Ecological Impact And Offset Needs Analysis for the proposed Upilanga Solar Facilities and associated infrastructure near Upington, Northern Cape Province:

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1. SCOPE & BACKGROUND

Emvelo Capital Projects (Pty) Ltd, is proposing to develop the Upilanga PV projects near Karoshoek, located southeast of Upington in the Northern Cape Province. There are various built, approved and in-process projects present on the site which form part of the greater Upilanga Solar Park. Although the majority of the affected area does not fall within a CBA or protected area expansion strategy focus area, the large number of projects at the site which total more than 8000ha, raise the potential for significant cumulative impact at the site. Particular concerns include the large number of protected trees that would be lost to the development as well as the potential for habitat fragmentation and loss of broad-scale ecological function. The developer has indicated that the entire property could potentially be set aside for conservation purposes as an offset to mitigate some of the impacts of the renewable energy developments on biodiversity. However, the benefits of doing so would need to be evaluated in terms of the likely cumulative impact of all the development on the site, the biodiversity features present within the footprint as well as across the remainder of the site and the extent to which setting the remainder of the site aside for conservation represents an adequate mitigation measure.

In order to address the potential use of the site as a biodiversity offset and to address the associated concerns in detail, the developer has commissioned this Ecological Terrestrial Biodiversity Offset Study in order to inform the decision-making process in line with the Draft National Offset Policy (Government Notice 276 of 2017).

The Ecological Offset Study has the following broad aims:

- Provide an outline of the current framework for biodiversity offsets. A summary of the current Draft National Biodiversity Offset Policy is provided, highlighting the relevant sections as they pertain to the current development.
- Place the habitats present at the site in a regional context and identify features of the site that may make it of local or regional significance.
- Identify if and where similar habitat may occur in the area.
- If relevant, explore potential offset areas in terms of the draft national offset guidelines and the regional conservation context to ensure that identified offset areas meet the like for like offset criterion, but also occur in an area where their long-term sustainability can be ensured.
- If appropriate, evaluate the most appropriate type of offset to be developed in terms of land acquisition or stewardship and the recommended management authority.
- Identify any further actions and priorities required for taking the offset process forward.

2. FRAMEWORK FOR BIODIVERSITY OFFSETS

Habitat loss is recognized as the primary driver of biodiversity loss and biodiversity offsets are becoming an internationally accepted tool which can be used to ensure that development is ecologically sustainable by enhancing the conservation and sustainable use of priority ecosystems and fragile biodiversity-rich areas not under formal protection. The National Biodiversity Framework (NBF), 2009, states that "*In some cases, following avoidance and mitigation, there is still residual damage to biodiversity as a result of a development. In such cases, if the development is socially and economically sustainable, ecological sustainability may be achieved through a biodiversity offset. A biodiversity offset involves setting aside land in the same or a similar ecosystem elsewhere, at the cost of the applicant, to ensure no net loss of important biodiversity. Biodiversity offsets are particularly important in securing threatened ecosystems and critical biodiversity areas."*

The desired outcome of biodiversity offsets is to ensure that:

1. The cumulative impact of development authorization and land use change does not:
    - result in the net loss of CBA's or jeopardize the ability to meet South Africa's targets for biodiversity conservation;
    - lead to ecosystems becoming more threatened than 'Endangered'; and/or
    - cause a decline in the conservation status of species and the presence of 'special habitats'.
2. Conservation efforts arising from the development application process, and contributing to improved protection of South Africa's unique species and ecosystems in perpetuity, are focused in areas identified as priorities for biodiversity conservation. Particular emphasis is on consolidation of priority areas and securing effective ecological links between priority areas; and
3. Ecosystem services provided by affected biodiversity and on which local or vulnerable human communities - or society as a whole - are dependent for livelihoods, health and/or safety, are at minimum safeguarded, and preferably improved.

The basic principles and tenets that underlie offsets and their practical implementation required to achieve the above goals are outlined below. The majority of this is taken directly or synthesised from the draft National Offset guidelines (2017).

1 Defining Biodiversity Offsets

Biodiversity Offsets are conservation measures designed to remedy the residual negative impacts of development on biodiversity and ecological infrastructure, once the first three groups of measures in the mitigation sequence have been adequately and explicitly considered (i.e. to avoid, minimize and rehabilitate/restore impacts). Offsets are the 'last resort' form of mitigation, only to be implemented if nothing else can mitigate the impact (Figure 1). It is important to note in this regard that the offset, if required, is therefore not a form of mitigation in itself and the implementation of an offset does not release the requirement or need to implement the full array of mitigation and avoidance options at the impacted site.

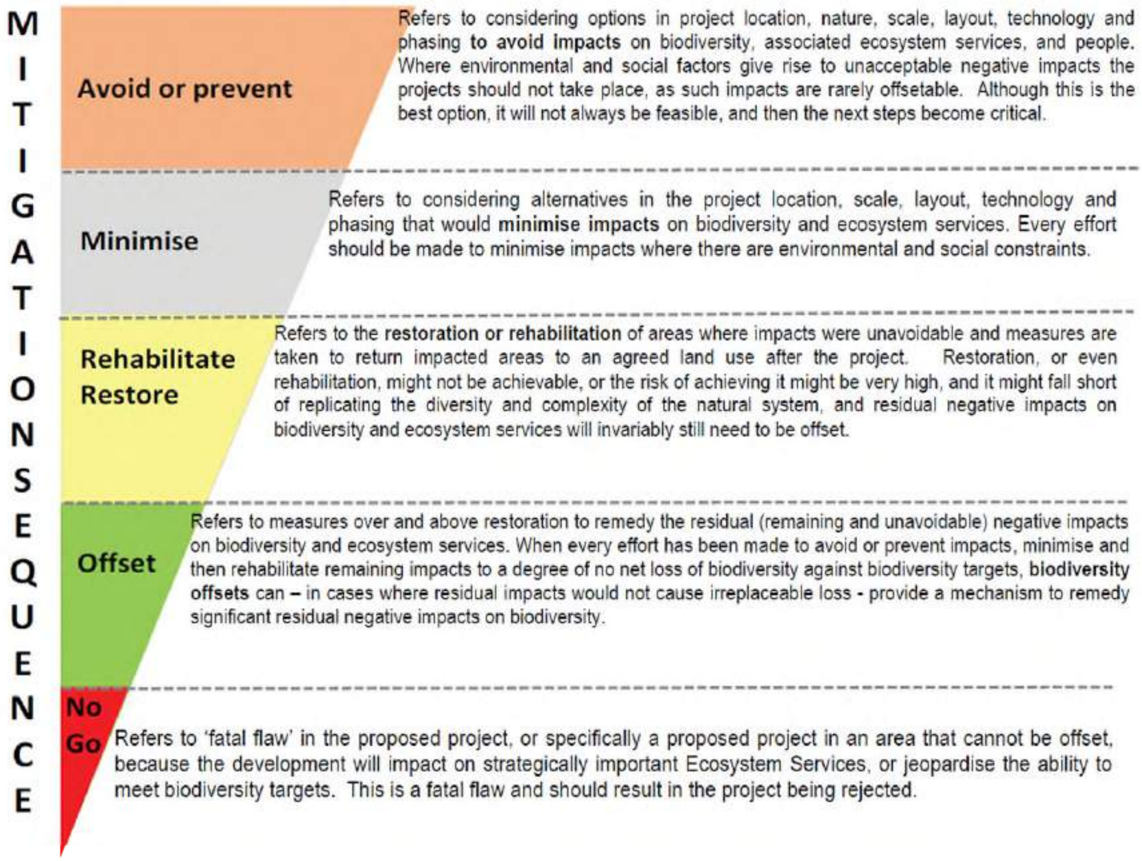

Figure 1. The mitigation hierarchy and the location of offsets within this context as the last resort for development.

2 There are limits to what can or should be offset

Biodiversity offsets are to be used in cases where the Environmental Impact Assessment (EIA) process identifies negative residual impacts of 'medium' or 'high' significance on biodiversity. Activities resulting in impacts of 'low' significance may not require an offset. Impacts on biodiversity of 'very high' significance may not be able to be fully offset because of the conservation status, irreplaceability, or level of threat to affected biodiversity, or the risk of preventing scientific targets for conserving that biodiversity from being met. In these cases, given that the proposed activity would lead to irreversible impacts and irreplaceable loss of biodiversity, alternatives to the proposal should be sought; i.e. the proposed activity should not be authorized in its current form.

3 The principle of ecosystem protection

Biodiversity offsets should ensure the long-term protection of priority ecosystems on the ground and improve their condition and function, thereby resulting in measurable positive outcomes for biodiversity conservation 'on the ground'. These outcomes could contribute to improved ecosystem integrity and increased use and/ or cultural value of offset areas and the ecosystems of which they are part.

4 No Net Loss up to specified limits of acceptable change
Biodiversity offsets should not be used to 'soften' a development proposal that would result in unacceptable loss of biodiversity. It should be designed in such a way that scientific targets for conserving ecosystems and other biodiversity features in the long term are attainable and not undermined as a consequence of the proposed activity. No biodiversity feature (species or ecosystem) should be at risk of being pushed beyond an Endangered threat status by a development.

5 Locating biodiversity offsets in the landscape
Biodiversity offsets should be located in the landscape in such a way that they help to secure priority areas for conservation, improve connectivity between these priority areas, and/ or consolidate or expand existing protected areas. Where priority ecosystem services are residually affected, biodiversity offsets should preferably be located in the landscape in such a way that they deliver equivalent services to affected parties; that failing, additional compensation measures would be needed for these parties.

6 Equivalence – 'like for like'
Biodiversity offsets should comprise - or benefit - the same biodiversity components as those components that would be negatively affected by development. In exceptional cases only, and only with support from the provincial conservation agency, could consideration be given to the biodiversity offset targeting a relatively more threatened ecosystem or habitat.

7 Additionality – new action required
Biodiversity offsets must result in conservation gains above and beyond measures that are already required by law or would have occurred had the offset not taken place.

8 Defensibility
The measure of residual negative impacts on biodiversity caused by a proposed development, as well as the design and implementation of biodiversity offsets, should be based on the best available biodiversity information and sound science, and should incorporate local traditional or conventional knowledge as appropriate. Offsets must consider all significant residual impacts on biodiversity: direct, indirect and/ or cumulative impacts. The scope of assessment must include due consideration of impacts on recognized priority areas for biodiversity conservation; impacts on biodiversity pattern (conservation status of ecosystem and species, importance to migratory species) and ecological and evolutionary processes (must look across scales and take into account connectivity, gradients and corridors); and impacts on ecosystems or species on which there is high dependence for health, livelihoods, and/ or wellbeing.

2.1 GENERAL PROCEDURES TO BE FOLLOWED WHEN CONSIDERING OFFSETS

The 2014 EIA Regulations (as amended) as part of the introduction of the "One Environmental System" (where different application and authorisation processes are run concurrently), impose very tight timeframes on Basic Assessment (BA) and Scoping and Environmental Impact Reporting (S&EIR) processes. In order for the biodiversity impacts to be adequately assessed and evaluated, and the mitigation sequence applied, it is desirable to evaluate the probable need for – and design of - offsets in the pre-application phase. It is therefore important for the applicant and Environmental Assessment Practitioner (EAP) to work with the Competent Authority (CA) [(e.g. the National Department of Environment, Forestry and Fisheries (DEFF)] in the pre-application phase to finalise as much of the biodiversity-related work as possible before the application is submitted. This should include:

a. Pre-application meeting with the CA and EAP to determine the possibility of an offset being required. If an offset might be required, it becomes imperative for the applicant to investigate other project alternatives during the EIA process, particularly where impacts are likely to be of high or very high significance.

b. The biodiversity specialist(s), appointed by the applicant, should be fully appraised of the development proposal, including feasible location or siting alternatives, proposed layouts, operational activities, associated activities and infrastructure on which the development depends, likelihood of risks (amongst others) in order to perform specialist studies that can produce reliable and defensible significance ratings for negative impacts on biodiversity, as well as mitigation recommendations. Specialist studies should be done well in advance of the submission of the application.

c. Should there be potentially significant negative impacts on biodiversity, the environmental assessment should undertake a process to exhaust the mitigation sequence to reduce the impact on biodiversity through the investigation of alternatives. The study should clearly show how the mitigation sequence has been followed.

d. Should residual impacts of very high significance be probable, the applicant would effectively be pursuing his/ her application on risk.

e. If the biodiversity specialist(s) subsequently confirms that the residual negative impacts on biodiversity of medium/high significance would be unavoidable, offsets should be discussed with the CA and, if deemed appropriate, offset investigation, planning and design would best commence pre-authorisation and be incorporated into all stages of the EIA/BA process.

f. If an offset is required, the EA should state that development may only commence after the offset has been secured.

