

Utilisation of habitat by Brolga (*Grus rubicunda*)
within the vicinity of the Macarthur Wind Farm - 2014

Report to AGL Energy Limited.

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1.0 INTRODUCTION

The Macarthur Wind Farm is currently the largest wind farm in the southern hemisphere, consisting of 140 turbines with a total capacity of 420 megawatts and is located on approximately 5,500 ha of privately owned agricultural land approximately 15km east of Macarthur in south-west Victoria. (Figure 1). Construction of the wind farm was completed in late 2012 and commissioned on 31 January 2013.

The Brolga (*Grus rubicunda*) is listed as threatened under the *Flora and Fauna Guarantee Act 1988* and classified as Vulnerable on the *Advisory List of Threatened Vertebrate Fauna in Victoria - 2013*. Much of the wind farm and surrounding landscape consists of wetland areas that provide habitat for Brolga, particularly during the wetter months. To assess the risk of Brolgas colliding with wind turbines, the Planning Permit for the site stipulated that a Bat and Avifauna Management Plan (BAM Plan) be developed which incorporated specific monitoring of Brolgas in the vicinity of the wind farm for at least two years following completion of the wind farm.

Pre-construction surveys of Brolgas within 40 km of the wind farm site were undertaken by Brett Lane and Associates Pty Ltd in April and October 2004. During the flocking season of April 2004, a total of 66 Brolgas were seen at four locations, ranging from two to 58 individuals at a site, most of which were located at Blackwood Lake, approximately 30 km north-east of the wind farm site. None were seen on the wind farm site. During the breeding season of October 2004, a total of six Brolgas, ranging from one to three individuals, were seen at three sites but all located at least 10 km from the wind farm. However, in September 2007 one pair of Brolgas was found on the wind farm site during an additional survey (BL&A 2005).

During construction of the wind farm from late 2010 to the end of 2012, a small number of Brolgas were seen on the site including one group of 10 juveniles. All Brolga sightings were reported to the Department of Sustainability and Environment. Two pairs constructed nests and attempted to breed, one of which successfully produced two chicks. These chicks were captured in October 2012 by Richard Hill (DEPI) and Inka Veltheim (University of Ballarat) to contribute to a PhD research project examining Brolga interactions with wind farms. Leg bands were attached to both chicks, and a satellite transmitter was fitted to one chick to monitor its movements over the following years.

Following completion of the wind farm, Australian Ecological Research Services Pty Ltd was engaged by AGL Energy Limited to undertake post-construction monitoring of any Brolga within the vicinity of the wind farm as required by the Planning Permit and BAM Plan. Brolga surveys were undertaken on and within 5 km of the wind farm during the flocking season (January to June) and within 3 km of the wind farm during the breeding season (July to December) throughout 2013. No Brolgas were found during the flocking season but up to 17 individuals consisting of seven pairs and three juveniles were seen within the vicinity of the wind farm during the breeding season (Wood 2013). Three pairs attempted nesting, two of which nested within the wind farm site and one nested approximately 2 km north of the northern-most wind farm boundary, but none were successful at producing offspring. Following discussions with the Department of Sustainability and Environment it was decided to

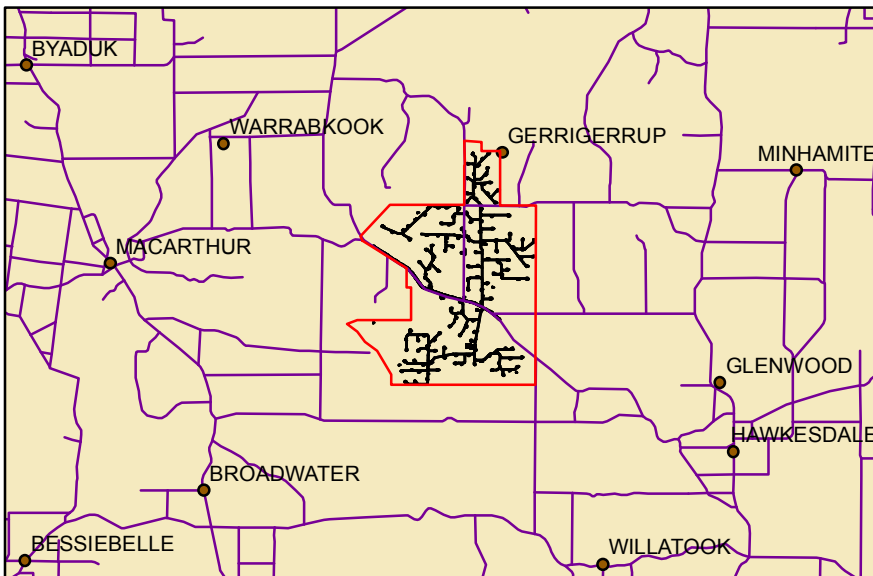
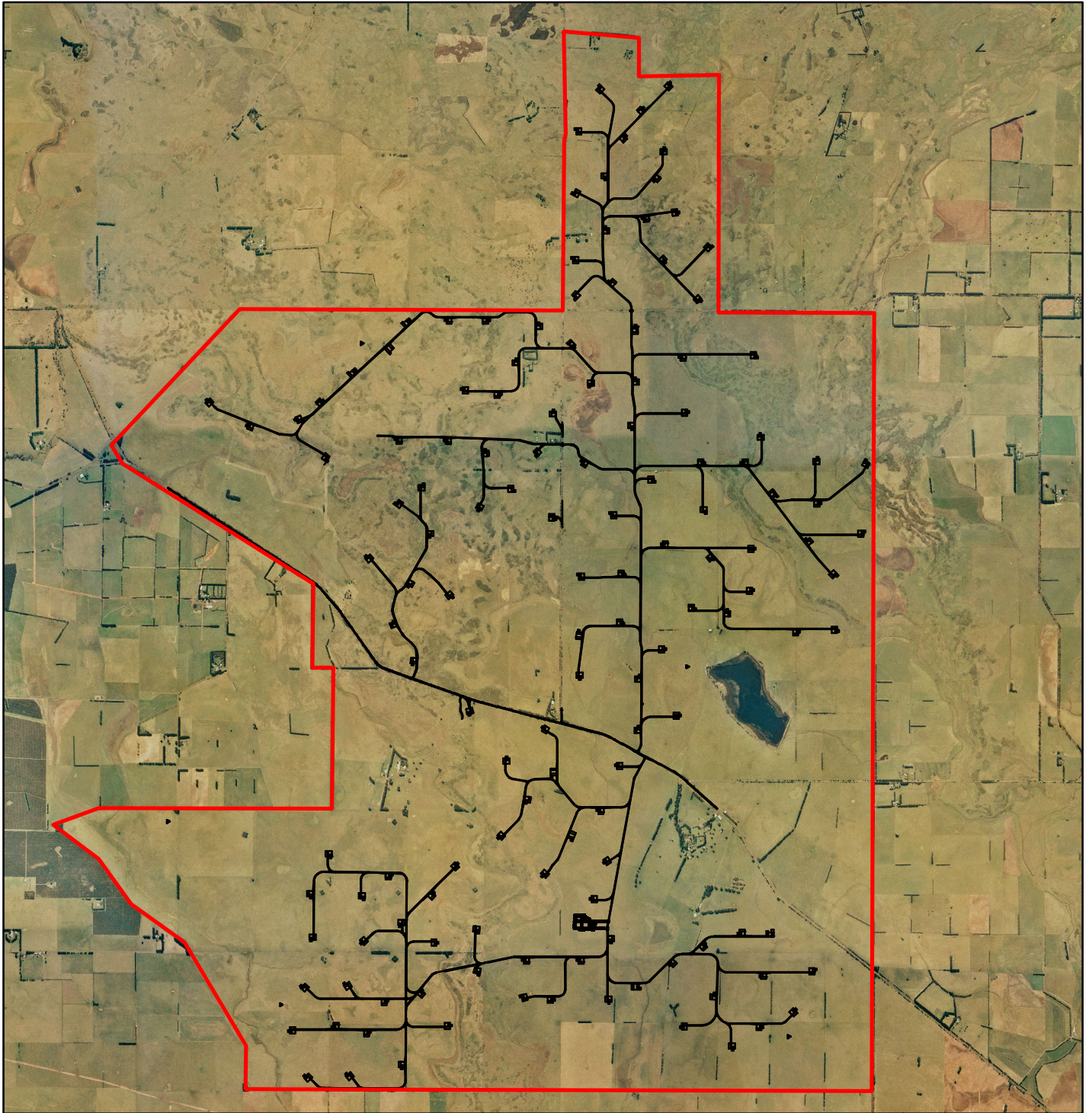
undertake future Brolga surveys only within the Breeding season as it was considered unlikely that any Brolga would be present during the flocking season due to the lack of suitable habitat during this time.

