Bird Impact Assessment Study

Proposed 60 year Ash Disposal Facility near to the Kusile Power Station

September 2013

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EXECUTIVE SUMMARY

Eskom proposes to extend the ash disposal facility and associated infrastructure for the new Kusile Power Station.

The additional ash disposal facility will need to cater for the ash produced over the 60 year lifespan of the power station. It is estimated that approximately 460 million m^3 ash will be produced which will cover a footprint of between 1200 – 1500 hectares and approximately 40 – 60m high at the end of its lifespan.

It is envisaged that the construction of the proposed ash disposal facility (ADF) will result in the radical transformation of an area of approximately 1500ha. The transformation will effectively displace the majority of avifauna currently utilizing the proposed development area, and, depending on where the development takes place, will result in the fragmentation of natural grassland and wetland habitat. The effect of this will be an overall reduction of species diversity and abundance in the study area.

The Blue Crane *Anthropoides paradiseus* which is one of the priority avifauna species listed in the Mpumalanga Biobase Report (Emery et al. 2002) was recorded during the on-site surveys. Five Red Data bird species (Blue Crane, Lesser Kestrel *Falco naumanni*, Lesser Flamingo *Phoenicopterus minor*, Secretarybird *Sagittarius serpentarius* and Greater Flamingo *Phoenicopterus roseus*) which have been prioritized by the Gauteng Department of Agriculture, Conservation and Environment (GDACE) were recorded during the field surveys conducted in the area. Based on the surveys conducted and the best available information from the South African Bird Atlas Project - 17 Red Data species could potentially occur in the habitat types present in the study area.

One of the objectives of this study is to arrive at a preferred alternative for the proposed development in terms of impacts on avifauna. In order to make an informed decision, the results of the on-site surveys supplemented by Red Data species reporting information from the South African Bird Atlas Project were used as an indication of sensitivity. Birds were counted at all the proposed siting alternatives (Sites A, B, C, F, G and Small A). A species richness index for all species and Red Data species was calculated at each alternative based on bird habitat preference and the available habitat in the respective alternative. From the analyses grassland and wetland habitat emerged as the most sensitive as they support the largest variety and density of birds.

Site alternative B has the lowest species richness ranking both from an "all species" as well as a "Red Data species" richness perspective. Site B is thus the most preferred alternative for the ash disposal facility from a bird impact perspective only as the agricultural operations on the site have already transformed the natural habitat completely. Due to the expansive natural grassland habitat present on site C, this site emerged as the most sensitive and the least preferred for the proposed development.

Site alternatives C, A, F and G all contain some wetland and grassland avifaunal habitats. Site F and contain an interesting ephemeral pan which supported both Lesser and Greater Flamingos during the surveys. These site alternatives are all located along the Wilge River. This would increase their importance rating. A pair of Blue Cranes was also recorded at site F on two occasions during the field surveys.

Sections of site alternatives C, F and G are located along the Wilge River, and this proximity could significantly increase potential downstream impacts on wetlands and other biodiversity, including avifauna, in the event of spillages and pollution from the ADF. At a regional level the Wilge River system is an important avifaunal habitat and feature in the landscape for Red Data species recorded in the study area.

Site alternative C remains as the most sensitive and least preferred for development as a result of the expansive grassland habitat and the proximity of the Wilge River immediately to the west.

From a strictly avifaunal perspective site alternative B remains as the preferred alternative as the cumulative impact of losing another 1300 hectares of grassland bird habitat in the eastern Gauteng / Mpumalanga Highveld should be regarded as a **moderate to high** impact within the overall context of existing pressure on natural grassland habitat in the area. If, however, the development is located on existing agricultural lands, the cumulative impact would be **lower**, as the agricultural operations have already transformed the natural habitat completely.

Avifaunal species associated with wetlands occur throughout the area in suitable habitat and are not known to have a preference for a specific river or wetland catchment area. It is however worthy to note that the proposed development footprint of site alternative B would extend over three catchments compared to site alternative A (which only extends over one catchment). The unmitigated impact from the ash disposal facility if it is located at site alternative B could therefore have more far reaching effects on the environment and consequently also negatively influence the avifaunal population over a wider area.

Kusile power station currently has an environmental authorisation for an on-site ash disposal facility just to the north-east of site alternative A (See Figure 6.1). Potential pollution and disturbance (if not properly mitigated) from this facility could negatively impact the surrounding habitat and therefore also affect avifaunal populations.

Site alternative A contain avifaunal habitat in the form of wetland and grassland down its centre and along the northern boundary (see Figure 4.1). These wetland areas are dependent on drainage lines originating further to the north, east and south. The planned New Largo coal mine would (if and when it goes ahead) be located to the east of site alternative A.

The Kusile Power Station and its associated on-site ash disposal facility (see Figure 6.1) coupled with the impacts of the envisaged New Largo coal mine could place severe pressure on the wetlands and associated grasslands on site A. If not adequately mitigated or in the event of mitigation measures failing this combined potential impact could negatively affect the avifaunal habitats at site alternative A.

The developments and their potential impacts described above would reduce the importance ranking of site alternative A compared to F and G which are located alongside the Wilge River (this in turn increases their importance rating).

A revised site alternative ranking taking the above cumulative impacts into consideration is presented in the below table.

Site Alternative ranking based on cumulative impacts.

Site Alternative	**Rank taking cumulative impacts into consideration.**
Site B	1
Site A	2
Site A_{small}&G	3
Site A_{small}&F	4
Site F&G	5
Site C	6

When viewed holistically and taking the influence of the cumulative factors as outlined above into consideration combined with the findings of the other specialist studies (e.g. wetlands) site alternative A could also be considered as a viable alternative from an avifaunal perspective.

RECOMMENDED MITIGATION

- If site alternative A is preferred the potential for off-setting the loss of natural grassland and wetland by conserving an equivalent quantity and quality of grassland bird habitat elsewhere on the eastern Gauteng or Mpumalanga Highveld should be considered. Provincial borders does not influence bird distribution or their habitat preference and as such a suitable area should be selected based on protecting largely similar habitat types. The relevant provincial and national environmental departments should be consulted and engaged in selecting an appropriate area. Alternatively, a financial contribution towards a legitimate conservation initiative for threatened grassland avifauna could also be considered as an off-set e.g. a contribution to Birdlife South Africa.
- Irrespective of whether site alternative A or B is used, the proposed recommendations of the Terrestrial Ecology and Wetlands Specialist Study for the Environmental Management Programme should be strictly applied to minimise the impact on the natural environment, specifically on the remaining wetlands and natural grasslands, as this is the most important bird habitat types in the study area.
- Maximum use should be made of existing infrastructure (e.g. access roads) to minimise the further fragmentation of natural grassland and wetland areas.

1 BACKGROUND

1.1 Scope

Zitholele Consulting was appointed by Eskom Holding as independent environmental practitioners to undertake the Environmental Impact Assessment (EIA) for the establishment of an ash disposal facility and associated infrastructure for the new Kusile Power Station. The ash disposal site will need to cater for the ash produced over the 60 year lifespan of the power station. It is estimated that approximately 460 million m^3 ash will be produced which will cover a footprint of between 1200 – 1500 hectares.

See Appendix 1 for a map showing the study area with the proposed alternative development areas which extends over both the Gauteng and Mpumalanga provinces.

Chris van Rooyen Consulting was appointed by Zitholele Consulting to conduct the investigations into the potential bird impacts that might occur as a result of the construction of the infrastructure and to rank the proposed alternatives in terms of potential avifaunal impacts. Albert Froneman was contracted by Chris van Rooyen consulting to conduct the field surveys and to compile this report.

1.2 Terms of reference

The terms of reference for this bird impact assessment report are as follows:

- The study area will be inspected to gain a first-hand impression of the bird habitat.
- Different bird micro-habitats will be described as well as the species associated with those habitats.
- Trends and conditions in the environment that affect the avifauna as it currently exist within the zone of influence will be identified and analysed
- Bird sensitive areas will be mapped in a sensitivity map for easy reference, and particular emphasis will be placed on habitat for Red Data and endemic species.
- A full description of potential impacts (direct and indirect) will be provided, relative to these specific developments.
- The potential impact on the birds will be assessed and evaluated.
- Practical mitigation measures will be recommended and discussed.
- If a need for the implementation of a monitoring programme in the EMP phase is evident, it will be highlighted and a programme proposed.

1.3 Sources of information

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the Southern African Bird Atlas Project 2 (SABAP2) was obtained from the Animal Demography Unit website (http://sabap2.adu.org.za,), for the Quarter-Degree Grid Cell (QDGC) where the proposed development is located (2528DD). 1% of the southern-most site (alternative G) falls within the 2628BB QDGC but for the purposes of this study only data from the 2528DD QDGC was used.
- The conservation status of all species considered likely to occur in the area was determined as per the most recent iteration of the southern African Red Data list for birds (Barnes 2000), and the most recent and comprehensive summary of southern African bird biology (Hockey *et al.* 2005). QDGCs are grid cells that cover 15 minutes of latitude by 15 minutes of longitude (15. × 15.), which correspond to the area shown on a 1:50 000 map.
- Additional bird distribution data and a classification of the vegetation types in the QDGCs were obtained from Southern African Bird Atlas Project 1 (SABAP1) (Harrison *et al.* 1997).
- Information on the micro habitat level was obtained through visiting the area in November and December 2012 and obtaining a first-hand perspective. Transect counts were conducted to establish the densities and diversity of the avifauna at the different alternative sites. Five transects were identified and each transect was counted three times.

- The Mpumalanga Biobase Report (Emery *et al*. 2002) as well as the Gauteng Department of Agriculture, Conservation and Environment (GDACE) Requirements for Biodiversity Assessments Version 2 (2009) was consulted to establish which bird species and habitats are regarded as conservation priorities in the respective provinces.
- Data from the Co-ordinated Avifaunal Road count project (CAR) for the Mpumalanga precincts were obtained (Young, Harrison, Navarro, Anderson and Colahan, 2003). This data was of particular importance in order to establish what densities of large terrestrial birds could be expected to occur in the study area, and especially what the habitat preferences of those species are.

