Updated Avifaunal Impact Assessment

Version 2: 31 January 2018

On behalf of

Emoyeni Wind Farm Project (Pty) Ltd

Addendum to

Avifaunal Specialist Report: Umsinde Emoyeni Wind Energy Facility Phase 1 & 2 and Associated Electrical Grid Connection Phase 1 & 2 Western Cape & Northern Cape

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1 INTRODUCTION

Arcus Consultancy Services South Africa (Pty) Ltd (Arcus) were appointed in June 2016 by Emoyeni Wind Farm Project (Pty) Ltd (EWFP) to conduct an *additional* 12 months of pre-construction avifaunal monitoring for the proposed Umsinde Emoyeni Wind Energy Facility (WEF) Phases 1 and 2 (the WEF site).

Between October 2013 and October 2014 Arcus conducted avifaunal monitoring ('the initial monitoring') in line with the applicable guidelines (and in some instances above the minimum requirements) over a period exceeding 12 months on the WEF site. The results of this *initial* monitoring programme were presented in various reports, including seasonal progress reports, a scoping report, and culminating in the final Avifaunal Specialist Report (Pearson, 2015)[1]. Pearson (2015) identified Verreaux's Eagle as the main concern regarding potential avifaunal impacts of the proposed project. The decision to initiate additional monitoring was taken by EWFP following comments received from Birdlife South Africa (BLSA) and Interested and Affected Parties (I&APs) on the final Environmental Impact Assessment (EIA) report, as well as the final Avifaunal Specialist Report, meetings between these parties and the specialists, and recommendations made by the specialists.

This Updated Avifaunal Impact assessment report (which serves as an addendum to Pearson, 2015) presents the survey design, methodology and results of the additional one year of pre-construction monitoring (the "2016/17 monitoring"). These results are then carefully considered, along with the results of the initial monitoring and all the findings from a thorough desk-based study (presented in Pearson, 2015), and an updated Impact Assessment is presented. This updated assessment is based on a revised layout (November 2017), which is the result of an iterative design process conducted by EWFP, and considers the latest available information regarding bird mortalities at operational WEFs in South Africa.

1.1 The WEF Site

The WEF site is located near the town of Murraysburg in the Western Cape Province. The WEF site largely consists of relatively flat plains, undulating hills and plateaus covered by karoo scrub vegetation interrupted by steeper slopes that form mesas and buttes. Mountainous areas can be found to the north, south and eastern borders of the WEF site. Grasses tend to dominate rather than Karoo scrub on some of the higher mountain tops and plateaus that experience regular frost. Other habitats within the WEF include farm dams, drainage lines dominated by relatively denser and taller riparian scrub vegetation (e.g. *Acacia karoo*), as well as rocky outcrops and cliffs. Some of the larger rivers have created deeply incised cliffs. A detailed description of available bird micro-habitats on and around the WEF site is given in Pearson (2015).

Through an interactive design process during the EIA process, the majority of the WEF site initially surveyed during 2013/2014 is already excluded from the proposed development. At the outset of the additional monitoring, the turbine layout consisted of two 140 MW phases in the north and north east of the WEF site (Figure 1), of up to 98 wind turbines each. *Figures 1-9 show this layout, as it was the layout used to advise the monitoring locations and effort*. Following the completion of the additional monitoring, EWFP further revised the layout based on the results of the additional monitoring and recommendations from the Arcus specialist, resulting in 55 turbines per phase. After further consultations with all specialists, EWFP reduced the number of turbines again. The resultant layout of up to 35 turbines per phase is presented in Figure 10, and is what the updated Impact Assessment (Chapter 5) was based upon. The reduction in the number of turbines

[1] Avifaunal Specialist Report. Umsinde Emoyeni Wind Energy Facility Phase 1 & 2 and Associated Electrical Grid Connection Phase 1 & 2, Western Cape and Northern Cape. September 2015.

per phase (to 35), also means that the turbine specifications have now changed, and each turbine will have a max hub height of 135 m and a max rotor diameter of 150 m. These new turbine dimensions have been considered in the updated Impact Assessment (Chapter 5).

1.2 The Grid Connections

The Grid Connection for the Phase 1 WEF will extend approximately 38 Km to connect with the proposed Ishwati Substation, while the Grid Connection for Phase 2 WEF will be approximately 2 km in length.

1.3 Purpose and Aims

The purpose of this updated impact assessment report is to present:

- The survey methods of the additional monitoring;
- A summary of results of the four seasonal surveys;
- Comparisons of survey results with initial monitoring conducted in 2013/2014;
- The results of two specialist nest surveys;
- Updated avifaunal sensitivity map/s of the site;
- Provide an updated Avifaunal Impact Assessment for the two WEF phases and the two Grid Connection Phases, based on consideration of the additional monitoring information and latest information regarding WEF impacts on South African avifauna;
- Recommended additional mitigation measures and/or updated mitigations; and
- Future recommendations for the WEF design.

The purpose of the additional avifauna monitoring was to gather more detailed data regarding key species particularly Verreaux's Eagle while simultaneously addressing various comments and concerns raised by BLSA and I&APs. The primary aims of the additional monitoring were therefore to:

- Gain a better understanding of the movement of Verreaux's Eagle around the proposed turbine area and at selected nest sites within 7.5 km from turbine locations;
- Gain a better understanding of inter-annual variation in abundance, movements and activity of Verreaux's Eagle, Blue Crane and migratory species such as Amur Falcon and Lesser Kestrel;
- Increase coverage of vantage point surveys in areas where there were potential sampling gaps in the initial monitoring;
- Confirm the status of nests; and
- Monitor the movement of birds dispersing from a sample of nests.

1.4 Limitations and Assumptions

- The SABAP1 data covers the period 1986-1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate. (For a full discussion of potential inaccuracies in SABAP data, see Harrison et al., 1997).
- There is still limited information available on the environmental effects of wind energy facilities in South Africa. Therefore, estimates of impacts are advised by knowledge gained internationally, which should be applied with caution to local species and conditions.
- While sampling effort was as recommended in applicable guidelines at the time, and even higher in most VP surveys, to achieve statistically powerful results it would need to be increased beyond practical possibilities. The data was therefore interpreted using a precautionary approach.
- At the time of the surveys, it was assumed that flights between 20 m above ground and 160 m would fall within the Rotor Swept Height (RSH) of the turbine (based on

dimensions proposed at the time). It is now proposed to utilise turbines with a maximum blade tip height of 210 m. Since height is difficult to judge in the field it can be assumed that most flights recorded as above 160 m were in fact very high flights and above 210 m. However, some flights that were recorded as above could have actually been within the new rotor swept height. This was considered in the impact assessment and a precautionary approach was adopted. Likewise, flights between 20 m and 60 m would previously have been grouped as being within RSH. These flights are now below the proposed lowest point of the blade tip.

- The results of operational monitoring at wind farms in South Africa to date, has shown that accurately predicting which species (and in what number) will be affected by mortality at wind farms is difficult, and not an exact science. Although we predict collisions to be most likely in high use areas (identified through monitoring), placing turbines outside of these areas does not automatically mean that there would be a low level of impact nor does it mean that mortalities will not occur. Based on the data collected, and in the absence of a standard method for using this data to identify sensitive areas, we have done the best sensitivity analysis possible to try to determine higher risk areas (as shown in figures 6 and 9). Because there are many unknowns and bird movement and usage of areas can be unpredictable and fluctuating (e.g. season to season and year to year), our confidence in the primary mitigation measure (i.e. placement outside of high sensitivity areas and no-go buffers) is low to moderate.

2 ADDITIONAL MONITORING SURVEY DESIGN AND METHODS

The survey design and method was developed by Arcus at the start of the surveys (June 2016) to be in line with the applicable best practice guidelines[2] where possible, while also considering the methodology used by Pearson (2015), so that the data is comparable and compatible, and can be combined with the data collected during the initial 12 month programme. The methodology was designed in consultation with Lucia Rodrigues (who through her involvement with the Western Cape Black Eagle Project has been monitoring Verreaux's Eagle populations throughout the Western Cape since 2004) as well as BLSA and was focussed on Verreaux's Eagle and the proposed turbine positions at the inception of the programme (Figure 1).

Four seasonal surveys, one specialist cliff nest survey and two focussed 'Nest Vantage Point (NVP)' surveys were conducted between July 2016 and April 2017 (Table 1). The seasonal surveys consisted of vantage point monitoring, driven transects, focal sites and incidental observations. The specialist cliff nest survey in winter was conducted to locate additional nests (additional to those found during the initial monitoring in 2013/2014). The NVP surveys were conducted to monitor and record activity around active nest sites with survey methods similar to those of vantage point monitoring detailed below.

Table 1: Seasonal Survey Dates

Survey	Dates
Winter Survey	01 – 09 July 2016
Cliff Nest Search	02 – 04 July 2016
Spring Survey	18 - 24 September 2016
Nest Vantage Point Survey 1	04 – 06 October 2016

[2] Best Practice Guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa (Jenkins *et al.* 2015).

Survey	Dates
Summer Survey	17 – 23 January 2017
Nest Vantage Point Survey 2	04 – 07 April 2017
Autumn Survey	21 – 27 April 2017

For the purposes of this report and the methodology, the following definitions apply:

- Priority species: all species occurring on the Birdlife South Africa (BLSA) and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list[3]. This list consists of 107 species with a priority score of 170 or more. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by WEFs, physical size, species behaviour, endemism, range size and conservation status;
- Target species: those particular bird species that are to be recorded by a specific survey method. Target species per survey method:
  - Driven transects: all raptors; all large (non-passerine) priority species;
  - Vantage point (VP) surveys: all raptors; all large (non-passerine) priority species; all waterfowl (e.g. ducks and geese);
  - Incidental observations: all raptors; all large (non-passerine) priority species; and
  - Focal sites: all species associated, utilising or interacting at/with the focal site.

2.1 Vantage Points

Ten vantage points were surveyed in areas selected to maximise coverage of the proposed turbine layouts of the two WEF phases. Six of the initial 14 VPs utilised during the 2013/14 survey were surveyed again. These are VP4, VP6, VP7[4], VP8, VP9 and VP14. An additional four new VPs were added to provide improved coverage of the turbine layouts. The additional vantage points surveyed were: VPW, VPX, VPY and VPZ (Figure 1). A pair of observers monitored a viewshed of 360 degrees (180 degrees each) with a radius of approximately 2.5 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these, they would also be recorded. For each flight of a target species the flight path was recorded on a large scale map along with data on the number/species of bird(s) and type of flight.

Flight heights were recorded through five height bands: 1: 0-20 m; 2: 20-40 m; 3: 40-120 m; 4: 120-160 m and 5: >160 m. Each VP was surveyed for 12 hours during each seasonal survey.

Using a pair of observers per VP represents an improvement from the methods employed during the 2013/2014 survey period, where only a single observer was used per VP. VP locations and hours surveyed are listed in Table 2.

Table 2: Vantage Point Geographic Co-ordinates and Hours Surveyed (Year 2 Only)

[3] Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used. *Priority species list updated in 2014 by BLSA.*

[4] This VP was moved slightly and re-named as VP7b (Figure 1).

VP	Co-ordinates		Total Time Winter	Total Time Spring	Total Time Summer	Total Time Autumn	Total Time Combined (2016/2017)
	South	East					
4	-31.8335	23.94515	12	12	12	12	48
6	-31.7430	24.02530	12	12	12	12	48
7b	-31.8474	24.06801	12	12	12	12	48
8	-31.8166	24.03301	12	12	12	12	48
9	-31.8800	23.99806	12	12	12	12	48
W	-31.7795	24.00773	12	12	12	12	48
X	-31.8122	23.98430	12	12	12	12	48
Y	-31.8551	24.02179	12	12	12	12	48
Z	-31.8279	23.88862	12	12	12	12	48
14	-31.7957	23.91604	12	12	12	12	48
Total			*120*	*120*	*120*	*120*	*480*

Verreaux's Eagle flight behaviour at active nests was recorded by establishing two nest vantage points (NVPs) at (or within 1 km) from two of the three closest active Verreaux's Eagle nests to proposed turbine locations (Figure 1). NVPs were surveyed in spring and autumn by an avifaunal specialist and a field surveyor. The nest locations are listed in Table 3. Details of breeding activity and success was also recorded during each NVP monitoring session. Although the focus was on recording Verreaux's Eagle flights, all VP target species were recorded if observed. In spring the NVPs were surveyed for nine hours (split into 3 x 3 hour sessions each) and during autumn the NVPs were surveyed for 5 and 8 hours respectively, due to interruptions by thunderstorms which prevented nine hours being completed at each NVP. Following the spring surveys, it was confirmed that the nest at NVP1 was being used by a pair of Jackal Buzzards. A decision was taken to relocate this NVP to another nest site in autumn, and the new NVP was named NVP1b.

Table 3: Nest Vantage Point Geographic Co-ordinates and Hours Surveyed

NVP	Co-ordinates (Decimal degrees)		Total Time Spring	Total Time Autumn
	South	East		
1	-31.79742	23.99242	9	0
2	-31.86229	24.09190	9	5
1b	-31.91464	23.97762	0	8

Average passage rates and standard deviations (SD) were calculated as the average number of individuals recorded flying per hour of vantage point observations.

2.2 Driven Transects

Target species were sampled using two driven transects on the WEF site (DT1 and DT2). These transects were each conducted twice during each of the seasonal surveys. The locations (of the start and end points) of the driven transects are shown in Table 4 and Figure 1 shows the routes of the driven transects. Target species were recorded by driving slowly (+- 25 km/h) with all windows open, and stopping occasionally to listen and scan the surrounding environment. When a target species was located, a GPS co-ordinate was recorded along with the distance and direction from the vehicle to the observed bird and additional information such as weather conditions and habitat type.

Table 4: Geographic Co-ordinates for Driven Transect Routes and Seasonal Repetitions

Ref	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)	
	South	East	South	East
DT1	-31.8693	24.0100	-31.8319	24.0680
DT2	-31.8112	23.9834	-31.8410	23.9233

2.3 Focal Sites

Focal sites for the 2016/17 survey period included nests previously identified in the initial monitoring and those located in the specialist nest survey (Section 2.5). The purpose of the focal site surveys was to confirm the species utilising each nest and determine if the nests were active or inactive. A large dam in the WEF site ('Swaelkrans Dam') frequented by waterfowl was added as a focal site during the second NVP survey and subsequently surveyed in the autumn survey. Figure 1 shows the locations of the focal sites surveyed per season while a brief description of each and the dates surveyed are given in Table 5.

Table 5: Geographic Positions and Descriptions of Focal Sites

Focal Site	Co-ordinates		Description	Dates Surveyed
	South	East		
Nest 1 (NVP1)	-31.7948	23.9931	Nest on cliff.	18/09/16 04/10/16 05/10/16
Nest 2	-31.8173	23.9066	Nest on cliff. Nest behind a bush and under a small overhang.	23/09/16 22/01/17
Nest 3	-31.8067	23.8910	Nest on cliff. Nest located above a bush in a crack between two outcrops.	20/09/16 23/09/16
FSV1	-31.7550	23.8835	Verreaux's Eagle Nest.	21/01/17 03/04/17
FSV2	-31.7557	23.9912	Suspected Verreaux's Eagle Nest.	22/01/17 03/04/17
FSV3	-31.8227	24.1308	Verreaux's Eagle Nest.	27/04/17
FSV4 (NVP2)	-31.8566°	24.0915	Verreaux's Eagle Nest located and active during 2013/2014 monitoring.	04/07/16 05/10/16 06/10/16 05/04/17 07/04/17
FSV5	-31.8811°	24.0923	Verreaux's Eagle Nest located and active during 2013/2014 monitoring.	19/09/16 07/04/16
FSV6	-31.9352°	24.0843°	Inactive, old Verreaux's Eagle Nest structure located in 2013/2014.	06/10/16 07/04/17
FSV7	-31.9416	24.0335	Verreaux's Eagle Nest located and active during 2013/2014 monitoring.	04/07/16 22/09/16 06/10/16
FSV8 (NVP1b)	-31.9146	23.9776	Large Verreaux's Eagle nest on cliff.	05/04/17 06/04/17

Focal Site	Co-ordinates		Description	Dates Surveyed
	South	East		
				27/04/17
Swaelkrans Dam	-31.7926	23.9782	Largest dam in WEF site.	07/04/17 21/04/17 24/04/17

2.4 Incidental Observations

Relevant observations of target species were recorded while commuting to or from, or on the WEF site, but outside the survey protocols and times described above. The locations of incidental target species were recorded using a GPS, along with additional relevant information such as weather and habitat type.

2.5 Cliff Nest Survey

A cliff nest survey was conducted by the avifaunal specialist and an assistant in June 2016 at the beginning of the breeding season of Verreaux's Eagle. The survey methodology broadly followed the methods recommended in Malan (2009), and involved an initial desk-based screening to identify the location of suitable cliffs, not previously surveyed in 2013/2014 (of which there were few). These were then visited using a 4 x 4 vehicle and traversing on foot (where access was possible). Cliffs were surveyed using a combination of 10 x 42 binoculars as well as a tri-pod mounted 20-60 x 60 Nikon Prostaff 5 fieldscope. The aim was to locate Verreaux's Eagle nests (which are typically large), however the presence of any cliff nest (active or inactive) was noted if observed.

2.6 Determination of Avian Sensitivity and No-Go Areas

Avifaunal No-Go Areas (Figure 6) were identified through consideration of Pearson (2015) including the results of the initial monitoring, as well as the results of the 2016/17 monitoring programme, as follows:

- National Freshwater Ecosystem Priority Areas (NFEPA) rivers and wetlands buffers: 200 m
- Cultivated lands buffer: 200 m
- Ridge buffer: 150 m
- Additional (i.e. identified on site during nest survey work) rocky ridge habitat buffer: 300 m
- European Bee-eater colony buffer: 500 m
- Nest/Roost Site buffers:
  - Verreaux's Eagle nest sites (active and inactive): 3 000 m
  - Martial Eagle nest site (active): 5 000 m
  - Pale Chanting Goshawk: 500 m
  - Jackal Buzzard: 500 m
  - Rock Kestrel: 500 m
  - Rufous-breasted Sparrowhawk: 500 m
  - Unidentified raptor or corvid nest: 1500 m
  - Verreaux's Eagle roost: 1000 m

Avifaunal Sensitivity Zones were designated based on observed flight activity during 2 x 12 months of avifaunal monitoring sessions on the WEF site (one from 2013/14, the other from 2016/17). All flights recorded across two years of monitoring were combined and analysed in GIS to determine sensitive areas based on flight activity.