The following report details the results of the second year of Brolga monitoring undertaken during the breeding season of 2014, detailing the presence, behaviour and movements of Brolgas found within the vicinity of the Macarthur Wind Farm.

2.0 METHODS

Wetland mapping undertaken by the Department of Sustainability and Environment was reviewed to identify potential Brolga habitats within the survey areas, up to five km from the outermost turbines. Wetland mapping included the modelled distribution of wetlands predicted to occur in 1788 and also the current extent of wetlands as at 1994. Wetland mapping is shown in Figure 2. Many wetlands were inaccessible, being located on private property outside the wind farm boundary and were not visible from public roads. As such, only those wetlands that could be viewed were surveyed for the presence of Brolga.

Brolga surveys, consisting of weekly inspections of wetlands to determine if any Brolga were present, were undertaken on and within 3 km of the wind farm during the breeding season (July to December) of 2014. The locations of any Brolga found were recorded using GIS to plot their location over a digitised aerial image of the site and their behaviour was observed to determine whether they were foraging, courting or nesting. Whilst undertaking searches for other Brolgas in the survey area, additional locations and observations were recorded at approximately hourly intervals, when possible, for those found earlier that day. Whilst all effort was made to locate all Brolgas during each survey, particularly those that had previously been located, this was not achieved on several occasions when individuals or pairs had moved from previous locations and could not be found. Much of the wind farm and surrounding land consists of stony rises and undulating terrain, which limits vehicle access and visibility across the landscape. Brolgas that could not be found were perhaps hidden in areas of undulating terrain. In addition, when Brolgas had disappeared from one area and others were seen elsewhere, unless the birds were banded and individuals could be identified, it could not be definitively determined that the same individuals were seen in a new location.