1.4 Assumptions & Limitations

This study made the assumption that the above sources of information are adequately reliable. However, there are factors that may potentially detract from the accuracy of the predicted results:

- Sources of error in the SABAP2 database, particularly limited coverage of some QDGCs. This means that the reporting rates of species may not be an accurate reflection of the true densities in QDGCs that has to date been sparsely covered during the data collecting. The 2528DD QDGC has been fairly well covered by SABAP2 with a total of 103 checklists submitted. This provides a reasonably comprehensive set of data with regard to the species that are likely to occur in the area.
- The SABAP2 information was supplemented with actual counts at the different site alternatives. The counts were conducted in December following good rains. These are the type of conditions which is most suitable for instantaneous sampling bouts on the eastern Gauteng and Mpumalanga highveld i.e. in the wet season when the highest species diversity and abundance is to be expected of both migratory and resident species. However, it must be accepted that bird distribution patterns may fluctuate in response to climatic conditions, particularly rainfall, and that ideally sampling over several seasons would be required to get a representative picture of all the species that occur in the area.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 Vegetation

Table 1 below shows the vegetation composition of the relevant QDGC, namely 2528DD (Harrison *et al.* 1997). It is generally accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (in Harrison *et al.* 1997). Therefore, the vegetation description below does not focus on lists of plant species, but rather on factors which are relevant to bird distribution.

Table 2.1. Vegetation composition of 2528DD (Harrison *et al.* 1997).

Biome	Vegetation type	2528DD
Grassland	Sour grasslands	95%
Woodland (or Savanna)	Moist Woodland	5%

The proposed alternatives fall within the grassland biome. The dominant plants in the grassland biome are grass species, with geophytes and herbs also well represented. Grasslands are maintained mainly by a combination of the following factors: relatively high summer rainfall; frequent fires; frost and grazing. These factors preclude the growth of trees and shrubs. This biome has been largely transformed in South Africa through various land uses such as afforestation, and in Mpumalanga and Gauteng, by crop cultivation and mining. **Sweet grassland** is generally found in the lower rainfall areas - vegetation is taller and sparser, and nutrients are retained in the leaves during winter. **Sour grassland** generally occurs in the higher rainfall areas on leached soils. Many grassland bird species show a preference for sour grassland over sweet or mixed grassland. **Mixed grassland** is a combination or a transition between the two grassland types above. In the study area itself, short, dense sour grassland is most prevalent, with the dominant grassland types in the

study area being Rand Highveld Grassland and Eastern Highveld Grassland (Mucina & Rutherford 2006).

Woodland is defined as having a grassy understorey and a distinct woody upperstorey of trees and tall shrubs. Moist woodland comprises predominantly broadleaved, winter deciduous trees interspersed with grass cover which is determined in extent by fire and grazing (Harrison *et al.* 1997). None of the alternatives are situated in woodland. Woodland habitat does not occur on the site alternatives and was therefore not regarded as relevant for this study.

2.2 Bird micro-habitats

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the broad vegetation type above, i.e. sour grassland, it is as important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors, such as vegetation type, topography, land use and manmade infrastructure. The land use in the study area is a variety of mixed farming practices. Livestock grazing is practised in parallel with crop farming.

The most important bird micro-habitats other than natural sour grassland that were identified during the field visit are the following (see Appendix 2 for a photographic record of recorded habitat):

- Agriculture - dryland cultivation: The habitat in the study area has been transformed through dryland cultivation, mostly maize but also other crops. The region has summer rainfall and therefore intensive crop farming is practiced on a wide scale.
- Dense stands of trees: Small stands of both exotic and indigenous trees are present scattered across all the site alternatives.
- Wetlands, dams and rivers: The five site alternatives for the proposed ADF all contain some form of wetland habitat. Small intermittent streams and ephemeral drainage lines with associated moist grassland habitat are present. Farm dams have been established along some of these drainage lines. An ephemeral pan exists on one of the site alternatives. The Wilge River passes through the area in close proximity to some of the site alternatives.

3 ENVISAGED IMPACTS

3.1 Reduction in species diversity and abundance due to habitat transformation and fragmentation.

It is envisaged that the construction of the proposed ADF will result in the radical transformation of an area of approximately 1500ha. The transformation will effectively displace the majority of avifauna currently utilizing the proposed development area, and, depending on where the development takes place, will result in the fragmentation of natural grassland and wetland habitat. The effect of this will be an overall reduction of species diversity and abundance in the study area.

4 AVIFAUNA IN THE STUDY AREA

The Blue Crane *Anthropoides paradiseus* which is one of the priority avifauna species listed in the Mpumalanga Biobase Report (Emery *et al*. 2002) was recorded during the on-site surveys. Five Red Data bird species (Blue Crane *Anthropoides paradiseus*, Lesser Kestrel *Falco naumanni*, Lesser Flamingo *Phoenicopterus minor*, Secretarybird *Sagittarius serpentarius* and Greater Flamingo *Phoenicopterus roseus*) which have been prioritized by the Gauteng Department of Agriculture, Conservation and Environment (GDACE) were recorded during the field surveys conducted in the area. The occurrence of other species included on these provincial priority lists cannot be ruled out (see Table 4.2 for a list of priority species that could potentially occur in the study area).

As indicated above the following avian habitat types were identified within the study area

4.1 Grassland

The CAR data indicates that natural grassland remains the preferred habitat of large terrestrial birds in the eastern Gauteng and Mpumalanga Highveld (Young *et al*. 2003). The presence of typical grassland Red Data bird species in the SABAP2 dataset for 2528DD (Blue Crane*,* White-bellied Korhaan *Eupodotis senegalensis*, Blue Korhaan *Eupodotis caerulescens*, Melodius Lark *Mirafra cheniana*, Secretarybird*,* Denham's Bustard *Neotis denhami* and Southern Bald Ibis *Geronticus calvus*) indicates that enough natural, un-fragmented grassland still exists in the QDGC to support these species. There is however quite significant habitat fragmentation (especially of grasslands) evident in the study area - largely due to cultivation. Several of the aforementioned species were recorded during on-site surveys, and the data collected during the surveys clearly indicated that grassland supported a higher variety of species than agricultural lands (see Tables 6.1 and 6.2 below).

4.2 Dryland cultivation (agriculture)

Data from the CAR project indicates that agricultural land in the eastern Gauteng and Mpumalanga Highveld is used to a limited extent by large terrestrial birds, but that they prefer natural grassland habitat. Although their preference is for grassland, fallow fields are used to a limited extent by Blue Cranes in summer whilst they might use recently ploughed fields in winter (Young *et al.* 2003). Other grassland Red Data species that may make limited use of the agricultural areas are the Blue Korhaan, Southern Bald Ibis, Lesser Kestrel and Black-winged Pratincole *Glareola nordmanni*. A pair of Blue Cranes was however recorded in cultivated fields during on site surveys. Lesser Kestrels were also recorded foraging over agricultural fields during the surveys albeit in lower numbers than over natural grasslands. Overall, the cultivated areas in the study area have significantly fewer species than the remaining grassland (see Tables 5.1 and 5.2 below).

4.3 Wetlands and dams

As indicated earlier each of the site alternatives contains some form of wetland habitat. Alternative B contains the least amount of wetland on site but there are nearby wetland habitats in catchments both upstream and downstream. Small intermittent streams and drainage lines with associated moist grassland habitat are present on all other site alternatives and these habitats could support African Grass-Owl *Tyto capensis*, African Marsh-Harrier *Circus ranivorus* and Blue Crane, all of which are wetland associated Red Data priority species. An ephemeral pan occurs on site alternative F which, during the on-site surveys, supported both Greater and Lesser Flamingos as well as numerous other waterbirds.

4.4 Dense stands of trees

Stands of trees both indigenous and exotic occur scattered across all the site alternatives. Although the trees support some passerine bird species not recorded in the other habitat types this habitat on its own does not support any of the Red Data priority species (see Table 4.2 below). Lesser Kestrels that hunt over the grassland and agricultural lands could use some of these stands of trees as roosting sites.

The surface area of each of the above habitat types was calculated within each alternative (see Table 4.1) using Satellite imagery supplemented by ground truthing done during the field surveys (see Figure 4.1). Table 4.1 quantifies the habitat types at the different site alternatives.

Table 4.1: Quantification of avifaunal habitat types per site alternative.

Site alternatives	Agriculture	Grassland	Trees	Wetland
A	51.7%	36.4%	0.5%	11.3%
A_{small}&F	52.4%	42.1%	0.8%	4.7%
A_{small}&G	57.6%	34.8%	2.5%	5.0%
B	89.5%	5.2%	5.1%	0.2%
C	1.0%	91.5%	4.6%	2.9%
F&G	52.7%	42.7%	2.8%	1.7%
Grand Total	50.3%	43.1%	2.7%	3.9%

