of drought (El Niño) and wetter periods (La Niña). There has been no major fire event in the last decade.

Threats to the Border Thick-tailed Gecko include grazing and trampling of habitat by domestic stock and feral goats. The site is grazed primarily by sheep and cattle and grazing pressure and management varies across the landscape. Feral goats have been recorded at the site. The proposal is considered unlikely to exacerbate over-grazing at the site, but may, in fact, contribute to a more sustainable grazing regime through the mitigation measures proposed in some parts of the site. In the absence of fire, grazing can be an important form of disturbance to prevent the accumulation of biomass that may not be favourable to some native flora species. Grazing will be periodically removed during construction, but should be reintroduced post-construction. Rotational periods of grazing and spelling help to foster healthy native pastures in the absence of fire.

Predation by foxes and feral cats threatens the Border Thick-tailed Gecko. However, the proposal is considered unlikely to contribute to increasing feral animal activity across the project site and instead is likely to assist with the management of these species through the proposed mitigation measures to be implemented within the study area and on the proposed offset sites. Positive impacts to potential Border Thick-tailed Gecko habitat is expected to result from a reduction in grazing pressure from livestock and feral animals and predation pressures from cats and foxes.

The risk of fire with wind farms is inherently low (CFA 2007). The location of wind turbines away from tall vegetation in the study area minimises the risk of fire. A threat to the Border Thick-tailed Gecko includes frequent burning of rocky dry open forest or woodland. It is unlikely that the proposal will increase the fire frequency at Sapphire and thus have a detrimental impact on potential Border Thick-tailed Gecko habitat. The proposed access roads will increase the accessibility across the site should a fire occur.

Therefore, significant changes to the current disturbance regime as a result of the proposal that may impact the Border Thick-tailed Gecko are considered unlikely.

How is the proposal likely to affect habitat connectivity?

The woodland and open forest areas of the study area have naturally large canopy gaps and a very open understorey, which therefore forms mostly marginal / low potential habitat for the Border Thick-tailed Gecko. Areas of potential habitat are restricted to granite or basalt areas with a dense canopy, rocky outcrops and / or fallen timber. Mapping of this potential habitat shows that they would occur as separate clusters within each of the three proposed turbine layouts being the Sapphire, Swan Vale and Wellingrove clusters. Within these areas of potential habitat, only a relatively small area of habitat will be cleared (1.6 % of potential habitat mapped).

Clearing within these potential habitat areas is restricted to linear areas for access roads (12 m wide during construction and rehabilitated to 6 m width post construction) and hardstand areas (approximately 45 m by 45 m) adjacent to each wind turbine for use by cranes during construction. Therefore, the maximum area of cleared habitat to be traversed by Border Thick-tailed Gecko between potential habitat is 45 m. This impact will be greatest within the Swan Vale cluster with very limited impacts within the Sapphire and Wellingrove clusters.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Appendix I: Biobank Credit Assessment Report

Sapphire Wind Farm

Indicative Biobanking Assessment Report

Prepared for
Wind Prospect CWP Pty Ltd

08 April 2011

Sapphire Wind Farm

Indicative Biobanking Assessment Report

PREPARED FOR	Wind Prospect CWP Pty Ltd
PROJECT NO	10SYDECO-0056
DATE	April 2011

DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Sapphire Wind Farm Indicative Biobanking Assessment Report
Project Number	10SYDECO-0056
File location	G:\Synergy\Projects\10SYDECO\10SYDECO-0056 Sapphire Wind Farm Part 3A\Report\Draft Reports
Prepared by	DJ
	TH
Approved by	RH
Status	Final
Version Number	0.1
Last saved on	08 April 2011

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Wind Prospect CWP Pty Ltd.

Contents

List of Figures

List of Tables

Abbreviations

ABBREVIATION	DESCRIPTION
BAMCCOM	Biobanking Assessment Methodology and Credit Calculator Operational Manual
DEC	Department of Environment and Conservation (now DECCW)
DECCW	NSW Department of Environment, Climate Change and Water
DNG	Derived Native Grassland
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
HBT	Hollow Bearing Tree
Project Site	Land within the cadastre boundaries of all properties likely to be directly impacted by the proposal
PTC	Paddock Tree Calculator
Study Area	Defined by the 100 metre buffer around the development footprint
Subject Site	The area directly impacted upon by the construction of the proposed action
TSC Act	NSW *Threatened Species Conservation 1995*

1 Introduction

An indicative Biobanking Assessment has been conducted for the proposed Sapphire wind farm (Figure 1) to inform the "quantum" of biodiversity offsets required in accordance with the Department of Environment, Climate Change and Water (DECCW) interim policy on Biodiversity offsets for Part 3A projects (DECCW 2010). While not a formal application for a Biobanking Statement, the approach has utilised the Biobanking Assessment Methodology (and the associated DECCW Improve or Maintain (IoM) principle) to calculate the area required to offset the ecological impact of the proposed Sapphire wind farm.

The assessment completed represents the 'worst case' scenario, in terms of ecological impact, caused by the various wind farm options. The assessment has assumed that the maximum turbine layout (159 2.05 MW turbines) will be selected, and has also utilised the 12m wide road design in the calculations. The impact of the wind farm may actually be less than calculated in this report should the final design utilise a smaller number of turbines and 6m wide roads (with 12m wide passing bays).

A full description of the proposal including turbine and road design options is provided in the Part 3A Ecological Assessment report (ELA 2011a).

The data used to undertake the indicative assessment is outlined in this report. Any assumptions made have been clearly identified and the credits required calculated. Due to the large geographic area of the proposal and the relatively small area of vegetation impacted, the demonstration of vegetation zones, threatened species sub zones and management zones using figures within this report could not be displayed effectively. Eco Logical Australia (ELA) can provide all data and the shapefiles created for DECCW to review the information contained in this report should they be required.

Although not an official application for a Biobanking Statement, the assessment has been conducted by an accredited Biobanking Assessor and follows the Biobanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009) for most aspects of the assessment. Some minor amendments to the methodology were agreed between ELA and DECCW before undertaking the assessment, including:

- The use of 3 assessment circles to assess landscape scores rather than the 15 required under the strict methodology;
- The entry of data against only one CMA subregion (rather than the two CMA subregions traversed by the proposed project).
- The use of local benchmarks (see local benchmark report in APPENDIX J of ELA 2011b);

All vegetation zones have the correct number of plots.