2.2 DESIGNING AND LOCATING AN OFFSET

There is no single best approach to decide on an appropriate biodiversity offset. However, unless there is a compelling reason not to follow this process, the offset design process should comprise of the following seven steps:

1. Obtain a measure of the residual loss of biodiversity (i.e. residual negative impacts) as a consequence of the proposed development. This measure at minimum relates to the area and condition of affected ecosystem/ habitat;
2. Determine the best type of offset;
3. Determine the required size of offset and, where applicable, its optimum location;
4. Investigate candidate offset site(s) in the landscape that could meet the offset requirements. Check whether any eligible offset receiving area is suitable;
5. Decide on the best way to secure the offset, and ensure that the offset option would be acceptable to the CA and the statutory conservation authorities;
6. Prepare a Biodiversity Offset Report or dedicated section within the EIA/BA report; and
7. Conclude agreements on offsets (between the applicant and an implementing agent) and develop an Offset Management Programme, where applicable.

2.3 REQUIREMENTS FOR A PROPOSED OFFSET AS PART OF THE EIA/BA PROCESS

A CA DEFF may require that an Offset Report or an Offset Agreement be submitted as part of the Final BA or EIA Report, or that an Offset Agreement be concluded prior to the commencement of the listed activity. Where the applicant has secured and will manage (or contract a third party to manage) an offset, an Offsets Management Plan/ Programme may also be required to be submitted to the CA.

Reporting on Offset performance and sufficiency should be included in the Environmental Management Programme (EMPr) for any project.

Any Offset Report would be submitted as a specialist report with, and incorporated into, the BA or EIA Report. At minimum, it should include the following information (see Appendix 3 of the NEMA EIA Regulations, 2014, as amended):

1. An evaluation of the adequacy of measures considered and adopted to avoid, minimize and rehabilitate potentially significant negative impacts on biodiversity. (That is, were these measures sufficient; were reasonable and feasible alternative measures investigated, or could greater effort have been made particularly to avoid and minimize these impacts?).
2. A clear statement regarding the appropriateness of considering biodiversity offsets in this case. (That is, are there any residual impacts of ‘very high’ significance that could lead to irreplaceable loss of biodiversity and/ or priority ecosystem services?).

3. A reliable measure of residual negative impacts on significant biodiversity and ecosystem services requiring offsets.
4. It must take into account gaps in information or low levels of confidence in the predicted negative impacts.
5. It must give due consideration to uncertainties or low levels of confidence in the outcome of proposed measures to avoid, minimise and/ or rehabilitate negative impacts.
6. The duration of residual negative impacts of the proposed activity on biodiversity, taking a risk-averse approach, to determine the minimum duration of the biodiversity offset(s).
7. An explicit statement on the required size of the biodiversity offset to remedy these residual negative impacts, applying the basic offset ratio and adjustments as appropriate.
8. A description of the offset options considered (like for like habitat, trading up, or other), giving defensible reasons for arriving at the proposed offset type.
9. Where the proposed offset comprises land to be secured and managed:
   a) Evaluation of the probable availability of suitable offset site(s) in the surrounding landscape to meet offset requirements.
   b) Description of potential site(s) for biodiversity offset(s).
   c) Description of stakeholder engagement process in identifying and evaluating the adequacy and acceptability of the proposed offset site.
   d) Description of proposed approach to securing the offset site(s) (e.g. conservation servitude, protected area consolidation/ stewardship) and how it would be managed.
   e) Evaluation of probable adequacy of proposed offset site(s) by biodiversity specialist(s) and, where relevant, a social/ livelihood specialist:
      - *Is there a high level of confidence that offset site(s) would remedy residual impacts on a) biodiversity pattern (threatened ecosystems, threatened species and special habitats), b) biodiversity process, and c) on ecosystem services, while making a positive contribution to the long term conservation of biodiversity in the South Africa?)*
      - *Would the offset sites be located in recognised 'offset receiving areas'?*
      - *If relevant, is the motivation for a 'trading up' offset defensible in the specific context?*
      - *Would the offset site(s) be functionally viable in the long term?*
   f) A reliable estimate of the costs of acquiring or securing, rehabilitating and managing the necessary offset site(s) for the duration of residual negative impacts;

g) Responsibility for managing, monitoring and auditing the biodiversity offset;
   - *Who would be responsible for implementing, managing and auditing the biodiversity offset?*
   - *Statement regarding the adequacy of capacity of the institution, organization or other party to meet obligations in terms of above responsibilities;*

h) What measures would be taken to ensure that society as a whole, and affected communities in particular, would not be left more vulnerable or less resilient as a consequence of the proposed development [i.e. where offsets are to remedy loss of biodiversity underpinning valued ecosystem services, would the proposed offset(s) be affordable, accessible and acceptable to the main affected parties];
   - *Any negative impacts on local communities and/or society as a whole as a consequence of the proposed offset. If yes, how would these negative impacts be avoided;*
   - *Would the proposed use of the biodiversity offset site(s) be compatible with biodiversity conservation objectives? In particular, where an offset for residual negative impacts on biodiversity also provides offsets for residual impacts on ecosystem services, assurance must be provided that the latter would not compromise the biodiversity value of that offset (e.g. if biodiversity is to be a direct-use resource, then use could lead to degradation of that biodiversity / ecosystem).*

i) What mechanism is to be used to provide sufficient funds for acquiring/ securing and managing the biodiversity offset site(s) for the duration of residual negative impacts of the proposed activity (i.e. Who will be the recipient of money? How will funds flow to the implementing agent?)

The above forms a Terms of Reference for the current study and outlines the basic questions to be addressed in this study.

3. UPILANGA SITE BASELINE ANALYSIS

In this section, the regional context and features of the site are analysed, starting at a broad scale and filtering down through ever-finer scales to the habitats of significance present at the site and the species of concern that would be affected. This provides the context for the site and the impacts associated with the development. In addition, the site is also described in that it is firstly the receiving environment, but secondly the remainder of the property represents the potential offset that is being offered to account for the residual impact of the development.

3.1 BROAD-SCALE VEGETATION TYPES

According to the national vegetation map (Mucina & Rutherford 2006 and 2018 SANBI Update), there are several vegetation types within the site (Figure 2). The majority of the site and the area lost to development falls within the Bushmanland Arid Grassland vegetation type. Towards the Orange River and on stony ground more widely, the vegetation consists of Kalahari Karroid Shrubland. There is also a fairly large extent of Gordonia Duneveld associated with the deeper sands and red dunes of the site. Particularly in the east of the site, but also in smaller unmapped extents across the site, Lower Gariep Broken Veld occurs on the rocky hills of the site. The descriptions as appear in Mucina & Rutherford (2006) are not repeated here, as these are described in the BA report but rather the different features of the site as observed in the field are illustrated and described below as they relate to the current study. It is however worth noting that is fairly unusual in the context of the Northern Cape and the Kalahari/Bushmanland Bioregion to have at least five different vegetation present within an area. As such, it can be seen that the site is fairly diverse in terms of the number of different vegetation types and habitats that it would offer fauna and flora.

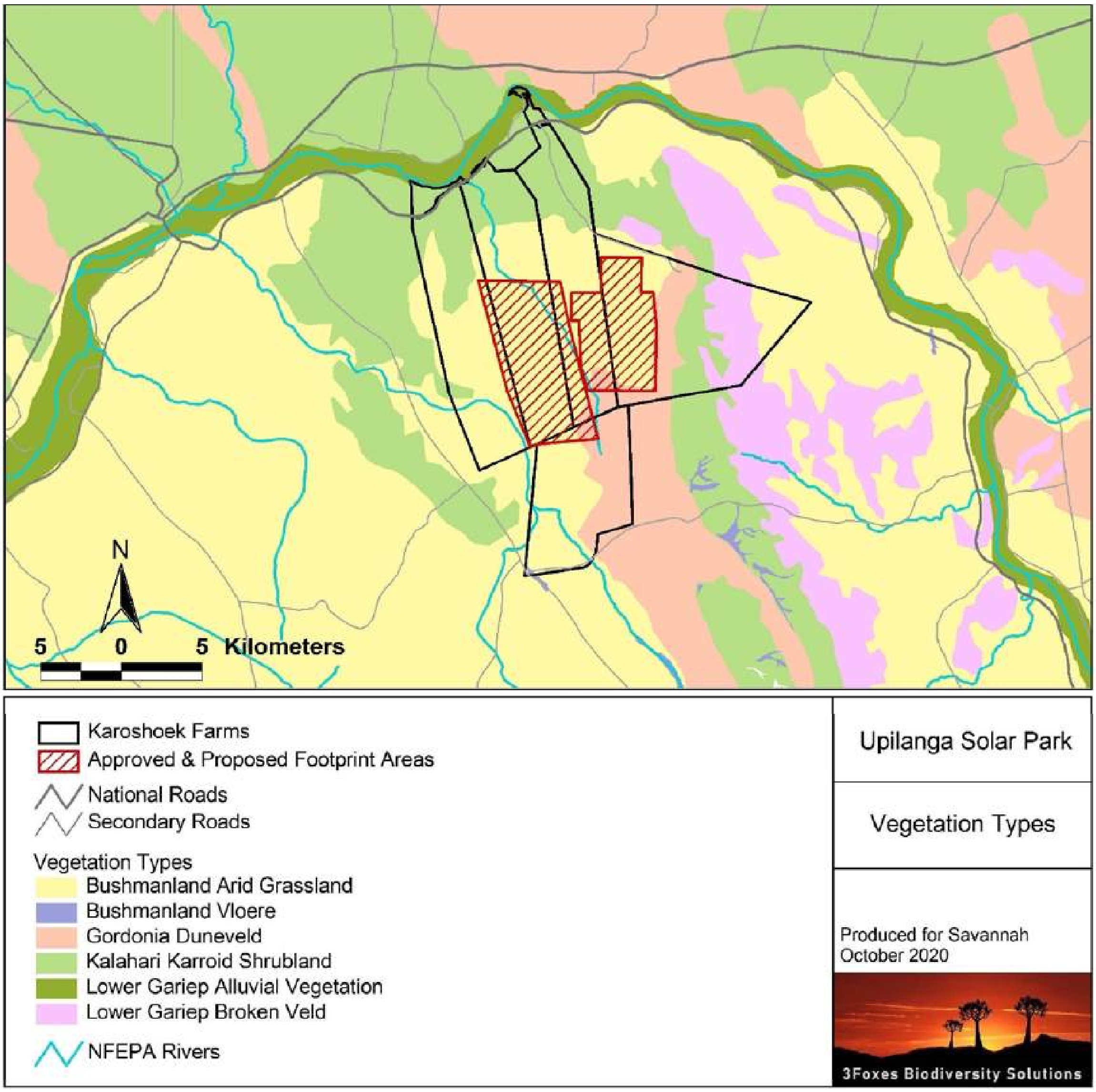

Figure 2. Vegetation map of the study area according to the 2018 update of the Mucina &

Rutherford (2006) vegetation map.

