AVIFAUNAL SPECIALIST REPORT

FOR THE

ENVIRONMENTAL IMPACT ASSESSMENT

BRANDVALLEY WIND ENERGY FACILITY, NORTHERN AND WESTERN CAPE PROVINCES

Figure 1: View east towards Brandkop and its adjacent ridge along which turbines will be located. Note the Eskom 400 kV line that runs across the northern section of the area proposed for the Brandvalley wind energy facility.

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REF: BRANDVALLEYFINALREP

African Insights

March 2016

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EXECUTIVE SUMMARY

Bird occurrence was monitored across 12-months in the area where Brandvalley Wind Power (Pty) Ltd (as subsidiary of G7 Renewable Energies (Pty) Ltd) propose to erect up to 70 wind turbines. Monitoring was conducted on a total of 20 days across four seasons in the period April 2015 to January 2016 (representative of the full annual cycle).

Conditions across the monitoring period became progressively drier and this period was the driest for this region since the 1930s. As a consequence of the aridity the number and diversity of birds across the entire development area, and especially on the hilltop areas, was markedly lower than on adjacent areas monitored in previous years using the same methods but during wetter conditions.

Terrain conditions imposed constraints on some of the methods normally used in pre-construction avifaunal monitoring of WEF development areas. Although there were various constraints as discussed in Section 3, the monitoring campaign fulfilled all the requirements of the bird monitoring guidelines. All of the 70 turbine positions initially indicated were covered from vantage points manned for 12 hours per season. The applicant amended the layout based on additional wind data during the course of the monitoring campaign. Due to un-notified changes in turbine positioning, six turbines fell outside the accepted observation range from vantage points as indicated in Figure 4 (distance ranging from 200m to 1.1km from the 2km radius around the vantage points). Although these six turbine positions (positions 1,2,3, 10, 11 and 47) are outside the range as per guidelines, the observers site experience expect similar conditions for these areas. None were close to features that would focus bird activities and general observations across the areas gave no indication of any likely risk to birds and it is therefore not a concern.

The only waterbodies in the area are three farm dams. These were dry through most of the monitoring year. The only dam which supported >100 individual waterbirds was near to, but outside, the development area, namely the Fortuin fam dam located 2 km from the closest turbine. No breeding sites of any priority bird species were found. A pair of Black Harriers gave suggestion of breeding in spring but subsequent visits to the locality provided no evidence that breeding actually occurred.

Four species of established (red-listed) conservation concern were recorded across the four field surveys: a Ludwig's Bustard (Endangered) seen once; Verreaux's Eagles (Vulnerable) were seen on numerous occasions; a single, immature, Martial Eagle (Endangered) was seen on Eskom pylons; and Black Harriers (Endangered) were seen twice. The species potentially at greatest risk of mortality through collision with turbine blades is the Namaqua Sandgrouse (not red-listed).

Conditions for birds in the Brandvalley area, and especially on the hilltops and ridge lines, are always poor. Food resources and suitable nesting habitat on the hilltops are both very limited, and the often persistent winds curb bird flight activities. Thus the local, hilltop, avifauna is always depauperate in diversity and numbers relative to conditions on lower slopes and in adjacent valleys. The local avifauna is thus more likely to be affected by habitat destruction and collision with elevated powerlines in the valley areas than by wind turbines on the hilltops. Two localities of especial collision risk concern are identified.

Smaller-bodied birds generally resident in the scrub vegetation keep low when they fly, usually less than three meters off the ground. This is well below the blade arcs of the proposed turbines. Fewer than ten species of birds were recorded flying over hilltops at heights where they could be at potential risk of mortality through collision with turbines. These species were all diurnal foragers, most with acute eyesight. They are not considered at high risk of collision since they will not be foraging at blade heights and or in strong winds. It is probable that there are some night-time movements of birds across the hills. Whilst collision risk at night will be greater, reasons are given in the text why collision risk of nocturnal fliers is also not considered of particular importance.

When wind strength increased often no birds at all were seen from vantage points for hours at a time. Consequently, neither the impacts of habitat loss with associated displacement, nor disturbance in the construction and operational phases, are considered to have significant impacts on the ridgetop bird populations.

The need for, and ability to, mitigate against factors negative to the native avifauna is limited. Three project specific mitigations are recommended namely:

1. Avoidance of any development (turbines, or powerlines not elevated to allow for sufficient ground clearance between the valley and the conductors) across two key flightpaths referred to as the Snydersberg saddle and Fortuin-Ou Mur col. Birds passing across ridge lines from one valley to the next tend to use saddles, the lowest points of the ridges, especially when they must fly into a headwind. To mitigate this most likely source of bird collision no turbines should be erected within 50 m on either side of the lowest points. Elevated powerlines across the two key flightpaths should have day and night visible bird diverters at two metre intervals along the line where it traverses the flightpath.
2. Positioning of turbines in the centre of ridge lines, where feasible, will mitigate the risk of collision for those birds that ride updraughts from windward valley sides.
3. The turbine strings will, where feasible, be linked by 33 kV cables along, or under, ground. Where the cables cross valleys, the risk of avian collisions is considered to be higher than with turbines. This must be mitigated by minimizing the number of such crossings and by the provision of diverters at 5 m intervals along all elevated powerlines that cross valleys.

Additional wind energy facilities are authorised or proposed to the north, east and south of the Brandvalley WEF. However, the cumulative effects are not considered critical given:

a) the similarity of the regional ecology and terrain;
b) the very small populations of species at particular risk of collision mortality; and
c) the low overall diversity of species; and d) the lack of any regular migration movements across the region.
The developer provided a range of alternative locations for access roads, substations, and construction camps – the alternatives being necessary as technical requirements that may affect selection have not yet been finalized. The alternatives were considered in relation to field knowledge and, from an avifaunal perspective, all are acceptable provided the recommended mitigations are undertaken.

Overall, there are no unacceptable impacts on the avifauna anticipated from the proposed Brandvalley WEF and, from an avifaunal perspective, the project can be authorised.

1 INTRODUCTION

1.1 Proposed Development

Brandvalley Wind Power (Pty) Ltd (a wholly owned subsidiary of G7 Renewable Energies (Pty) Ltd) propose to develop a wind energy facility with turbines situated on high points in the vicinity of Brandkop in the Roggeveld region of the Western Cape and Northern Cape Provinces.

Brandvalley WEF will have an energy generation capacity (at point of grid feed-in) of up to 140 megawatt (MW), and will include the following:

- Up to 70 potential wind turbine positions (between 1.5MW and 4MW in capacity each), each with a foundation of 25m in diameter and 4m in depth.
- The hub height of each turbine will be up to 120m, and the rotor diameter up to 140m. The develop indicates that the height of blades off the ground will be, at maximum, 20m to 190m.
- Permanent compacted hard-standing laydown areas for each wind turbine (70mx50m, total 24.5ha) will be required during construction and for on-going maintenance purposes.
- Electrical turbine transformers (690V/33kV) adjacent to each turbine (typical footprint of 2m x 2m, but can be up to 10m x 10m at certain locations) would be required to increase the voltage to 33kV.
- Underground 33kV cabling between turbines buried along access roads, where feasible.
- Internal access roads up to 12m wide, including structures for storm-water control would be required to access each turbine location and turning circles. Where possible, existing roads will be upgraded.
- 33kV overhead power lines linking groups of wind turbines to onsite 33/132kV substation(s). A number of potential electrical 33kV powerlines will be required in order to connect wind turbines to the preferred onsite substation. The layout of the 33kV powerlines will be informed by sensitive features identified. The facility will consist of both above and below ground 33kV electrical infrastructure depending on what will require the shortest distance and result in the least amount of impacts to the environment.
- A number of potential 33/132kV onsite substation location(s) will be assessed.
- Up to 4 x 120m tall wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a large construction camp (~10ha) and an on-site concrete batching plant (~1ha) for use during the construction phase.
- Fencing will be limited around the construction camp and the entire facility would not necessarily need to be fenced off. The height of fences around the construction camp are anticipated to be up to 4m.
- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately to this EIA process.

The following alternatives are proposed:

1. Fundamental alternatives:
   1.1 Project area location alternative: One project location alternative namely Brandvalley Wind Farm

1.2 Access road location alternatives: two access road alternatives namely access road alternative 1 and access road alternative 2
1.3 Construction camp alternatives namely construction camp 1, 2, or 3.
1.4 Four onsite substation location alternatives namely substation alternative 1, 2, 3 or 4.
1.5 Technology alternative: One technology alternative namely a WEF

2. Incremental alternatives:
   2.1 Turbine layout alternatives
   2.2 200m buffer on access roads for sensitivity alternatives
3. No-go alternative

1.2 Potential impacts and purpose of the assessment

A typical windfarm is expected to impact birds through:

1. Disturbance during construction and operation,
2. Habitat destruction during the construction phase, and
3. Mortality of birds through collision with turbines or associated powerlines during the operational phase.

The purpose of this study was to assess the impacts the proposed development may have on the local avifauna, including appraisal of any cumulative impacts that may accrue as a result of other developments in the region.

2 AFFECTED ENVIRONMENT

2.1 Climate

The Roggeveld region lies close to the eastern border of the Cape winter rainfall area. Though some summer showers may occur, there is usually no reliable rain from October to May. The degree of winter rainfall is variable and the area is considered semi-arid.

Climatic conditions are especially important for this evaluation. Monitoring of birds in the Brandvalley area took place during a period of generally increasing, and severe, dryness. Rainfall in the 2014 winter preceding the first seasonal survey was below average. This was followed by a long dry summer. As a result, the region was drier than usual before the avifaunal surveys of the Brandvalley area began in 2015. From the start of monitoring most farm dams were dry, there were no exposed annual plants, and the soils were very dry. Invertebrates were scarce and most sheep and birds were in the valleys, or near farms, where there was still access to water. During the winter of 2015 rainfall was again below average. Following the brief spring season, the summer of 2015-2016 was subject to the intense, El Nino induced, sub-continental drought with accompanying high temperatures. Local farm rainfall records dating from the 1920s show that 2015-2016 was the most intensely dry period since the 1930s (Mr Conradie of the farm Saaiplaas, pers. comm. 2016). This aridity had pronounced impact on food resources for animals in the region. The local avifauna was severely depressed during the 2015-16 surveys in both the number and diversity of birds relative to the situation in an adjacent area monitored during 2013 when conditions were substantially wetter.

The question may be raised whether, due to the extreme drought conditions that applied during this monitoring campaign, this survey was adequate in terms of assessment of the potential impacts of the proposed WEF. Members of the same avifaunal survey team have previously undertaken pre-construction surveys of the avifauna for three WEFs either immediately adjoining, or close to the Brandvalley area. These surveys were conducted when rainfall was close to, or somewhat above, average. Even in the resultant better conditions the number and diversity of birds in this semi-arid region were low. There was no change in the overall species diversity during the 2015-2016 survey but, due to the extremely dry conditions, bird numbers were severely depressed. In future wetter conditions bird numbers will recover without any change in overall diversity. In particular, there is unlikely to be any marked change in the occurrence of priority bird species as the habitat features which control their local populations have remained unchanged. Thus there is no reason to consider this avifaunal survey inadequate in terms of assessment of the potential impacts of the proposed WEF.

2.2 Terrain

The terrain in this part of the Roggeveld is one of hills with relatively flat, often broad, summits generally at about 1,100-1,200 m asl (metres above sea level) with a few higher hills to a maximum of 1,500 m (Figure 1). Valleys are cut towards the local base-level of ca. 900 m asl. The hills have very shallow, or no, soil cover. Over eons of time fine sediments have been washed down hill. This has left a surface of mostly loose stones on the hills (Figure 2) and accumulation of sediments in the valleys.

Figure 2: Typical surface conditions on the hills. The loose stones imposed the need for careful downward vision when walking.

2.3 Vegetation

Soils, and therefore vegetation, are thicker in the valleys than on the ridgelines. Except for patches of riparian trees or bushes along stream courses, the natural vegetation of the entire area is karoo scrub- or shrub-land, scrub here considered simply as woody bushes that grow to knee height and shrubs taller bushes generally reaching waist height. In wetter periods flowering plants (forbs) grow on patches of bare earth between the bushes and native ungulates and, especially, sheep crop the forbs.

During the dry conditions of this survey period there were few if any forbs on the hills. Due to the limited availability of forbs, and the near absence of grasses, the seed resource for granivorous birds was minimal.