The accredited assessor details are as follows:

Assessor Name: Darren James
Accreditation Number: 0032
Biobanking Credit Calculator Version: 1.2

In summary, the calculations conducted as part of this assessment identified that 288.8 hectares of impact by this proposal will require 5,464 ecosystem credits, with the largest credit requirements being for Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast (4,686 credits) and White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (504 credits). The credit requirement will translate to an approximate offset requirement of between 607-781 hectares.

In addition, impact on 18.7 hectares of potential Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*) habitat will require 249 species credits. This translates to an offset of approximately 41.5 hectares, which can be obtained at the same location as the ecosystem credits.

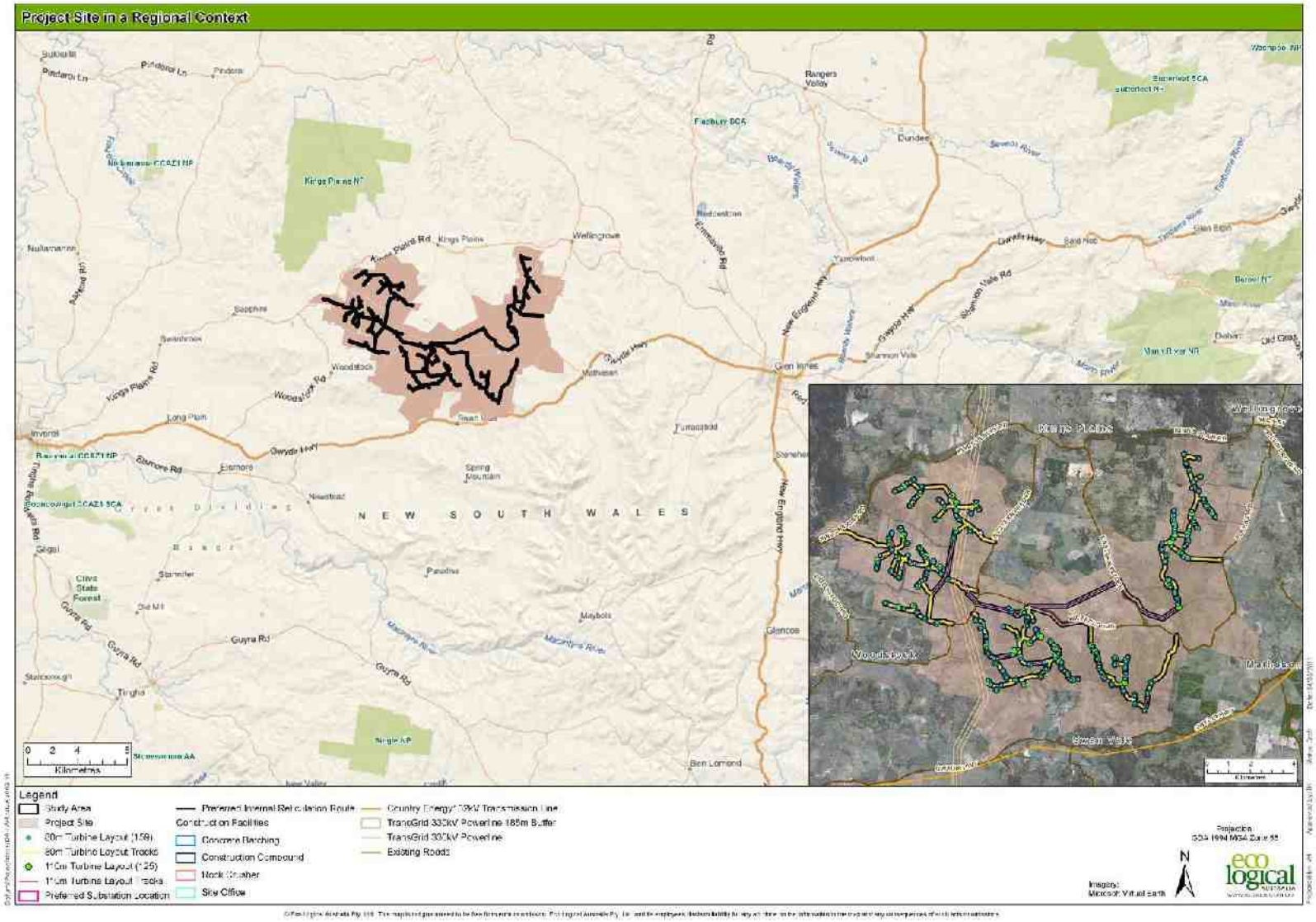

Figure 1: Study Area

2 Biobanking Assessment

The following sections provide the information collected and entered in order to complete the Biobanking Assessment for the Sapphire wind farm. Any limitations, amendments to the methodology or assumptions are provided.

2.1 IMPACT AREA

The impact area for the wind farm was divided into two broad categories, those with permanent loss and those areas with temporary loss. Areas of permanent loss include:

- Turbine footings;
- Area of permanent roads (including cut and fill);
- Loss of vegetation due to the construction of overhead powerlines;
- Substation footprint.

Areas of temporary loss are those areas that are to be cleared, but then revegetated with local provenance native vegetation and managed, and include:

- Area of temporary roads (including cut and fill);
- Concrete batching plants;
- Site office and construction compound;
- Rock crushing plants.

Different reductions in future site value score are recorded for both the permanent and temporary loss scenarios. These can be seen in Section 2.9. Where possible impact on large mature trees, particularly hollow bearing trees, will be avoided in both permanent and temporary impact areas. This objective is reflected in the future site value scores allocated to those areas.