Bushmanland Arid Grassland

The majority of the site is mapped as Bushmanland Arid Grassland and is associated with shallow sandy soils. The abundance of species of concern within this vegetation type is generally low. Protected species observed at the site within this vegetation type include *Hoodia gordonii*, *Boscia foetida subsp. foetida*, *Boscia albitrunca* and *Vachellia erioloba*. In terms of these species, Boscia albitrunca is probably the main species of concern due to its relative abundance compared to the other species. Apart from occasional small ephemeral pans, there are no specific features of concern within this vegetation type.

Figure 3. The majority of the site and the development footprint is located within the Bushmanland Arid Grassland vegetation type. Although the diversity and density of species of concern is low, protected trees and *Boscia albitrunca* in particular is quite common across the site and this vegetation type is no exception.

Kalahari Karroid Shrubland

Kalahari Karroid Shrubland occurs on shallow stony soils across the site. In some areas this may include weathered quartz on the soil surface. The density of protected trees is generally lower within this habitat type compared to the other habitat types at the site. There are however still several protected species present within this habitat type including *Adenium oleifolium*, *Aloe claviflora* and *Hoodia gordonii*. Overall, this is not considered to represent a very sensitive vegetation type.

Figure 4. Kalahari Karroid Shrubland occurs on shallow stony soils across the site. Although diversity is significantly higher than Bushmanland Arid Grassland, the abundance of species of concern is generally quite low.

Lower Gariep Broken Veld

The rocky hills of the site are classified as Lower Gariep Broken Veld. This vegetation type is considered relatively sensitive given its' high diversity as well as the presence of numerous species of concern. Some of the hills are composed of quartz and frequently contain specialised associated species such as *Lithops* spp., *Anacampceros* spp., *Dinteranthus* spp. and *Aloidendron dichotoma*. This habitat is also considered important for fauna due to the different nature of the habitat it offers compared to the adjacent plains, such as offering cliffs for birds to nest and rocky crevices and loose rock cover for reptiles. Although this is considered to represent an important habitat at the site, it is not within the development footprint. However, in terms of the conservation value of the site, this is highlighted as one of the most important features of the site that adds significantly to its' overall conservation value.

Figure 5. The open plains of the site are occasionally interrupted by rocky hills and ridges consisting of Lower Gariep Broken Veld.

Gordonia Duneveld

There is a strip of Gordonia Duneveld running though the site. These areas are associated with deep red sands that usually form parallel dunes separated by grassy or shrubby inter-dune flats. The abundance of species of concern associated with this habitat is low but usually includes *Boscia albitrunca*, *Harpagophytum procumbens*, *Vachelia erioloba* and *Vachelia haematoxylon*. Due to the presence of the loose sand, this is considered to represent a relatively sensitive vegetation type that is considered vulnerable to disturbance.

Figure 6. Gordonia Duneveld is associated with deep red Kalahari sands and is dominated by grasses with occasional trees including *Boscia albitrunca* and *Vachelia erioloba*.

Special Habitats

There are several minor habitats of significance at the site including numerous small pans, some drainage lines and quartz hills. Although these features occupy a very small proportion of the site, they are considered to be of significance for fauna and flora and disproportionately add to the value of the site. The drainage lines are of significance as they are flanked by relatively large *Vachelia erioloba* trees which offer nesting sites to raptors and various other bird species which favour large trees for nesting sites. The drainage lines are also considered to be of significance as they are used as corridors by various fauna as they move back and forth between the Orange River and the drier interior. There are also numerous small pans present at the greater Upilanga Solar Park site which contain water following good rains and represent important breeding sites for frogs and temporary water invertebrates. The quartz patches represent a restricted habitat that has a variety of associated flora and fauna including specialised species such as *Lithops bromfieldii* and *Dinteranthus wilmotianus*. This habitat is not well-protected at all and there do not appear to be any such habitat within formal protected areas in the Upington area.

Figure 7. Although there are no well-developed drainage lines at the site, there are some sandy river beds flanked by *Vachelia erioloba* trees. In addition, there are numerous small pans distributed across the site that provide important habitat for temporary water invertebrates as well as frogs, birds and other species which are associated with water.

3.2 IMPACT ON PLANT SPECIES OF CONSERVATION CONCERN

Three National Forest Act (Act No. 84 of 1998) of 1998 (NFA) protected tree species occur at the site; *Vachellia* (*Acacia*) *erioloba*, *Vachelia haematoxylon* and *Boscia albitrunca*. Within footprint of the proposed developments, *Boscia albitrunca* is relatively common and the density of this species at the site is estimated at 10 trees/ha with the result that the cumulative impact of the development would result in the loss of approximately 8000 individuals of this species as well as numerous individuals of some other protected trees such as *Vachelia erioloba* and many individuals of provincially protected species. The loss of 8000 individuals of *Boscia albitrunca*, exceeds the threshold amount of trees that DEFF finds acceptable for loss without an offset. Due to the concern associated with the loss of the *Boscia* trees from the site, a review and spatial analysis has been provided as part of this study. The review is included as Annex 1 of this study and specifically investigates the natural history of both *Boscia* species and provides an analysis as to whether the loss of the affected individuals justifies the implementation of an offset for the development.

Figure 8. *Boscia albitrunca* is common across the site and relatively large numbers of individuals would be lost to the development at the site should all the proposed projects go ahead.

3.3 TERRESTRIAL FAUNAL COMMUNITIES

The faunal communities of the Karoshoek area are generally not very diverse, although there are some exceptions in terms of the different groups of fauna. The only red-listed mammal that can reasonably be expected to be resident at the site is the Black-footed Cat *Felis nigripes* which is classified as Vulnerable. No reptile species of conservation concern are known from the area. The rocky hills are however highlighted as the most important habitat for reptiles at the site. No red-listed amphibians are known from the area. The Giant Bullfrog *Pyxicephalus adspersus* is known from the area, but has been down-listed to Least Concern in the latest amphibian assessment. As such, it is clear that the site and area in general is not particularly important for terrestrial vertebrates. In general, the major impact associated with the development of the site for terrestrial vertebrates would be habitat loss and the disruption of the broad-scale connectivity of the landscape. There do not appear to be any particular species that would be disproportionately affected and who's local populations might be compromised by the development.

3.4 AVIFAUNA

Although the total number of bird species recorded in the vicinity of the site is not very high, eleven (11) threatened species are known to occur within the broader study area (Table 1). The most important of the red-listed species is the Critically Endangered White-backed Vulture *Gyps africanus*, which has been recorded within the broader study area (>40km), however this was a single record and there are no known breeding or roosting sites nearby, primarily due to the absence of suitably large *Acacia erioloba* trees, and hence the species is considered only as an occasional visitor that may occasionally pass by during foraging forays and its presence in the area is infrequent based on SABAP records. Similarly, the Endangered Lappet-faced Vulture *Torgos tracheliotos,* which has been recorded within the broader study area is most likely also only an occasional visitor to the area. The Martial Eagle *Polemaetus bellicosus* (Endangered) is also an important species that has been reported in previous studies, records of an immature bird suggest that the species most likely breeds on a large pylon or tree in the broader study area and is thus most likely a resident.

Although not recorded during SABAP2, the nomadic Ludwig's Bustard has been recorded by previous studies on the site and is relatively common within the Upington Ilanga Solar Park at least during favourable years. The Tawny Eagle (Endangered) is only known from the area based on local knowledge, but probably only occurs on rare occasions as this species favours more wooded savannas, and can thus be considered to be a rare to uncommon visitor. The Black Harrier *Circus maurus* (Endangered; Near-endemic) and Verreaux's Eagle *Aquila verreauxii* (Vulnerable) have also been recorded within the Upington Ilanga Solar Park. The Black Harrier will most likely be impacted by reduced foraging range within its home range whereas the Verreaux's Eagle is unlikely to be significantly impacted preferring the rocky outcrops and cliffs for foraging and breeding.

In terms of the Vulnerable species, the Black Stork *Ciconia nigra,* Lanner Falcon *Falco biarmicus* and Secretarybird and have been reported in the broad study area but with no records on either SABAP1 or SABAP2 cards for the site. The Black Stork is associated with wetlands and river systems and in the area would be largely associated with the Orange River. The Lanner Falcon is a partial seasonal migrant and would likely lose some foraging habitat but it appears to occur in the area fairly infrequently. A Secretarybird was recorded close to the north eastern border of the developmental site during a previous avifaunal study and sightings have been recorded in the broader study area. Furthermore, an inactive nest was found within the developmental footprint of the CSP4 Facility of the Ilanga Solar Park. This species is highly mobile and if a resident pair is present, they would be displaced from the study site and the protection of breeding sites outside developmental site should be considered an important mitigation measure.

The two Near-Threatened species that most likely utilize the developmental site include Karoo Korhaan and Kori Bustard. The Karoo Korhaan has a relatively high reporting rate of 83% and is therefore likely to be common within the site. Karoo Korhaans will likely be found on the plains, particularly the more gravel-like plains which this species prefers compared to sandy soils. A significant degree of local habitat loss for this species is likely. The Kori

Bustard has a low reporting rate of 8%. Both species are likely to be displaced from the development areas as these species are strictly ground-dwelling foragers. The Kori Bustard does, however, have a very wide national range with the result that the regional and national population will not likely be significantly be impacted.

Table 1. Red-listed species recorded in the broader study area during SABAP1 (1987-1991), SABAP2 (2007 on-going) and previous avifauna studies, ranked according to their red-list status. Estimated importance of local population and probability of occurrence as well as threats from the development are also provided.

English name	Taxonomic name	Red-list status	Estimated importance of local population	Preferred habitat	Probability of occurrence	Threats
Vulture, White-backed	*Gyps africanus*	Critically Endangered	Low	Savanna	Low	Habitat loss/Disturbance Collisions/Electrocution
Vulture, Lappet-faced	*Torgos tracheliotos*	Endangered	Low	Savanna	Low	Habitat loss/Disturbance Collisions/Electrocution
Bustard, Ludwig's	*Neotis ludwigii*	Endangered	Moderate	Shrubland plains	High	Habitat loss/Disturbance Collisions
Eagle, Martial	*Polemaetus bellicosus*	Endangered	Moderate	Savanna & shrublands	Low	Habitat loss/Disturbance Collisions/Electrocution
Harrier, Black	*Circus maurus*	Endangered	Moderate	Shrublands & grassland	Low	Habitat loss/Disturbance Collisions/Electrocution
Eagle, Verreaux's	*Aquila verreauxii*	Vulnerable	Moderate	Mountainous	Low	Habitat loss/Disturbance Collisions/Electrocution
Falcon, Lanner	*Falco biarmicus*	Vulnerable	Moderate	Widespread	Recorded	Habitat loss/Disturbance Collisions/Electrocution
Secretarybird	*Sagittarius serpentarius*	Vulnerable	Moderate	Open savanna & grassland	High	Habitat loss/Disturbance Collisions
Stork, Black	*Ciconia nigra*	Vulnerable	Low	Water bodies	Low	Collisions
Bustard, Kori	*Ardeotis kori*	Near-Threatened	Moderate	Open savanna	High	Habitat loss/Disturbance Collisions
Korhaan, Karoo	*Eupodotis vigorsii*	Near-Threatened	Moderate	Shrubland plains	High	Habitat loss/Disturbance Collisions

3.5 CONSERVATION PLANNING CONTEXT

In this section, the relevant conservation planning tools for the broad area are illustrated and discussed. The most important of these are the Northern Cape Conservation Plan (2016) and the National Protected Area Expansion Strategy for South Africa (2018). These maps indicate biodiversity priority areas required to maintain species richness and ecological processes in the first instance and areas that should be targeted for formal conservation expansion in the second. The two above-mentioned plans are not entirely independent of one another as all areas demarcated as Conservation Expansion Focus Areas, are classified as Tier 1 or Tier 2 CBAs and some of the CBAs are demarcated with the specific purpose in mind of maintaining development-free corridors between existing conservation areas to facilitate future expansion of conservation areas into these corridors. The location of Priority Focus Areas is designed so as to ensure the minimum land requirement to meet conservation targets but also to avoid isolated target areas and append these onto existing conservation areas where possible.

