Appendix 6

Specialist Studies

Appendix 6A

Biodiversity Assessment

!XHA BOOM WIND FARM GRID CONNECTION:

FAUNA & FLORA SPECIALIST BASIC ASSESSMENT REPORT

PRODUCED FOR SiVEST

ON BEHALF OF MAINSTREAM RENEWABLE POWER SOUTH AFRICA

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CONTENTS

List of Figures:

NEMA 2014 Checklist

Section		NEMA 2014 Regulations for Specialist Studies	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	4-5	✓
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;		
	(b)	a declaration that the person is independent in a form as may be specified by the competent authority;		✓
	(c)	an indication of the scope of, and the purpose for which, the report was prepared;	6	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	8-10	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	8	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	10-17	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	20-23	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.		
	2	Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

PROFESSIONAL PROFILE OF CONSULTANT:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent experience and relevant projects in the immediate vicinity of the current site include the following:

- Mainstream South Africa Dwarsrug Wind Energy Facility: Fauna & Flora Specialist Impact Assessment Report. Sivest 2014.
- Basic Assessment Process for the Proposed Construction of the Transnet 15km 50 kV Power Line from Eskom Helios Substation to the proposed new Transnet Helios Traction Feeder Substation. Nsovo Environmental Consulting. 2014.
- Loeriesfontein Wind Energy Facility – Substation & Grid Connection. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.
- Proposed Re-Alignment of the Authorised Power Line for The Loeriesfontein 2 Wind Energy Facility.: Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2014.
- Mainstream Loeriesfontein 2 Wind Energy Facility: Fauna and Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.
- Mainstream Khobab Wind Energy Facility: Fauna And Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.

1 INTRODUCTION

As part of the proposed !Xha Boom Wind Farm, South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, a 132kV Linking Substation and an associated 132kV power line north of Loeriesfontein in the Northern Cape Province. The purpose of the grid connection is to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid at the Eskom Helios Substation. Mainstream have appointed SiVEST as the independent Environmental Assessment Practitioner (EAP) to undertake the required environmental authorisation process for the proposed development. SiVEST has appointed Simon Todd Consulting to provide a specialist terrestrial biodiversity study as part of the required Basic Assessment process for the grid connection and associated substations.

The purpose of the Terrestrial Biodiversity Basic Assessment Report is to describe and detail the ecological features of the proposed site; provide an assessment of the ecological sensitivity of the site and identify and assess the impacts associated with the development of the grid connection infrastructure. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed in Section 1.1 below.

1.1 Scope of Study

The scope of the study includes the following activities:

- a description of the environment that may be affected by a specific activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- an assessment of the significance of direct, indirect and cumulative impacts of the development;
- a description and comparative assessment of all alternatives including cumulative impacts;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr);

- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- a description of any assumptions uncertainties and gaps in knowledge; and
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity; and
    - a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations for the study included the following:

- Disclose any gaps in information (and limitations in the study) or assumptions made.
- Identify recommendations for mitigation measures to minimize impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the EMPr for faunal or flora related issues.
- The assessment of the potential impacts of the development and the recommended mitigation measures provided have been separated into the following project phases:
    - Pre-construction
    - Construction
    - Operational
    - Decommissioning

1.2 RELEVANT ASPECTS OF THE DEVELOPMENT

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely !Xha Boom Substation), as well as a 132kV Linking Substation and a 132kV power line. The aim of this development is to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the "proposed !Xha Boom Substation")
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV power line from the proposed !Xha Boom Substation, via the proposed Linking Substation to Helios substation, approximately 29km south-east of the proposed !Xha Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A power line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed power line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

It should be noted that two (2) alternative sites for the proposed on-site !Xha Boom Substation and the proposed Linking Substation are assessed during the Basic Assessment (BA), in conjunction with four (4) power line corridor alternatives.

The proposed power line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. An example of the type of line and typical footprint associated with the proposed power line can be seen low in Figure 1. The exact location of the towers will be determined during the final design stages of the power line.

The proposed !Xha Boom Wind Farm (part of a separate on-going EIA process) application site, proposed !Xha Boom Substation site and associated 132kV power line corridor route alternatives are shown in the locality map below (Figure 2).

Figure 1. A section of the 132kV grid connection for the Mainstream Khobab Wind Energy Facility, showing the type of infrastructure to be used and the associated footprint.

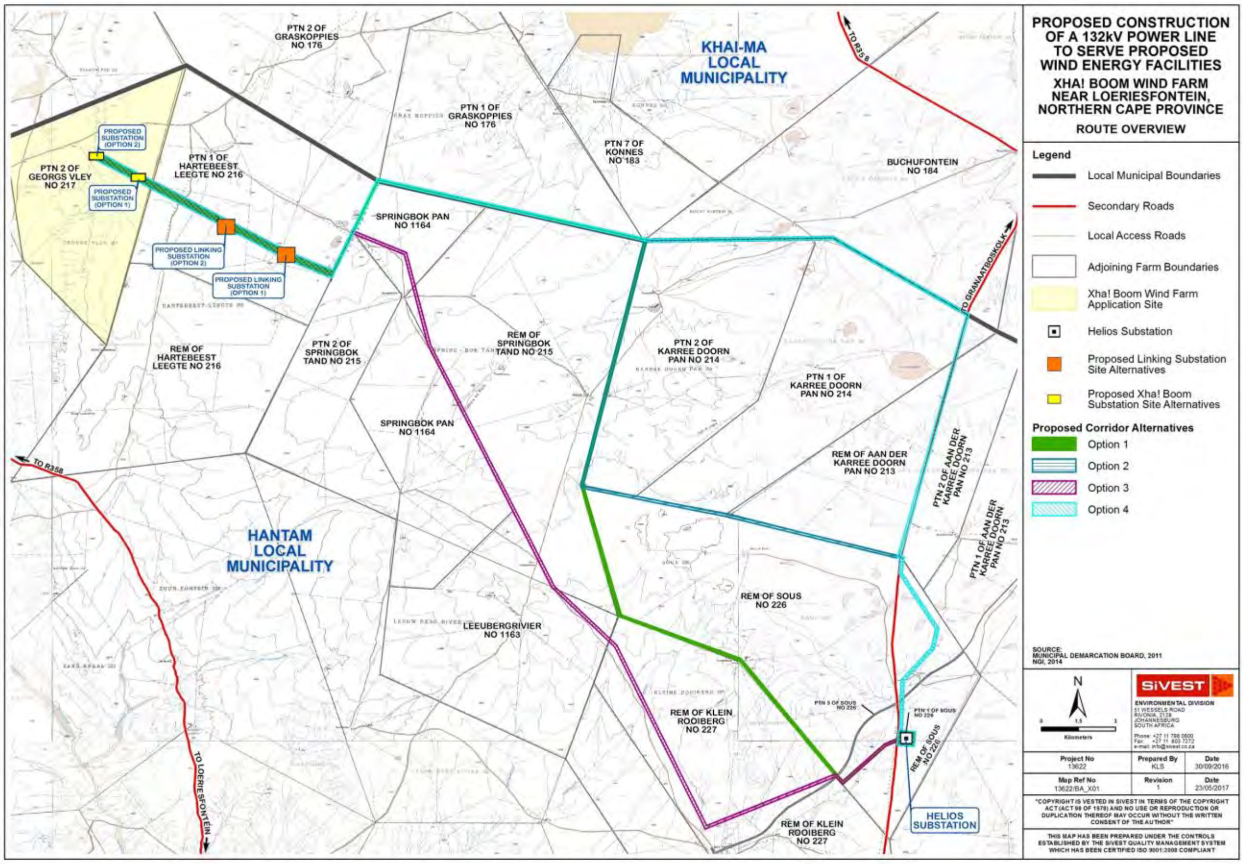

Figure 2. Layout of the !Xha Boom power line, linking substation and on-site !Xha Boom substation alternatives that are assessed in this study.

1.3 Assessment Approach and Philosophy

The assessment has been conducted according to the 2017 amended EIA Regulations as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

In terms of NEMA, this assessment demonstrates how the proponent intends to comply with the principles contained in Section 2 of NEMA, which amongst other things, indicates that environmental management should:

- (In order of priority) aim to: avoid, minimize or remedy disturbance of ecosystems and loss of biodiversity;
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;

- Protect the environment as the people's common heritage;
- Control and minimize environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making matters that may affect the environment. As such, it is incumbent upon the proponent to show (through the EIA process) how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined in terms of NEMA.

Furthermore, in terms of best practice guidelines as outlined by Brownlie (2005) and De Villiers et al. (2005), a precautionary and risk-averse approach should be adopted for projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (CBAs) (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

- The study includes data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:
- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighboring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

Species level

- Species of Conservation Concern (SCC) (giving location if possible using GPS)
- The viability of an estimated population size of the SCC species that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species); or
    - are of cultural significance.
- Provide monitoring requirements as input into the EMPr for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified and/or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries).
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

1.4 LIMITATIONS & ASSUMPTIONS

The current study is based on a number of site visits as well as an associated desktop study. Although it was not very wet at the time of the site visits, conditions were nevertheless suitable for the assessment and there no significant limitations associated with the timing of the field assessment. The presence of some fauna is difficult to verify in the field as these may be shy or rare and their potential presence at the site must be evaluated based on the literature and available databases. In many cases, these databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna and flora present at the site. This is acknowledged as a limitation of the study, however it is substantially reduced by the fact that the consultant has sampled the adjacent properties on multiple occasions across different seasons. In order to further reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant and animal species recorded for Quarter Degree Squares (QDS) 3019AC, AB, AD and BC was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- The IUCN conservation status (Figure 3) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2014).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).

- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2017 (See Figure 3) and where species have not been assessed under these criteria, the CITES status is reported where possible.

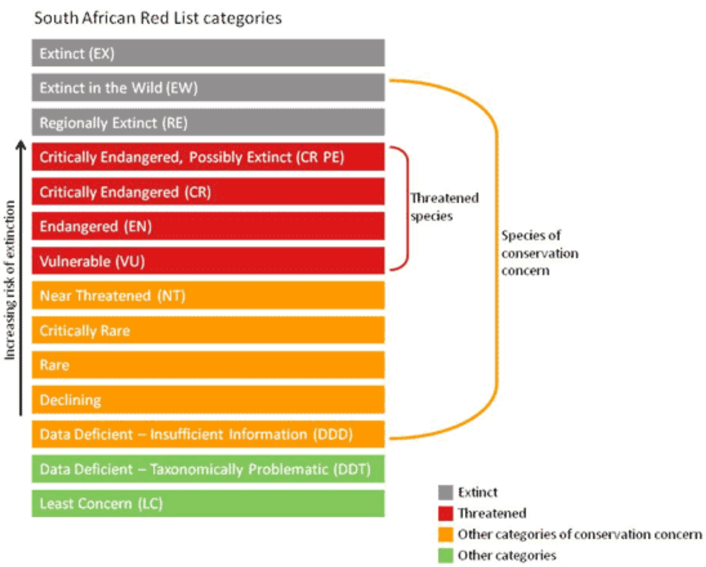

Figure 3.Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

2.2 SITE VISIT

The main site visit took place on the 11-13th of November 2016. During the site visit, the different biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. A preliminary habitat map for the site had been produced prior to the site visit and this was validated in the field and modified where necessary. The habitat map also served to guide the site visit and ensure that all the different habitats visible on the satellite imagery of the site were sampled in the field and that representative samples of all the affected areas were included. Walk-through-surveys were conducted within representative areas across the different habitats units identified and all plant and animal species observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. Within the context of the site, there was no perennial water present and no areas where amphibians were active at the time of the site visit. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site or included on the draft habitat map produced for the site. An additional site visit to verify some changes to the layout also took place on the 9th of June 2017.

2.3 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the results of the site visit with the available ecological and biodiversity information available in the literature and various spatial databases as described above. As a starting point, mapped sensitive features such as wetlands, drainage lines, rocky hills and pans were collated and buffered where appropriate to comply with legislative requirements or ecological considerations. Additional sensitive areas where then identified from the satellite imagery of the site and delineated. All the different layers created were then merged to create a single coverage. Features that were specifically captured in the sensitivity map include drainage features, wetlands and pans, as well as rocky outcrops and steep slopes. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a low impact on ecological processes and terrestrial biodiversity. This category represents transformed or natural areas where the impact of development is likely to be local in nature and of low significance with standard mitigation measures.
- **Medium** - Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. Development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas where also categorised between the above categories, such as Medium-High, where an area appeared to be of intermediate sensitivity with respect to the two defining categories. However, it is important to note that there are no sensitivities that are identified as "Medium to High" or similar ranged categories because this adds uncertainty to the mapping as it is not clear if an area falls at the bottom or top of such a range.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 BROAD-SCALE VEGETATION PATTERNS

The national vegetation map (Mucina & Rutherford 2006, 2012) for the study area is depicted below in Figure 4. The majority of the Xha! Boom grid connection site is mapped as falling within the Western Bushmanland Klipveld vegetation type, with a small proportion of Bushmanland Basin Shrubland along the eastern margin of the site. The site visit however revealed that the areas mapped as Bushmanland Basin Shrubland consist of a mosaic of Bushmanland Basin Shrubland and Bushmanland Arid Grassland. The On-site Substation Option 2 falls within the Western Bushmanland Klipveld vegetation type, while all the rest of the substation options and the majority of the power line corridors are mapped as falling within the Bushmanland Basin Shrubland vegetation type. Although the dominant and characteristic species associated with each of these vegetation types is described in Mucina & Rutherford, these lists are not repeated here as the actual vegetation as observed at the site is described in the next section.

With an extent of 34 690 km^2 Bushmanland Basin Shrubland is one of the most extensive vegetation types in South Africa. Bushmanland Basin Shrubland occurs on the extensive basin cantered on Brandvlei and Van Wyksvlei, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt in the north to around Williston in the south. The area is characterised by slightly irregular plains dominated by a dwarf shrubland, with succulent shrubs or perennial grasses in places. The geology consists largely of mudstones and shales of the Ecca group and Dwyka tillites with occasional dolerite intrusions. Soils are largely shallow to non-existent, with calcrete present in most areas. Rainfall ranges from 100-200 mm and falls mostly during the summer months as thunder storms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Threatened. There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed by Mucina and Rutherford as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum* subsp *oliverorum* are listed as being endemic to the vegetation type.