2.2 VEGETATION TYPES

Biometric vegetation types were mapped on site and are mandatory when applying the Biobanking Methodology. Six revised Biometric vegetation types have been mapped on site, five of these are impacted by the proposal (Table 1). The five vegetation types impacted by the proposal have been stratified into 11 vegetation zones (see Section 2.7 and Figure 2). The following vegetation types were mapped on site:

1. Black Cypress Pine – Tumbledown Gum – Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion
2. Blakely's Red Gum – Rough-barked Apple – Red Stingybark grassy open forest of the Western New England Tablelands

3. Blakely's Red Gum – Yellow Box grassy open forest or woodland of the New England Tablelands
4. Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast
5. Tenterfield Woollybutt – Silvertop Stringybark open forest of the New England Tablelands
6. White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions

Table 1: Revised Biometric Vegetation Types and Impact

Revised Biometric Vegetation Type	Area of Permanent Loss (ha)	Area of Temporary Loss (ha)	Total Loss (ha)
BR110: Black Cypress Pine – Tumbledown Gum – Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion	0.9	0.4	1.3
BR114: Blakely's Red Gum – Rough-barked Apple – Red Stingybark grassy open forest of the Western New England Tablelands	0	0	0
BR116: Blakely's Red Gum – Yellow Box grassy open forest or woodland of the New England Tablelands	7.1	10.5	17.6
BR153: Manna Gum – Rough-barked Apple – Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	116.2	124.7	240.9
BR227: Tenterfield Woollybutt – Silvertop Stringybark open forest of the New England Tablelands	0.6	0.5	1.1
BR240: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	15.8	12.1	27.9
Total	**140.6**	**148.2**	**288.8**

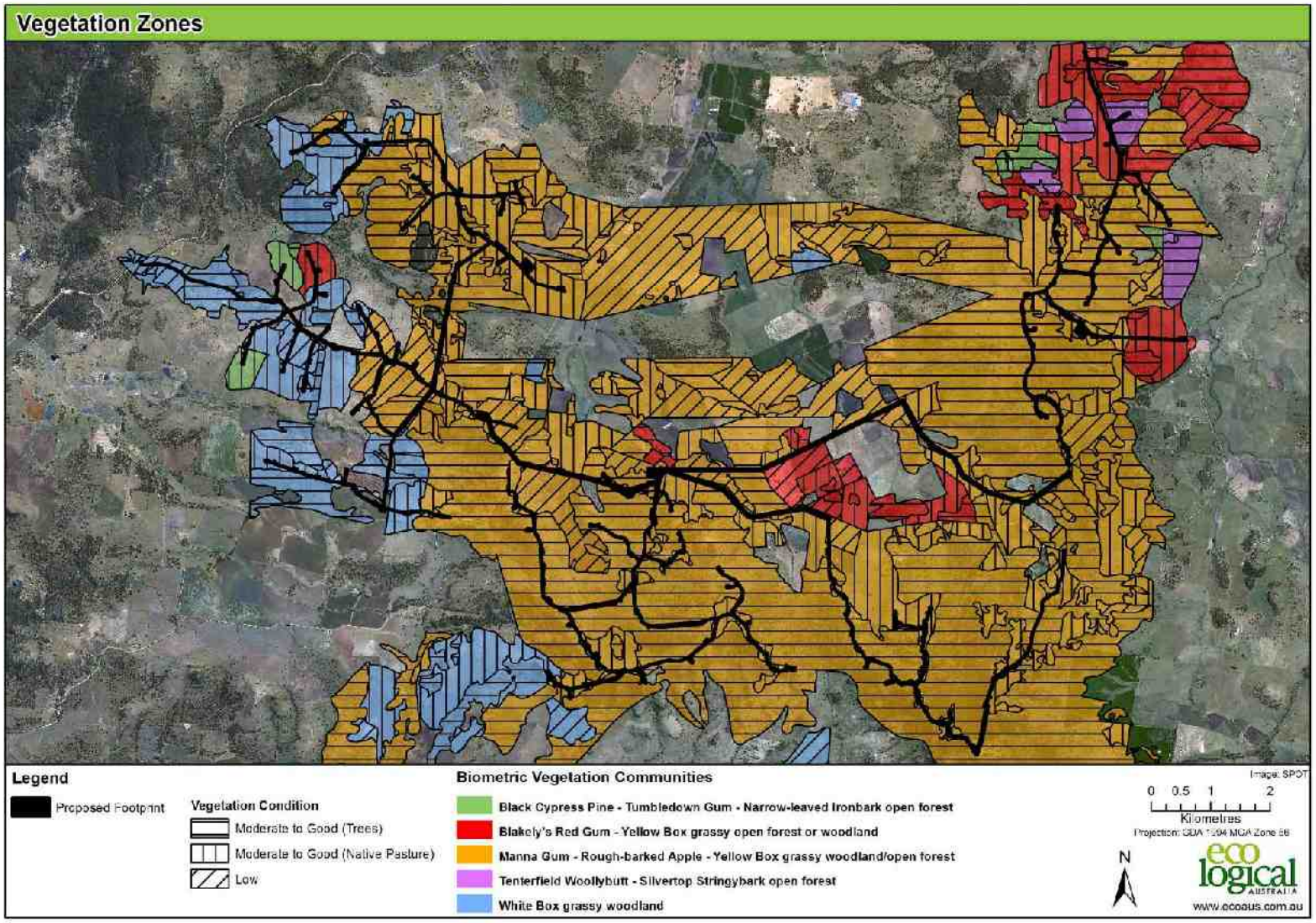

Figure 2: Vegetation Zones

2.3 CMA REGION, CMA SUBREGION AND MITCHELL LANDSCAPE

The site occurs wholly within the **Border Rivers/Gwydir** CMA region, however spans two CMA subregions (Figure 3). The proposal is predominantly within the Glen Innes-Guyra Basalts CMA subregion, however a small part of the proposal does cross into the Severn River Volcanics CMA subregion.

Due to a fault in the Biobanking Credit Calculator the entry of two CMA subregions is problematic. Therefore ELA approached DECCW to enter all data against the Glen Innes-Guyra Basalts CMA subregion, as it contains the majority of the subject site. DECCW has approved this approach, and therefore **Glen Innes-Guyra Basalts** CMA subregion has been entered into the credit calculator.

The study site, as it is long and linear, straddles several Mitchell Landscapes. The dominant Mitchell Landscape on site, where the majority of impact is occurring, is **Glenn Innes - Guyra Basalts**. The Mitchell Landscapes Version 3 data layer was used for this assessment.