Observed flight sensitivity was determined by creating a Grid Cell Sensitivity Score (GCSS), falling within either a Low, Medium, Medium-High or High classification for a 200 m x 200 m grid covering the WEF site. The GCSS was derived by analysing the following characteristics of all mapped priority species and raptors flight lines passing through each grid cell:

- Priority species score and the number of individuals associated with each flight line;
- Risk height factor, which considered if the flight was within the Rotor Swept Height;
- The duration of the flight; and
- The length of the flight.

These factors were considered in the following equation to determine a Flight Section Sensitivity Score (FSSS), for each section of flight within a grid cell. The GCSS is the sum of these flight sections within the grid cell, giving a sensitivity score specific to the cell.

$$FSSS = PSS \times N \times (X/Y \times D) \times (P+1)$$

Where:

- PSS is the Priority Species Score (Retief *et al.* 2011, updated 2014).
- N is the number of birds that are associated with the flight line.
- X is the length of the flight line section that is within a particular Grid Square.
- Y is the length of the whole flight line.
- D is the duration of the whole flight.
- P is the proportion of the flight line at Risk Height.

Grid cells within the WEF site boundary without a GCSS did not have any recorded priority species flights passing through from the monitoring survey, either because no species were recorded, or they were beyond the viewsheds covered by VP watches.

The resultant GCSS scores were categorised as follows: Low (0.1 – 15,000); Medium (15,000 - 40,000); Medium-High (40,000 - 110,000); and High (>110,000). These are shown for both the 2013/2014 data set (Figure 7) and the 2016/2017 data set (Figure 8).

Figure 9 was created to show the updated and *combined* final flight sensitivity map using both data sets. Due to the two monitoring programmes (i.e 2013/2014 and 2016/2017) sharing some VPs and also using different VP locations, with some vantage points having a higher number of surveying hours than others, the combined sensitivity map needed to use a different score to equalise the cell sensitivities based on VP effort. To do this, the combined sensitivity map of both programmes (Figure 9) uses a GCSS per surveyed hour, where the GCSS is divided by the number of surveyed hours at each vantage point. This is linked to the flight lines that are the basis for the GCSS.

The resultant GCSS scores for the combined map (Figure 9) were categorised as follows: Low (0.01 – 200); Medium (200 – 800); Medium-High (800 – 1,800); and High (>1,800).

3 SURVEY RESULTS-ADDITIONAL MONITORING

3.1 Vantage Points

3.1.1 Total observations

A total of 713 birds[5] of 23 target species were recorded by observing 490 flights (i.e. one flight may include a number of birds = flock) during vantage point monitoring in four seasonal surveys (Table 6, Figure 2). Verreaux's Eagle accounted for 30.5% of target birds recorded, followed by Blue Crane (18.8%) and Jackal Buzzard (15.8%). Of all the target species flights recorded, 72% included at least some time at a height between the lowest

[5] It must be noted that separate flights may have been conducted by the same individual/s and that the figures presented here are not an indication of abundance, but rather flight activity.

and highest blade tip heights (i.e. within the potential rotor swept area of a turbine), or at 'risk height' (i.e. within height bands 2: 20-40 m; 3: 40-120 m; or 4: 120-160 m).

The highest number of flights with a proportion at risk height was by Verreaux's Eagle (113 flights), followed by Jackal Buzzard (87 flights) and Rock Kestrel (48 flights). While Blue Crane had the third highest number of flights (48), the majority of these were low flights and only 20 (42%) included time at risk height.

Table 6: Total Number of Target Species Birds and Flights Recorded During Four Seasonal Surveys in 2016/2017

Species	Flights total	Birds total	Flights with proportion at risk height
Eagle, African Fish*	2	2	1 (50%)
Bustard, Ludwig's*	3	4	1 (33%)
Buzzard, Jackal*	104	113	87 (83%)
Buzzard, Steppe *	8	8	4 (50%)
Crane, Blue*	48	134	20 (42%)
Eagle, Booted*	8	8	8 (100%)
Eagle, Martial*	14	14	11 (79%)
Eagle, Verreaux's*	149	218	113 (76%)
Falcon, Lanner *	2	2	1 (50%)
Goose, Egyptian	18	35	8 (44%)
Goose, Spur-winged	3	24	3 (100%)
Goshawk, Pale Chanting*	17	18	5 (29%)
Harrier, Black*	3	3	2 (67%)
Harrier-hawk, African*	5	5	3 (60%)
Ibis, African Sacred	1	3	1 (100%)
Kestrel species (unidentified)	2	2	2 (100%)
Kestrel, Greater*	5	6	5 (100%)
Kestrel, Rock	70	74	48 (69%)
Korhaan, Karoo*	2	4	0 (0%)
Pipit, African Rock*	1	1	0 (0%)
Raptor (unidentified)	9	11	7 (78%)
Shelduck, South African	11	16	7 (64%)
Spoonbill, African	1	3	1 (100%)
Stork, Black*	4	5	3 (75%)
Total	490	713	353 (72%)

**Priority Species*

The average passage rate (number of target species birds per hour) over all VPs (excluding NVPs) over four seasonal surveys (Table 7) was 1.51 (SD±2.49). This is moderate to low in the specialist's experience. The average passage rate was lowest in summer (1.21 ± 2.63) and highest in spring (1.98 ± 2.17). VP13 had the highest passage rate (2.25 ± 2.08), followed by VP7b (2.22 ± 5.18) and VP8 (1.98 ± 2.11). VPX had the lowest passage rate (0.81 ± 1.59) followed by VPW (1.13 ± 1.68). Passage rates varied at

VPs with season. VP4 and VP6 showed very low passage rates in summer (0.50 ± 1.00 and 0.33 ± 0.65 respectively), and high passage rates in winter (2.50 ± 2.61 and 2.33 ± 2.23), while the average passage rate at VP7b was low in winter (0.33 ±0.65) and high in summer (3.44 ±7.09). The high number in summer was primarily due to a flock of 22 Spur-winged Goose observed at VP7b.

Table 7: Average Passage Rates (Number of Birds per Hour) of Target Species Per VP (Standard Deviations Given in Parentheses)

VP	Winter 2016	Spring 2016	Summer 2017	Autumn 2017	*Total*
	Average (SD)	Average (SD)	Average (SD)	Average (SD)	*Average*
4	2.50 (2.61)	1.25 (2.01)	0.50 (1.00)	2.42 (3.78)	*1.67 (2.61)*
6	2.33 (2.23)	1.17 (1.47)	0.33 (0.65)	1.00 (2.24)	*1.20 (1.87)*
7b	0.33 (0.65)	2.58 (2.47)	3.44 (7.09)	2.83 (7.66)	*2.22 (5.18)*
8	1.92 (1.62)	2.92 (3.03)	1.42 (1.62)	1.33 (1.21)	*1.98 (2.11)*
9	1.42 (1.73)	2.00 (1.21)	0.58 (0.79)	1.22 (1.73)	*1.30 (1.50)*
VPW	0.92 (1.56)	1.83 (2.17)	0.58 (0.90)	1.17 (1.80)	*1.13 (1.68)*
VPX	0.58 (1.44)	1.92 (2.27)	0.42 (1.16)	0.33 (0.65)	*0.81 (1.59)*
VPY	0.33 (0.89)	1.92 (2.57)	2.42 (3.82)	0.42 (0.67	*1.27 (2.47)*
VPZ	1.58 (1.38)	2.33 (2.02)	2.33 (1.67)	2.75 (2.99)	*2.25 (2.08)*
14	2.00 (1.71)	1.92 (2.19)	0.67 (1.23)	1.08 (1.24)	*1.42 (1.69)*
Total	1.39 (1.78)	1.98 (2.17)	1.21 (2.63)	1.45 (3.12)	*1.51 (2.49)*

Verreaux's Eagle was identified by the initial monitoring as the main species of concern for the proposed development, and were therefore of particular focus for the 2016/17 survey period. Figure 3 shows all Verreaux's Eagle flights. Average passage rates of Verreaux's Eagle for all VPs surveyed in 2016 and 2017 are displayed in Table 8. Verreaux's Eagle activity was similar across seasons ranging from 0.33 (±0.84) birds per hour in winter when pairs were nesting to 0.61 (±1.28) bird per hour in autumn when pairs were mating and preparing to breed. VPX showed the lowest activity of Verreaux's Eagle with an average of 0.21 (±0.74) birds per hour over four seasons, followed by VP7 (0.25±0.86) and VP4 (0.27±0.86). The overall average passage rate for Verreaux's Eagle was highest at VPZ (0.98±1.74), followed by VP9 (0.69±1.15) and VP14 (0.67±1.22). The combined passage rate of Verreaux's Eagle for all VPs across the full year study was 0.46±1.08 birds per hour.

This is a moderate rate when compared to other sites where Verreaux's Eagle passage rates had been calculated for the pre-construction monitoring phase. Approximate passage rates of Verreaux's Eagle at other sites are as follows (BLSA/Sam Ralston, Pers. Com; pers. Obs): Witteberg- 0.95 bird/hour; Ishwati Emoyeni- 0.2 birds/hour; Nobelsfontein (now operational) – 0.63 birds/hour; De Aar North – 0.18 birds per hour; Unnamed Site in Karoo- 0.84 birds/hour; Komsberg East and West- 0.33 birds per hour; Highlands Wind Farm – 0.26 birds per hour; Maanharberg- 0.1 birds/hour. Smallie (2015) recorded passage rates of approximately 0.2 birds per hour at the proposed Umsobomvu WEF. Verreaux's Eagle passage rates therefore range from 0.1 to 0.95 birds per hour, with Umsinde falling roughly in the middle of this range. Comparison is useful here with the only operational WEF within 100 km of Umsinde, i.e. Nobelsfontein (approximately 65 km west of the proposed turbine footprint area). At Noblesfontein pre-construction monitoring found a passage rate of 0.63 per hour (higher than Umsinde). At the Nobelsfontein Wind Farm, 7 Verreaux's Eagle nest sites are known within 14 km of the site boundary, 5 of which are situated within 7 km of operational turbines. Of these five, three are within 2.5 km of turbines and were found to be active between 2014 and 2017, with all three being active in 2017 (Craig Campbell pers.

com). In three years of operational monitoring (i.e. Nov 2014 - Nov 2017), low levels of bird mortality have been recorded with one Verreaux's Eagle fatality having been recorded at the Nobelsfontein WEF, and the three nest sites (2.1 km, 2.4 km, and 2.5 km from closest operational turbine) continue to be utilised indicating little or no displacement or breeding disruption.

*Table 8: Average Passage Rates (Number of birds per h**our) of Verreaux's Eagle per VP (Standard deviations given in parentheses)*

VP	Winter 2016	Spring 2016	Summer 2017	Autumn 2017	Combined
	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)
4	0.17 (0.58)	0.08 (0.29)	0	0.75 (1.28)	0.27 (0.86)
6	1.08 (1.51)	1.00 (1.21)	0.17 (0.39)	0.08 (0.29)	0.58 (1.07)
7	0.25 (0.62)	0.08 (0.29)	0.33 (1.15)	0.33 (1.15)	0.25 (0.86)
8	0	0.33 (0.78)	0.17 (0.39)	0.67 (0.98)	0.29 (0.68)
9	0.42 (0.67)	0.83 (1.19)	0.44 (0.88)	0.93 (1.53)	0.69 (1.15)
VPW	0.17 (0.39)	0.50 (1.17)	0.17 (0.39)	0.67 (1.66)	0.36 (0.98)
VPX	0	0.33 (0.78)	0.33 (1.15)	0.17 (0.58)	0.21 (0.74)
VPY	0.25 (0.87)	0.25 (0.62)	0.58 (1.24)	0.33 (0.90)	0.35 (0.91)
VPZ	0.08 (0.29)	1.25 (2.14)	1.00 (1.76)	1.58 (1.98)	0.98 (1.74)
14	0.83 (1.40)	0.50 (0.80)	0.75 (1.54)	0.56 (1.13)	0.67 (1.22)
Total	0.33 (0.84)	0.52 (1.08)	0.40 (1.06)	0.61 (1.28)	0.46 (1.08)

3.1.2 Nest Vantage Points

A total of 63 flights recorded 94 birds of 14 target species during 31 hours of NVP monitoring across both the spring and autumn NVP iterations (Table 9). The target species most regularly recorded was Verreaux's Eagle (24 flights), followed by Rock Kestrel (15 flights) and Jackal Buzzard (6 flights).

NVP1 was established near a suspected Verreaux's Eagle nest (i.e. Nest 1 in Section 3.3 below), which as monitoring progressed in spring was found to be an active Jackal Buzzard nest. No flights of Verreaux's Eagle were recorded at NVP1. However, due to the presence of a river near to NVP1, other water associated target species were recorded here e.g. South African Shelduck, Grey Heron, Egyptian Goose and African Spoonbill. Twelve target species were recorded at NVP1, with Jackal Buzzard, African Spoonbill and Egyptian Goose being recorded the most. NVP1 was not surveyed in autumn.

NVP1b was therefore established at a Verreaux's Eagle nest (FSV8 in Section 2.3 above) and monitored in autumn. This NVP was surveyed for a total of 8 hours in autumn, during which time a total of 7 target species flights were recorded, four by Rock Kestrel, two by Verreaux's Eagle and one by Blue Crane. The latter flight was by a flock of four Blue Crane, and was a very high flight (>200 m high). Two flights of adult Verreaux's Eagle were recorded, on separate days, and it could not be confirmed if this was the same individual or not. While the large cliff nest was confirmed to be that of a Verreaux's Eagle, the birds were not seen on or near the nest (or perched on the cliff) during the NVP monitoring. Closer inspection below the nest revealed large amounts of white-wash and Verreaux's Eagle prey remains indicating recent occupation, however breeding in 2017 had not yet begun.

The nest monitored from NVP2 was found to be active with a juvenile Verreaux's Eagle observed on the nest in spring 2016 and the adult pair regularly flying overhead or perched

on or near the cliff. No flights of the juvenile were observed and it is believed that this bird had not yet fledged (although it did appear close to fledging age) at the time of the spring NVP iteration. During the autumn NVP monitoring at NVP2, the pair of adult birds were again observed in a total of seven flights, and courtship behaviour was recorded, indicating preparation for breeding. No juvenile or sub adult birds were seen. The other target species recorded at NVP2 was Rock Kestrel, and the cliffs at this NVP appear to also be used for breeding by Rock Kestrel. Although no definitive nest position was observed, a pair was seen regularly perched near to the active Verreaux's Eagle nest, and mating behaviour by this pair of Rock Kestrel was observed on at least two occasions in spring.

Table 9: Total Number of Target Species Birds and Flights Recorded during NVP Monitoring in Spring and Autumn - Total Survey Hours per NVP Given in Parenthesis

Species	NVP1 (9 hours)		NVP2 (14 hours)		NVP1b (8 hours)		*Total*	
	No. Flights	No. Birds	No. Flights	No. Birds	No. Flights	No. Birds	*No. Flights*	*No. Birds*
Buzzard, Jackal	6	9	0	0	0	0	*6*	*9*
Cormorant, Reed	1	1	0	0	0	0	*1*	*1*
Crane, Blue	0	0	0	0	1	4	*1*	*4*
Eagle, African Fish	2	2	0	0	0	0	*2*	*2*
Eagle, Verreaux's	0	0	22	36	2	2	*24*	*38*
Goose, Egyptian	4	8	0	0	0	0	*4*	*8*
Hawk, African Harrier-	1	1	0	0	0	0	*1*	*1*
Heron, Grey	1	1	0	0	0	0	*1*	*1*
Ibis, Hadeda	1	1	0	0	0	0	*1*	*1*
Kestrel, Greater	1	1	0	0	0	0	*1*	*1*
Kestrel, Rock	1	1	10	16	4	4	*15*	*21*
Shelduck, South African	1	2	0	0	0	0	*1*	*2*
Sparrowhawk, Rufous-chested	1	1	0	0	0	0	*1*	*1*
Spoonbill, African	4	4	0	0	0	0	*4*	*4*
Total	24	32	32	52	7	10	*63*	*94*

Overall, the NVP monitoring did not meet the aims of providing substantial flight information surrounding the nest sites. No flights of dispersing juvenile Eagles were observed, and few courtship/display flights were recorded. No flights linked to nest building/preparation (e.g. birds carrying nesting material) were recorded either. The NVP monitoring did however, serve to confirm the status and activity of the nests monitored.

3.2 Driven Transects

The driven transects resulted in moderate to low numbers of target species being recorded. DT1 had the most records (20) and the most number of individuals (53). The most frequently recorded species was Blue Crane with a total of 9 records (38 individuals) followed by Jackal Buzzard and Rock Kestrel with four records each (Table 10).

Table 10: Number of Driven Transect Records Made Per Species During Four Seasonal Surveys. Total Number of Individuals Given in Parentheses.

Species	Number of Records per Driven Transect	
	DT1	DT2
Crane, Blue	7 (34)	2 (4)
Buzzard, Jackal	4 (4)	0
Eagle, Verreaux's	0	1 (1)
Goshawk, Pale Chanting	0	1 (1)
Korhaan, Karoo	3 (7)	0
Korhaan, Northern Black	1 (1)	0
Kestrel, Rock	3 (4)	1 (2)
Shelduck, South African	1 (2)	0
Unidentified Raptor	1 (1)	0
Total	20 (53)	5 (8)

3.3 Focal sites

Table 11 shows a summary of the results from the visits to focal sites associated with nests during the monitoring period.

The latest results showed that Nest 1 was confirmed to be an active Jackal Buzzard nest and Nests 2 and 3 were confirmed to be an active White-necked Raven nests. Of the known Verreaux's Eagle nest sites visited (FSV1-FSV8), one is definitely no longer in use by Verreaux's Eagle (FSV2), four nests (FSV4, FSV5, FSV7 and FSV8) were active or recently active, one appears abandoned but could possibly be used again in future (FSV1), and the activity at two (FSV3 and FSV6) could not be established.

The only focal site surveyed, that was not a nest site, was the Swaelkrans Dam. This site was surveyed three times in autumn 2017, once in early April 2017 and twice in late April 2017. The following species (total number of individuals in parenthesis) were recorded across all three surveys: African Fish Eagle (2); African Sacred Ibis (1); Blacksmith Lapwing (5); Black-winged Stilt (4); Brown-throated Martin (6); Cape Shoveller (5); Cape Wagtail (2); Egyptian Goose (34); Greater Striped Swallow (10); Little Grebe (3); Pied Avocet (1); South African Shelduck (56); and White-breasted Cormorant.