Bushmanland Arid Grassland is an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km^2. It extends from around

Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type.

The western two thirds of the !Xha Boom site consists of Western Bushmanland Klipveld, which forms part of the Succulent Karoo Biome and occurs on the northwestern plains of Bushmanland east of the Namaqualand Klipkoppe, north and south of Kliprand and west of Stofvlei. It consists of sparse plains of desertic character supporting dwarf succulent shrubs and drought-tolerant grasses. This vegetation type has an extent of 2297km2, of which 99% is still intact, with no major transformation, although erosion is extensive with as much as 70% considered to be suffering from significant erosion. Eight endemic species are reported for this vegetation type by Mucina & Rutherford, which is significant given the low extent of this vegetation type.

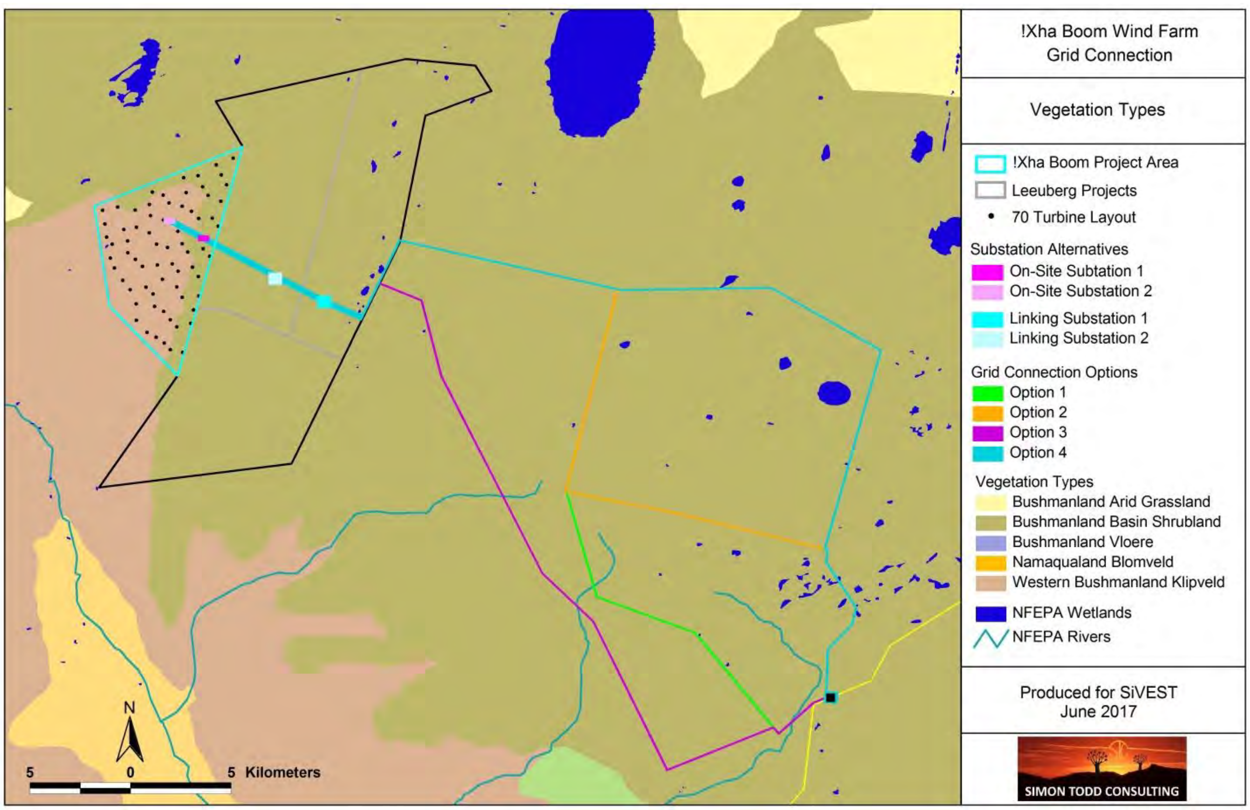

Figure 4. The national vegetation map (Mucina & Rutherford 2006/2012) for the study area. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011) are also depicted.

3.2 FINE-SCALE VEGETATION PATTERNS

The different habitats and landscape units associated with the various power line options and substation alternatives are described in detail below. Each unit is described and then the prevalence of this unit along the various power line routes and substation alternatives is discussed.

Bushmanland Arid Grassland

The site visit revealed that the eastern margin of the !Xha Boom as well as the majority of the rest of the greater Leeuberg site consists of open plains dominated by so-called "white grasses" and is clearly representative of the Bushmanland Arid Grassland vegetation type (Figure 5). This discrepancy with the vegetation map can be ascribed to the coarse nature of the national vegetation map and associated uncertainty along the boundaries of the vegetation units. In addition, boundaries between units have been mapped largely from aerial or satellite imagery and these boundaries are not always clearly visible. The main driver of vegetation pattern in the area is substrate. On gravels and stony soils, the vegetation consists of open shrub-dominated vegetation typical of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by various *Stipagrostis* species and is typical of Bushmanland Arid Grassland. There are also many areas on shallow soils, which consist of grassy shrublands and are clearly transitional areas between the two typical forms.

Figure 5. Looking west towards the boundary of the !Xha Boom site, showing the Bushmanland Arid Grassland habitat type that characterises this area. On-site Substation Option 1 is located within this habitat type.

The areas of Bushmanland Arid Grassland are associated with extensive flat to gently sloping open plains characterised by shallow red sands, sometimes with exposed calcrete as well (). This habitat tends to be very homogenous with low local and overall species richness and low species turnover. This unit is usually dominated by *Stipagrostis ciliata*, *S.brevifolia* and *s.obtusa* with low shrubs such as *Lebeckia spinescens*, *Monechma incanum*, *Asparagus capensis*, *Asparagus retrofractus*, *Eriocephalus microphyllus var. pubescens*, *Zygophyllum retrofactum* with occasional larger *Lycium pumilum* shrubs or small *Parkinsonia africana* trees. Protected or listed species are rare in this habitat and only an occasional *Hoodia gordonii* was observed within this vegetation type.

This habitat unit is present at On-site Substation Option 1 as well as the two Linking Substation options on Ithemba and Graskoppies Wind Farms to the east of the !Xha Boom site. Large sections of the power line options are also within this unit, especially the northern sections of alternatives, Option 1, Option 2 and Option 4 (Figure 6) as well as the majority of the central section of Option 3. This is not a sensitive habitat type as it is homogenous and has low diversity and abundance of SCC.

Figure 6. Bushmanland Arid Grassland along Power Line Option 4, looking east towards the R355.

Bushmanland Basin Shrubland

Shallow, stony soils dominate large parts of the site along the power line corridors and these areas are usually dominated by a sparse cover of low woody shrubs (Figure 7). This unit is representative of Bushmanland Basin Shrubland and are usually dominated by species such as *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Tetragonia fruticosa*, *Hermannia spinosa*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia glomerata*, *Pteronia sordida*, *Thesium* hystrix, *Euphorbia decussata* and *Salsola tuberculata*; as well as forbs such as *Aptosimum indivisum*, *Hypertelis salsoloides*, *Gazania lichtensteinii* and *Fockea sinuata*; succulent shrubs include *Aridaria noctiflora*, *Ruschia intricata* and *Sarcocaulon patersonii*; taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. There are occasional rocky outcrops present at the site of limited extent, which can also be attributed to this vegetation type; typical species include *Enneapogon scaber*, *Jamesbrittenia atropurpurea* subsp. *atropurpurea*, *Aloe falcata*, *Lycium oxycarpum*, *Dyerophytum africanum* and *Asparagus capensis*. The only species of significance observed on the plains was *Hoodia gordonii*, while *Aloe falcata* which is provincially protected is common on the rocky hills.

Figure 7. Bushmanland Basin Shrubland along Power Line Option 2, which exposed calcrete in the foreground, showing the low vegetation cover and lack of soil characteristic of this habitat type.

The Bushmanland Basin Shrubland habitat is not considered highly sensitive as it has low diversity and few species of concern present. This is a dominant habitat type along large sections of all the power line corridors, once they leave the greater Leeuberg Wind Farm site (Figure 8). Along with the Grassland habitat type, these two units occupy the majority of the affected area.

Figure 8. Bushmanland Basin shrubland along the central section of Corridor Option 3, after it has left the greater Leeuberg study area, showing the exposed calcrete and low vegetation cover which characterises this habitat unit.

Western Bushmanland Klipveld

The majority of the Xha! Boom site as well as a small proportion of the Hartebeest Leegte Wind Farm site consists of Western Bushmanland Klipveld (Figure 9). These areas are dominated by shrub species such as *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Zygophyllum retrofractum*, *Zygophyllum flexuosum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Hermannia spinosa*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia glomerata*, *Pteronia sordida*, *Thesium hystrix, Euphorbia decussata* and *Salsola tuberculata*; succulent shrubs including *Aridaria noctiflora*, *Ruschia intricate*, *Prenia tetragonia* and *Sarcocaulon patersonii*; annual grasses such as *Aristida congesta*, *Stipagrostis anomala* and *Enneapogon desvauxii*. Taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. There are also a number of forbs and annuals present including *Sesamum capense*, *Galenia sarcophylla*, *Gazania lichtensteinii*, *Leysera tenella*, *Osteospermum pinnatum* and *Tribulis terrestris*. Cover across most of this area is very low and while this can be partly attributed to the aridity of the area, livestock grazing also appears to have played a significant role in leading to the degradation of the area and further loss in the plant cover.

Overall, this is not considered a highly sensitive habitat as no species of conservation concern were observed in this habitat during the site visit. In addition, the affected area appears to have been negatively affected by livestock grazing which has had a negative effect on the diversity of this habitat. On the on-site substation Option 2 and the immediate adjacent section of power line are within this habitat.

Figure 9. Western Bushmanland Klipveld near to On-site Substation Option 2, showing the stony soils and very low vegetation cover which characterises this area.

Succulent Shrubland

Some of the low-lying areas in the south of the grid connection corridors consist of fine-textured soils overlying calcrete and are characterised by a higher proportion of succulent shrubs compared to the other shrub-dominated habitats. Typical and dominant species include *Brownanthus ciliatus*, *Euphorbia decussata*, *Ruschia robusta*, *Cephalophyllum rigidum*, *Aridaria noctiflora*, *Phyllobolus nitidus*, *Drosanthemum lique*, *Exomis microphylla*, *Octompoma quadrisepalum*, *Ruschia abbreviata*, *Galenia fruticosa*, *Sceletium tortuosum*, *Tetragonia fruticosa*, *Prenia tetragonia*, *Tripteris sinuata*, *Zygophyllum retrofractum*, *Lycium pumilum*. Although these areas are considered somewhat more sensitive than the other plains habitats, diversity remains relatively low and the abundance of species of concern is low. As a result, these areas have been classified as higher sensitivity than the Arid Grassland and Shrubland habitats, but are not considered high sensitivity to the extent that they need to be avoided.

The Succulent Shrubland habitat is conspicuous only in the south of the study area and is prevalent only along sections of Power Line Option 1 and 3 (Figure 10). As discussed above, it is not considered highly sensitive but has a higher abundance of provincially protected species and somewhat higher diversity than the other habitats.

Figure 10. Succulent Shrubland habitat near the point where Power Line Corridor 1 and Power Line Corridor 3 merge, about 2.5km from the Helios substation.

Drainage Lines

The drainage lines of the site are not very well developed and do not have a tall woody component (Figure 11). Typical and dominant species include *Stipagrostis namaquensis*, *Stipagrostis obtusa*, *Osteospermum armatum*, *Arctotis fastuosa*, *Deverra denudata*, *Melianthus comosus*, *Salvia disermas*, *Lycium pumilum*, *Lycium oxycarpum*, *Galenia sarcophylla*, *Salsola aphylla* and *Sesamum capense*. Although the drainage lines are not well developed, which can be ascribed to aridity of the area, they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events. As such disturbance to these areas should be minimised as far as possible.

Figure 11. The drainage lines of the site such as this one along Power Line Option 3, are typically broad and not well-defined. Typical and dominant species includes *Lycium pumilum* as seen above, as well as grasses such as *Stipagrostis spp.* and *Aristida congesta*.

Pans

There are a number of small pans in the vicinity of the development footprint, the most conspicuous of which are those to the west of the power line corridors on the Graskoppies Wind Farm. The pans of the area are quite diverse and can be divided into at least three different types; non-saline pans with a bare centre and fringed by taller woody vegetation; non-saline pans vegetated by *Athanasia minuta* and saline pans that are not vegetated. In the north of the site, the pans are not saline and are bare or vegetated in their centre by *Athanasia minuta* with species such as *Lycium pumilum*, *Salsola glabrescens*, *Salsola aphylla*, *Rhigozum trichotomum*, *Parkinsonia africana*, *Psilocaulon coriarium* and *Osteospermum armatum* around the fringes. The saline pans are not vegetated on account of the salt present, but are nevertheless ecologically important as they support a variety of temporary water organisms when they contain water.

As already mentioned, the pans on the adjacent Graskoppies project area are the most significant and well-developed in the study area (Figure 12). There are however one or two smaller pans present near to power line Alternative 4. These are considered sensitive features and while a direct impact on these features is not likely as they are outside of the development footprint, the low slope around some of these features makes them vulnerable to activities which can change the overland flow pattern of water, such as road construction.

Figure 12. One of the larger pans on the Graskoppies site north east of the Linking Substation Option 1. The power line, which includes all options at this point, runs across the face of the ridge on the other side of the pan, about 200m from the pan.

3.3 LISTED PLANT SPECIES

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. Listed and protected species observed in the area include the provincially protected species *Aloe falcata, A.claviflora* and *Hoodia gordonii* and *Aloinopsis luckhoffii* and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

3.4 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 40 terrestrial mammals suggesting that potential mammalian diversity at the site is quite low. Species observed in the area include Steenbok

Raphicerus campestris, Cape Porcupine *Hystrix africaeaustralis*, Aardvark *Orycteropus afer*, Yellow Mongoose *Cynictis penicillata*, Cape Hare *Lepus capensis,* Cape Fox *Vulpes chama*, Bat-eared Fox *Otocyon megalotis* and Round-eared Elephant Shrew *Macroscelides proboscideus*. In terms of specific habitats which are likely to be of above average significance, the low ridges and drainage lines are likely to contain the highest fauna abundance and diversity.