2.4 ASSESSMENT CIRCLES

In a standard Biobanking Assessment enough 1000ha assessment circles (and associated 100ha assessment circles) are required to completely cover the whole development impact area, although DECCW are considering an amendment to this methodology for long, linear projects such as wind farms and roads (John Seidel pers. comm.).

Due to the extremely large geographic extent of the proposal up to fifteen 1000ha assessment circles would require entry into the credit calculator, with associated Threatened Species Sub Zones, to strictly follow the Biobanking Assessment Methodology. As the impact across each of the 1000ha circles is relative minor, and this assessment is indicative, an alternate approach was agreed between DECCW and ELA for this assessment. Three 1000ha assessment circles were identified for the proposal to allow for the full range of threatened species filtering across the site, while minimising data entry requirements. The three categories identified are **0-10%, 21-30%** and **51-60%**. Each of the fifteen circles were allocated to one of these categories (based on each circles vegetation cover), and the vegetation zones entered into the appropriate circle within the Biobanking Credit Calculator **(**Figure 4**)**.

For the purposes of this assessment, and due to the relatively small impact of the proposal within each 1000ha circle, the pre-development and post-development categories for native vegetation do not change for the 1000ha circles. However, as the relative impact of the proposal is larger on the 100ha circles, it was agreed with DECCW that the 100ha circles would drop one native vegetation cover class category. Therefore the 100ha circles drop from **51-60%** (pre-development) to **41-50%** (post-development) (Table 2).

Table 2: Area of Native Vegetation in Each Assessment Circle

Circle Number	Circle Size	Native Vegetation Cover Class- Before Development (%)	Native Vegetation Cover Class- After Development (%)
1	1000ha Circle	0-10%	0-10%
1	100ha Circle	51-60%	41-50%
2	1000ha Circle	21-30%	21-30%
2	100ha Circle	51-60%	41-50%
3	1000ha Circle	51-60%	51-60%
3	100ha Circle	51-60%	41-50%