The only record of a priority species at this dam was the single observation of African Fish Eagle consisting of two birds, an Adult and a Juvenile, indicating that this species breeds on the WEF site.

When considering both phases (i.e. all 110 turbines) of the latest turbine layout (Figure 10), there are no Verreaux's Eagle nest sites within 3.5 km of proposed turbines. Within 5 km of proposed turbine positions there are four Verreaux's Eagle nest sites. Of these three are active/likely active nest sites (i.e. FSV4, FSV5 and FSV8), and one site (FSV1) is likely inactive and possibly abandoned. Within 7.5 km of proposed turbine positions there are three active/likely active Verreaux's Eagle nest sites (i.e. FSV4, FSV5 and FSV8), one nest site (FSV3) where activity could not be confirmed but is likely inactive, and one site (FSV1) that is likely inactive and possibly abandoned.

Table 11: Summary of Findings from Visits to the Nest Focal Sites

Focal Site	Findings			
	Winter 2016	Spring 2016	Summer 2017	Autumn 2017
Nest 1 (NVP1)	Located during Specialist Nest Survey, when a pair of adult Verreaux's Eagle were observed flying above. Suspected to be a Verreaux's Eagle nest	Single adult Verreaux's Eagle was observed perched on cliff 30 m from nest. However, nest was later confirmed active and in use by a pair of Jackal Buzzard. It is possible that the cliff is a roost site used by the adult Verreaux's Eagle observed.	Not Visited	Not Visited
Nest 2	Located during Specialist Nest Survey. Unconfirmed species or activity	Confirmed active and in use by a pair of White-necked Raven.	Not Visited	White-necked Raven observed on and near nest.
Nest 3	Located during Specialist Nest Survey. Unconfirmed species or activity	Confirmed active and in use by a pair of White-necked Raven.	Not Visited	Not Visited
FSV1	Not Visited	Not Visited	No Verreaux's Eagle recorded. No signs of activity or recent use.	No Verreaux's Eagle recorded. No evidence of recent use. Large stones/rocks in nest. Nest likely abandoned. African Harrier Hawk is possibly resident in gorge while a juvenile Martial Eagle was also observed in the vicinity.
FSV2	Not Visited	Not Visited	No Verreaux's Eagle recorded. No signs of activity or recent use.	No Verreaux's Eagle recorded. Possibly an old Verreaux's Eagle nest that is now in use by White-necked Raven. Some old prey remains found, including tortoise. Wool found in nest.
FSV3	Not Visited	Not Visited	Not Visited	No Verreaux's Eagle recorded. Long distance observations could not confirm activity of site.
FSV4 (NVP2)	Adult pair of Verreaux's Eagle observed flying above nest site. No activity on nest.	Juvenile Verreaux's Eagle observed on the nest and the adult pair regularly flying overhead or perched on or near the cliff.	Not Visited	Pair of adult Verreaux's Eagle present. Courtship displays observed as well as pair perching together on or near nest and calling in flight.

Focal Site	Findings			
	Winter 2016	Spring 2016	Summer 2017	Autumn 2017
FSV5	Not Visited	Adult pair observed circling overhead. Breeding success unconfirmed.	Not Visited	No Verreaux's Eagle observed. Activity unconfirmed.
FSV6	Not Visited	No Verreaux's Eagle observed. Activity unconfirmed. One adult Rock Kestrel recorded.	Not Visited	No Verreaux's Eagle observed. Activity unconfirmed.
FSV7	Not visited	Juvenile Verreaux's Eagle observed on the nest and the adult pair soaring overhead.	Not Visited	Not Visited
FSV8 (NVP1b)	Not Visited	Not Visited	Not Visited	No birds observed on large nest. Single adult Verreaux's Eagle was flushed from cliff upon first arrival at site. Single adult Verreaux's Eagle recorded again on two separate occasions. Large amounts of white-wash and Verreaux's Eagle prey remains present indicating recent use.

3.4 Incidental Observations

Table 12 gives a summary of all the incidental records of target species across the 12 month study. A total of 459 records were made over the 12 month period comprising 1089 individual birds from twenty-two species, of which 20 are priority species. Overall Blue Crane was the most frequently recorded and abundant species with 116 incidental records of 564 individuals, and was more abundant than during the initial monitoring. The second most regularly recorded species was Karoo Korhaan (99 incidental records), followed by Jackal Buzzard (67 records), Verreaux's Eagle (37 records) and Pale Chanting Goshawk (33 records). For most of these species (particularly Karoo Korhaan and Blue Crane). The same individuals were likely recorded multiple times and therefore incidental recordings are more useful to determine areas utilised by species of interest rather than the actual number of individuals in an area. Figure 4 shows the location of the priority species and raptor incidental records, and shows that Blue Crane were regularly seen incidentally in a number of areas of the site, and the same can be said for Jackal Buzzard. Karoo Korhaan were numerous in the northern areas of the WEF site, and a number of records were from the high lying western escarpment or 'Trouberg'.

Table 12: Incidental Records of Target Species

Species	Incidental Records (Total Individuals)				
	Winter	Spring	Summer	Autumn	Total
Bustard, Ludwig's*	1 (1)	7 (9)	4 (9)	0	12 (19)
Buzzard, Jackal*	27 (30)	18 (21)	10 (10)	12 (13)	67 (74)
Buzzard, Steppe*	0	0	5 (5)	0	5 (5)
Crane, Blue*	35 (196)	34 (187)	26 (59)	21 (122)	116 (564)
Eagle, African Fish*	2 (2)	1 (1)	0	0	3 (3)
Eagle, Booted*	0	1 (1)	0	0	1 (1)
Eagle, Martial*	0	2 (2)	4 (4)	1 (1)	7 (7)
Eagle, Verreaux's*	12 (14)	3 (5)	8 (13)	14 (19)	37 (51)
Francolin, Grey-winged*	0	4 (16)	2 (18)	6 (6)	12 (40)
Goshawk, Pale Chanting*	9 (9)	12 (17)	4 (4)	8 (8)	33 (38)
Hamerkop	0	0	0	1 (1)	1 (1)
Harrier, Black*	0	0	1 (1)	0	1 (1)
Hawk, African Harrier-*	4 (4)	4 (4)	0	1 (1)	9 (9)
Kestrel, Greater*	0	1 (1)	1 (1)	0	2 (2)
Kestrel, Rock	2 (3)	9 (11)	11 (12)	7 (7)	29 (33)
Kite, Black-shouldered*	2 (2)	0	0	0	2 (2)
Korhaan, Karoo*	38 (92)	21 (46)	23 (43)	17 (33)	99 (214)
Korhaan, Northern Black*	1 (1)	5 (6)	6 (6)	0	12 (13)
Owl, Cape Eagle-*	0	1 (1)	0	0	1 (1)
Owl, Spotted Eagle-*	0	0	1 (1)	1 (1)	2 (2)
Pipit, African Rock*	0	0	4 (4)	2 (3)	6 (7)
Secretarybird*	1 (1)	0	1 (1)	0	2 (2)

Species	Incidental Records (Total Individuals)				
	Winter	Spring	Summer	Autumn	Total
Total	134 (355)	123 (328)	111 (191)	91 (215)	459 (1089)

**Priority species*

3.5 Cliff Nest Survey

A total of four nest sites were located (Figure 1), including a suspected Verreaux's Eagle nest (Nest 1), suspected Booted Eagle nest (Nest 2), Rock Kestrel nest (-31.800190°S; 23.998806°E) and an unidentified raptor nest (Nest 3). Subsequent monitoring and visits to these sites as Focal Sites, revealed Nest 1 to be an active Jackal Buzzard nest, and Nests 2 and 3 to be active White-necked Raven nests (Table 12). A European Bee-eater colony was located during the nest survey (Figure 6).

3.6 Species Summary

A total of 100 species were recorded by the field team (across all survey methods and while traversing the WEF site) during the final autumn survey. This was less than in spring (117 species) and summer (118 species), but more than in winter (79 species).

Across all the seasonal surveys, the total number of recorded species was 158 (Appendix I). These included 10 Red Data species and 24 priority species, two of which (African Rock Pipit and Black Harrier) are endemic (Table 13). Of the Red Data species recorded, Blue Crane, Martial Eagle, Verreaux's Eagle, Karoo Korhaan and African Rock Pipit were recorded during each of the four seasonal surveys. Generally the most abundant and regularly recorded priority species were Jackal Buzzard, Blue Crane, Verreaux's Eagle, Grey-winged Francolin, Pale Chanting Goshawk, African Harrier Hawk, Karoo Korhaan, Northern Black Korhaan, and African Rock Pipit.

Table 13: Regional Red Data, Priority and Endemic Species recorded during the Winter, Spring, Summer and Autumn Surveys

Species	Status (Taylor *et al.* 2015)	Priority Species Score	Endemic*	Winter	Spring	Summer	Autumn
Bustard, Ludwig's	EN	320		X	X	X	
Buzzard, Jackal		250	X	X	X	X	X
Buzzard, Steppe		210				X	
Crane, Blue	NT	320		X	X	X	X
Eagle, African Fish		290		X	X		X
Eagle, Black-chested Snake		230		X			
Eagle, Booted		230			X	X	
Eagle, Martial	EN	350		X	X	X	X
Eagle, Verreaux's	VU	360		X	X	X	X
Falcon, Lanner	VU	300		X		X	
Francolin, Grey-winged		190	X	X	X	X	X
Goshawk, Pale Chanting		200		X	X	X	X
Harrier, Black	EN	345	X		X	X	
Hawk, African Harrier		190		X	X	X	X
Kestrel, Greater		174		X		X	
Kite, Black-shouldered		174		X			
Korhaan, Karoo	NT	240		X	X	X	X
Korhaan, Northern Black		180		X	X	X	X
Owl, Cape Eagle-		250			X		
Owl, Spotted Eagle-		170				X	X

Species	Status (Taylor *et al.* 2015)	Priority Species Score	Endemic*	Winter	Spring	Summer	Autumn
Pipit, African Rock	NT	200	X	X	X	X	X
Secretarybird	VU	320			X	X	
Sparrowhawk, Rufous-breasted		170			X		
Stork, Black	VU	330			X		

Appendix I also shows that a total of 24 endemic or near-endemic species were recorded. While some of these were larger birds and priority species (e.g. Grey-winged Francolin and Black Harrier), the majority are small passerines the most abundant of which and/or regularly observed included: Cape Bulbul, Fairy Flycatcher, Large-billed Lark, Karoo Prinia, Pied Starling, Grey Tit, Southern Double-collared Sunbird, Namaqua Warbler, and the *Near-Threatened* African Rock Pipit.

Generally the highest diversities and abundances of small passerine species were restricted to drainage lines, particularly where relatively dense riparian scrub habitat existed. The open plains and plateaux were frequented mainly by larks, pipits, chats, and korhaans. Raptors were generally observed flying over all habitat types. Key foraging areas for raptor species such as Verreaux's Eagle, Jackal Buzzard and Rock Kestrel were generally observed along ridges and cliff faces at higher altitude VPs, with flight paths often occurring along ridgelines. In contrast, Blue Crane, korhaans and bustards were observed foraging on the lower altitude plains. Birds of the family *Corvidae* (crows and ravens) were abundant with White-necked Raven, in particular, being one of the most regularly observed larger species.

Generally waterbirds were concentrated around farm dams and were moderately abundant with various waterbird and waterfowl species observed at Swaelkrans Dam. The importance of farm dams for avifauna in the area was established by the initial monitoring, and these features have been buffered accordingly. It was also considered that there would be movement of these species across the WEF site, from dam to dam. VP monitoring did not pick up high levels of waterbird/waterfowl movements, and no clear 'fly ways' could be identified, apart from the river upstream of Swaelkrans dam. It is important to note though that many of these species fly before dawn and after dusk, and may these nocturnal and crepuscular movements may have been missed.

Although not a red data species or a priority species, the Rock Kestrel population of the area remains substantial, and the species was abundant in 2016/17. This species has been known to collide with turbines in South Africa (pers. Obs; Ralston-Paton et al. 2017), and is therefore potentially at risk. Some protection can be obtained by buffering the prominent cliff and ridgeline habitats as well as the identified nest sites of this species.

4 GENERAL DISCUSSION

Each Red Data species, and its general occurrence in 2016/17 will now be discussed in more detail.

4.1 **Ludwig's Bustard (Endangered)**

A total of three flights were recorded for this species, two from VPX and one from VP4. Both these locations are in the center of the proposed WEF site and are in generally lower lying, flat areas, further away from steep ridges. The species was also occasionally seen incidentally, predominantly in the east and west of the WEF site. No breeding activity was observed, and no Lek areas located. The WEF site is predicted to be moderately important as a foraging area for this species, particularly after good rainfall events.

4.2 Martial Eagle (Endangered)

This species had moderate to low abundance on the site, and was recorded in all seasonal surveys. A total of 14 flights from VPs on the WEF site were recorded in 2016/17, while the species was also recorded incidentally on 7 occasions. An active breeding nest was located in 2013/14 approximately 6 km away from the closest initial proposed turbine positions (Figure 6), however this nest was not visited in 2016/17. It is possible that the individuals observed on the WEF site, are from the pair that occupied this nest in 2013/2014, however it is more likely that they are from another territory elsewhere. A juvenile Martial Eagle was observed in 2016/17 near FSV1 (Figure 1), which is approximately 12.5 km north of the known Martial Eagle nest site.

Although not nearly as abundant as Verreaux's Eagle, it remains an important species as it is *Endangered* and is scarce outside of protected areas with the population in the Eastern, Western and Northern Cape approximately 100-150 birds (<1 bird / 5000 km^2) (Hockey *et al.*, 2005). Its average breeding territory in north-east South Africa is 130-150 km^2 and at least 280 km^2 in the Nama Karoo and Namibia (Hockey *et al.,* 2005) while inter-nest distances in the central Karoo average about 15 km (Boshoff, 1993; Machange *et al.*, 2005). These large territories show that this is a wide ranging species. It is also important to note that this species is monogamous and the pair bond is often maintained over several seasons, regularly re-using and breeding at the same nest site.

4.3 Black Harrier (Endangered)

Black Harrier was recorded in spring and summer on the WEF site in 2016/17, during which three flights were recorded from VPs, and only one incidental observation was made. This translates to a relatively low occurrence and abundance of this species, and the WEF site is not thought to be particularly important for this species. No signs of breeding behaviour were recorded.

4.4 Black Stork (Vulnerable)

Recorded only in spring on the WEF site, this species had relatively low flight activity, with a total of four flights recorded. The site represents suitable habitat for this species, particularly along or near to major watercourses. However, no breeding locations were recorded for this species despite extensive surveys of cliff habitats, and it is thought to be of moderate to low concern for the development of the WEF phases.

4.5 **Verreaux's Eagle (**Vulnerable)

Verreaux's Eagle was confirmed as the main species of concern to the development and was observed across the WEF site in high abundance, during all seasonal surveys, with more than one pair being observed at a time on several occasions. On at least three occasions, groups of three birds were seen (including a juvenile bird). A total of 149 flights were recorded, the majority of which were by adult pairs or single adult birds, although 22 flights included juvenile or sub-adult birds. The species was found to be at least as abundant and more active (in terms of flight activity calculated as flights per hour of VP observation) as in 2013/14. The species was also regularly recorded incidentally as well as on the driven transect surveys. Of the nest sites within 7.5 km of the initial proposed turbine positions, FSV4, FSV5, FSV7, FSV8 where confirmed as active or recently active. FSV9 was not visited, and its assumed status (inactive) remains as per the 2013/14 surveys. FSV1 was confirmed inactive (and possibly abandoned), FSV2 was confirmed abandoned and is being used by another species (likely a White-necked Raven), and the activity/inactivity of FSV3 and FSV6 could not be confirmed. All these sites (except FSV2) retain their recommended buffer of 3 km (Figure 6). Considering the location of the nest sites relative

to the latest revised turbine layout, 3 active nest sites are within 5 km, while no nest sites were within 3.5 km of any turbine locations.

Figure 3 shows that the much of recorded activity of this species, was far from any known nest sites. There is the potential that other nest sites may occur (possibly in the vicinity of the two identified roost areas), however, extensive searching (including the dedicated nest search) could not locate any new Verreaux's Eagle nests in 2016/17. NVP monitoring at nest sites did not provide good data as no flights of dispersing juvenile eagles were observed, and few courtship/display flights were recorded. No flights linked to nest building/preparation (e.g. birds carrying nesting material) were recorded either. The lack of data recorded during NVP monitoring was most likely a result of the timing of the surveys. In spring, it was too soon as the juvenile observed had not yet fledged, and in autumn possibly too early as nest preparation activity may not have yet begun (particularly at VP1b). Other possible reasons were that the total survey time was possibly too low and a number of hours were lost due to thunderstorms, as well as the fact that the nest at NVP1 proved to not be in use by Verreaux's Eagle. However, the NVP monitoring was still deemed valuable, particularly at NVP2, where a juvenile on the nest was recorded in spring and courtship displays were recorded in autumn, confirming activity of this site. It also allowed the specialist additional time on site to record various other species and visit and verify the status of various nest sites.

Verreaux's Eagle is ranked third on the South African Birds and Renewable Energy Specialist Group's priority list and concerns that this species is vulnerable to collisions have been confirmed. During the first year of monitoring at operational wind farms in South Africa, one wind farm recorded four Verreaux's Eagle fatalities in the first year of operation (Ralston-Paton *et al.,* 2017). The fatalities occurred a considerable distance (at least 3.5 km) from suitable Verreaux's Eagle breeding habitat, and on relatively flat ground (Smallie, 2015). A single adult fatality occurred at another wind farm in August, again some distance from a nest 3.8 km away (Ralston-Paton *et al.,* 2017). As of 28 September 2017, 6 mortalities of Verreaux's Eagle had been recorded at wind farms in South Africa (BLSA, 2017). Eagle mortalities at wind farms are not unexpected. Fatalities at wind farms have been reported for Golden Eagle (e.g. Smallwood, 2013), White-tailed Sea Eagle (e.g. Hötker *et al.,* 2006), Bald Eagle (Pagel *et al.,* 2013) and White-bellied Sea Eagle (Smales & Muir, 2005). Verreaux's Eagle has recently been up-listed to Vulnerable and rough estimates of the population size are between 3500 and 3750 mature individuals (Taylor *et al.,* 2015).