2.4 Animals other than birds

A range of mammals were recorded onsite during the monitoring campaign. These include Chacma Baboon (*Papio ursinus*), Black-backed Jackal (*Canis mesomelas*) and Cape Grey Mongoose (*Herpestes pulverulenta*), all of which are potential predators of birds and their nest contents. It is highly likely that Caracal (*Caracal caracal*) also occur onsite. These varied predators restrict birds in their selection of breeding sites. The only mammals suitable as prey for large raptors are Scrub Hares, (*Lepus saxatilis*) though these are mainly crepuscular. No Dassies/ Rock Hyrax (*Procavia capensis*), prime prey for Verreaux's Eagles, were seen in the entire Brandvalley area. The only reptiles detected were 3-4 species of lizards infrequently seen. A few tortoises and a terrapin were seen after a summer shower. Along the hilltops, invertebrates were the most available animal food resource for birds and, due to the rocky nature of the ground and the extremely dry conditions, they were not abundant.

Though native ungulates still occurred on the hills during the survey period, sheep, an important potential source of carrion for large scavenging/predatory birds, were almost all confined to the valley bottoms where they had better access to food and water.

2.5 Human developments

The project area is sparsely populated with limited farmsteads per property. Most human activity and all housing is confined to valley bottoms where on small plots bushes have been cleared for crop growing, dams have been constructed, and alien trees planted.

3 STUDY APPROACH

3.1 Terms of Reference

The company African Insights, was appointed to:

3.1.1 Conduct a desktop review of existing literature relevant to the potential impacts of the development on the local avifauna, and the status of bird groups likely to be affected.

3.1.2 Monitor, across a 12-month period prior to the construction phase, bird occurrence on, and adjacent to, the hills where the development is proposed, with especial attention to species of birds considered of particular conservation concern. This monitoring campaign was in accordance with the best practice guidelines.

3.1.3 Discuss any gaps in knowledge or limitations with the assessment.

3.1.4 Assess the significance and acceptability of the likely impacts of the proposed development on birds during the construction and operational phases using the methodology provided by the Environmental Assessment Practitioner.

3.1.5 Suggest reasonable and feasible measures to mitigate any negative impacts.

Not included in the terms of reference of the monitoring campaign were:

a) nocturnal observations – but the risks were considered and mitigation measures are proposed
b) field consideration of any new access roads and the location of construction camps and sub-station. This was due to lack of finality on the routes and site locations
c) the installation of a 132 kV powerline to link the new project sub-station to the regional Eskom sub-station. This is being assessed by the developer in a separate Basic Assessment.

3.2 Desktop assessments

A desktop review was conducted. This considered two aspects: 1) the current conservation status of birds in southern Africa including the needs of species of local importance; and 2) the global literature concerning the impacts of equivalent developments on birds.

3.3 Field study

The occurrence of birds in the Brandvalley area was assessed in 2015-2016 during four periods, each with 5 days of observation across periods of 8-10 days. The Brandvalley region is on the edge of the southern African winter rainfall zone. The survey periods were:

1) 14-24 April 2015 i.e. early autumn –before any winter rainfall;
2) 12-20 August 2015 – late winter;
3) 29 September to 7 October 2015 i.e. early during the brief local spring, after the main annual rains, and timed to assess flight heights of displaying birds; and
4) 30 January – 5 February 2016- in mid-summer when temperatures were at their maximum (often >40^0C in the shade).

Monitoring in each season was undertaken by the same four observers. These, with their windfarm experience, were: Dr A. J. Williams professional ornithologist (8 WEFs); Brian VanderWalt professional birding guide (8 WEFs); Robyn Kadis (16 WEFs); and Vincent ward, doctoral student and part-time birding guide ((4 WEFs).

3.4 Field methodologies

BirdLife South Africa's guidelines for monitoring prior to wind farm approval (Jenkins *et al*. 2015) stress four key approaches. Two of these are observations at fixed points – focal localities (wetlands, breeding sites of priority bird species) and vantage points. The other two approaches are for mobile observations.

The guidelines are idealistic in the sense that they are assumed to be readily applicable across all climatic conditions and terrain types. Monitoring experience for five proposed wind farms in the Roggeveld region has shown that there are considerable constraints in applying the guidelines. Two of the four key approaches are easily complied with in the Roggeveld region but, due to local physical constraints, two of the other approaches had to be modified (see below). Nevertheless, accepting these caveats, the survey is considered compliant. The key monitoring areas are indicated in Figure 5.

3.4.1 Focal sites

In terms of the best practice bird monitoring guidelines, focal sites can include, but are not limited to, waterbodies or wetlands, and nest sites of any red-listed, or other locally significant bird species.

There were only three waterbodies in the Brandvalley area, all small farm dams. Two were dry through the first three survey periods. The third dam, though supplied from a borehole, was two thirds dry throughout the survey year (Figure 3). Rainfall during a thunderstorm in January 2016 only produced shallow pools within the two previously dry dams. Only the dam on the farm Fortuin, located outside the designated Brandvalley WEF area, held water throughout the monitoring period. Each of the three onsite dams was driven past at least five times during each season as they were beside the only access road. The dam at Fortuin was checked at least once during each season.

Figure 3: The borehole maintained waterbody north of Brandkop (focal point 2 in Table 1). Note: 1) the dried-down state of the dam; 2) the Eskom powerline erected in 2014; and 3) the access road to the Brandkop vantage point behind.

No breeding sites of any priority species were located in the Brandvalley area. The behaviour of a pair of Black Harriers (*Circus maurus*) just outside the extreme southwest of the Brandvalley survey area was indicative of a possible breeding attempt but subsequent investigation of the vicinity found no evidence that breeding took place.

3.4.2 Vantage Points

The aim of vantage point monitoring is primarily to assess the frequency, direction, and height of flights by birds to ascertain the risk of collision with turbines.

In each seasonal monitoring period watches by single observers were made from vantage points along the hilltops where turbines are proposed to be erected. In each season, monitoring began as early in the day as was feasible given that off-road access tracks could only safely be driven in daylight. On most days visibility was excellent, and it was usually possible to see mountains 70-150 km distant.

Vantage points were initially selected on maps prior to the first seasonal survey. Field experience of the local topography in the first season indicated a need to change some of the vantage points to offer better visual coverage of the proposed turbine positions. These changes were in the Kabeltou and Brandkop areas. In all, a total of 9 vantage points were tried to maximize coverage. Six VPs were used on every day of observations in each of the four seasons, four consistently through each season. The other three VPs were initially tried in the first season and subsequently adjusted to maximize cover relative to topographic features. Each used VP was manned for 12 hours and so in each season 72 hours of observations were made from VPs, with additional observations made whilst travelling to and from the VPs. Across the four seasons the overall time spent in vantage point observations was 288 hours. All the turbine positions initially indicated by the developer were within 2 km of vantage points (Figure 4) and covered in all seasons.

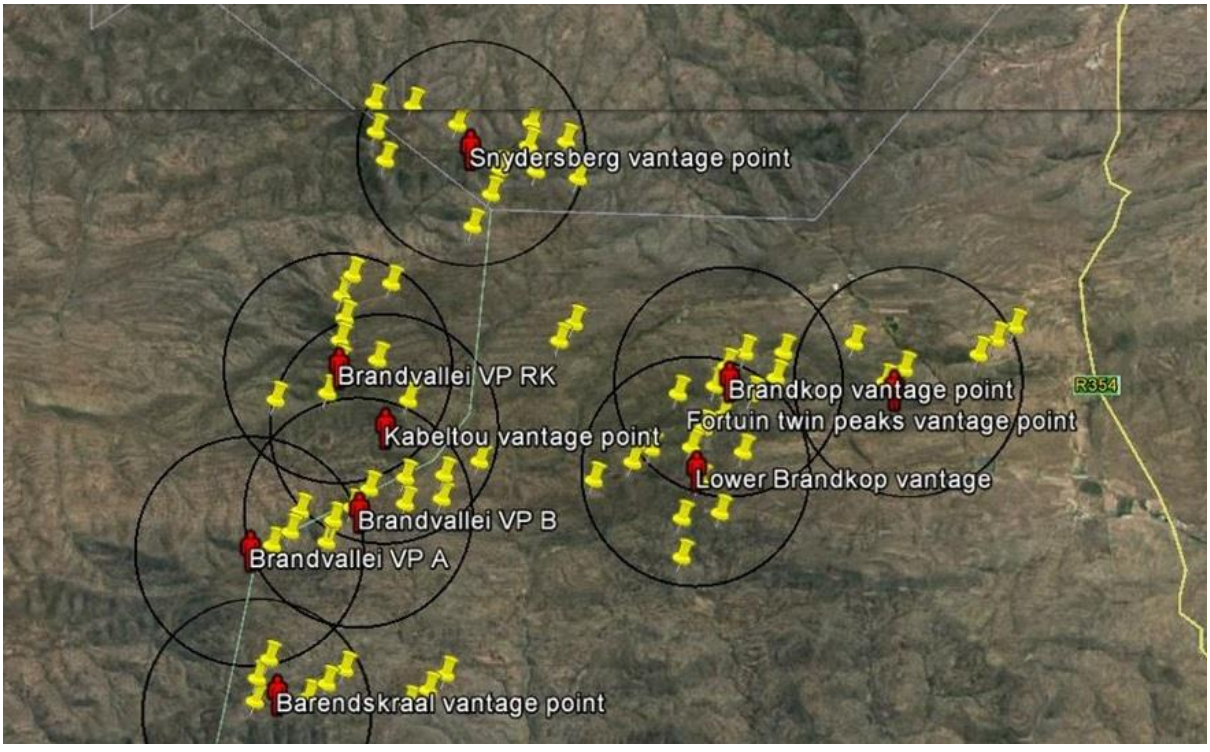

Figure 4: The location of turbines (yellow markers) and vantage points (red men). The circles indicate the area within 2 km of each central vantage point.

During the year of surveys the developer made adjustments to some turbine locations. These were not communicated to the bird observers until after the final field survey. Six turbines positions were reallocated in a layout optimisation during the last phase of the monitoring campaign and so are not within the normal 2 km radii of observation from any vantage point. However, in the open terrain with excellent visibility, the areas concerned were, with one exception (the turbine closest to the R354 road), reasonably covered during normal visual scanning from the manned vantage points, and in most cases from several different VPs. None of the new sites were adjacent to features considered of importance to birds of particular collision risk e.g. at saddles in hill ridges. Therefore, no major issues are expected to be posed by these positions. In view of the generally sparse observations of species of collision risk potential in the overall Brandvalley area these new turbine positions are considered acceptable from an avifaunal perspective. Although the turbine position near the R354 was not overlooked by any of the vantage points its position near the road meant that the area was passed numerous times in the course of journeys to and from monitoring areas in the Brandvalley and adjacent Rietkloof WEFs and had also been passed during work on three other WEFs. The site had no particular habitat features that would attract risk-species and despite observers recording birds for atlassing during the journeys no priority species were recorded in the vicinity.

The most recent guidelines recommend that all turbine positions to be monitored should be within 1.5 km of vantage points. Whilst this range is suitable for relatively flat areas it is inappropriate in areas of high hills. In the variable Brandvalley terrain it was difficult to monitor all the area immediately around a vantage point. This was because the hill slopes fell away steeply and the hill summits also undulated. This severely curtailed monitoring of nearby areas. The most effective means of monitoring in this terrain was to "summit scan" (moving the binoculars along the skyline with the bottom of the lenses along the ridge lines). Large birds (sandgrouse size or larger) – i.e. those most likely at risk of collision with turbine blades - flying above hills were easily detected against the pale sky background often at ranges of 3-5 km. Simultaneous observations of birds from two vantage points confirmed that, under the excellent visual conditions that prevail in this area, Verreaux's Eagles flying above summit level could be identified for up to 8 km. Summit scanning determined the frequency of occurrence and the preferred areas of larger birds. However, this method, though providing the majority of priority species observations, would not enable precise locations relative to the ground below.

The guidelines call for 12 hours of observation per vantage point. Ideally watches at vantage points are for four three-hour periods that, together, cover the daylight period from dawn to dusk. Conditions in the Roggeveld preclude this idealist approach. The limited off-road tracks often require slow 4x4 driving to reach places where observers could start to walk to vantage points. Observers then had to spend 30-60 minutes walking to attain the hilltops where vantage points were located. Care had to be taken when walking up, and especially down, these slopes covered in loose stones. In light of limited access tracks, and to ensure the safety of observers, off-road drives to and from vantage access points were only made during daylight as were all walks to and from vantage points. Observations at vantage points were therefore made for two periods

each of 6 hours on days 4 to 5 apart. Vantage points were thus each manned for a total of 12 hours.

In addition to vantage point monitoring, birds were recorded opportunistically on the slopes of the hillsides and in the valleys of the adjoining areas during driving or walking to or from the ridge-top monitoring sites. This permitted comparison of bird diversity in lower areas relative to that of the ridge-tops.

3.4.3 Drive transect

In each season a drive was made along the single farm track that traversed the area. This was from the Brandkop dam gate to the gate on the boundary between the Barendskraal and Hartjieskraal farms. The distance driven was 15 km.