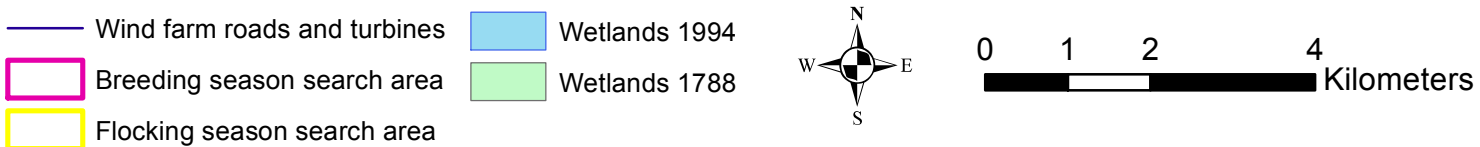
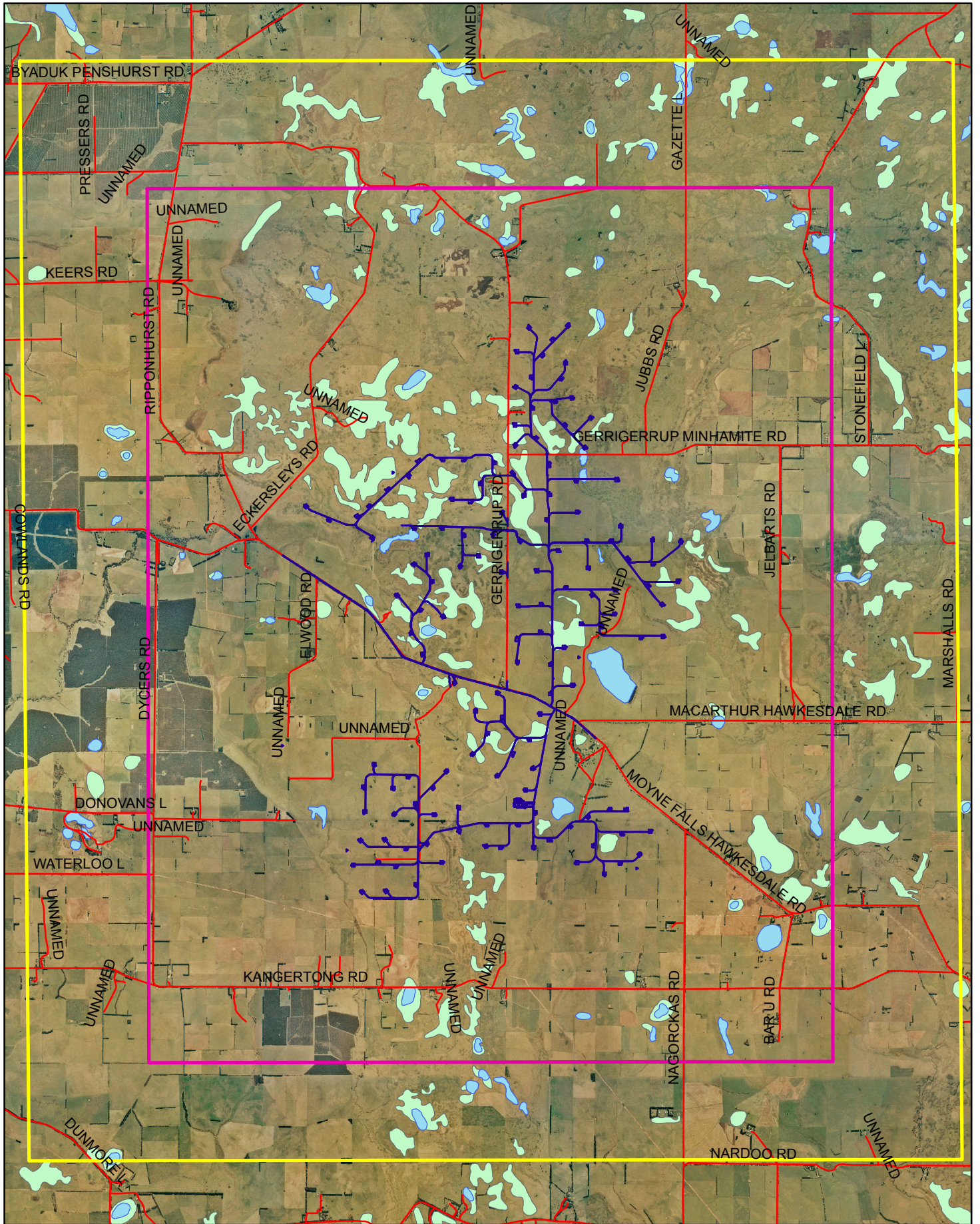


— MWF roads and turbines

— Wind Farm boundary



0 0.5 1 2 Kilometers



3.0 RESULTS

A total of 11 Brolgas, consisting of five adult pairs and one juvenile, were seen to utilise habitat within 3 km of the wind farm during the breeding season of 2014. All except one pair were found within the wind farm. The following describes observations of Brolgas found during weekly surveys.

Brolga pair 1.

The first pair of Brolgas to be seen within the vicinity of the wind farm during the 2014 breeding season was on 17 June at a large wetland approximately 1 km east of the substation. Later that day, the pair was observed to fly in a west-north-west direction for approximately 2 km to another wetland near turbine # 96 where they remained foraging within the wetland for at least the rest of the day. Their flight between the two wetlands was carefully observed to examine their behaviour around nearby turbines. Both flew at an altitude within the rotor swept area but appeared to make deliberate alterations to their course to avoid turbines, flying between them with a wide berth from each turbine they passed. It was confirmed that this pair of Brolgas were the same birds that were first seen on the wind farm in 2012 with two chicks and which attempted nesting again during the following breeding season of 2013 in a wetland east of turbine # 77. One of these birds had a distinctive white rump which assisted in identifying the pair from other Brolgas on site. During the next survey on 23 June 2014, the pair of Brolgas were again observed foraging at the same wetland near turbine # 96 and remained there for the entire day. On the morning of 30 June 2014, this pair of Brolgas were found at the wetland east of turbine # 77 where they had attempted nesting during the previous breeding season. Later that day they were found foraging on pasture 60m east of turbine # 45, approximately 2 km from their last known location. During observations at this location they were seen foraging and walking around the area and sometimes walking over the hard stand within 10m from the base of the turbine.

During the next survey on 7 July, this pair of Brolgas were seen foraging on an area of pasture approximately 100 - 200 m north-east of turbine # 18. Small patches of this area were inundated by water in which the Brolgas spent much of their time throughout the day.

On 15 July, Pair 1 was seen foraging in and around an area of inundated pasture approximately 50 m north of turbine # 93 and remained in this area for the rest of the day.

During the next survey on 23 July, Pair 1 was observed foraging in the wetland east of turbine # 77 where they had attempted breeding during the previous breeding season. Later that day they were observed to both fly approximately 3.5 km north to a wetland just north of turbine # 20. Observations of this flight again indicated that they consciously avoided the blades of turbines by flying at low altitude below the rotor-swept area; on one occasion flying directly underneath the rotating blades of a turbine.

On 1 August this pair was found foraging in an area of dry pasture to the south-east of turbine # 89 and east of turbine # 92 and spent the remainder of the day walking around and foraging over several hectares.

During the next survey on 6 August, these Brolgas had returned to the wetland near turbine # 20 and were observed to be constructing a nest in the middle of the wetland whilst periodically walking around and foraging within the wetland.

On 14 August, Pair 1 were observed to have laid two eggs on the nest (Plate 1). Both birds alternated nesting duties every hour or two whilst the other foraged mostly within the same wetland and surrounding pasture areas.