4.6 Lanner Falcon (Vulnerable)

Recorded in winter and summer, this species was scarce on the WEF site with a total of two flights across the full year monitoring programme. It was not recorded incidentally or in any of the other surveys. The WEF site is believed to have a relatively low importance for this species, and while collisions are possible, it is unlikely that this species would be significantly negatively affected by the proposed development.

4.7 Secretarybird (Vulnerable)

A total of two incidental records of this species were made, one in spring and one in summer. No flights were recorded 2016/17. The WEF site is believed to have a relatively low importance for this species, and while collisions are possible, they are unlikely. This species is likely to be more affected by disturbance and displacement impacts, although not at a highly negative level.

4.8 Blue Crane (Near-Threatened)

Blue Crane was widespread and abundant on the WEF site during the 2016/17 monitoring surveys. It was the second most record species at VP watches, and the most regularly

recorded species incidentally. While very large flocks (>50) were rarely seen, on one occasion in spring 2016 a flock of approximately 100 birds was recorded on the WEF site, approximately 4.5 km south of VP7b. Medium sized flocks (10-30 birds) were regularly recorded, especially in autumn and winter. The species did also occur in small groups and pairs with one or two chicks were regularly recorded. It is therefore definitely breeding on the WEF site. Figure 5 shows the location of all Blue Crane records (including flights) from 2013/14 and 2016/17, showing the increased activity observed in 2016/17. It must be noted that some of this apparent observed increase in numbers in 2016/2017, may be due to increased time spent in areas important to this species as the survey effort (and time spent on the ground travelling between survey locations) in 2013/2014 was spread over a much larger area and therefore was 'diluted' in certain areas

To date there have been six Blue Crane fatalities at Wind Farms in South Africa out of the 636 bird fatalities recorded across all species to date (BLSA, 2017). This species is also known to be highly susceptible to collisions with power lines, and the grid connection infrastructure may therefore pose a greater threat to the species than the turbines itself.

4.9 Karoo Korhaan (Near-Threatened)

While only two flights of this species (which is largely terrestrial) were observed from VPs in 2016/17, it was recorded regularly on the WEF site incidentally and during driven transects. Its abundance was found to be high and it was recorded across the site, although more numerous in the northern areas of the WEF site, and a number of records were from the high lying western escarpment or 'Trouberg'.

The species is likely to be most at risk from collision with power line infrastructure, as well as possible disturbance impacts, especially during construction.

4.10 African Rock Pipit (Near-Threatened)

This was the only priority passerine species recorded and was relatively widespread and abundant across the WEF site. Passerines were not the focus of this monitoring programme and hence walked transects were not conducted in 2016/2017, however the species was recorded during all seasons and was recorded incidentally on a number of occasions, especially along higher lying rocky ridges.

The species is unlikely to be severely impacted by turbine collisions, but may be susceptible to disturbance and displacement impacts.

4.11 Comparison with 2013/2014 monitoring data

While direct and detailed comparisons of the data are not possible, primarily due to differing methods used (including different VP locations) and different sample effort, some important high level observations and comments can be made when comparing the 2013/14 and 2016/17 data sets, as follows:

- A combined total of 181 species was recorded in and around the WEF and control sites during the 2013/14 programme. This included 29 priority species 13 Red Data species. All 10 Red Data species recorded in 2016/17 (Table 13) were recorded in 2013/14, as well as Southern Black Korhaan[6] (Vulnerable), Double-banded Courser (Near-threatened), Greater Flamingo (Near-threatened) and Kori Bustard (Near-threatened). The numbers of recorded priority species during both programmes are considered high (in the specialists' experience), compared with other sites in South Africa.
- Passage rates of target species from vantage points were higher in 2016/17. In 2013/14 the overall average ± SD passage rate for the WEF was 0.97 ± 2.02 target birds per hour of observation, while in 2016/17 the average passage rate was 1.51 ±2.49.

[6] It is possible that records of this species in 2013/2014 were miss-identifications of Northern Black Korhaan by the field team.

- Raptors accounted for 80.43 % of recorded flight paths in 2013/14, and 81.2 % of recorded flight paths in 2016/17.
- Verreaux's Eagle, Jackal Buzzard, Rock Kestrel and Blue Crane were the species most regularly recorded from VPs during both monitoring programmes.
- Verreaux's Eagle was the most frequently recorded target species and its activity was regarded as high in both programmes, although it was slightly higher in 2016/17. In approximately 895 hours of VP monitoring on the WEF site in 2013/14, 252 flight paths were recorded for this species. This equates to approximately 0.28 flights per hour. In 480 hours of VP monitoring on the WEF site in 2016/17, 149 flight paths were recorded, which equates to approximately 0.31 flights per hour.
- No new Verreaux's Eagle nests were located in 2016/17.
- Blue Crane was more numerous and widespread in 2016/17. For example, 54 incidental records were made of Blue Crane in 2013/14 and 116 were made in 2016/17 (during less days on site). Whereas in 2013/14, the majority of records for this species were in the far south, and beyond the WEF site boundary, in 2016/17 the species was observed in higher numbers in the north of the WEF site (although it was present throughout). It is possible that the increase in numbers of this species in 2016/17 is due to inter-annual variation in climatic conditions (e.g. rainfall) and food availability. Another contributing factor may be the increased effort in certain areas favoured by this species (resulting in more records – possibly of the same birds) during the 2016/17 monitoring
- No Lesser Kestrel or Amur Falcon were observed in 2016/17. Following the initial monitoring, there was concern raised by I&APs that these species may have been missed due to inter-annual variation and timing of surveys. However, the 2016/17 surveys (which included surveys in January 2017) confirmed that the site is currently unlikely to be important for these species (although this could change in the future due to unforeseen climatic changes and changes to prey availability).

4.12 Observed Turbine Mortality in South Africa

Considering the observed wind turbine fatalities of Red Data species in South Africa to date (Pers Com BLSA and BARESG; BLSA, 2017) five species effected by mortality from wind turbines have been recorded on the Umsinde Emoyeni WEF site. They are Verreaux's Eagle (6 mortalities), Black Harrier (5), Lanner Falcon (4), Martial Eagle (4), Blue Crane (6), Southern Black Korhaan (3), Greater Flamingo (1) and Secretarybird (1). Following the completion of the 2013/14 monitoring and during the compilation of the bird impact assessment report (Pearson, 2015), there was much uncertainty surrounding whether certain species would be impacted upon or not by WEFs in South Africa. We now know that the above Red Data species are susceptible to collision, along with the following more common species that have been worst impacted upon in South Africa to date, and which may occur in relatively moderate abundance on the Umsinde site: Jackal Buzzard (63 mortalities), Rock Kestrel (33 mortalities), Egyptian Goose (12 mortalities) Bokmakierie (21 mortalities), Booted Eagle (11 mortalities) and Steppe Buzzard (7 mortalities). The above information was considered in the updated impact assessment.

5 UPDATED IMPACT ASSESSMENT

The baseline avifauna environment of the WEF site was described in Section 3 of Pearson (2015). The land use, vegetation types and bird micro-habits did not change significantly between 2013/2014 and 2016/2017. Changes in the presence and behaviour of avifauna have been captured by the description of the monitoring results above. Therefore, the impact assessment below considered the baseline information from Pearson (2015), as well as any changes to this baseline from the results of the additional monitoring. The potential impacts were then identified by considering the updated project description and layout (Figure 10). The significance of these impacts during the construction, operation and decommissioning phases were then rated using a set criteria (as used in Pearson, 2015).

Where there was no change to the impact rating from the rating given by Pearson (2015), this is stated as such, and the impact rating tables are not shown.

Due to the impacts being the same for WEF Phase 1 and Phase 2, these impact descriptions and assessment tables have been presented in a combined section. The assessment presented is for the individual phases of the WEF development and not the assessment for the combined WEF Phase 1 and Phase 2. The combined results are presented in the Cumulative Assessment (Section 5.3).

5.1 Construction Phase

5.1.1 Habitat destruction

No change.

The overall significance of this impact for WEF Phase 1 separately or WEF Phase 2 separately is considered medium if no mitigation takes place. With properly implemented mitigation measures as detailed in Table 19 in Pearson (2015) the intensity of habitat destruction can be decreased to low. The residual significance of the impact will therefore be reduced to low after mitigation.

5.1.2 Disturbance & Displacement

No change.

Prior to mitigation the significance of this impact is rated as low. With implementation of all mitigation measures detailed in Table 20 in Pearson (2015) the intensity of the impact can be reduced to low for either phase, resulting in a very low significance.

5.2 Operational Phase

5.2.1 Disturbance and Displacement

No change.

For both phases, separately, the intensity is considered potentially medium and probable to occur, resulting in a medium significance for each phase separately. With implementation of the mitigation measures listed in Table 21 in Pearson (2015) the intensity can be lowered to low resulting in a low significance.

5.2.2 Electrocution

Update results in a new significance rating of *low*.

Electrocution of birds from electrical infrastructure including overhead lines is an important and well documented cause of unnatural bird mortality, especially raptors and storks (APLIC 1994; van Rooyen and Ledger 1999). Electrocution may also occur within newly constructed substations. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocutions are therefore more likely for larger species whose wingspan is able to bridge the gap such as eagles or storks. Various large raptors (such as Martial Eagle, Verreaux's Eagle and African Fish-Eagle), susceptible to electrocution (particularly in the absence of safe and mitigated structures) occur on the WEF site.

The extent of the impact is local and restricted to the WEF. As the result of the impact is likely mortality of a number of birds the intensity is considered high and the duration long-term. Since electrocution is known to affect many species in South Africa the impact is

possible to occur without mitigation, resulting in a medium significance. If the majority of all new powerlines on the WEF site (i.e. those connecting the turbine strings to the on-site substation) are buried, and any new overhead power line sections are of a bird-friendly design as detailed in Table 14, the probability of electrocution occurring can be reduced to improbable, resulting in an impact of Low significance for each phase separately.

Table 14: WEF Phase 1 or 2 Operational Phase: Impact Assessment for Electrocution

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Long-term 3	High 7	Possible	Medium	Negative	High
Essential mitigation measures: • New powerlines on the WEF site (i.e. those connecting the turbine strings to the on-site substation) should be buried. • Any overhead power lines must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' monopole structures, with clearances between live components of 2 m or greater.								
With mitigation	Local 1	High 2	Long-term 3	Medium 6	Improbable	Low	Negative	High

5.2.3 Power Line Collisions

No change.

Prior to mitigation the significance of this impact is high, but the mitigation measures detailed in Table 23 in Pearson (2015) can lower the probability of the impact occurring, thus lowering the significance to medium.

5.2.4 Wind Turbine Collisions

No Change. The impact was re-assessed, and the values for extent and intensity after mitigation were adjusted. The resultant significances of the impact before and after mitigation remained the same at Very High and Medium respectively. The recommended mitigation measures were updated, particularly because the avifaunal buffer map (Figure 6) has been updated.

WEFs can have adverse impacts on avifauna through the collision of birds with moving turbine blades. A number of factors influence the number of birds impacted by collision, including:

- Number of birds in the vicinity of the WEF;
- The species of birds present and their flying patterns and behaviour;
- The design of the development including the turbine layout, height and size of the rotor swept area.

It is important to understand that not all birds that fly through the WEF at heights swept by rotors automatically collide with blades. In fact avoidance rates for certain species have proven to be extremely high. In a radar study of the movement of ducks and geese in the vicinity of an off-shore wind facility in Denmark, less than 1% of bird flights were close enough to the turbines to be at risk, and it was clear that the birds avoided the turbines effectively (Desholm & Kahlert 2005). Whilst avoidance rates for SA species are currently unknown due to the lack of data, comparisons can be drawn between functionally similar species, for example Verreaux's Eagle with Golden Eagle, in order to inform an assessment.

The majority of international studies on collisions caused by wind turbines have recorded relatively low mortality levels (Madders & Whitfield 2006). This is perhaps largely a reflection of the fact that many of the studied wind farms are located away from large

concentrations of birds. It is also important to note that many records are based only on finding carcasses, with no correction for carcasses that were overlooked or removed by scavengers (Drewitt & Langston 2006). Relatively high collision mortality rates have been recorded at several large (particularly in terms of turbine numbers), poorly-sited wind farms in areas where large concentrations of birds are present (including IBAs), especially among migrating birds, large raptors or other large soaring species, e.g. in the Altamont Pass in California, USA (Thelander & Smallwood 2007), and in Tarifa and Navarra in Spain (Barrios & Rodrigues 2004).

Although large birds with poor manoeuvrability (such as cranes, flamingos, korhaans, bustards and Secretarybird) are generally at greater risk of collision with structures (Jenkins *et al*. 2015), it is noted that these classes of birds (unlike raptors) do not feature prominently in literature as wind turbine collision victims. It may be that they avoid wind farms, resulting in lower collision risks, or that they are not distracted and focussed on hunting and searching the ground while flying, as is the case for raptors.

Collisions of various bird species with turbine infrastructure (including the tower) have been observed recently in South Africa (pers. Obs). To date a total 6 Verreaux's Eagle mortalities at wind farms in South Africa have been recorded (BLSA, 2017). Three of these Verreaux's Eagle mortalities were from collisions with operational wind turbines in May 2015 at one WEF in the Eastern Cape (Smallie 2015). The fatalities were unexpected as they occurred on relatively flat topography a considerable distance (at least 3.5km) from suitable Verreaux's Eagle breeding habitat, and pre-construction bird monitoring by Smallie (2015) on the site recorded 'low Verreaux's Eagle flight activity'. Without seeing and analysing the detailed data collected by Smallie (2015) it's difficult to quantify what is meant by 'low activity', as this may be a relative description. However, what is relevant is that it has been confirmed that this species collides with turbines and that collisions may not necessarily occur where predicted, and that they can occur away from areas perceived to be preferred use areas. This information has reduced the confidence with which we assessed collision impacts based on perceived sensitivities for this species (e.g. nest sites and ridgelines in the case of Verreaux's Eagle).

Due to the high observed density of Verreaux's Eagle nests in the broader Murraysburg area mortalities could create a 'sink-hole effect', where a dead bird is replaced by another, which also collides, and so on, and in this way the impact would be able to affect the regional population. Other Priority species or raptors at most risk of collision with turbines are Rock Kestrel, Steppe Buzzard and Jackal Buzzard, and to a lesser extent Martial Eagle, and Blue Crane.

The duration of the impact will be at least for the operational phase of the facility and the intensity of the impact is high (Table 15). In terms of the Arcus avifaunal specialist's experience, the WEF site has relatively high levels of Verreaux's Eagle, Jackal Buzzard and Rock Kestrel flight activity, and therefore collisions of these species are probable. The resulting significance of this impact is very high for each phase separately if unmitigated. The impacts for Phase 1 and 2 are expected to be similar and of equal significance.

Table 15: WEF Phase 1 or 2 Operational Phase: Impact Assessment for Wind Turbine Collisions

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Regional 2	High 3	Long-term 3	Very High	Probable	Very high	Negative	Medium

Essential mitigation measures:

- No turbines may be constructed within Avifaunal No-go Buffers described in Section 2.6. Note: This requirement has been adhered to in the current proposed layout (see figure 10).
- The hierarchy of sensitivity scores presented in the combined Flight Sensitivity Map (Figure 9) should be considered, with preferential turbine placement in areas of Low Sensitivity, and decreasing preference through to High Sensitivity areas. Where two or more sensitivity areas overlap, the layer with the higher sensitivity designation should take preference.
- Develop and implement a carcass search programme for birds during the first two years of operation as a minimum, in line with the South African monitoring guidelines, and again at least in year 5, 10, 15, 20 and 25. All constructed turbines (not the minimum number allowed by the guidelines) must be regularly (i.e. at least weekly, or more often if advised by the results of scavenger removal trails) searched for carcasses.
- Develop and implement a two year post-construction bird activity monitoring program that mirrors the pre-construction monitoring surveys completed by Arcus and is in line with the South African post-construction monitoring guidelines. This program must include thorough and ongoing nest searches and nest monitoring. This program should be enhanced to include sampling during dusk and dawn.
- A GPS/Satellite tagging study should be implemented to monitor the birds, and to establish the true ranges, and how the birds respond to the presence of turbines. Birds from at least three of the eagle territories closest to proposed turbines should be tagged and monitored.
- Onsite and off-site habitat management. A habitat management plan must be developed which aims to prevent an influx/increase in preferred prey items (e.g. Dassies) in the turbine area due to the construction and operation activities, while improving raptor habitat and promoting prey availability within the core 3 km buffers around nest sites (i.e. away from the turbine site).
- Frequent and regular review of operational phase monitoring data (activity, carcass and GPS/satellite tracking) and results by the bird specialist. This review should also establish the requirement for continued monitoring studies throughout the operational and decommissioning phases of the development. Such operational monitoring may be required beyond the first two years as stipulated as the minimum in point 3 above).
- The above reviews should strive to identify sensitive locations at the development including turbines where high mortality is observed and areas of increased collisions with power lines that may require additional mitigation. If unacceptable impacts are observed (as agreed upon by the bird specialist in consultation with BLSA, applicable species experts, and EWT)), the specialist should conduct a literature review specific to the impact (e.g. collision and/or electrocution) and provide updated and relevant mitigations to be implemented. The developer must make financial allowances for additional mitigation measures.
- The following may need to be considered if their effectivity is proven and appropriate for this project, and suitable financial allowances should be made for:
    - Using deterrent devices (e.g. visual and noise deterrents)
    - Deterrent and/or shutdown systems e.g. DT Bird and Radar Assisted Shutdown on Demand (RASOD) e.g. BIRDTRACK to reduce collision risk.
    - Identify options to modify turbine operation to reduce collision risk.

With mitigation	Regional 2	Medium 2	Long-term 3	High 7	Possible	Medium	Negative	Medium

The most effective mitigation for collision impacts currently available is wind farm placement, as well as specific turbine placement within a WEF to avoid high use areas. Such recommendations have been made. While not yet tested in South Africa, deterrent devices and shut-down on demand strategies have been implemented internationally. Foss *et al.* (2017) found monochromatic LEDs that specifically target avian photoreceptors could provide a useful tool to divert raptors from hazardous situations, while in Scotland trials are underway by Scottish Natural Heritage (SNH) using laser beams to deter Sea Eagles from feeding on lambs[7]. Tome *et al.* (2017) found that a Radar Assisted Shutdown on

[7] http://www.bbc.com/news/uk-scotland-highlands-islands-42578354

Demand (RASOD) system at the Barão de São João wind farm in Portugal's Sagres region resulted in zero mortality of soaring birds over five consecutive autumn migratory seasons. While such strategy should not be relied upon completely (also considering that they are use internationally during migration events), they should not be discounted and may well hold valuable application in South Africa.