The only mammal species of conservation concern which may occur at the site is the Black-footed cat *Felis nigripes* (Vulnerable). As this species has a broad distribution across South Africa, the relatively limited footprint of the development is not likely to compromise the local or regional populations of this species. In addition, the majority of the site would still be accessible to such fauna and it is likely that most predators will continue to use the site. In terms of the power line, there is little scope for interaction between mammals and the power line in the operational phase and long-term impacts would be low. The substations would be fenced and although some smaller fauna would use this area if there is any natural vegetation within the site, in general mammals would avoid this area and given the large amount of intact available habitat in the area, a significant disruption of landscape connectivity for fauna is highly unlikely.

Reptiles

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3), comprising 5 tortoises, 12 snakes, 15 lizards and skinks, 8 geckos and 1 chameleon. This is a comparatively low total, suggesting that reptile diversity at the site is likely to be low. There are no listed species which are likely to occur at the site. Species which were observed in the area include the Karoo Girdled Lizard *Karusasaurus polyzonus*, Namaqua Sand Lizard *Pedioplanis namaquensis*, Spotted Desert Lizard *Meroles suborbitalis*, Western Sandveld Lizard *Nucras tessellata*, Southern Rock Agama *Agama atra*, Ground Agama *Agama aculeata* subsp. *aculeata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii*. There are no specific areas of high reptile importance at the site as it is homogenous with no rocky outcrops or other major features of high significance.

In terms of the likely impacts of the development on reptiles, habitat loss is not likely to be highly significant as the direct footprint of the development is not likely to exceed a hundred hectares and this would not be significant in context of the relatively homogenous and intact surrounding landscape. In some situations, the loss of vegetation cover associated with roads and other cleared areas can generate significant impact on reptiles as they may be vulnerable to predation while crossing such cleared areas, but as the site is arid, plant cover is already low and the reptile species present are mostly well-adapted to low-cover environments.

Amphibians

Given the aridity of the site and lack of surface water in the area, it is not surprising that only six frog species may occur in the area. Of these only those which are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis* are likely to occur within the site itself. Impacts on amphibians are likely to be low given the limited extent of the development as well as low likely density of amphibians in the area. Although there are some pans present in the area, these are not necessarily available to amphibians as many of the pans are saline and not suitable for amphibians.

3.5 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The recently completed Northern Cape Critical Biodiversity Areas (CBAs) map (Oosthuysen & Holness 2016) is depicted below for the study area (Figure 13). This biodiversity assessment identifies CBAs which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. There are no CBAs within !Xha Boom or the other properties which make up the greater Leeuberg Wind Farm. However, there are some short sections of CBA 1 and CBA 2 along all of the grid connection options. These are associated with drainage lines and aimed at protecting these features. The power line would however not generate significant impact on these features and the associated CBAs with the appropriate mitigation. The site does not lie within a National Protected Area Expansion Strategy (NPAES) focus area and has therefore not been identified as an important area for future conservation area expansion.

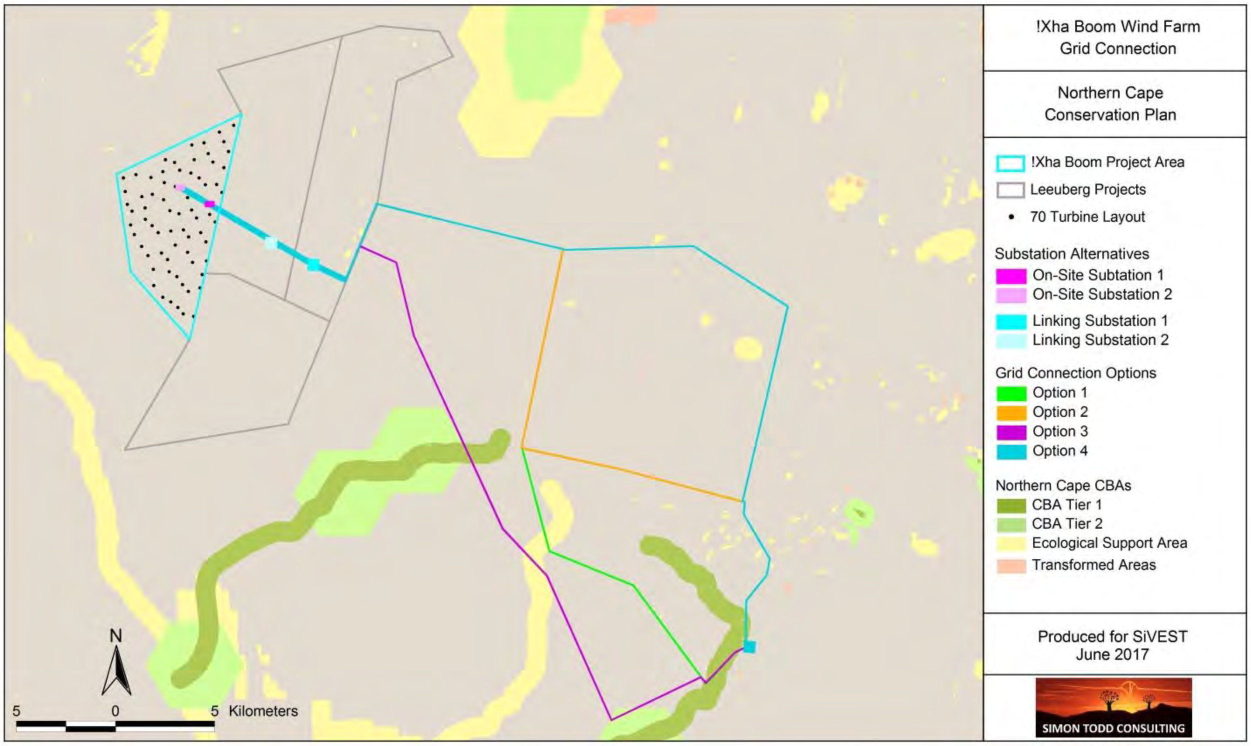

Figure 13. Extract of the Northern Cape Conservation Plan for the study area, showing that there are no CBAs within the !Xha Boom site.

3.6 Cumulative Impacts

Where there other renewable energy developments within 30km of a site, a cumulative impact assessment is required. This includes a general assessment of cumulative impact as well as an assessment of different potential cumulative impact sources and an indication of the size or extent of the identified cumulative impact. It is important to note that this consultant has worked on all of the wind farms in the area and as such has intimate knowledge of the affected environment of each as well as the distribution of impact and the recommended mitigation measures associated with each approved or in-process facility.

The majority of the footprint from the grid connection would come from the substations, with the on-site substation listed at 15ha and the linking substation listed at 36ha. These are however the maximum values required and the actual size of the substations that would be built would occupy only about 25% of this area. Some of this footprint has already been considered as part of the wind farm, but as the features are shared, a portion of the footprint is allocated to the power line as well. The grid connection is however associated with a wind energy facility and as such, the development of the two components of the wind farm are not independent of one another. As such, the consideration of cumulative impact for the power line considered here, includes the associated wind farm impact. The analysis and discussion of cumulative impact provided below is taken from the Ecological Study for the !Xha Boom Wind Farm, but is repeated here for consistency. The total footprints listed below for the wind farms has taken account of and included the footprint of the power line and substations.

In terms of existing impacts in the area and the potential for the !Xha Boom grid connection sites to contribute to cumulative impacts, other renewable energy developments are detailed below in Table 1 and the affected land portions shown in Figure 14. Although the DEA also maintains a map of approved and in-process renewable energy facilities that are part of the RE IPPP, this is currently not up to date and is not illustrated here as a result. All of the other wind energy and grid connection developments in the area are to the east of the !Xha Boom site, mostly between the site and the Helios substation, with only the Dwarsrug facility further east.

It is clear that a node of renewable energy development is developing around the Helios Substation. The large amount of development in the area would potentially generate significant cumulative impact in terms of habitat loss and potential disruption of landscape connectivity. These two major potential cumulative impacts are further explored and described with regards to the area.

In terms of developments that are preferred bidders or under construction, there are three projects, the Khobab and Loeriesfontein 2 Wind Farms and the Hantam Solar Facility. The total extent of habitat loss from these developments is approximately 500ha. In terms of already authorised wind farm projects that have not been awarded preferred bidder status and thus may or may not be built, there is only the 140MW Dwarsrug Wind Farm with the remaining authorised projects in the area being four solar PV projects. There are a number of projects which are currently still in the EIA process, which includes the Graskoppies, Hartebeest Leegte and Ithemba Wind Farms which are part of the larger Leeuwberg development of which the current development is a part and then the three Kokerboom wind farms. All of the latter projects are 235-240MW in output but would not have a significantly larger footprint than the older 140MW projects due to technology advances and the larger output of the current and future turbines. The estimated footprint of each wind farm is estimated to be 100ha. As such, there is 100ha of potential habitat loss due to the authorised Dwarsrug Wind Farm and approximately 700ha of habitat loss due to the projects currently in process if they are all authorised. The total extent of habitat loss from the 4 solar projects would be up to 1600ha, although it is highly unlikely that all proposed projects would ever be built. It is important to note that the footprint of wind energy facilities is decreasing relative to solar PV plants on a per MW basis due to the increasing output of wind turbines but the relatively static nature of PV panel output. The total actual and potential extent of habitat loss is therefore 500ha of existing habitat loss, about 1700ha of potential habitat loss due to already approved projects and 700ha due to projects in process, giving rise to a total of just under 3000ha of total habitat loss.

The majority of the above footprint is located within the Bushmanland Basin Shrubland vegetation type. This vegetation unit has an extent of 34 690 km^2 and is one of the most extensive vegetation types in the country. The total extent of potential habitat loss from all developments in the current study area would amount to less than 0.1% of this vegetation unit. Consequently, it is clear that there is no potential for habitat loss to significantly impact the national availability of this unit or elevate it to a higher threat status. Within a 30km radius of the Helios substation, the potential habitat loss from all projects would amount to approximately 1% of the area. This suggests that even if all projects are built, the total extent of habitat loss would not be significant at this local landscape level either. At a more local level, the affected area is relatively homogenous and there are few species or habitats of conservation concern that would be affected by the developments in the area. There are also no large drainage features or other obvious environmental corridors present in the area that would be directly affected by the development of the area. These results indicate that direct habitat loss is not a highly significant concern in the area and the low fauna and flora diversity of the area further reduces the potential significance of cumulative impact in the area due to habitat loss.

The potential impacts of the current developments on landscape connectivity are more difficult to quantify as this is not directly related to the footprint of the facilities. Wind energy facilities are not fenced but occur within the general farming landscape, whereas solar PV plants are generally fenced with electrified fencing and thus prevent most fauna from traversing the fenced area. On the other hand, PV facilities are concentrated within a limited area compared to wind farms which occupy a large area at low density. A significant proportion of the impact associated with wind farms results from access roads which usually far exceed the footprint of the turbines and their hard stands. Roads pose a significant obstacle to some fauna which cannot or do not cross roads and experience habitat fragmentation as a result. Species that are typically affected by roads include subterranean and fossorial mammals and reptiles as well as many smaller above-ground species which avoid open ground on account of predation risk. However, as there is little soil in the study area, which consists mostly of exposed gravels or calcrete, subterranean species are not common at the site so this is not likely to be a significant impact. In addition, the arid nature of the area means that vegetation cover is naturally low with the result that most fauna are adapted to or accustomed to traversing open ground and not likely to be significantly affected by wind farm roads, which are gravel in any case.

Some fauna may be affected by turbine noise and thus experience habitat loss as a result of wind farms. However, this has not been documented for any fauna and indications are that most fauna quickly become habituated to turbines and do not avoid them to any significant degree. Wind farms are thus not likely to significantly contribute to landscape connectivity for most fauna present in the area and would remain porous for most species. The potential for significant disruption of landscape connectivity due to the wind farms of the area is therefore considered low.

In addition, this is not considered directly relevant here as the power line and substations considered under this application would generate low operational impacts on fauna.

In terms of the potential for the !Xha Boom Wind Farm to contribute to the above cumulative impacts, the total extent of habitat loss would be about 100ha, which is not highly significant and the potential for habitat fragmentation would also be low. In terms of the acceptability of a node of high renewable energy development and associated grid connection infrastructure to occur at the site, this is seen as a positive aspect rather than a negative factor. The area has generally low ecological sensitivity and the concentration of development within this low sensitivity area is seen as positive compared to a more dispersed development pattern which would generate an overall greater impact. As such, the current development is therefore seen as being acceptable in terms of its contribution to cumulative impact.