Plate 1. Photo of eggs on Brolga nest in wetland north of turbine # 20.



During the next survey on 22 August, Pair 1 were seen to be still nesting. One of the birds was observed to fly to a wetland approximately 1 km east-north-east of the nest site near turbine # 17 just north of Gerrigerrup-Minhamite Road. This bird foraged in and around this wetland returning to the nest to assist with incubation of the eggs every hour or two enabling the other bird to be relieved from the nest and forage nearby. This wetland was used regularly by the same Brolga over the following two weeks.

On 29 August, Brendan Ryan, Wind Energy Operations Manager – Vic, and myself set-up a temporary electric fence constructed using insulated star pickets and nylon electric fencing tape to exclude cattle from the wetland in which the Brolgas were nesting to prevent the eggs from being trampled by cattle (Plate 2). All effort was taken to minimise disturbance to the Brolga whilst erecting

the fence which surrounded the wetland and was at least 60m from the nest. Both Brolgas remained within the wetland, nesting and foraging throughout the day.

Plate 2. Photo of electric fence to exclude cattle from the wetland in which Brolgas were nesting.



On 8 September it was observed that a chick had hatched at the nest and both parents were foraging in very close proximity (Plate 3). The parents seemed to be very alert and intensively protecting the chick, hiding it in dense tussock grasses and occasionally moving from one tussock to another. Given that only one chick was seen, the nest was inspected on 10 September to determine whether only one or both eggs had hatched. Unfortunately, one chick was found dead at the side of the nest and appeared to have died soon after hatching, possibly from exposure to cold weather (Plate 4).

Plate 3. Photo of Brolga chick soon after hatching.



Plate 4. Photo of dead Brolga chick at side of nest.



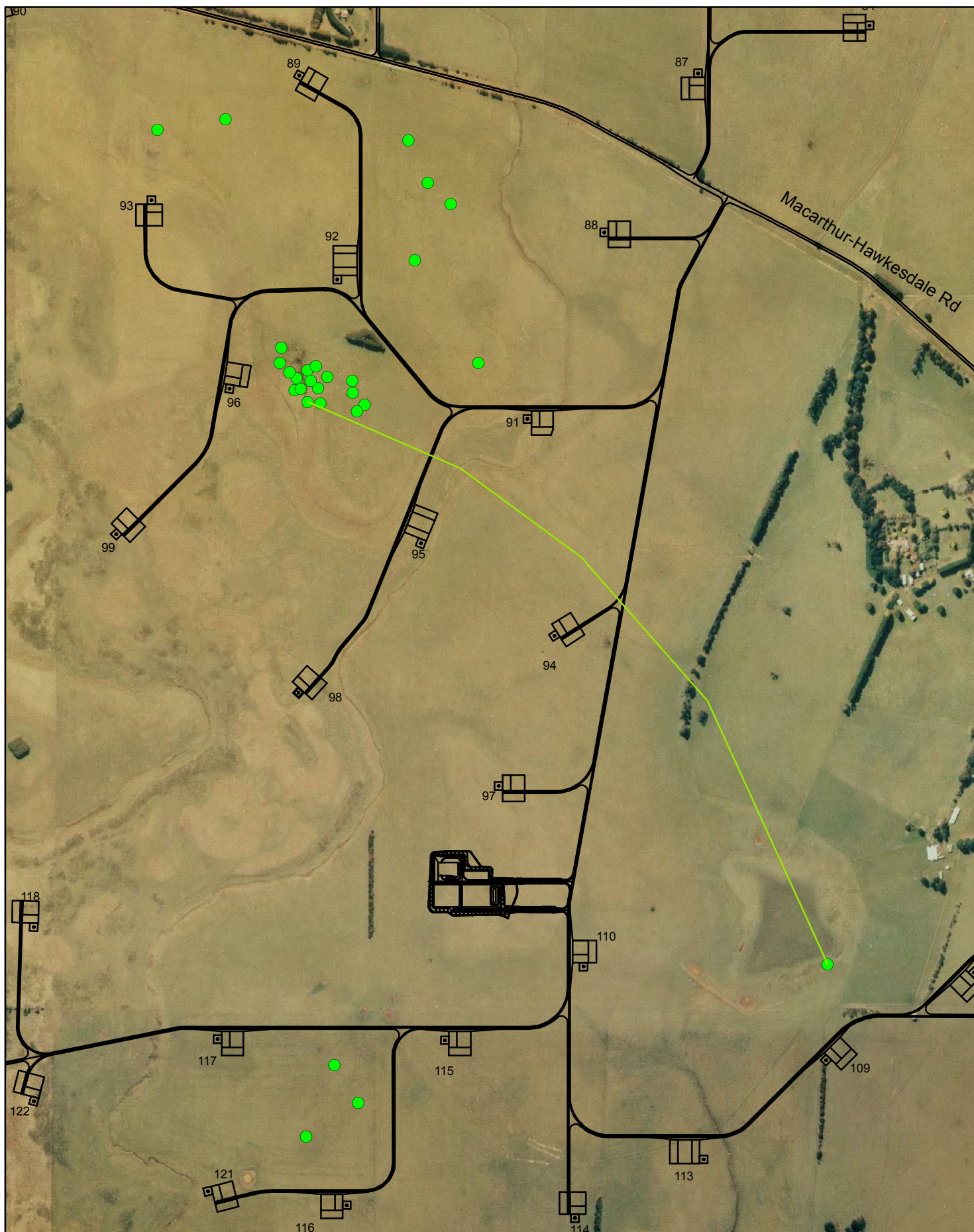
The parents and chick were observed again on 15 September but had moved to the wetland on the southern side of turbine # 20, approximately 170 m south of turbine # 30. Again they were observed to forage in close proximity to the chick. The chick was still hiding in dense vegetation but followed the parents when they moved on. The parents and chick were observed next on the 22 September. The chick had grown significantly and was more inclined to venture away from dense vegetation following its parents to more open areas of pasture (Plate 5).