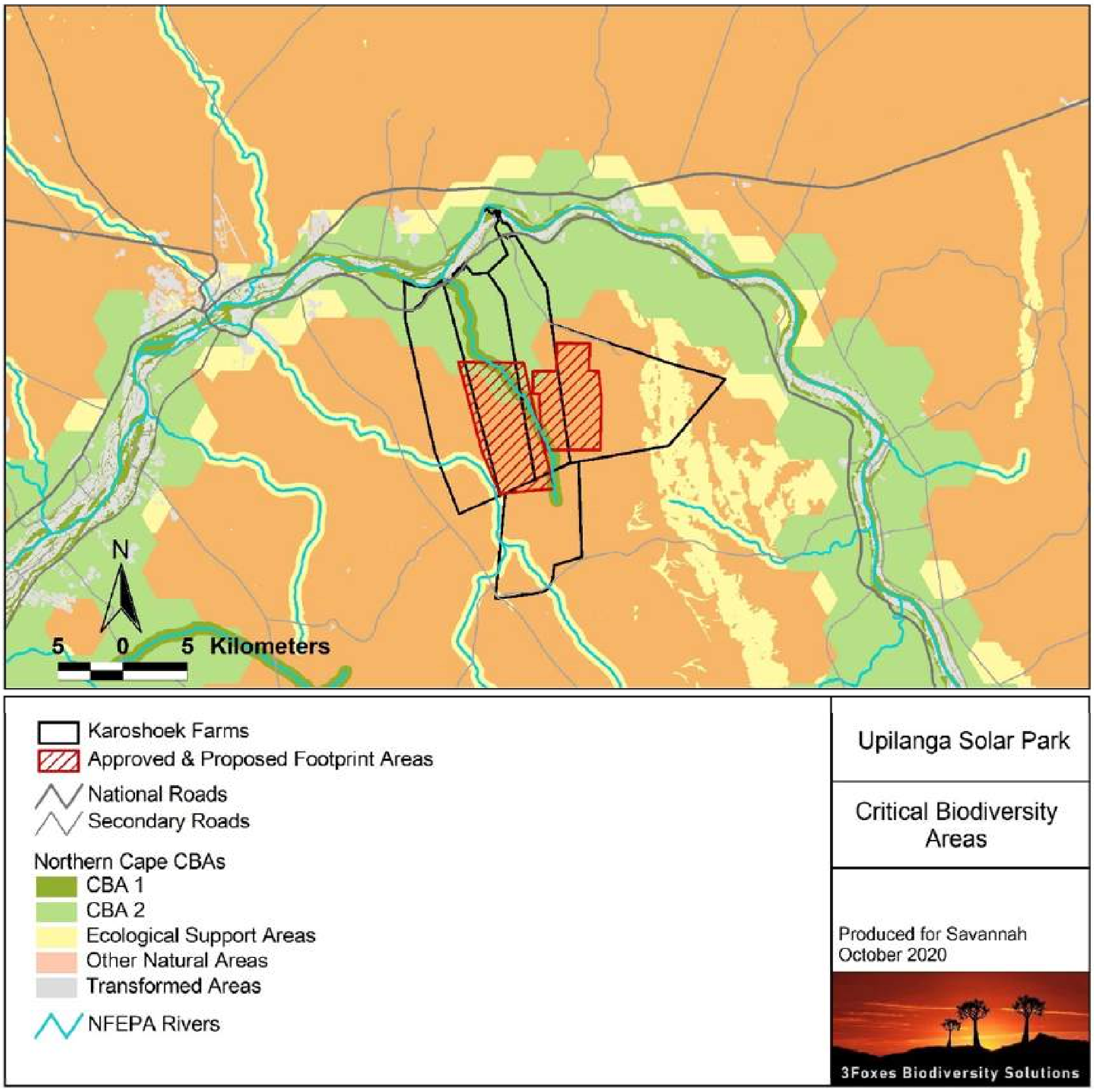

Figure 9. Critical Biodiversity Areas map for the study area, showing that the majority of the proposed Upilanga development is within other natural areas with a small portion of CBA 2 in the north.

The relevant section of the Northern Cape Conservation Plan which maps CBAs for the Northern Cape is illustrated above in Figure 9. The map illustrates that the northern part of the site including some of the proposed PV and CSP areas fall within a CBA 2. There is also a small drainage line that runs through the proposed development areas that has a CBA 1 buffer area. However, overall it is clear that the development of the site would not generate a very large impact on the CBAs of the site, with the loss of some CBA 2 area not likely to compromise the ecological function of the broader area. There are no Protected Area Expansion Strategy Focus Areas within or near the site (**Figure 10),** indicating that the site and adjacent areas have not been identified as important current priorities for conservation expansion. It is however worth noting that the site falls within an area that remains severely under-protected. The impact of the development on NPAES Focus Areas and CBAs is not considered sufficient to warrant the implementation of an offset in their own right.

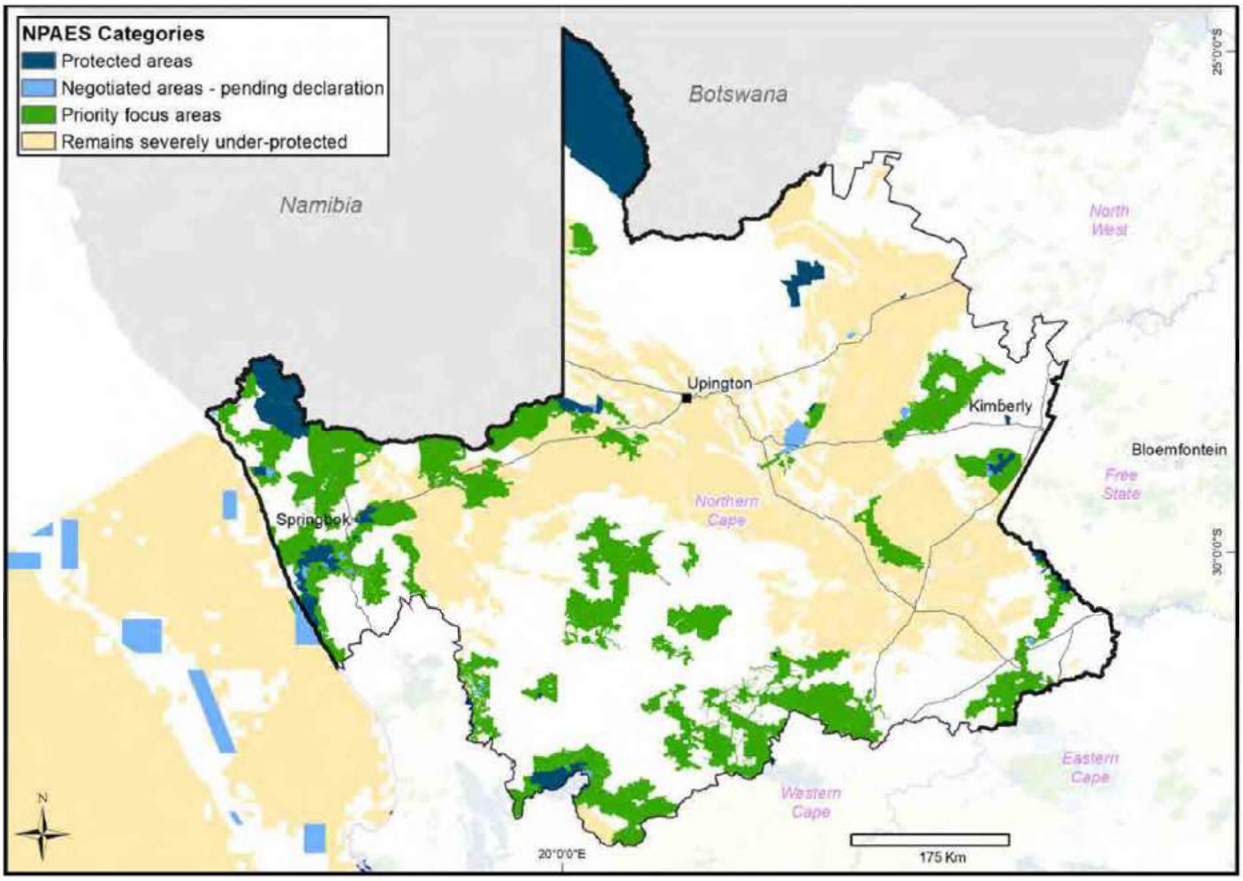

Figure 10. Extract of the 2016 NPAES showing the Northern Cape. There are no priority focus areas near Upington.

3.6 CUMULATIVE IMPACTS

The density of renewable energy development in the Upington area is very high, with numerous built, approved and in-process solar energy developments in the area (Figure 11). There are two main foci of development, the Karoshoek projects being considered here and then the projects west of Upington along the R27. These projects contribute to cumulative impacts on habitat loss and fragmentation in the area and since each project on its own generally has low residual impacts, it is the density of development in the area that is amounting to moderate overall cumulative impacts on fauna and flora.

The major impact associated with the development of renewable energy in the Upington area is likely to be the disruption of landscape connectivity, especially for fauna as the facilities are either fenced with mesh fencing or electrified fencing which makes it difficult for fauna to traverse these areas. Personal observations from the area suggest that seasonal movement to and from the Orange River is important for many fauna and the major ephemeral drainage lines leading to the River are likely to be of particular significance in this regard as they provide cover for shy types of fauna which usually avoid open ground.

Given the high development pressure in the Upington area, the area would benefit from a fine-scale conservation plan, which would enhance development planning in the area. The current approach is ad-hoc with developers burdened with the responsibility of identifying offset areas where required. However, this is not likely to result in long-term sustainable development or an optimal outcome in terms of biodiversity maintenance. As such, any offsets or formal conservation areas resulting from renewable energy development in the area should form part of a broader plan to enhance biodiversity outcomes in the area. Currently, there is no such plan available, but potentially, the Upilanga site could form the initial basis from which such a plan can be developed.

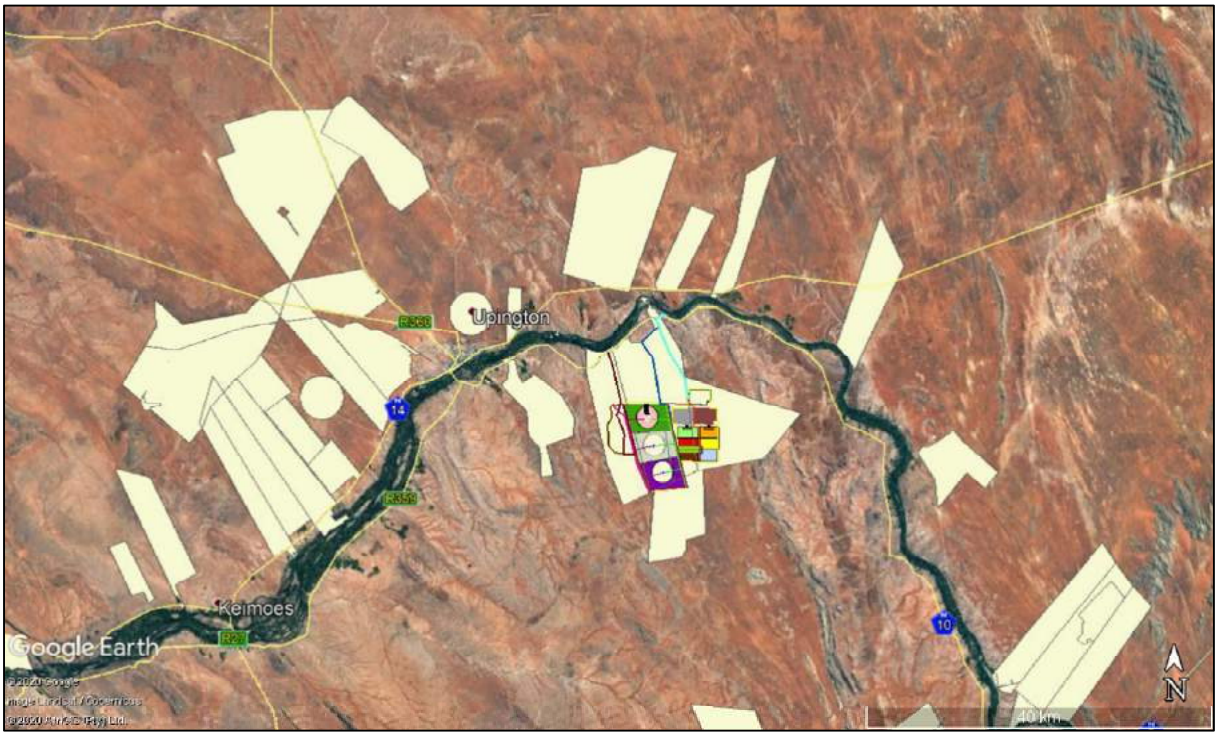

Figure 11. Map of other proposed renewable energy developments in the wider Upington area, showing the different projects at the Upilanga site. Note that the actual developments would not occupy the whole of the indicated land portions and that some more recent approved developments are not shown in the above map.