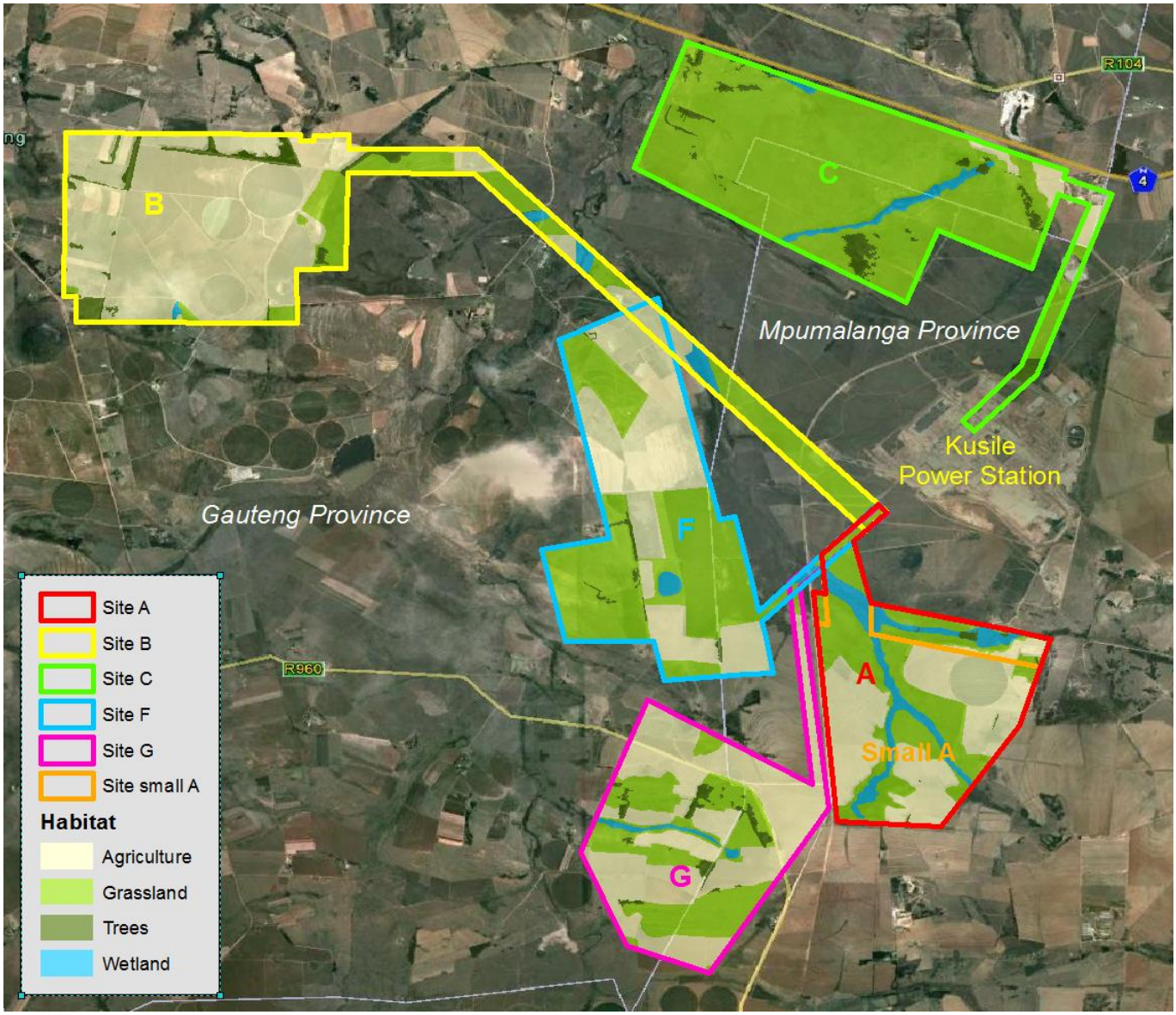

Figure 4.1: Bird habitat types within the various site alternatives in the study area.

Table 4.2 below lists Red Data species that could potentially occur in the study area.

Table 4.2: Threatened species (17) potentially occurring at the site alternatives, based observations during the surveys, existing SABAP data and the existence of suitable habitat.

Red Data Species	Conservation Status	Mpumalanga Priority	Gauteng Priority	SABAP1 Reporting rate	SABAP2 Reporting rate	Recorded during surveys	Habitat preference				Likelihood of occurrence
							Agriculture	Grassland	Trees	Wetland	
Lesser Kestrel *Falco naumanni*	VU		x	10.6	13.3	Yes					High. Summer migrant - recorded in high numbers over natural grasslands during surveys – particularly at site alternative C.
Peregrine Falcon *Falco peregrinus*	NT	x			4.1						Medium. Could be recorded hunting over most of the habitat types. But would roost at suitable high buildings e.g. Kusile.
Melodious Lark *Mirafra cheniana*	NT			2.1	3.1	Yes					High. Recorded frequently in natural grassland – especially at site C. Display flights suggested that breeding was taking place.
Southern Bald Ibis *Geronticus calvus*	VU	x			3.1						Medium. Could be encountered in grassland areas and freshly ploughed lands.
African Grass-Owl *Tyto capensis*	VU	x	x		2						High. Could be encountered in stands of grassland taller than 75cm on any of the site alternatives.
Half-collared Kingfisher *Alcedo semitorquata*	NT		x		2						Low. Prefers fast flowing streams with overhanging trees. Unlikely to occur on any of the site alternatives but likely to occur along the nearby Wilge River.
Black-winged Pratincole *Glareola nordmanni*	NT			2.1	2						Medium. Could be encountered in agricultural areas or seasonally wet grasslands.
Greater Flamingo *Phoenicopterus roseus*	NT		x		2	Yes					High. Recorded during surveys on the ephemeral pan on site F and a pan and wetland area adjacent to site B. Presence linked to suitable water levels in the pans.

Secretarybird *Sagittarius serpentarius*	VU		x	4.3	1	Yes					High. Recorded during surveys on site C. Could be encountered in any of the grassland areas. Fragmentation would reduce the suitability of grassland habitats.
Denham's Bustard *Neotis denhami*	VU	x			1						Low. Could be encountered in any of the grassland areas. Grassland fragmentation would reduce the chances of occurrence.
Caspian Tern *Hydroprogne caspia*	NT				1						Low. Could be encountered on any of the pans or dams but prefers larger water bodies.
White-bellied Korhaan *Eupodotis senegalensis*	VU	x	x	4.3	1						Medium. Could be encountered in any of the grassland areas. Grassland fragmentation would reduce the chances of occurrence.
Lesser Flamingo *Phoenicopterus minor*	NT		x			Yes					High. Recorded during surveys on the ephemeral pan on site F and a pan and wetland area adjacent to site B. Presence linked to suitable water levels in the pans.
Corn Crake *Crex crex*	VU					Yes					High. Summer migrant – recorded in grassland habitat on site C during familiarisation site visit prior to surveys. Could be encountered in any of the grassland areas.
African Marsh-Harrier *Circus ranivorus*	VU	x	x	4.3							Medium. Could be encountered in any of the moist grassland areas on the site alternatives.
Blue Crane *Anthropoides paradiseus*	VU	x	x	6.4		Yes					High. Recorded during surveys in grassland and agricultural lands between site alternatives A, G and F. Could occur in any of the grassland or open agricultural areas.
Blue Korhaan *Eupodotis caerulescens*	NT	x		2.1							Low. Could be encountered in any of the grassland areas. Grassland fragmentation would reduce the chances of occurrence.

5 IDENTIFYING A PREFERRED ALTERNATIVE

One of the objectives of this study is to arrive at a preferred alternative for the proposed ash disposal facility in terms of impacts on avifauna. In order to make an informed decision, the results of the on-site surveys were used as an indication of sensitivity. Birds were counted on all site alternatives by driving slowly along a predetermined fixed transect route and stopping regularly to scan the surroundings for birds. The number of birds and habitat type for all species seen or heard were recorded.

A total of 93 species were recorded during the surveys (see Appendix 3) of which 6 were Red Data species, an additional Red Data species the Corn Crake was recorded during the initial site familiarisation visit.

The number of species recorded in each habitat type was calculated from the transect survey data (see table 5.1). A species richness index per habitat type was calculated for the entire study area by dividing the number of species recorded in each habitat type by the fraction of that habitat type in the study area (see Table 5.1).

Table 5.1: All species diversity per habitat type for all site alternatives combined.

Habitat	Species	Habitat fraction of total area	Habitat species richness index
Grassland	64	0.43	148.8
Wetland	46	0.04	1150
Agriculture	40	0.50	80
Tree stands	25	0.03	833.3

Species habitat preference for Red Data species was derived from the survey data combined with published habitat preference information for the Red Data species likely to occur in the study area (see Table 4.2 and Table 5.2).

Table 5.2: Red Data species diversity per habitat type for all site alternatives combined.

Habitat	Number of Red Data species that could potentially occur in habitat type	% distribution (habitat significance factor)
Agriculture	5	19%
Grassland	13	48%
Trees	2	7%
Wetland	7	26%

5.1 Site alternative ranking

A species richness index for each respective site alternative was then calculated as the sum of the per habitat species richness indexes (calculated as the overall habitat type species richness (Table 5.1) multiplied by the percentage of that habitat in the alternative (Table 4.1) multiplied by the habitat significance factor (Table 5.2)). The habitat significance factor was calculated as the percentage distribution of likely habitat use by Red Data species (see Table 4.2).

The combined species richness indexes at each site alternative for all species and Red Data species was then used to rank the sites in terms of importance (see Table 5.3 – 5.5).

Table 5.3: Site alternative ranking based on an all species richness index per habitat in each site alternative.

Site alternatives	Agriculture	Grassland	Trees	Wetland	Total	Rank
Site B	12.1	5.5	4.5	0.8	23.0	1
Site F&G	7.5	31.7	1.6	5.3	46.1	2
Site A&G	9.0	22.1	1.6	15.2	47.8	3
Site A&F	7.4	32.3	0.6	12.2	52.4	4
Site A	8.4	23.5	0.4	28.9	61.2	5
Site C	0.3	67.0	3.4	11.6	82.4	6

Table 5.4: Site alternative ranking based on a Red Data species richness index per habitat in each site alternative.

Site alternatives	Agriculture	Grassland	Trees	Wetland	Total	Rank
Site B	1.6	0.8	0.3	0.1	2.8	1
Site F&G	1.0	6.2	0.2	0.8	8.1	2
Site A&G	1.1	5.1	0.1	2.3	8.6	3
Site A&F	1.0	6.1	0.0	2.2	9.3	4
Site A	1.0	5.3	0.0	5.3	11.5	5
Site C	0.0	13.3	0.2	1.4	14.9	6

The above analysis also indicates that grassland and wetland are the most sensitive habitat types, as it supports a larger variety of bird species.

Table 5.5: Comparative site alternative ranking based on an all species richness index and a Red Data species richness index.

Site alternatives	All species richness index	All species Rank	RD species richness index	Red data species Rank
Site B	23.0	1	2.8	1
Site F&G	46.1	3	8.1	2
Site A&G	47.8	2	8.6	3
Site A&F	52.4	4	9.3	4
Site A	61.2	5	11.5	5
Site C	82.4	6	14.9	6

Based on the above (see Table 5.5) site alternative B has the lowest ranking both from an "all species" as well as a "Red Data species" richness perspective. Site B is thus the most preferred alternative for the ash disposal facility purely from an avifaunal impact perspective.