If implemented correctly, the measures listed in Table 15 may result in fewer collisions and the probability of collisions reduces to possible, and the intensity reduces to Medium. The residual significance of wind turbine collisions *for each phase separately* will therefore be reduced to medium, although confidence in this assessment is moderate due to the lack of operational phase data (particularly in the central Karoo) and data on the interactions of local species with turbines as well as uncertainties with regarding the effectiveness of mitigation measures (including turbine placement outside of high risk areas), particularly for Verreaux's Eagle.

5.3 Decommissioning Phase

5.3.1 Disturbance and Displacement

No Change.

Prior to mitigation this impact significance is low, and following implementation of mitigation measures listed in Table 25 in Pearson (2015), the significance for this impact is very low for each WEF phase separately.

5.4 Grid Connection Phase 1 and 2

5.4.1 Construction Phase

5.4.1.1 Habitat Destruction

No Change

Following implementation of mitigation measures listed in Tables 26 and 27 in Pearson (2015), the significance for this impact is very low for each Grid Connection Phase separately.

5.4.1.2 Disturbance and Displacement

No Change

Following implementation of mitigation measures listed in Tables 28 and 29 in Pearson (2015), the significance for this impact is very low for each Grid Connection Phase separately.

It must be noted that the mitigations include the requirement to re-route the proposed Grid Connection to avoid, by 2 km or more, the location of the Verreaux's Eagle nest located at 31°43'39.50"S; 23°40'44.07"E by Smallie, 2014.

5.4.2 Operational Phase

5.4.2.1 Disturbance and Displacement

No Change

Following implementation of mitigation measures listed in Table 30 in Pearson (2015), the significance for this impact is very low for each Grid Connection Phase separately.

5.4.2.2 Electrocution

No Change

Following implementation of mitigation measures listed in Table 31 in Pearson (2015), the significance for this impact is Medium for each Grid Connection Phase separately.

5.4.2.3 Power Line Collisions

No Change

Following implementation of mitigation measures listed in Tables 32 and 33 in Pearson (2015), the significance for this impact is Medium for each Grid Connection Phase separately.

5.4.3 Decommissioning Phase

5.4.3.1 Disturbance and Displacement

No Change

Following implementation of mitigation measures listed in Tables 34 and 35 in Pearson (2015), the significance for this impact is Insignificant for each Grid Connection Phase separately.

5.5 Cumulative Impacts

All of the above mentioned impacts, and particularly those associated with the operational phase of the proposed project, may be intensified to some degree due to the potential cumulative impacts of both WEF phases and/or a number of proposed WEFs within 50 km of the proposed turbine footprint. The proposed Umsinde Emoyeni Wind Energy Facility Phase 2 is neighbouring the proposed Ishwati Emoyeni Wind Energy Facility and together with Phase1 these may contribute to habitat fragmentation and disruptions of broad-scale ecological processes such as the dispersal and migration of species in response to fluctuations of local and regional climate (in the case that more than one of these proposed projects is constructed). If all three facilities are constructed (i.e. Ishawti Emoyeni and Umsinde Emoyneni Phase 1 and Phase 2) they may present a barrier to movement of birds, particularly in the north-south direction. The extent of this impact depends on the final turbine layout and numbers of turbines constructed (at the three projects) and can be reduced if constraints corridors, such as those suggested around the Snyderskraal River in the east of the Ishwati Emoyeni Wind Energy Facility (CSIR 2014), remain free of turbines, and if the minimum number of turbines for each WEF phase at Umsinde constructed. It is important to note that due to the optimisation of the proposed wind energy projects' layouts based on a variety of environmental constraints and the wind resource and other economic factors, the layout of any one (or multiple projects) is unlikely to be a continuous string of turbines, because environmental constraints such as river valleys and topography result in breaks and corridors between the turbines.

5.5.1 Updated Cumulative Impact Assessment

Currently there are three further wind energy facilities (one of which includes a solar technology project component) under application or approved within a 50 km of the revised turbine development footprint. Whether any, or all of these will ever be constructed is unknown, however for the purpose of our assessment we assume that all three will become operational. They are:

- The proposed establishment of Modderfontein Wind Energy Facility on a site near Victoria West.

- The proposed development of the Mainstream wind and solar energy facility at Victoria West.
- The approved Ishwati Emoyeni Wind Farm Project.

Conducting a detailed cumulative impact assessment of all of these facilities together on a regional scale is beyond the scope of this specialist study and would need the input of all developers and specialists working on the above mentioned projects. Such an assessment is best undertaken by appropriate regional or national agencies in the context of strategic planning, and should not be required in the context of assessing a single proposal. In the scope of this study it is therefore difficult to say at this stage what the cumulative impact of all the proposed developments will be on birds because there is no cumulative baseline to measure against. The extent of actual impacts will only become known once a few wind farms are developed in the area and operational more data becomes available, and noting that the developments considered may not all be constructed.

However, at a high level and with medium confidence, it can be said that if all of these facilities are approved and constructed they may present a very high significant threat to birds, with an unacceptable level of impact Electrocutions, collisions with powerlines and wind turbines can potentially affect the viability of regional and even national populations, particularly of Verreaux's Eagle and Blue Crane. The extent of these impacts will depend largely on the final turbine numbers and layouts of each facility which can be reduced if turbine placement is informed by pre-construction monitoring and nest surveys, and the minimum number of turbines is constructed. Corridors, such as those suggested around the Snyderskraal River in the east of the Ishwati Emoyeni Wind Energy Facility (CSIR, 2014) and the high sensitivity areas identified by Smallie (2014), should remain free of turbines.

If all proposed projects implement appropriate mitigation measures as well as post-construction monitoring programmes and share the information gained from these, then the overall significance of the discussed impacts can be reduced. This may include the need for projects (or phases thereof) not yet built (but approved) to be stopped should already operational sites result in very high impacts (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group) particularly to Verreaux's Eagle, Blue Crane and Ludwig's Bustard. The significance of some cumulative impacts are likely to remain very high negative even after mitigation (Table 16-18).

Table 16: Cumulative Impact of Electrocution (Operation phase)

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confiden*
Without mitigation	Regional 2	High 3	Long-term 3	Very High 8	Probable	Very High	Negative	High
Essential mitigation measures: • Applicable specialist recommendations and mitigations are implemented on all projects considered. • Pre-construction, construction (if applicable) and post-construction monitoring are implemented at all the new proposed projects considered, in accordance with the latest best practice guidelines. • Results from monitoring must be assessed collectively with data from surrounding projects, and be made publicly available. • Operational Results to advise phases/projects not yet constructed, and if unacceptable impacts (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group) are observed, and can't be mitigated, further development on nearby sites should be re-considered.								
With mitigation	Regional 2	Medium 2	Long-term 3	High 7	Improbable	Medium	Negative	Medium

Table 17: Cumulative Impact of Power Line Collisions (Operation Phase)

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*

Without mitigation	Regional 2	High 3	Long-term 3	Very High 8	Definite	Very High	Negative	High
Essential mitigation measures: • Applicable specialist recommendations and mitigations are implemented on all projects considered. • Pre-construction, construction (if applicable) and post-construction monitoring are implemented at all the new proposed projects considered, in accordance with the latest best practice guidelines. • Results from monitoring must be assessed collectively with data from surrounding projects, and be made publicly available. • Operational Results to advise phases/projects not yet constructed, and if unacceptable impacts (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group) are observed, and can't be mitigated, further development on nearby sites should be rec-considered.								
With mitigation	Regional 2	High 3	Long-term 3	Very High 8	Possible	High	Negative	Medium

Table 18: Cumulative Impact of Collisions from Wind Turbines

	Extent	*Intensity*	*Duration*	*Consequence*	*Probabilit*	*Significance*	*Status*	*Confidence*
Without mitigation	Regional 2	High 3	Long-term 3	Very High 8	Definite	Very high	Negative	Medium
Essential mitigation measures: • Applicable specialist recommendations and mitigations are implemented on all projects considered. • Pre-construction, construction (if applicable) and post-construction monitoring are implemented at all the new proposed projects considered, in accordance with the latest best practice guidelines. • Post-construction monitoring results must be made publicly available and interpreted collectively with facilities in the area • Operational Results to advise phases/projects not yet constructed, and if unacceptable impacts (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group) are observed, and can't be mitigated, further development on nearby sites should be rec-considered.								
With mitigation	Regional 2	High 3	Long-term 3	Very High 8	Probable	Very High	Negative	Low

6 CONCLUSION AND RECCOMENDATIONS

Numerous Red Data species, endemic or near-endemic species and priority species were again recorded on the Umsinde Emoyeni WEF site in 2016/17. Generally, activity of these and other target species was found to be similar to the initial monitoring programme (Pearson, 2015). However, a slight increase in flight activity (per hour of VP survey effort) was noted for Verreaux's Eagle, while an increase in Blue Crane records and abundance was observed on the WEF site, which may be partly attributable to an increase in survey effort in certain locations favoured by this species. While no additional Verreaux's Eagle nests were located in 2016/17, activity of this species remained high on the WEF site. Some species of potential concern, e.g. Amur Falcon, Lesser Kestrel, Steppe Buzzard, Booted Eagle, Secretarybird and Black Harrier, were not recorded (or were recorded in lower than expected numbers/activity) during the additional monitoring.

The results of 12 months of avifaunal monitoring were combined with the results of the initial monitoring and used to produce an updated and combined Flight Sensitivity Map (Figure 9) and to identify no-go areas (Figure 6 and Figure 9). It was recommended that turbines and overhead power lines are not placed within the "No-go for turbine and overhead powerline placement" shown in Figure 9. No turbines should be constructed in all Avifaunal No-go Buffers described in Section 2.6. The current proposed layout adheres to this recommendation (see Figure 10).

These areas informed the placement of turbines in the revised turbine layout, with all turbines in the revised layout being placed outside of high or medium-high flight sensitivity areas (Figure 10). This area covers grid cells with a flight sensitivity score of High or Medium-High, buffered by 100 m and 50 m respectively (to allow for some error in observer accuracy). These areas are where most priority species, especially Verreaux's Eagle undertook most of their flights at risk height, and constitute areas that are likely to have higher risk of collisions. It was recommended that the hierarchy of sensitivity scores presented in the Flight Sensitivity Map be considered, with preferential turbine placement in areas with Low Sensitivity areas, followed by Medium Sensitivity areas. This, to a large degree has been adhered to in the revised layout, with most turbines located in low flight sensitivity zones, some in medium zones, and none in medium-high or high sensitivity zones.

After consideration of the additional monitoring findings, and recent data regarding mortality of species at operational WEFs in South Africa, it was the specialists opinion that the initially proposed 196 turbines (across both phases combined) would cause (if all turbines are built) an unacceptably high impact to the regions avifauna, particularly on a cumulative level. The layout was then reduced 55 turbines per phase. This number of turbines per phase was found to be acceptable, if the impacts from only one phase are considered in isolation. However, in the specialist's opinion the impact of 110 turbines may result in unsustainable levels of mortality to key species such as Verreaux's Eagle, and thus EWFP further reduced the layout to 35 turbines per phase which is acceptable, although it would be preferable if a reduced number (i.e. less than 70) is actually constructed (which if possible considering the likely improvements in turbine technology and outputs at the time of construction in a number of years from now).

We do not believe the site itself to be fatally flawed for wind development, especially when one considers all avifauna and species, although caution should be taken including implementing thorough operational monitoring. If unsustainable levels of mortality to key threatened species are realised (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group), mitigations including turbine shutdown, and even possible turbine relocation may need to be considered (and enforced by the DEA where required).

Without conducting detailed collision risk modelling (CRM)[8], it is difficult to estimate the potential Verreaux's Eagle mortality from the proposed WEF sites. Ralston-Paton *et al.* (2017) found that among the REIPPP Round 1 operational wind farms assessed, estimated bird (all species) fatality rates ranged from 2.1 to 8.6 birds per turbine per year, with a mean of 4.1. The latest number of Verreaux's Eagle fatalities is 6 out of 636 fatalities (all birds) found on 16 wind farms in South Africa (unadjusted numbers). At all operational facilities in South Africa, mortality of this species has been recorded at 3 sites (4 fatalities at one site, and one fatality at each of the other sites). At Dorper Wind Farm, where four fatalities of this species have been recorded, "*Pre-construction bird monitoring on site recorded low Verreaux's Eagle flight activity, albeit with a slight peak in autumn",* while conversely at Nobelsfontein Wind Farm (which has three active nests within 2.5 km of turbine positions) high Verreaux's Eagle passage rates of 0.63 birds/hour were recorded in pre-construction monitoring, and after three years of operational monitoring one fatality has been recorded.

It is also important to consider potential mortality in context to the Karoo population of Verreaux's Eagle, and the associated natural background mortality of Verreaux's Eagle. The regional population is estimated to be 3500-3750 adult birds, while Percival (2016) recently estimated the Karoo population to be approximately 940 pairs (or 1880 adults), and estimated the baseline adult annual mortality (based on a mortality rate of 5%) to be 94

[8] The accuracy of CRM for South African species is yet to be tested and verified in South Africa.

birds. In the UK a 1% increase over the baseline mortality is being used as an initial filter threshold above which there may be a concern with the predicted collision mortality while collision risks below this level are usually considered to be insignificant and would not require mitigation (Percival, 2016). Higher levels of mortality may be acceptable, but would require additional mitigation measures.

It is noted here that as technology improves, the use of fewer, more powerful machines is possible, potentially resulting in a smaller development footprint and a lower probability of collision impacts for birds. Therefore it is unlikely that 70 turbines will be constructed, as the proposed project is 'up to 35 turbines per phase' and it is more likely that a lower number would be constructed. Should the project be approved, it is strongly recommended that the absolute minimum number of turbines to reach the required MW output be utilised.

All applicable mitigation measures and recommendations (where they are not in contradiction to, or superseded by those given in this report) in the avifaunal impact assessment report (Pearson, 2015) must be adhered to. In summary these include:

- Ongoing monitoring of all Verreaux's Eagle nest sites prior to construction (to determine nest status), and through the construction and entire operational phase of the project.
- Pre-construction walk-through by the avifaunal specialist covering the final road, powerline and turbine layouts.
- The implementation of a site specific Construction Environmental Management Plan (CEMP).
- Prior approval by an avifaunal specialist before clearing of any alien vegetation or stands of trees.
- On-site and off-site habitat management. A habitat management plan must be developed which aims to prevent an influx/increase in preferred prey items (e.g. dassies) in the turbine area due to the construction and operation activities, while improving raptor habitat and promoting prey availability within the core 3 km buffers around nest sites (i.e. away from the turbine site).
- Implementation of a habitat restoration plan (which can be included in the above habitat management plan) to ensure rehabilitation of disturbed areas following construction.
- The appointed Environmental Control Officer (ECO) and the on-site WEF manager (during operations) must be trained by the avifaunal specialist to identify the potential priority species and make a concerted effort to look out for breeding activities of red data species. If any of the red data species are confirmed to be breeding (e.g. if a nest site is found), activities within 1 km of the breeding site must cease, and the avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed.
- Nest searches by an avifaunal specialist of all potentially suitable cliffs and/or tree nesting sites within 1 km of the Phase 1 and Phase 2 turbine footprints that were not surveyed as part of the pre-construction cliff surveys. This additional survey must preferably be prior to construction commencement or as soon as possible thereafter. The aim will be to locate nest sites, so that these may continue to be monitored during the construction and operation phase, along with the monitoring of already identified nest sites.
- Appoint a specialist to design and conduct monitoring of eagle nest sites that are within 5 km of a turbine position. This should be done at least three times during a calendar year during construction and operation, optimally spaced before, during and after the breeding season.
- The implementation of a site specific Operational Environmental Management Plan (OEMP).
- No turbines should be placed in any Avifaunal No-go area.
- There should be preferential turbine placement in areas of Low Sensitivity.

- Develop and implement a carcass search programme at all turbines for birds during the first two years of operation as a minimum, in line with the South African monitoring guidelines.
- Develop and implement a two year post-construction bird activity monitoring program that mirrors the pre-construction monitoring surveys completed by Arcus and is in line with the South African post-construction monitoring guidelines. This program must include thorough and ongoing nest searches and nest monitoring. This program should be enhanced to include sampling during dusk and dawn.
- A GPS/Satellite tagging study should be implemented to monitor Verreaux's Eagle, and to establish the true ranges and how the birds respond to the presence of turbines. Birds from at least three of the eagle territories closest to proposed turbines should be tagged and monitored. This will help to contribute greatly towards our understanding of how this species interacts with wind energy developments and will assist in determining the true levels of impact on this species, in order to more accurately advise future WEF development in the Karoo, and South Africa as a whole.
- Frequent and regular review of operational phase monitoring data (activity, carcass and GPS/satellite tracking) and results by the bird specialist.
- If unacceptable impacts are observed (in the opinion of the bird specialist in consultation with BLSA/EWT and DEA), the specialist should provide updated and relevant mitigations to be implemented. The developer must make financial allowances for additional mitigation measures.
- The following, if deemed necessary by the specialist conducting operational monitoring, may need to be considered and suitable financial allowances should be made for using deterrent devices (e.g. visual and noise deterrents) or deterrent and/or shutdown systems e.g. DT Bird and Radar Assisted Shutdown on Demand (RASOD) e.g. BIRDTRACK.
- If unacceptable impacts persist following implementation of additional mitigation, problem turbines may need to be temporarily/permanently shut down or re-located.
- If unacceptable impacts persist following implementation of additional mitigation, offset programmes must be investigated for possible implementation by the Wind Farm operator, and may include land stewardship/land purchase and rehabilitation to enhance Verreaux's Eagle populations elsewhere and/or financial assistance towards bird conservation.
- Powerlines connecting turbines strings on the WEF site must be buried where possible.
- Any overhead power lines must be constructed near to existing lines where possible, and must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' monopole structures, with clearances between live components of 2 m or greater.
- An avifaunal specialist must conduct a site walk through of all above ground power line routings (both on the WEF site and the Grid Connection) prior to construction to determine if, and where, bird flight diverters (BFDs) are required.
- Install bird flight diverters as per the instructions of the specialist following the site walkthrough, which may include the need for modified BFDs fitted with solar powered LED lights on certain spans.
- The proposed Phase 1 Grid Connection should be re-routed to avoid, by 2 km or more, the location of the Verreaux's Eagle nest located at (31°43'39.50"S; 23°40'44.07"E) by Smallie, 2014.
- Results from monitoring must be assessed collectively with data from surrounding projects, and be made publicly available.
- Operational results to advise phases/projects not yet constructed, and if unacceptable impacts (as agreed between the specialist in consultations with DEA, BLSA and the BARESG group) are observed, and can't be mitigated, further development on nearby sites must be re-considered and/or stopped.