4. GAPS IN INFORMATION

Although the site has been visited numerous times between 2012 and 2020 as part of the specialist studies for the various projects on site, the focus was always on the affected areas and power line or water pipeline routes. As a result those parts of the site outside of the development footprint have not been very well investigated. As such some assumptions are made in this regard, especially with regards to the features that are outside of the development footprint. In addition, it is not possible to derive the nature and spatial distribution of ecological processes operating at the site with a high degree of confidence without long-term monitoring at the site. As such, the current assessment is based on an evaluation of the features present and their presumed value and importance for broad-scale ecological processes in the area. Although this is clearly a limitation associated with the current study, this is a problem inherent in the vast majority of such studies. In addition, the CBA maps themselves are based on similar assumptions regarding ecological processes and have largely not been empirically tested. On the other hand, the footprint of the development is well-defined and unlike wind farms, where impacts are diffuse and hard to delineate, the solar projects generate little operational phase noise and disturbance outside of their footprint areas. As a result, the overall consideration of impact and the potential benefit of the proposed mitigation or offset has a relatively high degree of confidence.

5. EVALUATION OF THE NEED & SUITABILITY OF AN OFFSET

In terms of the requirements for an offset study, it is required to evaluate the adequacy of measures considered and adopted to avoid, minimize and rehabilitate potentially significant negative impacts on biodiversity. Any development must ensure that there are no residual impacts of high significance that could lead to irreplaceable loss of biodiversity and/ or priority ecosystem services. In other words, an offset does not negate the need to reduce on-site impacts to an acceptable level.

A summary of the pre- and post-mitigation impacts associated with the proposed Upilanga development is provided below in Table 2. This is considered to represent the cumulative impact associated with all the proposed projects on the site and are not related to a specific project per se, but rather the overall impact associated with the whole development. This is considered appropriate because it is the cumulative and not the individual impact of any one project that warrants the need for an offset.

Table 1. Pre- and post-mitigation impacts associated with the proposed Upilanga projects.

Phase/Impact	Before Mitigation	After Mitigation
Construction Phase		
Impact on plant SCC	Moderate	Moderate
Impact on Terrestrial Fauna	Moderate	Low
Impact on Avifauna	Moderate	Moderate
Operational Phase		
Increased Habitat Degradation due to alien invasion and alien plants	Moderate	Low

Increased Alien Plant Invasion	Moderate	Low
Terrestrial Faunal Impact	Moderate	Low
Avifaunal Impact	Moderate	Low
Decommissioning Phase		
Increased Habitat Degradation due to alien invasion and alien plants	Moderate	Low
Terrestrial Faunal Impact due to decommissioning	Moderate	Low
Avifaunal impact due to decommissioning	Moderate	Low
Cumulative Impacts		
Impact on Broad-Scale Ecological Processes	Moderate	Moderate
Ability to Meet Conservation Targets	Moderate	Low

Although there is not a single impact that clearly demands that the study should require an offset, the combination of several moderate residual impacts requires that exceptional mitigation is implemented at the site, which could include an offset. Factors that detract from the need for an offset for the development include the fact that the proposed development largely avoids the more sensitive parts of the site and that potential impacts on red-listed species would in fact be low. Residual impacts on protected tree species, avifauna and broad-scale ecological processes would however remain moderate even after mitigation and motivate for some kind of exceptional mitigation. In terms of the mitigation hierarchy, it is always preferable to mitigate impacts on-site before the consideration of an off-site conservation measure.

The developer has indicated that the remainder of the properties on which the Upilanga project is located could be set aside as an offset and committed to formal conservation. This requires an evaluation before it can be accepted as a valid offset for the development. The extent of each vegetation type within the site and within the development footprint is indicated below in Table 3. The majority of the development footprint is located within the Bushmanland Arid Grassland vegetation type with less than 10% of the footprint within the Gordonia Duneveld vegetation type. Overall, the ratio of the development footprint to the total extent of the site is less than 1 to 4. In other words, this would amount to the offset ratio for the development. In general offset ratios are considerably higher than this which brings the suitability and adequacy of the site into question as an offset. However, there are several factors that should be considered before evaluating the site purely in terms of an offset ratio. The vast majority of the development footprint is located within the Bushmanland Arid Grassland vegetation type. This is considered to represent the lowest sensitivity vegetation type present on the site and is one of the most extensive vegetation types in the country. As such, the Bushmanland Arid Grassland cannot be equated with the other vegetation types on the site on a one to one basis. The key habitats at the site are Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld and in particular, their juxtaposition in the east of the site which creates a diversity of contrasting habitats within the relatively small area. This serves to enhance the ecological value of this area and is identified as the most important part of the site from a biodiversity point of view. In addition to the 1824ha of Lower Gariep Broken Veld mapped under the Vegmap, there are in fact more than 200ha of additional rocky hills at the site which have not been mapped and which can be considered to represent more of this vegetation type. The contribution of 2000ha of this vegetation type to conservation is considered significant as it is currently classified as Poorly Protected and even after the full implementation of the NPAES would remain severely under-protected. The protection of the site would add 0.44% of this vegetation type to conservation and at least in the local context, this is considered to represent a significant and meaningful contribution. In addition, the only vegetation type in the area that is currently adequately protected is Gordonia Duneveld. As a result, the conservation of the other vegetation types at the site such as the Kalahari Karroid Shrubland would also contribute to some degree to meeting conservation targets for these vegetation types. The habitat diversity of the site is also significant as this increases the resilience of the site to environmental changes and would enhance the overall biodiversity gain achieved through the conservation of the site.

Table 3. The extent of each vegetation type within the site and within the development footprint.

Vegetation Type	Total Extent within Site (Ha)	Total Extent within Development footprint (Ha)	Proportion not in footprint (%)
Bushmanland Arid Grassland	18 958	7 655	59.6
Kalahari Karroid Shrubland	6 338	0	100
Gordonia Duneveld	4 110	573	86
Lower Gariep Broken Veld	1 824	0	100
Bushmanland Vloere	15.8	0	100
Totals	**31 246**	**8 228**	**3.8**

The overall conclusion reached is that the remaining extent of the site would not be adequate as an offset if it was comprised solely of Bushmanland Arid Grassland or other vegetation types of low diversity. However, the fact that the site contains a significant extent of Lower Gariep Broken Veld is notable and significantly increases the conservation value of the site. Although the remaining extent of the site (ca. 23 000ha) is not that large in context of an arid environment, it is considered sufficient to provide for the maintenance of ecological processes across the site. Furthermore, the fact that the majority of the surrounding environment is not transformed means that the site would not be isolated from the surrounding area and does not need to maintain all ecological functions internally. Hence, the potential contribution of the site to conservation targets and outcomes is considered to be significant and as such is therefore adequate to offset the moderate residual impacts of the development.

6. CONCLUSIONS AND RECOMMENDATIONS

The primary motivations for an offset for the Upilanga projects include the cumulative impact of the development on habitat loss, fragmentation and the loss of individuals of protected tree species. The residual impact associated with each is moderate and each on its own is not considered sufficient to warrant an offset. However, given the scale of development at the site and combined impact on ecological function and biodiversity at the site, exceptional mitigation beyond standard avoidance and minimising of impacts is warranted. In order to address these concerns, the developer has indicated that the remaining undeveloped part of the site could potentially be set aside as an offset for the development. However, this should not be accepted without critical evaluation and the current analysis provides an examination of the potential of the site to be used as an offset to reduce the residual impacts of the development.

This investigation reveals the following outcomes and conclusions regarding the site and its potential value and limitations as an offset:

1. The majority of the development footprint is within the Bushmanland Arid Grassland vegetation type. This is an extensive vegetation type with few species or features of conservation concern present. The remaining extent of Bushmanland Arid Grassland at the site is not considered sufficient to offset the impacts of the development.

2. The diversity of habitats at the site is quite high and this is seen as an important feature of the site as such habitat diversity does not often occur in the Kalahari/Bushmanland Bioregion. Of particular importance is the presence of approximately 2000ha of Lower Gariep Broken Veld at the site. This vegetation type is currently Poorly Protected and is likely to remain severely under-protected into the future as a sufficient extent does not fall within any NPAES focus areas.

3. Should the site be committed to formal conservation, the contribution of 2000ha of Lower Gariep Broken Veld to conservation would add 0.44% of the existing extent to conservation. Although this is not highly significant at the national level, it is considered locally significant. In addition, it is important to note that many of the specialised species and species of conservation concern of the wider area are

associated with the Lower Gariep Broken Veld vegetation type. As such it clear that the biodiversity value of Lower Gariep Broken Veld is greater than that of Bushmanland Arid Grassland on a per-area basis and the two cannot be traded on a 1 to 1 basis.

4. The principle of like for like is a critical element of an offset, and in the current situation it could be argued that using Lower Gariep Broken Veld as an offset for the loss of habitat within Bushmanland Arid Grassland violates this principle. This is however not a valid argument, because it is the cumulative impacts on broad scale ecological processes and protected tree species that are the primary drivers of the need for an offset and neither of these are specifically associated with Bushmanland Arid Grassland but rather the ecosystem more generally. As such, the fact that the ecosystem within the development footprint is relatively poor in terms of biodiversity value, is expected given the first two tiers of the mitigation hierarchy which aim to avoid impact on the high value ecosystems of the site. In addition, ecological processes in semi-arid and arid regions operate over large scales and the development can therefore be seen within the context of the surrounding ecosystem and should not be isolated to just the affected vegetation type. Therefore, it is clear that the undeveloped parts of the property represent the best opportunity to offset the impacts of the development on a like for like basis.

5. The density of protected trees within the undeveloped area is variable, but as a rough estimate, it is estimated that there would be 5-10 times the number of protected trees outside of the development footprint as compared to those within the proposed footprint. This is considered adequate representation of protected trees within the offset to counter the loss of trees within the footprint.

6. The overall conclusion and recommendation regarding the potential of the undeveloped part of the site to act as an offset is that the potential contribution of the site to conservation targets and outcomes is considered to be significant and as such is adequate to offset the moderate residual impacts of the development.

7. Given the high development pressure in the Upington area, the area would benefit from a fine-scale conservation plan, which would enhance development planning in the area. This should focus on the distribution of rare and localised habitats with specific associated species such as quartz patches and pans. It should also focus on ensuring that the broad-scale connectivity and functioning of the landscape is maintained as the impacts of renewable energy development are likely to be most felt by faunal which move extensively about the landscape.