Due to the more expansive natural grassland habitat present on site C it emerged as the most sensitive and the least preferred for development.

Sensitive bird habitats with the respective site alternatives were mapped and ranked as high and medium (see Figure 5.1) taking into consideration bird habitat preference and existing habitat fragmentation. Note that from an avifaunal impact perspective that site alternative B contains no sensitive bird habitats.

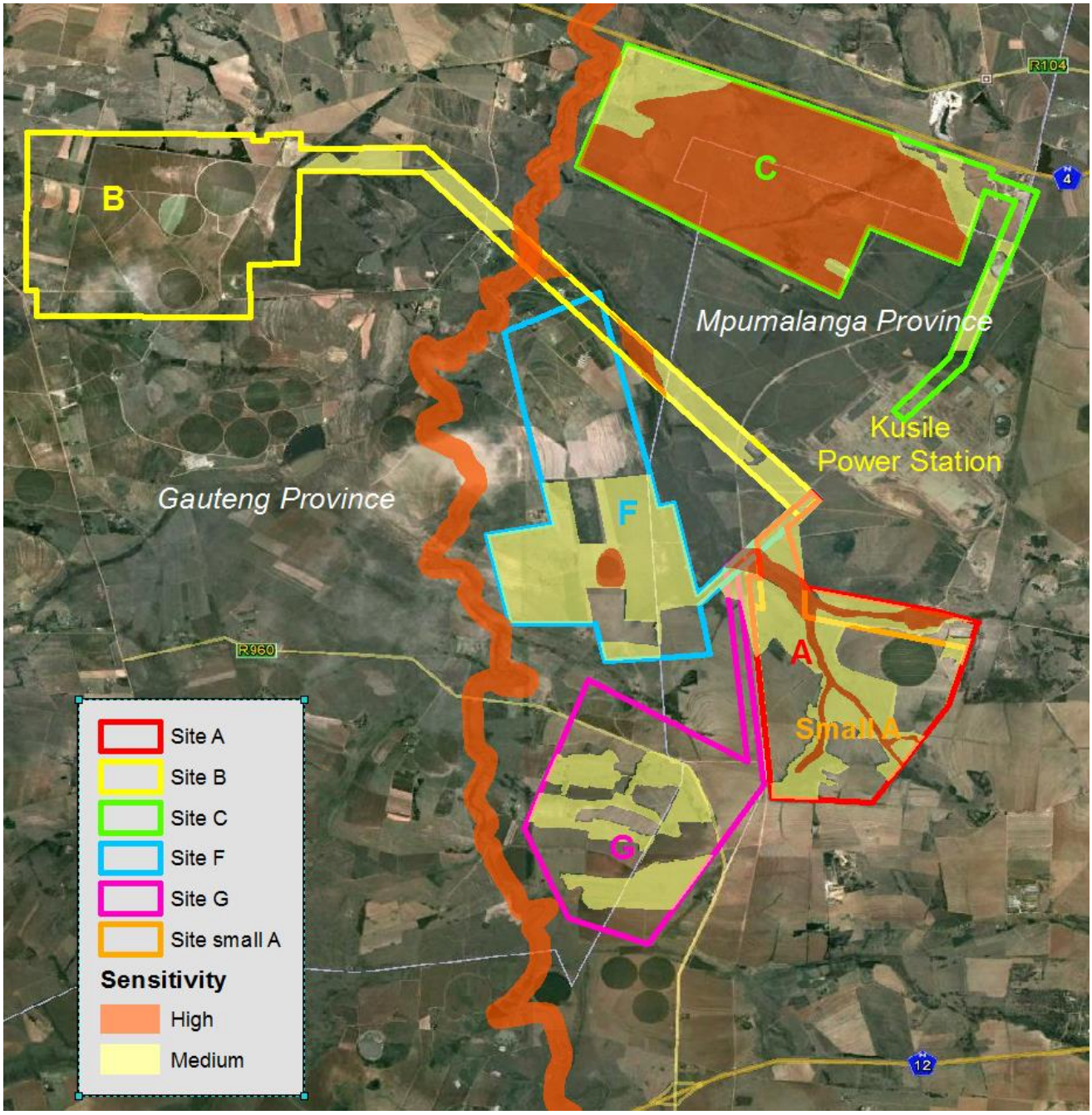

Figure 5.1: Sensitivity map.

5.2 Conveyor corridors to site alternatives

The ash from the Kusile power station would be transferred via an overland conveyor belt system to the selected site alternative.

The conveyor belt system itself has a narrow footprint and as a result its direct impact on avifauna will be very limited. It is however acknowledged the conveyor system would need to cross sensitive wetland habitat and the Wilge River in order to reach the recommended site. The construction and operation of the conveyor through and over these sensitive areas would create some additional disturbance. Spillages and other pollution which may occur along the conveyor corridor could have potential negative impacts on the sensitive wetland habitat in its immediate vicinity and further downstream. Such impacts, if they occur, could also ultimately negatively affect the avifauna in the area.

6 CUMULATIVE IMPACTS AND THEIR POTENTIAL INFLUENCE ON THE RANKING OF THE ALTERNATIVES.

The proposed development is situated in the grassland biome. The grassland biome in the eastern parts of Gauteng and Mpumalanga is under severe threat from many sources, including crop cultivation, industrialisation, afforestation and urbanisation (see for example Alan 1997). The birds least likely to show the effects of these transformations are the small species which are able to persist in tiny fragments of undisturbed habitat. Conversely, the species most likely to show disrupted patterns of distribution are the bigger species with large home ranges. This is particularly evident in the disastrous decline of cranes in the Mpumalanga Highveld where numbers have crashed by more than 80% in the past four decades (Barnes 2000).

Site alternatives C, A, F and G all contain some wetland and grassland avifaunal habitats. Site F and small A contain an interesting ephemeral pan which supported both Lesser and Greater Flamingos during the surveys. These site alternatives are all located along the Wilge River (see Figure 4.1). This would increase their importance rating. A pair of Blue Cranes was also recorded at site F on two occasions during the field surveys.

Sections of site alternatives C, F and G are located along the Wilge River (see Figure 5.1) this could significantly increase potential downstream impacts on wetlands and other biodiversity including avifauna in the event of spillages and pollution from the ash damps. At a regional level the Wilge River system is an important avifaunal habitat and feature in the landscape for Red Data species recorded in the study area.

Site alternative C remains as the most sensitive and least preferred for development as a result of the expansive grassland habitat and the proximity of the Wilge River immediately to the west.

From a strictly avifaunal perspective site alternative B remains as the preferred alternative as the cumulative impact of losing another 1300 hectares of grassland bird habitat in the eastern Gauteng / Mpumalanga Highveld should be regarded as a **moderate to high** impact within the overall context of existing pressure on natural grassland habitat in the area. If, however, the development is located on existing agricultural lands, the cumulative impact would be **lower**, as the agricultural operations have already transformed the natural habitat completely.

Avifaunal species associated with wetlands occur throughout the area in suitable habitat and are not known to have a preference for a specific river or wetland catchment area. It is however worthy to note that the proposed development footprint of site alternative B would extend over three catchments compared to site alternative A (which only extends over one catchment). The unmitigated impact from the ash disposal facility if it is located at site alternative B could therefore have more far reaching effects on the environment and consequently also negative influence the avifaunal population over a wider area.

Kusile power station currently has an environmental authorisation for an on-site ash disposal facility just to the north-east of site alternative A (See Figure 6.1). Potential pollution and disturbance (if not properly mitigated) from this facility could negatively impact the surrounding habitat and therefore also affect avifaunal populations.

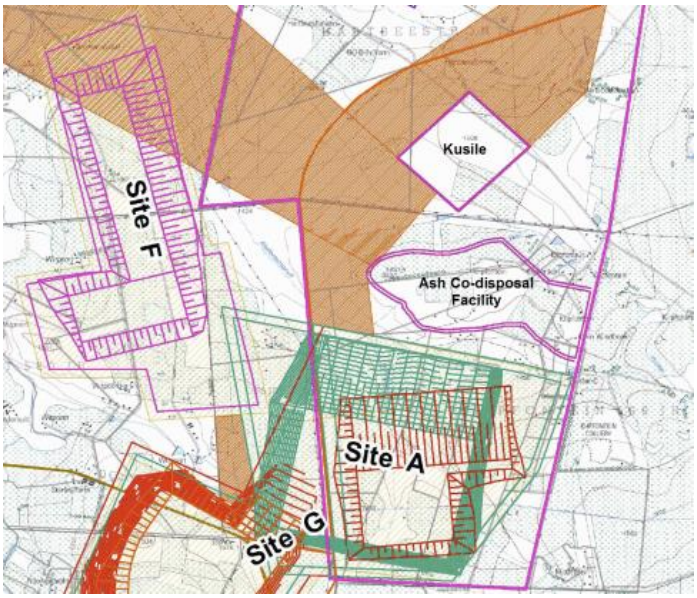

Figure 6.1: Co-Disposal facility located just north of site alternative A.

Site alternative A contain avifaunal habitat in the form of wetland and grassland down its centre and along the northern boundary (see Figure 4.1). These wetland areas are dependent on drainage lines originating further to the north, east and south. The planned New Largo coal mine would (if and when it goes ahead) be located to the east of site alternative A.

The Kusile Power Station and its associated on site ash disposal facility (see above Figure 6.1) coupled with the impacts of the envisaged New Largo coal mine could place severe pressure on the wetlands and associated grasslands on site A. If not adequately mitigated or in the event of mitigation measures failing this combined potential impact could negatively affect the avifaunal habitats at site alternative A.

The developments and their potential impacts described above would reduce the importance ranking of site alternative A compared to F and G which are located alongside the Wilge River (this in turn increases their importance rating).

A revised site alternative ranking taking the above cumulative impacts into consideration is presented in Table 6.1 below.

Table 6.1 Site Alternative ranking – revised based on cumulative impacts.

Site Alternative	**Rank taking cumulative impacts into consideration.**
Site B	1
Site A	2
Site A&G	3
Site A&F	4
Site F&G	5
Site C	6

When viewed holistically and taking the influence of the potential cumulative factors as outlined above into consideration combined with the findings of the other specialist studies (e.g. wetlands) site alternative A could also be considered as a viable alternative from an avifaunal perspective.

