AVIFAUNAL IMPACT ASSESSMENT REPORT: METSIMATALA CSP FACILITY

On behalf of

Enviroworks

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SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Arcus is independent and has no business, financial or personal interest in the activity, application or appeal in respect of which it was appointed, other than fair remuneration for work carried out. There are no circumstances that compromise the objectivity of their specialists performing such work.

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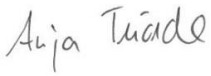

Anja Terörde (03 June 2016)

1 INTRODUCTION

Metsimatala CSP Solar Energy (Pty) Ltd ('the Developer') intends to construct a 150 megawatt (MW) Concentrated Solar Power (CSP) facility to capture and covert solar radiation into electricity on the Remaining Extent as well as Portions 4 and 5 of the Farm Groenwater No. 453 in the Northern Cape Province ('the project'). The project will also include a new overhead 132 kV powerline to connect the CSP facility to the Eskom grid, as well as a diversion of the existing transmission line currently traversing the proposed CSP site.

The Environmental Assessment Practitioner appointed by the developer is Enviroworks, who appointed Arcus Consultancy Services Ltd ('Arcus') to provide avifaunal specialist input, conduct pre-construction avifaunal monitoring, and compile an Avifaunal Impact Assessment Report for the project. The results of a thorough desk top study as well as the results of the onsite pre-construction bird monitoring have advised the impact assessment.

The application process for Environmental Authorisation (EA) is divided into three components namely:

- A Basic Assessment (BA) for the construction and operational phases of a new 132 KV powerline which will originate at the substation of the proposed facility and will connect into Eskom's national power grid at the existing Eskom Manganore Substation ('the Grid Connection').
- A Basic Assessment (BA) for the re-routing of the existing transmission line ('the Transmission Line Diversion') currently traversing the CSP site.
- A full Scoping and Environmental Impact Assessment (EIA) process for the construction and operational phases of the CSP facility and associated infrastructure ('the CSP facility').

This report is suitable for use in all three components as it has separately assessed the CSP facility, the Grid Connection and the Transmission Line Diversion. The purpose and aims of this report is to provide:

- A confirmation of the terms of reference adopted for the avifaunal study;
- A description of the pre-construction monitoring programme and the methods used as part of the Impact Assessment;
- The results of the monitoring programme;
- A description of the avifaunal baseline, including a description of avifaunal microhabitats available on the project site; and
- A description of potential predicted impacts to avifauna as well as a significance rating, impact assessment and mitigation measures.

1.1 The Project Description and Location

The proposed 150 MW CSP facility will be established on the Farm Groenwater No 453 which is approximately 11 894.77 hectares (ha) in total size and located directly adjacent to the west of the informal settlement of Metsimatala. The property is within the Tsantsabane Local Municipality and is owned by the Groenwater Communal Property Association (CPA) members and is situated approximately 22 km northeast of the town of Postmasburg (Figure 1) and 17 km northwest of the town of Lime Acres in the Northern Cape Province.

The CSP site covers an area of approximately 493 ha. The boundary of the proposed CSP site is illustrated in Figure 1. Within the site, two CSP technology options are being considered. Technology Alternative 1 would utilise CSP trough technology, while Technology Alternative 2 would utilise CSP central receiver tower technology.

The Grid Connection site consists of two alternative line routings, both running from the substation on the proposed CSP site, to the existing Eskom Manganore Substation (Figure 1).

- Route Alternative 1 is approximately 31.4 km in length and runs directly north from the CSP site, traversing hills covered with Kuruman Mountain Bushveld, and after approximately 11 km it turns north west and runs parallel to an existing power line to Manganore Substation.
- Route Alternative 2 is approximately 26 km in length, and heads directly north west to Manganore Substation and crosses the Groenwaterspruit.

The project will also include the re-routing of approximately 3.3 km of the existing 132 kV Overhead Transmission Line (OHTL) that currently traverses the CSP site. Two alternatives for this diversion are proposed (Figure 1):

- Transmission Line Diversion Alternative 1 follows the east and northern boundaries of the CSP site and will be approximately 4.6 km in length.
- Transmission Line Diversion Alternative 2 follows the west and southern boundaries of the CSP site and will be approximately 5.3 km in length.

1.2 Terms of reference

The following terms of reference were utilised for the preparation of this report:

- Conduct an avifaunal monitoring study for the CSP site, to be broadly in line with draft guidelines for bird monitoring at solar facilities in South Africa ('the solar guidelines').
- Description of existing avifaunal baseline conditions through field and desktop research including a description of the methodology adopted;
- Identification of information gaps and limitations;
- Identification of the sensitivity of the avifaunal baseline to the development, specifically with regard to the conservation status of species;
- Identification of the Regional Red Data species present and potentially present on the project site;
- Prediction of likely potential impacts on the avifauna, including cumulative impacts, during construction and operation of the CSP plant, the Grid Connection powerline, and the Transmission Line Diversion;
- Assessment of identified likely potential impacts, as well as cumulative impacts; and
- Identification of appropriate mitigation measures and monitoring requirements, or enhancement measures, to minimise impacts on avifauna or deliver enhancement from the proposed project.

2 POLICY AND LEGISLATIVE CONTEXT

The legislation relevant to this specialist field and the proposed project are as follows:

2.1 The Convention on Biological Diversity (CBD), 1993

A multilateral treaty for the international conservation of biodiversity, the sustainable use of its components and fair and equitable sharing of benefits arising from natural resources. Signatories have the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction. The CBD is based on the precautionary principle which states that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat and that in the absence of scientific consensus

the burden of proof that the action or policy is not harmful falls on those proposing or taking the action.

2.2 The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention), 1983

An intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. The fundamental principles listed in Article II of this treaty states that signatories acknowledge the importance of migratory species being conserved and agree to take action to this end "whenever possible and appropriate", "paying special attention to migratory species the conservation status of which is unfavourable and taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat".

2.3 The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), 1999

An intergovernmental treaty developed under the framework of the Convention on Migratory Species (CMS), concerned with the coordinated conservation and management of migratory waterbirds throughout their entire migratory range. Signatories of the Agreement have expressed their commitment to work towards the conservation and sustainable management of migratory waterbirds, paying special attention to endangered species as well as to those with an unfavourable conservation status.

2.4 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) – Threatened or Protected Species List (TOPS)

Amendments to the TOPS Regulations and species list were published on 31 March 2015 in Government Gazette No. 38600 and Notice 256 of 2015. The amended species list excluded all species threatened by habitat destruction and which are not affected by other restricted activities, but included the following target species that may be relevant for this study: *Endangered* – Martial Eagle, Tawny Eagle, White-backed Vulture, and Ludwig's Bustard.

2.5 The Nature and Environmental Conservation Ordinance No 19 of 1974; Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009)

These were developed to protect both animal and plant species within the various provinces of the country which warrant protection. These may be species which are under threat or which are already considered to be endangered and species are listed in the relevant documents. The provincial environmental authorities are responsible for the issuing of permits in terms of this legislation.

2.6 The Civil Aviation Authority Regulations, 2011

These are relevant to the issue of lighting of energy facilities which may be are relevant to bird collisions.

2.7 The Equator Principles (EPs) III, 2013

The principles applicable to the project are likely to include:

- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;

- Principle 7: Independent Review ;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

These principles, among various requirements, include a requirement for an assessment process (e.g. EIA process), an Environmental and Social Management Plan (ESMP) to be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards, and the appointment of an independent environmental expert to verify monitoring information.

3 METHODOLOGY

3.1 Description of the receiving environment (Defining the baseline)

The baseline avifauna environment for the project was defined utilising a desk based study and informed by onsite avifaunal monitoring. The sources of information were examined to determine the potential location and abundance of avifauna which may be sensitive to development, and to understand their conservation status and sensitivity.

3.1.1 Sources of information

- Bird distribution data of the Southern African Bird Atlas Project (SABAP-1, Harrison *et al.,* 1997) and Southern African Bird Atlas Project 2 (SABAP-2) obtained from the Avian Demography Unit of the University of Cape Town;
- Co-ordinated Water-bird Count (CWAC) project (Taylor *et al.,* 1999);
- The Important Bird Areas of southern Africa (IBA) project (Marnewick *et al*., 2015);
- Publically available satellite imagery;
- Specialist Avifaunal Impact Assessment for the Proposed Humansrus Solar Thermal Energy Power Plant (EWT, 2011);
- Results of the pre-construction avifaunal monitoring programme.

3.2 Identification and Rating of Potential Impacts

After collation of the baseline data from the source of information listed above the potential impacts of the project on avifauna (and particularly on focal species) were identified, for the construction and operation phases. This was done for each of the three project components: the CSP plant; the Grid Connection; and the Transmission Line Diversion.

Generally, the key potential impact types on avifauna from CSP projects and associated infrastructure include: burning; collision; electrocution; disturbance and displacement; habitat destruction; water pollution; and excessive use of water.

Once identified, the potential impacts were rated, considering all focal species, and based on set criteria and methodology as supplied to Arcus by the Environmental Assessment Practitioner (EAP) and shown in Appendix 2.

Focal species for the assessment were identified utilising the following method:

- Identification of the micro-habitats (section 4.1.1 below);
- Determining which species are likely to be present from the information sources;
- Identification of species which have a high likelihood of being present on, and/or utilising, the project site considering steps 1 and 2 and the findings of pre-construction monitoring; and which of these species has the potential to be impacted upon by the type of development i.e. CSP and associated infrastructure (based on a review of international literature and the experience and opinion of the specialist);
- Determining species conservation status or other reasons for protecting the species. This involved primarily consulting the Red data species (Taylor *et al.,* 2015).

3.3 Pre-Construction Bird Monitoring

3.3.1 Survey Design

The avifaunal monitoring programme for the project[1] was designed to be in line with the Draft Birds and Solar Energy Best Practice Guidelines, compiled by Bird Life South Africa, and recently released for public comment. Knowledge of these imminent solar guidelines ('the solar guidelines') and international best practise were also considered in the design of the surveys.

Due to the inherent mobility of birds, it is important to consider avifauna not only on the project site, but also the avifauna and available avifaunal microhabitats beyond the project site. Therefore, surveys were extended up to 3.5 km beyond the CSP site boundary. The following survey types were performed on and around the CSP site during the 12-month pre-construction surveys:

- Walked transects;
- Driven transects;
- Vantage point surveys;
- Focal site surveys; and
- Incidental observation recording.

The project site was initially visited on 16 November 2015 by the avifaunal specialist in order to confirm accessibility, identify focal sites (FS) and confirm the location of vantage points (VP), driven transects (DT) and walked transects (WT). Following this initial set up visit, three seasonal visits of 4-5 days in length were conducted during which the required surveys were completed.

The following definitions were applied:

- Priority species: all species occurring on the BirdLife South Africa (BLSA) and EWT Avian Sensitivity Map priority species list[2] (Retief *et al.*, 2011).
- Red Data species: All species with a regional status of either *Near Threatened*, *Vulnerable*, *Endangered* or *Critically Endangered* as listed in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.*, 2015).
- Endemic or Near Endemic: Endemic or Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.
- Target species: those particular bird species that were[3] recorded by a specific survey method.
    - Target species per survey method:
        - Walked transects (WT): all birds;
        - Driven transects (DT): all raptors; all large (non-passerine) priority species; corvids (crows and ravens) and korhaans.

[1] The survey is in line with the guidelines for Technology Alternative 1 (CSP trough technology) only and would need to be expanded should the Technology Alternative 2 (CSP central receiver tower technology) be selected.

[2] 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. 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 Wind Energy Facilities (WEFs), physical size, species behaviour, endemism, range size and conservation status. While the list is applicable to WEFs, it is believed to be of value for consideration in Solar Projects, and no such similar list is available for Solar Energy.

[3] Species/groups of species may be added to a particular survey method's target species list as the programme progresses.

- Vantage point (VP) surveys: all raptors; all large (non-passerine) priority species; doves; corvids (crows and ravens); sandgrouse; korhaans; egrets; geese; ibises and lapwings.
- Incidental observations: all Red Data species (Taylor *et al*., 2015); all raptors; and all large (non-passerine) priority species; and
- Focal sites (FS): all species associated, utilising or interacting at/with the focal site.

3.3.2 Survey Methodology

Three seasonal surveys were carried out, spread over a 6 month period (November 2015 to April 2016): Spring (17-20 November 2015); summer (25-29 February 2016); and autumn (19-22 April 2016).

3.3.2.1 Walked Transects

The purpose of the walked transect surveys was to estimate bird populations and densities across, and beyond the site, with a particular focus on small terrestrial species and passerines. Four walked transects were established and conducted two on the CSP site and two beyond the site boundary (Figure 2). In spring, WT1, WT2 and WT3 were each conducted twice. In summer, WT1-WT3 were conducted twice, while WT4 was added and conducted on three occasions. In Autumn WT1-WT3 were conducted twice, while WT4 was conducted on three occasions

Each transect was 1 km in length and two observers walked between the start and end points of the transects whilst recording all birds seen or heard up to 150 m on either side of the transect. The perpendicular distance in meters to the transect line was noted as well as number and age of individuals, their behaviour and if they were seen or heard. Beyond 150 m, only priority species were noted and were recorded as incidental sightings. Locations, dates and times of the WT are presented in Appendix 6.

To estimate density Index of Kilometric Abundance (IKA) values were calculated by taking the sum of the number of individual birds observed per 1 km transect divided by the number of transects. Species richness reports the average number of species recorded per transect over each season.

3.3.2.2 Vantage Points

Three vantage points were surveyed VP1, VP2 and VP3 (Figure 2).

Single observers monitored a viewshed of 360 degrees with a radius of 1.5 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these (or if a species being recorded flew out of the viewshed but was still visible), they were also 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: <15 m; 2: 15-50 m; 3: 50-100 m; 4: 100-150 m and 5: >150 m.

VPs were surveyed in either 2 hour, 3 hour or 4 hour sessions, ensuring that at least 12 hours per VP per season were obtained where possible spread over different days and different times of the day, per VP. In spring, VP1 and VP2 were each surveyed for a total of 12 hours. Updated site information was received following the spring survey resulting in VP2 being discarded and VP3 added. In summer and autumn, VP1 was again surveyed for 12 hours each season. In order to obtain the same effort for VP1 and VP3, VP3 was surveyed for 18 hours in both summer and autumn. The co-ordinates of the VPs and the

total hours surveyed are presented in Table 1 below. A total of 84 hour of VP observations were obtained over the 6 month period across three seasonal surveys.

Average passage rates and standard deviations (SD) were calculated as the average number of individuals recorded flying per hour of observations at VP 1 and VP3. Data from VP2 was not used in calculating passage rates, and was considered as supplementary information only.

Table 1: Geographic Positions of Vantage Points and Seasonal Survey Durations.

VP	Co-ordinates		Spring	Summer	Autumn	Total time surveyed
	South	East				
1	-28.293742°	23.296197°	12 h	12 h	12 h	*36 h*
2	-28.287007°	23.279407°	12 h	-	-	*12 h*
3	-28.272886°	23.296698°	-	18 h	18 h	*36 h*
		Total	*24 h*	*30 h*	*30 h*	*84 h*

**VP1 was relocated approximately 300m south to in summer and autumn.*

3.3.2.3 Driven Transects

Driven transect target species were sampled using three driven transects (Figure 2), that were each conducted on two occasions during each seasonal survey resulting in a total of 6 replications per transect across the monitoring programme. Transects were conducted by driving slowly (approximately 20-30 km/h) with the vehicle windows open, and stopping regularly to scan surrounding open areas. All target species were recorded, along with the geographical location of the vehicle for each record.

DT1 runs through the centre of the CSP site and to the west of the CSP site. DT2 runs east from Metsimatala village and then north along a district dirt road ending approximately 3.5 km to the north of the CSP site. Locations, dates and times of the driven transects are presented in Appendix 7 and Figure 2.

3.3.2.4 Focal Sites

Focal sites are any identifiable features within the landscape that are likely to support notable avifauna or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems, roost or nesting site).

Two Focal sites (FS1 and FS2) were identified and surveyed each was surveyed twice per seasons for a period of 15 minutes at a time, during which target species were counted and any relevant notes were taken (Table 2; Figure 2).

Table 2 Focal Site Positions, Descriptions and the Seasons Surveyed.

Focal Site	Co-ordinates		Description	Spring	Summer	Autumn
	South	East				
FS1	-28.301444°	23.268640°	A livestock water point with windmill, watering troughs, kraals and scattered trees.	✓	✓	✓
FS2	-28.255939°	23.323749°	Two adjacent small to medium sized farm dams, with exposed mud flats as well as extensive reed beds.	✓	✓	✓

3.3.2.5 Incidental Records

Relevant observations of target species were recorded while commuting to or from the project site, or in the broader project area while viewing the grid connection routes, but outside the survey protocols and times described above.

3.4 Assumptions and Limitations

- The SABAP1 data covers the period 1986-1997. Bird distribution patterns can change regularly according to availability of food and nesting substrate. (For a full discussion of potential limitations in the SABAP1 data, see Harrison *et al*., 1997).
- There is still limited information available on the environmental effects of large scale solar energy facilities in South Africa. No operational monitoring reports (detailing impacts) were available for operational facilities in South Africa. Therefore, estimates of impacts are mostly based on knowledge gained internationally, which has been applied with caution to local species and conditions.
- While sampling effort was as recommended in the solar guidelines, to achieve statistically robust results it would need to be increased beyond practical possibilities. The data was therefore analysed at a relatively basic level and interpreted using a precautionary approach.
- Relatively dry, drought conditions were experienced during the first two seasonal surveys, and some species may therefore not have been present or were present in lower numbers.

4 BASELINE ENVIRONMENT

4.1 Vegetation and Land Use

The proposed Grid Connection routes cover various vegetation types the most prevalent being: Kuruman Mountain Bushveld; Kuruman Thornveld and Postmasburg Thornveld (Mucina and Rutherford, 2006; Figure 1). The CSP site is covered primarily by Olifantshoek Plains Thornveld, with sections of Kuruman Mountain Bushveld in the north west. The land use on the CSP site is primarily that of communal grazing, with the residential township of Metsimatala adjacent to the site.

4.1.1 Avifaunal Micro-habitats

It is important to consider habitats that are generally evident at a much smaller spatial scale than vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. Inspection of the project site and surrounding areas (up to 10 km from the site), revealed the presence of the following bird micro-habitats.

4.1.1.1 Kraals and Associated Reservoirs and/or Water Troughs

Through overgrazing and the clearance of vegetation by livestock at these feeding and watering points, a microhabitat favoured by certain species has been created. Species such as chats, canaries, wagtails and sandgrouse are attracted to the water trough itself to drink, while the open, short grassy areas may be favoured by terrestrial species such as coursers, lapwings, francolins and korhaans and passerines such as larks, buntings and sparrowlarks.

This micro-habitats was present on and around both the CSP site and the Grid Connection routes, an example of which was monitored as FS1 during the monitoring surveys (Section 3.3.2.4).

4.1.1.2 Thornveld/Bushveld

Small patches of *Acacia* thickets and bushes were observed, usually close to disturbed areas such as kraals. As one moves to the periphery of the CSP site (towards the north and west particularly, as well as some distance to the south, across the tar road), away from the flat grassy areas, the elevation rises and small trees and bushveld (Plate 1) appear (depicted as "Kuruman Mountain Bushveld" discussed above). Although much of the natural bushveld/thrornveld is disturbed, these areas may attract smaller passerine species such as Robins and Shrikes. Weavers and Sparrow-weavers use the tree as structures for nesting and Raptors such the Southern Pale Chanting Goshawk and Lanner Falcon may use these areas for perching.

Plate 1: Bushes and small trees cover the hills to the north of the CSP site and the on the Grid Connection site.

4.1.1.3 Drainage Lines and Rivers

There are some draining lines in the hills to the north and west of the CSP site, which may occasionally hold water. No noticeable drainage lines or rivers were observed on the CSP site. Drainage lines are often associated with trees and thickets, and as such may be important to a host of passerine species. A National Freshwater Ecosystem Priority Area (NFEPA) river, the Groenwaterspruit, is situated approximately 10 km northwest of the CSP site and is crossed by the Grid Connection Route Alternative 2. Rivers and drainage lines are often used as fly-ways for various species e.g. ducks, herons, cormorants, geese and ibises.