7. WAY FORWARD

It is important to note that the following steps and measures will need to be considered and undertaken to take the offset process forward:

- The recommendations of this report would need to be taken to the provincial and national authorities for discussion and input. Despite the recommendations of this report, the authorities may indicate that alternative offset arrangements beyond those suggested here would need to be implemented as the current recommendations may not adequately align with their own views and priorities.
- The offset area would need to be entered into a formal conservation agreement that commits the property to long-term conservation and limits the kinds of land use that can be practiced in this area.
- The nature and duration of the offset would need be negotiated with the provincial and national authorities. It is however recommended here that this should be into perpetuity.
- The offset would require funds to manage the offset area into the future. In general, funds for the management of the area would need to be allocated for at least the operational period of the solar developments, but possibly longer.
- The nature and extent of the offset would need to finalised before the BA process is finalised so that DEA can provide the appropriate stipulations in this regard in their EA.
- It is important to note that the offset is only implemented once the project becomes a preferred bidder and is thus certain to go ahead. The stipulations that would be provided by DEA above, usually only come into effect at financial close of the project before construction is about to commence. However, the extent and nature of the offset must be determined before this time and included in the final EIA report.

8. ANNEX 1. BOSCIA REVIEW & SPATIAL ANALYSIS

Literature review of *Boscia albitrunca* and *Boscia foetida* subsp *foetida*, species in the Upington Area

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1. INTRODUCTION AND PURPOSE

Due the cumulative impact of solar development on protected tree species in the Upington area, the commenting authorities have variously raised concern regarding several projects in the area that appear to have potential to generate significant impact on certain protected tree species. Of particular concern are *Boscia albitrunca* and *Boscia foetida* subsp. *foetida* both of which are common in the area and may be disproportionately impacted by habitat loss due to solar energy development. These are also very slow-growing species with the result that generation time is very long and it is not possible to translocate or cultivate these species in sufficient numbers to counter these losses. In order to address these concerns, a literature review and spatial analysis is conducted on *Boscia albitrunca* and *Boscia foetida* subsp. *foetida*.

The purpose of the literature view and spatial analysis is to provide a review of the biology and recruitment dynamics of *Boscia albitrunca* and *Boscia foetida* subsp. *foetida* and secondly to provide a spatial analysis of potential and actual cumulative impacts on the species and their habitats in the Upington area, resulting from the current as well as other renewable energy projects in the area.

2. PART 1. LITERATURE REVIEW

2.1 BOSCIA ALBITRUNCA

Fodder and Grazing Value

According to a thorough review by Alias et al. (2003) *B. albitrunca* has high value as a fodder and food source (Palmer and Pitman 1972, Brundin and Karlsson 1999, in Alias et al. 2003). As it is often the only available dense shade tree in the hot arid environment of the southwestern regions of its distribution (Bothma 1982), livestock congregate under the tree and it is speculated that this, along with its ability to take up minerals through its deep rooting system, leads to nutrient enrichment under these trees (Alias et al. 2003). *B. albitrunca* is also considered to therefore contribute to nutrient cycling in mainly oligotrophic sands, as well as performing other ecological services such as reducing nutrient leaching, mitigating soil degradation, preventing soil erosion, sequestering carbon and replenishing organic matter (Alias et al. 2003).

B. albitrunca's usefulness is most apparent in times of drought, of which it is very tolerant (Parry 1989, in Alias et al. 2003), and during which periods, its branches may be cut to supplement feed domestic livestock (Alias et al. 2003). According to Le Riche & Van der Walt

(1999) it is one of the most important forage trees in the Kalahari. *Boscia* trees are important for animal production due to their deep root system which enables them to take up minerals and access ground water during droughts (Topps, 1992). A *B. albitrunca* specimen found in the central Kalahari in 1974 had roots extending to 68 m deep, making it the plant with the deepest known roots (Canadell et al. 1986).

A study undertaken by the University of Stellenbosch (Wand et al. 1999), which examined several drought-adapted trees in the Richtersveld region, discovered that many of the tree species responded more to fluctuations in water acquisition potential than to evaporative demand. *B. albitrunca* is a sclerophyllous evergreen with a low water potential, and was unique in the study due to its high leaf nitrogen contents, photosynthetic rates and stomatal conductances, despite very low leaf water potentials (Wand et al. 1999). For all the investigated species, including *B. albitrunca*, leaf stable carbon isotope composition C13δC) varied between species (−22 to −27‰), but was lower than the mean for arid regions worldwide (Wand et al. 1999), which indicated moderately high levels of water use efficiency, however interestingly there was a less conservative strategy in *Boscia albitrunca*. The authors conclude that the affinity of *B. albitrunca* to summer rainfall biomes, their apparent decline in the western arid regions in recent geological history following aridification, and their absence southwards in the winter rainfall regions, suggest that this wash species relies on sporadic summer rainfall events to some extent (Wand et al. 1999).

The species is also considered an important fodder for game species (reviewed in Alias et al. 2003), for example, it is one of top ten most important browse species for the Black Rhino in Augrabies National Park. On the other hand, this obviously is species-specific as Springbok have been shown to actually avoid *B. albitrunca* clumps in the Park (Reid 2005).

Its value in restoration programmes has been recorded as practitioners recommend the retention of ecologically valuable species of trees that are not encroachers - such as *Boscia albitrunca* – because of these constituting important food sources for animals (Wand et al. 1999).

Cultural values

The *B. albitrunca* tree has a variety of cultural uses and values. The root is pounded to make porridge, used as a substitute for coffee or chicory, to make beer and to treat haemorrhoids (Roodt 1998, van Rooyen 2001, Alias et al. 2003). An infusion of the leaves is used to treat eye infections in cattle (van Rooyen 2001, Alias et al. 2003). The fruits are used in traditional dishes and the flower buds as caper substitutes in pickles (van Rooyen 2001). Household utensils are made from the wood (Alias et al. 2003). Decoctions of leafy twigs are applied to treat earache and eye complaints (*Boscia salicifolia* (PROTA). (2014).

Coates Palgrave (2015) refers to this species as 'a tree of life' because of the multiple uses it has to humans, livestock, and wild animals. However, Eckert (2000) noted during her study on natural resource management by communities in the Northern Province that the mohlopi tree (*Boscia albitrunca*) has lost relevance for the human diet. Although previously the roots were processed into a meal substituting the conventional porridge, currently, to bridge food scarcities, people are more inclined to fall back upon the pension payments of elderly family members to purchase mealie meal (Eckert 2000). Similarly, although the roasted roots of *Boscia albitrunca* make a pleasantly flavoured tea, most of these teas are rarely used today as a result of the readily available commercial tea and coffee (Mabogo 1990).

The leaves provide nourishing fodder for game and livestock (see Alias et al. 2003 for a review). Birds, baboons, monkeys, elephants, as well as humans, eat the fruit. Livestock as well as other herbivores in savanna areas such as giraffe, gemsbok and kudu browse the tree. Walker (2007) noticed that cattle browsed heavily on the evergreen *B. albitrunca*, which contained low concentrations of fibre and condensed tannins. Evergreen trees store carbon reserves in their leaves; hence browsing removes carbon reserves which lowers the carbon: nutrient ratio and subsequently improves palatability of evergreens (see review by Stamp 2003, Katjiua 2006). Katjiua (2006) recorded that *Boscia albitrunca* had high levels of CP and suggests that this demonstrates why *B. albitrunca* may constitute a key browse species in other arid and semi-arid environments (Owen-Smith 1993, Hendricks *et al.* 2002 in Katjiua 2006).

Distribution and Habitat

This species is found in the drier parts of southern Africa, in areas of low rainfall. The vast distribution range covers Botswana, Limpopo, Gauteng, North-West, Swaziland, the Free State, Northern Cape and KwaZulu-Natal. It also extends into Zambia, Zimbabwe and Mozambique. This species is widespread in dry, open woodland and bushveld and is especially characteristic in semi-desert vegetation of the Kalahari/ Karoo-Namib transition, but also extends northwards into various Zambesian woodlands and shrublands (Anon 1984, see Alias et al. 2003). *B. albitrunca* favours sandy, loamy and calcrete soils (Venter & Venter 1996, in Alias et al. 2003).

The following map accessed from the SANBI POSA website (http://newposa.sanbi.org/sanbi/Explore), retrieved on the 22 March 2017, shows the extensive distribution of *B. albitrunca*:

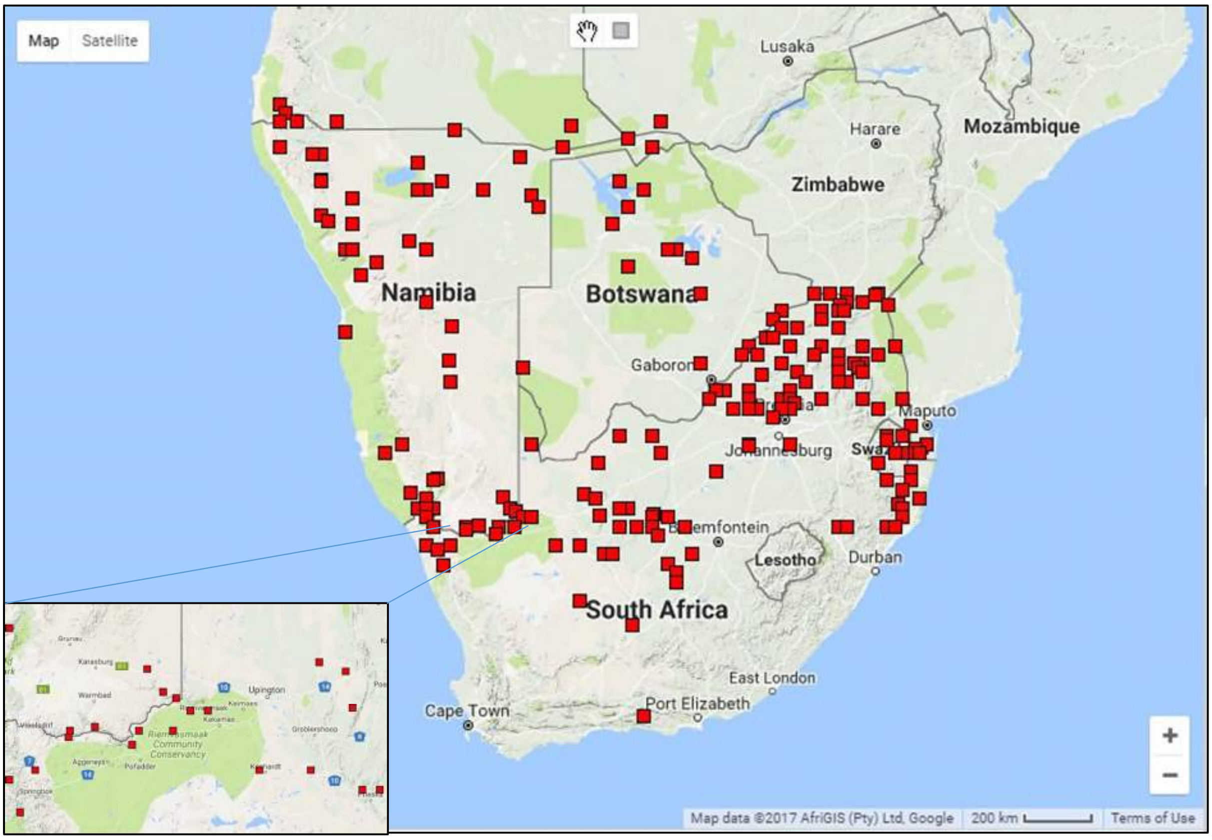

Figure 1. The distribution of *B. albitrunca* across southern Africa, based on the database from SANBI POSA. Note the inset showing the fairly scarce Northern Cape distribution around Upington, although this is more a sampling artefact than a real reflection of the distribution in this area.