7. ENVIRONMENTAL IMPACT STATEMENT

7.1 Impact Assessment Methodology

Approach to Assessing Impacts:

- Impacts are assessed separately for the **construction**, **operational**, **closure**, and post-closure phases of the project;
- Impacts are described according to the ***Status Quo***, ***Project Impact***, ***Cumulative Impact***, ***Mitigation Measures*** and ***Residual Impact*** as follows:
  - The Status Quo assesses the existing impact on the receiving environment. The existing impact may be from a similar activity, e.g. an existing ADF, or other activities e.g. mining or agriculture.
  - The project impact assesses the potential impact of the proposed development on an environmental element;
  - The cumulative impact on an environmental element is the description of the project impact combined with the initial status quo impacts that occur;
  - Mitigation measures that could reduce the impact risk are then prescribed; and
  - The residual impact describes the cumulative impact after the implementation of mitigation measures.
- Impacts are rated against a predetermined set of criteria including (magnitude, duration, spatial scale, probability, and direction of impact);
- A rating matrix is provided for each environmental element per project phase summarising all the aforementioned in a single table.

More detailed description of each of the assessment criteria and any abbreviations used in the rating matrix is given in the following sections.

Magnitude / Significance Assessment:

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 7.1 below.

Table 7.1: Description of the significance rating scale.

Rating			Description
Score	**Code**	**Category**	
7	SEV	SEVERE	Impact most substantive, no mitigation

			possible
6	VHIGH	VERY HIGH	Impact substantive, mitigation difficult/expensive
5	HIGH	HIGH	Impact substantive, mitigation possible and easier to implement
4	MODH	MODERATE-HIGH	Impact real, mitigation difficult/expensive
3	MODL	MODERATE-LOW	Impact real, mitigation easy, cost-effective and/or quick to implement
2	LOW	LOW	Impact negligible, with mitigation
1	VLOW	VERY LOW	Impact negligible, no mitigation required
0	NO	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

Spatial Scale

The spatial scale refers to the extent of the impact e.g. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 7.2.

Table 7.2: Description of the spatial rating scale.

Rating			Description
Score	**Code**	**Category**	
7	NAT	*National*	The maximum extent of any impact.
6	PRO	*Provincial*	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a provincial scale
5	DIS	*District*	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a district scale
4	LOC	*Local*	The impact will affect an area up to 5 km from the proposed route corridor.
3	ADJ	*Adjacent*	The impact will affect the development footprint and 500 m buffer around development footprint
2	DEV	*Development footprint*	Impact occurring within the development footprint
1	ISO	*Isolated Sites*	The impact will affect an area no bigger than the servitude.

Duration / Temporal Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 7.3.

Table 7.3: Description of the temporal rating scale.

Rating			Description
Score	**Code**	**Category**	
5	PERM	Permanent	The environmental impact will be permanent.
4	LONG	Long term	The environmental impact identified will operate beyond the life of operation.
3	MED	Medium term	The environmental impact identified will operate for the duration of life of the line.
2	SHORT	Short-term	The environmental impact identified will operate for the duration of

			the construction phase or a period of less than 5 years, whichever is the greater.
1	INCID	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.

Degree of Probability

The probability or likelihood of an impact occurring will be described as shown in Table 7.4 below.

Table 7.4: Description of the degree of probability of an impact accruing

Score	Code	Category
5	OCCUR	*It's going to happen / has occurred*
4	VLIKE	*Very Likely*
3	LIKE	*Could happen*
2	UNLIKE	*Unlikely*
1	IMPOS	*Practically impossible*

Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 7.5 below. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 7.5: Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

Impact Risk Calculation

To allow for impacts to be described in a quantitative manner in addition to the qualitative description, a rating scale of between 1 and 5 (7 in the case of significance and spatial rating scales) was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$Impact\ Risk = \frac{\text{Significance} + \text{Spatial} + \text{Temporal}}{2.714} \times \frac{\text{Probability}}{5}$$

An example of how this rating scale is applied is shown below in Table 7.6:

Table 7.6: Example of rating scale

Impact	Magnitude	Spatial scale	Temporal scale	Probability	Rating
Greenhouse gas emissions	2	*3*	3	3	1.8
	LOW	*Local*	Medium Term	*Could Happen*	**LOW**

***Note**: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 2.714 to give a criteria rating of 2,95. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,95 is then multiplied by the probability rating (0,6) to give the final rating of 1,8, which is rounded to the first decimal.*

The impact risk is classified according to 5 classes as described in Table 7.7 below.

Table 7.7: Impact Risk Classes

Rating	Impact class	Description
6.1 - 7.0	**7**	**SEVERE**
5.1 - 6.0	**6**	**VERY HIGH**
4.1 - 5.0	**5**	**HIGH**
3.1 - 4.0	**4**	**MODERATE-HIGH**
2.1 - 3.0	**3**	**MODERATE-LOW**
1.1 - 2.0	**2**	**LOW**
0.1 - 1.0	**1**	**VERY LOW**

Therefore with reference to the example used for greenhouse gas emissions above, an impact rating of 1.8 will fall in the Impact Class 2, which will be considered to be a Low impact.

Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

- Significance or magnitude- IN CAPITALS
- Spatial Scale – *in italics*
- Duration – in underline
- Probability – *in italics and underlined.*
- Degree of certainty - **in bold**

7.2 Impact on Avifauna

Status Quo

The current land use at site alternative B can largely be classified as agriculture, therefore the existing impact is as a result of agricultural practises which have transformed almost all the avifaunal habitat on the site.

In addition to the natural grassland and a wetland habitat on site alternative A the current land use is characterised by agriculture, therefore the existing on-site impact relates to agricultural practices. An ash disposal facility for the Kusile Power Station has been approved on the northern boundary of site A. The proposed New Largo coal mine will be located immediately to the east of site A. Both

these activities, combined with the existing agriculture, will in all probability have a negative impact on site A as they are *located 'upstream' in the catchments which feed into the wetland habitat on site A.*

Project Impact (Unmitigated)

During the construction, operational and closure phase of the ash disposal facility the habitat on the site will be transformed and fragmented which will result in a reduced species diversity and abundance of birds. These impacts will occur as a result of disturbance, vegetation clearing and excavation.

The combined weighted impact on avifauna will **definitely** be of a HIGH negative significance affecting the *local area*. The impact will be permanent and is going to happen. The impact risk class during construction is thus **Very High**.

Cumulative Impact

The existing and anticipated future impacts as outlined in the above status quo section combined with the impacts as a result of construction, operation and closure of the 60year ash disposal facility will definitely have a VERY HIGH cumulative impact. This impact will affect the bird population in the local area. The impact *is going to happen* and will be permanent. The impact risk class is thus **Very High**.

Mitigation Measures

- Utilise site alternative B since the current land use on the site is largely agriculture and establishing the ash disposal facility there will have the least direct impact from an avifaunal perspective, or;
- Site A could also be considered as a possibility because it is located close the Kusile Power Station (and does not require conveyor routes crossing the sensitive Wilge river system). Site A will in all likelihood be heavily impacted upon as a result of adjacent coal mining and another ash disposal facility (see 6 above), and;
- Establish off-sets i.e. conserve and improve suitable alternative grassland and wetland habitat in the region in order to improve and provide additional suitable habitat for impacted avifaunal species. Off-set mitigation should be concentrated in one specific area e.g. on site C or a suitable alternate locality, and;
- Contribute towards existing grassland and wetland conservation initiatives already active in the region.
- Irrespective of whether site alternative A or B is used, the proposed recommendations of the Terrestrial Ecology and Wetland Specialist Study for the Environmental Management Programme should be strictly applied to minimise the impact on the natural environment, specifically on the remaining wetlands and natural grasslands, as this is the most important bird habitat types in the study area.
- Maximum use should be made of existing infrastructure (e.g. access roads) to minimise the further fragmentation of natural grassland and wetland areas.

Residual Impact

The impact to the habitat (grasslands and wetlands) on the site itself will be permanent as pre-development land capability will not be restored, the best that can be hoped to achieve is a post

closure land capability that will be some form of restored grassland. In this regard there will be a loss of avifaunal habitat on the site itself. With mitigation measures:

- Suitable habitat will be put aside and conserved elsewhere in the region to support the red data bird species of concern.

The residual impact to avifauna beyond the closure phase of the project will be reduced through mitigation measures but not to within baseline conditions. After mitigation the impacts to avifauna will **definitely** be of a HIGH negative significance, affecting the *study area* in extent. The impact *is going to happen* and will be permanent. The impact risk class is thus **High**.

Impact Matrices

The impacts identified and discussed above have been rated according to the impact assessment methodology described in section 7.1 above. These ratings are provided in the matrix presented in Table 7.8 below.

Table 7.8: Impact matrices for site alternative B & A during construction, operation, closure and post closure phases of the project.