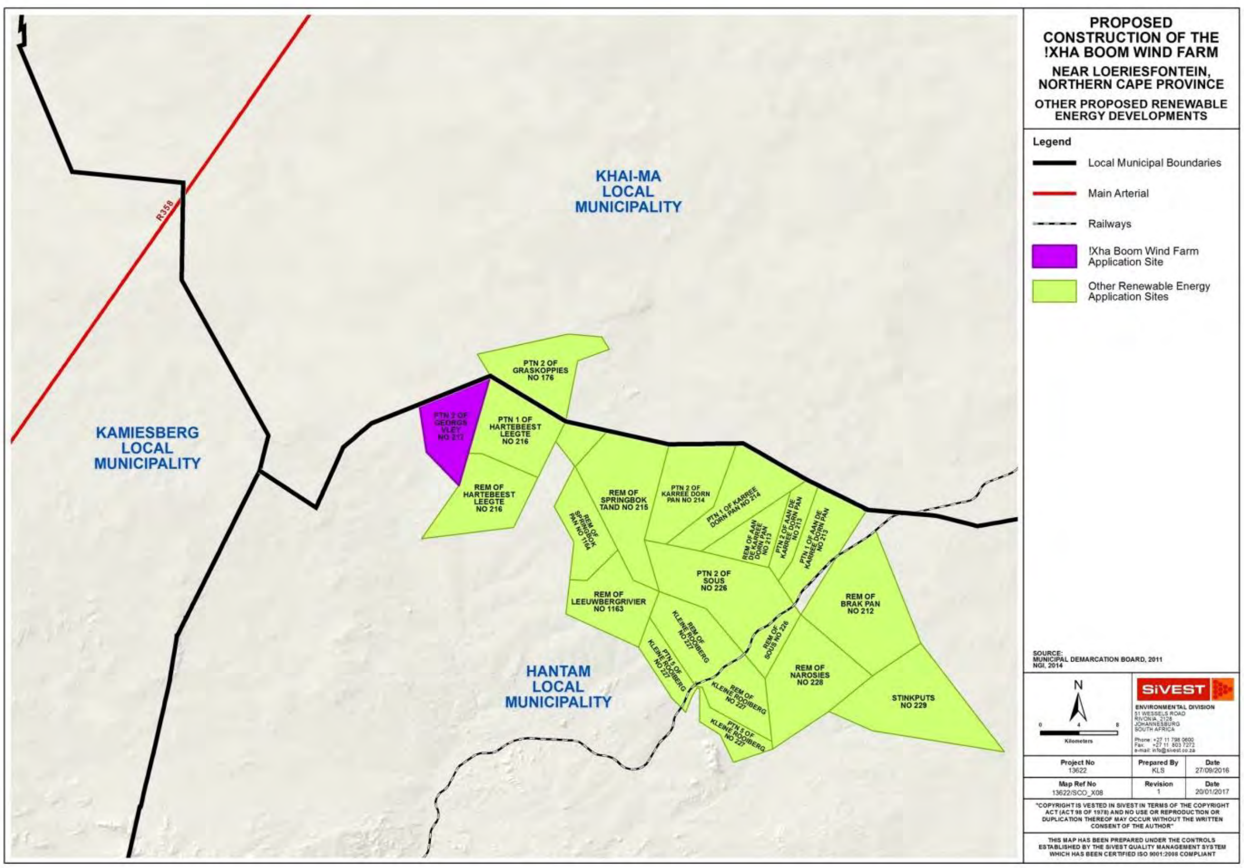

Figure 14. Renewable energy projects known from the vicinity of the !Xha Boom grid connection (purple) and showing the other Leeuwberg WEFs as well as other developments in the wider area.

Table 1. Renewable energy developments in the vicinity of the !Xha Boom grid connection site. So far only the Loeriesfontein 2 and Khobab wind farms and the Hantam PV Solar Energy Facility are under construction or have preferred bidder status.

Development	Current status of EIA/development	Proponent	Capacity	Farm Portions
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Aan De Karree Doorn Pan No. 213;

Development	Current status of EIA/development	Proponent	Capacity	Farm Portions
				Portion 1 of the Farm Karree Doorn Pan No. 214; and Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

4 !XHA BOOM GRID CONNECTION SENSITIVITY ASSESSMENT

The sensitivity map for the study area is depicted below in Figure 15. The majority of the site consists of arid grasslands or low open shrublands on open plains that are not considered highly sensitive. The substation alternatives are all located within the Western Bushmanland Klipveld or Arid Grassland habitat types which are low sensitivity with few species of concern present. There are few significant features present along the power line corridors and the only sensitive features present are the occasional drainage lines. As the drainage lines are not very large, they would easily be spanned by the power line and a significant impact on these features can easily be avoided. The overall impact of the development would be local in nature and there are no highly significant impacts that cannot be reduced to a low level.

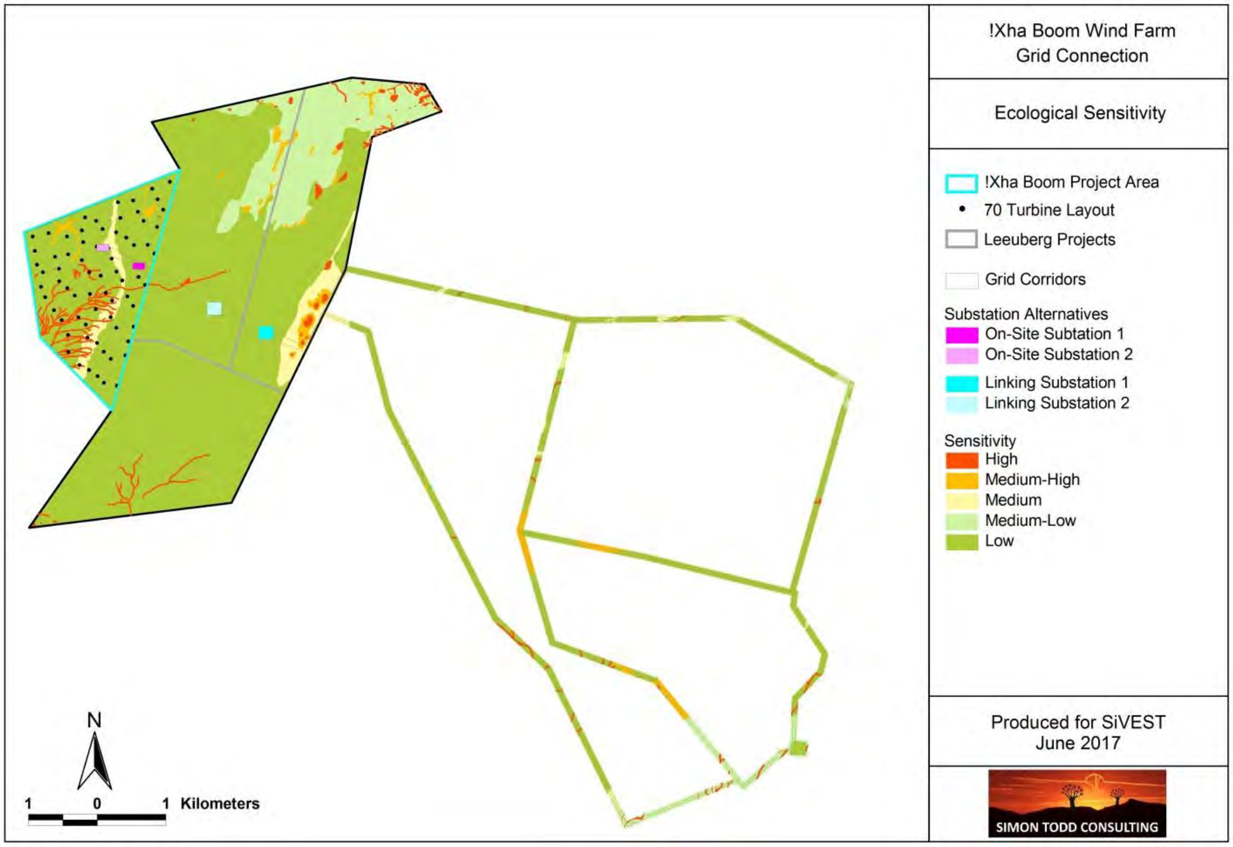

Figure 15. Ecological sensitivity map for the !Xha Boom study area. The majority of the site is arid grassland or low open shrublands of low sensitivity.

5 IMPACTS AND ISSUES IDENTIFICATION

The development of the !Xha Boom grid connection, is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as substations, access roads and powerlines, etc. The following impacts are identified as the major impacts that are likely to be associated with the development and which are assessed for the !Xha Boom grid connection, for the preconstruction, construction, operational and decommissioning phases of the development.

The likely impacts on the terrestrial ecology of the site resulting from the development of the !Xha Boom grid connection are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed

Impact 1. Impacts on vegetation and listed or protected plant species

The development would require vegetation clearing for the substations, access roads and pylon foundations. Apart from the direct loss of vegetation within the development footprint, listed and protected species would potentially be impacted. These impacts are likely to occur during the construction phase of the development, with additional vegetation impacts during operation likely to be relatively low. This impact is therefore assessed for the development, for the construction phase only.

Impact 2. Direct Faunal Impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed if proper management and monitoring is not in place. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity was high. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. During the operational phase, impacts associated with the power line and substation would be low and are not considered significant. Faunal impacts will therefore be assessed only during the construction and decommissioning phases of the development.

Impact 3. Increased Erosion Risk

Disturbance created during construction would leave the site vulnerable to wind and water erosion. Soil disturbance associated with the development will render the impacted areas vulnerable to erosion and measures to limit erosion will need to be implemented. This impact is likely to manifest during construction and would persist into the operational phase and is therefore be assessed for both phases.

Impact 4. Alien Plant Invasion

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Some woody aliens are already present and additional alien plant invasion is inevitable and regular alien plant clearing activities would be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, the site will be less vulnerable to alien plant invasion, however, roadsides are likely to remain foci of alien plant invasion for years. This impact would manifest during the operational phase, although some of the required measures to reduce this impact are required during construction.

***Impact 5.** Cumulative Impact 1. Impacts on broad-scale ecological processes and cumulative habitat loss*

The development will contribute to cumulative impacts on habitat loss in the area and potentially the ability to meet future conservation targets. The main source of impact in this regard would come from the substations as well as access and service roads associated with the power line. This impact is however assessed for the project as a whole and not just the power line as this would not be built without the establishment of the wind farm. This impact would persist for the life of the development and is thus assessed for the operational phase of the grid connection.

6 ASSESSMENT OF IMPACTS

An assessment of the likely extent and significance of each impact identified above is made below for each phase of the development.

6.1 CONSTRUCTION PHASE

Impact 1.Impacts on vegetation and protected plant species

Impact 1. Impacts on vegetation and protected plant species	
Environmental Parameter	Vegetation and protected plant species
Issue/Impact/Environmental Effect/Nature	Vegetation clearing for powerline, access roads and substations will impact on vegetation and protected plant species.
Extent	The extent of the impact will be restricted to the grid connection footprint and as such would be local in nature.
Probability	This impact will definitely occur as vegetation clearing will be required for the construction and establishment of the project.
Reversibility	This impact is not highly reversible as it would take a long time for any cleared areas to return to their former state and rehabilitation of arid environments is very difficult.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources.
Duration	The construction phase itself will be of short duration, but the resulting impact would persist for a long time.
Cumulative effect	The clearing would contribute to vegetation impacts in the area, the contribution of the grid connection development itself would be low, but as there are several facilities in the area, the cumulative impact would be moderate at the local level, but low at a broader scale.

Impact 1. Impacts on vegetation and protected plant species		
Intensity/magnitude	The intensity of the impact would be low as the extent of the footprint to be cleared is limited and localised.	
Significance Rating	Without mitigation, this impact would be of low significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-13 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Placement of pylons and other infrastructure within the High Sensitivity areas and drainage lines should be avoided. 2) Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are avoided where possible. 3) Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible. 4) Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development. 5) Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes topics such as no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. 6) Demarcate all areas to be cleared with construction tape or other appropriate and effective means. However caution should be exercised to avoid using material that might entangle fauna.	

Impact 2. Impacts on fauna due to construction phase activities

Impact 2. Impacts on fauna during construction		
Environmental Parameter	Faunal impacts due to construction activities	
Issue/Impact/Environmental Effect/Nature	Vegetation clearing, the use of heavy machinery and human presence during construction is likely to negatively affect resident fauna during construction.	
Extent	The extent of the impact will be restricted the site and as such would be local in nature.	
Probability	This impact is likely to occur and some impact is certain to occur.	
Reversibility	Noise and disturbance is largely reversible but habitat loss due to transformation of intact habitat is not considered easily reversible.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.	
Duration	The construction phase itself will be of relatively short duration.	
Cumulative effect	The clearing would contribute to cumulative habitat loss for fauna in the area, but this would be largely local in nature and limited in extent.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	Construction phase impact would be of relatively short duration (2 years) but of low to moderate intensity. Overall significance is likely to be low before mitigation and very low thereafter.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-20 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Preconstruction walk-through of the substation and powerline sites to identify areas of faunal sensitivity. 2) During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.	

Impact 2. Impacts on fauna during construction	
	3) Any trenches that are required for cabling etc, should not be left open for extended periods as fauna such as tortoises will fall in an become trapped. Any open trenches should be checked regularly for trapped fauna. 4) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. 5) No fires should be allowed within the site as there is a risk of runaway veld fires. 6) No fuelwood collection should be allowed on-site. 7) No dogs or cats should be allowed on site apart from that of the landowners. 8) If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs) as far as practically possible, which do not attract insects and which should be directed downwards. 9) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 10) No unauthorized persons should be allowed onto the site and site access should be strictly controlled 11) All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. 12) All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and snakes which are often persecuted out of fear or superstition.

6.2 OPERATIONAL PHASE IMPACTS

Impact 3. Increased Erosion Risk

Impact 3. Increased Soil Erosion Risk	
Environmental Parameter	Ecosystem integrity and the delivery of ecosystem services such as grazing and clean water.

Impact 3. Increased Soil Erosion Risk		
Issue/Impact/Environmental Effect/Nature	Following construction, the site will be vulnerable to soil erosion due to the disturbance created and likely low natural revegetation of disturbed areas.	
Extent	The extent of the impact will be restricted to the grid connection and as such would be local in nature.	
Probability	This impact would be likely to occur due to the disturbance generated during construction.	
Reversibility	Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	The risk of this impact is likely to persist for several years after construction.	
Cumulative effect	Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to erosion.	
Significance Rating	Without mitigation, this impact would be of moderate to low significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-10 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan. 2) All hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. 3) Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance, as per the Erosion Management and Rehabilitation Plans for the project.	

Impact 3. Increased Soil Erosion Risk	
	4) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 5) All cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow.