During the next two surveys on 30 September and 7 October neither of these Brolgas were seen in the wetland where they were last located nor in any other areas within the survey area. It was suspected that the chick had been taken by a predator such as a fox or raptor and the parents had left the site. On 11 October, the parents were found at the wetland east of turbine # 96 but no sign of the chick. It appears that the chick had died, most likely from predation, particularly considering the distance travelled by the parents from where the chick was last seen. Both adults foraged within this wetland for the rest of the day. On 15 October this pair was seen foraging at the wetland east of turbine # 77 and later in the day were seen in the wetland south-east of turbine #16 in the northern section of the wind farm. It was not until 29 October when this pair was seen again in an area of dry pasture approximately 200 m north of turbine # 116 in the southern area of the wind farm. After this date they were not found within the survey area, possibly returning to flocking sites near Penshurst. The observed locations of this pair of Brolgas, including the location of their nest are shown in Figures 3 and 4.

Plate 5. Photos of Brolga chick at approximately 14 days old.



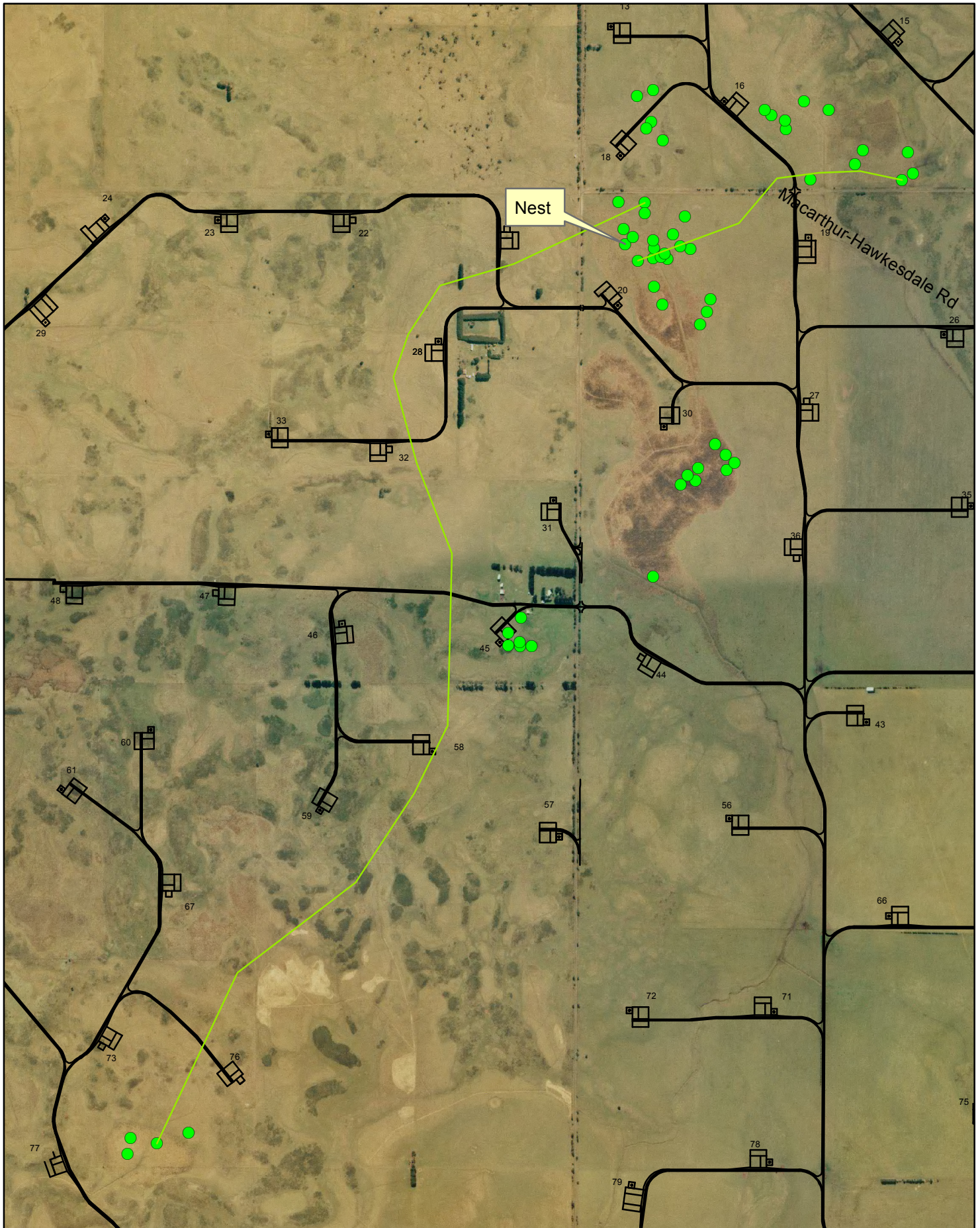
Figure 3. Locations of Brolga pair 1 observations (southern section)



- Brolga pair 1 locations
- Pair 1 observed flights
- Roads and turbines

0 125 250 500
Meters

Figure 4. Locations of Brolga pair 1 observations (northern section)



- Brolga pair 1 locations
- Pair 1 observed flights
- Roads and turbines



Brolga pair 2.

On 30 June, another pair of Brolgas with one juvenile were seen foraging on an area of pasture with small patches inundated by water to the west of Gerrigerrup Road and east of turbine # 28 (Plate 6). On return to the site, approximately one hour later, the birds had moved from this area but were relocated approximately 850 m to the north-west in an area of dry pasture just beyond the wind farm boundary.