		Site B						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	3 MODL	4 LOC	5 PERM	5 OCCUR	**-4.4** **HIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	5 PERM	5 OCCUR	**-4.8** **HIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3 MODL	4 LOC	4 LONG	5 OCCUR	**-4.1** **HIGH**

		Site A						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	4 LOC	5 PERM	5 OCCUR	**-5.5** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	5 OCCUR	**-4.8** **HIGH**

		Site B						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	OPERATION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	4 MODH	4 LOC	5 PERM	5 OCCUR	**-4.8** **HIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	5 OCCUR	**-4.4** **HIGH**

		Site A						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	OPERATION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	4 LOC	5 PERM	5 OCCUR	**-5.5** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	5 OCCUR	**-4.8** **HIGH**

		Site B						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	4 MODH	4 LOC	5 PERM	5 OCCUR	**-4.8** **HIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	4 LONG	5 OCCUR	**-4.4** **HIGH**

		Site A						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	4 LOC	5 PERM	5 OCCUR	**-5.5** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	5 HIGH	4 LOC	4 LONG	5 OCCUR	**-4.8** **HIGH**

		Site B						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	POST CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	3 MODL	4 LOC	5 PERM	5 OCCUR	**-4.4** **HIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	4 MODH	4 LOC	5 PERM	5 OCCUR	**-4.8** **HIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	3 MODL	2 DEV	4 LONG	5 OCCUR	**-3.3** **MODH**

		Site A						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	POST CLOSURE							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	6 VHIGH	4 LOC	4 LONG	4 VLIKE	**-4.1** **HIGH**
Project Impact 1	Reduction in species diversity and abundance due to habitat transformation and fragmentation.	Negative	**Probable**	5 HIGH	4 LOC	5 PERM	5 OCCUR	**-5.2** **VHIGH**
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	Negative	**Probable**	6 VHIGH	4 LOC	5 PERM	5 OCCUR	**-5.5** **VHIGH**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	Negative	**Probable**	5 HIGH	2 DEV	4 LONG	5 OCCUR	**-4.1** **HIGH**

8 RECOMMENDED MITIGATION

- If site alternative A is preferred the potential for off-setting the loss of natural grassland and wetland by conserving an equivalent quantity and quality of grassland bird habitat elsewhere on the eastern Gauteng or Mpumalanga Highveld should be considered. Provincial borders does not influence bird distribution or their habitat preference and as such a suitable area should be selected based on protecting largely similar habitat types. The relevant provincial and national environmental departments should be consulted and engaged in selecting an appropriate area. Alternatively, a financial contribution towards a legitimate conservation initiative for threatened grassland avifauna could also be considered as an off-set e.g. a contribution to Birdlife South Africa.
- Irrespective of whether site alternative A or B is used, the proposed recommendations of the Terrestrial Ecology and Wetlands Specialist Study for the Environmental Management Programme should be strictly applied to minimise the impact on the natural environment, specifically on the remaining wetlands and natural grasslands, as this is the most important bird habitat types in the study area.
- Maximum use should be made of existing infrastructure (e.g. access roads) to minimise the further fragmentation of natural grassland and wetland areas.

9 ENVIRONMENTAL MANAGEMENT PLANNING

Impacts identified during the EIR phase must be mitigated through implementable actions in the Environmental Management Programme.

In addition to the recommendations below, specific to avifauna, it is essential that the actions recommended by the Terrestrial Ecology and Wetlands Specialist Study for the Environmental Management Programme be strictly applied. This will minimise the impact on the natural environment, specifically on the remaining wetlands and natural grasslands, as this is the most important bird habitat types in the study area.

Table 9.1: Avifaunal Environmental Management programme

Management / Environmental Component:	**EMPr Reference Code:**		
Avifauna	EMPr-Avifauna		
Primary Objective:			
Minimise the negative impacts due to habitat loss and fragmentation on avifauna.			
Implementation:	**Responsibility:**	**Resources:**	**Monitoring/Reporting:**

1) Identify, procure and set aside for conservation purposes an equivalent (or larger) area of grassland and wetland in the district taking overall biodiversity functioning into consideration.	ESKOM - Environmental / Biodiversity Manager	Acquisition of suitable land as an offset - Financial	Bi-annual
2) Contributing financially towards a legitimate conservation initiative for threatened grassland avifauna could also be considered as an off-set e.g. a contribution to Birdlife South Africa.	ESKOM - Environmental Manager	Financial	

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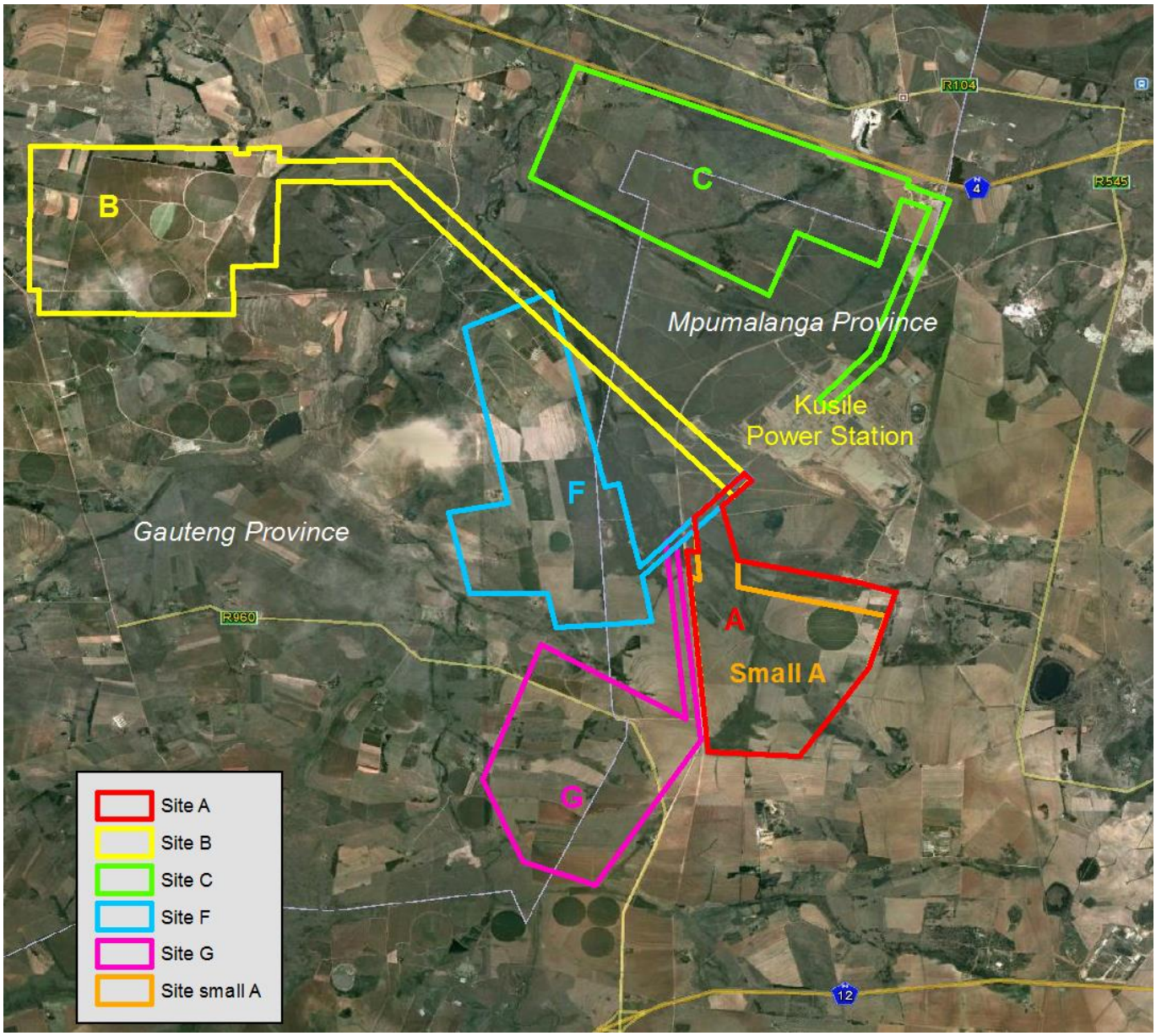
APPENDIX 1: MAP OF STUDY AREA



APPENDIX 2 - BIRD HABITAT

Figure 1: Natural grasslands with drainage line (site A) 25°57'23.31"S; 28°54'29.322"E

Figure 2: Farm dam, wetlands and stands of trees (site A) 25°57'1.944"S; 28°55'16.494"E

Figure 3: Cultivated fields (site A, G, ~~F2~~small A) 25°57'30.288"S;~~-~~ 28°55'26.286"E

Figure 4: Wetland and grassland habitat (site A, G, ~~F2~~small A) 25°58'0.174"S;- 28°55'0.768"E

Figure 5: Cultivated lands (Site B) 25°53'1.26"S;— 28°48'56.166"E

Figure 6: Cultivated fields (site B)- 25°52'56.442"S;- 28°47'21.18"E

Figure 7: Grassland and wetlands (Site C) 25°52'53.286"S; 28°55'0.132"E

Figure 8: Natural grasslands (Site C) 25°52'56.112"S; 28°54'28.158"E

Figure 9: Natural grassland (site F) 25°57'9.408"S; 28°52'33.036"E

Figure 10: Ephemeral pan (Site F) 25°56'26.33"S; 28°52'32.08"E

Figure 11: Grassland and trees on a rocky area (site G) 25°58'11.19"S; 28°52'52.992"E