- The implementation of a site specific Decommissioning Environmental Management Plan (DEMP).
- Prior to decommission, consult with the avifaunal specialist who will advise if any additional relevant and updated mitigations must be implemented during this phase

It is extremely important that the results and recommendations of this report are used to advise the design of an appropriate construction phase and operational phase monitoring programme in line with current guidelines (Jenkins *et al*., 2015), both of which must be implemented if the WEF site is to be developed. Should operational monitoring reveal high levels of mortality, the developer must be prepared to institute appropriate operational mitigations which may include curtailment and/or a shut-down on demand strategy, all of which must be advised by ongoing operational bird activity and mortality monitoring.

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APPENDIX I: 2016/2017 MONITORING-CUMULATIVE SPECIES LIST

Alphabetical Name	Scientific	Red Data Status	Endemic/ Near-Endemic	Priority Score	Winter	Spring	Summer	Autumn
Avocet, Pied	*Recurvirostra avosetta*					x	x	x
Barbet, Acacia Pied	*Tricholaema leucomelas*				x		x	x
Batis, Cape	*Batis capensis*				x			
Batis, Pririt	*Batis pririt*					x	x	
Bee-eater, European	*Merops apiaster*					x	x	
Bishop, Southern Red	*Euplectes orix*						x	x
Bokmakierie	*Telophorus zeylonus*				x	x	x	x
Bulbul, African Red-eyed	*Pycnonotus nigricans*				x	x	x	x
Bulbul, Cape	*Pycnonotus capensis*		X		x	x	x	
Bunting, Cape	*Emberiza capensis*				x	x	x	x
Bunting, Lark-like	*Emberiza impetuani*					x	x	x
Bustard, Ludwig's	*Neotis ludwigii*	EN		320	x	x	x	
Buzzard, Jackal	*Buteo rufofuscus*		X	250	x	x	x	x
Buzzard, Steppe	*Buteo buteo*			210			x	
Canary, Black-headed	*Serinus alario*		X			x	x	x
Canary, Cape	*Serinus canicollis*					x		
Canary, White-throated	*Crithagra albogularis*				x	x	x	x
Canary, Yellow	*Crithagra flaviventris*				x	x	x	x
Chat, Ant-eating	*Myrmecocichla formicivora*				x	x	x	x
Chat, Familiar	*Cercomela familiaris*				x	x	x	x
Chat, Karoo	*Cercomela schlegelii*				x	x	x	x
Chat, Sickle-winged	*Cercomela sinuata*		X		x	x		x
Chat, Tractrac	*Cercomela tractrac*					x	x	
Cisticola, Grey-backed	*Cisticola subruficapilla*				x	x	x	x
Cisticola, Levaillant's	*Cisticola tinniens*					x		x
Coot, Red-knobbed	*Fulica cristata*				x	x	x	
Cormorant, Reed	*Phalacrocorax africanus*					x		
Cormorant, White-breasted	*Phalacrocorax lucidus*						x	
Crane, Blue	*Anthropoides paradiseus*	NT		320	x	x	x	x
Crombec, Long-billed	*Sylvietta rufescens*					x	x	x
Crow, Cape	*Corvus capensis*				x	x		
Crow, Pied	*Corvus albus*				x	x	x	x
Cuckoo, Diederik	*Chrysococcyx caprius*						x	
Dove, Cape Turtle	*Streptopelia capicola*				x	x	x	x
Dove, Laughing	*Streptopelia senegalensis*					x	x	x
Dove, Namaqua	*Oena capensis*						x	x

Alphabetical Name	Scientific	Red Data Status	Endemic/ Near-Endemic	Priority Score	Winter	Spring	Summer	Autumn
Dove, Red-eyed	*Streptopelia semitorquata*				x		x	x
Dove, Rock	*Columba livia*				x			
Drongo, Fork-tailed	*Dicrurus adsimilis*						x	
Duck, African Black	*Anas sparsa*						x	
Duck, Yellow-billed	*Anas undulata*				x	x	x	x
Eagle, African Fish	*Haliaeetus vocifer*			290	x	x		x
Eagle, Black-chested Snake	*Circaetus pectoralis*			230	x			
Eagle, Booted	*Hieraaetus pennatus*			230		x	x	
Eagle, Martial	*Polemaetus bellicosus*	EN		350	x	x	x	x
Eagle, Verreauxs'	*Aquila verreauxii*	VU		360	x	x	x	x
Eremomela, Yellow-bellied	*Eremomela icteropygialis*				x	x	x	x
Falcon, Lanner	*Falco biarmicus*	VU		300	x		x	
Finch, Scaly-feathered	*Sporopipes squamifrons*						x	
Fiscal, Common	*Lanius collaris*				x	x	x	x
Flycatcher, Fairy	*Stenostira scita*		X		x	x	x	x
Flycatcher, Fiscal	*Sigelus silens*		X		x	x		
Francolin, Grey-winged	*Scleroptila africana*		X	190	x	x	x	x
Goose, Egyptian	*Alopochen aegyptiaca*				x	x	x	x
Goose, Spur-winged	*Plectropterus gambensis*				x	x	x	x
Goshawk, Pale Chanting	*Melierax canorus*			200	x	x	x	x
Grebe, Little	*Tachybaptus ruficollis*				x	x		
Guineafowl, Helmeted	*Numida meleagris*				x	x	x	x
Hamerkop	*Scopus umbretta*				x			
Harrier, Black	*Circus maurus*	EN	X	345		x	x	
Hawk, African Harrier-	*Polyboroides typus*			190	x	x	x	x
Heron, Black-headed	*Ardea melanocephala*					x	x	x
Heron, Grey	*Ardea cinerea*				x	x	x	
Hoopoe, African	*Upupa africana*						x	x
Ibis, African Sacred	*Threskiornis aethiopicus*				x	x	x	x
Ibis, Hadeda	*Bostrychia hagedash*				x	x	x	x
Kestrel, Greater	*Falco rupicoloides*			174	x		x	
Kestrel, Rock	*Falco rupicolus*				x	x	x	x
Kingfisher, Brown-hooded	*Halcyon albiventris*						x	
Kingfisher, Giant	*Megaceryle maxima*				x			
Kingfisher, Malachite	*Alcedo cristata*				x	x		
Kite, Black-shouldered	*Elanus caeruleus*			174	x			
Korhaan, Karoo	*Eupodotis vigorsii*	NT		240	x	x	x	x
Korhaan, Northern Black	*Afrotis afraoides*			180	x	x	x	x

Alphabetical Name	Scientific	Red Data Status	Endemic/ Near-Endemic	Priority Score	Winter	Spring	Summer	Autumn
Lapwing, Blacksmith	*Vanellus armatus*				x	x	x	x
Lapwing, Crowned	*Vanellus coronatus*					x	x	x
Lark, Black-eared Sparrow-	*Eremopterix australis*		X					x
Lark, Eastern Clapper	*Mirafra fasciolata*				x	x	x	x
Lark, Grey-backed Sparrow	*Eremopterix verticalis*					x	x	x
Lark, Karoo	*Calendulauda albescens*		X			x	x	x
Lark, Karoo Long-billed	*Certhilauda subcoronata*				x	x	x	x
Lark, Large-billed	*Galerida magnirostris*		X			x	x	x
Lark, Red-capped	*Calandrella cinerea*					x	x	x
Lark, Sabota	*Calendulauda sabota*					x		x
Lark, Spike-heeled	*Chersomanes albofasciata*					x	x	x
Longclaw, Cape	*Macronyx capensis*					x	x	
Martin, Brown-throated	*Riparia paludicola*				x	x	x	x
Martin, Rock	*Hirundo fuligula*				x	x	x	x
Mousebird, Red-faced	*Urocolius indicus*					x	x	x
Mousebird, Speckled	*Colius striatus*				x			
Mousebird, White-backed	*Colius colius*				x	x	x	x
Neddicky	*Cisticola fulvicapilla*						x	
Owl, Cape Eagle-	*Bubo capensis*			250		x		
Owl, Spotted Eagle-	*Bubo africanus*			170			x	x
Penduline-tit, Cape	*Anthoscopus minutus*					x	x	x
Pigeon, Speckled	*Columba guinea*				x	x	x	x
Pipit, African	*Anthus cinnamomeus*					x	x	
Pipit, African Rock	*Anthus crenatus*	NT	X	200	x	x	x	x
Pipit, Long-billed	*Anthus similis*							x
Plover, Three-banded	*Charadrius tricollaris*				x	x	x	x
Prinia, Black-chested	*Prinia flavicans*							x
Prinia, Karoo	*Prinia maculosa*		X		x	x	x	x
Raven, White-necked	*Corvus albicollis*				x	x	x	x
Robin, Karoo Scrub	*Erythropygia coryphoeus*				x	x	x	x
Robin-chat, Cape	*Cossypha caffra*				x	x	x	x
Sandgrouse, Burchell's	*Pterocles burchelli*						x	
Sandgrouse, Namaqua	*Pterocles namaqua*					x		x
Secretarybird	*Sagittarius serpentarius*	VU		320		x	x	
Shelduck, South African	*Tadorna cana*				x	x	x	x
Shoveler, Cape	*Anas smithii*				x	x		
Sparrow, Cape	*Passer melanurus*				x	x	x	x

Alphabetical Name	Scientific	Red Data Status	Endemic/ Near-Endemic	Priority Score	Winter	Spring	Summer	Autumn
Sparrow, House	*Passer domesticus*						x	x
Sparrow, Southern Grey-headed	*Passer diffusus*					x	x	x
Sparrowhawk, Rufous-breasted	*Accipiter rufiventris*			170		X		
Spoonbill, African	*Platalea alba*				x	x		
Starling, Common	*Sturnus vulgaris*				x		x	x
Starling, Pale-winged	*Onychognathus nabouroup*					x	x	x
Starling, Pied	*Lamprotornis bicolor*		X		x	x	x	x
Starling, Red-winged	*Onychognathus morio*				x	x	x	x
Starling, Wattled	*Creatophora cinerea*					x		
Stilt, Black-winged	*Himantopus himantopus*				x	x		x
Stork, Black	*Ciconia nigra*	VU		330		x		
Sunbird, Dusky	*Cinnyris fuscus*					x	x	
Sunbird, Greater Double-collared	*Cinnyris afer*		X				x	
Sunbird, Malachite	*Nectarinia famosa*					x	x	
Sunbird, Southern Double-collared	*Cinnyris chalybeus*		X		x	x	x	x
Swallow, Barn	*Hirundo rustica*					x	x	
Swallow, Greater Striped	*Cecropis cucullata*					x	x	x
Swallow, White-throated	*Hirundo albigularis*					x	x	x
Swift, African Black	*Apus barbatus*					x	x	
Swift, Alpine	*Tachymarptis melba*					x	x	x
Swift, Horus	*Apus horus*						x	
Swift, Little	*Apus affinis*						x	x
Swift, White-rumped	*Apus caffer*						x	
Teal, Cape	*Anas capensis*					x		
Teal, Red-billed	*Anas erythrorhyncha*					x		
Thick-knee, Spotted	*Burhinus capensis*						x	x
Thrush, Karoo	*Turdus smithi*		X				x	
Thrush, Short-toed Rock	*Monticola brevipes*							x
Tit, Grey	*Parus afer*		X		x	x	x	x
Tit-Babbler, Chestnut-vented	*Sylvia subcaerulea*						x	x
Tit-Babbler, Layard's	*Sylvia layardi*		X			x	x	x
Trogon, Narina	*Apaloderma narina*				x			
Wagtail, Cape	*Motacilla capensis*					x	x	x
Warbler, African Reed	*Acrocephalus baeticatus*					x		
Warbler, Cinnamon-breasted	*Euryptila subcinnamomea*		X			x		

Alphabetical Name	Scientific	Red Data Status	Endemic/ Near-Endemic	Priority Score	Winter	Spring	Summer	Autumn
Warbler, Lesser Swamp	*Acrocephalus gracilirostris*					x		x
Warbler, Namaqua	*Phragmacia substriata*		X		x	x	x	x
Warbler, Rufous-eared	*Malcorus pectoralis*				x	x	x	x
Waxbill, Common	*Estrilda astrild*							x
Weaver, Cape	*Ploceus capensis*		X				x	x
Weaver, Southern Masked	*Ploceus velatus*				x	x	x	
Wheatear, Capped	*Oenanthe pileata*					x		
Wheatear, Mountain	*Oenanthe monticola*				x	x	x	x
White-eye, Cape	*Zosterops capensis*		X			x	x	x
Whydah, Pin-tailed	*Vidua macroura*					x		
Woodpecker, Cardinal	*Dendropicos fuscescens*							x
Woodpecker, Ground	*Geocolaptes olivaceus*		X			x		x

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Umsinde Emoyeni Wind Energy Facility Phase 1 and Phase 2, Western and Northern Cape Provinces.

Specialist:	Arcus Consulting		
Contact person:	Andrew Pearson		
Postal address:	Room 220, Cube Workspace, Cnr Long & Hans Strjidom R.D		
Postal code:	8001	Cell:	0725580080
Telephone:	-	Fax:	
E-mail:	andrewp@arcusconsulting.co.za		
Professional affiliation(s) (if any)	SACNASP		

Project Consultant:	Arcus Consulting		
Contact person:	Ashlin Bodasing		
Postal address:	Room 220, Cube Workspace, Cnr Long & Hans Strjidom R.D		
Postal code:	8001	Cell:	076 340 8914
Telephone:	021 412 1529	Fax:	
E-mail:	ashlinb@arcusconsulting.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Andrew Pearson , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

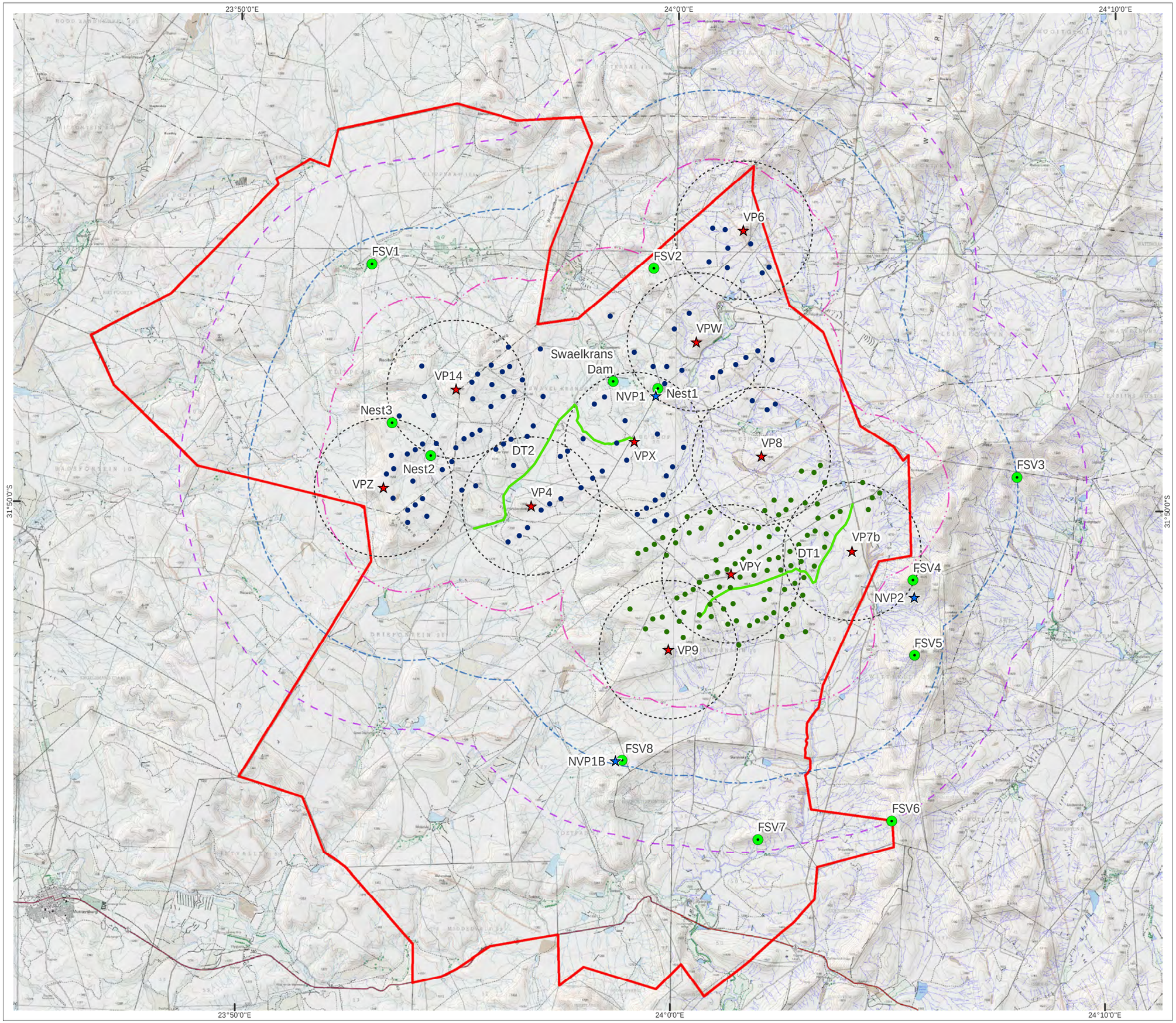
Signature of the specialist:

Arcus Consulting

Name of company (if applicable):

06/02/2018

Date:



Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- 7.5 km from Turbine Positions
- 5 km from Turbine Positions
- 2.5 km from Turbine Positions
- Nest Vantage Point
- Focal Site
- Driven Transect
- 2.5 km Radius from VP