Each of the four seasonal drive transects was conducted by at least two observers and driven slowly in order to record all sightings of larger birds

3.4.4 Walk Transects

Walk transects have two aims: to determine the occurrence of species and, in particular, to allow, through statistical analysis, the calculation of population changes from conditions before, to those after, turbine construction.

Formal walk transects were difficult to conduct in this study. There were two prime reasons for this. First as described earlier, the ground on the hills and adjacent slopes is covered with loose stones and or scrub (Figure 2). This required close attention to where observer's feet were positioned with each step. Constantly watching one's step reduces the opportunity to see and record birds. This is especially the case in low scrub vegetation where most passerines flush, fly low, and within seconds drop into cover. However, all large birds seen during walks to or from vantage points were recorded.

Second, the number of birds, naturally low in this resource depauperate terrain, was depressed by the prolonged dry conditions (often at vantage points no birds were seen, or even heard, for periods of an hour or more). Overall, the numbers of birds seen were too low to support any meaningful statistical analysis.

Effective walk transects are shown in Figure 5.

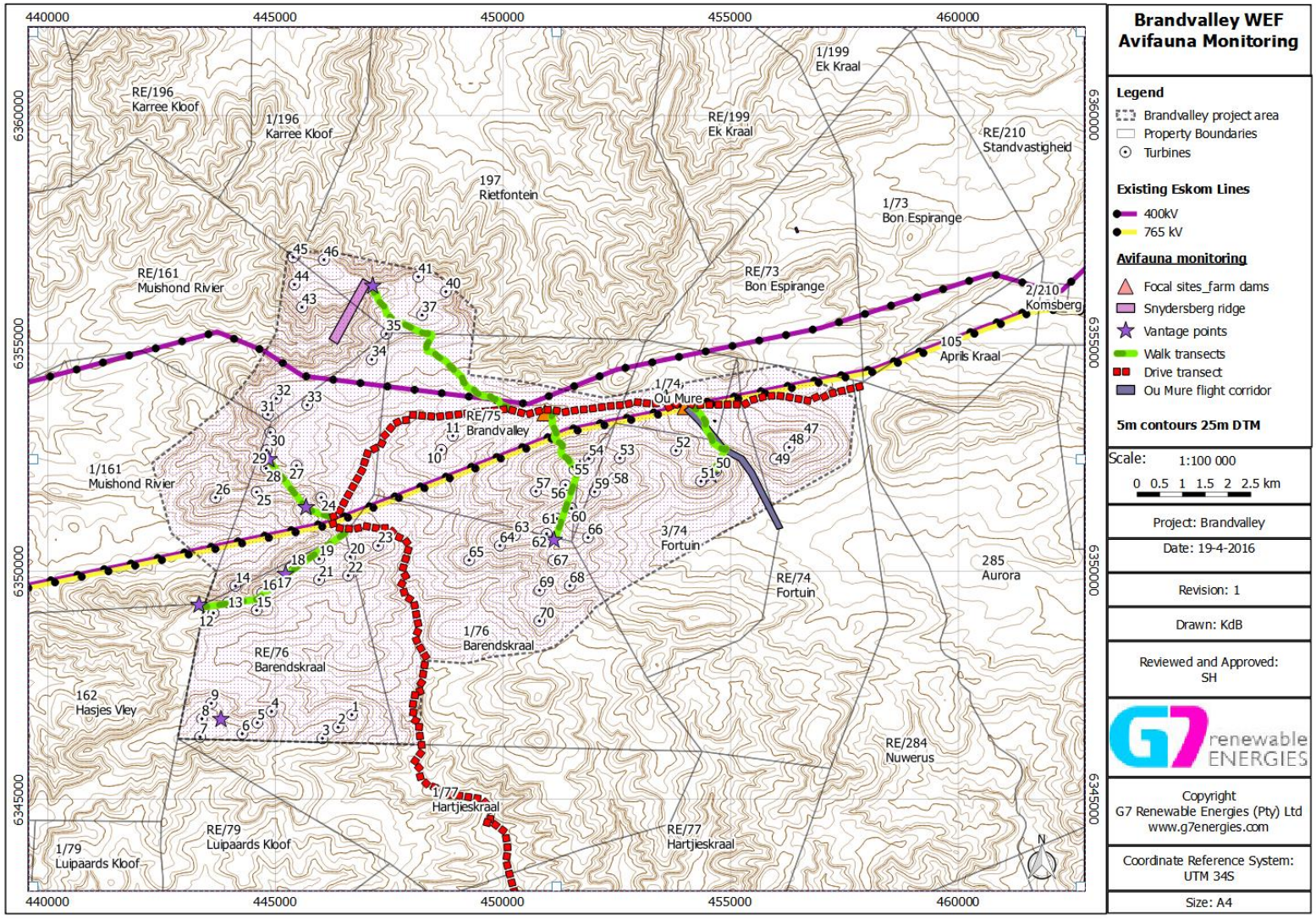

Figure 5: Focal sites, vantage points, drive and walk transects

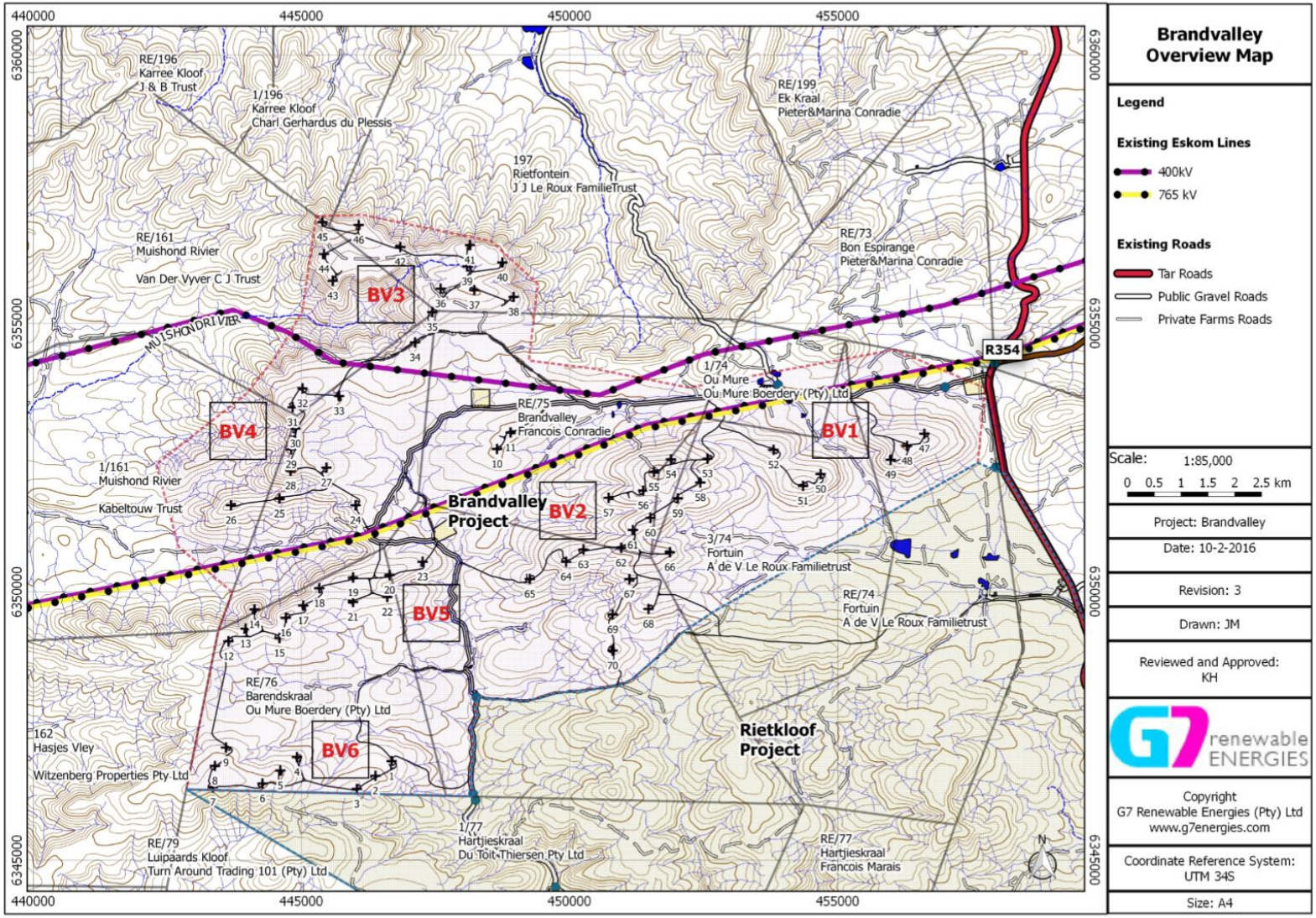

Figure 6: naming convention for ridgelines

4 BIRD SURVEY

4.1 Focal Waterbodies

The only significant waterbody that persisted through the four monitored seasons was the dam on the farm Fortuin which is close to, but outside, the Brandvalley WEF area. Numbers of birds at this dam ranged between ca. 100 and 0 as it progressively dried down. The three principal species at this dam were South African Shelduck, Egyptian Goose and Yellow-billed Duck, none of which are red-listed. No threatened waterbird species were recorded at this dam. Considerable numbers (>30) of South African Shelduck and Egyptian Geese occurred on irrigated fields near the Fortuin farm.

The three small farm dams were: either dry throughout; held only a small area of water (the borehole dam); or, in January 2016, held small areas of very shallow water following the thunderstorm a week before the survey period. The three focal dams had previously been surveyed in wetter conditions during monitoring for the adjacent Roggeveld WEF. The most waterbirds recorded on any of the three dams never exceeded 30 individuals, mainly coot. During the Brandvalley monitoring these dams in total never supported more than 10 individual waterbirds. In both wet and dry conditions no red-listed species were recorded at the dams.

4.2 Focal nest sites

No raptor nest sites were located, nor, with one exception, was any raptor activity seen that indicated a breeding site. The exception was the chasing away of a Pale Chanting Goshawk by a pair of Black Harriers from a valley just outside the Brandvalley area but close to the south-westernmost Brandvalley BV6 turbine string (Figure 6) in the spring survey. That the pair was involved in the chase indicates that breeding had not commenced. This area was revisited in the summer survey in January 2016 when no indication of breeding was found. Given the extremely dry conditions it is unlikely that breeding would have been attempted.

Figure 7: View westwards to the Barendskraal plateau (highest area left of centre). The pair of Black Harriers was seen in the bushy vegetated valley on the extreme left middle distance. The road is the one that was followed by drive transects. Note the gently sloped moorland with no substantial cliffs.

All cliffs that might potentially have raptor nests were scrutinized. None of these cliffs housed old or new nests. Most were unsuitable for raptor nests. Many cliffs were a single rock stratum high, and so usually with less than 3 m of exposed rock, and accessible to potential predators (including baboons). In the case of taller cliffs most either had

overhanging upper strata and lacked ledges, or faced south and so would never be sun warmed during the winter, when most resident birds of prey would breed.

Figure 8 and Figure 9: Cliffs around the western Snydersberg plateau. Note the tendency for upper strata to overhang slightly hence the lack of ledges suitable for nests, and the small, < 5-7 m, cliff faces.

4.3 Bird species of particular concern

In the Brandvalley area three groups of birds are considered to be potentially at risk of collision with turbine blades and powerlines. These groups are: 1) large ground foraging species; 2) birds of prey; and 3) corvids. Each of these groups are described below.

4.3.1 Large ground foraging species

The only large ground foraging species of collision risk concern that were recorded during the four season survey were a single Ludwig's Bustard (Endangered) and Namaqua Sandgrouse (not red listed). Neither species was common.

The single Ludwig's Bustard was seen only once, in the valley near the northern Eskom line. This bustard is a generally lowland foraging species. The greatest collision risk is likely to be with powerlines in the valleys. When these heavily built birds want to fly across ridges to other valleys it is likely that they will use the lowest saddle on the ridge. This would put them at collision risk with any elevated powerlines linking turbine strings. Turbines are considered to be of lower risk potential for this species. Through seasonal surveys of four proposed windfarms across a three-year period in the Roggeveld region Ludwig's Bustards have been recorded only four times and never with more than two individuals at a time. Thus, due to the small data set we lack sufficient knowledge of any routes taken, heights flown, and whether movements are by day or night, all factors that will affect collision risk. However, given the minimal numbers concerned, and the infrequency of occurrence, the risk of collision mortality for this endangered species is considered very low.