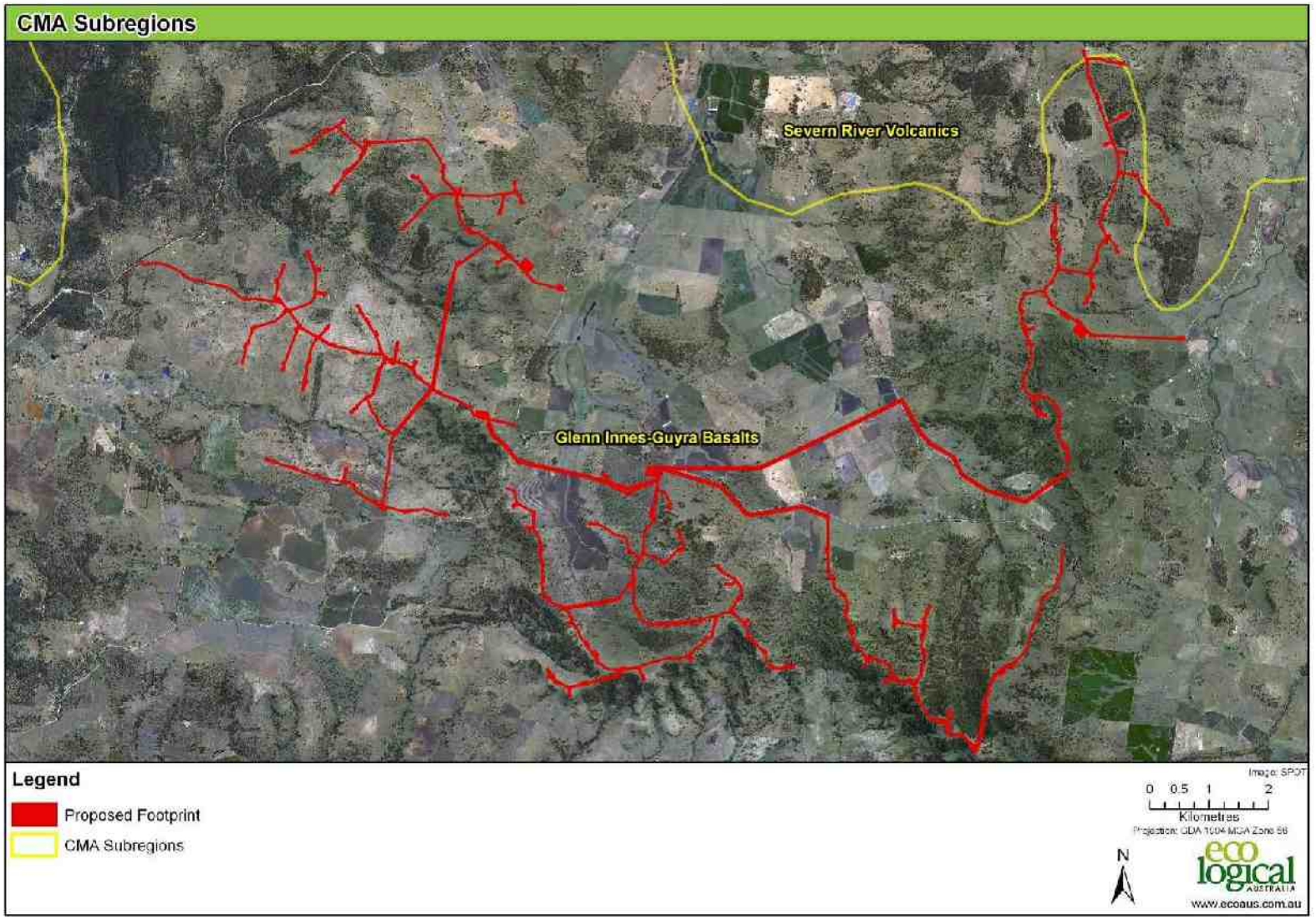

Figure 3: CMA Subregions

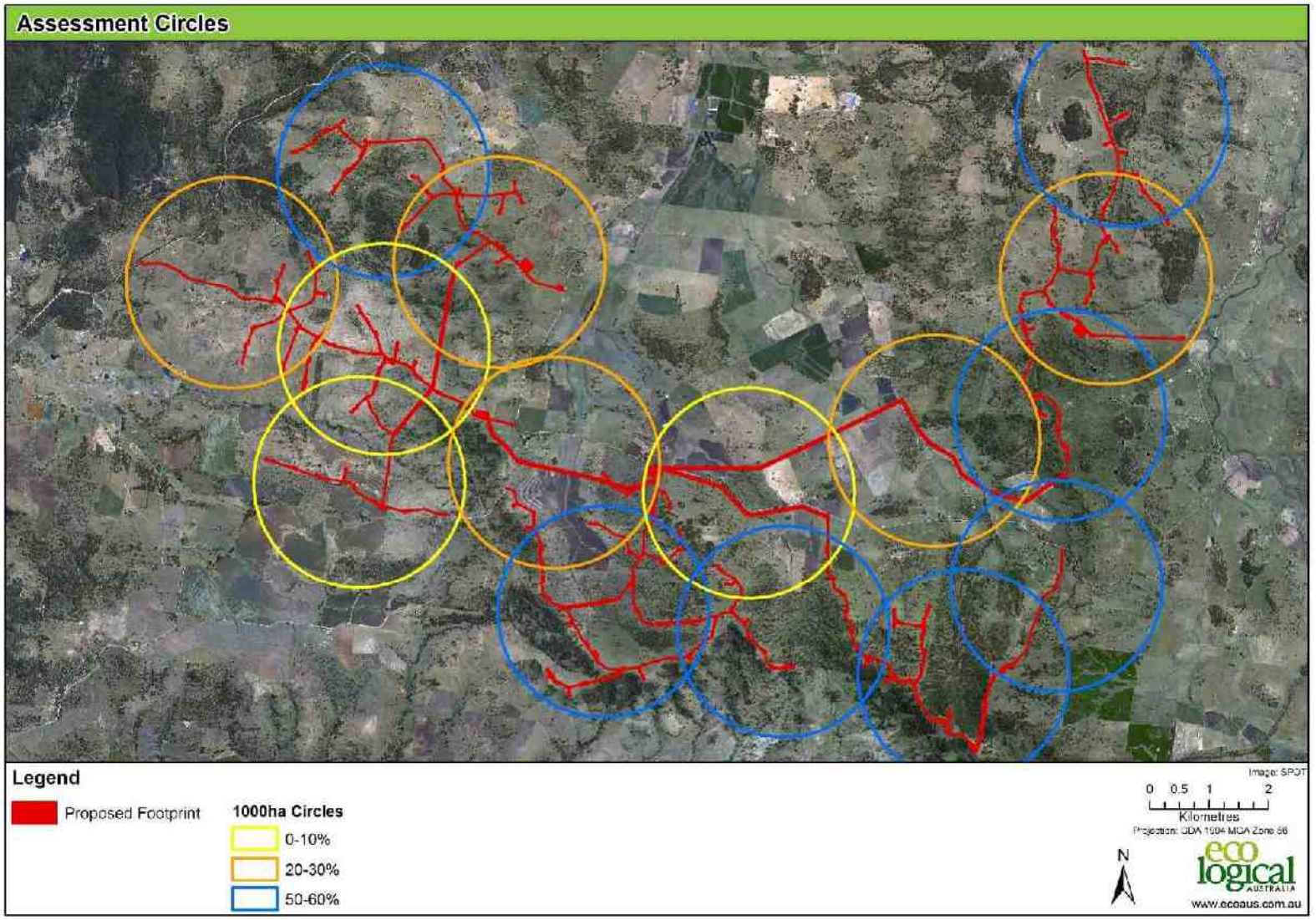

Figure 4: Assessment Circles

2.5 CONNECTIVITY ASSESSMENT

A connectivity assessment was conducted for the proposal using the technique outlined in the Biobanking Methodology. The following aspects were considered:

- The width of the current and future connecting link
- The condition of the current and future connecting link (over-storey and mid-storey/ground cover)

As the proposed development is contiguous, and any assessment circles would overlap, the Biobanking Methodology stipulates that only one connectivity assessment be conducted for the proposal.

Vegetated connections run off the site in all directions, and are extremely difficult to assess due to the lack of over-storey cover and extremely large study area. The north-west and north-eastern corners of the study area are close to larger vegetation remnants (including Kings Plains National Park), however the connectivity value of the site itself is mixed with much of the over-storey vegetation removed from woodland areas. The understorey, however, is generally in moderate/good condition as defined by the Biobanking Methodology.

Below is a description of the connectivity width assessment and connectivity condition assessment.

2.5.1 Connectivity Width Assessment

Although much of the over-storey vegetation has been removed from the site, field survey has confirmed that most of the vegetation remains in moderate/good condition due to the abundance of a native under-storey.

Due to the large extent of moderate/good vegetation, the current corridor width (before development) has been measured to the maximum width of **>500m**. This width occurs across the site.

The proposed development, with an average impact width of approximately 20m, does not break any connection as defined by the Biobanking Methodology (i.e. all connected vegetation remains within 100m of another patch). Therefore the connectivity width remains unchanged at **>500m** after development (Table 3).

Table 3: Connectivity Width Classes Before and After Development

	Width Class (Before Development)	Width Class (After Development)
Connectivity Value (Width)	>500m	>500m

2.5.2 Connectivity Condition Assessment

The connectivity condition assessment was undertaken on woody vegetation as woody vegetation types dominate the site. Two measures were used to assess the condition of the connection;

1. The condition of over-storey vegetation before and after development
2. The condition of ground cover vegetation before and after development

Over-storey vegetation has been cleared over much of the site and surrounding areas, however some areas of tree cover do remain. The average condition of the over-storey has therefore been assessed as "**PFC <25% of lower benchmark**". The impact on the condition of the over-storey vegetation on site

will be minimal. It is therefore expected that the average over-storey condition after development will remain the same at "**PFC <25% of lower benchmark**".

Ground cover vegetation across the site and surrounding areas for the woody vegetation types is in better condition than the over-storey, with significant native ground cover identified. From the field surveys the average condition of the ground cover has been measured as "**PFC mid-storey/ground cover >25% of lower benchmar**k". Again, the impact of the development will be minimal and the ground cover will remain at "**PFC mid-storey/ground cover >25% of lower benchmark**" after development (Table 4).