1:130,000 Scale @ A3

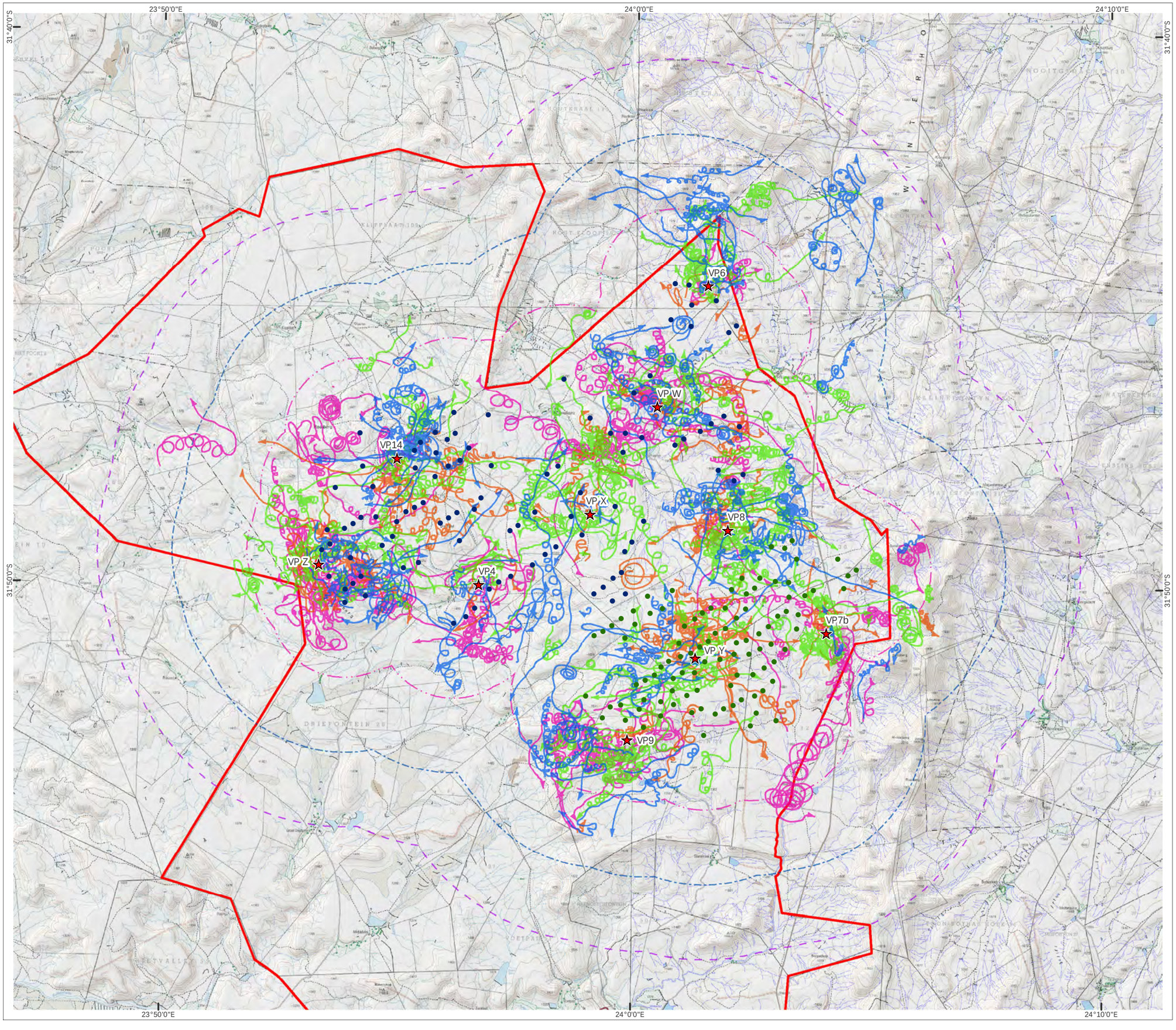
0 2 4 km

N

Produced: AA Reviewed: SC Approved: AB	Ref: 2472/REP/016
	Date: 06/07/2017

Survey Locations
Figure 1

Umsinde Emoyeni WEF: **Updated** Avifaunal **Impact Assessment**



Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- 7.5 km from Turbine Positions
- 5 km from Turbine Positions
- 2.5 km from Turbine Positions
- Vantage Point
- Winter Survey Flight
- Spring Survey Flight
- Summer Survey Flight
- Autumn Survey Flight

1:120,000 Scale @ A3

0 2 4 km

N

Produced: AA Reviewed: SC Approved: AB	Ref: 2472/REP/016
	Date: 06/07/2017

All Target Species Flights
2016/2017
Figure 2

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**

23°52'0"E
24°0'0"E
24°8'0"E
31°44'0"S
31°52'0"S

VP6
VP W
VP14
NVP1
VP X
VP8
VP Z
VP4
VP7b
VP Y
NVP2
VP9
NVP1B

Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- 7.5 km from Turbine Positions
- 5 km from Turbine Positions
- 2.5 km from Turbine Positions
- Vantage Point
- Nest Vantage Point
- Inactive / Active Verreaux's Eagle Nest
- Verreaux's Eagle Roost
- 3 km Verreax's Eagle Nest Buffer
- 1 km Verreaux's Eagle Roost Buffer
- Winter Survey Flight
- Spring Survey Flight
- Summer Survey Flight
- Autumn Survey Flight
- Nest Survey Flight

1:120,000 Scale @ A3

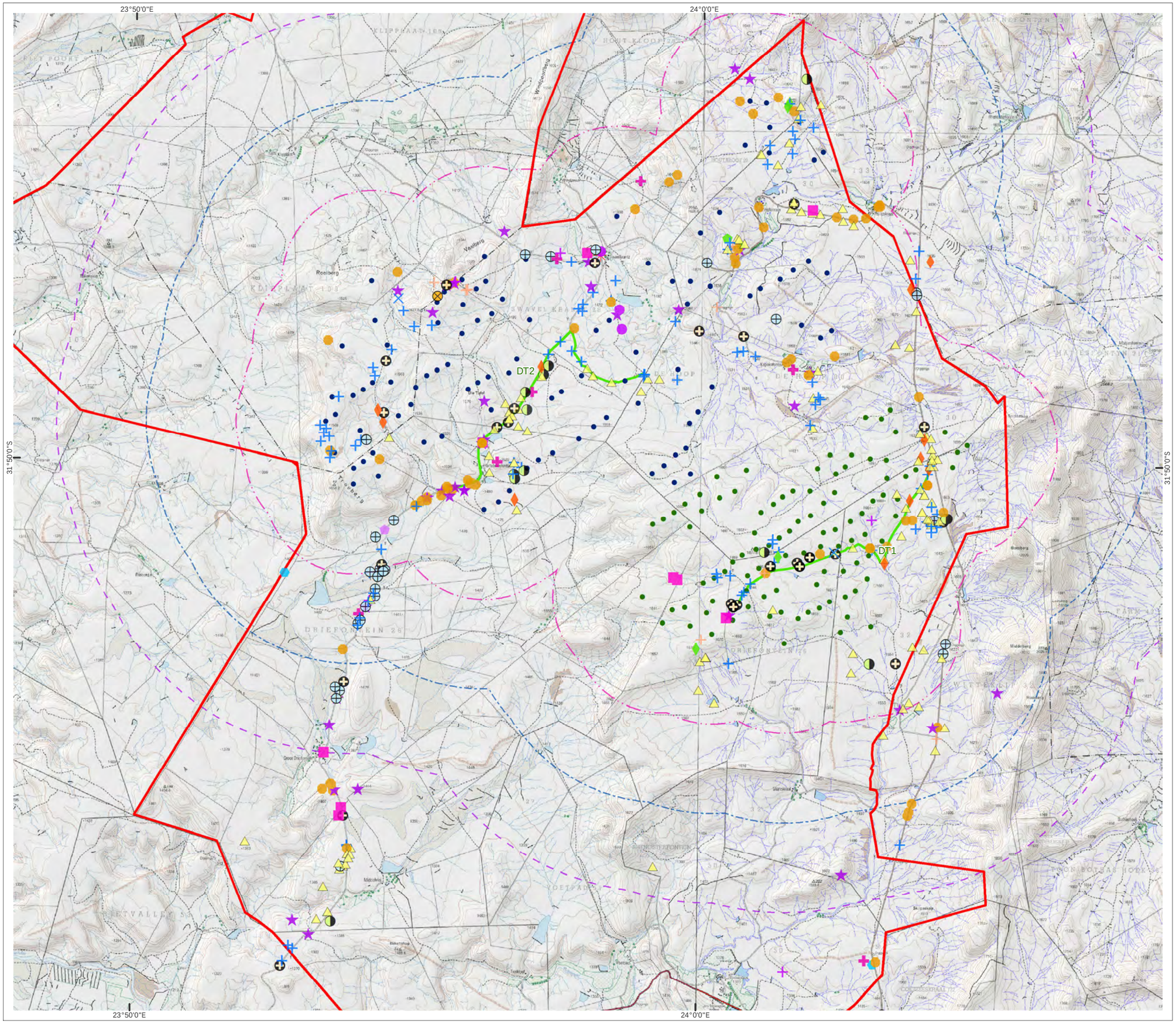
0 2 4 km

N

Produced: AA Reviewed: SC Approved: AB	Ref: 2472/REP/017
	Date: 06/07/2017

Verreaux's Eagle Flights
2016/2017
Figure 3

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**



Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- 7.5 km from Turbine Positions
- 5 km from Turbine Positions
- 2.5 km from Turbine Positions
- Driven Transect
- African Fish Eagle
- African Harrier Hawk
- African Rock Pipit
- Blue Crane
- Black Harrier
- Booted Eagle
- Black-shouldered Kite
- Cape Eagle Owl
- Greater Kestrel
- Grey-winged Francolin
- Jackal Buzzard
- Karoo Korhaan
- Ludwig's Bustard
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk
- Rock Kestrel
- Secretarybird
- Spotted Eagle Owl
- Steppe Buzzard
- Verreaux's Eagle

1:100,000 Scale @ A3

0 2 4 km

N

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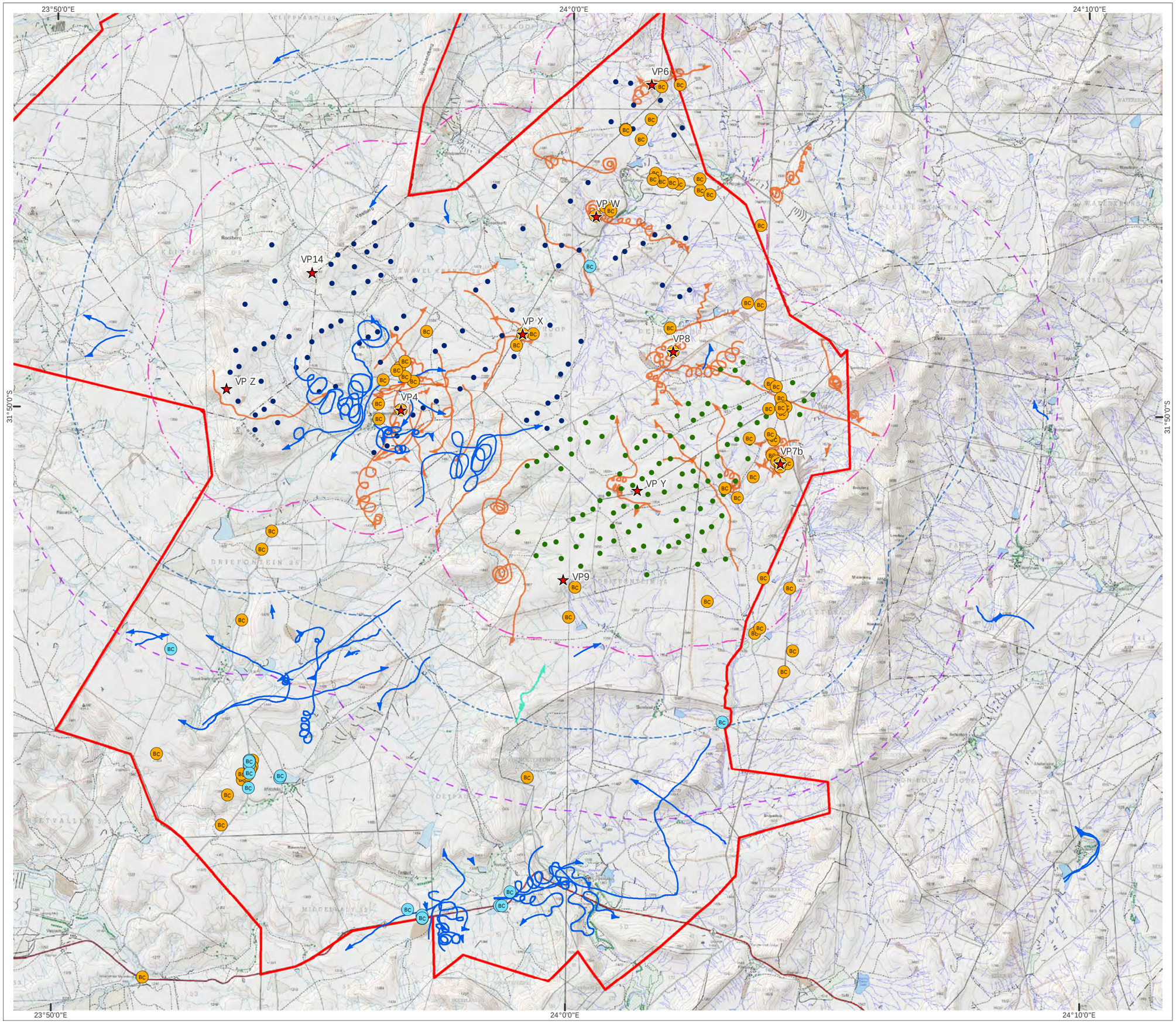
	Date: 07/07/2017

Incidental and Driven Transect Priority Species and Raptor Records
Figure 4

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**



Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- Vantage Point
- 7.5 km from Turbine Positions
- 5 km from Turbine Positions
- 2.5 km from Turbine Positions
- 2013/2014 Blue Crane Sighting
- 2016/2017 Blue Crane Sighting
- 2013/2014 Blue Crane Flight
- 2016/2017 Blue Crane Flight

1:110,000 Scale @ A3

0 2 4 km

N

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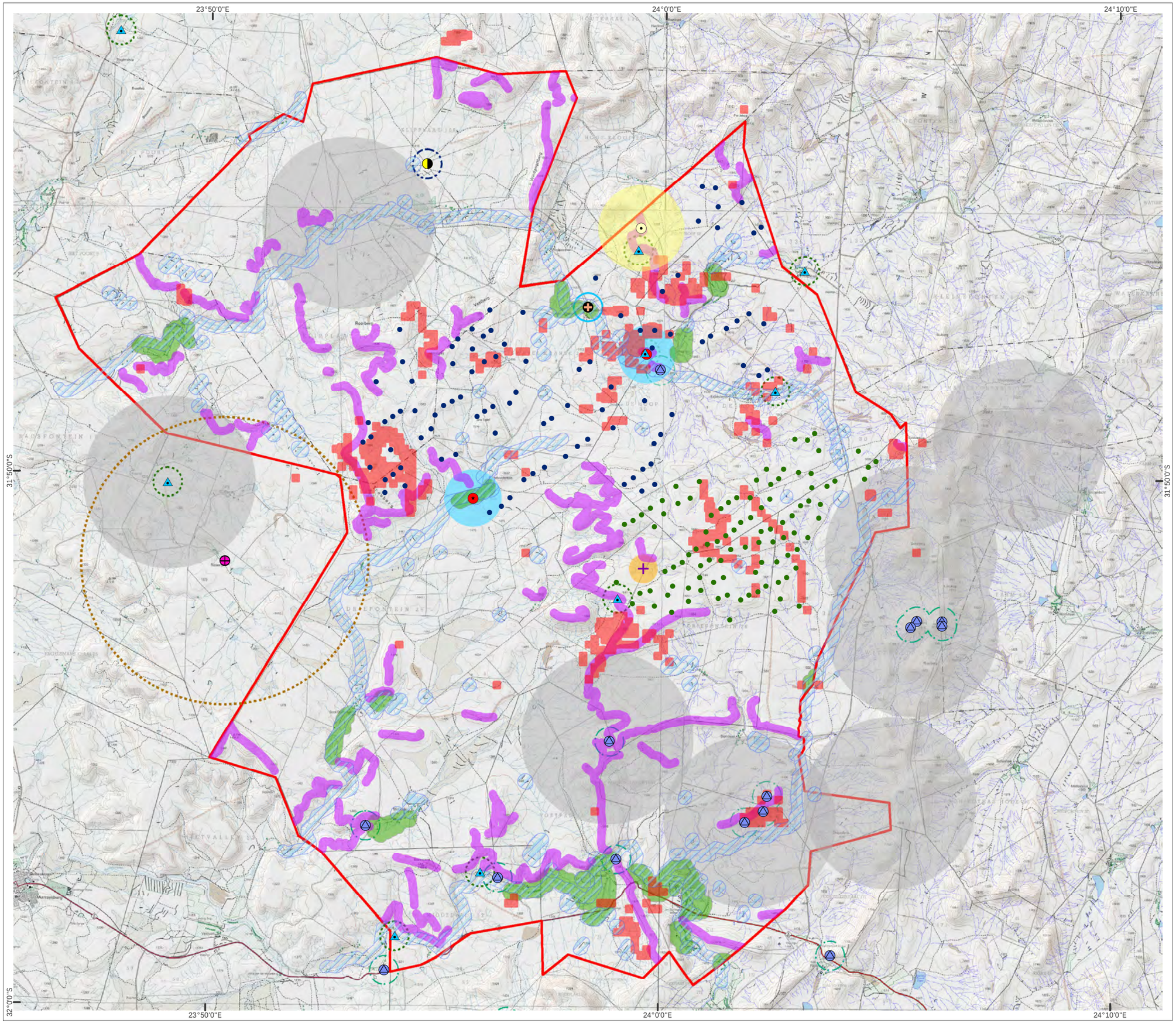
	Date: 06/07/2017

Blue Crane Records
2013/2014 and 2016/2017
Figure 5

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**



ARCUS

- WEF Site Boundary
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- Unconfirmed Raptor or Corvid Nest
- Verreaux's Eagle Roost
- Jackal Buzzard Nest
- Martial Eagle Nest
- Pale-chanting Goshawk Nest
- Rock Kestrel Nest
- Rufous-breasted Sparrowhawk Nest
- Bee-eater Colony
- 3 km Verreaux's Eagle Nest Buffer
- 1.5 km Buffer of Unfonfimed Raptor or Corvid Nest
- No-Go for Turbines and Overhead Powerlines
- 200 m buffer of NFEPA Wetlands and Rivers
- 150 m Ridge Buffer
- 200 m Cultivated Lands Buffer
- 500 m Rock kestrel Nest Buffer
- 1 km Buffer of Verreaux's Eagle Roost
- Bee-eater Colony Buffer
- 500m Buffer of Jackal Buzzard Nest
- 500m Buffer of Pale-chanting Goshawk Nest
- 500m Buffer of Rock Kestrel Nest
- 500m Buffer of Rufus-breasted Sparrowhawk Nest
- 5km Buffer of Martial Eagle Nest