According to Emilia (2015), *B. albitrunca* and *B. foetida* had amongst the highest niche breadth values (thus able to exploit a wide range of resources) across all plant species in several vegetation communities in the Karibib thornbush savannah (semi desert and savannah ecotone classified as sparse shrubland dominated by grasslands and scattered trees) in the Erongo region of Namibia, indicating a wide tolerance.

Ecology & Dynamics

The flowering period extends from August to November (Venter & Venter 1996), or after rain (Coates Palgrave 1983). The flowers are small and inconspicuous, star-shaped and without petals (Coates Palgrave 2015). The fruit is round and berry-like, yellow with a reddish flesh (Venter & Venter 1996), measuring 10-15 mm in diameter (Van Wyk 1984, Coates Palgrave 2015). The species has a number of pollinators.

As reviewed by Alias et al. (2003), the seeds of *B. albitrunca* are endozoochorous (Milton and Dean 1995, Dean et al. 1999, Leistner 1967, 1996, van der Walt and le Riche 1999) and non-dormant, with a short life expectancy (Briers 1988). The plant is easily propagated in horticulture both from seed and shoot.

In the laboratory the effect of some abiotic factors on seed germination and seedling growth of *B. albitrunca* was investigated by Pendota et al. (2016) and showed that warm stratification (30 C) of intact seeds (with seed coat) for 14 days achieved maximum germination (100%), whereas intact seeds without stratification showed very low germination (8%). They also recorded that "smoke–water (1:500 v/v)-treated seeds (without seed coat) showed a significant increase in germination (83%) compared to the control (47%) at 25 °C under a 16 h photoperiod. Increasing watering frequency enhanced most of the growth parameters of four-month-old *B. albitrunca* seedlings. Similar results were obtained when seedlings were treated with 25% Hoagland's nutrient solution. Deficiency of macronutrients (N, P and K) negatively affected growth of *B. albitrunca* seedlings. Higher antimicrobial activity of the experimental seedlings was observed in 80% ethanol extracts compared to the water extracts." (Pendota et al. 2016).

Apparently in order to propagate the seed, all the flesh must be removed from the seed as it contains a growth inhibitor and seed on the ground is usually parasitized (Jacana 2012). Seeds usually germinate after 7-14 days and seedlings need to be transplanted directly into open ground, as if planted out into nursery bags, growth tends to stop. The growth rate depends on the amount of moisture in the ground, and it is usually fast growing during the first five years but thereafter grow fairly slowly. Seedlings are hardy and drought resistant, but sensitive to extreme cold.

This species is observed in the field to establish beneath other large trees within its environment, primarily *Acacia erioloba*, which serve as resting and perch sites for animals and birds (Milton and Dean 1995, Dean et al. 1999, Leistner 1967, 1996, Ernst & Tolsma 1990). As such Alias et al. (2003) suggest that recruitment is thus likely favoured by availability of such sites, making the species dependent on large tree species in arid savanna.

With respect to germination, *B. albitrunca* seeds germinate rapidly compared to other arid zone species under ideal conditions, but their rate of germination is low (27.8%) (Briers 1988). It is possible, according to Alias et al (2003) that the slow growth rate (van Wyk 1984) of this deep-rooted species (Canadell et al. 1996) is likely attributable to extensive investment in establishing and maintaining a deep taproot system, prior to above-ground growth (Cunningham 2002).

In arid and semi-arid savannas, Wiegand et al. (2005) maintain that seeds of woody plants need relatively high soil moisture content over a prolonged period (several rain events in a single year) to germinate and establish (Obeid & Seif El Din 1971; O'Connor 1995; Wilson & Witkowski 1998, in Wiegand et al. 2005). The rarity of this occurrence increases the probability of mature tree stands or patches reverting to open savanna before germination occurs (Wiegand et al. 2005). There are no records of natural establishment and recruitment rates. In arid areas, water is likely the limiting factor and given the relative paucity of smaller trees in most populations, recruitment is clearly not a frequent event and probably happens only a few times a century.

According to the review by Alias et al. (2003), *B. albitrunca* was found to be among the most drought-tolerant species during the drought preceding 1960 but individuals smaller than 50cm either died or were resprouting from the base after aerial parts had dried up (Leistner 1967 in Alias et al. 2003).

Browsing, branch removal or the cutting of entire crowns as fodder supplement during severe droughts can transform specimens into flat, multi-stemmed shrubs (Van der Walt and Le Riche 1999, in Alias et al. 2003). High browsing pressure, cutting of branches for browse, and trampling of seedlings are possible threats to recruitment, establishment and overall survival of this species (Alias et al. 2003) although there are no studies done in this regard.

Conservation & Protection Status of Boscia albitrunca

B. albitrunca is considered a protected tree species, as per the National Forests Act (Act 84 of 1998)

The criteria used to select tree species for inclusion in the protected tree list are:

- Red List Status (rare or threatened species);
- Keystone Species Value (whether species play a dominant role in an ecosystem's functioning);
- Sustainability of Use (whether a species is threatened by heavy use of its products such as timber, bark etc);
- Cultural or Spiritual Importance (outstanding landscape value or spiritual meaning attached to certain tree species); and
- Other Legislation (whether a species is already adequately protected by other legislation).

Although *B. albitrunca* is not considered to be in decline and is therefore listed as Least Concern (Foden & Potter 2005, SANBI 2017), it was included on the list of protected species because it was considered a keystone species in the arid parts of South Africa, where it not only provides browse, but shade and microhabitat for other biota, and also because of its great cultural importance and potential uses (Izak van der Merwe, pers. comm.) (Alias et al. 2003).

2.2 BOSCIA FOETIDA SUBSP. FOETIDA

The synonym for *Boscia foetida* subsp *foetida* is *Boscia rautanenii* Schinz. Common names include the Foetid Bush, Knoudoring, Mohlopyana, Mohlotswana, Mopipi, Noenieboom, Old Woman's Bush, Stink Shepherds-tree.

B. foetida subsp *foetida* is a spiny shrub or small tree up to 5 m tall, occurring in dry woodland in Namibia, Botswana, Zimbabwe, Mozambique and South Africa (Jacana 2012). It is evergreen and has no defence against predators, and grows in isolated random distribution (Sjors 2006).

There is a paucity of literature on this species, particularly regarding its regeneration and threats to its survival.

Fodder and Grazing Value of Boscia foetida subsp foetida

Havenga et al. (2004) investigated the nutritional value of *B. foetida* and showed that *Boscia foetida* would make a useful contribution to most of the nutrient requirements of goats. *Boscia foetida* contains sufficient concentrations of Ca, Mg and Mn for the requirements of goats but lacks in P, Cu and Zn. The wide Ca:P ratio may present a problem, but ruminants can tolerate a relatively wide Ca:P ratio in the diet, provided that the P intake is high. The gemsbok population of the Torra conservancy used leaves from perennial bushes such as *Boscia foetida* (Lehmann et al. 2013).

B. foetida subsp *foetida* fruit are eaten by rodents, birds and people. Birds feed on the flowers and use it as nesting material (Curtis & Mannheimer 2005). Ground squirrels eat the stem and leaves of this species. A. Gunster observed that *Boscia foetida* was likely an important plant for the establishment of the stem-succulent *Salvadora aspersifolia* in Damaraland.

Regeneration and Growth

The species flowers from August to April, with a peak in September and October. Fruit has been recorded almost all year round, but mostly from October to March (Irish 2017). It produces abundant globose fruit that ripen to a yellowish or pale-brown colour, with a single brown seed (Wikipedia *Boscia foetida* 2017). They have a velvet-textured exterior, as supposed to those of *B. albitrunca*, which are smooth. They are about 1 cm in diameter (Wikipedia *Boscia foetida* 2017). Its reproductive height is 200cm (Irish 2017). It is likely that birds disperse the seeds.

Seed germination of *B. foetida* showed poor success (Birnbaum et al. 2005); and low rates over a prolonged period. Improved rates of germination were obtained by mechanical and acid treatment, the most successful treatment being with concentrated sulphuric acid for 30 minutes which resulted in 80% germination within 7 days (Birnbaum et al. 2005).

Teketay et al. (2016) studied vegetation community responses in Botswana's Mokolodi Nature Reserve showed that woody species, including *Boscia foetida*, had an unstable population structure, indicating the absence or inadequate number of large-sized trees, which, in turn, suggests that the reserve is still in the recovery phase several years after its exposure to heavy anthropogenic impacts, especially over-stocking with its associated over-grazing. However, based on personal observation, this species is generally tolerant of heavy grazing and is usually able to persist in areas with high continuous grazing such as communal areas. The branches are however brittle and heavy goat or cattle browsing can significantly impact established trees through breaking off of branches up to 5cm thick.

Distribution

Boscia foetida subsp *foetida*'s range extends from Namibia (where it is widespread and common to uncommon across most of Namibia) to Northern Cape, South Africa. It grows mainly on plains in semi-desert or arid bushveld but also presents on hillsides, rocky outcrops, termite mounds or along dry river courses (Curtis & Mannheimer 2005).

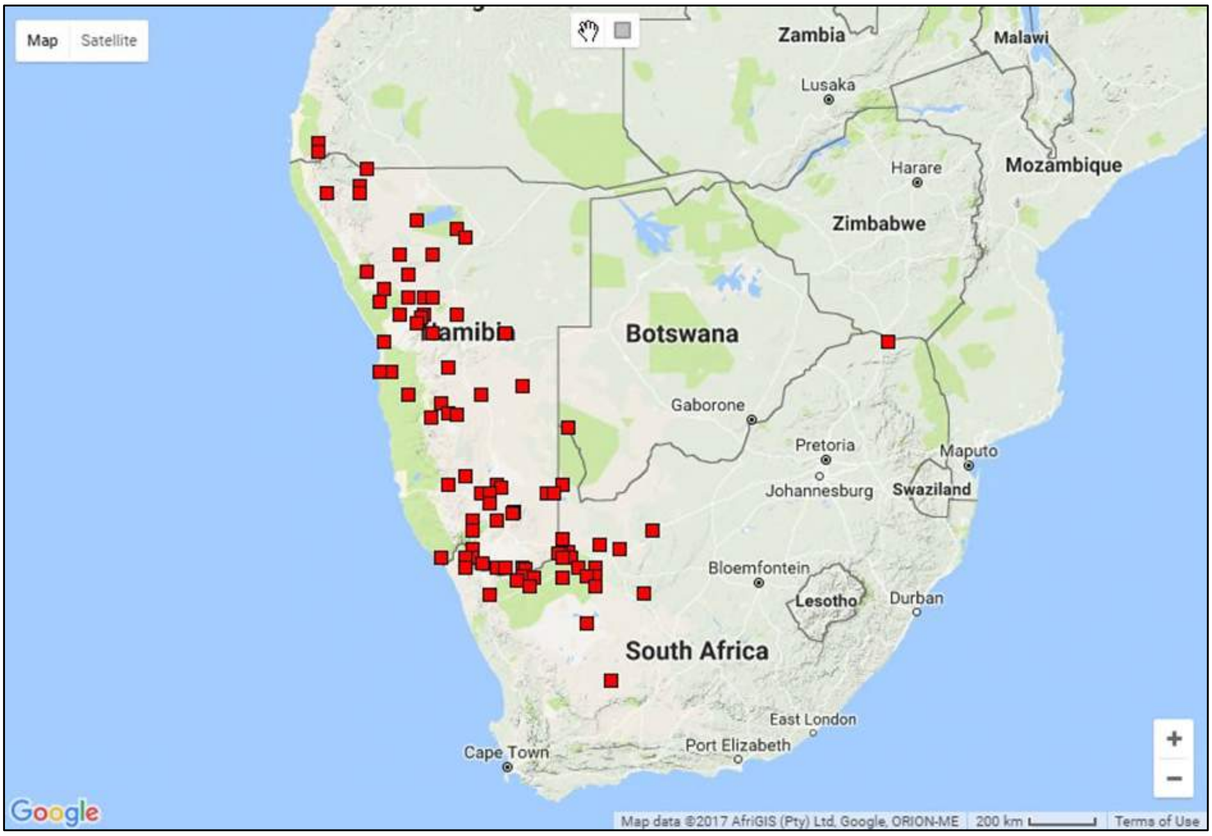

Figure 2. The distribution of *B. foetida* subsp *foetida* across southern Africa, based on the database from SANBI POSA.