The highly distinctive calls of Namaqua Sandgrouse were heard several times in the Brandvalley area and 20 were seen in fields near the farm Ou Mure. In wetter conditions, when forbs grew and produced seeds on the hilltops, flocks of this sandgrouse were quite common on a monitored WEF immediately adjacent to Brandvalley. They often flew along ridges at heights that would bring them into the lower arcs of turbine blades. This species is known to collide with powerlines and so, when the Brandvalley area

experiences wetter conditions, sandgrouse must be considered at collision risk both with turbines and powerlines and are likely to be the species most impacted by collisions. Measures are therefore recommended to mitigated this risk.

4.3.2 Birds of prey

Fourteen species of birds of prey have been reported either in the Brandvalley area or on closely adjacent WEFs. Most occur in the valleys where prey is more abundant. In the Brandvalley surveys only four species were recorded at turbine location heights. These were: Verreaux's Eagle, Rock Kestrel, Pale Chanting Goshawk, and Jackal Buzzards. Only the eagle and kestrel were seen with any frequency from vantage points. For both these species many of the recorded flight paths will represent repeated flights by the same individuals – e.g. a kestrel hovering, dropping out of sight and then returning into view or, in the case of the eagle a pair on one day repeatedly circling around the Snydersberg plateaux.

Verreaux's Eagles *Aquila verreauxii* – Status: Vulnerable. This is the species that has been considered of greatest concern of collision risk with wind turbines in the Roggeveld sub-region. It was one of the two raptor species most commonly observed at or above hilltops. Most summit observations were either brief, as birds flew below summits and out of sight, or the eagles "sky loafed" (prolonged leisurely circling) without any link to ground features and so could not be precisely mapped. It is considered that the total number of individuals recorded in the Brandvalley area was less than 6 with none clearly resident in the overall Brandvalley area presumably because of the extreme shortage of potential food resources – no Dassies, few hares and during the survey year no sheep carcasses as all sheep had been moved to valley areas near farmsteads.

Based on the vantage point observations (Figure 8) there is only one area particularly favoured by these eagles within the proposed development area – the cliffs around the two Snydersberg high plateaux and specifically use of the saddle between the two plateaux (BV3 in Figure 6). The repeated occurrence of these eagles, including two at a time, probably indicates use of local updraughts as there were no activities suggestive of breeding. All the cliffs visible from within the Brandvalley area were scrutinized for possible nests but none were seen. Those sections of cliff not visible from within the Brandvalley survey area were scanned for nests during monitoring in 2014 and 2016 for the Karreebosch WEF which immediately adjoins the Snydersberg area and offers front-face views of the Snydersberg cliffs. Breeding on the cliffs is also considered unlikely because most have overhanging upper strata, and lack ledges. There is no nearby source of prey (the only active breeding site in the four adjoining WEF areas is close to the only Dassie colony in the same area- some 8 km from the Brandvalley project area). Also, use of the area was spasmodic. Thus in the spring survey, there was considerable activity in the Snydersberg area on one day – believed to be repeated passes by the same two individuals – but no activity in the following monitoring period 5 days later. Without association with established nest or roost sites Verreaux's Eagles range widely, especially over areas, like the Roggeveld, where food resources are sparse. Those individual eagles whose position could be related to the ground below favoured areas with steeper slopes.

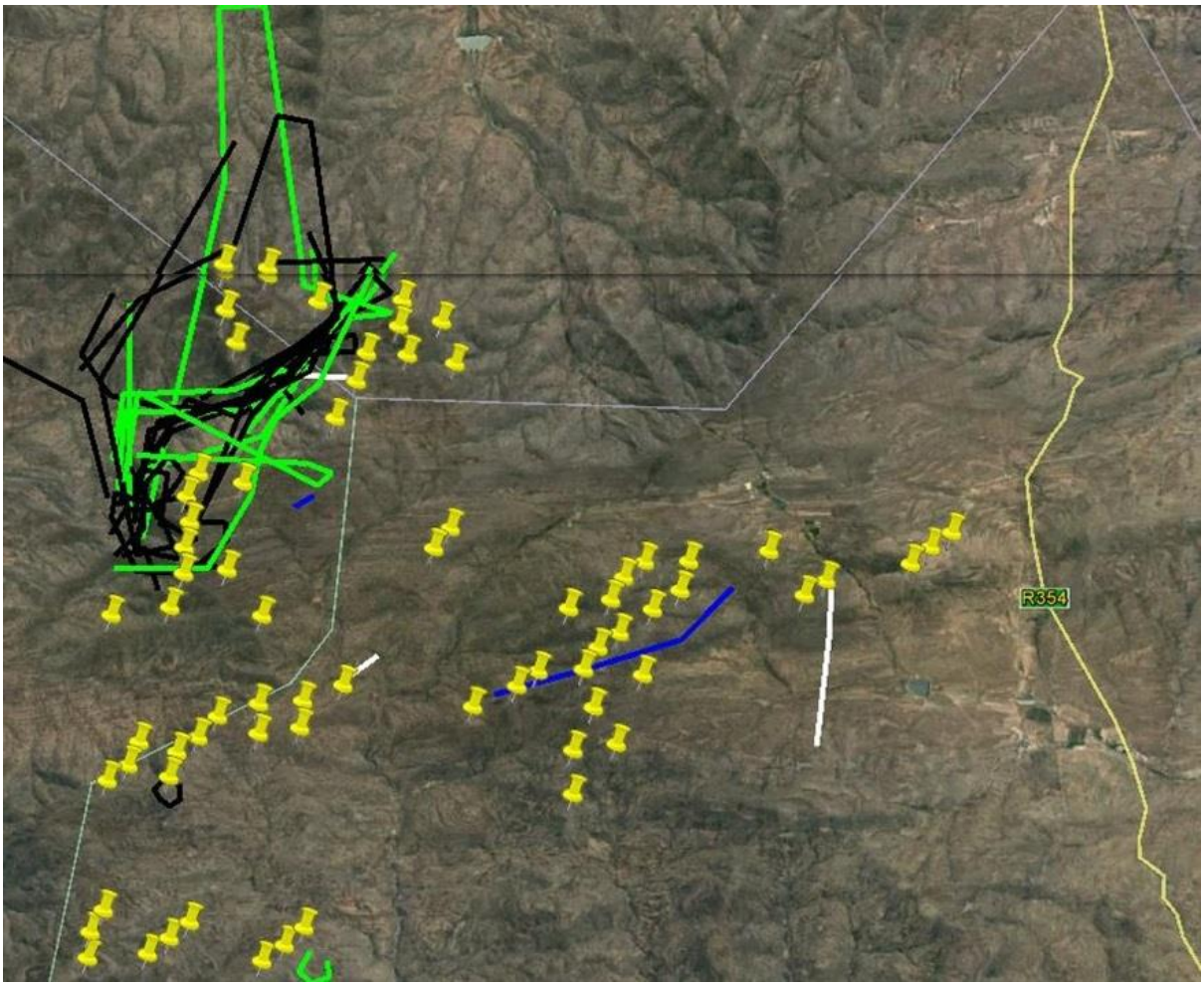

Figure 8: Seasonal Verreaux's Eagle flight paths: autumn flights in white, winter flights in black, spring flights in green and summer flights in blue.

Verreaux's Eagles were seen more in winter than in other seasons and only on one day during the summer survey.

Martial Eagle (*Polemaetus bellicosus –(*Pink dot on Figure 9) Status: Endangered: The only individual seen was an immature bird observed on one day only, perched on an Eskom pylon during the 2016 summer survey

Booted Eagle (*Hieraetus pennatus* – (Orange track on Figure 9): The only record was in spring when a pair flew along the lower slopes of the ridge that forms the southern edge of the Luiperd valley.

Black Harrier Status: Endangered (Blue track on Figure 9) The only observations in the Brandvalley area were of a single bird in the winter survey flying eastwards parallel to the southern Eskom powerline. The pair observed once in spring were close to the southwestern boundary of the Brandvalley southernmost proposed turbine string (BV6- see Figure 6).

Rock Kestrels (*Falco tinnunculus* – Green tracks on Figure 9)**:** These were seen near summits during calmer conditions but more in the valleys during strong winds. Those

hovering at summit heights were generally doing so over the upper slopes of adjacent valleys. Direct observations around vantage points indicated a lack of potential prey for kestrels along the hilltops, at least in the dry conditions across the four monitored seasons. Kestrel flights at summits were mainly when birds crossed from one valley to another. During this survey most summit crossings by kestrels were below the predicted turbine blade heights.

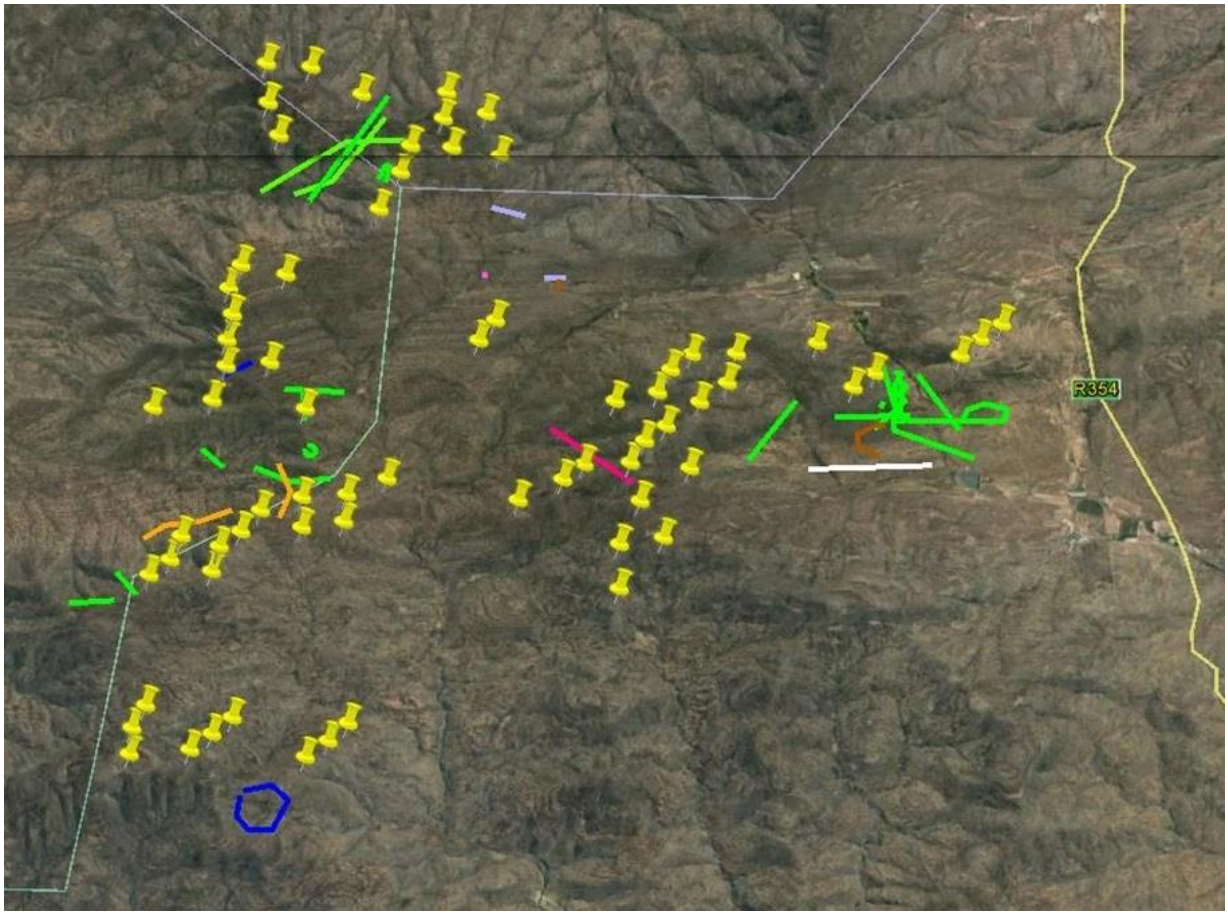

Figure 9: All season flight paths of raptors other than Verreaux's Eagles. Legend: Black Harrier – blue; Rock Kestrel – green; Booted Eagle - orange; Pale chanting Goshawk - grey; Martial Eagle - pink; Jackal Buzzard - brown; Steppe Buzzard - white.

Jackal Buzzards (*Buteo rufofuscus* - Brown tracks on Figure 9): Individuals were seen in only two seasons. These were during the winter drive transect and in the summer survey when a juvenile was photographed near the Kabeltou gate and an adult flew near the Eskom line north of Brandkop.

Steppe Buzzard (*Buteo buteo* – White track in Figure 9): An individual in the summer survey was the only record.

Pale Chanting Goshawk (Grey tracks on Figure 9): This species is common in lowland areas outside the Brandvalley area. They were seldom recorded within the area.