4.1.1.4 Dams and Wetlands

Artificially constructed dams have become important attractants to various bird species in the South African landscape. Various waterfowl frequent these areas and crane species often use dams to roost in communally. Birds such as flamingos and African Spoonbills may make use of these areas. Therefore dams are a key element of this study, and should be classed as focal sites for continued monitoring during the construction and operation phases of the project.

Although no dams or wetlands were identified on the CSP site, the desktop study revealed the presence of natural Salt Pans in the surrounding area, which (when they hold water) may be used by various wading birds as well as birds such as geese, ducks and flamingos. Some man made farm dams were also located on or near to the grid connection routes. A group of farm dams was monitored as a focal site (FS2) (Figure 2).

4.1.1.5 Hills and Ridges

Although limited on the CSP site, hills and ridges are prevalent in the broader areas surrounding the site and along the grid connection routes. These areas are associated with 'denser' more 'woody thicket' vegetation and thus would be utilised by a variety of common passerines. Where rock ridges and cliffs are present, raptors such as Verreaux's Eagle may be attracted to the Rock Hyrax (if present) a prey source. Raptors such as Rock Kestrel Greater Kestrel, Black Shouldered Kite, Booted Eagle, Martial Eagle and Black-chested Snake Eagle may hunt over hills and ridges and use slopes to 'gain lift' and for slope soaring.

4.1.1.6 Open Grassy/Scrubland Areas

Grassy scrubland areas (although predominantly over-grazed and disturbed) make up the majority of the CSP site (Plate 2) and fall within the areas classified as Olifantshoek Plains Thornveld vegetation type. Grasslands (in their natural state) would represent a significant feeding area for many bird species such as Secretarybird, Kori Bustard and Northern Black Korhaan. Although disturbed, the grassy open areas on the CSP site may be used by these species occasionally, and particularly Northern Black Korhaan. The grassland patches are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl, as well as potentially for small mammals such as mice, Suricates and Ground Squirrels. This in turn may attract raptors such as Lanner Falcon, Greater Kestrel, Booted Eagle, Southern Banded Snake-Eagle and Martial Eagle because of both the presence and accessibility of prey.

Plate 2: Flat, open, heavily grazed grassland/scrubland on the CSP site.

4.1.1.7 Rural Community

Immediately to the east of the site lies the Metsimatala community. Birds such as crows, ibises, egrets, doves, sparrows and ravens are likely to frequent these areas, while raptors such as Spotted Eagle-Owl, Black-shouldered Kite and Greater Kestrel may utilise structures (e.g. street lamps, telephone poles) as perches and hunt for rodents along the grassy road verges.

4.2 Results of the Avifaunal Community Desktop Study

4.2.1 Southern African Bird Atlas Project 1

The SABAP1 data was collected over an 11 year period between 1986 and 1997 and is one of the best long term data sets on bird distribution and abundance available in South Africa at present. This data was collected in quarter degree squares (QDS), with the proposed project (CSP facility and Grid Connection routes) falling into QDS 2823AD, 2823AB, 2823AA and 2823AC (Figure 1). Table 3 indicates the reporting rate[4] for all Red Data species, raptors and priority species recorded by the SABAP1 data within these squares, as well as giving a total number of species recorded in each square.

Table 3: Report Rates for Red Data Species, Raptors and Priority Species Recorded by SABAP1 in the Quarter Degree Squares Covering the Project Site.

Species	Red Data Status	Priority Species Score	SABAP1 QDS			
			2823AD	2823AB	2823AA	2823AC
Number of Cards Submitted			77	8	11	10
Total Species			168	82	102	92
Barn Owl			4	-	27	-
Black Harrier	EN	345	1	-	-	-
Black Stork	VU	330	5	-	-	-
Black-chested Snake Eagle		230	1	-	-	-
Black-shouldered Kite		174	69	13	36	20
Blue Crane	NT	320	6	-	-	-
Booted Eagle		230	4	-	9	-
Burchell's Courser	VU	210	1	13	9	10
Double-banded Courser	NT	204	8	-	-	10
Gabar Goshawk			-	-	9	-
Greater Flamingo	NT	290	5	-	-	-
Greater Kestrel		174	12	13	9	10
Kori Bustard	NT	260	1	13	18	-
Lanner Falcon	VU	300	-	-	-	10
Lesser Kestrel		214	13	-	-	-
Maccoa Duck	NT		34	-	-	-
Martial Eagle	EN	350	6	-	9	-

[4] Report rates are essentially percentages of the number of times a species was recorded in the square, divided by the number of times that square was counted. It is important to note that these species were recorded in the entire quarter degree square in each case and may not actually have been recorded on the proposed project site.

Northern Black Korhaan		180	34	25	64	10
Pale Chanting Goshawk		200	39	50	82	60
Pygmy Falcon			-	-	-	10
Rock Kestrel			79	-	55	-
Secretarybird	VU	320	9	-	9	-
Spotted Eagle-Owl		170	1	13	18	-
Steppe Buzzard		210	1	-	-	10
Tawny Eagle	EN	290	1	-	-	-
Verreaux's Eagle-Owl		210	-	-	9	-
Verreaux's Eagle	VU	360	55	-	27	10
White-backed Vulture	CR	300	17	13	-	-

CR=Critically Endangered; EN=Endangered; VU=Vulnerable; NT=Near-threatened.

The SABAP1 data considered showed that 14 Red Data Species have been recorded of which only one species, Maccoa Duck, is not considered a priority species. Of the 14 Red Data Species, one is regarded as *Critically Endangered*, namely White-backed Vulture and three as *Endangered*, namely Black Harrier, Martial Eagle and Tawny Eagle. These three species all had relatively low report rates. Twenty-three priority species were recorded, including nine species that are not Red data species. Pale Chanting Goshawk, Northern Black Korhaan, Black Shouldered Kite, Greater Kestrel and Burchell's Courser were recorded in all four QDS considered, although the last two species were at relatively low report rates.

4.2.2 Southern African Bird Atlas Project 2

This project is part of an ongoing study by the Animal Demography Unit (ADU), a research unit based at the University of Cape Town (UCT). SABAP2 records data in pentads, which are roughly 8 km x 8 km squares, and smaller than the quarter degree squares used in SABAP1. The CSP site falls within pentad 2815_2315 (Figure 1) which only has one card[5] submitted and therefore a low counting effort. Fifty-one species were recorded in this pentad, including one priority species, Northern Black Korhaan, but no Red Data species or raptors were recorded. The Grid Connection Route Alternatives traverse an additional five pentads, of which two (2810_2310 and 2810_2315) have been counted and their data was considered. Due to the inherent mobility of birds, data were also considered from neighbouring pentads 2815_2310, 2810_2320 and 2815_2320 because of their close proximity to the project as well as pentads 2820_2320 and 2820_2325 because of their high counting effort (24 and 156 cards submitted respectively)(Table 4). The data considered recorded 29 species that are raptors, priority species or Red Data Species. The 13 Red Data species recorded included one listed as *Critically Endangered* (White-backed Vulture), and three as *Endangered* (Martial Eagle, Tawny Eagle and Ludwig's Bustard). It's important to note that (most likely due to the low number of cards submitted) none of the Red Data species shown in Table 2 were recorded in pentads within the project site. All records came from either pentad 2820_2320 or 2820_2325. Of the relevant species considered in Table 2, the majority had low reporting rates except for Black-chested Snake Eagle, Pale Chanting Goshawk, Northern Black Korhaan, Black-shouldered Kite, Gabar Goshawk and Rock Kestrel, which had relatively moderate to high reporting rates.

Four Red Data species recorded by the SABAP1 data were not recorded by the SABAP2 data, namely Black Harrier, Black Stork, Kori Bustard and Double-banded Courser.

[5] Each time that birds in a pentad have been counted by a citizen scientist registered with the ADU, a pentad 'card' is submitted online to the ADU. The number of cards therefore indicate the number of times a pentad has been counted.

Table 4: Report Rates for Red Data Species, Raptors and Priority Species Recorded in the SABAP2 Pentad Squares Covering the Project Site.

Species	Red Data Status	Priority Species Score	SABAP 2 Pentad							
			2810_2310	2815_2310	2815_2315	2810_2315	2810_2320	2815_2320	2820_2320	2820_2325
Number of cards submitted			*1*	*1*	*1*	*2*	*4*	*3*	*24*	*156*
Total Species			*45*	*36*	*51*	*59*	*66*	*72*	*159*	*179*
Eagle, Verreauxs'	VU	360	-	-	-	-	-	-	-	4.49
Eagle, Martial	EN	350	-	-	-	-	-	-	4.17	-
Bustard, Ludwig's	EN	320	-	-	-	-	-	-	8.33	-
Crane, Blue	NT	320	-	-	-	-	-	-	4.17	-
Secretarybird	VU	320	-	-	-	-	-	-	4.17	0.64
Vulture, White-backed	CR	300	-	-	-	-	-	-	12.5	-
Falcon, Lanner	VU	300	-	-	-	-	-	-	4.17	1.92
Eagle, Tawny	EN	290	-	-	-	-	-	-	-	0.64
Flamingo, Greater	NT	290	-	-	-	-	-	-	4.17	1.28
Flamingo, Lesser	NT	290	-	-	-	-	-	-	-	8.33
Eagle, African Fish		290	-	-	-	-	-	-	-	2.56
Buzzard, Jackal		250	-	-	-	-	-	-	-	-
Eagle, Black-chested Snake		230	-	-	-	-	-	-	16.67	1.28
Eagle, Booted		230	-	-	-	-	-	-	-	-
Stork, White		220	-	-	-	-	-	-	4.17	1.28
Kestrel, Lesser		214	-	-	-	-	75	50	8.33	1.28
Courser, Burchell's	VU	210	-	-	-	-	-	-	4.17	-
Buzzard, Steppe		210	-	-	-	-	-	-	-	2.56
Goshawk, Pale Chanting		200	-	-	-	-	25	50	37.5	7.69

Species	Red Data Status	Priority Species Score	SABAP 2 Pentad							
			2810_2310	2815_2310	2815_2315	2810_2315	2810_2320	2815_2320	2820_2320	2820_2325
Korhaan, Northern Black		180	-	100	100	50	100	100	95.83	1.28
Kestrel, Greater		174	-	-	-	-	-	-	25	2.56
Kite, Black-shouldered		174	-	-	-	-	-	-	16.67	16.67
Owl, Spotted Eagle-		170	-	-	-	-	-	-	-	3.21
Duck, Maccoa	NT		-	-	-	-	-	-	54.17	-
Painted-snipe, Greater	VU		-	-	-	-	-	-	-	0.64
Goshawk, Gabar			-	-	-	-	-	-	12.5	28.85
Kestrel, Rock			-	-	-	-	25	-	4.17	27.56
Owl, Western Barn			-	-	-	-	-	-	-	0.64
Owlet, Pearl-spotted			-	-	-	-	-	-	-	0.64

CR=Critically Endangered; EN=Endangered; VU=Vulnerable; NT=Near-threatened.

4.2.3 Coordinated Waterbird Count (CWAC) Data

There are four registered CWAC sites within 50 km of the proposed project site. Danielskuil Pan, Great Pan and Rooipan are approximately 30 km from the project site, and Soutpan is approximately 50 km from the project site.

At Danielskuil Pan 21 species of water associated birds have been recorded to date, none of which were priority species or raptors. No data was available for Great Pan and Rooipan. At Soutpan 25 species of water-associated birds were recorded, including one priority species (Greater Flamingo).

4.2.4 Coordinated Avifaunal Road-count (CAR) Data

There are no CAR routes within approximately 150 km of the proposed project site. It is unlikely that numbers of key species recorded on CAR routes further than 100 km from the project site would regularly interact with the project site, and therefore information from this source was no longer considered.

4.2.5 Important Bird Area (IBA) Project

IBAs are sites of global significance for bird conservation. They are identified nationally by experts using globally standardised and scientifically agreed criteria. These are based on the significant presence of globally and regionally threatened bird species, assemblages of restricted-range and biome-restricted species, and large concentrations of congregatory species (Marnewick *et al.*, 2015). Since the late 1970s, more than 12 000 IBAs have been identified in virtually all of the world's countries and territories, both on land and at sea. In 1998, 122 South African IBAs were identified and listed in Barnes (1998). This inventory was revised to 112 IBAs in 2015 (Marnewick *et al.*, 2015).

There are no IBAs within 100 km of the proposed project site. It is unlikely that numbers of key species potentially present at IBA's further than 100 km from the project site would regularly interact with the project site, and therefore information from this source was no longer considered.

4.2.6 Proposed Humansrus Solar Thermal Energy Power Plant Specialist Avifaunal Impact Assessment

This study, conducted by the Endangered Wildlife Trust (EWT), was authored by Andrew Pearson in 2011. The study covered an area less than 5 km to the east of the project site. The study was a desk top assessment and included a single site visit. The study highlighted the species as being potentially important (although not necessarily recorded on the site during the study), including: Martial Eagle, Lesser Kestrel, Blue Crane, White-backed Vulture, Secretarybird, Greater Flamingo, Verreaux's Eagle, Black-shouldered Kite, Pale Chanting Goshawk, Rock Kestrel, Northern Black Korhaan, Double-banded Courser, Namaqua Sandgrouse, White-rumped Swift, Barn Swallow, Namaqua Dove, Sociable Weaver, Kalahari Scrub-robin, Red-billed Quelea and Yellow Canary.

The study did not report on any additional species or data not already recorded in the other data sources considered.

4.3 6 Month Pre-construction Monitoring Results

4.3.1 Walked Transects

The purpose of the walked transect surveys is to estimate small bird populations and densities, and the method used was found to be suitable in all of the habitats surveyed.

In the broader project area average bird numbers were variable across the three walked transects, ranging from 48 to 87.67 birds per kilometre transect, with an overall average of 64.63 (SD±39.46) (Table 5). The mean number of species per transect was 15.08 (SD±5.34).

Table 5: Summary of 1 km walked transect results across all seasons.

Transect	IKA* (all birds)	IKA (target species)	Species richness
	Mean ± SD	Mean ± SD	Mean ± SD
WT1	48 (±28.60)	0.5 (±0.84)	10.83 (±4.49)
WT2	87.67 (±27.83)	0	17.67 (±3.78)
WT3	62.50 (±55.26)	1.17 (±1.83)	14.67 (±6.74)
WT4	60.33 (±38.98)	1.83 (±1.60)	17.16 (±4.02)
Total	64.63 (±39.46)	0.87 (±1.39)	15.08 (±5.34)

**IKA: Index of Kilometric Abundance = Birds/km; SD = Standard Deviation*

On the project site, 708 observations were made totalling 1540 individual birds (including single observations of flocks of more than 10 birds) and 77 positively identified species during 24 WT surveys conducted over the 6 month period (i.e. each of the four WTs were conducted on six occasions each).

WT2 resulted in the highest number of observations (249) and birds (526). WT3 and WT4 recorded the highest number of species (49 each), while WT1 had the lowest species richness with 32 species recorded.

Generally, the species seen across transects were similar, within certain common species being abundant on most transects such as African-Red-eyed Bulbul, Black-chested Prinia, Yellow-bellied Eremomela, Grey-backed Cisticola. Larks were also prevalent, with Karoo Long-billed Lark and Spike-heeled Lark being regularly recorded while Eastern Clapper Lark was especially abundant in summer while displaying. Sabota Lark, Large-billed Lark and Red-capped Lark were also recorded. Three bunting species, Lark-like, Cape and Golden-breasted, were recorded while mousebirds, finches, doves, swallows, swifts and canaries were relatively abundant.

The priority species recorded were Greater Kestrel, Pale Chanting Goshawk, and Northern Black Korhaan. The approximate locations of the observers when recording these species during the walked transects are displayed in Figures 6 along with other selected incidental and drive transect target species records. Northern Black Korhaan was particularly abundant in summer on WT4, with 15 observations totalling 21 birds over the two counts.

Other species deemed relevant and important to highlight were Spur-winged Goose, Eastern Clapper Lark, Alpine Swift, Common Swift, European Bee-eater, Namaqua Sandgrouse, Namaqua Dove, and Short-toed Rock-Thrush. Table 6 shows a summary of results from each walked transect conducted.

Table 6: Small Terrestrial Species Transect Results

Transect Name	Total Observations (Number of Individual Birds)	Total Species	Priority species (P), Red data species (Status)* or Focal species (F)	Frequently recorded and/or abundant.
WT1	130 (288)	32	Northern Black Korhaan (P), Eastern Clapper Lark (F), Namaqua Sandgrouse (F), Alpine Swift (F).	African Red-eyed Bulbul, Black-chested Prinia, Bokmakierie, Grey-backed Cisticola, Yellow-bellied Eremomela, Eastern Clapper Lark, Grey-backed Sparrowlark, Spike-heeled Lark, Kalahari Scrub-Robin, Namaqua Sandgrouse, Alpine Swift, Chestnut-vented Tit-Babbler, Rufous-eared Warbler.
WT2	249 (526)	38	Eastern Clapper Lark (F), Namaqua Sandgrouse (F), Namaqua Dove (F), Barn Swallow (F).	African Red-eyed Bulbul, Black-chested Prinia, Bokmakierie, Cape Bunting, Lark-like Bunting, Pririt Batis, Yellow Canary, Grey-backed Cisticola, Cape Turtle Dove, Namaqua Dove, Yellow-bellied Eremomela, Scaly-feathered Finch, Red-faced Mousebird, Kalahari Scrub-Robin, Wattled Starling, Chestnut-vented Tit-Babbler, Rufous-eared Warbler, Violet-eared Waxbill.
WT3	170 (372)	49	Greater Kestrel (P), Pale Chanting Goshawk (P), Northern Black Korhaan (P), Eastern Clapper Lark (F), Namaqua Dove (F), Short-toed Rock-Thrush (F), Common Swift (F), European Bee-eater.	European Bee-eater, African Red-eyed Bulbul, Black-chested Prinia, Bokmakierie, Golden-breasted Bunting, Lark-like Bunting, Familiar Chat, Grey-backed Cisticola, Common Fiscal, Eastern Clapper Lark, Karoo Long-billed Lark, White-backed Mousebird, Cape Sparrow, Greater Striped Swallow, Common Swift, Namaqua Warbler.
WT4	159 (354)	49	Northern Black Korhaan (P), Eastern Clapper Lark (F), Namaqua Dove (F), Namaqua Sandgrouse (F), Common Swift (F).	African Red-eyed Bulbul, Lark-like Bunting, White-throated Canary, Yellow Canary, Ant-eating Chat, Grey-backed Cisticola, Cape Turtle Dove, Yellow-bellied Eremomela, Red-headed Finch, Northern Black Korhaan, Crowned Lapwing, Eastern Clapper Lark, Karoo Long-billed Lark, Red-capped Lark, Spike-heeled Lark, Black-chested Prinia, African Quail-finch, Namaqua Sandgrouse, White-browed Sparrow-Weaver, Little Swift, Rufous-eared Warbler.

**Red List (Taylor, 2015) status: EN=Endangered. VU= Vulnerable. NT=Near Threatened. F=Focal species deemed relevant and important to highlight by the specialist. P=priority species (Retief et al. 2011. Updated 2014).*

4.3.2 Vantage Points

Following new information received regarding the CSP site layout, monitoring at VP2 was discontinued after the first seasonal survey. Eight flights totalling 11 individual birds were recorded in the 12 hours conducted at VP 2 in spring, with only one flight of a priority species or raptor being recorded, that of a single Pale Chanting Goshawk. The remaining flights were by more common species namely either Namaqua Dove (1 flight), Namaqua Sandgrouse (3 flights), Pied Crow (2 flights), and Cape Turtle Dove (1 flight). Although noted for additional information data for VP2 is not considered in the passage rate analysis (Table 7) or more detailed analysis below.

Generally, flight activity of target species was highest in summer with a combined average of 2.5 birds per hour of observation, and lowest in autumn with a combined average of 0.53 birds per hour of observation. Flight activity was slightly higher at VP3, while the combined average passage rate for both VPs on the CSP site over three seasons was 1.63 birds per hour, which is low in the specialists' experience.