Table 4: Condition Classes Before and After Development

Storey	Condition Class (Before Development)	Condition Class (After Development)
Connectivity Value (Over-storey Condition)	PFC <25% of lower benchmark	PFC <25% of lower benchmark
Connectivity Value (/Ground Cover Condition)	PFC mid-storey/ground cover >25% of lower benchmark	PFC mid-storey/ground cover >25% of lower benchmark

2.6 GEOGRAPHIC AND HABITAT FEATURES

The following questions were asked in Step 2 of the calculator (Table 5). The default answer for these questions is "Yes", however an answer of "No" was given when confirmed after a field visit.

Table 5: Geographic and Habitat Questions and Answers

Question Does any part of the development impact on:	Answer
coastal headlands, grassland, grassy open forest or woodland on fertile or moderately fertile soils	Yes
grassy forest or woodland on fertile or moderately fertile soils	Yes
grassy open forest or woodland on either shallow soils or at the edges of gorges	Yes
heath on sandy soils, or moist areas in open forest	No
land containing caves or similar structures	No
land within 100 m of stream or creek banks	Yes
land within 40 m of rainforest, coastal scrub, riparian or estuarine communities	Yes
land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	Yes
seasonally wet/boggy sites (including table drains)	Yes
seeding native grasses within 100 m of water	Yes
shallow or infertile soils	Yes
land within eastern part of subregion in Nandewar, Northern Complex CMA subregion	No
land within far north-eastern part in Glen Innes-Guyra Basalts CMA subregion	No

2.7 VEGETATION ZONES

Vegetation zones are defined as areas of the same vegetation type and condition within the development area, and have been mapped for the study area. The area of each vegetation zone was determined by intersecting the broader study area vegetation zone data layer with the impact footprint derived from information provided by Wind Prospect CWP Pty Ltd.

ELA have assigned condition categories to all vegetation, with vegetation being assessed as "moderate/good" or "low" as per the Biobanking Methodology. In addition, the ancillary codes of "Native Pasture" (or derived grasslands) and "Trees" have been used to further stratify the site and differentiate areas of differing vegetation cover. In total 11 vegetation zones have been identified, with the area of each vegetation zone and its condition detailed in Table 6.

Table 6: Vegetation Zones within Impact Area for each Option

Veg Zone ID	Vegetation Type	Legal Cond.*	Ancillary Code	Area of Permanent Loss (ha)	Area of Temporary Loss (ha)	Total Impact (ha)
1	Black Cypress Pine - Tumbledown Gum - Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion	M/G	Native Pasture	0.9	0.4	1.3
2	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	Low		0.0	5.5	5.5
3	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	M/G	Native Pasture	6.1	4.5	10.6
4	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	M/G	Trees	1.0	0.5	1.5
5	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	Low		14.3	36.2	50.5
6	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	M/G	Native Pasture	33.3	56.6	89.9
7	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	M/G	Trees	68.6	31.9	100.5
8	Tenterfield Woollybutt - Silvertop Stringybark open forest of the New England Tablelands	M/G	Trees	0.6	0.5	1.1
9	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Low		2.7	1.6	4.3
10	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	M/G	Native Pasture	7.9	6.4	14.3
11	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	M/G	Trees	5.2	4.1	9.3
N/A	**N/A**	**N/A**	**N/A**	**140.6**	**148.2**	**288.8**

*M/G- Moderate/Good

2.8 SITE SURVEY

The Biobanking Methodology requires field survey to be undertaken on-site to accurately calculate credits. Field survey consists of:

- Transects/plots to sample vegetation zones
- Targeted threatened species survey for species identified by the credit calculator

Eco Logical Australia undertook the required number of transects/plots and targeted threatened species surveys across the Project and Subject site. The details of these surveys can be found in the main body of the Environment Assessment (EA) Report (ELA 2011a).

2.8.1 Vegetation Plots

In total 40 plots were undertaken within the vegetation zones being impacted by the proposal (a minimum of 30 plots are required for the proposed layout) (Table 7 and Figure 5). The minimum number of vegetation plots were completed for all vegetation zones, with some vegetation zones having more than the minimum number of plots completed. The completion of additional plots was generally caused by changes to the impact footprint, which has lead to changes in the area of each vegetation zone being impacted and therefore the number of plots required for each zone. The attributes recorded for each plot are outlined in Appendix 1.

It is important to note that some of the plots have not been undertaken within the actual impact area of the wind farm, but have been undertaken within the broader vegetation zone mapped in the study area. It was not possible to undertake all plots within the wind farm footprint due to changes in the footprint and the size of the impact (narrow roads make it difficult to complete vegetation plots). This approach is consistent with large projects where the actual impact site is adjusted regularly during the planning phase.