1:125,000 Scale @ A3

N

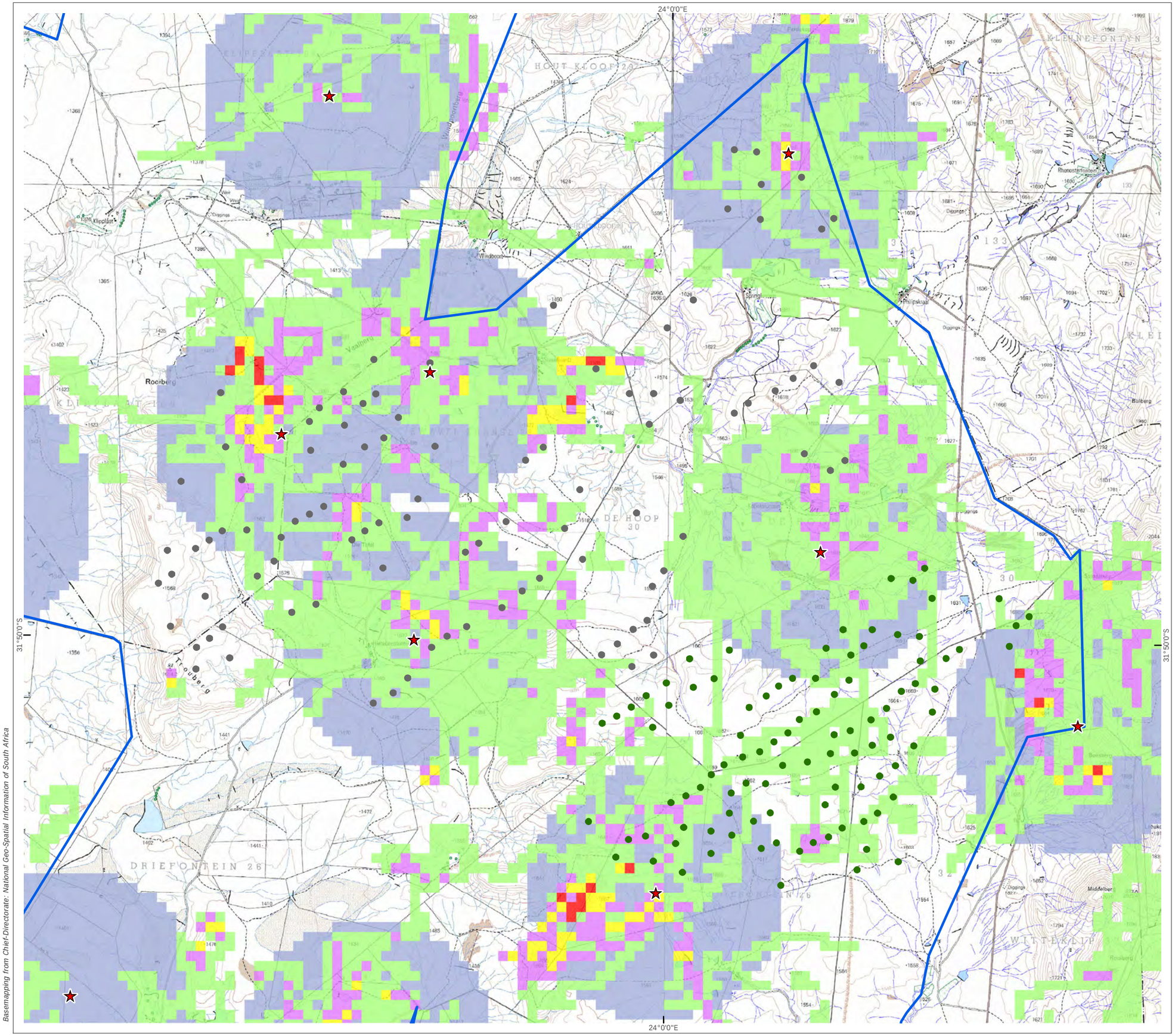
0 2 4 km

Produced: AA Reviewed: SC Approved: AB	Ref: 2472/REP/020
	Date: 07/07/2017

Avifaunal Buffer Map
Figure 6

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**

Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa



ARCUS

- WEF Site Boundary
- Vantage Point
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2

Sensitivity Score

- Areas with no observed activity within viewshed
- Low
- Medium
- Medium - High
- High

1:75,000 Scale @ A3

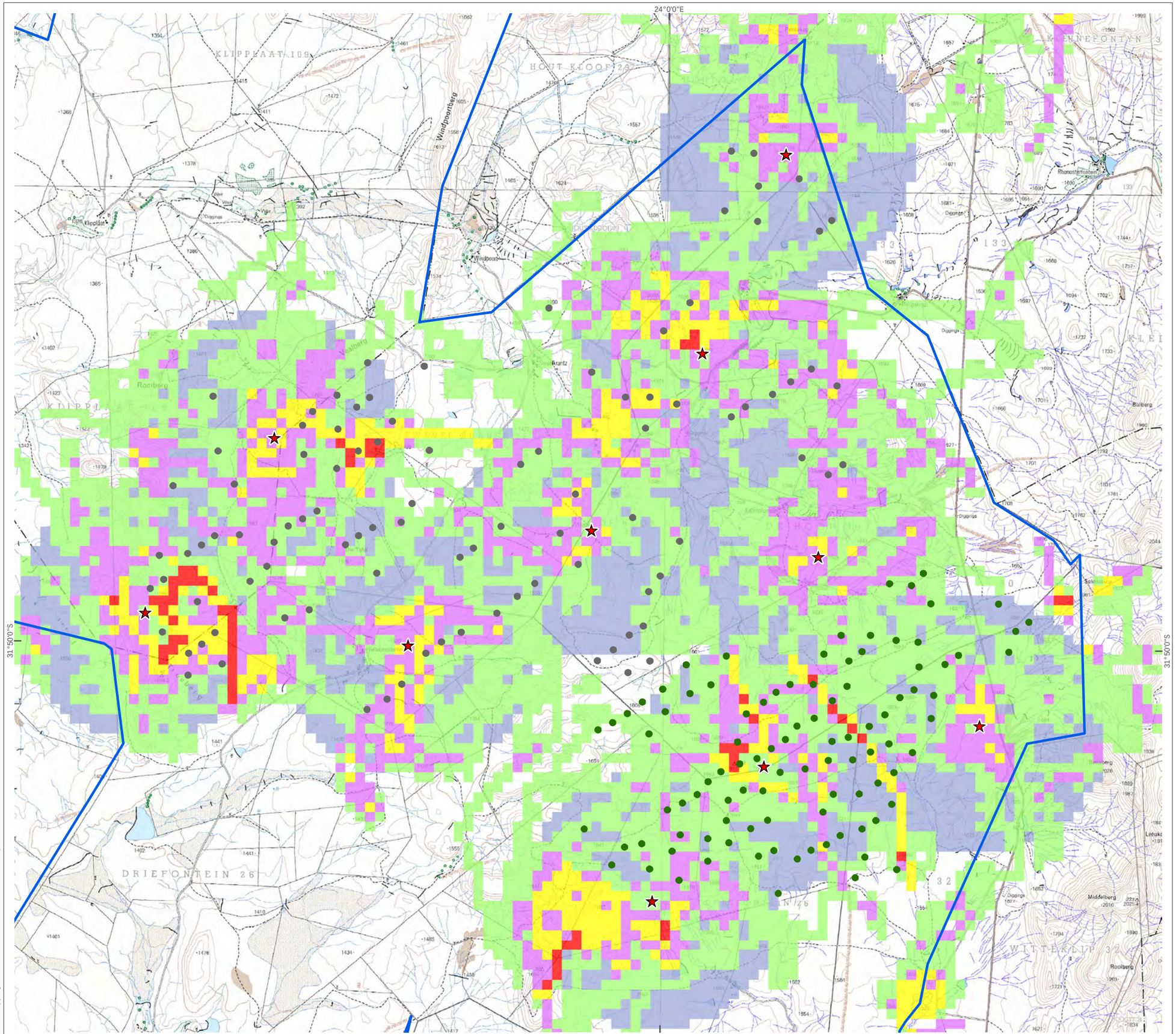
N

0 2 4 km

Produced: SC Reviewed: RMc Approved: AP	Ref: 2472/REP/021 Date: 05/07/2017

Bird Sensitivity Map 2013/14 Data
Figure 7

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**



ARCUS

- WEF Site Boundary
- Vantage Point
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2

Sensitivity Score

- Areas with no observed activity within viewshed
- Low
- Medium
- Medium - High
- High

1:75,000 Scale @ A3

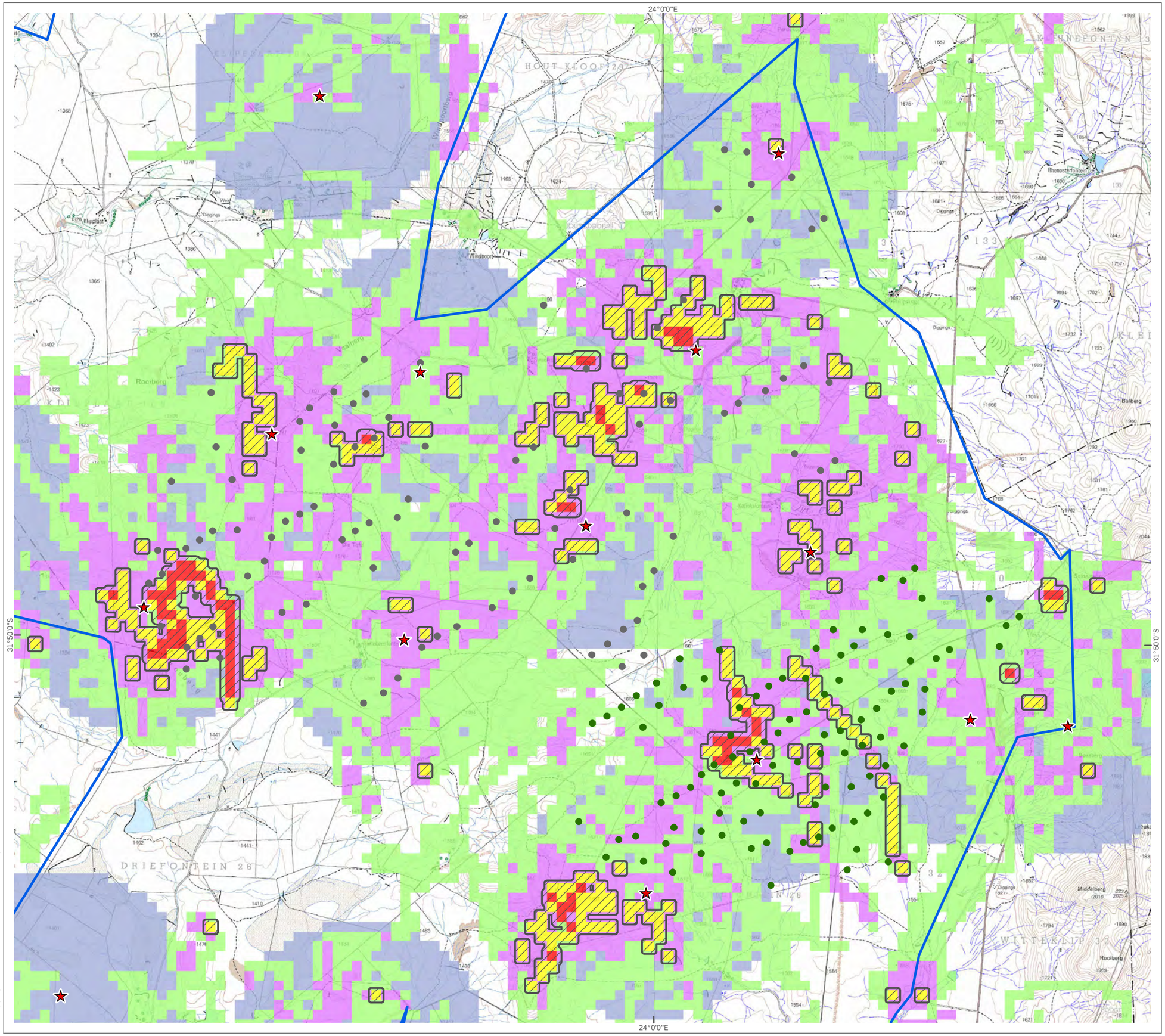
N

0 2 4 km

Produced: SC Reviewed: RMc Approved: AP	Ref: 2472/REP/022 Date: 05/07/2017

Bird Sensitivity Map 2016/17 Data
Figure 8

Umsinde Emoyeni WEF: **Updated Avifaunal Impact Assessment**



Basemapping from Chief Directorate: National Geo-Spatial Information of South Africa

ARCUS

- WEF Site Boundary
- Vantage Point
- Proposed Turbine Phase 1
- Proposed Turbine Phase 2
- No-Go for Turbines and Overhead Powerlines

Sensitivity Score

- Areas with no Observed Activity within Viewshed
- Low
- Medium
- Medium - High
- High

1:75,000 Scale @ A3

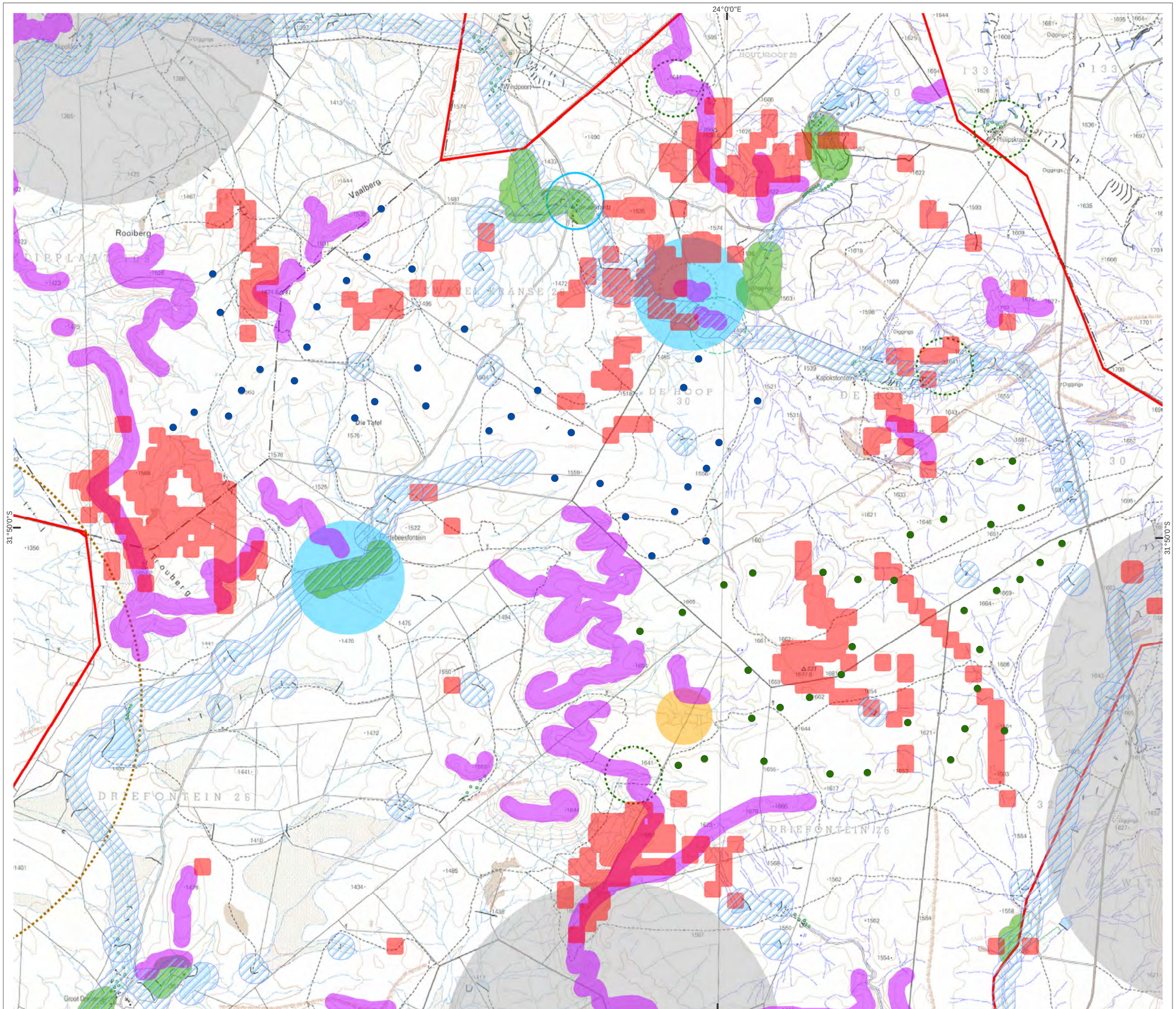
N

0 2 4 km

Produced: SC Reviewed: AP Approved: AB	Ref: 2472/REP/023 Date: 05/07/2017

Combined Flight Sensitivity Map
Figure 9

Umsinde Emoyeni **WEF: Updated Avifaunal Impact Assessment**



Basemapping from Chief-Directorate: National Geo-Spatial Information of South Africa

ARCUS

- Proposed Turbine Phase 1
- Proposed Turbine Pahse 2
- WEF Site Boundary
- 3 km Verreaux's Eagle Nest Buffer
- 1 km Buffer of Verreaux's Eagle Roost
- No-Go for Turbines and Overhead Powerlines
- 200 m buffer of NFEPA Wetlands and Rivers
- 150 m Ridge Buffer
- 200 m Cultivated Lands Buffer
- Bee-eater Colony Buffer
- 500 m Rock kestrel Nest Buffer
- 500 m Buffer of Jackal Buzzard Nest
- 500 m Buffer of Rufous-breaseted Sparrowhawk
- 5 km Buffer of Martial Eagle Nest

1:63,360 Scale @ A3

0 1.5 3 km

N

Produced: AP Reviewed: SC Approved: AB	Ref: 2472/REP/020
	Date: 01/02/2018

Avifaunal Buffer Map
Revised Turbine Layout
Figure 10

Umsinde Emoyeni WEF: Updated Avifaunal Impact Assessment