Table 7: Average Passage Rate per Hour for Target Species

VP	Birds/hour	Birds/hour	Birds/hour	Average Birds/hour (± SD)*
	Spring	Summer	Autumn	
VP1	2.17 ± 2.62	2.17 ± 2.90	0.17 ± 0.58	1.50 ± 2.20
VP3	N/A	2.72 ± 6.66	0.77 ± 1.26	1.75 ± 4.82
VPs Combined	2.17 ± 2.62	2.5 ± 5.30	0.53 ± 1.07	1.63 ± 3.72

**SD=Standard Deviation*

Tables 8 shows summaries of the flight activity data of each target species recorded from VP1 and VP3. A total of 118 birds of 18 target species (including nine priority species and two Red Data species) were recorded by observing a total of 62 flight paths (i.e. one flight path may include a number of birds = flock) during the VP monitoring at VP1 and VP 3 over 12 months (i.e. 72 hours of observation time). It must be noted that separate flight paths may have been conducted by the same bird/s and that the figures presented here are not an indication of abundance, but rather flight activity. For example, on 26 February 2016, 7 flights of Martial Eagle were recorded at VP1 between 14:23pm and 16:24 pm. One of these flights, at 15:27pm was of two birds. It is logical therefore that the other 6 flights (and quite possibly all 11 flights of this species) were all conducted by one of these same two individuals. Flight paths of all target species on and around the CSP site (including those recorded from VP2 in spring) are shown in Figure 3. Flight paths of Korhaans and Raptors are shown per species in Figure 4, while Figure 5 shows the other target species flight paths per species.

Martial Eagle (11 flight paths) was the most recorded species during VP watches. All flights of this species were recorded on two days in summer, and were likely conducted by one or both of the same pair of birds. Pied Crow, with eight flights was the second most recorded species followed by Namaqua Dove and Northern Black Korhaan with six flights each, and then by Namaqua Sandgrouse and Pale Chanting Goshawk with 5 flights each.

A total of 31 raptor flights were recorded, which equates to 50 % of all flight paths. This is more an indication of the inactivity of other target birds on the CSP site than high activity by raptors, as the 31 raptor flights equates to approximately 10 flights per season, or roughly 0.42 flights per hour of observation, which is a relatively low amount of activity in the specialists' experience. Apart from Martial Eagle, the only other Red Data species recorded flying during VP watches was Lanner Falcon (2 flights).

Height analysis of flight paths indicates that 89 % of flights included at least some time below 50 m. It is predicted that at less than 50 m (based on information regarding the height of proposed infrastructure) birds may be at a higher risk of collision impacts. Eighteen flights (29 %) included time in height bands 3 or 4 (i.e. between 50 m and 150 m) while 12 flights (19 %) included a portion of time above 150 m. Flights above 150 m are regarded as less likely to be susceptible to impacts from the CSP infrastructure.

Table 8: Flight Path Target Species – CSP Site

Species	Priority species score	Red Data status	Total no. of flight paths recorded	Total no. of birds recorded*	No. of flights with portion <50 m high	No. of flights with portion 50-150 m high	No. of flights with portion >150 m high
Black-chested Snake Eagle	230	-	4	4	4 (100%)	1 (25%)	1 (25%)
Booted Eagle	230	-	2	3	2 (100%)	1 (50%)	1 (50%)
Cape Turtle Dove	-	-	1	1	1 (100%)	0	0
Crowned Lapwing	-	-	1	2	1 (100%)	0	0
Gabar Goshawk	-	-	1	1	1 (100%)	0	0
Greater Kestrel	174	-	3	3	3 (100%)	0	0
Hadeda Ibis	-	-	1	2	1 (100%)	1 (100%)	0
Jackal Buzzard	250	-	2	2	2 (100%)	0	0
Lanner Falcon	300	VU	2	2	2 (100%)	1 (50%)	0
Martial Eagle	350	EN	11	13	6 (55%)	7 (64%)	8 (73%)
Namaqua Dove	-	-	6	9	6 (100%)	0	0
Namaqua Sandgrouse	-	-	5	40	5 (100%)	0	0
Northern Black Korhaan	180	-	6	6	6 (100%)	0	0
Pale Chanting Goshawk	200	-	5	6	5 (100%)	2 (40%)	2 (40%)
Pied Crow	-	-	8	14	6 (75%)	4 (50%)	0
Spur-winged Goose	-	-	2	2	2 (100%)	0	0
Steppe Buzzard	210	-	1	1	1 (100%)	1 (100%)	0
Western Cattle Egret	-	-	1	7	1 (100%)	0	0
Totals			62	118	55 (89%)	18 (29%)	12 (19%)

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times. EN = Endangered, VU=Vulnerable.*

4.3.3 Driven Transects

Over the three seasons of monitoring, the driven transects resulted in 24 records of eight target species (including five priority species and one Red Data species), totalling 36 birds (Table 9). DT1 and DT2 each had 11 observations/records of target species, while DT3 had two records (both being Pied Crow records).

Greater Kestrel was the most regularly recorded target species on driven transects with 5 records, four of which were on DT2. One of these records is noteworthy as it involved four birds (that appeared to be two adults and two juveniles) perched on a low, exposed dead branch, below a powerline pylon. In the pylon above, a nest was noted, which could possibly have been a Greater Kestrel nest. Following the precautionary principle, it is assumed that this nest is an active Greater Kestrel nest, and it has been afforded appropriate protection (see Section 5.1). Pale Chanting Goshawk and Pied Crow were the second most regularly recorded drive transect target species with four records each, followed by Northern Black Korhaan and Crowned Lapwing with three records each.

Resident Northern Black Korhaan have a high chance of being encountered multiple times if their territory is close to a drive transect and therefore it is likely that the same individuals may be flushed (and recorded) during each transect. This is likely the case with the three records of this species on DT1.

Table 9: Summary of Driven Transect Results

Species (Red Data Status)	Total Birds Recorded	Max. Flock Count **	Number of Records				Season/s recorded
			DT1	DT2	DT3	*Total*	
Black-chested Snake Eagle*	1	1	1	-	-	*1*	summer
Crowned Lapwing	8	4	1	2	-	*3*	autumn
Greater Kestrel*	8	4	1	4	-	*5*	spring; summer
Lanner Falcon (VU)*	2	1	2	-	-	*2*	summer
Northern Black Korhaan*	5	3	3	-	-	*3*	spring; summer; autumn
Pale Chanting Goshawk*	4	1	-	4	-	*4*	spring; summer; autumn
Pied Crow	6	2	1	1	2	*4*	spring; summer; autumn
Red-crested Korhaan	2	1	2	-	-	*2*	summer
Total	36	NA	11	11	2	*24*	

**Priority species (Retief et al., 2011) **Size of the biggest group/flock of birds of the same species observed in one record. EN=Endangered; VU=Vulnerable; NT=Near Threatened.*

Overall the average number of individuals encountered per transect on the project site was 1.55 ± 2.01). The average was highest for DT 1 (2.17 ± 2.15) even though it was shorter than DT 2 (4.92 km versus 11.6 km). The average number of individuals encountered on DT 2 was 2 ± 2.53 while the average number of individuals encountered on DT 3 was 0.5 ± 0.84. DT 3 was the shortest drive transect but also had the lowest average number of individuals per km (0.13 ± 0.84) while DT 1 had the highest average number of individuals per km (0.44 ± 0.43) and the average number of individuals recorded per km on DT 2 was 0.17 ± 0.22) (Table 10).

Table 10: Summary of Abundance of Target Species for the Combined Driven Transect Results

Driven Transect	IKA* (target species)
	Mean ± SD
DT1	0.44 (±0.43)
DT2	0.17 (±0.22)
DT3	0.13 (±0.84)
Total	0.24 (±0.32)

**IKA: Index of Kilometric Abundance = Birds/km; SD = Standard Deviation*

4.3.4 Focal Sites

Observations from the visits to the focal sites (Figure 2) are presented in Table 11 below. The focal site reference refers to the focal site number, and whether it was the first or second visit to that particular focal site during a given season. For example, FS2.2 refers to the second visit to focal site 2. The focal sites were located by the avifaunal specialist during the site set up and the first seasonal survey.

Observations at the water trough and kraal (FS1) did not record any Red Data or priority species, with the only species of note for the development being Cape Turtle Dove, Laughing Dove and Namaqua Dove. Doves are generally high speed, low altitude flyers, which may put them at a higher risk of collisions with solar infrastructure. The observations at FS1 show that, particularly in the drier seasons (i.e. spring and summer), water points attract doves as well as numerous other passerines.

Observations at the farm dams surveyed (FS2), which are approximately 3 km north east from the CSP project site, showed the importance of these water bodies for water associated species in this generally arid environment. While the only priority species recorded here was a Steppe Buzzard, other important species recorded included waterfowl such as Red-billed Teal and Yellow-billed Duck, waders such as Three-banded Plover, Ruff, Wood Sandpiper and Common Greenshank, as well as aerial foraging species such as White-rumped Swift and Barn Swallow.

Table 11: Focal Site Survey Results over Three Seasonal Surveys.

Focal Site Visit	Spring		Summer		Autumn		Notes
	Priority species, Red data species or Focal species* (Total No. Birds)	Other Species (Total No. Birds)	Priority species, Red data species or Focal species* (Total No. Birds)	Other Species (Total No. Birds)	Priority species, Red data species or Focal species* (Total No. Birds)	Other Species (Total No. Birds)	
FS1.1	Cape Turtle Dove (2), Laughing Dove (1)	African Red-eyed Bulbul (35), Cape Bunting (1), Lark-like Bunting (1), Yellow Canary (1), Ant-eating Chat (1), Cape Sparrow (3), White-browed Sparrow-weaver (2), Cape Wagtail (1), Violet-eared Waxbill (1), White-throated Canary (1).	Namaqua Dove (2), Laughing Dove (4)	African Red-eyed Bulbul (4), Red-headed Finch (10), White-backed Mousebird (2), Cape Sparrow (2), White-browed Sparrow-weaver (4), Southern Masked Weaver (2).	None recorded.	White-browed Sparrow-weaver (2).	Survey followed heavy overnight rain in Autumn and disturbance by farm workers.
FS1.2	Cape Turtle Dove (2), Namaqua Dove (1)	African Red-eyed Bulbul (20), Golden-breasted Bunting (1), Lark-like Bunting (5), Ant-eating Chat (1), Fiscal Flycatcher (2), Cape Sparrow (2), White-browed Sparrow-weaver (3), Cape Wagtail (1), Southern Masked Weaver (2).	Laughing Dove (2)	African Red-eyed Bulbul (4), Cape Weaver (2), White-browed Sparrow-weaver (5), Southern Masked Weaver (3).	Cape Turtle Dove (2), Crowned Lapwing (3)	African Red-eyed Bulbul (3), Common Fiscal (2), White-backed Mousebird (4), Cape Sparrow (6), White-browed Sparrow-weaver (8).	Disturbance from cows being herded to water point in summer.
FS2.1	Namaqua Dove (5), Common Greenshank (3), Rock Martin (2), Ruff (2), Wood Sandpiper (1), African Snipe (1), Black-winged Stilt (3), Barn Swallow (1), Red-billed Teal (18), White-rumped Swift (1).	Southern Red Bishop (15), Red-knobbed Coot (3), African Sacred Ibis (1), Blacksmith Lapwing (7), Common Moorhen (2), Three-banded Plover (3), Southern Masked Weaver (2).	Steppe Buzzard (1), Namaqua Dove (6), Laughing Dove (6), Greater-striped Swallow (8),	Southern Red Bishop (28), Blacksmith Lapwing (4), Cape Wagtail (2), Lesser Swamp Warbler (2), Southern Masked Weaver (6), Pin-tailed Whydah (2).	Rock Martin (2)	Yellow Canary (2)	None
FS2.2	Cape Turtle Dove (1), Namaqua Dove (8), Common Greenshank (3), Grey Heron (1), Wood Sandpiper (1), Greater-striped Swallow (2), Little Swift (3), Red-billed Teal (15), White-rumped Swift (2).	Southern Red Bishop (25), African Red-eyed Bulbul (20), Levaillant's Cisticola (1), Red-knobbed Coot (2), African Sacred Ibis (1), Blacksmith Lapwing (4), Neddicky (1), Three-banded Plover (4), African Reed Warbler (1), Southern Masked Weaver (3).	Namaqua Dove (6), Laughing Dove (2), Yellow-billed Duck (3), Barn Swallow (6), Crowned Lapwing (2)	Southern Red Bishop (25), African Red-eyed Bulbul (3), Red-knobbed Coot (1), Blacksmith Lapwing (4), Three-banded Plover (1), Cape Wagtail (2), Southern Masked Weaver (30), Pin-tailed Whydah (2).	Namaqua Sandgrouse (3)	Southern Red Bishop (9), Unidentified canary (4), Red-knobbed Coot (2), Hadeda Ibis (3), Blacksmith Lapwing (3), Lesser Swamp Warbler (1)	None

4.3.5 Incidental Observations

Twenty-eight incidental observations were made of 7 target species comprising up to 33 birds (a single observation may include numerous birds of one species i.e. a flock) (Table 12 and Figures 6). The 7 target species were all priority species and included three Red Data species: Lanner Falcon, Martial Eagle and White-backed Vulture.

The species most regularly observed incidentally was Northern Black Korhaan accounting for 43 % of all the incidental observations. Although the 12 observations of this species counted a total of 12 birds, it's likely that on many occasions the same bird was observed/recorded more than once. It is estimated that the incidental observations of this species were of approximately 2-4 separate individual birds.

Pale Chanting Goshawk was the second most recorded species, accounting for 21 % of all the incidental observations, and again, many of these observations may have been of the same bird. Martial Eagle was the third most recorded species, accounting for 14 % of all the incidental observations, although it is likely that the four observations (made over three days in summer), were of one of a pair of birds.

Three incidental observations were made of Greater Kestrel, and one each for Booted Eagle, Lanner Falcon and White-backed Vulture. The latter was a significant observation of a flock of five of White-backed Vulture, which have a Red Data status of *Critically Endangered*.

Table 12: Number of Incidental Records of Target Species during Four Seasonal Surveys

Species (Red Data Status)	Number of observations	Total individuals**	Maximum flock count	Season/s observed
Booted Eagle*	1	1	1	summer
Greater Kestrel*	3	4	2	spring; autumn
Lanner Falcon (VU)*	1	1	1	autumn
Martial Eagle (EN)*	4	4	1	summer
Northern Black Korhaan*	12	12	1	spring; summer; autumn
Pale Chanting Goshawk*	6	6	1	spring; summer; autumn
White-backed Vulture (CR)*	1	5	5	summer
TOTALS	28	33	NA	

**Priority species (Retief et al., 2011). ** Multiple observations may have been made of the same individuals at different times.*

4.4 Summary and Discussion

201 bird species were recorded in the SABAP2 data examined, of which 108 were recorded on and around the project site by the three seasonal surveys. Arcus recorded eight species while monitoring that were not recorded in the SABAP data, and therefore a total of 116 positively identified species were recorded during the three seasonal surveys conducted. This includes 10 priority species, three Red Data species and five endemic or near endemic species. Sixty-nine species were recorded during the spring survey, 88 during the summer survey and 61 during autumn.

The full species list of all birds recorded by the monitoring surveys and SABAP2, indicating their conservation status, endemism, priority species score and where a species had been recorded is provided in Appendix I. Consideration of SABAP1 and SABAP2 data found that up to 17 Red Data species are potentially present, three of which were recorded by the monitoring surveys.

Table 13 below shows the micro habitats that each Red Data bird potentially present on the project site (identified through the desk based data search and the surveys conducted to date) data typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis below represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time. While it is possible that all these species may at some point traverse over or through the project site, the specialist has given a prediction of occurrence for each species in the table below. Occurrence is defined as a species actually regularly using the site (either for foraging, roosting, hunting, breeding etc.).

Table 13: Red Data Species Potentially Present, Preferred Habitats and Likelihood of Occurrence on the Project Site.

Species	Red Data Status	Preferred Habitats and/or Micro-habitats	Likelihood of Occurrence on site	Observed in monitoring surveys
White-backed Vulture	CR	Savanna; Woodland; Thornveld	Likely	✓
*Black Harrier**	EN	Grassland; Shrubland; Renosterveld	Unlikely	x
Ludwig's Bustard	EN	Karoo scrub; Arid Savanna	Possible	x
Martial Eagle	EN	Savanna; Grassland; Open woodland; Karoo shrubland	Likely	✓
Tawny Eagle	EN	Woodland; Savannah	Unlikely	x
Black Stork	VU	Lakes; Rivers; Estuaries; Cliffs	Unlikely	x
Lanner Falcon	VU	Grassland; Karoo shrubland	Likely	✓
Secretarybird	VU	Savannah; Grassland; Open thornveld	Likely	x
Verreaux's Eagle	VU	Rocky hills and/or ridges; Cliffs; Mountains	Unlikely	x
Burchell's Courser	VU	Sparsely grassed open plains; Open shrubland.	Possible	x
Greater Painted-snipe	VU	Marshes; Flooded grasslands.	Unlikely	x
Blue Crane	NT	Agricultural lands; Grassland	Unlikely	x
Greater Flamingo	NT	Lakes; Saltpans; Estuaries	Unlikely	x
Kori Bustard	NT	Semi-arid savanna; Open Thornveld; Grassland	Unlikely	x
Lesser Flamingo	NT	Lakes; Saltpans; Estuaries	Unlikely	x

Species	Red Data Status	Preferred Habitats and/or Micro-habitats	Likelihood of Occurrence on site	Observed in monitoring surveys
Maccoa Duck	NT	Freshwater Lanes; Dams	Unlikely	x
Double-banded Courser	NT	Semi-arid gravel plains.	Unlikely	x

Italics=Recorded in SABAP1 data only. CR=Critically Endangered; EN=Endangered; VU=Vulnerable; NT=Near Threatened.

Of the Red Data species in Table 13, six species may possibly occur and/or are likely to occur, at least with some regularity, on the CSP site or Grid Connection sites, and are discussed in more detail below.

Burchell's Courser is an uncommon nomad in dry sparsely grassed plains and open fields, and although not recorded on site, the specialist has seen this species within 50 km of the project site. If present, it is likely to be moderately impacted upon by disturbance and displacement and habitat destruction.

Although Secretarybird had low report rates in the SABAP data and was not observed on the project site, the habitat in the area appears suitable to support this species. It is also a generally wide ranging species, has been observed by the specialist in the broader area, and may occasionally utilise the site.

Lanner Falcon is likely to occur regularly on the project site, and was observed during all three seasonal monitoring surveys. It is a fairly common resident and local nomad in a wide range of habitats, only really avoiding forests. This species is regarded as *Vulnerable* (Taylor, 2015), and its general hunting behaviour of using high speed flight, makes it vulnerable to collision and burn impacts from the CSP plant. As it is known to nest on pylons (usually using an old crow nest), it may also be susceptible to disturbance impacts.

Comparison of South African Bird Atlas Project data from 1987-1993 and 2007-2012 suggests that Martial Eagle have undergone rapid and drastic population declines, reducing in number by nearly 60 % in 20 years (Cloete, 2013). Martial Eagle are listed as *Endangered* (Taylor *et al*., 2015) as a result of these declines, with an estimated population size of only 600 pairs in South Africa (Cloete, 2013). Martial Eagles exhibit strong fidelity to nesting sites (Herholdt & Mendelsohn, 1995) but a breeding pair may alternate breeding attempts between multiple nests in their breeding territory (Machange *et al.* 2005), which range in size from 100 – 800 km^2 in South Africa (Hockey *et al*. 2005). Boshoff (1993) estimated the size of the breeding territory to be a minimum of 284 km^2 for Martial Eagles breeding on transmission towers in the Nama-Karoo (Boshoff, 1993). A pair of birds were observed in the summer surveys, and it is possible that they may be nesting in the broader area, although no nest site could be located. All sightings of this species are believed to be of this adult pair. The relatively low number of records of this species on the CSP site, may indicate that the site is not favoured for foraging by this species, and it is likely that the less disturbed areas beyond the CSP are favoured. It may therefore occur regularly within the Grid connection site.

Ludwig's Bustard were not recorded during the monitoring surveys, however this species movements are wide ranging, erratic and often linked to rainfall events. The project site may becomemore important to this species following high levels of rainfall, and it is also a species that is highly susceptible to power line collisions.