According to Haimbili (2015), *B. albitrunca* and *B. foetida* had amongst the highest niche breadth values (thus able to exploit a wide range of resources) across all plant species in several vegetation communities in the Karibib thornbush savannah (semi desert and savannah ecotone classified as sparse shrubland dominated by grasslands and scattered trees) in the Erongo region of Namibia, indicating a wide tolerance.

Conservation and Protection Status

B. foetida is considered a protected tree species in the Northern Cape Province. It is not considered in decline and is therefore listed as Least Concern (Foden & Potter 2005, SANBI 2017). It not protected at the national level and is therefore not on the National List of Protected Trees as is the case for *B.albitrunca*.

2.3 SPATIAL ASSESSMENT OF B.ALBITRUNCA AND B.FOETIDA SUBSP FOETIDA

Cumulative Impact

The map of DEA-registered renewable energy projects in the Upington area is illustrated below in Figure 4. The map illustrates the large number of renewable energy projects in the

Upington area. However it is important to note that the map does not show the actual footprint of each development, which is usually significantly less than the cadastral units indicated. In addition, the map clearly illustrates the extensive tracts of intact habitat that would remain in the broader Upington area. B*oscia albitrunca* and *B.foetida* subsp. *foetida* are habitat generalists and are widespread within suitable habitat across the Northern Cape. As such, it can be seen that while renewable energy development in the Upington area is likely to have some local impact on the populations of these two species, a wider province-level impact is unlikely as the total number of affected individuals in the Upington area is likely to represent a small proportion of the provincial or national population.

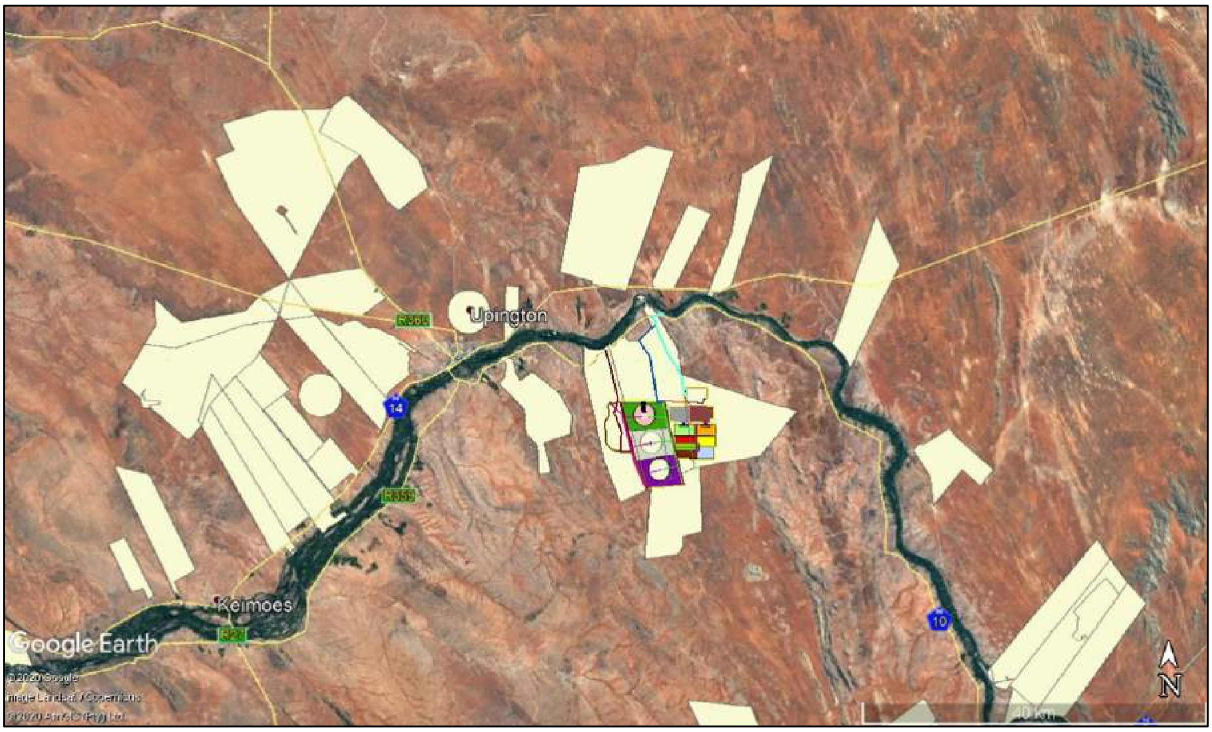

Figure 4. Map of DEA-registered renewable energy projects from the Upington area. It is important to note that the map depicts the whole affected cadastral unit and not the actual footprint of the development.

Local Significance of the Affected Boscia Populations

Although both *Boscia* species are considered Least Threatened and relatively widespread, the affected populations could be of local significance and it is important to evaluate the significance of the affected populations and the potential impact of their loss from the area as a result of the current as well as other developments in the Upington area. In order to evaluate the significance of the affected population of *Boscia* trees, the *Boscia* densities obtained from a number of different studies by the consultant were collated.

The density of *B.albitrunca* and *B.foetida foetida* at the current as well as a number of other sites is provided below in Table 1. The density of *B.albitrunca* varied from zero up to just over 80 trees per square kilometre. The Karoshoek area had a relatively high density of *B.albitrunca* with the only site with a higher density being the Garob WEF near Copperton. This suggests that the Karoshoek area has a higher than average density for the Upington area. A large amount of variation in *B.albitrunca* density is typical for this species and areas with very high densities can be observed for example along the N14 towards Olifantshoek and then in the Prieska area as well. This is likely related to the substrate conditions and relatively deep sands overlying bedrock or calcrete layers seem to favour this species. As such, the high densities observed at the Karoshoek site are not considered exceptional as areas with much higher densities can be observed but at least within the immediate vicinity of Upington, the site has a significantly larger *B.albitrunca* population than any other site in the area.

The density of *B.foetida* subsp. *foetida* at the Karoshoek site is relatively low compared to other projects in the Upington area. Given the widespread nature of this species in the Upington area as well as more broadly in the Northern Cape, it is highly unlikely that the loss of around 1000 trees from all of the Upilanga projects would generate a significant impact, even at the local level. Consequently, the impact on *B.foetida* subsp. *foetida* is considered to be low and not of broader significance. Based on the current densities obtained from the Upington area, it can be estimated that there are likely more than 200 000 *B.foetida foetida* trees within 25km of Upington and potentially as many a million trees within 100km. These estimates suggest that this species is likely to be fairly robust to local impact and the loss of trees from the current as well as other developments in the Upington area is not likely to have a significant impact on this species.

Table 1. Density of *Boscia* trees at the current as well as a number of other sites in the Upington and wider Northern Cape region.

Site	Sample Area (ha)	Boscia albitrunca (Trees/km^2)	Boscia foetida subsp. foetida (Trees/km2)
Dyasons' Klip 1 (Upington)	207	0	176.81
Dyasons' Klip 2 (Upington)	220	0.45	207.27
Sirius 1 (Upington)	244	4.10	92.21
Sirius 2 (Upington)	244	19.67	194.67
Karoshoek (Upington)	118	50.85	29.66
Klipkraal (Upington)	2000	7.39	9.91
Rooipunt (Upington)	2200	0.14	9.73
Konkoonsies (Pofadder)	200	0	30.00
Adams (Kathu)	500	5.20	0
Garob (Copperton)	45	82.22	0
Mean		**17.00**	**83.36**

3. UTILITY OF A BIODIVERSITY OFFSET FOR BOSCIA IMPACTS

Boscia species are considered fairly sensitive species because they are slow-growing (after initial rapid establishment), require zoochorous dispersal and require adequate recruitment sites for successful germination. However, they occur broadly across different biomes and community types of South Africa and beyond. They are not habitat specialists and are widespread and common within many parts of the Northern Cape. They are not associated with sensitive habitats or ecosystems of exceptional biodiversity value or which provide critical ecosystem services. Thus, while they can be considered to represent iconic trees of the summer-rainfall arid regions, their presence in an area is not of specific significance especially as there are other similarly tall trees present at the site.

The impact of the current development on *Boscia* spp. is considered relatively low based on the following considerations:

(a) The relatively localized impact on these trees given their widespread abundance across many other habitats across southern South Africa,
(b) The lack of existing threats to the species,
(c) The fact that most of the affected area does not fall within a Critical Biodiversity Areas nor a National Protected Areas Expansion Strategy Focus Area (NPAES), and
(d) The low levels of cultural use of these species in this particular context;

Rates of natural regeneration for *Boscia* species are low (Birnbaum et al. 2004), so there is concern that the loss of thousands of trees could lead to local population-level impacts on these species. However, it is not likely that the loss of the affected trees would impact the remaining trees ability to recruit or set seed as there are extensive populations remaining in unaffected areas, both within the Karoshoek site as well as more generally in the Upington area.

Offsets are appropriate when there is an imminent threat to the remaining examples of the affected species or habitat. However, given the abundance of both *Boscia* species in the Northern Cape, and the apparent lack of a clear threat to their future in the area, an offset for the sole purpose of protecting *Boscia* trees cannot be easily justified. The trees that are present on private farmland do not appear to be under any kind of threat and the species is also well represented in conservation areas.

4. CONCLUSIONS & RECOMMENDATIONS

While both *Boscia* species can be considered to represent iconic trees of Bushmanland and the Kalahari, they do not appear to be under any specific and pervasive threat to their further persistence in the Northern Cape. They can certainly be considered ecologically important where they occur, but the loss of some trees from a relatively restricted area is not likely to carry any broader consequences. They are not associated with sensitive habitats or ecosystems of exceptional biodiversity value or which provide critical ecosystem services. Based on the abundance estimates obtained from the current as well as other studies in the Upington and broader Northern Cape region, it is likely that many millions of each species is present in the Northern Cape.

The impact of the current developments on *B.albitrunca* and *B.foetida* subsp. *foetida* is considered low and not likely to compromise the wider population based on the following considerations:

(a) The relatively localized extent of habitat loss from the three current development given their widespread distribution across South Africa,
(b) Their relatively broad habitat tolerance and lack of specific association with sensitive habitats or ecosystems of exceptional biodiversity value or which provide critical ecosystem services.
(c) The apparently stable current population and lack of existing threats to the species,
(d) The fact that the affected area does not fall within a Critical Biodiversity Areas nor a National Protected Areas Expansion Strategy Focus Area (NPAES).

(e) The presence of extensive tracts of intact and unaffected habitat across the broader Upington area.

Based on the above analysis, the following conclusion is reached with regards to the potential and need for a biodiversity offset to counter the impact on these species in the Upington area:

- An offset is not considered appropriate to offset the impact of the Upilanga projects on *Boscia foetida* subsp. *foetida*. The number of affected individuals is not very large and the affected area has a below-average density of this species. In addition, this species is relatively small and not as important as *Boscia albitrunca* in terms of providing ecological services to the environment.
- The density of *Boscia albitrunca* within the site is considered to be relatively high. The impact on the local population of this species is also considered to be relatively high as it is not very common in the Upington area. The wider provincial impact on this species would however be low as there are several areas in the Northern Cape where the density of this species is significantly higher and more extensive than at the current site. From an ecological perspective, the impact on *Boscia albitrunca* alone does not warrant an offset in its' own right. However, when considered in light of the other impacts associated with the development, the potential impact on *Boscia albitrunca* is a significant contributor to the significance of the overall negative impacts of the development on biodiversity at the site. As such, any offset implemented at the site should include provision for the conservation and protection of this species.

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