4.3.3 Corvids (neither species red-listed)

White-necked Ravens (*Corvus albicollis* - White tracks in Figure 10): Members of this species were the birds most widely recorded flying at above hill summit heights. Ravens are highly intelligent birds, adept at coping with strong and variable winds in mountainous areas. It is considered highly unlikely that they will experience significant mortality through collision with turbine blades. Up to six were seen at a time though usually observations were of single or paired birds. There were concentrations of White-necked Raven flights at two localities across the four seasons. These localities were the same as those used by Rock Kestrels - the saddle between the two Snydersberg plateaux, and of the col in the ridge between the Ou Mure and Fortuin valleys (Figure 10). Noticeably fewer ravens were seen in the hot dry summer survey.

Ravens are winter breeders. In other, better studied, raven species, newly fledged juvenile birds feed on large invertebrates found whilst walking. If this applies to White-necked Ravens then in spring those that have bred successfully must move to lowland areas where, for the juvenile ravens to cope, walking is easier and suitable prey are more abundant. Since collisions are more likely among juvenile than adult birds the likely removal of recently fledged ravens from the ridges will reduce overall collision mortality risk.

As with the Verreaux's Eagle and Rock Kestrel, many of the flight paths represent repeated flights by the same locally operative individuals

Pied Crows (*Corvus albus* - Yellow in Figure 10): A few individuals were seen at turbine summit heights. These crows, which are not red-listed, were far less common than ravens and most seemed to be transients passing across, and not resident within, the Brandvalley area.

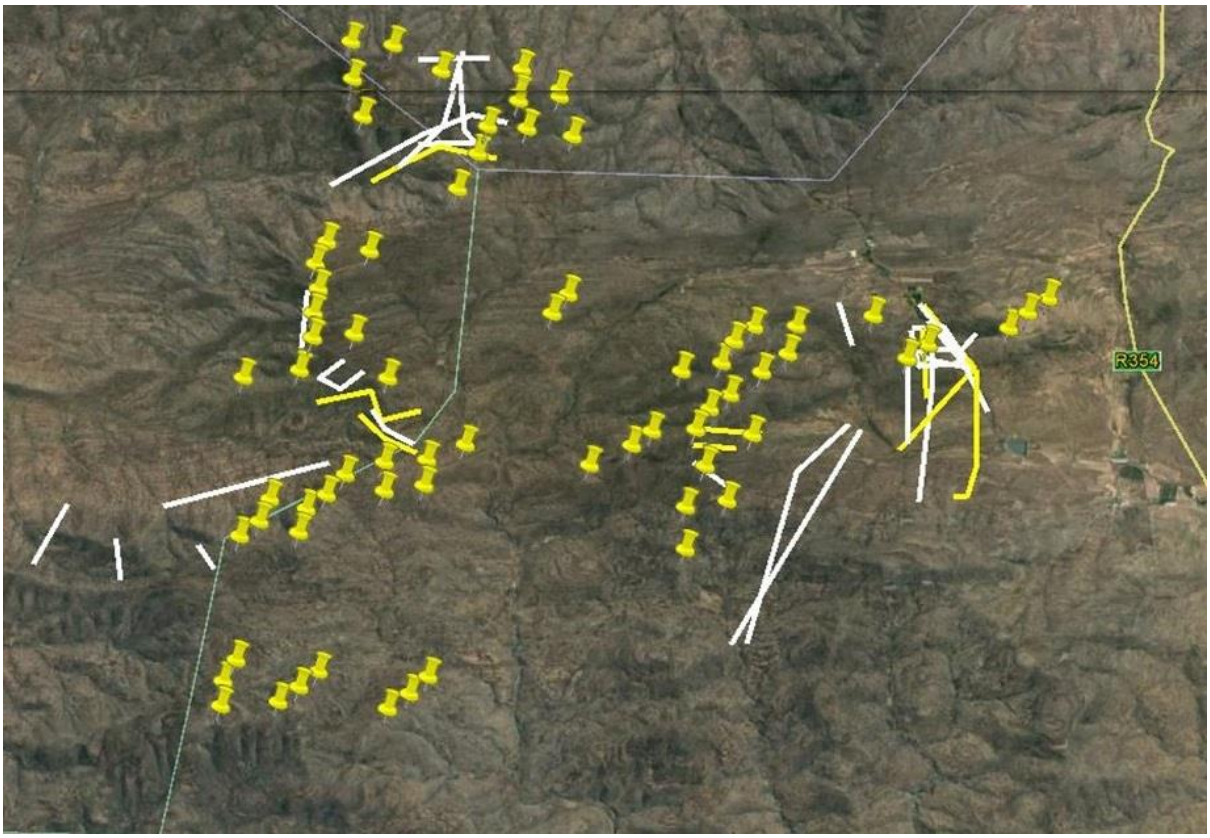

Figure 10: All seasons flight paths of corvids. White-necked Raven – white; Pied Crow - yellow. Note the two areas of concentrated observations: in the northwest where ravens use the saddle between the two Snydersberg plateaux turbine strings; and in the east where ravens used the col in the ridge between the Ou Mure and Fortuin farms.

4.3.4 General comment on summit risk species

Monitoring under drought conditions will under- indicate bird use, and potential collision risk, in the area relative to wetter conditions that are likely to apply at some stages through the 20 years working life of turbines. However, even if wetter conditions become more persistent, the consensus of all four observers, based on bird monitoring experience in adjacent parts of the Roggeveld during wetter years, is that even in the better wetter conditions the available habitats cannot support more than a low number of raptors and corvids, the birds most often seen in flight over ridges at heights that might bring them into risk of collision with turbine blades.

All four observers agreed that more eagles and ravens were seen during the winter monitoring than in the autumn and spring seasons. The only explanation that fits this situation is that when winter cold fronts pass along the south coast there is often persistent cloud over the Witteberg Mountains and other areas to the south of the Brandvalley area whilst, at the same time, the Roggeveld region often remains cloud free (Figure 12). In order to locate food, large birds of prey and ravens often scan wide areas whilst flying at height. This method of foraging will be constrained by low cloud conditions. At times when their normal foraging areas are cloud covered it is reasonable to anticipate that these birds may temporarily move from the clouded region into the cloud free Roggeveld area. This is suggested as the main reason why more raptors were recorded during winter monitoring. During the autumn, spring, and summer monitoring

periods both the Witteberg and Roggeveld were largely cloudless (Figure 11 and 12). With clear skies over the Witteberg there would be no displacement of raptors or ravens from the that region. Several windfarms have been proposed for both the Witteberg and Roggeveld. The suggested movements of eagles, and probably some other species, across such wide areas may bring them into additional collision risk situations – a cumulative effect.

Figure 11: View south from the southern Roggeveld during August 2015. Note the distant Witteberg covered in low cloud whilst the Roggeveld area is clear.

Figure 12: The view south-eastwards from the Roggeveld in late September 2015. Note the reduced cloud cover over the distant Witteberg and adjoining mountains.

4.3.4 Other summit species

Odd individuals of several species were recorded on the summits. Seen several times were Cape Bunting, Sickle-winged Chat, Grey-backed Cisticola, Mountain Wheatear, Rock Martin and, in summer, Common Swift. Also occasionally seen were Karoo Prinia, Southern Double-banded Sunbirds, Fiscal Flycatcher, and Cape Penduline Tit. Two pairs of Ground Woodpeckers were seen once at summit height. None of these species flew at heights that would bring them into collision risk with turbine blades, and most not even at heights that would bring them at risk with the 33kV powerlines linking turbine strings. Noticeably more passerines were seen near the summits on days of calm or low winds days when turbines either would not be operating or with turbine blades moving very slowly.

4.3.5 Night active birds

Diurnal monitoring provides little or no information about the potential risk of birds colliding with turbines or powerlines at night. There are two fundamental types of night activity by birds: foraging and other activities by locally resident species including, in the Roggeveld region, owls, nightjars and thick-knees; and transient, cross-country, movements.

There is unlikely to be any substantial nocturnal use of the hill-top areas by locally active nocturnal bird species as the food resources are too poor to sustain them and the frequent strong winds will deter them. Owls are the most likely to occur but most will remain in the valley bottoms, or forage along the lower slopes, where prey is more abundant. Furthermore, even if they do fly over the ridges, owls are unlikely to fly at turbine blade heights. The two species known or likely to occur in the region take their prey off the ground. They forage in low light conditions when detection of prey, either visually or through hearing, requires them to remain close to the ground.

Birds which are transient across turbine arrays and powerlines are considered at greater risk of collision mortality than birds that are resident in the immediate vicinity of turbines. The risk to transients is increased when their movement is at night. Long distance migrants often fly by night but most do so at heights that will keep them well above turbines even those on the Roggeveld hilltops. Nor is there any particular attraction which would lead them to descend towards this part of the Karoo.

The birds of potentially greatest concern are regionally resident birds that disperse at night. This particularly applies to waterbirds of which, during the wetter 2013 surveys, a surprising number and diversity (>30 species) were recorded on dams in the valleys to the north of Brandvalley. Most waterbirds move between wetlands at night in order to avoid predatory eagles. There is the possibility that, in moving between dams, they would fly across ridges. It is likely that they fly high at night to be able to survey for wetland areas reflecting moonlight. They would thus potentially fly at turbine blade heights. However, in this area the dams lie in relatively deep valleys. It is more likely that, when dispersing, these birds initially fly downstream and so would not cross ridges with their turbine arrays. Their reconnaissance excursions are also likely to be during clear nights and especially during full moon when waterbodies reflect the light and so are more readily detected by birds in flight. These conditions will also illuminate turbines. Most of the waterbird species likely to be involved are not of particular current conservation concern. However, the Maccoa Duck, rated Near threatened, regularly occurs on dams in a valley immediately to the north of the Brandvalley WEF area and can be expected to sometimes fly from there to the Fortuin dam and so across the north-eastern portion of the Brandvalley WEF. It is likely that, especially in headwind conditions, night dispersing birds cross ridges at their lowest points, saddles. The predicted localities of greatest risk for waterbirds will be the saddle where the road from Leeustert to Ou Mure crosses the Spitskop ridge and the col in the ridge between the Ou Mure and Fortuin farm areas. Overall, at this stage of our understanding, the risk of nocturnal collisions is considered to be low and within acceptable levels.

4.3.6 General comment

The vegetation on the hilltops, where it is proposed to erect turbines, is predominantly scrub. Such bushes lack height and sufficient woody structure suitable for birds to build nests in. Given the strong winds and the paucity of food resources along the hilltops, most birds apparently opt for breeding on the hill slopes or in the valley bottoms where the generally taller vegetation gives improved protection for nesting, shelter for foraging, as well as offering better food resources.

In terms of both bird numbers and diversity the hilltops are depauperate. There were only two areas where terrain features caused local flightpaths where large birds often flew at heights that would create collision risk with elevated powerlines. These two localities were the:

1) saddle between the two Snydersberg plateaux

2) col in the ridge between the Ou Mure and Fortuin farmlands (see Figure 5).

The number of birds, and the diversity of species, was notably lower across the entire surveyed area during the 2015-2016 monitoring campaign than had been experienced during previous monitoring for two proposed WEFs just to the north of Brandvalley. Those northern WEF areas were surveyed during considerably wetter conditions. Valleys in the northern WEF areas had more extensive riparian bushes and trees than occur in the Brandvalley along the valleys. Also farm dams in the Brandvalley area are smaller than those to the north, and were largely dry during the monitoring period.

5 IMPACTS

Windfarm developments have two forms of impact on birds namely:

1) habitat loss and displacement

2) mortality through collisions with either turbine blades or with associated powerlines.

5.1 Habitat loss

Habitat loss is anticipated to occur in three ways:

1) in the short-term through disturbance during construction (with minor short-term repetitions during maintenance);

2) in the long–term through outright habitat destruction in the course of infrastructure construction

3) displacement from the proximity of infrastructure.

5.1.1 Disturbance associated with construction activities

Disturbance is largely confined to the construction phase. This causes displacement of birds from the immediate vicinity of human activities particularly when large machinery is in use. Larger birds are usually affected at greater distance from disturbance than smaller birds are. Disturbance has its greatest effect on birds that are engaged in breeding and can cause those with breeding sites close to the disturbance to desert their breeding sites, eggs or young. In this semi-arid region, the window in which most birds can successfully breed is short and, depending upon what stage of breeding is reached before disturbance, most birds will lose their ability to breed in the year of disturbance. This is particularly the case with larger bird species.

The effect of disturbance varies between different groups of birds and for non-breeding birds may have little impact. Two years prior to the present survey a new Eskom 400 kV powerline was constructed through the northern half of the Brandvalley area. During pre-construction monitoring for an immediately adjacent WEF large birds of prey were still often seen in the area despite considerable vehicle and human activity and, subsequent to the completion of the line and, during the present study, continued to be seen close to, or even perching on, the Eskom pylons.