The regional Red Data status of White-backed Vulture was recently changed from *Vulnerable* to *Critically Endangered* (Taylor *et al*., 2015) primarily due to projections that estimate a population size reduction of 80% within three generations. This is primarily due

to a recent increase in large scale poisoning incidents throughout the broader southern African range of this species, as well as ongoing negative interactions with powerlines This species was only observed incidentally during the summer survey more than ten km west of the CSP site and was not recorded flying on the CSP site from VP watches. The specialist has also observed this species within 5 km of the project site during 2011 and 2012. The potential risk of this species to burring and collision impacts of CSP infrastructure is uncertain, and it is likely to be at greatest risk from electrocutions on power lines. It is therefore vital that any new power lines are correctly designed and insulated to prevent any mortalities of this species.

Northern Black Korhaan were regularly encountered, particularly in the north east of the CSP site. A second Korhaan species, Red-crested Korhaan, was also recorded. Although not red data species, both Northern Black and Red-crested Korhaans are considered important to the study as they are potentially at risk of impacts from collision and displacement. During the surveys evidence of a collision fatality was observed when a carcass of a Northern Black Korhaan was found on the CSP site, under the existing transmission powerline.

Plate 3: Northern Black Korhaan Collision victim under the existing transmission line on the CSP site.

Seasonal differences in the compilation of the bird community in an arid environment are expected to be large (Dean, 2004). This arises for several reasons for different groups of birds: wetland species (e.g. flamingos, stilts, snipes, teals, ducks and crakes) are attracted to the sudden appearance of wetlands in flooded pans, and may follow rain fronts to find such ephemeral wetlands (Simmons *et al.*, 1999). Passerine birds (e.g. larks, canaries, queleas, buntings) are attracted to seeding grasses following good rain events, and may accumulate in very large flocks (Dean, 2004). For raptors, rain means more prey potentially resulting in increased hunting activity and breeding success after rains. Nomadic species such as bustards are attracted to high rainfall areas because of the explosion of insects that follows rains. Some seasonal variation was observed during the surveys, especially during the final autumn season which followed good rains in the area, yet interestingly resulted in the fewest number of species being recorded. However, extreme differences in bird data between seasons were not observed. Open artificial water sources attracted moderate numbers of passerine particularly during the warner spring and summer surveys. Observations at the dams at FS2 showed the importance of these permanent water sources

for a variety of birds. Numerous waders, waterfowl and other water associated species were recorded. The birds may remain at this dam for a long period of time, without making long distance movements. They may make unpredictable long distance movements when the water dries up, or following large rainfall events, in search for ephemeral pans and dams. These movements are often at dusk or early evening, and may also have been missed by the diurnal monitoring conducted.

5 AVIFAUNAL SENSITIVITY ZONES

Avifaunal sensitivity zones were identified at both a desk-based level as well as from observation during the seasonal site visits. No 'fatal flaws' or High Sensitivity 'No-go' areas in terms of avifauna were identified either on or around both the CSP and Grid Connection sites. The following avifaunal sensitivity zones were mapped (Figure 7) and are described below:

5.1 Medium-High Sensitivity Zone

A Medium-High sensitivity zone was related to a 1 km buffer of a nest identified on a power line pylon beyond the CSP site boundary. Greater Kestrel, including juvenile birds, were observed below the nest, and although it could not be confirmed 100 % that the nest is an active Greater Kestrel nest, erring on the side of caution it has been designated as such. It recommended that no new CSP or Grid Connection infrastructure be constructed within this zone and to prevent impacts of disturbance and displacement, construction activities and construction staff should not be allowed in this area (except when in transit along the main public road).

5.2 Medium Sensitivity Zones

Various landscape features were identified and buffered by varying distances to create zones of medium avifaunal sensitivity. They include micro-habitats that potential support/attract important avifauna or areas that were confirmed to support important species and/or support moderate-high abundances of birds at certain times. The Medium Sensitivity Zones consist of the following:

- A 250 m buffer around all NFEPA wetlands.
- A 500 m buffer around all NFEPA rivers.
- A 250 m buffer around the farm dams at FS2.
- A 250 m buffer around Southern Kalahari Salt Pans (extracted from Mucina and Rutherford, 2006).
- A 100 m buffer around artificial water-points.
- An area identified by monitoring as being important for Norther Black Korhaan (and various passerines) and includes an open pan.

Although important, these areas are not sufficiently sensitive so as to totally preclude development, although placement of new infrastructure in these areas should be avoided where possible. The spans of the selected Grid Connection power line route passing through these zones may require collision mitigation in the form of Bird Flight Diverters (BFDs).

With regards to the Medium Sensitivity Zones within the CSP site, it is understood that should the project proceed these areas may be completely destroyed/removed. This has been taken into account when conducting the impact assessment for habitat destruction and disturbance.

5.3 Undetermined Sensitivity Zones

Undetermined Sensitivity Zones are all the remaining areas of the project site not buffered in Figure 7 or related to the features discussed above. These areas show no obvious avifaunal features, patterns or sensitivities and are preferred for infrastructure placement. Considering the general avifauna of the area, it is likely that these zones are Low-Medium sensitivity.

6 BACKGROUND TO INTERACTIONS BETWEEN SOLAR ENERGY FACILITIES AND BIRDS

South Africa receives among the highest levels of solar radiation on earth (Robbins & Burger, 2009; Munzhedi *et al*., 2009) and there is huge potential for solar energy generation in the country (Fluri, 2009).

Despite its benefits of reduced toxic and carbon emissions and renewable generation, utility scale solar development can impact ecological systems and species and their habitats (Walston *et al.,* 2015). Worldwide the impacts of solar energy developments on wildlife, and particularly birds, are not well understood (Gunerhan *et al*., 2009; Lovich and Ennen, 2011; Hernandez *et al*., 2014; RSPB 2011), and there are few systematic and empirically based studies that address bird fatality issues (Walston *et al.,* 2015). Unlike wind energy development, there is presently no clear pattern in the species or groups of birds impacted. Burn and collision casualties recorded to date include a wide variety of bird groups (McCary 1986, Kagan *et al*., 2014). However, Walston *et al.* (2015) did find that Passerines were the taxonomic group most frequently found killed or injured at all six California facilities studied, with doves and pigeons also being highly impacted upon. The potential impacts also vary amongst technologies, with CSP power tower technology (i.e central receiver tower) recently proving to be (Harvey and Associates, 2015) more detrimental to avifauna.

It stands to reason that the more birds that are attracted to the CSP facility or its immediate surrounds, the more likely burn and/or collision impacts are to occur. Swallows, swifts and martins may be attracted to the plant infrastructure for use as roosts and/or nesting substrates, or to hunt insects which are attracted to the facility. This potentially positive effect (e.g. of increased breeding success) is likely to be offset by the indirect result of these birds placing themselves at increased risk of collision or burn impacts. Furthermore there are indications that insects may for some reason (possibly influenced by the lighting used) be attracted to the vicinity of certain types of solar energy facilities (particularly CSP tower projects). This in turn may attract insectivores, including both birds and bats.

Waterbirds may be attracted to solar energy facilities in mistaking the hardware for expanses of open water, and at least some of the larger, more mobile species considered prone to collision with wind turbines, may also be prone to trauma- and solar flux-based mortality (McCary, 1986; Kagan *et al*., 2014). The attraction of birds to the reflective surfaces which may be mistaken for large water bodies ('the lake effect'), has been proposed as a contributing factor towards burn and collision fatalities at solar energy facilities. This phenomenon may be possible for either the reflective parabolic troughs or the heliostat field components of wither CSP technology alternatives of the proposed project.

Another concern with CSP facilities surrounds the use of large evaporation ponds for the treatment of wastewater. Any open water in an arid environment in South Africa is likely to attract avifauna, putting them at more risk from the impacts of burning and collision. CSP facilities utilising wet cooling technologies require greater amounts of water for operational activities than dry cooling technologies, which may increase water demand and alter the availability of surface and groundwater sources to sustain bird habitats such as riparian vegetation.

The impacts of CSP parabolic trough technologies (i.e CSP technology alternative 1) are primarily associated with the loss of habitat and disturbance during construction, as well as collision with the parabolic troughs (although little evidence or studies surrounding this impact could be found). Of more concern regarding CSP parabolic trough plants, may be the associated grid connection powerline. In South Africa, powerline impacts (primarily from collision and electrocution) on sensitive avifauna such as cranes, bustards, storks, korhaans, and vultures, are well known and documented (APLIC 1994; van Rooyen, 2004; van Rooyen & Smallie, 2006; Shaw *et al.*, 2010).

The solar guidelines (Birdlife SA, in press) report that the number of solar energy development proposals in South Africa has rapidly increased over the last five years, with more than 500 projects proposed and under review by the Department of Environmental Affairs. With almost 400 of these already having been authorised (solar guidelines-Birdlife SA in press) a main concern with solar energy facilities is the displacement or the exclusion of nationally and/or globally threatened, rare, endemic, or range-restricted bird species from important habitats.

The key potential impacts on avifauna, arising from each project component's construction and operational phases have been identified below.

7 AVIFAUNAL IMPACT ASSESSMENT

Considering all the bird baseline data (including the results of 6 months of seasonal monitoring), resulted in the identification of a set of focal species. The focal species for the Impact assessment were determined to be: White-backed Vulture, Martial Eagle, Black-chested Snake Eagle, Lanner Falcon, Pale-chanting Goshawk, Greater Kestrel, **Ludwig's Bustard, Northern Black Korhaan, Burchell's Courser,** Greater Flamingo, Secretarybird, Red-billed Teal, Common Greenshank, Black-winged Stilt, Namaqua Dove, Namaqua Sandgrouse, Eastern Clapper Lark, Karoo Long-billed Lark, European Bee-eater, Alpine Swift, Little Swift, Barn Swallow and Violet-eared Waxbill. By considering focal species we are not ignoring other birds, as in most cases these focal species serve as surrogates for other species, examples being Black-chested Snake Eagle for Booted Eagle, Greater Flamingo for Lesser Flamingo, Red-billed Teal for various ducks and waterfowl, and Violet-eared Waxbill for various small passerines.

A significance rating and impact assessment (considering the baseline bird data available to date) has been done for each impact using set criteria (Appendix 2) and impact tables (Appendices 3, 4 and 5), and is summarised in sections 4 and 5 below. Appendix 3 shows the impact tables for the CSP facility, Appendix 4 gives the impact tables for the Grid Connection, while Appendix 5 gives the impact tables for the Transmission Line Diversion. Mitigation measures for each of the identified impacts has also been provided in Appendices 3, 4 and 5.

7.1 CSP Facility

7.1.1 Construction Phase

7.1.1.1 Habitat destruction

Clearing activities during the construction phase will remove vegetation and therefore habitat that birds may require for breeding, foraging and roosting. It is assumed that the majority of the 493 ha CSP site would be totally cleared for construction. While some of the impact may be temporary in the case of construction offices or laydown areas mitigation through rehabilitation of such areas is possible, however there will also be direct long-term loss of vegetation associated with the footprint of the solar arrays, power plant infrastructure, operation offices, and access roads etc.

It is assumed that in excess of 90 % of the proposed CSP site will be stripped of all vegetation for construction. Habitat loss may effect, and be more significant for important terrestrial species such as larks, coursers and korhaans. Raptors (e.g. Martial Eagle, Lanner Falcon, Black-chested Snake-Eagle and Pale Chanting Goshawk) may also be effected to a lesser degree, through the loss of potential hunting habitat. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium-High prior to mitigation and Medium after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium-High prior to mitigation and Medium after mitigation.

7.1.1.2 Disturbance and displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by construction and activities associated with the CSP plant, which may lead to temporary or permanent displacement and/or a reduction in breeding success. While all species observed on the CSP site are at risk, of most concern are the effects of this impact on Northern Black Korhaan, raptors such as Greater Kestrel, Pale Chanting Goshawk, and White-backed Vulture, various larks, as well as Endemic or Near Endemic species such as Fiscal Flycatcher and Large-billed Lark. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium prior to mitigation and Low after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium prior to mitigation and Low after mitigation.

7.1.2 Operation Phase

7.1.2.1 Burning

The reflective surfaces (of either heliostats or parabolic troughs) focus beams of sunlight into a small area resulting in concentrated solar flux which may burn birds. In technology Alternative 2, large heliostat arrays focus solar flux on a central "power tower", exposing passing birds to the risk of being singed or burnt in the flux beams, particularly as they aggregate close to the receiver. Birds with only partially singed feathers are likely to die from predation or starvation as a result of not being able to fly. When not in full operation, certain numbers of heliostats are focussed on various points in the sky (and not on the tower) known as stand-by focal points and birds may also be burnt in the stand-by focal points of the heliostats. Bird mortalities from burning have been recorded in the USA at the Ivanpah CSP project where mortalities of falcons, hawks, warbles and sparrows (as well as other species) have been found[6]. In a follow on detailed study at the same facility, Harvey and Associates (2015) estimated over 3500 birds to have died in a single year (many from being burnt or singed).

This impact can be largely avoided by adopting Technology Alternative 1.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Low prior to and after mitigation.

[6] http://www.livescience.com/43458-bird-deaths-ivanpah-solar-energy-plant.html

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as High prior to mitigation and Medium- High after mitigation.

7.1.2.2 Collision with Reflective Structures and/or CSP Infrastructure (Excluding Power Lines)

Birds may be attracted to, and collide with, the reflective surfaces (e.g. heliostats or parabolic troughs) which may be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death. For Technology Alternative 2, birds may also collide with the central receiver tower.

Furthermore, if Technology Alternative 2 utilises evaporative cooling ponds, these bodies of water may provide artificial habitat to birds and their prey (e.g. insects), thus attracting more birds to the site which may result in a greater risk of collision with project structures. Likewise, the presence of artificial water points (e.g. livestock water points or leaking pipes/pumps) on and around the CSP site, may attract additional avifauna, placing them at risk of collision (or burn) impacts.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium-High prior to mitigation and Medium after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as High prior to mitigation and Medium-High after mitigation.

7.1.2.3 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by operational and maintenance activities associated with the CSP plant, which may lead to temporary or permanent displacement and/or a reduction in breeding success.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium prior to mitigation and Low after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium prior to mitigation and Low after mitigation.

7.1.2.4 Collision with Power Lines

Birds may collide with over-head power lines (excluding grid connection lines) on the CSP site, particularly during times of low light or poor visibility. Species at most risk are generally fast flying, large-bodied birds with poor manoeuvrability such as bustards, korhaans, flamingos and some raptors.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium-High prior to mitigation and Low after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium-High prior to mitigation and Low after mitigation.

7.1.2.5 Electrocution

Birds may be electrocuted either in the on-site substation or on the overhead powerlines on the CSP site. Electrocution of birds from electrical infrastructure including overhead lines is an important and well documented cause of bird mortality, especially raptors and storks (APLIC, 1994; van Rooyen, 2004). 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 more likely for larger species whose wingspan is able to bridge the gap such as eagles or vultures. Various large raptors (such as White-backed Vulture, Martial Eagle and Black-chested Snake Eagle), susceptible to electrocution (particularly in

the absence of safe and mitigated structures) may occur on the CSP site. Electrocution is possible on electrical infrastructure within the substation particularly for species such as crows and owls which may attempt to nest on the substation infrastructure.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as High prior to mitigation and Low after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as High prior to mitigation and Low after mitigation.

7.1.2.6 Water Pollution and Waste-water

Pollution of water resources used by birds may result from the operational CSP, through use of chemicals and other pollutants on the site as well as the production of wastewater (brine), which can be difficult to manage and treat. In an arid environment, artificial evaporation ponds may attract various birds that could be poisoned and/or drown. This attraction to evaporation ponds will can increase the avian activity on the site, and may result in more fatalities from collisions and/or burning.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Medium prior to mitigation and Low after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium prior to mitigation and Low after mitigation.

7.1.2.7 Use of Large Amounts of Water

Certain CSP technologies, particularly those employing wet-cooling technologies, may use large amounts of water during operations. Using large amounts of water, may drain/deplete local reserves used by birds in naturally dry habitats.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Low prior to and after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium prior to and after mitigation.

7.1.2.8 Disruption of Local Bird Movement Patterns

Utility scale solar energy facilities may form a physical barrier to movement of birds across the landscape, and this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as hunting/foraging areas and ephemeral wetlands. This potential impact is not yet well understood, is likely to be more significant as a cumulative impact with surrounding developments, is difficult to measure and assess, and therefore mitigation measures are difficult to identify.

For Technology Alternative 1 (i.e. parabolic trough), this impact was rated as Low prior to and after mitigation.

For Technology Alternative 2 (i.e. central receiver tower), this impact was rated as Medium prior to and after mitigation.

7.2 Grid Connection

7.2.1 Construction Phase

7.2.1.1 Habitat destruction

Clearing activities during the construction phase will remove vegetation and therefore habitat that birds may require for breeding, foraging and roosting. While some of the

impact may be temporary as some areas could be rehabilitated, there will also be direct long-term loss of vegetation associated with the footprint of the power line towers, and clearances of servitudes and access tracks. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Route Alternative 1, this impact was rated as Medium-High prior to mitigation and Medium after mitigation.

For Route Alternative 2, this impact was rated as Medium prior to mitigation and Medium after mitigation.

7.2.1.2 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by construction, activities associated with the grid connection, which may lead to temporary or permanent displacement and/or a reduction in breeding success. While various species observed are at risk, of most concern are the effects of this impact on Northern Black Korhaan, raptors such as Greater Kestrel, Pale Chanting Goshawk, Martial Eagle and White-backed Vulture, various larks, as well as Endemic or Near Endemic species such as Fiscal Flycatcher and Large-billed Lark. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Route Alternative 1, this impact was rated as Medium prior to mitigation and Low after mitigation.

For Route Alternative 2, this impact was rated as Medium prior to mitigation and Low after mitigation.

7.2.2 Operation Phase

7.2.2.1 Collision with Power Lines

Collisions with large (132 kV or above) power lines are a well-documented threat to birds in southern Africa (van Rooyen, 2004; Shaw *et al.,* 2010), while smaller lines pose a higher threat of electrocution but can still be responsible for collision. Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground. Especially heavy-bodies birds such as bustards, cranes and waterbirds, with limited manoeuvrability are susceptible to this impact (van Rooyen, 2004). Many of the collision sensitive species are also considered threatened in southern Africa. The Red Data (Taylor *et al*., 2015) species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

Birds may collide with the new grid connection over-head power lines, particularly during times of low light or poor visibility. Species that are more likely to be affected include Ludwig's Bustard, Northern Black Korhaan, Red-crested Korhaan, and Greater Flamingo. Ludwig's Bustard is known to be particularly prone to collision (pers. Com R. Simmons, J. Smallie, M. Martins and BARESG) (Shaw *et al.,* 2010). The relatively low number of records of collision prone Red Data species during the monitoring survey, suggest that this may be a less significant impact for the project although mitigation in certain areas is still recommended.

For Route Alternative 1, this impact was rated as High prior to mitigation and Medium after mitigation.

For Route Alternative 2, this impact was rated as High prior to mitigation and Medium after mitigation.

7.2.2.2 Electrocution

When perching on the towers of the new grid connection power line, large birds may be electrocuted if they bridge the air gap between live components. Of particular concern are large raptors (e.g. Martial Eagle, Black-chested Snake Eagle and White-backed Vulture) and storks, which due to their size and nature are prone to electrocution impacts.

For Route Alternative 1, this impact was rated as Very High prior to mitigation and Medium after mitigation.

For Route Alternative 2, this impact was rated as Very High prior to mitigation and Medium after mitigation.

7.2.2.3 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by operational and maintenance activities (e.g. ongoing clearance of servitudes, tower and line repairs and standard maintenance) associated with the grid connection power line, which may lead to temporary or permanent displacement and/or a reduction in breeding success. Of particular concern is disturbance to breeding raptors (e.g. Martial Eagle and Greater Kestrel) which may build nests on the new infrastructure and roosting vultures.

For Route Alternative 1, this impact was rated as Medium prior to mitigation and Low after mitigation.

For Route Alternative 2, this impact was rated as Medium prior to mitigation and Low after mitigation.

7.3 Transmission Line Diversion

7.3.1 Construction Phase

7.3.1.1 Habitat destruction

Clearing activities during the construction phase will remove vegetation and therefore habitat that birds may require for breeding, foraging and roosting. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Transmission Line Diversion Alternative 1, this impact was rated as Medium prior to and after mitigation.