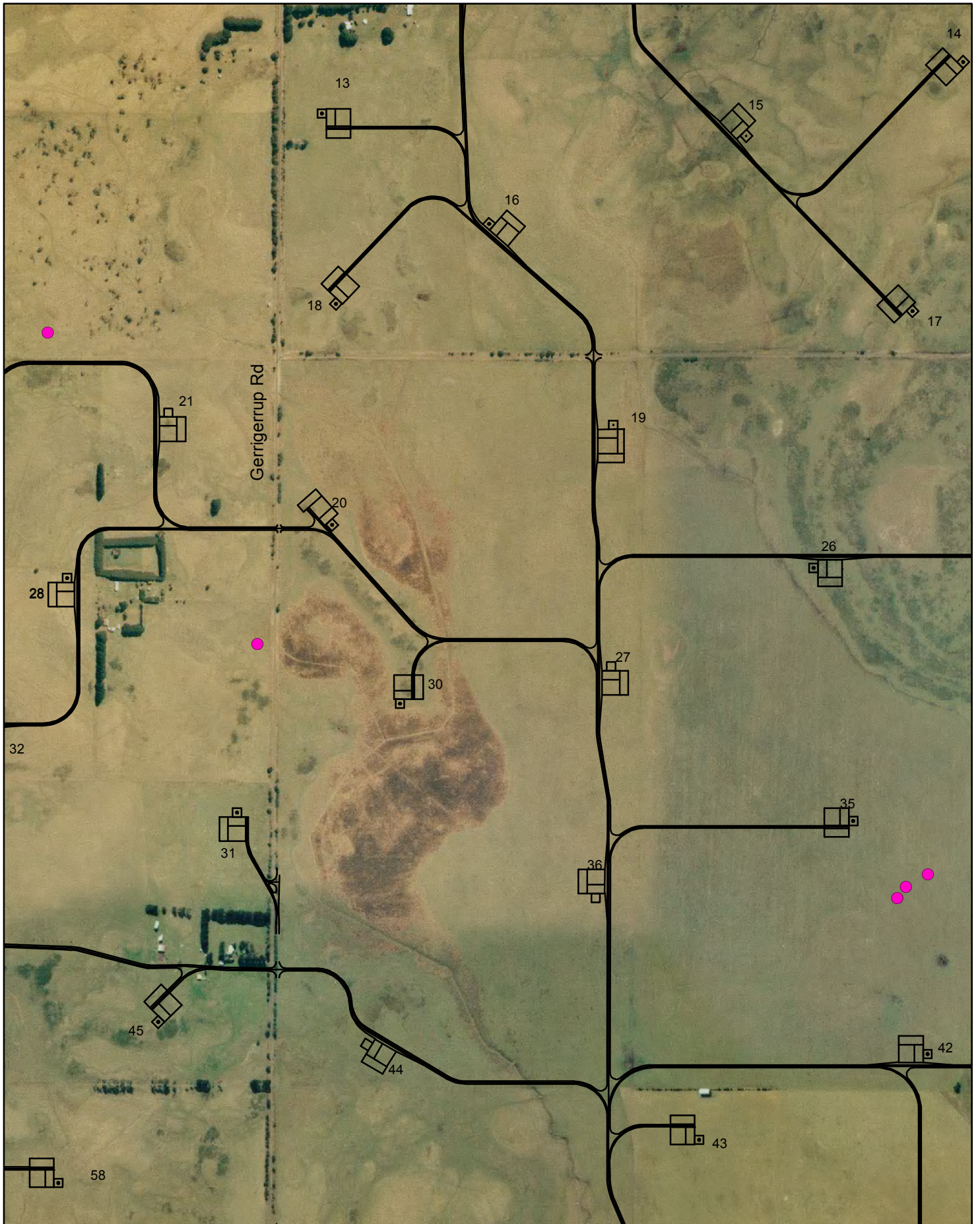
On 8 July a juvenile Brolga was seen foraging on pasture near turbine # 35. Soon after a pair of adult Brolgas were observed to fly in and aggressively chase the juvenile away. The juvenile may have been the offspring of the adults, conceived during the previous breeding season, which was now being forced to become independent from the parents. It is believed that these three Brolgas were those observed earlier on 30 June east of turbine # 28. The observed locations of this pair of Brolgas is shown in Figure 5.

Plate 6. Photo of Brolga pair with juvenile.

***Brolga pair 3.***

A pair of Brolgas was seen on 8 July foraging at a wetland approximately 200 m north-west of turbine # 34. These birds were not seen in again in any subsequent surveys. Figure 6 shows the observed locations of these Brolgas.