5.1.2 Habitat destruction during construction phase

Habitat destruction occurs during the construction phase through the clearing of vegetation and displacement of stones etc. for the insertion of infrastructure – access roads, crane and turbine pads, provision of substation and powerlines etc. In the semi-arid Roggeveld vegetation loss is a permanent effect. Inevitably habitat destruction causes the loss of foraging and nesting habitat for most locally resident species of birds. Insertion of roads leads to fragmentation of habitat and can create edge effects –easier access by non-volant predators and, as many birds prefer continuous vegetation cover, a shift in bird habitat use away from the break in habitat.

5.1.3 Displacement

There are three ways in which birds may be displaced from their original, and presumed preferred areas. These are through: 1) through short-term disturbance associated with construction activities; 2) habitat destruction with associated edge effects; and 3) through avoidance, even of natural habitat, for some distance around infrastructure - birds in many species avoid areas of suitable habitat for some distance around infrastructure. Larger birds generally have a greater avoidance range around infrastructure than smaller species.

Birds that are displaced from their original preferred area must find alternative suitable habitat, which may be less favourable. In the alternative areas the displaced birds must usually compete for resources with an already established population of birds of the same or other species, potentially to the detriment of both residents and immigrants. The net result is usually a reduction in the overall local population.

Habitat loss in the proposed Brandvalley windfarm will affect birds far more in the valleys and lower hill-slopes than on the upper slopes and ridge summits. The lower areas, where water and sediments accumulate support richer vegetation and consequently higher bird diversity and numbers than the higher areas where vegetation is shorter and a higher proportion of the ground is covered in stones or bare rock. The most severe impact of infrastructure development on birds will occur on the lower slopes where new access roads must be developed and existing tracks widened.

5.2 Collision mortality

The crucial issues of avifaunal concern are the potential mortality of birds, especially those of conservation concern, through collision with either the turbine rotor blades or the 33 KV powerlines that run between turbine strings and the local substation. 33kV line routes can only be mapped during the detailed design phase. A preliminary area was therefore considered as indicated in Figure 13.

The risk of collision mortality varies in several general ways. These affect the manner in which collision mortality can be mitigated. Birds flying in daylight have a better chance of seeing and avoiding turbines than those flying at night – hence the concern over the night moving transients. In the Roggeveld low clouds often cover the ridges in fog in which visibility is severely reduced. It is unclear to what extent birds fly over the ridges in such conditions.

A number of factors affect bird collision with turbines. These are the:

1) Degree to which birds fly at heights equivalent to the turbine rotor blades – planned in the Brandvalley WEF to be between 20 and 190 m above ground level;
2) Bird's ability to manoeuvre in flight to avoid last minute collisions. Larger and heavier bird species, and for most birds in headwinds;
3) Degree to which birds may be pre-occupied - i.e. through chasing prey or in courtship display – and so pay less attention to moving rotor blades;
4) Familiarity with the location of turbines;
5) Frequency with which individual birds place themselves at risk of collision; and
6) Bird's angle of approach to the turbines, since rotor blades are more conspicuous seen head-on than from the side.

Powerlines are less conspicuous than turbines. Some will cross hill slopes and valleys where, in the Brandvalley area, most birds occur and bird movements at night are more likely than over ridges. In the Brandvalley area the risk of collision mortality for birds is considered considerably more probable from powerlines than from turbines.

Powerlines should avoid the two identified high sensitivity areas as far as possible. Where overhead 33kV powerlines are required, these should preferably not cross valleys and if they do so must have bird diverters at 5 m intervals along the line.

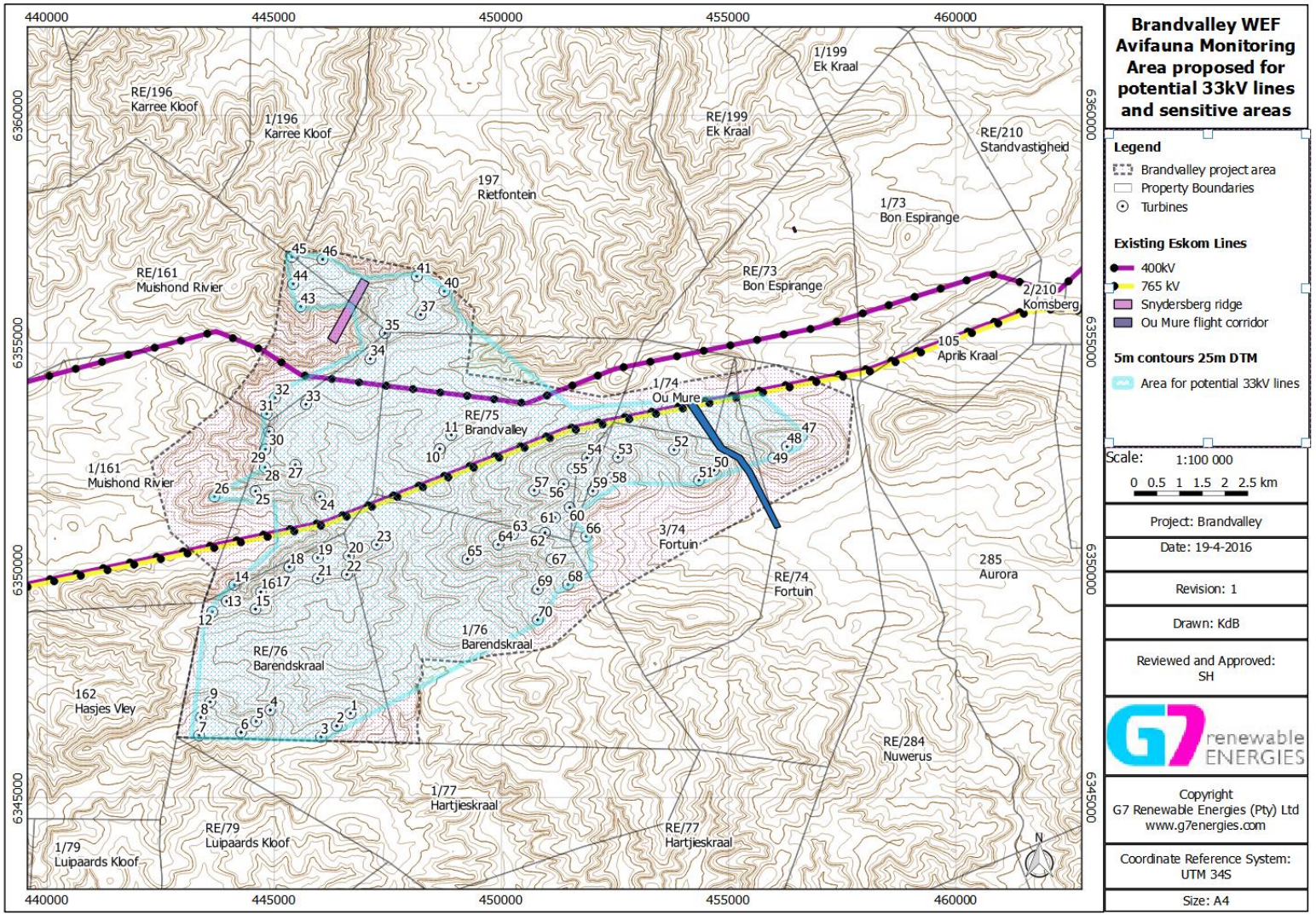

Figure 13: Area where 33kV powerline might be required in relation to sensitive areas

5.3 No-go alternative

The no-go alternative refers to the status quo and not proceeding with the proposed development. The area is currently utilised predominantly for low density sheep grazing. Existing electrical infrastructure, including Eskom substations and powerlines, have little impact on the avifauna. The impacts caused by the combination of status quo activities plus the additional potential impacts associated from the proposed wind farm will be acceptable if mitigation measures are implemented.

6 CUMULATIVE EFFECTS

6.1 Types of cumulative effects

There are several forms of cumulative effects relative to windfarm developments. One is when a bird species resident in a proposed windfarm is likely to be affected by not one but several impacts in that area. Another is the accumulative effect of impacts in the broader region within which the proposed wind farm is located. This may be from the development of other windfarms – as are proposed for areas immediately to the north and south of the Brandvalley WEF – or other significant land use changes (Figure 14). A third is when changes at some distance (even continentally) have the effect of changing the population of a bird species which is then potentially further impacted through loss of habitat or collision mortality at the proposed windfarm. All these effects can be subject to further cumulative effects over time.

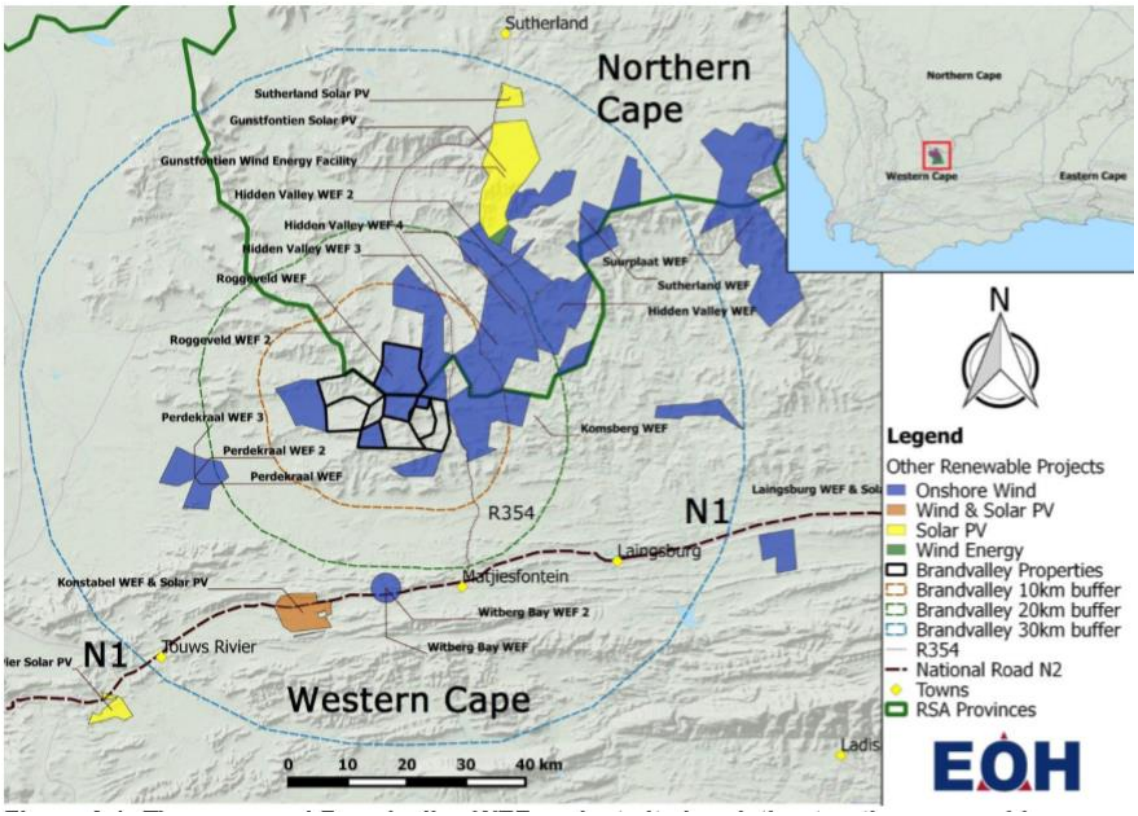

Figure 14: The proposed Brandvalley WEF project site in relation to other regional renewable energy projects (solar and wind)

6.2 Local effects

Local cumulative impacts may arise if a bird species is likely to be affected, to a considerable extent, by more than a single form of impact. The main perceived impacts of the proposed Brandvalley windfarm are habitat destruction, disturbance, displacement, noise, and injury or death through collision with either turbines or powerlines. It is likely that several locally resident bird species will be adversely affected by cumulative local impacts. However, in no case is this likely to be to an extent that raises conservation concern.

6.3 Regional effects

On a regional basis the only new developments likely to impact the avifauna are renewable energy projects – solar power plants and WEFs. The Roggeveld region, because of its persistent winds, has attracted major interest from developers of wind energy projects. Some ten or more such projects are proposed (some already authorised) in the Roggeveld and so close to, or abutting, the proposed Brandvalley project. The cumulative effect will inevitably be reduction in populations of regionally resident birds. As the region has extensive areas of similar terrain and vegetation the population reductions of most bird species will not be significant on a regional basis.