For Transmission Line Diversion Alternative 2, this impact was rated as Medium prior to and after mitigation.

7.3.1.2 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by construction, activities associated with the grid connection, which may lead to temporary or permanent displacement and/or a reduction in breeding success. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

For Transmission Line Diversion Alternative 1, this impact was rated as Medium prior to mitigation and Low after mitigation.

For Transmission Line Diversion Alternative 2, this impact was rated as Medium prior to mitigation and Low after mitigation.

7.3.2 Operation Phase

7.3.2.1 Collision with Power Lines

Birds may collide with new transmission line, particularly during times of low light or poor visibility. Species at most risk are generally fast flying, large-bodied birds with poor manoeuvrability such as bustards, korhaans and some raptors.

For Transmission Line Diversion Alternative 1, this impact was rated as High prior to mitigation and Medium after mitigation.

For Transmission Line Diversion Alternative 2, this impact was rated as Medium-High prior to mitigation and Medium after mitigation.

7.3.2.2 Electrocution

When perching on the towers of the diverted transmission power line, large birds may be electrocuted if they bridge the air gap between live components. Of particular concern are large raptors (e.g. Martial Eagle, Black-chested Snake Eagle and White-backed Vulture) and storks, which due to their size and nature are prone to electrocution impacts.

For Route Alternative 1, this impact was rated as High prior to mitigation and Medium after mitigation.

For Route Alternative 2, this impact was rated as High prior to mitigation and Medium after mitigation.

7.3.2.3 Disturbance and Displacement

Sensitive and/or breeding species may be disturbed by operational and maintenance activities (e.g. ongoing clearance of servitudes, tower and line repairs and standard maintenance) associated with the diverted transmission power line, which may lead to temporary or permanent displacement and/or a reduction in breeding success.

For Route Alternative 1, this impact was rated as Medium prior to mitigation and Low after mitigation.

For Route Alternative 2, this impact was rated as Medium prior to mitigation and Low after mitigation.

7.4 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 a number of proposed commercial scale solar energy projects within 50 km of the project site.

Approximately 8 large solar energy projects in various stages of the EIA application process fall within this 50 km radius of the project site. Should five or more of these projects be constructed the cumulative impact significance of the residual impacts of burning and collision (if Technology Alternative 2 is constructed) may be High. The other impacts discussed above, are likely to have a residual (i.e. after mitigation) cumulative impact ranging between Low and Medium.

Each identified impact was rated cumulatively considering that 5 or more of the 8 large scale solar projects discussed above are constructed as well as the Metsimatala project. The before and after mitigation cumulative ratings for each impact are all given in appendices 3, 4 and 4.

8 CONCLUSION

Based on a thorough desk based study and three seasonal site surveys conducted over a 6 month period, it can be concluded that the project site has a moderate sensitivity in terms of avifauna.

The species of most concern are the *Critically Endangered* White-backed Vulture and the *Endangered* Martial Eagle. It was noted though that former species was recorded on one occasion only in the surveys conducted and has a generally low reporting rate in the SABAP data considered. A pair of Martial Eagle was see regularly in summer and the abundance and flight activity levels of all raptors and priority species recorded on the project site was generally relatively low. Other species of concern included Lanner Falcon, Black-chested Snake Eagle, Greater Kestrel, Northern Black Korhaan and Ludwig's Bustard, although the latter was not recorded on the project site during the surveys. Northern Black Korhaan was relatively abundant and, although believed to be less at risk from burning impacts, is at high risk from collisions with powerlines and disturbance and displacement impacts.

Although a relatively diverse number of species and a high number of Red Data species were found to be potentially present after examining the SABAP data, many of these species were not recorded by monitoring, and many are unlikely to occur on the project site due to unsuitable habitat (see Table 13). In most cases the frequency of records and the activity (especially flight activity) of priority species and Red Data species on the project site was low. Vantage point passage rates were also particularly low when compared with the specialists experience in other parts of South Africa.

Commercial scale solar farms, and particularly CSP developments, are relatively new in South Africa and little information therefore exists on the potential impacts of these technologies on South African avifauna. Some information is available internationally which shows that the main potential impacts may include: burning; collision; electrocution; disturbance and displacement; habitat destruction; water pollution; and excessive use of water. Impacts of associated infrastructure (e.g. the grid connection power lines) is however well understood.

The Impact Assessment showed that the most significant potential impacts are burning and collision with reflective structures and/or CSP infrastructure which were both rated (after the application of mitigation) Medium-High for Technology Alternative 2 (central receiver tower). Cumulatively, (i.e. considering all projects within a 50 km radius) these impacts are likely to have a High significance rating. The residual impacts of burning and collision for technology Alternative 1 (CSP Trough) were rated as low and medium respectively. The cumulative rating for burning and collision impacts for Technology Alternative 1 (when considering all projects in a 50 km radius) are both Medium Significance. Therefore, Technology Alternative 1 is the preferred alternative for avifauna.

For the Grid Connection, the residual impacts of habitat destruction, collision and electrocution were all found to have a Medium Significance rating after mitigation, with all other impacts having a low rating. This indicates that either route alternative is acceptable from an avifaunal perspective with neither being preferred. Similar ratings were obtained for the Transmission Line Diversion, and both route alternatives are acceptable, with alternative two being slightly preferred as it runs along the main tar road.

Generally, when viewed as a whole, and considering the lack of confirmed impacts of CSP projects on birds in South Africa, the potential important contribution that CSP power may

have on slowing climate change, the impacts are not viewed as being of an extent or significance so as to preclude development, and all three components of the project may proceed subject to all recommendations (including construction and operational phase monitoring) and proposed mitigations in this report being implemented. However, it is recommended that CSP Technology Alternative 1 (CSP Trough) be used. Should Technology Alternative 2 (central receiver tower) be used, the 6 month bird survey conducted would not be in line with the solar monitoring guidelines and would not be sufficient to properly asses this technology (i.e. an additional 6 months of bird monitoring would be required). The potential impacts (and particularly cumulative impacts) of Technology Alternative 2 are likely to be more significant on birds than Technology Alternative 1.

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APPENDIX 1: SABAP 2 AND ARCUS SURVEYS BIRD LIST

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad								Arcus survey		
				2810_ 2310	2815_ 2310	2815_ 2315	2810_ 2315	2810_ 2320	2815_ 2320	2820_ 2320	2820_ 2325	Season 1	Season 2	Season 3
Number of cards submitted				*1*	*1*	*1*	*2*	*4*	*3*	*24*	*156*			
Number of species				*45*	*36*	*51*	*59*	*66*	*72*	*159*	*179*	*69*	*88*	*61*
Avocet, Pied										8.33	1.92			
Barbet, Acacia Pied				100			100	75	75	75	80.77		x	
Barbet, Black-collared											2.56			
Barbet, Crested											64.1			
Batis, Pririt							50	25	25	8.33	5.77	x	x	x
Bee-eater, European				100	100	100	50	50	100	25	40.38		x	
Bee-eater, Swallow-tailed											21.15			
Bee-eater, White-fronted											36.54			
Bishop, Southern Red				100			100		75	83.33	85.9	x	x	x
Bishop, Yellow-crowned										12.5				
Bokmakierie				100	100	100	100	100	75	100	61.54	x	x	x
Bulbul, African Red-eyed				100	100	100	100	100	100	95.83	100	x	x	x
Bunting, Cape							50	50		20.83	12.18	x	x	x
Bunting, Cinnamon-breasted								75	25	45.83	14.1			x
Bunting, Golden-breasted						100	100		25	8.33	14.1	x		x
Bunting, Lark-like								25		12.5	18.59	x	x	x
Bustard, Ludwig's	EN		320							8.33				
Buzzard, Common (Steppe)			210								2.56		x	
Buzzard, Jackal		x	250										x	
Canary, Black-throated							50		50	20.83	37.82			
Canary, White-throated				100				25		20.83	33.33	x		x
Canary, Yellow				100	100	100	100	100	100	100	99.36	x	x	x
Chat, Ant-eating				100	100	100	100	100	100	100	34.62	x	x	x
Chat, Familiar				100		100	50	25	75	70.83	94.23	x	x	x
Cisticola, Desert				100	100	100	50	75	75	62.5	17.95		x	x
Cisticola, Grey-backed					100		50	75	50	37.5	30.77	x	x	x
Cisticola, Levaillant's										95.83	2.56	x		
Cisticola, Zitting											0.64			
Coot, Red-knobbed						100				95.83	47.44	x	x	x
Cormorant, Reed										41.67	17.95			
Cormorant, White-breasted										4.17	1.92			
Courser, Burchell's	VU		210							4.17				
Crane, Blue	NT		320							4.17				
Crombec, Long-billed					100				25	4.17	5.13		x	
Crow, Cape										8.33				

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad								Arcus survey		
				2810_ 2310	2815_ 2310	2815_ 2315	2810_ 2315	2810_ 2320	2815_ 2320	2820_ 2320	2820_ 2325	Season 1	Season 2	Season 3
Crow, Pied				100	100		50	50	100	66.67	83.33	x	x	x
Cuckoo, Diederik				100	100	100	50	25	25	50	32.05		x	
Dove, Cape Turtle				100	100	100	100	50	50	91.67	80.77	x	x	x
Dove, Laughing						100	100	75	50	95.83	98.72	x	x	x
Dove, Namaqua				100		100	100	75	50	54.17	22.44	x	x	x
Dove, Red-eyed				100		100			25	33.33	97.44			
Dove, Rock													x	
Duck, Maccoa	NT									54.17				
Duck, White-faced Whistling										20.83	0.64			
Duck, Yellow-billed										83.33	36.54		x	
Eagle, African Fish			290								2.56			
Eagle, Black-chested Snake			230							16.67	1.28	x	x	
Eagle, Booted			230									x	x	
Eagle, Martial	EN		350							4.17			x	
Eagle, Tawny	EN		290								0.64			
Eagle, Verreauxs'	VU		360								4.49			
Egret, Little										4.17				
Egret, Western Cattle										8.33	1.92	x		
Eremomela, Yellow-bellied				100					25	12.5	9.62	x	x	x
Falcon, Lanner	VU		300							4.17	1.92	x	x	x
Finch, Red-headed										4.17	9.62		x	x
Finch, Scaly-feathered				100	100	100	100	100	75	62.5	69.23	x	x	x
Firefinch, Red-billed											1.28			
Fiscal, Common				100	100	100	100	100	100	100	66.67	x	x	x
Flamingo, Greater	NT		290							4.17	1.28			
Flamingo, Lesser	NT		290								8.33			
Flycatcher, Chat						100		50	50	54.17	1.92		x	x
Flycatcher, Fairy		x								16.67	26.92			
Flycatcher, Fiscal		x			100	100	100	75	75	91.67	99.36	x		x
Flycatcher, Spotted											14.74			
Francolin, Orange River						100				25	13.46			
Goose, Egyptian							50	25		45.83	28.21		x	
Goose, Spur-winged				100					25	54.17	5.13		x	x
Goshawk, Gabar										12.5	28.85	x		
Goshawk, Pale Chanting			200					25	50	37.5	7.69	x	x	x
Grebe, Black-necked										29.17				
Grebe, Little						100				66.67	45.51			
Greenshank, Common										33.33	6.41	x		
Guineafowl, Helmeted					100		100		75	66.67	55.77		x	
Gull, Grey-headed											0.64			

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad								Arcus survey		
				2810_2310	2815_2310	2815_2315	2810_2315	2810_2320	2815_2320	2820_2320	2820_2325	Season 1	Season 2	Season 3
Hamerkop										12.5	8.97			
Heron, Black-crowned Night										4.17	1.28			
Heron, Black-headed										25	3.85			
Heron, Grey						100		25		70.83	13.46	x		
Heron, Squacco						100				8.33				
Honeyguide, Greater											0.64			
Honeyguide, Lesser											4.49			
Hoopoe, African				100			50		50	12.5	96.15	x		
Hornbill, African Grey											8.33			
Hornbill, Southern Yellow-billed											5.77			
Ibis, African Sacred										58.33		x		
Ibis, Glossy										20.83				
Ibis, Hadeda						100		25	50	91.67	98.72		x	x
Kestrel, Greater			174							25	2.56	x	x	x
Kestrel, Lesser			214					75	50	8.33	1.28			
Kestrel, Rock								25		4.17	27.56			
Kingfisher, Malachite										4.17				
Kingfisher, Pied											0.64			
Kite, Black-shouldered			174							16.67	16.67			
Korhaan, Northern Black			180		100	100	50	100	100	95.83	1.28	x	x	x
Korhaan, Red-crested					100			50	75	4.17	10.9		x	
Lapwing, Blacksmith				100		100		25	25	100	93.59	x	x	x
Lapwing, Crowned				100		100	50	25	25	45.83	17.31	x	x	x
Lark, Chestnut-backed Sparrow-										4.17				
Lark, Eastern Clapper				100				100	75	70.83	28.85	x	x	x
Lark, Eastern Long-billed									25	4.17				
Lark, Fawn-coloured				100	100			100	25	29.17	12.18			
Lark, Grey-backed Sparrow										12.5	1.92	x		
Lark, Karoo Long-billed									25		1.28		x	
Lark, Large-billed		x								4.17			x	x
Lark, Red-capped														x
Lark, Sabota				100			50	25		4.17	30.13		x	
Lark, Spike-heeled				100			50		75	29.17	2.56	x	x	x
Longclaw, Cape													x	
Martin, Banded					100	100	50	50	50	33.33	5.77			
Martin, Brown-throated										45.83	25			
Martin, Rock				100		100	100		50	41.67	93.59	x	x	x
Moorhen, Common										29.17	23.08	x		
Mousebird, Red-faced				100	100		50	25		12.5	22.44	x	x	x

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad								Arcus survey		
				2810_ 2310	2815_ 2310	2815_ 2315	2810_ 2315	2810_ 2320	2815_ 2320	2820_ 2320	2820_ 2325	Season 1	Season 2	Season 3
Mousebird, White-backed				100	100	100	50	100	50	75	98.72		x	x
Myna, Common										4.17	85.9			
Neddicky				100	100	100	100	25	25	4.17	41.67	x		
Nightjar, Rufous-cheeked					100	100	50			8.33	7.69			
Ostrich, Common						100				8.33	0.64			
Owl, Spotted Eagle-			170								3.21			
Owl, Western Barn											0.64			
Owlet, Pearl-spotted											0.64			
Painted-snipe, Greater	VU										0.64			
Penduline-tit, Cape					100		50	50	50	12.5	10.26	x	x	
Pigeon, Speckled				100				25	25	16.67	88.46			
Pipit, African					100	100	100	25	75	83.33	42.95		x	
Pipit, Buffy									25		0.64	x		
Plover, Kittlitz's										12.5				
Plover, Three-banded										75	28.21	x	x	
Pochard, Southern										41.67	0.64			
Prinia, Black-chested					100	100	50	100	75	95.83	87.18	x	x	x
Quail, Common								25			1.28			
Quail-finch, African										12.5	7.69		x	
Quelea, Red-billed				100		100	100			50	38.46			
Robin, Kalahari Scrub				100	100	100	100	100	75	66.67	91.67	x	x	x
Robin, Karoo Scrub								25	50	16.67	57.69		x	x
Robin-chat, Cape						100	50			45.83	98.72			
Roller, Lilac-breasted											1.28			
Ruff										37.5	0.64	x		
Sandgrouse, Namaqua								25		4.17	16.03	x	x	x
Sandpiper, Common											1.28			
Sandpiper, Curlew										4.17				
Sandpiper, Wood										16.67	0.64	x		
Secretarybird	VU		320							4.17	0.64			
Shelduck, South African						100				91.67	32.69			x
Shoveler, Cape										75	3.21			
Shrike, Crimson-breasted				100		100	100			20.83	25.64			
Shrike, Lesser Grey								50	25	12.5	4.49		x	
Shrike, Red-backed					100			50		25	12.18		x	
Snipe, African										83.33		x		
Sparrow, Cape				100		100	100	100	100	100	98.72	x	x	x
Sparrow, House							100			16.67	93.59			
Sparrow, Southern Grey-headed							50		25	4.17	17.95		x	x

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad								Arcus survey		
				2810_2310	2815_2310	2815_2315	2810_2315	2810_2320	2815_2320	2820_2320	2820_2325	Season 1	Season 2	Season 3
Sparrow-weaver, White-browed				100	100	100	100	100	100	100	51.28	x	x	x
Spoonbill, African										25				
Starling, Cape Glossy						100	50			20.83	7.69	x	x	
Starling, Pale-winged						100			50	45.83	91.03		x	x
Starling, Pied						100					1.92			
Starling, Wattled							50			20.83	4.49		x	
Stilt, Black-winged										75	9.62	x		
Stint, Little										29.17	1.28			
Stonechat, African										79.17	0.64			
Stork, White			220							4.17	1.28			
Sunbird, Dusky											15.38		x	
Sunbird, Marico											5.77			
Sunbird, White-bellied											4.49			
Swallow, Barn				100	100	100		100	50	54.17	28.21	x	x	
Swallow, Greater Striped				100	100			25	75	66.67	63.46	x	x	
Swallow, Red-breasted								25		8.33				
Swallow, White-throated							50	25		8.33	14.1			
Swift, African Palm										29.17	7.69			
Swift, Alpine									25	25	19.23	x	x	
Swift, Bradfield's													x	
Swift, Common								25	25	16.67	2.56		x	
Swift, Little				100			100		75	62.5	76.28	x	x	x
Swift, White-rumped				100		100			100	50	31.41	x		x
Tchagra, Brown-crowned					100		50	25	25	12.5	15.38		x	x
Teal, Cape										79.17	36.54			
Teal, Red-billed										91.67	36.54	x		
Thick-knee, Spotted										8.33	15.38			
Thrush, Groundscraper										37.5	89.74			
Thrush, Karoo		x					50			33.33	99.36			
Thrush, Short-toed Rock						100					0.64	x		
Tit, Ashy				100				25	25	12.5	8.97		x	
Tit-Babbler, Chestnut-vented				100	100	100	100	100	50	50	91.67	x	x	
Tit-Babbler, Layard's		x									0.64			
Vulture, White-backed	CR		300							12.5			x	
Wagtail, Cape				100		100	100		75	100	96.79	x	x	x
Warbler, African Reed										4.17	0.64	x		
Warbler, Icterine											1.28			
Warbler, Lesser Swamp						100					12.82		x	x
Warbler, Namaqua		x											x	x
Warbler, Rufous-eared								50	25	50	8.33	x	x	x

	Red Data	Endemic/ Near Endemic	Priority Score	SABAP 2 Pentad							Arcus survey		
				2810_ 2310	2815_ 2310	2815_ 2315	2810_ 2315	2810_ 2320	2815_ 2320	2820_ 2320	2820_ 2325	Season 1	Season 2	Season 3
Warbler, Willow											5.13			
Waxbill, Black-faced											13.46			
Waxbill, Common										4.17	10.26			
Waxbill, Violet-eared							100	25	25	4.17	32.69	x		x
Weaver, Cape		x											x	
Weaver, Sociable					100	100		100			0.64		x	
Weaver, Southern Masked				100	100		50	50	75	87.5	96.15	x	x	
Wheatear, Capped				100	100		50	50	50	37.5	5.77			x
Wheatear, Mountain							50				27.56			x
White-eye, Cape		x									1.28			
White-eye, Orange River										20.83	95.51			
Whydah, Pin-tailed										25	16.03		x	x
Whydah, Shaft-tailed							50	75	25	4.17	0.64		x	x
Wood-hoopoe, Green											38.46			
Woodpecker, Cardinal											0.64			
Woodpecker, Golden-tailed										4.17	28.21			

CR=Critically Endangered; EN=Endangered; VU=Vulnerable; NT=Near Threatened.

APPENDIX 2: IMPACT ASSESSMENT METHODOLOGY

METHODOLOGY FOR IMPACT ASSESSMENT AND RISK RATING

The tables below indicate and explain the methodology and criteria used for the evaluation of the Environmental Risk Ratings as well as the calculation of the final Environmental Significance Ratings of the identified potential environmental impacts.

Each potential environmental impact is scored for each of the Evaluation Components as per Table 4 below.