Impact 4. Alien plant invasion risk

Impact 4. Alien Plant Invasion		
Environmental Parameter	Biodiversity, ecosystem integrity and the delivery of ecosystem services such as forage.	
Issue/Impact/Environmental Effect/Nature	Following construction, the site will be vulnerable to alien plant invasion due to disturbance.	
Extent	The extent of the impact will be restricted the powerline and substation sites and as such would be local in nature.	
Probability	This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance.	
Reversibility	Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	This impact is likely to persist for several years after construction.	
Cumulative effect	Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to invasion.	
Significance Rating	With avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	2

Impact 4. Alien Plant Invasion		
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-24 (Low negative)	-10 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the sites and a long-term control plan will need to be implemented. Problem woody species such as *Prosopis* are already present in the area and are likely to increase rapidly if not controlled. 3) Regular monitoring for alien plants within the development footprint should be carried out. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	

6.3 Decommissioning Phase Impacts

Impact 5. Impacts on fauna due to decommissioning phase activities

Impact 5. Impacts on fauna during decommissioning	
Environmental Parameter	Faunal impacts due to decommissioning activities
Issue/Impact/Environmental Effect/Nature	Fauna will be negatively affected by the decommissioning of the grid connection due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.
Extent	The extent of the impact will be restricted the site and as such would be local in nature.
Probability	This impact is likely to occur to some degree.
Reversibility	Noise and disturbance would be of relatively short duration and are considered reversible.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.
Duration	This impact would be transient and persist for the active decommissioning period only.

Impact 5. Impacts on fauna during decommissioning		
Cumulative effect	There would be transient contribution to cumulative disturbance impacts, but this would cease after decommissioning and ultimately if decommissioned, the impacts associated with the development would largely cease.	
Intensity/magnitude	The intensity of the impact would be moderate.	
Significance Rating	This impact would occur at a moderate intensity but would be transient in nature and overall significance is likely to be moderate before mitigation and low thereafter.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	-20 (low negative)	-18 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decommissioning activities. 2) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 3) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises. 4) No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped. 5) All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the decommissioning and	

Impact 5. Impacts on fauna during decommissioning	
	recycling plan, and as per the agreements with the land owners concerned.

Impact 6. Increased Erosion Risk due to Decommissioning

Impact 6. Increased Soil Erosion Risk		
Environmental Parameter	Ecosystem integrity	
Issue/Impact/Environmental Effect/Nature	Following decommissioning, the site will be vulnerable to soil erosion due to the disturbance created by the removal of infrastructure from the site.	
Extent	The extent of the impact will be restricted the powerline and substation sites and as such would be local in nature.	
Probability	This impact would be likely to occur due to the large amount of disturbance generated during decommissioning.	
Reversibility	Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	This impact is likely to persist for several years after decommissioning.	
Cumulative effect	Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to erosion and is limited in extent.	
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	2
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-9 (very low negative)

Impact 6. Increased Soil Erosion Risk	
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as a result of the disturbance, and if they do, to immediately implement erosion control measures. 2) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 3) All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.

Impact 7. Alien plant invasion risk following decommissioning

Impact 7. Alien Plant Invasion	
Environmental Parameter	Ecosystem integrity and diversity.
Issue/Impact/Environmental Effect/Nature	Following decommissioning, the site will be vulnerable to alien plant invasion due to disturbance
Extent	The extent of the impact will be restricted to the site and as such would be local in nature.
Probability	This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance.
Reversibility	Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.
Duration	This impact is likely to persist for several years after decommissioning.
Cumulative effect	Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.
Intensity/magnitude	The intensity of the impact would be moderate as the site is not considered highly vulnerable to invasion and is limited in extent.
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level.

Impact 7. Alien Plant Invasion		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	1	1
Intensity/magnitude	3	2
Significance rating	-33 (medium negative)	-18 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned. 3) Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are no longer a problem at the site. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	

6.4 CUMULATIVE IMPACTS

Cumulative Impact 1. Cumulative habitat loss and fragmentation

Impact 8. Cumulative impacts and loss of broad-scale connectivity	
Environmental Parameter	Broad-scale ecological processes, especially habitat fragmentation.
Issue/Impact/Environmental Effect/Nature	Transformation and presence of the development will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.
Extent	Should all the developments in the area go ahead, then this would result in a landscape-level impact.

Impact 8. Cumulative impacts and loss of broad-scale connectivity		
Probability	This impact is likely to occur as some facilities have already been built and some additional habitat loss would occur if the current development proceeds.	
Reversibility	This impact would to some degree be reversible when the facilities are decommissioned.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources.	
Duration	This impact would persist for the lifespan of the development.	
Cumulative effect	The development would contribute to cumulative impacts on habitat loss and fragmentation in the area, and while the contribution of a single facility would be low, there are several facilities in the area and so overall cumulative impacts are likely to be moderate.	
Intensity/magnitude	The intensity of the impact would be moderate to low as the area is not sensitive and the overall total footprint is not highly significant.	
Significance Rating	Due to the relatively low contribution of the development and the low overall current level of impact in the area, the significance of this impact is likely to be low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-26 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Minimise the development footprint within the high sensitivity areas. 2) There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora. 3) All disturbed areas should be rehabilitated with locally occurring shrubs and grasses after construction and decommissioning to reduce the overall footprint of the development.	

7 IDENTIFICATION OF PREFERRED ALTERNATIVES

As described, there are two alternatives each for the on-site and linking substation and then four different power line routes being considered. Overall, there is not a lot of difference between the different substation options as these are all within a very similar environment with few features of concern present. Although the power line options each take different routes to the Helios substation, their overall sensitivity is not widely different and the shorter options, that being Alternative 3 and Alternative 1 are seen as the most favourable as a result. However, all of the power line options are seen as being acceptable as no route has any highly significant features present.

The comparative assessment is provided below, for each component of the development.

COMPARATIVE ASSESSMENT OF ALTERNATIVES

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	**Preference**	**Reasons (incl. potential issues)**
ON-SITE SUBSTATION ALTERNATIVES		
On-site Substation Option 1	Preferred	The site is located on the eastern plateau area of the site dominated by *Stipagrostis* grasslands. There are no sensitive features of SCC within the footprint area. No significant issues associated with the site. This is clearly the preferred option for the substation.
On-site Substation Option 2	Not Preferred	The site is located in a transitional area between the arid grasslands in the east and the Klipveld in the west. There are numerous small drainage features or washes in the site and it is not considered favourable in comparison with the preferred alternative.
Linking Substation Alternatives		
Linking Substation Option 1	Preferred	Located within the Arid Grassland habitat type, there are so features of concern within the site and it is considered favourable. The only distinguishing feature which makes this alternative less preferred

Alternative	Preference	Reasons (incl. potential issues)
		is the proximity to the nearby pans as well as the slightly greater slope of the site.
Linking Substation Option 2	Favourable	Located on a homogenous open *Stipagrostis ciliata*-dominated plain. There are no features of significance in the footprint or vicinity of the site. The is identified as the preferred alternative as the site is flatter than the alternative, but the difference in preference is marginal and there is not real difference between the two alternatives.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Corridor Option 1	(Less) Favourable	Traverses some low hills in the south that are considered moderately sensitive as well as some succulent shrubland habitat that is also more sensitive than the other shrubland and grassland types. Considered acceptable, but only as the third Option, with both Option 2 and Option 4 being seen as more favourable alternatives.
Grid Corridor Option 2	Preferred	No highly sensitive features along the route and the last third of the line towards Helios is located along existing roads and disturbed areas. Overall impact is considered the lowest of the options. Proximity to existing disturbance and power lines make this the preferred option.
Grid Corridor Option 3	Not Preferred	This Option traverses more drainage features than the other alternatives and the also runs through a long section where there are no other power lines and as such the additional disturbance is considered greater than for the other routes. The route traverses an extensive area of currently little-disturbed habitat and includes some more sensitive succulent shrubland habitat in the south. As a result this is considered the least favourable option.
Grid Corridor Option 4	(More) Favourable	There are no high sensitivity features along the route and as it runs adjacent to existing roads for much of its length, the additional disturbance generated during construction is likely to be low.

Alternative	Preference	Reasons (incl. potential issues)
		The route is adjacent to existing main access routes for large sections of the route with the result that overall impact is low and is identified as the next preferred alternative after Option 2.

8 CONCLUSION & RECOMMENDATIONS

The on-site substation Option1 as well as both the Linking Substation alternatives are located within the Bushmanland Arid Grassland habitat type. The on-site Substation Option 2 is located within the Western Bushmanland Klipveld. These are extensive vegetation units with low diversity and low abundance of species of conservation concern. Consequently, nearly all of the substation alternatives are considered acceptable and would generate low impact. Only on-site Substation Option 2 is considered unfavourable as there a numerous small drainage lines in the affected area. On-site Substation Option 1 was identified as the preferred on-site substation alternatives and while differences are small, Linking Substation Option 1 was identified as the preferred linking substation alternative.

In terms of the grid corridors, there was also not a lot of difference between the alternatives and preferences were based on relatively small differences in potential impact as no alternatives were considered fatally-flawed. Grid Corridor Option 2 was identified as the preferred route as there are no highly sensitive features along the route and the last third of the line towards Helios substation is located along existing roads and disturbed areas. The overall impact of this option would be the lowest of the options considered. Grid Corridor Option 4 is considered the next most favourable option as the route is adjacent to existing access routes or power lines for large sections of the route with the result that construction-phase disturbance is likely to be relatively low.

Although the current assessment is only for the grid connection and substations, the grid connection is contingent on a wind energy facility being built and as such, the development of the power line and the wind farm are not independent of one another. Consequently, cumulative impacts for the power line have been considered in context of the wind farm as a whole, including the grid connection. An analysis of potential cumulative impacts in the area indicates that a node of renewable energy facilities is developing round the Helios Substation. The total potential extent of direct habitat loss from all proposed developments if they were all to be built would amount to about 3000ha. This represents about 1% of the local area and less than 0.1% of the Bushmanland Basin Shrubland or Bushmanland Arid Grassland vegetation type. This indicates that the current developments at the site do not pose a risk of significantly impacting the national availability of the affected units or elevate them to a higher threat status. The development of the !Xha Boom

Wind Farm with associated grid connection would generate about 100ha of direct habitat loss which is not considered highly significant and the potential for habitat fragmentation from the development would also be low. The broader study area has low ecological sensitivity and the concentration of development within this low sensitivity area is seen as having significantly less ecological impact compared to a more dispersed development pattern over a wider area. Based on these results, total cumulative impacts and the contribution of the !Xha Boom Wind Farm and associated grid connection to cumulative impacts in the region are seen as being acceptable and would remain of low overall significance.

With the application of relatively simple mitigation and avoidance measures, the impact of the !Xha Boom Wind Farm's grid connection can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the grid connection that cannot be reduced to an acceptable level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

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10 ANNEX 1. LIST OF PLANTS

List of plant species known from the vicinity of the !Xha Boom grid connection study site, based on the SANBI SIBIS database. Conservation status is from the South African Red Data List of Plants 2016.

Family	Species	IUCN Status	Family	Species	IUCN Status
ACANTHACEAE	*Acanthopsis disperma*	LC	ACANTHACEAE	*Blepharis furcata*	LC
AIZOACEAE	*Aizoon canariense*	LC	AIZOACEAE	*Galenia africana*	LC
AIZOACEAE	*Galenia fruticosa*	LC	AIZOACEAE	*Galenia sarcophylla*	LC
AIZOACEAE	*Galenia squamulosa*	LC	AIZOACEAE	*Plinthus karooicus*	LC
AIZOACEAE	*Tetragonia arbuscula*	LC	AIZOACEAE	*Tetragonia fruticosa*	LC
AIZOACEAE	*Tetragonia microptera*	LC	AMARYLLIDACEAE	*Brunsvigia comptonii*	LC
APOCYNACEAE	*Gomphocarpus filiformis*	LC	APOCYNACEAE	*Fockea sinuata*	LC
APOCYNACEAE	*Hoodia gordonii*	DDD	APOCYNACEAE	*Quaqua incarnata*	LC
ASPARAGACEAE	*Asparagus africanus*	LC	ASPARAGACEAE	*Asparagus capensis var. capensis*	LC
ASPHODELACEAE	*Aloe claviflora*	LC	ASPHODELACEAE	*Aloe falcata*	LC
ASTERACEAE	*Amellus microglossus*	LC	ASTERACEAE	*Amellus strigosus subsp. pseudoscabridus*	LC
ASTERACEAE	*Arctotis fastuosa*	LC	ASTERACEAE	*Dicoma capensis*	LC
ASTERACEAE	*Didelta carnosa var. carnosa*	LC	ASTERACEAE	*Didelta spinosa*	LC
ASTERACEAE	*Dimorphotheca polyptera*	LC	ASTERACEAE	*Eriocephalus ericoides subsp. ericoides*	LC
ASTERACEAE	*Eriocephalus microphyllus var. pubescens*	LC	ASTERACEAE	*Eriocephalus spinescens*	LC
ASTERACEAE	*Felicia clavipilosa subsp. clavipilosa*	LC	ASTERACEAE	*Foveolina dichotoma*	LC
ASTERACEAE	*Gazania lichtensteinii*	LC	ASTERACEAE	*Gazania jurineifolia*	LC
ASTERACEAE	*Helichrysum herniarioides*	LC	ASTERACEAE	*Lasiopogon glomerulatus*	LC
ASTERACEAE	*Osteospermum pinnatum var. pinnatum*	LC	ASTERACEAE	*Osteospermum spinescens*	LC
ASTERACEAE	*Pegolettia retrofracta*	LC	ASTERACEAE	*Pentzia spinescens*	LC
ASTERACEAE	*Pteronia adenocarpa*	LC	ASTERACEAE	*Pteronia glauca*	LC
ASTERACEAE	*Pteronia glomerata*	LC	ASTERACEAE	*Pteronia leucoclada*	LC
ASTERACEAE	*Pteronia mucronata*	LC	ASTERACEAE	*Pteronia oblanceolata*	LC
ASTERACEAE	*Rosenia humilis*	LC	ASTERACEAE	*Senecio niveus*	LC
ASTERACEAE	*Senecio abbreviatus*	LC	ASTERACEAE	*Tripteris sinuata var. linearis*	LC
ASTERACEAE	*Tripteris sinuata var. sinuata*	LC	ASTERACEAE	*Ursinia nana subsp. nana*	LC
BIGNONIACEAE	*Rhigozum trichotomum*	LC	BRASSICACEAE	*Heliophila arenosa*	LC