The greatest concern over cumulative impacts is for those larger-bodied and less numerous species already of conservation concern. Based on observations in the Brandvalley and immediately adjoining areas the key species are three Endangered species - Ludwig's Bustard, Black Harrier and Martial Eagle and two Near-threatened species - Verreaux's Eagle and Karoo Korhaan. From a national perspective the total number of individuals of these species in the Roggeveld is very small and largely inconsequential. The likely number of breeding pairs, for those species which do breed in the region, is for each species probably fewer than ten pairs. This conclusion is based on pre-construction monitoring of birds in five proposed windfarms in the region and the confirmation across these five farms of only a single active breeding site of Verreaux's Eagles, and of no other species of special conservation concern. If, as climate scientists propose (as heard reported at workshops), the prognosis is that the Karoo will become increasingly arid as a consequence of global warming, then the regional number of birds of conservation concern will inevitably be reduced. This scenario is supported by comparison of bird numbers and diversity found during bird monitoring in three adjacent proposed WEFs during wetter conditions with two WEFS during the El Nino drought. Though not quantifiable, the strong impression of the four bird monitors was that the local populations of all bird species were substantially lower in the dry conditions of 2015-2016 than during monitoring in wetter years.

An unanticipated probable cumulative situation arose during the 2015-2016 surveys of the proposed Brandvalley and the immediately adjacent Rietkloof WEF. This was the likely displacement into the areas of these WEFs of large birds from mountains some distance to the south of the Roggeveld to the south during periods of persistent low cloud. The near absence of Verreaux's Eagle activity in the two WEF areas during the peak summer drought suggests that there may be a reciprocal situation in which raptors from the Brandvalley area move across country to southern mountains which receive more reliable rainfall and so offer a better availability of food. These indicated situations suggest that any negative impacts of the proposed WEFs (there are no beneficial ones) may have cumulative impacts across a wider area than normally anticipated.

6.4 Longer range effects

The majority of bird species in the Roggeveld are regionally resident. Few of the species that occur in the region are long distance migrants. Those migrants that occur in the region do so in only low numbers. Thus there is little likelihood that cumulative impacts on a wider international scale will have any substantial impact on the population of these migrant birds in the Roggeveld. Nor will developments in the Roggeveld have any serious cumulative effect on these species.

6.5 The overall cumulative situation

For several reasons cumulative effects on birds are not considered a serious impediment to authorisation of the proposed Brandvalley WEF. These reasons are:

1) Most of the bird species recorded are local residents with extensive ranges in similar habitats across a wide swathe of South Africa
2) Other than the limited footprints of WEFs and solar power there are unlikely to be any other new major changes in regional land use that will overlap with the construction phases of the WEFs and have any serious effect on local bird distribution and numbers.
3) The forecast for the karoo in the medium term – equivalent to the predicted operational life, 20-30 years, of wind turbines - is of progressive drying. If this equates to the summer conditions in 2016 it will considerably reduce bird populations and so decrease the potential impacts on birds of wind farms in the Roggeveld.

Provided, as stringently required, appropriate mitigation measures are applied in all the proposed regional wind and solar projects, the cumulative impact must be considered acceptable from an avifaunal perspective. This is especially so relative to the situation in coastal lowland areas of the Western Cape where the number and diversity of birds at risk, especially those of conservation concern, is far greater than in the Roggeveld region. From an avifaunal perspective this semi-arid, low resourced region, is probably one of the areas in South Africa the development of WEFs will have the least negative impact on the avifauna.

CUMULATIVE IMPACTS		
Nature: the combined impacts from the other renewable energy developments within close proximity to the Brandvalley wind farm		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Medium term (2)	Medium term (2)
Magnitude	Severe (4)	Severe (4)
Probability	Probable (3)	Probable (3)
Significance	Moderate (12)	Moderate (12)
Status (positive/negative)	Negative	Negative
Reversibility		No
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?		Yes
Mitigation measures		
Cumulative impacts:		Greater than that of turbines
Residual impacts:	Long Term	Long term

7 MITIGATION

7.1 Habitat destruction

During construction habitat destruction should be kept to a minimum, especially so in the valley bottoms and lower slopes where resources, and so bird numbers, are greatest. An environmental control officer, with a brief that includes minimization of habitat destruction, should be appointed to manage this.

7.2 Disturbance

Disturbance is inevitable during the construction period. As far as possible construction activities should be kept to a minimum in terms of space and time. Construction of sub-stations in the valleys, where in this region most birds occur, should as far as possible, be timed to avoid the main breeding season for local birds which is the period August to October inclusive.

7.4 Avoidance of ridge saddles and cols

Birds of many species often use saddles (the lowest areas along ridge sections) or cols (effectively short valleys across ridges) when crossing ridges, especially when this requires them to fly into headwinds. Saddles and cols are thus funnels for local bird movement. Obstructions (turbines or elevated powerlines) across the funnel features will increase the risk of bird collision mortalities. The risk of collision mortalities can be mitigated by leaving a 100 m gap between successive turbines across saddles and avoidance of elevated powerlines across saddles and cols where possible. If not avoidable all overhead 33 KV powerlines on these saddles and cols should have diverters at 5 m intervals on the lines.

The seasonal surveys showed that there are two localities in the Brandvalley area where the potential risk of collision mortalities is sufficient to warrant mitigation. Bird use of two saddle/cols in the Brandvalley area is such that turbine positioning must follow the 100 m gap and where no elevated powerlines should be permitted. These two localities are 1) the saddle between the two Snydersberg plateaux and 2) the col in the ridge between the Ou Mure and Fortuin farm valleys (Figure 15Figure 5). At these localities a) no turbines should be erected within 100 m of the lowest point in the saddle/col and b) overhead lines should have bird diverters of a type visible by day and night set at 2 m intervals along the line. Away from these two localities, where overhead powerlines cross valleys, bird flight diverters should be placed on the line at a spacing of 5m. It is accepted that diverters are likely to deteriorate across the operational life of the lines. The main aim is to alert bird to the lines in the immediate post-construction years when the lines will be a novel risk which locally resident birds will, over years, learn to compensate for.

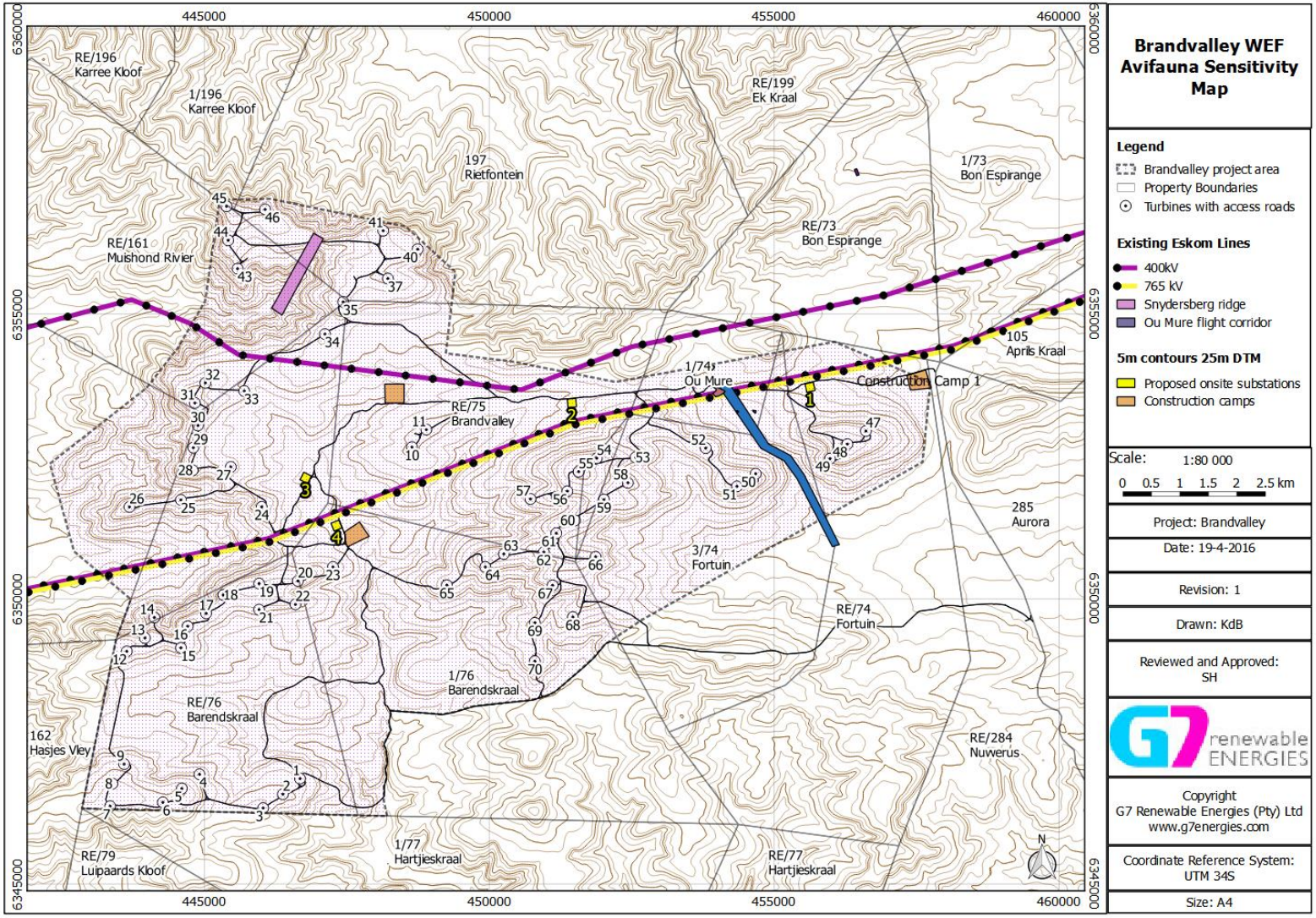

Figure 15: Avifauna sensitivities in relation to the project infrastructure

7.6 Need for mitigation in key areas

From an avifaunal perspective there are two key high risk areas in the Brandvalley area (Figure 15). These areas are:

1) The saddle between the two Snydersberg plateaux each with its turbine string. This saddle is regularly used by Verreaux's Eagles and White-necked Ravens.

2) The col on the ridge between the Ou Mure and Fortuin farms. This is a preferred flight path for waterbirds moving between the Fortuin dam and dams to the north. Waterbirds, which often fly low during localized movements and also fly in flocks, are likely to use this route at night when any obstructions, such as powerlines are detectable.

7.7 DECOMMISIONING

If constructed, the indicated operational life of the turbines, and use of associated infrastructure, is for at least 20 years. It is probable that towards the end of that time the existing turbines will be replaced by others of more advanced technology. Thus decommissioning is on a time frame beyond the scope this avifaunal report.

8 IMPACT ASSESSMENTS

8.1 HABITAT LOSS ASSOCIATED WITH THE CONSTRUCTION PHASE (ALL INFRASTRUCTURE AND ALL ALTERNATIVES)

Nature: Destruction of vegetation will reduce habitat available to birds

	Without mitigation	**With mitigation**
Extent (spatial scale)	Study area (2)	Localised (1)
Duration (temporal scale)	Medium term (2)	Medium term (2)
Magnitude (severity)	Slight (1)	Slight (1)
Probability (likelihood)	Probable (3)	Probable (3)
Significance	Low (8)	Low (7)
Status (positive/negative)	negative	negative
Reversibility	Nil	
Irreplaceable resource loss?	Yes	
Can impacts be mitigated?	Yes	
Mitigation: Mitigation measures		Appoint an ECO to see destruction of habitat is kept to a minimum, especially in valleys
Cumulative impacts:		Possible for larger species
Residual impacts:		Permanent

Confidence: High, habitat must be destroyed to develop infrastructure

8.2 DISTURBANCE ASSOCIATED WITH THE CONSTRUCTION PHASE (ALL INFRASTRUCTURE AND ALL ALTERNATIVES)

Nature: Human activity and noise that causes birds to leave areas of preferred habitat

	Without mitigation	With mitigation
Extent	Study area (2)	Localised (1)
Duration	Medium term (2)	Medium term (2)
Magnitude	Slight (1)	Slight (1)
Probability	Probable (3)	Probable (3)
Significance	Low (8)	Low (7)
Status (positive/negative)	negative	negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?		Yes
Mitigation: Mitigation measures		1) Avoidance of construction of sub-stations during the main breeding season for local birds which is the period August to October inclusive, as far as possible.
Cumulative impacts:		Minimal
Residual impacts:		Minimal

Confidence: High, the impact varying according to bird sensitivity

8.3 DISPLACEMENT ASSOCIATED WITH THE CONSTRUCTION PHASE (ALL INFRASTRUCTURE AND ALL ALTERNATIVES)

Nature: Activities and or presence of intrusive structures cause birds to permanently move away from infrastructure