Table 1: Scale utilised for the evaluation of the Environmental Risk Ratings

Evaluation Component	Rating Scale and Description/criteria
MAGNITUDE of NEGATIVE IMPACT (at the indicated spatial scale)	**10 - Very high**: Bio-physical and/or social functions and/or processes might be *severely* altered. **8 - High**: Bio-physical and/or social functions and/or processes might be *considerably* altered. **6 - Medium**: Bio-physical and/or social functions and/or processes might be *notably* altered. **4 - Low** : Bio-physical and/or social functions and/or processes might be *slightly* altered. **2 - Very Low**: Bio-physical and/or social functions and/or processes might be *negligibly* altered. **0 - Zero**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
MAGNITUDE of POSITIVE IMPACT (at the indicated spatial scale)	**10 - Very high (positive)**: Bio-physical and/or social functions and/or processes might be *substantially* enhanced. **8 - High (positive)**: Bio-physical and/or social functions and/or processes might be *considerably* enhanced. **6 - Medium (positive)**: Bio-physical and/or social functions and/or processes might be *notably* enhanced. **4 - Low (positive)**: Bio-physical and/or social functions and/or processes might be *slightly* enhanced. **2 - Very Low (positive)**: Bio-physical and/or social functions and/or processes might be *negligibly* enhanced. **0 - Zero (positive)**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
DURATION	**5 - Permanent** **4 - Long term**: Impact ceases after operational phase/life of the activity > 60 years. **3 - Medium term**: Impact might occur during the operational phase/life of the activity – 60 years. **2 - Short term**: Impact might occur during the construction phase - < 3 years. **1 - Immediate**
EXTENT (or spatial scale/influence of impact)	**5 - International**: Beyond National boundaries. **4 - National**: Beyond Provincial boundaries and within National boundaries. **3 - Regional**: Beyond 5 km of the proposed development and within Provincial boundaries. **2 - Local**: Within 5 km of the proposed development. **1 - Site-specific**: On site or within 100 m of the site boundary. **0 -** None

IRREPLACEABLE loss of resources	**5 – Definite** loss of irreplaceable resources. **4 – High** potential for loss of irreplaceable resources. **3 – Moderate** potential for loss of irreplaceable resources. **2 – Low** potential for loss of irreplaceable resources. **1 – Very low** potential for loss of irreplaceable resources. **0 - None**
REVERSIBILITY of impact	**5 –** Impact **cannot** be reversed. **4 – Low** potential that impact might be reversed. **3 – Moderate** potential that impact might be reversed. **2 – High** potential that impact might be reversed. **1 –** Impact **will be** reversible. **0 –** No impact.
PROBABILITY (of occurrence)	**5 - Definite**: >95% chance of the potential impact occurring. **4 - High probability**: 75% - 95% chance of the potential impact occurring. **3 - Medium probability**: 25% - 75% chance of the potential impact occurring **2 - Low probability**: 5% - 25% chance of the potential impact occurring. **1 - Improbable**: <5% chance of the potential impact occurring.
Evaluation Component	**Rating Scale and Description/criteria**
CUMULATIVE impacts	**High**: The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Medium**: The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Low**: The activity is localised and might have a negligible cumulative impact. **None**: No cumulative impact on the environment.

Once the Environmental Risk Ratings have been evaluated for each potential environmental impact, the Significance Score of each potential environmental impact is calculated by using the following formula:

- **SS (Significance Score) = (magnitude + duration + extent + irreplaceable + reversibility) x probability.**

The maximum Significance Score value is 150.

The Significance Score is then used to rate the Environmental Significance of each potential environmental impact as per Table 5 below. The Environmental Significance rating process

is completed for all identified potential environmental impacts both before and after implementation of the recommended mitigation measures.

Table 2: Scale used for the evaluation of the Environmental Significance Ratings

Significance Score	Environmental Significance	Description/criteria
125 – 150	Very high (VH)	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options.
100 – 124	High (H)	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options.
75 – 99	Medium-high (MH)	If left unmanaged, an impact of medium-high significance could influence a decision about whether or not to proceed with a proposed project. Mitigation options should be relooked.
40 – 74	Medium (M)	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project.
<40	Low (L)	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.
+	Positive impact (+)	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project.

APPENDIX 3: IMPACT RATING TABLES: CSP FACILITY

Table 1: Impact Assessment Rating for Habitat Destruction during Construction-CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Removal and/or destruction and/or alteration of habitat used by birds.	Removal and/or destruction and/or alteration of habitat used by birds.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low (4)	Medium (6)	-
Duration of impact:	Long term (4)	Long term (4)	-
Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	Low (2)	Low (2)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Definite (5)	Definite (5)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium-High (75)	Medium-High (85)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All		-

	contractors are to adhere to the CEMP and should apply good environmental practice during construction • High traffic areas and buildings such as offices, batching plants, storage areas etc. should, where possible be situated in areas that are already disturbed; • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • No off-road driving; • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).		
Cumulative impact post mitigation:	Medium	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (65). Magnitude is reduced to 3, and reversibility to 2.	Medium (70). Magnitude is reduced to 4, and reversibility to 2.	-

Table 2: Impact Assessment Rating for Disturbance and Displacement during Construction-CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Medium (6)	Medium (6)	-

Duration of impact:	Short-term (2)	Short-term (2)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	High (4)	High (4)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (68)	Medium (68)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction. • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • The appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. • Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road and power line routes as well as the CSP layout, to identify		-

	any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.		
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (34). Probability reduces to 2	Low (34). Probability reduces to 2	-

Table 3: Impact Assessment Rating for Burning during Operation-CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Birds may fly between the troughs and the receiver unit. The reflective surfaces focus beams of sunlight into a small area resulting in concentrated solar flux which may burn the bird.	Large heliostat arrays focus solar flux on a central "power tower", exposing passing birds to the risk of being singed or burnt in the flux beams, particularly as they aggregate close to the receiver. Birds may also be burnt in the stand-by focal points.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Local (2)	Regional (3)	-

Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	Improbable (1)	High (4)	-
Cumulative impact prior to mitigation:	Medium	High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (25)	High (104)	-
Proposed mitigation:	• Attractants to birds, such as open water sources, foraging and perching opportunities should be limited in the immediate vicinity of the facility. • A maintenance plan must be developed for all water associated infrastructure, so that any leakages etc. are identified and fixed as soon as possible so that birds in this arid environment are not attracted to a temporary artificial water source. • Develop and implement an operational monitoring programme for birds in line with applicable guidelines, which must include searching for mortalities. • Frequent and regular review of operational phase monitoring data and results by an avifaunal specialist. • The above reviews should strive to identify sensitive locations at the	• The occurrence and intensity of standby focal points should be kept to a minimum by careful focusing of heliostats when not in use. • Attractants to birds, such as open water sources, foraging and perching opportunities should be limited in the immediate vicinity of the facility. • A carcass management plan must be developed in discussion with all neighbouring landowners within 5 km of the CSP site, which will stipulate how and when livestock carcasses are disposed, and must ensure that carcasses are cleared from neighbouring farms as soon as possible so as to prevent attracting vultures to the CSP site and its surrounds. • A maintenance plan must be developed for all water associated infrastructure, so that any leakages	-

	development including those which may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist and independent review), the specialist should conduct a literature review specific to the impact and provide updated and relevant mitigation options to be implemented. As a starting point for the review of possible mitigations, the following may need to be considered: o Assess the suitability of using bird deterrent devices to reduce burning risk.	etc. are identified and fixed as soon as possible so that birds in this arid environment are not attracted to a temporary artificial water source. • Develop and implement an operational monitoring programme for birds in line with applicable guidelines, which must include searching for mortalities. • Frequent and regular review of operational phase monitoring data and results by an avifaunal specialist. • The above reviews should strive to identify sensitive locations at the development including those which may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist and independent review), the specialist should conduct a literature review specific to the impact and provide updated and relevant mitigation options to be implemented. As a starting point for the review of possible mitigations, the following may need to be considered: o Assess the suitability of using bird deterrent devices to reduce burning risk. o Various approaches to standby aiming of heliostats, which could significantly reduce flux levels.	
Cumulative impact post mitigation:	Medium	High	-

Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (25)	Medium-High (78). Probability reduces to 3.	-

Table 4: Impact Assessment Rating for Collision with Reflective Structures and/or CSP infrastructure (excluding power lines) during Operation.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Birds collide with the parabolic troughs. Birds may be attracted to the reflective surfaces which may be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death.	Birds collide with heliostats and/or the central receiver tower. Birds may be attracted to the reflective surfaces which may be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	Medium (3)	High (4)	-

Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium-High (75)	High (100)	-
Proposed mitigation:	• Where possible, infrastructure should be located away from known bird flight paths or features which are attractive to birds, e.g. natural or man-made open water areas or agricultural fields. • To limit bird traffic across the site, perch able structures should be avoided where possible. • Lighting should be kept to a minimum to avoid attracting insects and birds and light sensors/switches should be utilised to keep lights off when not required. • Lighting fixtures should be hooded and directed downward, to minimize the skyward and horizontal illumination which could attract night-flying birds (Ledec et al., 2010). • Where possible, lighting should be intermittent or flashing-beam lights. • Careful selection of and modifications to solar facility equipment should be made where possible. For instance, white borders could be applied to trough panels to reduce the resemblance that arrays have of waterbodies. • Develop and implement an operational monitoring programme for birds in line with applicable guidelines, which must include searching for mortalities. • Frequent and regular review of operational phase monitoring data and results by an avifaunal specialist. • The above reviews should strive to identify sensitive locations at the development including that may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist and independent review), the specialist should conduct a literature review specific to the impact and provide updated and relevant mitigation options to be implemented. As a starting point for the review of possible mitigations, the following may need to be considered: o Assess the suitability of using deterrent devices to reduce collision risk.		-
Cumulative impact post mitigation:	Medium	Medium-High	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (50)	Medium-High (75). Probability reduces to 3.	-

Table 5: Impact Assessment Rating for Disturbance and Displacement during Operation- CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species) by operational and/or maintenance activities, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species) by operational and/or maintenance activities, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Medium (6)	Medium (6)	-
Duration of impact:	Medium-term (2)	Medium-term (2)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Medium (3)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium-High	Medium-High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (51)	Medium (51)	-

Proposed mitigation:	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • The on-site facilities manager (or a suitably appointed Environmental Manager) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on or within 3 km of the operational facility, the nest/breeding site must not be disturbed and the avifaunal specialist must be contacted for further instruction. • Operational phase bird monitoring, in line with applicable guidelines, must be implemented.		-
Cumulative impact post mitigation:	Low-Medium	Low-Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (32). Reversibility is 2, and probability is 2.	Low (32). Reversibility is 2, and probability is 2.	-

Table 6: Impact Assessment Rating for Collision with associated power lines on the CSP site during Operation.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Birds collide with overhead power lines on the CSP site.	Birds collide with overhead power lines on the CSP site.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-

Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	Medium (3)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium-High	Medium-High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium-High (78)	Medium-High (78)	-
Proposed mitigation:	• All on site power cables and power lines (excluding the Grid Connection lines) to be buried underground.		-
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (26). Probability is 1	Low (26). Probability is 1	-

Table 7: Impact Assessment Rating for Electrocution on the CSP site during Operation.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative

Identified Environmental Impacts	Birds may be electrocuted either in the on-site substation or on overhead powerlines on the CSP site.	Birds may be electrocuted either in the on-site substation or on overhead powerlines on the CSP site.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	High (4)	High (4)	-
Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	High (104)	High (104)	-
Proposed mitigation:	• All on site power cables and power lines to be buried underground. • Within the on-site substation, electrical components are to be properly insulated in line with Eskom standard guidelines. Where possible, clearances between live components should be greater than 2 m.		-
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation	Low (26). Probability is 2	Low (26). Probability is 2	-

(Low, Medium, Medium-High, High, or Very-High)			

Table 8: Impact Assessment Rating for Water Pollution and Waste Water during Operation-CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Pollution of water resources used by birds. Production of wastewater (brine), which can be difficult to manage and treat. Artificial evaporation ponds attract waterbirds, which could be poisoned and/or drown.	Pollution of water resources used by birds. Production of wastewater (brine), which can be difficult to manage and treat. Artificial evaporation ponds attract waterbirds, which could be poisoned and/or drown.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low-Medium (5)	Medium (6)	-
Duration of impact:	Medium-term (3)	Medium-term (3)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Low (2)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Medium (3)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium	Medium	

Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (48)	Medium (54)	-
Proposed mitigation:	• Ensure that birds do not get in contact with evaporation ponds i.e. ponds should be covered with wire mesh or netting to reduce the possibilities of, attracting, drowning, or poisoning birds. • All cleaning products used on the site should be environmentally friendly and bio-degradable. • The OEMP must include site specific measures for the effective management and treatment of waste water.		-
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (30). Magnitude 4. Probability is 2.	Low (30). Magnitude 4. Irreplaceability is 2. Probability is 2.	-

Table 9: Impact Assessment Rating for Use of Large Amounts of Water during Operation- CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	Using large amounts of water may drain local reserves used by birds in naturally dry habitats.	Using large amounts of water may drain local reserves used by birds in naturally dry habitats.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low (4)	Medium (6)	-
Duration of impact:	Medium-term (3)	Medium-term (3)	-

Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Low (2)	High (4)	-
Cumulative impact prior to mitigation:	Low	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (32)	Medium (72)	-
Proposed mitigation:	None recommended	None recommended. The selection of Technology Alternative 1 would like result in reduced water use.	-
Cumulative impact post mitigation:	Low	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (32)	Medium (72)	-

Table 10: Impact Assessment for Disruption of Local Bird Movement Patterns during Operation- CSP Site.

Bio-Physical Aspects			
	Technology Alternative 1 (parabolic trough)	Technology Alternative 2 (central receiver tower)	No-Go Alternative
Identified Environmental Impacts	CSP plant forms a barrier to movement of birds across the landscape, and this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as hunting/foraging areas and ephemeral wetlands.	CSP plant forms a barrier to movement of birds across the landscape, and this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as hunting/foraging areas and ephemeral wetlands.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low (4)	Medium (6)	-
Duration of impact:	Long-term (4)	Long-term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Low (2)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium	Medium-High	
Significance rating of impact prior to mitigation	Low (34)	Medium (57)	-

(Low, Medium, Medium-High, High, or Very-High)			
Proposed mitigation:	None recommended	None recommended	-
Cumulative impact post mitigation:	Medium	Medium-High	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (34)	Medium (57)	-

APPENDIX 4: IMPACT RATING TABLES: GRID CONNECTION

Table 1: Impact Assessment Rating for Habitat Destruction during Construction- Grid Connection.

Bio-Physical Aspects			
	Route Alternative 1	Route Alternative 2	No-Go Alternative
Identified Environmental Impacts	Removal and/or destruction and/or alteration of habitat used by birds.	Removal and/or destruction and/or alteration of habitat used by birds.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low (4)	Very Low (2)	-
Duration of impact:	Long term (4)	Long term (4)	-
Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	Low (2)	Low (2)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Definite (5)	Definite (5)	-
Cumulative impact prior to mitigation:	Medium-High	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium-High (75)	Medium (65)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction		-

	• High traffic areas and buildings such as offices, batching plants, storage areas etc. should, where possible be situated in areas that are already disturbed; • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • No off-road driving; • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).		
Cumulative impact post mitigation:	Medium	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (65). Magnitude is reduced to 3, and reversibility to 2.	Medium (60). Reversibility to 2.	-

Table 2: Impact Assessment Rating for Disturbance and Displacement during Construction-Grid Connection.

Bio-Physical Aspects			
	Route Alternative 1	Route Alternative 2	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Medium (6)	Medium (6)	-
Duration of impact:	Short-term (2)	Short-term (2)	-

Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Medium (3)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (51)	Medium (51)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction. • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • The appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. • Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area,		-

	including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.		
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (34). Probability reduces to 2	Low (34). Probability reduces to 2	-

Table 3: Impact Assessment Rating for Collision with power lines during Operation-Grid Connection.

Bio-Physical Aspects			
	Route Alternative 1	Route Alternative 2	No-Go Alternative
Identified Environmental Impacts	Birds collide with overhead power lines.	Birds collide with overhead power lines.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	Medium (4)	Medium (4)	-

Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	High (104)	High (104)	-
Proposed mitigation:	• Where possible, grid infrastructure should avoid sensitive avifaunal habitats. • Where possible, grid infrastructure should follow existing servitudes such as existing power lines, roads and fences. • An avifaunal specialist must conduct a site walk through of the final Grid Connection route and pylon positions 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 operational monitoring programme for the associated CSP site must be in line with applicable monitoring guidelines and must include regular (i.e. at least every two months) monitoring of the grid connection power line for collision (and electrocution) mortalities. Any mortalities should be reported to the Endangered Wildlife Trust (EWT).		-
Cumulative impact post mitigation:	Medium-High	Medium-High	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (72). Extent is 2. Irreplaceability is 3. Probability is 3	Medium (72). Extent is 2. Irreplaceability is 3. Probability is 3	-

Table 4: Impact Assessment Rating for Electrocution during Operation- Grid Connection.

Bio-Physical Aspects			
	Route Alternative 1	Route Alternative 2	No-Go Alternative
Identified Environmental Impacts	Birds are electrocuted on overhead powerlines.	Birds are electrocuted on overhead powerlines.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	Definite (5)	Definite (5)	-
Cumulative impact prior to mitigation:	Very High	Very High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Very High (130)	Very High (130)	-
Proposed mitigation:	• Any grid connection power line/s 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 and which provide a safe bird perch.		-

	• The pylon structures to be constructed must first be approved by an avifaunal specialist who should consult with the Endangered Wildlife Trust's (EWT) Wildlife and Energy Programme. • The operational monitoring programme for the associated CSP site must be in line with applicable guidelines and must include regular (i.e at least every two months) monitoring of the grid connection power line and all new associated substations for electrocution (and collision) mortalities. Any mortalities should be reported to the EWT.		
Cumulative impact post mitigation:	Medium-High	Medium-High	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (50). Irreplaceability is 3. Probability is 2.	Medium (50). Irreplaceability is 3. Probability is 2.	-

Table 5: Impact Assessment Rating for Disturbance and Displacement during Operation-Grid Connection.

Bio-Physical Aspects			
	Route Alternative 1	Route Alternative 2	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species) during operation and maintenance, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species) during operation and maintenance, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Medium (6)	Medium (6)	-
Duration of impact:	Medium-term (3)	Medium-term (3)	-
Extent of the impact	Regional (3)	Regional (3)	-

Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Moderate (3)	Moderate (3)	-
Cumulative impact prior to mitigation:	Medium-High	Medium-High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (54)	Medium (54)	-
Proposed mitigation:	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • The applicable maintenance staff that conduct maintenance or repairs on this power line must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on or within 3 km of the operational facility, the nest/breeding site must not be disturbed and the avifaunal specialist must be contacted for further instruction. • No nests may be disturbed or removed from any power line structures prior to consultation with and approval from the avifaunal specialist. • Operational phase bird monitoring, in line with applicable guidelines, must be implemented.		-
Cumulative impact post mitigation:	Medium	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (36). Probability reduces to 2	Low (36). Probability reduces to 2	-

APPENDIX 5: IMPACT RATING TABLES: TRANSMISSION LINE DIVERSION

Table 1: Impact Assessment Rating for Habitat Destruction during Construction- Transmission Line Diversion.

Bio-Physical Aspects			
	Transmission Line Diversion Alternative 1	Transmission Line Diversion Alternative 2	No-Go Alternative
Identified Environmental Impacts	Removal and/or destruction and/or alteration of habitat used by birds.	Removal and/or destruction and/or alteration of habitat used by birds.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very Low (2)	Very Low (2)	-
Duration of impact:	Long term (4)	Long term (4)	-
Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	Low (2)	Low (2)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Definite (5)	Definite (5)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (65)	Medium (65)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All		-

	contractors are to adhere to the CEMP and should apply good environmental practice during construction • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).		
Cumulative impact post mitigation:	Medium	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (60). Reversibility to 2.	Medium (60). Reversibility to 2.	-

Table 2: Impact Assessment Rating for Disturbance and Displacement during Construction-Transmission Line Diversion.