Figure 12: Disturbed grassland (site G) 25°59'6.336"S; 28°52'10.41"E

APPENDIX 3 AVIFAUNAL SURVEY DATA

Species composition	
All Species	93
Red Data species	6
Other species	87

Number of replications 3

Red Data species	*Scientific name*	S1	S2	S3	Total	Mean	StDev	StErr
Blue Crane	*Anthropoides paradiseus*	3	2	0	5	1.67	1.53	0.88
Greater Flamingo	*Phoenicopterus ruber*	1	42	29	72	24.00	20.95	12.10
Lesser Flamingo	*Phoenicopterus minor*	0	38	0	38	12.67	21.94	12.67
Lesser Kestrel	*Falco naumanni*	36	35	44	115	38.33	4.93	2.85
Melodious Lark	*Mirafra cheniana*	0	1	8	9	3.00	4.36	2.52
Secretarybird	*Sagittarius serpentarius*	0	1	0	1	0.33	0.58	0.33
	Grand Total:	89	117	83	1482	96.33	18.15	10.48
Non threatened species	*Scientific name*	S1	S2	S3	Total	Mean	StDev	StErr
African Darter	*Anhinga rufa*	2	1	1	4	1.33	0.58	0.33
African Pipit	*Anthus cinnamomeus*	32	26	26	84	28.00	3.46	2.00
African Quailfinch	*Ortygospiza atricollis*	11	13	29	53	17.67	9.87	5.70
African Snipe	*Gallinago nigripennis*	1	0	0	1	0.33	0.58	0.33
African Stonechat	*Saxicola torquatus*	12	6	8	26	8.67	3.06	1.76
African Wattled Lapwing	*Vanellus senegallus*	3	5	0	8	2.67	2.52	1.45
Amur Falcon	*Falco amurensis*	22	89	2	113	37.67	45.57	26.31
Ant-eating Chat	*Myrmecocichla formicivora*	15	21	14	50	16.67	3.79	2.19
Banded Martin	*Riparia cincta*	18	4	15	37	12.33	7.37	4.26
Barn Swallow	*Hirundo rustica*	292	502	921	1715	571.67	320.23	184.89
Bar-throated Apalis	*Apalis thoracica*	1	0	0	1	0.33	0.58	0.33
Black-chested Prinia	*Prinia flavicans*	10	2	6	18	6.00	4.00	2.31
Black-headed Heron	*Ardea melanocephala*	0	1	1	2	0.67	0.58	0.33
Black-shouldered Kite	*Elanus caeruleus*	3	2	0	5	1.67	1.53	0.88
Blacksmith Lapwing	*Vanellus armatus*	21	27	45	93	31.00	12.49	7.21
Black-throated Canary	*Crithagra atrogularis*	2	7	5	14	4.67	2.52	1.45
Bokmakierie	*Telophorus zeylonus*	1	0	0	1	0.33	0.58	0.33
Brown-throated Martin	*Riparia paludicola*	0	0	50	50	16.67	28.87	16.67
Burchell's Coucal	*Centropus burchellii*	1	0	1	2	0.67	0.58	0.33
Cape Crow	*Corvus capensis*	1	0	0	1	0.33	0.58	0.33
Cape Glossy Starling	*Lamprotornis nitens*	0	3	0	3	1.00	1.73	1.00
Cape Longclaw	*Macronyx capensis*	13	12	9	34	11.33	2.08	1.20
Cape Robin-chat	*Cossypha caffra*	3	1	1	5	1.67	1.15	0.67
Cape Sparrow	*Passer melanurus*	3	11	11	25	8.33	4.62	2.67
Cape Turtle-Dove	*Streptopelia capicola*	20	30	33	83	27.67	6.81	3.93
Cape Weaver	*Ploceus capensis*	0	0	2	2	0.67	1.15	0.67
Capped Wheatear	*Oenanthe pileata*	1	0	0	1	0.33	0.58	0.33
Cattle Egret	*Bubulcus ibis*	55	33	27	115	38.33	14.74	8.51
Cloud Cisticola	*Cisticola textrix*	62	52	50	164	54.67	6.43	3.71
Common Fiscal	*Lanius collaris*	4	5	3	12	4.00	1.00	0.58
Common Myna	*Acridotheres tristis*	3	6	4	13	4.33	1.53	0.88
Common Waxbill	*Estrilda astrild*	10	13	24	47	15.67	7.37	4.26
Crowned Lapwing	*Vanellus coronatus*	9	18	8	35	11.67	5.51	3.18
Cuckoo Finch	*Anomalospiza imberbis*	0	0	1	1	0.33	0.58	0.33
Dark-capped Bulbul	*Pycnonotus tricolor*	3	3	2	8	2.67	0.58	0.33
Diderick Cuckoo	*Chrysococcyx caprius*	8	6	6	20	6.67	1.15	0.67
Eastern Clapper Lark	*Mirafra fasciolata*	1	1	1	3	1.00	0.00	0.00

Egyptian Goose	*Alopochen aegyptiaca*	26	8	25	59	19.67	10.12	5.84
Fan-tailed Widowbird	*Euplectes axillaris*	10	6	13	29	9.67	3.51	2.03
Great Crested Grebe	*Podiceps cristatus*	0	0	4	4	1.33	2.31	1.33
Greater Striped Swallow	*Hirundo cucullata*	5	10	6	21	7.00	2.65	1.53
Hadeda Ibis	*Bostrychia hagedash*	17	8	7	32	10.67	5.51	3.18
Helmeted Guineafowl	*Numida meleagris*	39	15	16	70	23.33	13.58	7.84
House Sparrow	*Passer domesticus*	2	0	0	2	0.67	1.15	0.67
Laughing Dove	*Streptopelia senegalensis*	44	49	76	169	56.33	17.21	9.94
Levaillant's Cisticola	*Cisticola tinniens*	52	42	51	145	48.33	5.51	3.18
Little Grebe	*Tachybaptus ruficollis*	1	0	5	6	2.00	2.65	1.53
Little Rush-warbler	*Bradypterus baboecala*	1	0	1	2	0.67	0.58	0.33
Little Swift	*Apus affinis*	19	0	0	19	6.33	10.97	6.33
Long-crested Eagle	*Lophaetus occipitalis*	0	1	2	3	1.00	1.00	0.58
Long-tailed Widowbird	*Euplectes progne*	82	105	122	309	103.00	20.07	11.59
Maccoa Duck	*Oxyura maccoa*	0	12	10	22	7.33	6.43	3.71
Montagu's Harrier	*Circus pygargus*	0	0	2	2	0.67	1.15	0.67
Neddicky	*Cisticola fulvicapilla*	0	1	0	1	0.33	0.58	0.33
Northern Black Korhaan	*Afrotis afraoides*	7	10	13	30	10.00	3.00	1.73
Orange River Francolin	*Scleroptila levaillantoides*	3	0	7	10	3.33	3.51	2.03
Pied Crow	*Corvus albus*	1	3	2	6	2.00	1.00	0.58
Pied Starling	*Spreo bicolor*	4	14	1	19	6.33	6.81	3.93
Pin-tailed Whydah	*Vidua macroura*	13	26	34	73	24.33	10.60	6.12
Red-billed Quelea	*Quelea quelea*	64	199	188	451	150.33	74.97	43.28
Red-chested Cuckoo	*Cuculus solitarius*	2	3	3	8	2.67	0.58	0.33
Red-eyed Dove	*Streptopelia semitorquata*	1	2	2	5	1.67	0.58	0.33
Red-knobbed Coot	*Fulica cristata*	16	22	0	38	12.67	11.37	6.57
Rufous-naped Lark	*Mirafra africana*	27	23	22	72	24.00	2.65	1.53
South African Cliff-swallow	*Hirundo spilodera*	266	103	35	404	134.67	118.71	68.54
Southern Boubou	*Laniarius ferrugineus*	1	1	0	2	0.67	0.58	0.33
Southern Grey-headed Sparrow	*Passer diffusus*	0	1	0	1	0.33	0.58	0.33
Southern Masked-weaver	*Ploceus velatus*	168	85	80	333	111.00	49.43	28.54
Southern Pochard	*Netta erythrophthalma*	0	35	8	43	14.33	18.34	10.59
Southern Red Bishop	*Euplectes orix*	437	486	431	1354	451.33	30.17	17.42
Speckled Pigeon	*Columba guinea*	100	108	48	256	85.33	32.58	18.81
Spike-heeled Lark	*Chersomanes albofasciata*	0	3	3	6	2.00	1.73	1.00
Spotted Flycatcher	*Muscicapa striata*	1	0	0	1	0.33	0.58	0.33
Spotted Thick-knee	*Burhinus capensis*	0	5	0	5	1.67	2.89	1.67
Spur-winged Goose	*Plectropterus gambensis*	2	6	12	20	6.67	5.03	2.91
Steppe Buzzard	*Buteo vulpinus*	4	3	1	8	2.67	1.53	0.88
Swainson's Spurfowl	*Pternistis swainsonii*	17	31	13	61	20.33	9.45	5.46
Temminck's Courser	*Cursorius temminckii*	1	0	0	1	0.33	0.58	0.33
Whiskered Tern	*Chlidonias hybrida*	0	2	0	2	0.67	1.15	0.67
White-breasted Cormorant	*Phalacrocorax lucidus*	1	1	0	2	0.67	0.58	0.33
White-rumped Swift	*Apus caffer*	63	15	29	107	35.67	24.68	14.25
White-throated Swallow	*Hirundo albigularis*	5	0	0	5	1.67	2.89	1.67
White-winged Widowbird	*Euplectes albonotatus*	128	91	79	298	99.33	25.54	14.75
Willow Warbler	*Phylloscopus trochilus*	0	1	2	3	1.00	1.00	0.58
Yellow-billed Duck	*Anas undulata*	12	10	6	28	9.33	3.06	1.76
Yellow-crowned Bishop	*Euplectes afer*	30	33	11	74	24.67	11.93	6.89
Zitting Cisticola	*Cisticola juncidis*	52	61	79	192	64.00	13.75	7.94
	Grand Total:	2367	2540	2755	7662	2554.00	194.38	112.22