Figure 5. Locations of Brolga pair 2 observations

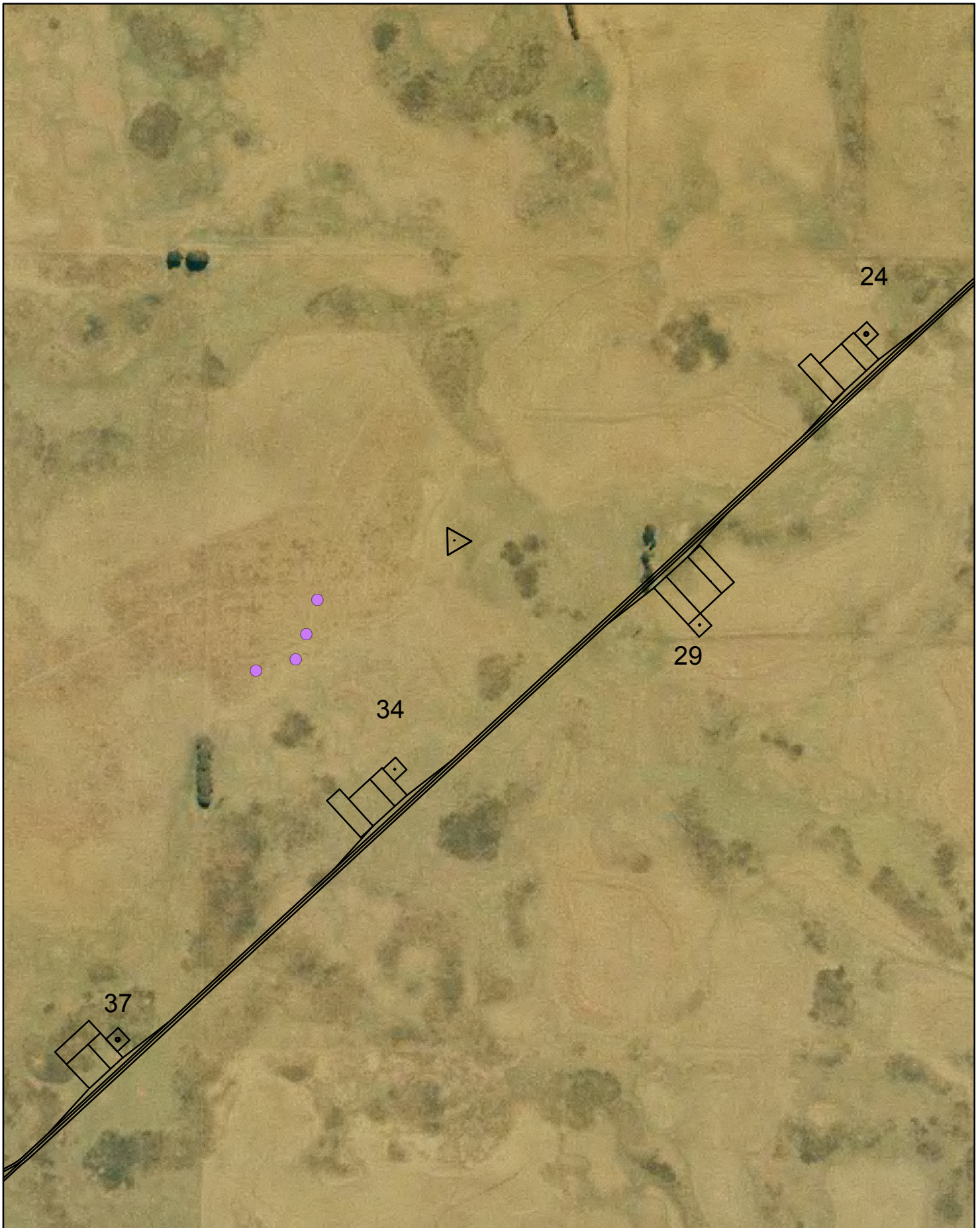


● Brolga pair 2 locations

— Roads and turbines

0 150 300 600
Meters

Figure 6. Locations of Brolga pair 3 observations



● Brolga pair 3 locations
— Roads and turbines

0 100 200 400
Meters

Brolga pair 4.

On 15 July another pair of Brolgas were found to be nesting in a wetland approximately 2 km north of the northern-most boundary of the wind farm. Whilst one bird sat on the nest, the other foraged nearby within the same wetland. This was at the same wetland adjacent to Gerrigerrup Road where a pair of Brolgas attempted nesting during the previous breeding season (Wood 2013). As Brolgas are known to use the same breeding sites throughout consecutive breeding seasons (Merchant and Higgins 1993), it is likely that this pair of Brolgas are those that used the site during the last breeding season.

On 23 July, one Brolga was seen sitting on the nest and appeared to be incubating at least one egg. The mate, however, was not seen but was possibly foraging in wetlands further to the north which were not accessible or visible from public roads. On 1 August, one Brolga was sitting on the nest but the mate was still not seen. During the next survey on 6 August, the nest had been abandoned and no Brolgas were seen within the wetland and were not seen in subsequent surveys. The observed locations of this pair of Brolgas, including the location of their nest is shown in Figure 7.

Brolga pair 5.

On 6 August, another pair of Brolgas were seen foraging in the far northern section of the wind farm, east of turbine # 3. These birds were observed to fly east from this area and landed approximately 850 m away in an area of pasture close to another wetland. Both flew at very low altitude and passed beneath the rotating blades of turbine # 1. As observed with Pair 1, these birds also appeared to deliberately fly at low altitude to avoid the blades of turbines. The observed flight path of these Brolgas is shown in Figure 7. Both birds spent the rest of the day walking and foraging around areas of pasture and near the edge of a wetland.

On 14 August both Brolgas were observed foraging further south near a small wetland south-east of turbine # 2. Both Brolgas were not seen during the following survey of 22 August but may have been in paddocks further north of the wind farm boundary which were not accessible or visible from the wind farm. On 29 August both were observed foraging in a drainage line approximately 850 m east of turbine # 1. During the next survey on 8 September, only one of the Brolgas was seen walking and foraging in a wetland approximately 450 m east of turbine # 1. However, on the next survey on 15 September, both Brolgas were seen foraging back at the drainage line where they had been seen on 29 August. Both brolgas were observed again on 22 September foraging at the edge of the wetland approximately 450 m east of turbine # 1, Both Brolgas were seen over the next three surveys on 30 September, 7 and 14 October foraging within and near this wetland. These brolgas appear to have left the site soon after this date as they were not seen in any subsequent surveys. During all observations of this Brolga pair there was no indication of any attempted breeding. The observed locations of this pair of Brolgas is shown in Figure 8.