BRASSICACEAE	*Lepidium desertorum*	LC	CARYOPHYLLACEAE	*Dianthus namaensis var. dinteri*	LC
CHENOPODIACEAE	*Atriplex vestita var. appendiculata*	LC	CHENOPODIACEAE	*Bassia salsoloides*	LC
CHENOPODIACEAE	*Exomis microphylla var. axyrioides*	LC	CHENOPODIACEAE	*Salsola aellenii*	LC
CHENOPODIACEAE	*Salsola aphylla*	LC	CHENOPODIACEAE	*Salsola henriciae*	LC
CHENOPODIACEAE	*Salsola procera*	LC	CHENOPODIACEAE	*Salsola tuberculata*	LC
CHENOPODIACEAE	*Suaeda fruticosa*	LC	CHENOPODIACEAE	*Suaeda merxmuelleri*	LC
CHENOPODIACEAE	*Sasola kali*	Alien	CHENOPODIACEAE	*Atriplex semibaccata*	Alien
CHENOPODIACEAE	*Atriplex lindleyi subsp inflata*	Alien	EUPHORBIACEAE	*Euphorbia aequoris*	LC
EUPHORBIACEAE	*Euphorbia multiceps*	LC	FABACEAE	*Lebeckia spinescens*	LC
FABACEAE	*Lessertia macrostachya var. macrostachya*	LC	FABACEAE	*Lotononis leptoloba*	LC
FABACEAE	*Melolobium candicans*	LC	FABACEAE	*Parkinsonia africana*	LC
FABACEAE	*Sutherlandia frutescens*	LC	FABACEAE	*Prosopis glandulosa*	Alien
FRANKENIACEAE	*Frankenia pulverulenta*	LC	GERANIACEAE	*Pelargonium minimum*	LC
GERANIACEAE	*Sarcocaulon patersonii*	LC	HYACINTHACEAE	*Drimia intricata*	LC
IRIDACEAE	*Moraea pallida*	LC	IRIDACEAE	*Tritonia karooica*	LC
LAMIACEAE	*Salvia disermas*	LC	LORANTHACEAE	*Septulina glauca*	LC
MALVACEAE	*Hermannia paucifolia*	LC	MALVACEAE	*Hermannia spinosa*	LC
MALVACEAE	*Radyera urens*	LC	MELIANTHACEAE	*Melianthus comosus*	LC
MESEMBRYANTHEMACEAE	*Aloinopsis luckhoffii*	DDT	MESEMBRYANTHEMACEAE	*Antimima evoluta*	LC
MESEMBRYANTHEMACEAE	*Aridaria noctiflora subsp. straminea*	LC	MESEMBRYANTHEMACEAE	*Cephalophyllum fulleri*	Rare
MESEMBRYANTHEMACEAE	*Conophytum uviforme subsp. uviforme*	LC	MESEMBRYANTHEMACEAE	*Drosanthemum lique*	LC
MESEMBRYANTHEMACEAE	*Lampranthus haworthii*	LC	MESEMBRYANTHEMACEAE	*Lampranthus uniflorus*	LC
MESEMBRYANTHEMACEAE	*Lithops otzeniana*	VU	MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum*	LC
MESEMBRYANTHEMACEAE	*Mesembryanthemum stenandrum*	LC	MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	LC
MESEMBRYANTHEMACEAE	*Psilocaulon junceum*	LC	MESEMBRYANTHEMACEAE	*Ruschia abbreviata*	LC
MESEMBRYANTHEMACEAE	*Ruschia robusta*	LC	MESEMBRYANTHEMACEAE	*Stoeberia frutescens*	LC
MESEMBRYANTHEMACEAE	*Stomatium mustellinum*	LC	MOLLUGINACEAE	*Hypertelis salsoloides var. salsoloides*	LC
MOLLUGINACEAE	*Limeum aethiopicum*	LC	NEURADACEAE	*Grielum humifusum var. parviflorum*	LC
OXALIDACEAE	*Oxalis beneprotecta*	LC	PEDALIACEAE	*Sesamum capense*	LC
PLUMBAGINACEAE	*Dyerophytum africanum*	LC	POACEAE	*Aristida adscensionis*	LC
POACEAE	*Ehrharta calycina*	LC	POACEAE	*Enneapogon desvauxii*	LC
POACEAE	*Enneapogon scaber*	LC	POACEAE	*Fingerhuthia africana*	LC
POACEAE	*Schismus barbatus*	LC	POACEAE	*Stipagrostis anomala*	LC

POACEAE	*Stipagrostis brevifolia*	LC	POACEAE	*Stipagrostis ciliata var. capensis*	LC
POACEAE	*Stipagrostis namaquensis*	LC	POACEAE	*Stipagrostis obtusa*	LC
POLYGALACEAE	*Polygala seminuda*	LC	RUTACEAE	*Agathosma virgata*	LC
SANTALACEAE	*Thesium hystricoides*	LC	SANTALACEAE	*Thesium hystrix*	LC
SANTALACEAE	*Thesium lineatum*	LC	SCROPHULARIACEAE	*Aptosimum indivisum*	LC
SCROPHULARIACEAE	*Aptosimum procumbens*	LC	SCROPHULARIACEAE	*Aptosimum spinescens*	LC
SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. atropurpurea*	LC	SCROPHULARIACEAE	*Nemesia calcarata*	LC
SCROPHULARIACEAE	*Peliostomum leucorrhizum*	LC	SCROPHULARIACEAE	*Selago albida*	LC
SCROPHULARIACEAE	*Selago pinguicula*	LC	SOLANACEAE	*Lycium cinereum*	LC
SOLANACEAE	*Lycium pilifolium*	LC	SOLANACEAE	*Lycium oxycarpum*	LC
SOLANACEAE	*Solanum burchellii*	LC	SOLANACEAE	*Solanum capense*	LC
URTICACEAE	*Forsskaolea candida*	LC	ZYGOPHYLLACEAE	*Tribulus terrestris*	LC
ZYGOPHYLLACEAE	*Tribulus zeyheri*	LC	ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	LC
ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*	LC	ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	LC
ZYGOPHYLLACEAE	*Zygophyllum simplex*	LC			

11 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the !Xha Boom grid connection study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2016.

Scientific Name	Common Name	Status	Habitat	Likelihood
Afrosoricida (Golden Moles):				
Chrysochloris asiatica	Cape Golden Mole	LC	Coastal parts of the Northern and Western Cape	High
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	Confirmed
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Low
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	Low
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Confirmed
Rodentia (Rodents):				
Cryptomys hottentotus	African Mole Rat	LC	Wide diversity of substrates, from sandy soils to heavier compact substrates such as decomposed schists and stony soils	High
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	Confirmed
Mus minutoides	Pygmy Mouse	LC	Wide habitat tolerance	High
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	High

Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Otomys unisulcatus	Bush Vlei Rat	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Confirmed
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	Low
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	High
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	Confirmed

Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Confirmed
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	Low
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	Moderate
Pelea capreolus	Grey Rhebok	LC	Associated with rocky hills, rocky mountainsides, mountain plateaux with good grass cover.	Low
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Low
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	Low
Chiroptera (Bats)				
Sauromys petrophilus	Flat-headed free-tailed bat	LC	Rocky areas and the availability of narrow rock fissures essential requirements	Low
Neoromicia capensis	Cape Serotine Bat	LC	Wide habitat tolerances, but often found near open water	High
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	In arid areas. often associated with water sources	High
Nycteris thebaica	Egyptian Slit-faced Bat	LC	Wide habitat tolerance	High
Rhinolophus clivosus	Geoffroy's horsehoe bat	LC	Wide habitat tolerance but Roost in caves	Low
Rhinolophus capensis	Cape horseshoe bat	LC	Many records from coastal caves	Low

12 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur in the broad vicinity of the !Xha Boom grid connection site, based on records from the SARCA database, conservation status is from Bates et al. 2013.

Type	Family	Genus	Species	Subspecies	Common name	Red list category
Chameleon	*Chamaeleonidae*	*Chamaeleo*	*namaquensis*		Namaqua Chameleon	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern
Geckos	*Gekkonidae*	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*capensis*		Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*labialis*		Western Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*weberi*		Weber's Gecko	Least Concern
Geckos	*Gekkonidae*	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern
Lizards	*Agamidae*	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern
Lizards	*Agamidae*	*Agama*	*atra*		Southern Rock Agama	Least Concern
Lizards	*Cordylidae*	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern
Lizards	*Cordylidae*	*Namazonurus*	*peersi*		Peers' Girdled Lizard	Least Concern
Lizards	*Gerrhosauridae*	*Cordylosaurus*	*subtessellatus*		Dwarf Plated Lizard	Least Concern
Lizards	*Lacertidae*	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern
Lizards	*Lacertidae*	*Nucras*	*tessellata*		Western Sandveld Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*laticeps*		Karoo Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern
Lizards	*Scincidae*	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*variegata*		Variegated Skink	Least Concern
Snakes	*Colubridae*	*Boaedon*	*capensis*		Brown House Snake	Least Concern
Snakes	*Colubridae*	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern
Snakes	*Colubridae*	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern
Snakes	*Colubridae*	*Lamprophis*	*guttatus*		Spotted House Snake	Least Concern

Snakes	*Colubridae*	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern
Snakes	*Colubridae*	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern
Snakes	*Colubridae*	*Pseudaspis*	*cana*		Mole Snake	Least Concern
Snakes	*Colubridae*	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern
Snakes	*Elapidae*	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed
Snakes	*Elapidae*	*Naja*	*nivea*		Cape Cobra	Least Concern
Snakes	*Typhlopidae*	*Rhinotyphlops*	*lalandei*		Delalande's Beaked Blind Snake	Least Concern
Snakes	*Viperidae*	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern
Tortoises	*Testudinidae*	*Chersina*	*angulata*		Angulate Tortoise	Least Concern
Tortoises	*Testudinidae*	*Homopus*	*signatus*	*signatus*	Namaqua Speckled Padloper	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*subsp. ?*	Tent Tortoise (subsp. ?)	Least Concern
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*tentorius*	Karoo Tent Tortoise	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed

13 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in in the broad vicinity of the !Xha Boom grid connection site. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the Minter et al. 2004.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Vandijkophrynus gariepensis	Karoo Toad	Least Concern	Karoo Scrub	Widespread	High
Xenopus laevis	Common Platanna	Least Concern	Any more or less permanent water	Widespread	Very Low
Amietia fuscigula	Cape River Frog	Least Concern	Large still bodies of water or permanent streams and rivers.	Widespread	Very Low
Cacosternum namaquense	Namaqua Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Cacosternum boettgeri	Common Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Tomopterna tandyi	Tandy's Sand Frog	Least Concern	Nama karoo grassland and savanna	Widespread	High

Appendix 6B

Avifaunal Assessment

Xha! Boom Wind Energy Facility

Loeriesfontein, Northern Cape

Bird Impact Assessment Report for proposed 132kV Grid Connection

July 2017

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Chris van Rooyen

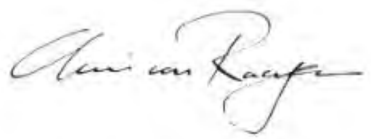
Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Pr.Sci.Nat)

Albert has an M. Sc. in Conservation Biology from the University of Cape Town, and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Aurecon was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with the Basic Assessment for the Xha! Boom Wind Energy Facility Grid Connection.



Director: Chris van Rooyen Consulting

EXECUTIVE SUMMARY

The proposed Xha! Boom grid connection and associated substations will have potential impacts on Red Data avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss; and
- Collisions with the earthwire of the 132kV grid connection

Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace Red Data species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in June 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. Options 1 and 3 are approximately 1.2km from the nest at their closest point, while Options 2 and 4 are 2km from the nest at their closest point.

The pre-mitigation risk of displacement due to disturbance during the construction phase is rated as low, but could be further reduced through appropriate mitigation.

Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at the proposed Xha! Boom substation sites is common in the greater study area and the transformation of a few hectare of habitat should not impact any of the Red Data species significantly.

The risk of displacement through habitat destruction during construction is rated as low, which could be reduced through appropriate mitigation.

Collisions of Red Data species with the earthwire of the 132kV grid connection

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as high which can be reduced to medium through appropriate mitigation.

Concluding statement

The proposed Ithemba grid connection will have potential impacts on avifauna, ranging from high to low, prior to the implementation of mitigation. With the implementation of mitigation measures, the high impacts could be reduced to medium, while the low impacts can be further reduced. All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred:

- It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions;
- About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and
- It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be moderate to minor within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

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DEFINITIONS

Greater study area: This refers to the area that are covered by the 16 SABAP2 pentads where the proposed alignments are located.

WEF study area: This refers to the area that comprises the four proposed Leeuwberg WEFs plus a control area and immediate environment.

Powerline study area: This refers to a 2km zone around the proposed alignments.

1. INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, namely the Xha! Boom Substation, a 132kV Linking Substation and an associated 132kV power line near Loeriesfontein in the Northern Cape Province (hereafter referred to as the ‘proposed development’). The proposed development is aimed at feeding electricity generated by Mainstream’s proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

1.2 Project Description

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely Xha! Boom Substation), as well as a 132kV Linking Substation and a 132kV power line. The aim of this development is to feed electricity generated by the proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the “proposed Xha! Boom Substation”)
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV power line from the proposed Xha! Boom Substation, via the proposed Linking Substation to Helios substation, approximately 33km south-east of the proposed Xha! Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A power line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed power line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

It should be noted that two (2) alternative sites for the proposed on-site Xha! Boom Substation and the proposed Linking Substation have been assessed during the Basic Assessment (BA), in conjunction with four (4) power line corridor alternatives.

The proposed power line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures (**Figure 1**) for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the power line.

Figure 1: **Tower Type**

The proposed Xha! Boom Wind Farm (part of a separate on-going EIA process) application site, proposed Xha! Boom Substation site and associated 132kV power line corridor route alternatives are shown in the locality map below (Figure 2).