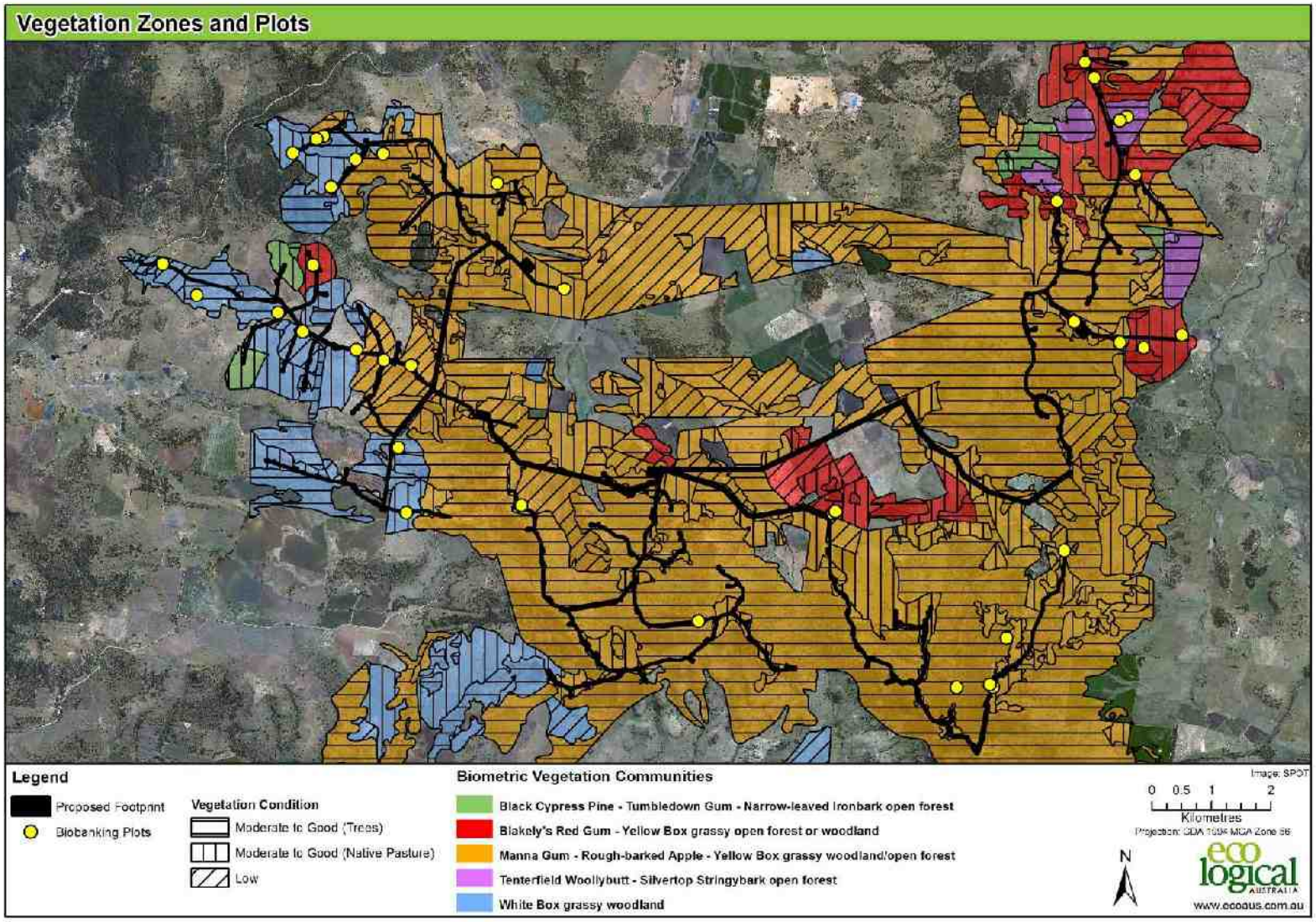

Figure 5: Vegetation Zones and Plots

Table 7: Number of Plots Required

Veg Zone ID	Vegetation Type	Legal Cond.	Ancill. Code	Total Impact (ha)	Plots Req.	Plots Collected
1	Black Cypress Pine - Tumbledown Gum - Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion	M/G	Native Pasture	1.3	1	3
2	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	Low		5.5	2	2
3	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	M/G	Native Pasture	10.6	3	4
4	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	M/G	Trees	1.5	1	3
5	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	Low		50.5	3	3
6	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	M/G	Native Pasture	89.9	5	6
7	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	M/G	Trees	100.5	6	6
8	Tenterfield Woollybutt - Silvertop Stringybark open forest of the New England Tablelands	M/G	Trees	1.1	1	2
9	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Low		4.3	2	3
10	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	M/G	Native Pasture	14.3	3	5
11	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	M/G	Trees	9.3	3	3
N/A	**N/A**	**N/A**	**N/A**	**288.8**	**30**	**40**

2.8.2 Local Benchmarks

The Biobanking Assessment Methodology allows and encourages assessors to collect benchmark data from local reference sites, particularly when the standard benchmarks provided are at a vegetation class rather than vegetation type level. This locally collected data generally reflects the local environmental condition of the vegetation more closely than the CMA wide benchmarks. ELA collected local benchmark data in accordance with Section 2.11.2 and 3.4.3 of the BAMCCOM for all vegetation types impacted. A “request to use” local Benchmark data report has also been prepared (Appendix J of ELA 2011b).

DECCW agreed to the use of the local benchmarks by ELA, and the benchmarks have been amended in the tool to reflect the local data. The data entered for each vegetation type is provided below (Table 8 to Table 12).

Table 8 Comparison of biometric benchmark, local benchmark plot data and calculated local benchmark for Vegetation Type BR110.

Keith Formation & Class: Dry sclerophyll forests (shrubby sub-formation) - Northern Tableland Dry Sclerophyll Forests					
Vegetation Type: Black Cypress Pine - Tumbledown Gum - Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion					
Veg Type ID: BR110	**Current Benchmark**	**Plot 1**	**Plot 2**	**Plot 3**	**Revised Local Benchmark**
20m x 20m Plot					
Native plant species	30	46	40	43	≥43
50m transect					
Native over-storey cover	25-40	21	20	23.5	20-23
Native mid-storey cover	6-25	0	0	2	*0-2
Native ground cover (grasses)	20-30	62	64	58	59-64
Native ground cover (shrubs)	3-10	2	0	0	0-2
Native ground cover (other)	3-5	58	30	34	31-53
50m x 20m plot					
Number of trees with hollows	2	9	5	8	≥8
Total length of fallen logs	20	210	234	220	≥220
Note: * Anything with a benchmark with a value of zero should be discussed with DECCW and changed to a value of 0.1 as per other benchmarks and correspondence with John Seidel.					

Table 9 Comparison of biometric benchmark, local benchmark plot data and calculated local benchmark for Vegetation Type BR116.

Keith Formation & Class: Grassy Woodlands - New England Grassy Woodlands					
Vegetation Type: Blakely's Red Gum - Rough-barked Apple - Red Stringybark grassy open forest of the western New England Tablelands					
Veg Type ID: BR116	**DECCW benchmark**	**Plot 1**	**Plot 2**	**Plot 3**	**Local Benchmark**
20m x 20 m plot					
Native plant species	25	39	38	39	≥39
50m transect					
Native over-storey cover	6-25	21.5	20	21	20-21
Native mid-storey cover	0-5	0	0	1	*0-1
Native ground cover (grasses)	30-40	48	42	44	42-47
Native ground cover (shrubs)	3-10	0	2	0	*0-2
Native ground cover (other)	3-5	24	12	20	14-23
50m x 20m plot					
Number of trees with hollows	1	6	3	5	≥5
Total length of fallen logs	15	95	73	57	≥73
Note: * Anything with a benchmark with a value of zero should be discussed with DECCW and changed to a value of 0.1 as per other benchmarks and correspondence with John Seidel.					