Bio-Physical Aspects			
	Transmission Line Diversion Alternative 1	Transmission Line Diversion Alternative 2	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species), which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low-Medium (5)	Low-Medium (5)	-
Duration of impact:	Short-term (2)	Short-term (2)	-

Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	Moderate (3)	Moderate (3)	-
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Medium (3)	Medium (3)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (45)	Medium (45)	-
Proposed mitigation:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction. • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • The appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. • Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final transmission line diversion route, to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time,	-

	scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.		
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (30). Probability reduces to 2	Low (30). Probability reduces to 2	-

Table 3: Impact Assessment Rating for Collision with power lines during Operation-Transmission Line Diversion.

Bio-Physical Aspects			
	Transmission Line Diversion Alternative 1	Transmission Line Diversion Alternative 2	No-Go Alternative
Identified Environmental Impacts	Birds collide with overhead power lines.	Birds collide with overhead power lines.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-

Probability of occurrence:	Medium-High (4)	Medium (3)	-
Cumulative impact prior to mitigation:	High	High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	High (104)	Medium-High (78)	-
Proposed mitigation:	• Where possible, power lines should follow existing servitudes such as existing power lines, roads and fences as closely as possible. • An avifaunal specialist must conduct a site walk through of the final Transmission Line Diversion route and pylon positions 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 operational monitoring programme for the associated CSP site must be in line with applicable monitoring guidelines and must include regular (i.e. at least every two months) monitoring of the transmission line diversion route for collision (and electrocution) mortalities. Any mortalities should be reported to the Endangered Wildlife Trust (EWT).		-
Cumulative impact post mitigation:	Medium	Medium	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (72). Extent is 2. Irreplaceability is 3. Probability is 3	Medium (42). Magnitude is 8. Extent is 2. Irreplaceability is 2. Probability is 2	-

Table 4: Impact Assessment Rating for Electrocution during Operation- Transmission Line Diversion.

Bio-Physical Aspects			
	Transmission Line Diversion	Transmission Line Diversion	No-Go Alternative

	Alternative 1	Alternative 2	
Identified Environmental Impacts	Birds are electrocuted on overhead powerlines.	Birds are electrocuted on overhead powerlines.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Very High (10)	Very High (10)	-
Duration of impact:	Long-Term (4)	Long-Term (4)	-
Extent of the impact	Regional (3)	Regional (3)	-
Degree to which local resources are irreplaceable	High (4)	High (4)	-
Degree to which the impact can be reversed:	Cannot (5)	Cannot (5)	-
Probability of occurrence:	High (4)	High (4)	-
Cumulative impact prior to mitigation:	Very High	Very High	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	High (104)	High (104)	-
Proposed mitigation:	• Any pylon or tower structure used 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 and which provide a safe bird perch. • The pylon structures to be constructed must first be approved by an avifaunal specialist who should consult with the Endangered Wildlife Trust's (EWT) Wildlife and Energy Programme. • The operational monitoring programme for the associated CSP site must be in line with applicable guidelines and must include regular (i.e at least every two months) monitoring of transmission line diversion route and all new associated substations for		-

	electrocution (and collision) mortalities. Any mortalities should be reported to the EWT.		
Cumulative impact post mitigation:	Medium-High	Medium-High	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (50). Irreplaceability is 3. Probability is 2.	Medium (50). Irreplaceability is 3. Probability is 2.	-

Table 5: Impact Assessment Rating for Disturbance and Displacement during Operation-Transmission Line Diversion.

Bio-Physical Aspects			
	Transmission Line Diversion Alternative 1	Transmission Line Diversion Alternative 2	No-Go Alternative
Identified Environmental Impacts	Disturbance of birds (particularly sensitive and breeding species) during operation and maintenance, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	Disturbance of birds (particularly sensitive and breeding species) during operation and maintenance, which may lead to temporary or permanent displacement and/or a reduction in breeding success.	The proposed development will not take place and as such this impact will not occur
Magnitude of Impact	Low (4)	Low (4)	-
Duration of impact:	Medium-term (3)	Medium-term (3)	-
Extent of the impact	Local (2)	Local (2)	-
Degree to which local resources are irreplaceable	Low (2)	Low (2)	-

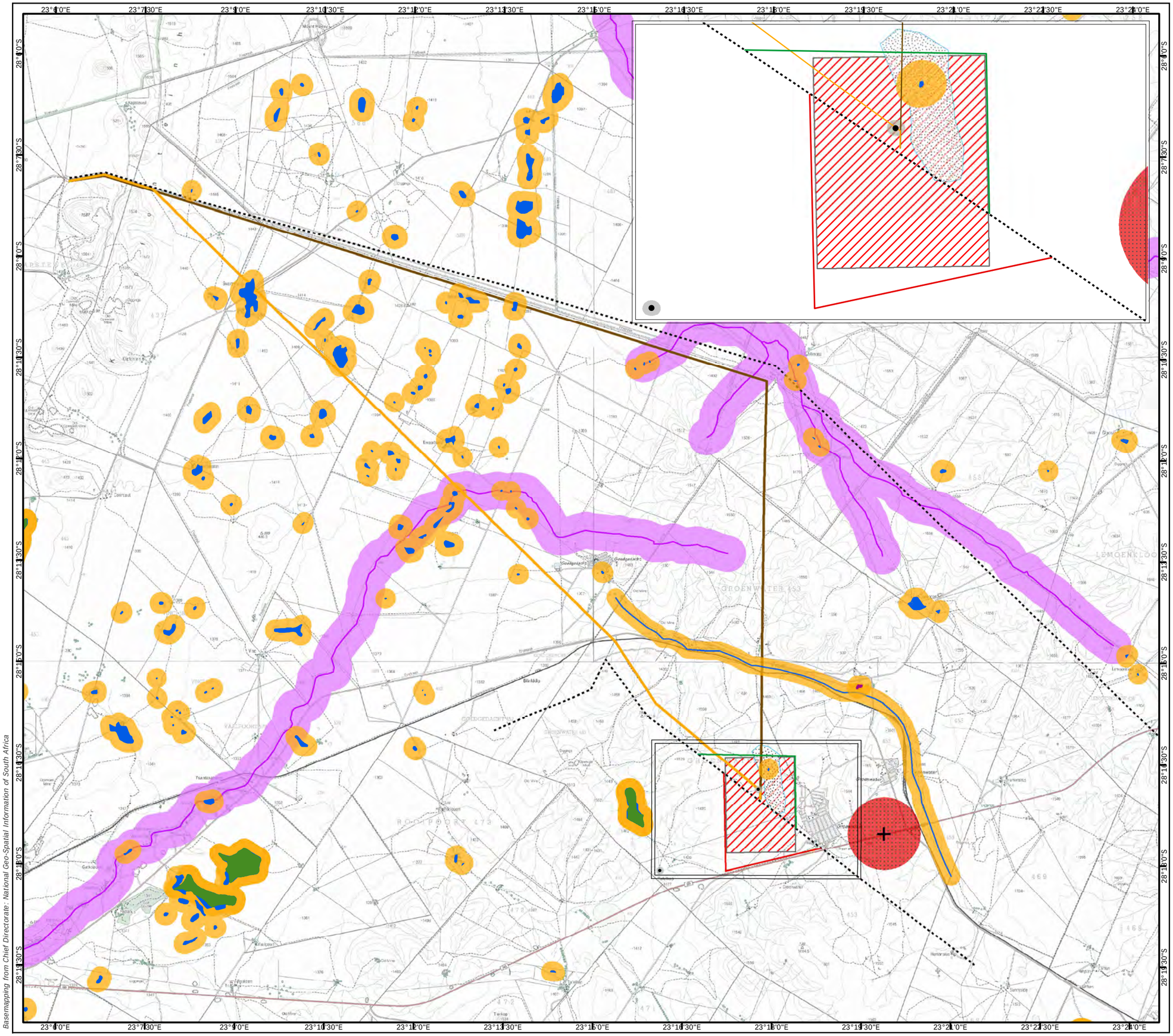
Degree to which the impact can be reversed:	Moderate (3)	Moderate (3)	-
Probability of occurrence:	Moderate (3)	Moderate (3)	-
Cumulative impact prior to mitigation:	Medium	Medium	
Significance rating of impact prior to mitigation (Low, Medium, Medium-High, High, or Very-High)	Medium (42)	Medium (42)	-
Proposed mitigation:	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • The applicable maintenance staff that conduct maintenance or repairs on this power line must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on or within 3 km of the operational facility, the nest/breeding site must not be disturbed and the avifaunal specialist must be contacted for further instruction. • No nests may be disturbed or removed from any power line structures prior to consultation with and approval from the avifaunal specialist. • Operational phase bird monitoring, in line with applicable guidelines, must be implemented.		-
Cumulative impact post mitigation:	Low	Low	-
Significance rating of impact after mitigation (Low, Medium, Medium-High, High, or Very-High)	Low (28). Probability reduces to 2	Low (28). Probability reduces to 2	-

APPENDIX 6: LOCATIONS, DATES AND TIMES OF THE WALK TRANSECTS.

Ref	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
	South	East	South	East	Date	Start Time	Finish Time
WT1.1	-28.290674	23.296209	-28.292599	23.286054	17-11-15	08:40	09:10
WT1.2	-28.290674	23.296209	-28.292599	23.286054	20-11-15	09:07	09:28
WT1.3	-28.290674	23.296209	-28.292599	23.286054	27-02-16	06:20	07:05
WT1.4	-28.290674	23.296209	-28.292599	23.286054	28-02-16	10:50	11:35
WT1.5	-28.290674	23.296209	-28.292599	23.286054	19-04-16	09:50	10:41
WT1.6	-28.290674	23.296209	-28.292599	23.286054	20-04-16	07:37	08:06
WT2.1	-28.293097	23.2711	-28.284659	23.274741	18-11-15	06:15	06:53
WT2.2	-28.293097	23.2711	-28.284659	23.274741	19-11-15	17:47	18:24
WT2.3	-28.293097	23.2711	-28.284659	23.274741	28-02-16	08:50	09:40
WT2.4	-28.293097	23.2711	-28.284659	23.274741	29-02-16	09:26	10:10
WT2.5	-28.293097	23.2711	-28.284659	23.274741	19-04-16	07:45	08:33
WT2.6	-28.293097	23.2711	-28.284659	23.274741	21-04-16	10:19	11:05
WT3.1	-28.306972	23.271756	-28.312608	23.279644	19-11-15	10:33	10:58
WT3.2	-28.306972	23.271756	-28.312608	23.279644	20-11-15	08:12	08:39
WT3.3	-28.306972	23.271756	-28.312608	23.279644	28-02-16	06:20	07:12
WT3.4	-28.306972	23.271756	-28.312608	23.279644	29-02-16	06:25	07:26
WT3.5	-28.306972	23.271756	-28.312608	23.279644	21-04-16	07:55	08:36
WT3.6	-28.306972	23.271756	-28.312608	23.279644	22-04-16	09:05	09:34
WT4.1	-28.28129	23.301835	-28.273364	23.296505	27-02-16	06:05	06:56
WT4.2	-28.28129	23.301835	-28.273364	23.296505	28-02-16	07:34	08:20
WT4.3	-28.28129	23.301835	-28.273364	23.296505	29-02-16	08:42	09:16
WT4.4	-28.28129	23.301835	-28.273364	23.296505	20-04-16	07:17	07:58
WT4.5	-28.28129	23.301835	-28.273364	23.296505	21-04-16	09:34	09:58
WT4.6	-28.28129	23.301835	-28.273364	23.296505	22-04-16	07:13	08:01

APPENDIX 7: LOCATIONS, DATES AND TIMES OF THE DRIVE TRANSECTS.

Transect Name	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
		South	East	South	East	Date	Start Time	Finish Time
DT1.1	4.92	-28.290547	23.302911	-28.294225	23.271081	17-11-15	12:32	13:04
DT1.2	4.92	-28.290547	23.302911	-28.294225	23.271081	20-11-15	9:10	9:40
DT1.3	4.92	-28.290547	23.302911	-28.294225	23.271081	28-02-16	7:50	8:47
DT1.4	4.92	-28.290547	23.302911	-28.294225	23.271081	29-02-16	8:51	9:25
DT1.5	4.92	-28.290547	23.302911	-28.294225	23.271081	19-04-16	8:54	9:34
DT1.6	4.92	-28.290547	23.302911	-28.294225	23.271081	21-04-16	9:38	10:19
DT2.1	11.6	-28.296157	23.315517	-28.244714	23.278027	19-11-15	11:34	12:49
DT2.2	11.6	-28.296157	23.315517	-28.244714	23.278027	20-11-15	10:40	11:10
DT2.3	11.6	-28.296157	23.315517	-28.244714	23.278027	27-02-16	10:51	11:57
DT2.4	11.6	-28.296157	23.315517	-28.244714	23.278027	29-02-16	12:44	13:25
DT2.5	11.6	-28.296157	23.315517	-28.244714	23.278027	21-04-16	12:15	12:38
DT2.6	11.6	-28.296157	23.315517	-28.244714	23.278027	22-04-16	9:58	10:27
DT3.1	3.79	-28.298987	23.30327	-28.311558	23.277294	18-11-15	11:55	12:22
DT3.2	3.79	-28.298987	23.30327	-28.311558	23.277294	19-11-15	11:11	11:30
DT3.3	3.79	-28.298987	23.30327	-28.311558	23.277294	28-02-16	6:10	6:30
DT3.4	3.79	-28.298987	23.30327	-28.311558	23.277294	29-02-16	6:28	6:55
DT3.5	3.79	-28.298987	23.30327	-28.311558	23.277294	21-04-16	8:21	9:01
DT3.6	3.79	-28.298987	23.30327	-28.311558	23.277294	22-04-16	8:27	8:40



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

ARCUS

- CSP Project
- Greater Kestrel Nest
- Artifical
- Existing Power
- Transmission Line Diversion Alternative 1
- Transmission Line Diversion Alternative 2
- Route Alternative
- Route Alternative
- NFEPA Rivers
- Watercourse
- Southern Kalahari Salt Pans
- NFEPA Wetlands
- Farm Dams
- Pan and Northern Black Korhaan Area (Medium Sensitivity)
- Artifical Waterpoints 100 m Buffer (Medium Sensitivity)
- 250 m Buffer (Medium Sensitivity)
- NFEPA River 500 m Buffer (Medium Sensitivity)
- Greater Kestrel Nest 1km Buffer (Medium-High Sensitivity)

1:100,000 Scale @ A3

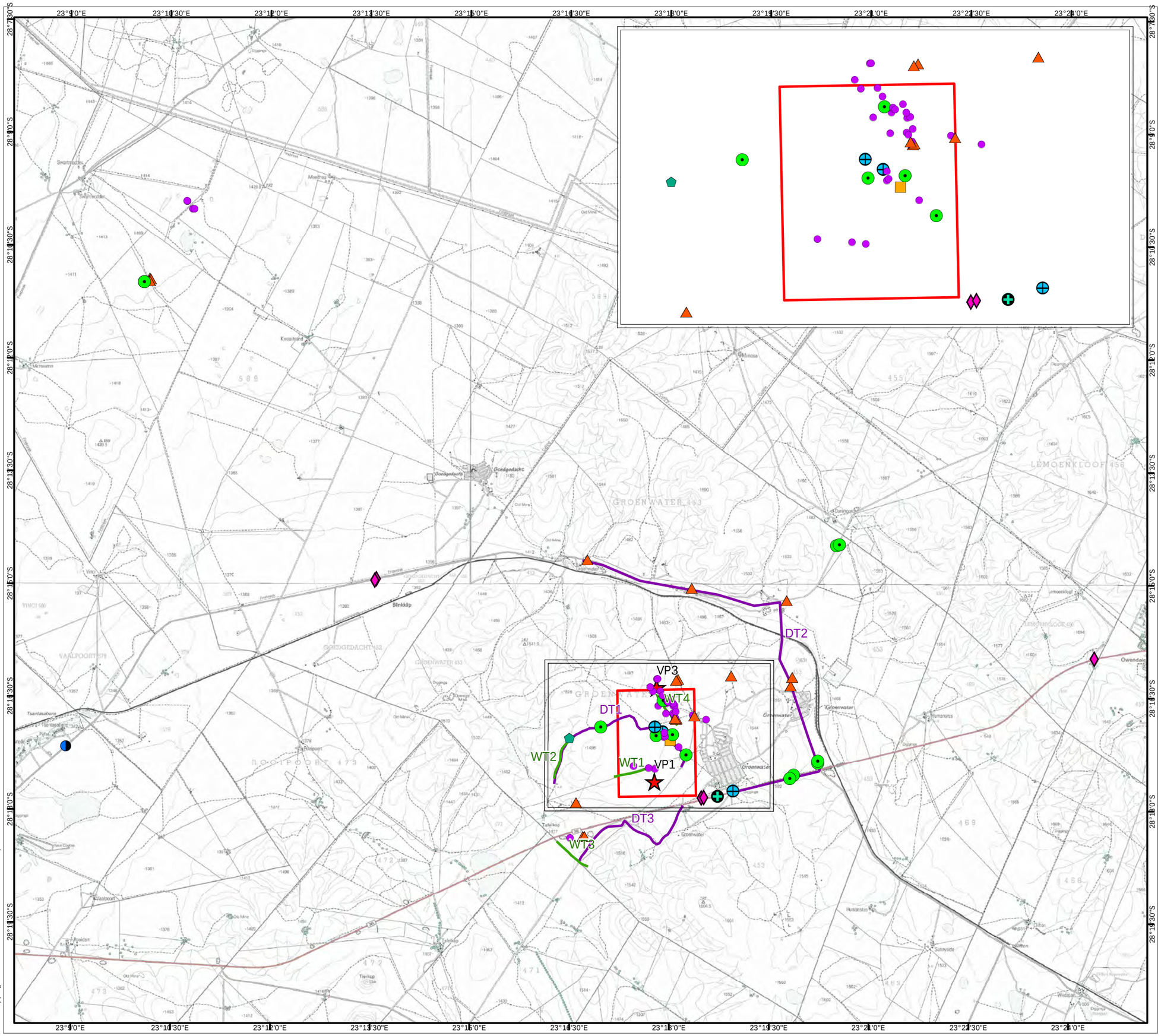
N

0 2 4 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/010 Date: 02/06/2016

Avifaunal Sensitivity Map
Figure 7

Metsimatala CSP Facility
Avifaunal Impact Assessment Report



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

ARCUS

- CSP Project Site Boundary
- Driven Transect
- Walked Transect
- Black-chested Snake Eagle
- Booted Eagle
- Greater Kestrel
- Lanner Falcon
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk
- Red-crested Korhaan
- White-backed Vulture