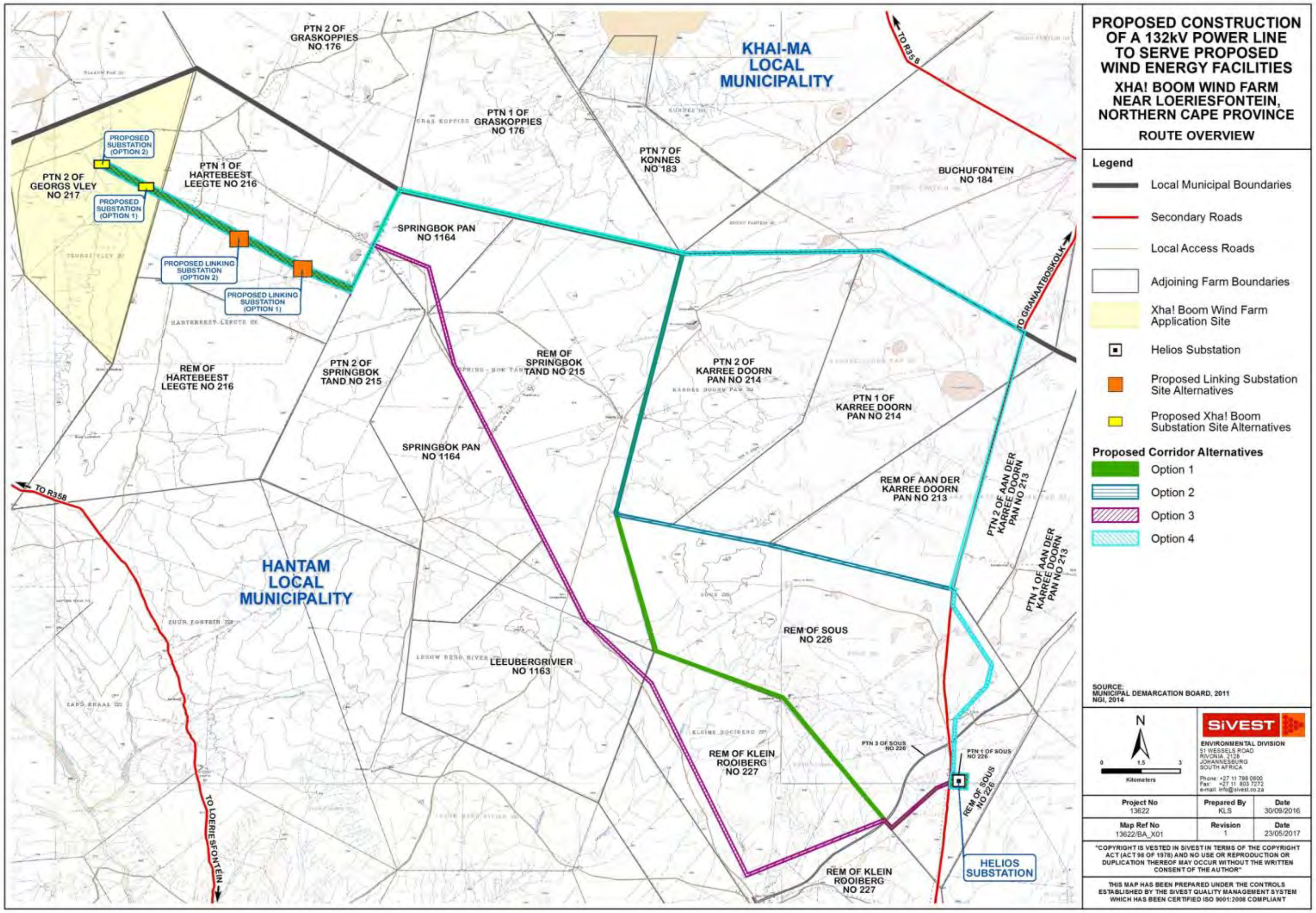

Figure 2: **The proposed layout of the Xha! Boom grid connection, showing the various corridor alternatives**

2. TERMS OF REFERENCE

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts; and
- Recommend mitigation measures to reduce the expected impacts.

3. SOURCES OF INFORMATION

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

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e. within an area consisting of 16 pentad grid cells within which the proposed alignments are situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between January 2009 and January 2017, a total of 63 full protocol cards (i.e. 63 surveys lasting a minimum of two hours or more each) have been completed for this area (see Table 3 -1 and Figure 3).
- The national threatened status of all Red Data species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all Red Data species was determined by consulting the IUCN Red List of Threatened Species Version 2016.2.[1]
- A classification of vegetation types was obtained from Southern African Bird Atlas 1 (Harrison *et al.* 1997) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird Areas of Southern Africa (Barnes 1998; Marnewick *et al*. 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery obtained from Google Earth (May 2016) was used in order to view the broader powerline study area on a landscape level and to help identify bird habitat on the ground.
- Information on the micro habitat level was obtained through a pre-construction monitoring programme for the proposed WEFs which was conducted in the greater study area over four seasons between November 2015 and September 2016, as well as through a site visit conducted in June 2017.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of the pre-construction monitoring programme in the greaetr study area which was implemented between November 2015 and Sept 2016. The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **APPENDIX A** for a detailed explanation of the monitoring methods).
- Information gained from previous Environmental Impact Assessments at three neighbouring sites in close proximity to the current site, namely Khobab WEF (under construction), Loeriesfontein WEF (under

[1] http://www.iucnredlist.org/

construction), and Dwarsrug WEF (authorised in 2015) assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area (see Figure 1).

Table 3-1: The SABAP2 pentads where the study area is located

Pentad	**Number of completed cards**
3015_1915	4
3015_1920	5
3015_1925	0
3015_1930	1
3020_1915	4
3020_1920	4
3020_1925	0
3020_1930	4
3025_1915	1
3025_1920	3
3025_1925	8
3025_1925	11
3030_1915	1
3030_1920	0
3030_1925	4
3030_1930	13
Total	**63**

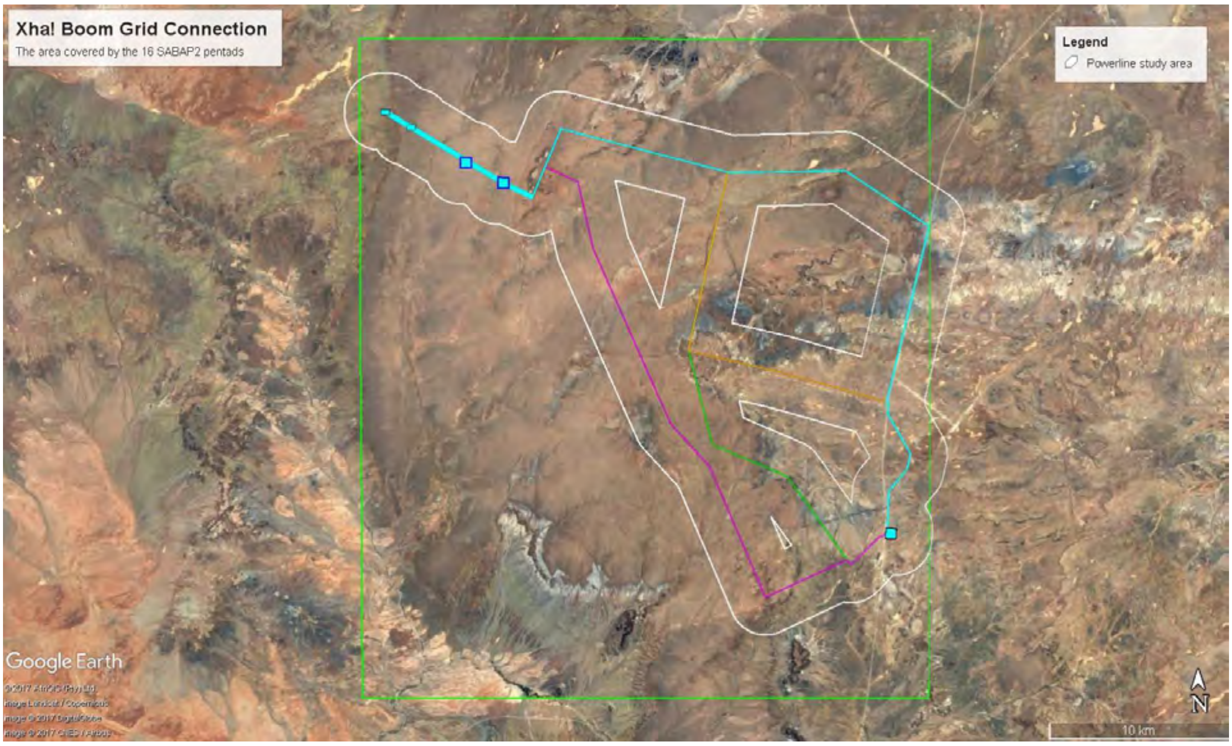

Figure 3: The area covered by the 16 pentads where the proposed alignments are located (green rectangle).

4. ASSUMPTIONS

This study made the basic assumption that the sources of information used are reliable. However, the following must be noted:

- A total of 63 full protocol lists has been completed to date for the 16 pentads where the powerline study area is located (i.e. listing surveys lasting a minimum of two hours each). This is a fairly comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed powerline study area. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, SABAP1 records (Harrison *et al.* 1997), the results of the 12-months pre-construction monitoring and observations during a follow-up site visit.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. However, bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- Specific emphasis was placed on the potential impact on Red Data species.

5. LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 5-1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[2]

Table 5-1: Agreements and conventions which South Africa is party to and which are relevant to the conservation of avifauna

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity	Global

[2] (BirdLife International (2016) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south africa. Checked: 2016-04-02).

	The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

5.2 Best Practice Guidelines

There are currently no best practice guidelines for the assessment of electricity infrastructure impacts on birds.

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 Natural environment

The powerline study area is located on a vast, arid, topographically uniform plain. The habitat is very uniform, and consists primarily of Bushmanland Basin Shrubland. Bushmanland Basin Shrubland consists of dwarf shrubland dominated by a mixture of low, sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also abundant annual flowering plants such as species of *Gazania* and *Leysera* (Mucina & Rutherford 2006). A number of ephemeral drainage lines flow through the powerline study area, but they only hold water for brief periods after exceptional rainfall events, which are rare events. The greater study area is extremely arid with a mean annual rainfall of 170.5mm, with peak rainfall between March and July[3]. The temperatures are highest on average in January, at around 22.8 °C. The lowest average temperatures in the year occur in July, when it is around 9.9 °C.[4] The powerline study area is situated in an ecological transitional zone between the

[3] South African Rain Atlas http://wsopuppenkiste.wiso.uni-goettingen.de/rainfall
[4] http://en.climate-data.org/location/27137/

Nama Karoo and Succulent Karoo biomes (Harrison *et al.* 1997). In comparison with Succulent Karoo, the Nama Karoo has higher proportions of grass and tree cover. The ecotonal nature of the greater study area is apparent from the presence of typical avifauna of both Succulent and Nama Karoo e.g. Karoo Eremomela *Eremomela gregalis* (Succulent Karoo) and Red Lark *Calendulauda burra* (Nama Karoo). The two Karoo vegetation types support a particularly high diversity of bird species endemic to Southern Africa, particularly in the family *Alaudidae* (Larks). Its avifauna typically comprises ground-dwelling species of open habitats (Harrison *et al* 1997). Because rainfall in the Nama Karoo falls mainly in summer, while peak rainfall in the Succulent Karoo occurs mainly in winter, it provides opportunities for birds to migrate between the Succulent and Nama Karoo, to exploit the enhanced conditions associated with rainfall. Many typical karroid species are nomads, able to use resources that are patchy in time and space (Barnes 1998).

A feature of the greater study area where the proposed site is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are typical of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison *et al.* 1997). The proposed powerline study area itself contains a number of small pans (e.g. Kareedoringpan), and there are several larger pans situated north and east of the powerline study area (e.g. Konnes se Pan, Dwaggasoutpan, Boegoefonteinpan and Bitterputspan). The pans are normally dry and covered by a distinctive vegetation type known as Bushmanland Vloere, a form of inland saline scrub vegetation. When these pans hold water (which is only likely after exceptional rainfall events), waterbird movement to and from these pans is possible, including Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoenicopterus minor*. It is possible that nocturnal flamingo movement might take place over the powerline study area between coast and the abovementioned pans, although this should be sporadic rather than regularly.

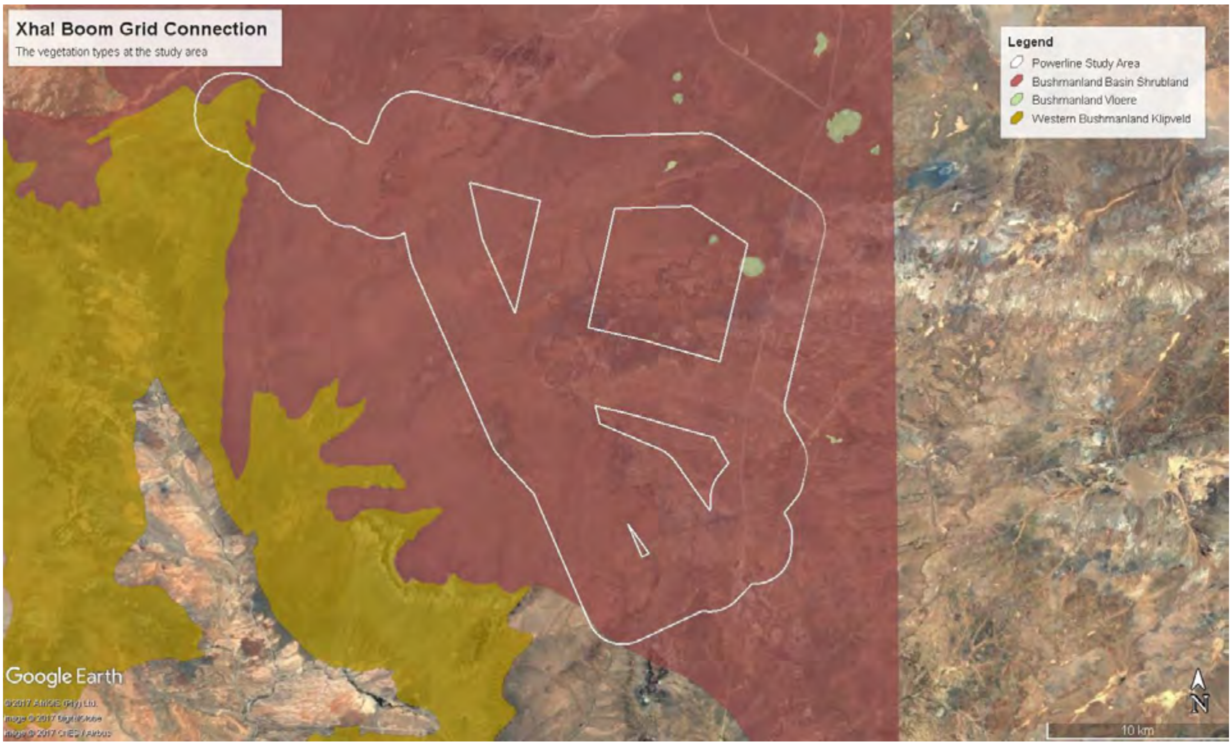

Figure 4: Vegetation types, indicating the homogenous character of the habitat at the powerline study area (Mucina & Rutherford 2006). The powerline study area is indicated by the white polygon.