	Without mitigation	With mitigation
Extent	Localised (1)	Localised (1)
Duration	Medium term (2)	Medium term (2)
Magnitude	Severe (4)	Severe (4)
Probability	Probable (3)	Probable (3)
Significance	Moderate (10)	Moderate (10)
Status (positive/negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable resource loss?		No
Can impacts be mitigated?		No. Relates to species' sensitivity
Mitigation measures		None
Cumulative impacts:		Number of regional wind farms
Residual impacts:	Long term	Long term

Confidence: Medium. The effect will vary related to differences in species' sensitivity

8.4 TURBINE COLLISION MORTALITY

Nature: Birds collide with turbine blades and are killed

	Without mitigation	With mitigation
Extent	Localised (1)	Localised (1)
Duration	Medium term (2)	Medium term (2)
Magnitude	Moderate (2)	Moderate (2)
Probability	Probable (3)	Probable (3)
Significance	Low (8)	Low (8)
Status (positive/negative)	Negative	Negative
Reversibility	None	None
Irreplaceable resource loss?	Yes	Yes
Can impacts be mitigated?		Yes
Mitigation measures		Blades higher off ground
Cumulative impacts:		Number of regional wind farms
Residual impacts:	Long term	Long term

Degree of confidence: Medium (due to uncertainty about nocturnal bird activities)

8.5 POWERLINE COLLISION MORTALITY ASSOCIATED WITH THE PLACEMENT OF 33KV POWERLINES THROUGHOUT THE PROJECT SITE		
Nature: Powerlines are less visible than turbines and when placed where unanticipated by birds have a greater potential for collision mortality than hilltop turbines		
	Without mitigation	**With mitigation**
Extent	Localised (1)	Localised (1)
Duration	Medium term (2)	Medium term (2)
Magnitude	Severe (4)	Severe (4)
Probability	Probable (3)	Probable (3)
Significance	Moderate (10)	Moderate (10)
Status (positive/negative)	Negative	Negative
Reversibility		No
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?		Yes
Mitigation measures		1.Bury powerlines where possible. 2.Lines across the two specified localities to have day-night diverters at 2 m intervals 3. Minimize powerline crossing of valleys. 4. Lines across valleys to have diverters at 5 m intervals
Cumulative impacts:		Greater than that of turbines
Residual impacts:	Long Term	Long term

Based on the findings, any of the proposed alternatives and the project components (access tracks, sub-station positions and 33 kV powerlines) can proceed if mitigation measures are implemented.

9 CONCLUSIONS

The impacts of the proposed Brandvalley wind farm will have a negligible effect on the majority of bird species that occur in the affected area. The means of mitigating the impacts on birds of the proposed wind farm development are simple but limited.

The turbines will be established on hilltops and far from most sensitive habitats. Where possible habitat destruction should be kept minimal in the valley bottoms and lower hill slopes where resources for birds are greatest. Major construction of substations should be kept to a minimum, during the local bird breeding season of mid-August to mid-October.

The only project components of concern are potential mortality through collisions with 1) turbine blades and, in particular, 2) powerlines that link the turbine strings to the transformer substation. Collision with turbine blades especially applies to the Namaqua Sandgrouse and to waterbirds flying across the ridges at night. Collision risk with powerlines is greatest at low points on ridges and elevated powerlines should be avoided in the two identified flightpaths passes, or if essential must be marked with day and night visible bird diverters.

Based on the bird-depauperate habitat, the low overall number of birds, and the small number of species that, at least by day, fly over the hills at potential collision height there is minimum probable impact on the local avifauna whether in terms of habitat loss, disturbance, or collision risk. This site is likely to cause substantially less impact on birds than a WEF of equivalent size in a lowland situation. There is no particular reason from an avifaunal perspective to object to this WEF development, provided key mitigation measures are applied, and authorisation is recommended.

The developer provided a range of alternative locations for access roads, substations, and construction camps – the alternatives being necessary as the technical requirements that may affect selection have not yet been finalized. The alternatives were considered in relation to field knowledge and, from an avifaunal perspective, all are acceptable provided the recommended mitigations are undertaken.

Overall, there are no unacceptable impacts on the avifauna anticipated from the proposed Brandvalley WEF and, from an avifaunal perspective, the project can be authorised.

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DEUTSCHLANDER, M.E., PHILLIPS, J.B. & BORLAND, S.C. 1999. The case for light-dependent magnetic orientation in animals. J. *Experimental Biology* 202: 891-908.

FORMAN, R.T.T. & DEBLINGER, R.D. 2000. The ecological road-effect zone of a Massachusetts (USA) suburban highway. *Conservation Biology* 14: 36-46.

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WILTSCHKO, W., MUNRO, U., FORD, H. & WILTSCHKO, R. 1993. Red light disrupts magnetic orientation of migratory birds. *Nature* 364: 525-527.

11 DECLARATION OF CONSULTANT'S INDEPENDENCE AND QUALIFICATIONS

Dr. Anthony (Tony) Williams is an independent consultant. He has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

Dr. Williams has been a professional ornithologist for 45 years, including 9 years as a researcher at the FitzPatrick Institute of African Ornithology, 19 years as specialist scientist in Cape Nature (Conservation), five years at the (then) Avian Demography Unit, and 11 years as a consultant. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information.

CONSULTANT'S CURRICULUM VITAE

Dr A.J. (Tony) Williams

SA ID: 420902 5541 080

QUALIFICATIONS

B.Sc. *Cum laude,* in Geography, University of Sheffield, UK 1964

Postgraduate Certificate in Museum Studies, University of Leicester, UK 1968

M.Sc. Zoology, University of Sheffield, UK 1972

Ph.D. Zoology, University of Cape Town, South Africa 1980

EMPLOYMENT

2008-present:	**Consultant. Co-director: African Insights. Director: Dr Williams Bird Surveys**
2001-2007	Seconded, as ornithological researcher, by Cape Nature to **Avian Demography Unit, University of Cape Town.**
1994-2007	Senior Professional Officer (Ornithology) at **Western Cape Nature Conservatio**n (later renamed as **Cape Nature**). Provision of expert avifaunal advice to the organisation and the Government of the Western Cape Province. Conducting research and directing researchers. Representing the organisation on EIA appraisals
1988-1994	Senior Ornithologist **Cape Provincial Nature Conservation**: Responsible for Walvis Bay and all guano islands 1988-1994; Conducting research and directing researchers. Representing the organisation on EIA appraisals
1982-1988:	Ornithologist for **Department of Conservation and Tourism SW Africa/ Namibia**

1973-1982:	Research officer at **Percy Fitzpatrick Institute of African Ornithology, University of Cape Town**: dealing with sub-Antarctic Marion and Gough Islands (23 published scientific papers) and coastal birds in the southwestern Cape (6 papers)
1969-1972	**Norway** – research assistant at University of Tromso
1967-1968	**UK** Museum Studies course at Leicester University
1965-1966	**Canada** - Assistant Planner in Vancouver, British Columbia
1964-1965	**UK** Peak District National Park - Assistant planner
Overall:	43 years as a professional ornithologist; 25 years as a conservation ornithologist; and 20 years involvement in consultancy.

CONSULTATIONS

Fields of expertise:

Specialist avifaunal assessments/ surveys;

Development of tourism concepts;

Provision of nature interpretational material/signage

TERRESTRIAL DEVELOPMENTS

Energy projects:

Eskom: Appraisal of new power lines at Kimberley and at Misverstand (Swartland); and three lines related to wind energy facilities in the Roggeveld (border between Northern and Western Cape Provinces). Review of the potential impacts of electricity infrastructure on birds in the entire West Coast District Municipality.

Wind Energy Facilities (WEF): Work on 10 WEFs. Scoping for a WEF, with associated radar survey and full moon observations of bird movements, near Vredenburg; Scoping for Denham WEF near Struis Bay; Avifaunal EIA section for Zen WEF near Gouda (2013-2014); Seasonal pre-construction avifaunal field monitoring for 5 WEFs in the Roggeveld region between Matjiesfontein and Sutherland (2013-16); Socio-economic plans related to Witteberg WEF near Laingsburg, and for proposed WEFs near Klawer and in the Richtersveld.

Solar Power Plants (SPP): Avifaunal EIAs for 9 PV solar arrays: near Langebaan (2014); near Touws River (2015); near Vanderkloof Dam in the Free State (2015-2016); and 6 proposed SPPs near Vryburg in the North West Province (2015-2016).

Nuclear Power Plants: Specialist peer-reviewer for faunal reports prepared for 3 proposed nuclear plants (2009)

URBAN PROJECTS:

Residential developments: Strandfontein (2008), Paarl golf estate (1999), Atlantic Hills (Cape Town) (2012)

Landfills: Avifaunal appraisals in terms of habitat loss, bird use, and problems in developed landfills for proposed new regional landfills for Eden (2011) and Winelands (2013) District Municipalities

Roads: Impacts of new roads on birds, including pollution and disturbance: R 300 Strandfontein (2004) & Military Road (2008) proposals; R27 Elands Bay to Lamberts Bay phases 1 (2000) and 2 (2004). Prepared global review of road impacts on reptiles

WETLAND RELATED DEVELOPMENTS

Century City, Cape Town: Reports on: the control of building heights (2007); Canoeist disturbance of birds (2008); Impacts on birds of rotenone poisoning of fish (2009). Also 20 years as ornithologist on the environmental advisory committee for the Intaka Island Nature reserve within Century City.

Paardevlei, Somerset West: Pre-draining appraisal (2004), Impacts on birds of rotenone poisoning of fish (2005), wetland development plan and bird monitoring ongoing 2013-2016

Flamink Vlei, Berg River: 2006-2011 impacts on birdlife of this major – 900 residential units – development; reports on potentials for avi-tourism (2007) and for establishing a guano enterprise (2007)

Paarl: 10 years in advisory role for the Bird Sanctuary/ WWTW; Advice to the Paarl Golf Estate;

Miscellaneous: Assessment of impacts on birds of developments at Uilenkraal (2 separate residential development proposals eastern (2002) western (2005)); Thesen Island, Knysna (1996); De Plaat – on Berg River (2005-2011); Atlantic Hills, Richwoood (2012): – How to reduce waterbird use of wetlands to avoid collision mortalities.

MARINE/ COASTAL DEVELOPMENTS

Offshore: Marine oil, gas and diamond EIAs (1998-2004). Assessment of proposed salmon farm in Saldanha Bay (2012)

Onshore: Avifaunal advisor for Saldanha Port development (2014-2016); Site selection for the proposed West Coast District Municipality desalination plant (2012); Report on the potential for further guano platforms along the Namibian coast (1989). Effects of off-road vehicles on beach birds (published scientific paper)

Coastal residential developments: in the Uilenkraal valley, near Gansbaai (1999), Laaiplek (2005), Doring Bay (2008), Strandfontein (near Olifants River)(2008),

TOURISM/ ECO-EDUCATION DEVELOPMENTS

Concept developer, fund raiser, and partial project manager of numerous tourism developments most connected with the development of local communities

Rietvlei wetland eco-centre: Developed concept, motivated funding, taken to full Scoping level.

West Coast Investment Initiative: 1997-1999. Prepared tourism development proposals for Verloren Vlei and Pakhuis Pass (Cederberg). Concept development, fund motivator, and project manager for Lamberts Bay Bird Island tourism phases 1 (completed 1998) and 2 (completed 2001).

Cape Nature: Project manager for the Whale Hiking Route at De Hoop Nature Reserve (2002). Rocher Pan – provision of interpretation material (2009).

Coastcare: 2005> Developed proposals for Coastcare funding of tourism facilities at Kleinbaai (near Gansbay), Bettys Bay, and Lamberts Bay. All were short-listed, field inspected, and endorsed by the authorities. However, the foreign donor withdrew funding at national level. The Bettys Bay development at Stoney Point has been developed under different funding and I provided the interpretation material (2012-2014).

Flandos & associates: Matzikama Eco-park in Vredendal taken from concept to completion (2002-2004). Proposed developments at Doring Bay (2007), Graafwater, Citrusdal, and near Darling are still being considered.

Miscellaneous: Boschberg eco-residential/ ecotourism development (Somerset East) for Blue Crane Route (2010); Paardevlei (Heartlands); Flamenco Eco-centre, De Plaat; provision of interpretation material for Lamberts Bay Bird Island tourism phase 3 (2012-2015).

SCIENTIFIC ACHIEVEMENT

110 peer-reviewed papers in the international scientific literature.

SANCCOB (South African National Council for Conservation of Oiled Birds). Member of the executive committee 1994-2000, chairperson 1998-2000. High level involvement during the *Apollo Sea* spill in 1994; research into subsequent survivability and reproduction of de-oiled penguins 1994-1999; and advisor to the top level daily response committee for the *Treasure* spill of 2000.