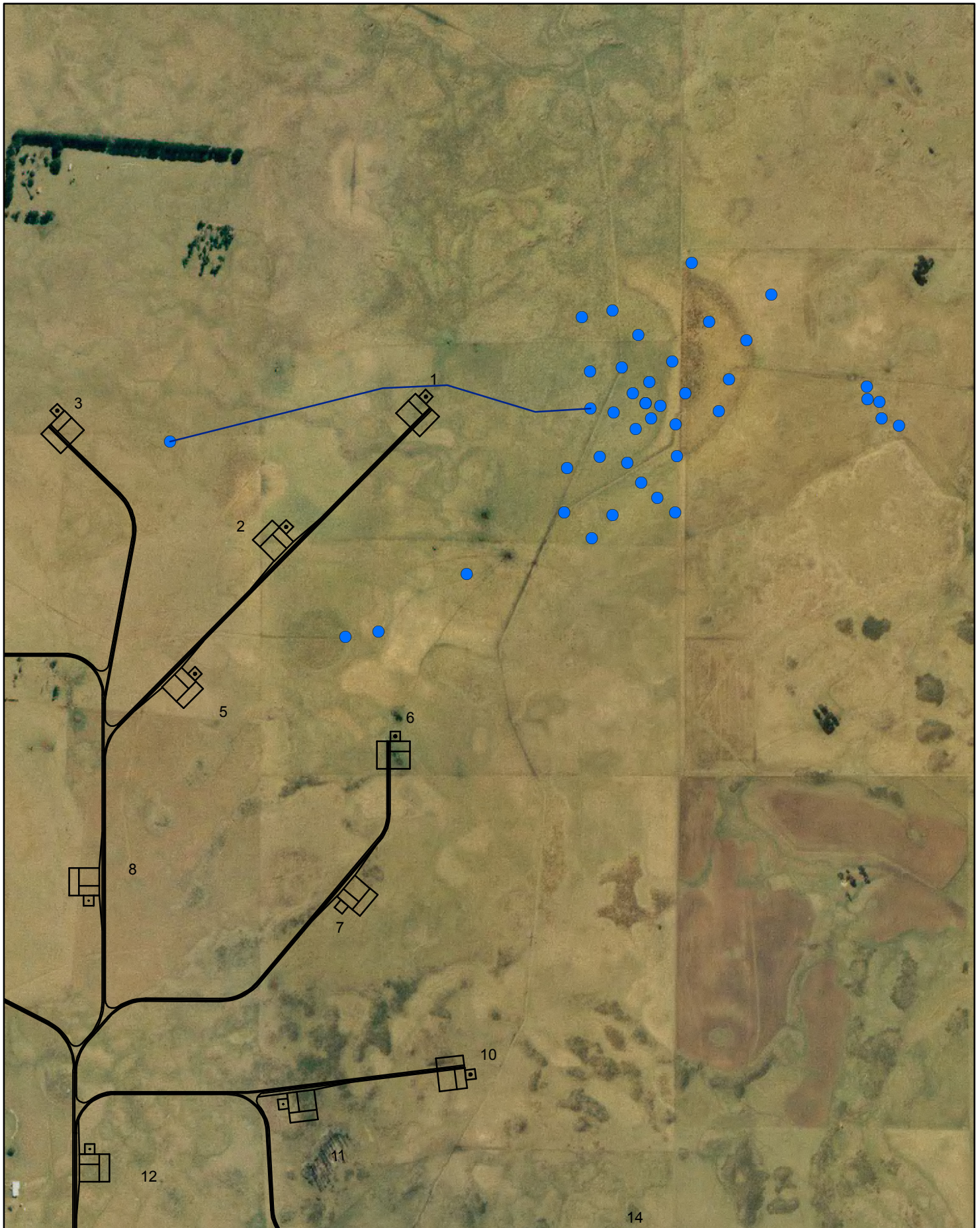


● Brolga pair 4 locations

— Roads and turbines

0 25 50 100
Meters

Figure 8. Locations of Brolga pair 5 observations



- Brolga pair 5 locations
- Pair 5 observed flight
- Roads and turbines

0 100 200 400
Meters

4.0 DISCUSSION

Suitable breeding habitat for Brolga generally consists of shallow freshwater wetlands, less than 0.5m deep, with adequate cover of herbs, tussock grasses and sedges to provide material for nest construction (Merchant and Higgins 1993). There are a number of wetlands within the vicinity of the Macarthur Wind Farm which provide potential breeding habitat for Brolgas. During the current breeding season, breeding was attempted at two of the surveyed wetlands, one of which was located on the wind farm. Another two wetlands on the wind farm were also used by Brolgas for breeding in the previous year (Wood 2013). There may have also been other wetlands which were not included in the survey due to their remote location on private property where breeding was also attempted.

Whilst two Brolga chicks were born on the wind farm during the current survey, neither survived to fledging. One appeared to have died soon after hatching, possibly from exposure to cold weather and the other, whilst it appeared to be growing well for the first two weeks, was most likely taken by a predator such as a fox. One of the greatest threats to Brolgas is the predation of young chicks by foxes and raptors. The chicks are extremely vulnerable to predation, not being able to fly for approximately 100 days from birth and live on the ground as opposed to most other bird species which usually nest in trees, hidden and out of reach of most predators. Poor reproductive success of Brolgas, primarily due to the loss of suitable breeding habitat and predation of young by foxes, is considered to be the main factor responsible for the decline of the species (DSE 2003, Herring 2005, 2007).

The turbines of the wind farm do not appear to deter Brolgas from utilising existing habitat. The Brolga nest constructed on the wind farm during the 2014 breeding season was located approximately 200m from a turbine and Brolgas were observed on several occasions to forage within 100m from turbines. It has been suggested that wind turbines may create partial barriers to the movements of birds, forcing them to travel further and thereby increase their energy requirements (Drewitt and Langston 2006). Whilst Brolgas were only occasionally observed in flight, the turbines did not appear to significantly obstruct their flight paths. On two occasions Brolgas were observed to fly at low altitude below the rotor-swept area of the turbine and on another occasion were seen to deliberately avoid the turbines when flying at altitudes within the rotor-swept area, diverting their course slightly to fly between turbines. The Brolgas seemed well aware of the turbine blades and consciously avoided these areas but appeared comfortable to fly between turbines.

The main potential impact of the wind farm on the local Brolga population is mortality arising from the collision with turbines or powerlines. Although a number of Brolgas use the wind farm site, the risk of collision with turbines seems relatively low considering their use is primarily only during the breeding season when they spend most of their time either foraging or incubating eggs and the frequency of flights is very low, typically less than two flights per day (Arnol *et.al.* 1984). The overhead powerlines which run through the wind farm from Gerrigerrup-Minhamite Road to the Tarrone substation, approximately 12 km south of the wind farm may also pose a potential collision risk to Brolgas. Whilst Brolgas have been known to collide with power lines (Goldstraw and Du Guesclin 1991), Brolgas at

the Macarthur wind farm have been observed to avoid collision by flying low underneath the powerlines. It is expected that the risk of collision with the high voltage powerlines of the Macarthur wind farm will be relatively low as these powerlines consist of several heavy gauge lines which are highly visible.

This Brolga monitoring project has determined that the Macarthur Wind Farm and surrounding landscape provides important breeding habitat for a number of Brolgas. The risk of collision with the blades of turbines appears to be very low considering the low frequency of flights, and apparent avoidance behaviour of Brolga when flying near turbines. The Macarthur Wind Farm does not appear to have had any detrimental impact on the local Brolga population, either from the direct impact with turbines or displacement from habitat.

5.0 REFERENCES

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