Number of replications	3																			
	Agriculture					Grassland					Tree stands					Wetlands					
Red Data species	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Grand Total:
Blue Crane	3	1.00	1.73	1.00	60%	2	0.67	1.15	0.67	40%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	5
Greater Flamingo	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	72	24.00	20.95	12.10	100%	72
Lesser Flamingo	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	38	12.67	21.94	12.67	100%	38
Lesser Kestrel	0	0.00	0.00	0.00	0%	104	34.67	9.07	5.24	90%	10	3.33	5.77	3.33	9%	1	0.33	0.58	0.33	1%	115
Melodious Lark	0	0.00	0.00	0.00	0%	9	3.00	4.36	2.52	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	9
Secretarybird	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
	3	1.00	1.73	1.00	1%	116	38.67	11.24	6.49	48%	10	3.33	5.77	3.33	4%	111	37.00	39.96	23.07	46%	240
	Agriculture					Grassland					Tree stands					Wetlands					
Non threatened species	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Grand Total:
African Darter	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	4	1.33	0.58	0.33	100%	4
African Pipit	52	17.33	3.06	1.76	62%	32	10.67	2.31	1.33	38%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	84
African Quailfinch	7	2.33	0.58	0.33	13%	46	15.33	9.29	5.36	87%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	53
African Snipe	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	1
African Stonechat	5	1.67	1.53	0.88	19%	18	6.00	2.00	1.15	69%	0	0.00	0.00	0.00	0%	3	1.00	1.73	1.00	12%	26
African Wattled Lapwing	0	0.00	0.00	0.00	0%	8	2.67	2.52	1.45	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	8
Amur Falcon	1	0.33	0.58	0.33	1%	61	20.33	18.01	10.40	54%	51	17.00	28.58	16.50	45%	0	0.00	0.00	0.00	0%	113
Ant-eating Chat	0	0.00	0.00	0.00	0%	50	16.67	3.79	2.19	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	50
Banded Martin	0	0.00	0.00	0.00	0%	37	12.33	7.37	4.26	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	37
Barn Swallow	155	51.67	36.83	21.26	9%	1445	481.67	311.46	179.82	84%	0	0.00	0.00	0.00	0%	115	38.33	32.93	19.01	7%	1715
Bar-throated Apalis	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	1
Black-chested Prinia	6	2.00	2.00	1.15	33%	5	1.67	1.53	0.88	28%	7	2.33	2.08	1.20	39%	0	0.00	0.00	0.00	0%	18
Black-headed Heron	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	0.58	0.33	100%	2
Black-shouldered Kite	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	40%	3	1.00	1.00	0.58	60%	0	0.00	0.00	0.00	0%	5
Blacksmith Lapwing	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	93	31.00	12.49	7.21	100%	93
Black-throated Canary	3	1.00	1.00	0.58	21%	8	2.67	2.52	1.45	57%	3	1.00	1.73	1.00	21%	0	0.00	0.00	0.00	0%	14
Bokmakierie	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Brown-throated Martin	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	50	16.67	28.87	16.67	100%	50
Burchell's Coucal	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	0.58	0.33	100%	2
Cape Crow	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Cape Glossy Starling	0	0.00	0.00	0.00	0%	3	1.00	1.73	1.00	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	3
Cape Longclaw	0	0.00	0.00	0.00	0%	34	11.33	2.08	1.20	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	34
Cape Robin-chat	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	5	1.67	1.15	0.67	100%	0	0.00	0.00	0.00	0%	5
Cape Sparrow	4	1.33	2.31	1.33	16%	3	1.00	1.00	0.58	12%	16	5.33	3.51	2.03	64%	2	0.67	1.15	0.67	8%	25
Cape Turtle-Dove	2	0.67	0.58	0.33	2%	14	4.67	2.52	1.45	17%	66	22.00	7.81	4.51	80%	1	0.33	0.58	0.33	1%	83

Non threatened species	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Grand Total:
Capped Wheatear	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Cattle Egret	6	2.00	1.00	0.58	5%	104	34.67	11.93	6.89	90%	0	0.00	0.00	0.00	0%	5	1.67	2.08	1.20	4%	115
Cloud Cisticola	16	5.33	7.57	4.37	10%	148	49.33	1.15	0.67	90%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	164
Common Fiscal	0	0.00	0.00	0.00	0%	5	1.67	2.08	1.20	42%	5	1.67	1.15	0.67	42%	2	0.67	0.58	0.33	17%	12
Common Myna	0	0.00	0.00	0.00	0%	4	1.33	1.53	0.88	31%	7	2.33	2.08	1.20	54%	2	0.67	1.15	0.67	15%	13
Common Waxbill	0	0.00	0.00	0.00	0%	27	9.00	1.00	0.58	57%	0	0.00	0.00	0.00	0%	20	6.67	7.23	4.18	43%	47
Crowned Lapwing	2	0.67	1.15	0.67	6%	33	11.00	6.08	3.51	94%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	35
Cuckoo Finch	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Dark-capped Bulbul	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	25%	6	2.00	1.73	1.00	75%	0	0.00	0.00	0.00	0%	8
Diderick Cuckoo	3	1.00	1.00	0.58	15%	12	4.00	1.00	0.58	60%	4	1.33	0.58	0.33	20%	1	0.33	0.58	0.33	5%	20
Eastern Clapper Lark	0	0.00	0.00	0.00	0%	3	1.00	0.00	0.00	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	3
Egyptian Goose	2	0.67	1.15	0.67	3%	3	1.00	1.73	1.00	5%	0	0.00	0.00	0.00	0%	54	18.00	8.89	5.13	92%	59
Fan-tailed Widowbird	0	0.00	0.00	0.00	0%	19	6.33	2.08	1.20	66%	0	0.00	0.00	0.00	0%	10	3.33	1.53	0.88	34%	29
Great Crested Grebe	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	4	1.33	2.31	1.33	100%	4
Greater Striped Swallow	7	2.33	0.58	0.33	33%	14	4.67	3.06	1.76	67%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	21
Hadeda Ibis	1	0.33	0.58	0.33	3%	19	6.33	8.50	4.91	59%	11	3.67	3.51	2.03	34%	1	0.33	0.58	0.33	3%	32
Helmeted Guineafowl	15	5.00	7.00	4.04	21%	55	18.33	6.81	3.93	79%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	70
House Sparrow	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	100%	0	0.00	0.00	0.00	0%	2
Laughing Dove	39	13.00	4.36	2.52	23%	36	12.00	3.61	2.08	21%	59	19.67	7.02	4.06	35%	35	11.67	16.86	9.74	21%	169
Levaillant's Cisticola	2	0.67	1.15	0.67	1%	56	18.67	3.79	2.19	39%	0	0.00	0.00	0.00	0%	87	29.00	10.44	6.03	60%	145
Little Grebe	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	6	2.00	2.65	1.53	100%	6
Little Rush-warbler	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	0.58	0.33	100%	2
Little Swift	16	5.33	9.24	5.33	84%	3	1.00	1.73	1.00	16%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	19
Long-crested Eagle	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	67%	1	0.33	0.58	0.33	33%	3
Long-tailed Widowbird	7	2.33	4.04	2.33	2%	291	97.00	23.07	13.32	94%	0	0.00	0.00	0.00	0%	11	3.67	6.35	3.67	4%	309
Maccoa Duck	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	22	7.33	6.43	3.71	100%	22
Montagu's Harrier	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	50%	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	50%	2
Neddicky	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Northern Black Korhaan	0	0.00	0.00	0.00	0%	30	10.00	3.00	1.73	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	30
Orange River Francolin	0	0.00	0.00	0.00	0%	10	3.33	3.51	2.03	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	10
Pied Crow	1	0.33	0.58	0.33	17%	5	1.67	0.58	0.33	83%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	6
Pied Starling	0	0.00	0.00	0.00	0%	18	6.00	7.21	4.16	95%	1	0.33	0.58	0.33	5%	0	0.00	0.00	0.00	0%	19
Pin-tailed Whydah	15	5.00	2.00	1.15	21%	52	17.33	10.50	6.06	71%	0	0.00	0.00	0.00	0%	6	2.00	1.00	0.58	8%	73
Red-billed Quelea	112	37.33	33.56	19.38	25%	272	90.67	65.31	37.71	60%	0	0.00	0.00	0.00	0%	67	22.33	21.13	12.20	15%	451
Red-chested Cuckoo	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	13%	7	2.33	1.15	0.67	88%	0	0.00	0.00	0.00	0%	8
Red-eyed Dove	0	0.00	0.00	0.00	0%	4	1.33	0.58	0.33	80%	1	0.33	0.58	0.33	20%	0	0.00	0.00	0.00	0%	5
Red-knobbed Coot	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	38	12.67	11.37	6.57	100%	38
Rufous-naped Lark	9	3.00	1.73	1.00	13%	63	21.00	2.65	1.53	88%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	72

Non threatened species	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Total	Mean	StDev	StErr	%	Grand Total:
South African Cliff-swallow	3	1.00	1.73	1.00	1%	401	133.67	117.05	67.58	99%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	404
Southern Boubou	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	0.58	0.33	100%	0	0.00	0.00	0.00	0%	2
Southern Grey-headed Sparrow	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Southern Masked-weaver	95	31.67	42.00	24.25	29%	87	29.00	2.65	1.53	26%	79	26.33	6.35	3.67	24%	72	24.00	6.56	3.79	22%	333
Southern Pochard	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	43	14.33	18.34	10.59	100%	43
Southern Red Bishop	304	101.33	89.07	51.43	22%	311	103.67	13.61	7.86	23%	0	0.00	0.00	0.00	0%	739	246.33	71.70	41.39	55%	1354
Speckled Pigeon	210	70.00	26.51	15.31	82%	45	15.00	13.45	7.77	18%	1	0.33	0.58	0.33	0%	0	0.00	0.00	0.00	0%	256
Spike-heeled Lark	0	0.00	0.00	0.00	0%	6	2.00	1.73	1.00	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	6
Spotted Flycatcher	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	1
Spotted Thick-knee	0	0.00	0.00	0.00	0%	5	1.67	2.89	1.67	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	5
Spur-winged Goose	3	1.00	1.73	1.00	15%	10	3.33	5.77	3.33	50%	0	0.00	0.00	0.00	0%	7	2.33	0.58	0.33	35%	20
Steppe Buzzard	7	2.33	1.53	0.88	88%	1	0.33	0.58	0.33	13%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	8
Swainson's Spurfowl	14	4.67	2.08	1.20	23%	45	15.00	8.19	4.73	74%	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	3%	61
Temminck's Courser	1	0.33	0.58	0.33	100%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	1
Whiskered Tern	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	1.15	0.67	100%	2
White-breasted Cormorant	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	2	0.67	0.58	0.33	100%	2
White-rumped Swift	8	2.67	2.52	1.45	7%	94	31.33	23.86	13.78	88%	0	0.00	0.00	0.00	0%	5	1.67	2.89	1.67	5%	107
White-throated Swallow	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	5	1.67	2.89	1.67	100%	5
White-winged Widowbird	11	3.67	0.58	0.33	4%	146	48.67	15.95	9.21	49%	0	0.00	0.00	0.00	0%	141	47.00	23.07	13.32	47%	298
Willow Warbler	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	3	1.00	1.00	0.58	100%	0	0.00	0.00	0.00	0%	3
Yellow-billed Duck	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	28	9.33	3.06	1.76	100%	28
Yellow-crowned Bishop	1	0.33	0.58	0.33	1%	51	17.00	9.64	5.57	69%	0	0.00	0.00	0.00	0%	22	7.33	4.04	2.33	30%	74
Zitting Cisticola	14	4.67	4.73	2.73	7%	178	59.33	18.04	10.41	93%	0	0.00	0.00	0.00	0%	0	0.00	0.00	0.00	0%	192
Grand Total:	1161	387.00	142.71	82.40	15%	4440	1480.00	214.13	123.63	58%	343	114.33	41.53	23.97	4%	1718	572.67	168.67	97.38	22%	7662