Table 10 Comparison of biometric benchmark, local benchmark plot data and calculated local benchmark for Vegetation Type BR153.

Keith Formation & Class: Grassy Woodlands - Tableland Clay Grassy Woodlands					
Vegetation Type: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast					
Veg Type ID: BR153	**DECCW benchmark**	**Plot 1**	**Plot 2**	**Plot 3**	**Local Benchmark**
20m x 20 m plot					
Native plant species	23	38	31	38	≥38
50m transect					
Native over-storey cover	6-25	18.5	12	21.5	13-21
Native mid-storey cover	0-5	0	0	0	*0-0
Native ground cover (grasses)	30-40	80	62	72	64-78
Native ground cover (shrubs)	0	8	10	2	3-10
Native ground cover (other)	3-5	16	0	16	3-16
50m x 20m plot					
Number of trees with hollows	1	0	1	4	≥1
Total length of fallen logs	15	146	31	133	≥133
Note: * Anything with a benchmark with a value of zero should be discussed with DECCW and changed to a value of 0.1 as per other benchmarks and correspondence with John Seidel.					

Table 11 Comparison of biometric benchmark, local benchmark plot data and calculated local benchmark for Vegetation Type BR227.

Keith Formation & Class: Dry sclerophyll forests (shrub/grass sub-formation) - New England Dry Sclerophyll Forests					
Vegetation Type: Tenterfield Woollybutt - Silvertop Stringybark open forest of the New England Tablelands					
Veg Type ID: BR227	**DECCW benchmark**	**Plot 1**	**Plot 2**	**Plot 3**	**Local Benchmark**
20m x 20 m plot					
Native plant species	33	53	35	49	≥49
50m transect					
Native over-storey cover	25-40	30.5	18.5	15.5	16-28
Native mid-storey cover	6-25	4	2	0	*0-4
Native ground cover (grasses)	18-20	12	36	84	17-74
Native ground cover (shrubs)	3-10	14	18	4	6-17
Native ground cover (other)	3-5	8	18	18	10-18
50m x 20m plot					
Number of trees with hollows	2	4	3	0	≥3
Total length of fallen logs	20	80	364	157	≥157
Note: * Anything with a benchmark with a value of zero should be discussed with DECCW and changed to a value of 0.1 as per other benchmarks and correspondence with John Seidel.					

Table 12 Comparison of biometric benchmark, local benchmark plot data and calculated local benchmark for Vegetation Type BR227.

Keith Formation & Class: Dry sclerophyll forests (shrub/grass sub-formation) - New England Dry Sclerophyll Forests					
Vegetation Type: Tenterfield Woollybutt - Silvertop Stringybark open forest of the New England Tablelands					
Veg Type ID: BR227	**DECCW benchmark**	**Plot 1**	**Plot 2**	**Plot 3**	**Local Benchmark**
20m x 20 m plot					
Native plant species	33	53	35	49	≥49
50m transect					
Native over-storey cover	25-40	30.5	18.5	15.5	16-28
Native mid-storey cover	6-25	4	2	0	*0-4
Native ground cover (grasses)	18-20	12	36	84	17-74
Native ground cover (shrubs)	3-10	14	18	4	6-17
Native ground cover (other)	3-5	8	18	18	10-18
50m x 20m plot					
Number of trees with hollows	2	4	3	0	≥3
Total length of fallen logs	20	80	364	157	≥157
Note: * Anything with a benchmark with a value of zero should be discussed with DECCW and changed to a value of 0.1 as per other benchmarks and correspondence with John Seidel.					

2.8.3 Paddock Tree Calculator

The Paddock Tree Calculator (PTC) was used for degraded vegetation zones where data for over-storey cover and the number of hollows was difficult to collect (as described in Section 3.3 of the BAMCCOM). The PTC data was collected for areas of low condition, along with areas of native pasture.

The data entered into the PTC included:

- Average crown diameter of paddock trees;
- Average per cent foliage cover of paddock trees;
- Number of paddock trees and sample area;
- Lower benchmark for the vegetation type (taken from ELA local benchmarks);
- Number of hollow bearing trees (HBTs) in sample area.

The vegetation zones where the PTC was applied, and the results, are provided in Table 13. Two vegetation types (Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast and White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions) have used the same PTC data for both low condition and native pasture vegetation zones as their characteristics are very similar.

Please note that due to a fault in the tool the hollow data from the PTC (which is not expressed as a whole number i.e. 1.2 HBT per plot) cannot be entered into the Biobanking Credit Calculator tool. ELA have therefore amended the data entered into the tool to attempt to reflect the PTC values for hollows in the final site value score (Appendix 1).

Table 13: Results of the Paddock Tree Calculator

Veg Zone ID	Vegetation Type	Legal Cond.	Ancill. Code	Over-storey Results	No. Hollows
1	Black Cypress Pine - Tumbledown Gum - Narrow-leaved Ironbark open forest of northern parts of the Nandewar Bioregion	M/G	Native Pasture	0.6	1
3	Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	M/G	Native Pasture	0.6	0.21
5	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	Low		0.8	0.19
6	Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tablelands and North Coast	M/G	Native Pasture	0.8	0.19
9	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Low		0.6	0.23
10	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	M/G	Native Pasture	0.6	0.23

2.8.4 Targeted Threatened Species Surveys

The Biobanking Credit Calculator identified 14 threatened species requiring survey. During the project nine of these species were targeted during survey (Table 14).

The targeted threatened species surveys were conducted throughout the study area in a manner consistent with the draft DEC Threatened Species Survey Guidelines (DEC 2004), and occurred between the months of October to December 2008, April and May 2009, September to December 2010 and January 2011. Full details on the survey undertaken can be seen in Section 4.0 of the Environmental Assessment Report (ELA 2011a).

In addition to the species requiring survey, some fauna species are “predicted” on the site and included in the calculation of ecosystem credits. Although predicted species do not require survey, some species did undergo survey as part of the broader environmental assessment process. Details can be seen in Appendix 2.