1:89,497 Scale @ A3

N

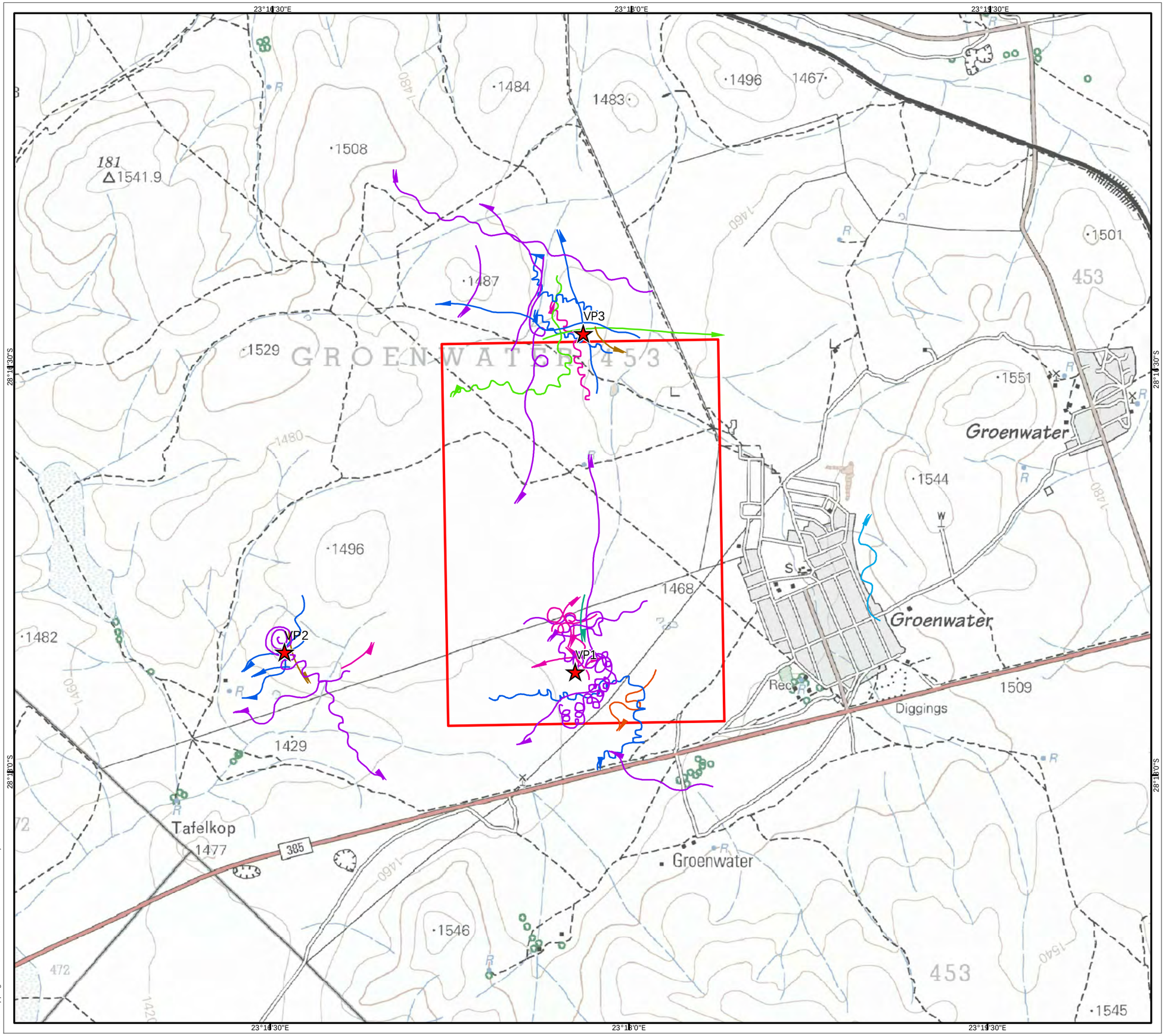
0 1.5 3 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/009 Date: 03/06/2016

Selected Incidental and Transect Species Records
Figure 6

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report

Z:\GIS\Projects\2211 Metsimatala CSP\Document Files\Reports\AIA\2211 Fig 06 Selected Incidental and Transect Species Records.mxd



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

Z:\GIS\Projects\2211 Metsimatala CSP\Document Files\Reports\AIA\2211 Fig 05 Selected Target Species Flights.mxd

ARCUS

- CSP Project Site Boundary
- Vantage Point
- Crowned Lapwing
- Cape Turtle Dove
- Hadeda Ibis
- Namaqua Dove
- Namaqua Sandgrouse
- Pied Crow
- Spur-winged Goose
- Western Cattle Egret

1:25,000 Scale @ A3

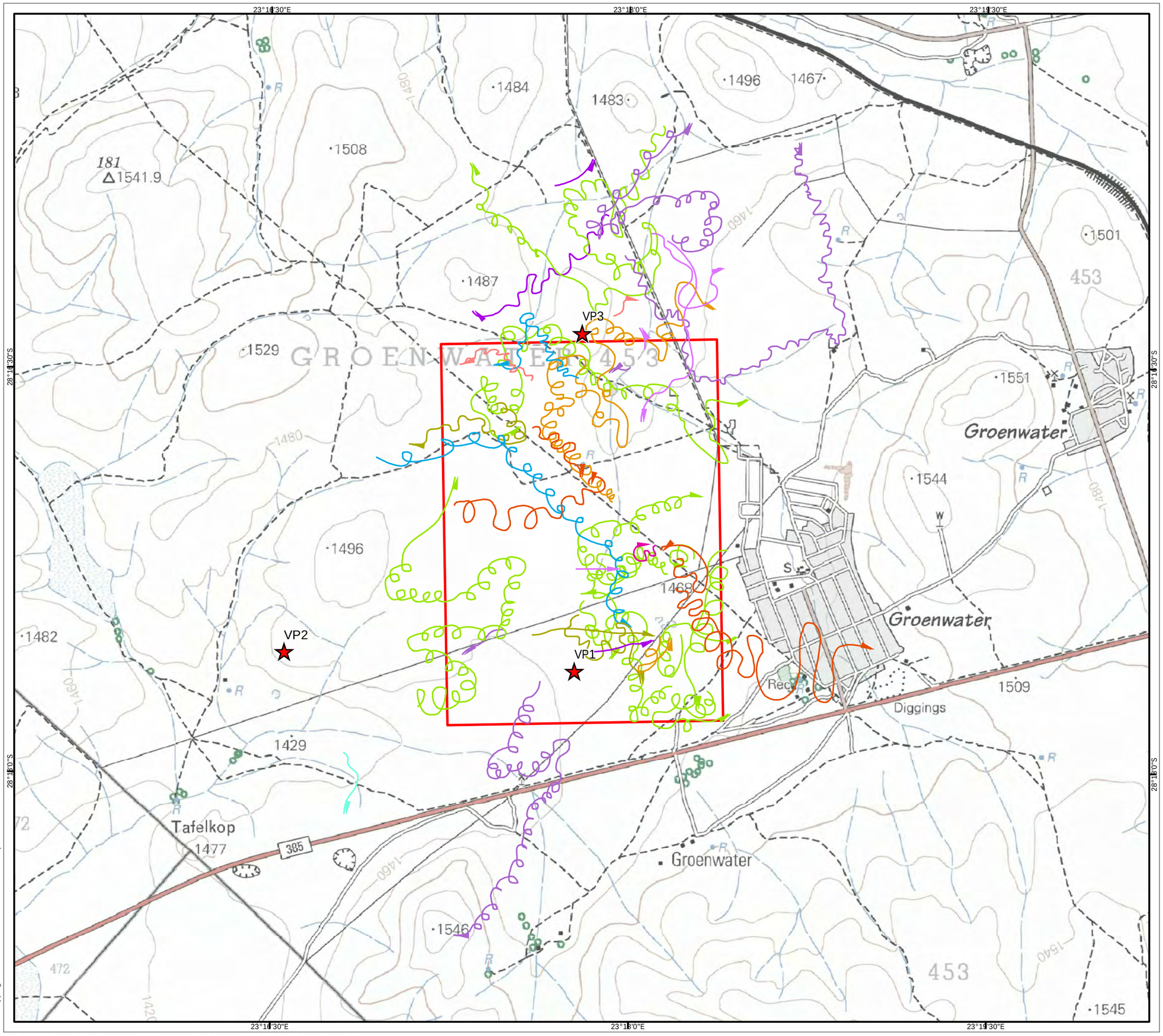
N

0 0.5 1 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/008
	Date: 01/06/2016

Selected Target Species Flights
All Seasons
Figure 5

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report



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

Z:\GIS\Projects\2211 Metsimatala CSP\Document Files\Reports\AIA\2211 Fig 04 Target Species Flights.mxd

ARCUS

- CSP Project Site Boundary
- Vantage Point
- Black-chested Snake Eagle
- Booted Eagle
- Steppe Buzzard
- Gabar Goshawk
- Greater Kestrel
- Jackal Buzzard
- Lanner Falcon
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk

1:25,000 Scale @ A3

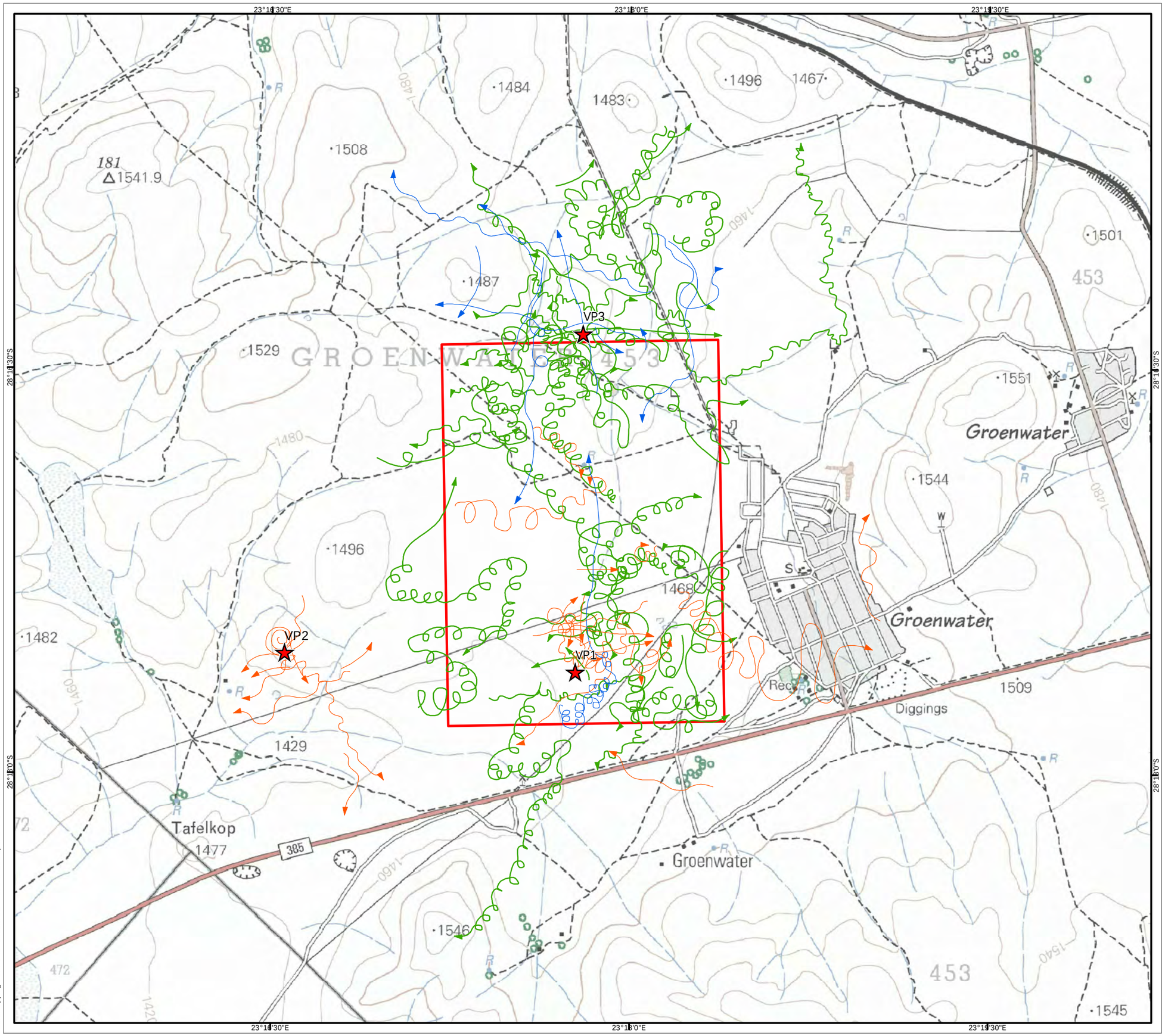
N

0 0.5 1 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/007 Date: 01/06/2016

Raptor and Korhaan Flights
All Seasons
Figure 4

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report



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

ARCUS

- CSP Project Site Boundary
- Vantage Point
- Survey 1 Flight
- Survey 2 Flight
- Survey 3 Flight

1:25,000 Scale @ A3

N

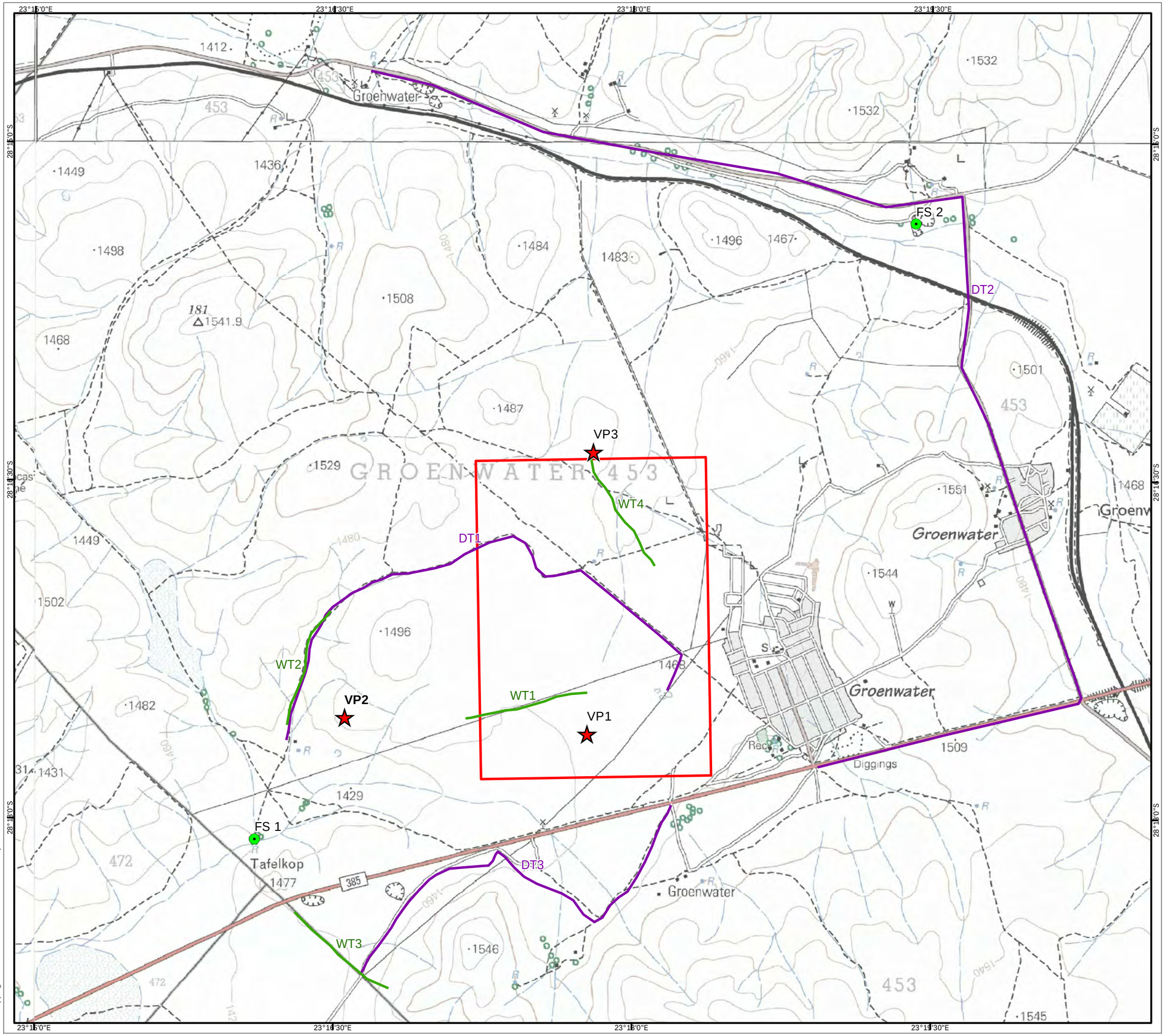
0 0.5 1 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/006
	Date: 01/06/2016

Target Species Flights Survey 1, 2 and 3 Figure 3

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report

Z:\GIS\Projects\2211 Metsimatala CSP\Document Files\Reports\AIA\2211 Fig 03 Target Species Flights Survey 1, 2 and 3.mxd



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

ARCUS

- CSP Project Site Boundary
- Vantage Point
- Focal Site
- Walked Transect
- Driven Transect

1:30,000 Scale @ A3

0 0.5 1 km

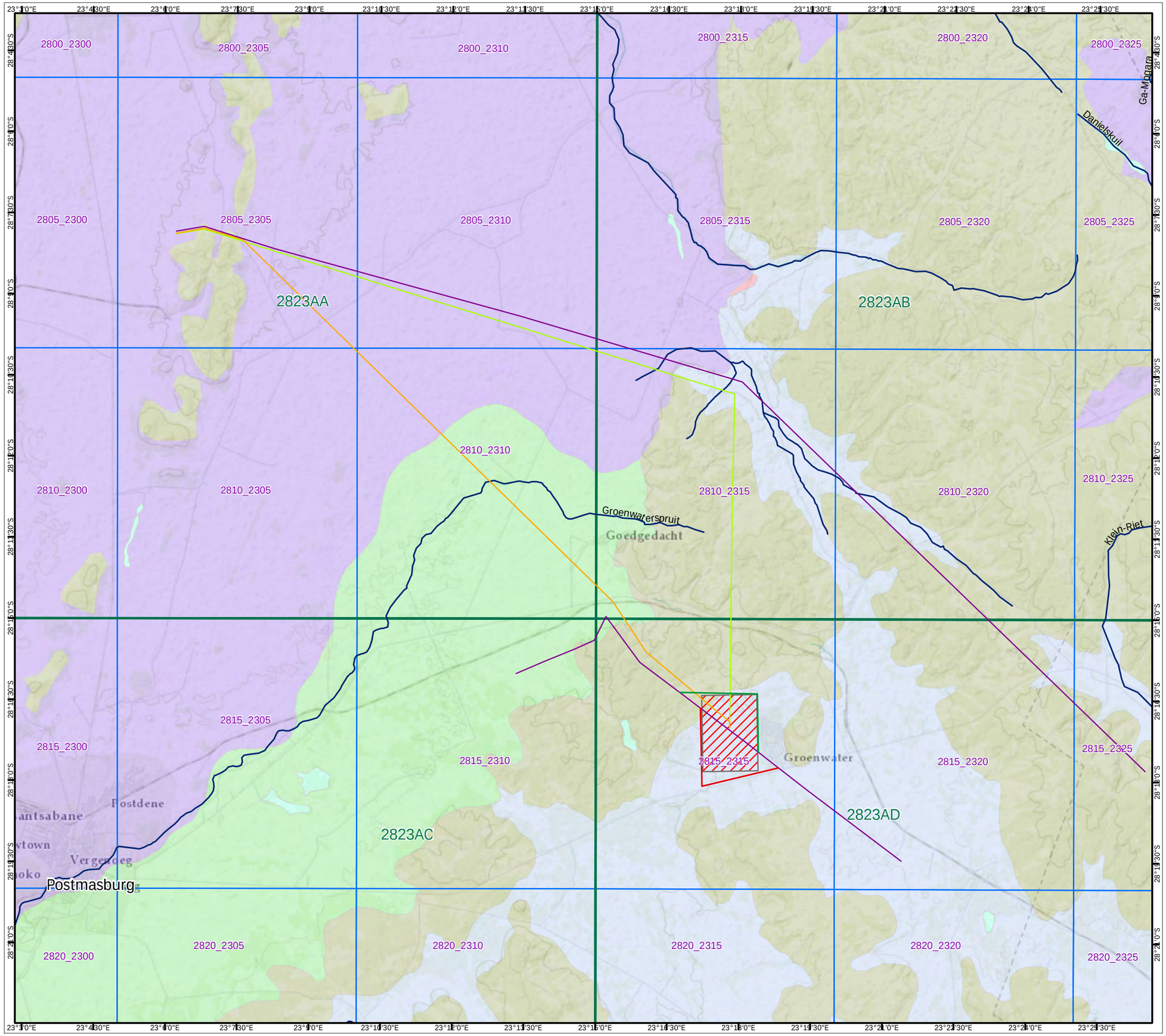
N

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/005
	Date: 01/06/2016

Survey Locations
Figure 2

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report

Z:\GIS\Projects\2211 Metsimatala CSP\Document Files\Reports\AIA\2211 Fig 02 Survey Locations.mxd



ARCUS

- CSP Project Site
- Route Alternative 1
- Route Alternative 2
- Existing Power Line
- Transmission Line Diversion Alternative 2
- Transmission Line Diversion Alternative 1
- NFEPA River
- Quarter Degree Square
- SABAP2 Pentad
- Kuruman Mountain Bushveld
- Kuruman Thornveld
- Northern Upper Karoo
- Olifantshoek Plains Thornveld
- Postmasburg Thornveld
- Southern Kalahari Salt Pans

1:125,000 Scale @ A3

N

0 2.5 5 km

Produced: AT Reviewed: SC Approved: AB	Ref: 2211/REP/004 Date: 01/06/2016

Project Location, Vegetation, Rivers and SABAP Squares
Figure 1

Metsimatala CSP Facility
Avifaunal Impact
Assessment Report