6.2 Modified environment

Whilst the distribution and abundance of the bird species in the greater study area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine the few external modifications to the environment that may influence the distribution and abundance of avifauna in the powerline study area.

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the powerline study area:

- **Water points:** The land use in the powerline study area is mostly small stock farming. The entire powerline study area is divided into grazing camps, with several boreholes with associated water reservoirs and drinking troughs. In this arid environment, open water is a big draw card for several bird species, including Red Data species such as Martial Eagle and Sclater's Lark that use the open water troughs to bath and drink.
- **Transmission lines:** The Aries - Helios 400kV transmission line runs to the east of the powerline study area, with only small section falling within it. The transmission towers are used by raptors for perching and roosting, and also for breeding. Three Martial Eagle nests were recorded on the Aries - Helios 400kV transmission line, one of which falls within the powerline study area (see Figure 5).

APPENDIX B provides a photographic record of the habitat at the powerline study area and the greater study area. A map of the powerline study area, indicating the location of water points and the Martial Eagle nests is shown in Figure 5.

Figure 5: Location of water points and Martial Eagle nests in the powerline study area.

7. AVIFAUNA

Table 7-1 lists Red Data species that could potentially occur in the proposed powerline study area. The list is based on a combination of the pre-construction monitoring that was conducted in the WEF study area, supplemented with other data sources e.g. SABAP1, SABAP2, environmental impact assessments conducted for other wind farms in the same habitat, and a site visit in June 2017. **It is important to note that while some of the monitoring was not conducted strictly within the powerline study area, or across the whole of the powerline study area, the uniformity of the habitat makes the data gathered during surveys in the greater study area equally relevant for the powerline study area.**

Table 7-2 lists all species that were recorded through pre-construction monitoring in the WEF study area. Data was collected by means of drive transect counts, walk transect counts, vantage point (VP) watches and incidental sightings.

APPENDIX C lists all the species that were recorded by SABAP2 surveys in the period between January 2009 and January 2017.

Table 7-1: Red Data species potentially occurring in the powerline study area. Species recorded during pre-construction monitoring in the WEF study area are shaded.

The following abbreviations and acronyms are used:

VU Vulnerable
NT Near threatened
EN Endangered
SAE Southern African endemic or near endemic
Dd Displacement through disturbance
Dh Displacement through habitat transformation
C Collisions with grid connection

Name	Scientific name	SABAP2 reporting rate % (63 cards)	Regional threatened status (Taylor et al. 2015)	Global threatened status (IUCN 2016)	Likelihood of occurrence	Potential impact
Martial Eagle	*Polemaetus bellicosus*	18.75	EN	NT	**Confirmed**. One incidental sighting of a flying bird in the broader area, and recorded briefly flying high over the greater study area. Could sporadically be attracted to water troughs. The nest near Helios MTS which falls within the powerline study area was active in June 2017.	Dd
Ludwig's Bustard	*Neotis ludwigii*	31.25	SAE, EN	EN	**Confirmed**. Occurrence likely to be linked to habitat conditions. The species is nomadic and a partial migrant and may occur sporadically.	C, Dd,
Secretarybird	*Sagittarius serpentarius*	0	VU	VU	**Low**. May occur sporadically	C, Dd,
Kori Bustard	*Ardeotis kori*	1.25	NT	Least concern	**Low**. May occur sporadically. Lack of dry watercourses with trees may be an inhibiting factor.	C, Dd,
Lanner Falcon	*Falco biarmicus*	10%	VU	Least concern	**Confirmed**. Breeding resident. Most likely to perch on fence lines and powerlines running through the powerline study area, but may also be attracted to the water points where it hunts small birds.	-

Name	**Scientific name**	**SABAP2 reporting rate % (63 cards)**	**Regional threatened status (Taylor et al. 2015)**	**Global threatened status (IUCN 2016)**	**Likelihood of occurrence**	**Potential impact**
Sclater's Lark	*Spizocorys sclateri*	11.25	SAE, NT	NT	**Confirmed**. The species is nomadic and may occur sporadically.	Dd
Red Lark	*Calendulauda burra*	57.7	SAE, VU	NT	**Confirmed.** The species were recorded regularly all over the site but in relatively low densities.	Dd
Verreaux's Eagle	*Aquila verreauxi*	1.25	VU	Least concern	**Confirmed**. Solitary single birds were recorded sporadically. Could sporadically be attracted to water troughs, one individual was recorded drinking at a water trough.	-
Karoo Korhaan	*Eupodotis vigorsii*	70%	SAE, NT	Least concern	**Confirmed**. One of the most commonly recorded terrestrial species. Occurs all over the greater study area.	Dd, C
Burchell's Courser	*Cursorius rufus*	5%	SAE, VU	Least concern	**Confirmed**. Mostly recorded in the west of the greater study area.	C
Greater Flamingo	*Phoenicopterus roseus*	0	NT	LC	**Low**. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, perhaps once a decade during which the pans will contain standing water for a short period.	C
Lesser Flamingo	*Phoeniconaias minor*	0	NT	NT	**Low**. Might be attracted to large pans outside the study area, but occurrence is linked to standing water. This will only happen after exceptional rain events, perhaps once a decade during which the pans will contain standing water for a short period.	C

Table 7-2: List of all species recorded during pre-construction surveys and incidental counts in the WEF study area.

Common name	Taxonomic Name
Black-Chested Snake-Eagle	*Circaetus pectoralis*
Booted Eagle	*Aquila pennatus*
Burchell's Courser	*Cursorius rufus*
Double-banded Courser	*Rhinoptilus africanus*
Greater Kestrel	*Falco rupicoloides*
Jackal Buzzard	*Buteo rufofuscus*
Karoo Korhaan	*Eupodotis vigorsii*
Lanner Falcon	*Falco biarmicus*
Ludwig's Bustard	*Neotis ludwigii*
Martial Eagle	*Polemaetus bellicosus*
Northern Black Korhaan	*Afrotis afraoides*
Red Lark	*Calendulauda burra*
Sclater's Lark	*Spizocorys sclateri*
Southern Pale Chanting Goshawk	*Melierax canorus*
Verreaux's Eagle	*Aquila verreauxii*
Yellow-Billed Kite	*Milvus aegyptius*
Acacia Pied Barbet	*Tricholaema leucomelas*
African Pipit	*Anthus cinnamomeus*
Anteating Chat	*Myrmecocichla formicivora*
Barn Swallow	*Hirundo rustica*
Black-Eared Sparrowlark	*Eremopterix australis*
Bokmakierie	*Telophorus zeylonus*
Cape Bunting	*Emberiza capensis*
Cape Crow	*Corvus capensis*
Cape Penduline-Tit	*Anthoscopus minutus*
Cape Sparrow	*Passer melanurus*
Cape Turtle-dove	*Streptopelia capicola*
Capped Wheatear	*Oenanthe pileata*
Chat Flycatcher	*Bradornis infuscatus*
Common Fiscal	*Lanius collaris*
Common Quail	*Coturnix coturnix*
Eastern Clapper Lark	*Mirafra [apiata] fasciolata*
Egyptian Goose	*Alopochen aegyptiaca*
European Bee-eater	*Merops apiaster*
Familiar Chat	*Cercomela familiaris*
Greater Striped Swallow	*Hirundo cucullata*
Grey Tit	*Parus afer*

Grey-backed Cisticola	*Cisticola subruficapilla*
Grey-backed Sparrowlark	*Eremopterix verticalis*
Karoo Chat	*Cercomela schlegelii*
Karoo Eremomela	*Eremomela gregalis*
Karoo Long-Billed Lark	*Certhilauda subcoronata*
Karoo Prinia	*Prinia maculosa*
Karoo Scrub-Robin	*Cercotrichas coryphoeus*
Large-Billed Lark	*Galerida magnirostris*
Lark-Like Bunting	*Emberiza impetuani*
Laughing Dove	*Streptopelia senegalensis*
Little Swift	*Apus affinis*
Long-billed Crombec	*Sylvietta rufescens*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Pied Crow	*Corvus albus*
Red-Billed Teal	*Anas erythrorhyncha*
Red-Capped Lark	*Calandrella cinerea*
Red-Headed Finch	*Amadina erythrocephala*
Rock Kestrel	*Falco rupicolus*
Rock Martin	*Hirundo fuligula*
Rufous-Eared Warbler	*Malcorus pectoralis*
Sabota Lark	*Calendulauda sabota*
South African Shelduck	*Tadorna cana*
Southern Masked-weaver	*Ploceus velatus*
Southern Pale Chanting Goshawk	*Melierax canorus*
Speckled Pigeon	*Columba guinea*
Spike-Heeled Lark	*Chersomanes albofasciata*
Spotted Thick-Knee	*Burhinus capensis*
Spur-Winged Goose	*Plectropterus gambensis*
Stark's Lark	*Spizocorys starki*
Tractrac Chat	*Cercomela tractrac*
White-rumped Swift	*Apus caffer*
White-throated Canary	*Crithagra albogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-bellied Eremomela	*Eremomela icteropygialis*

8. POTENTIAL IMPACTS ON AVIFAUNA

Because of their size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines. (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013). Other problems include electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen *et al.* 2002), and displacement through disturbance and habitat destruction during construction and maintenance activities.

8.1 Electrocution of Red Data species on the HV powerlines and in the 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). The pole/tower design largely determines the electrocution risk. The tower design that has been proposed for this project is the steel monopole (see Figure 1).

Clearance between phases on the same side of the 132kV steel monopole structure is approximately 2.2m, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of birds on the towers to negligible. The length of the stand-off insulators is approximately 1.6m. If a very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole, which is an unlikely occurrence, except occasionally with vultures. Vultures are unlikely to occur within the study area; therefore, it can be concluded that the risk of electrocutions on the proposed 132kV power lines is practically non-existent.

Electrocutions within the proposed Xha! Boom substations are possible, but should not affect the more sensitive Red Data bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting.

Given the low risk of electrocutions for Red Data species, this potential impact need not be further assessed in the report

8.2 Collisions of Red Data species with the earthwire of the 132kV grid connection

Collisions are unquestionably the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001). In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994)."

Power line collisions are generally accepted as a key threat to bustards (Raab *et al.* 2009; Raab *et al.* 2010; Jenkins & Smallie 2009; Barrientos *et al.* 2012, Shaw 2013). In a recent study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions, power line configuration and powerline size. The large transmission lines kill more birds than the smaller distribution lines, especially as far as Ludwig's Bustards are concerned. (Shaw 2013). An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

A potential impact of the proposed 132kV grid connection power line is collisions with the earth wire. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 10 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

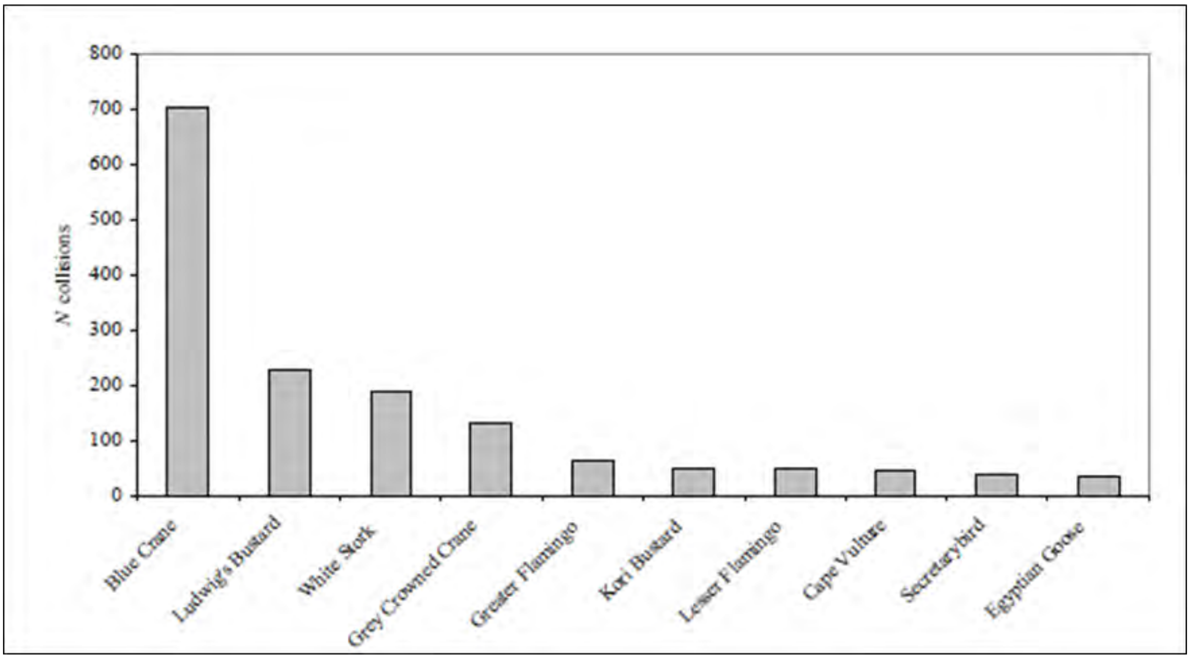

Figure 6:The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom-EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al*. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Barrientos *et al.* 2011; Jenkins *et al.* 2010; Alonso & Alonso 1999; Koops & De Jong 1982), although it is less effective for bustards (Barrientos *et al.* 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

<u>Xha! Boom Grid Connection</u>

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

8.3 Displacement due to habitat destruction and disturbance

During the construction phase and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

<u>Xha! Boom Grid Connection</u>

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at both the proposed Xha! Boom and Linking substation sites is common in the greater study area and the transformation of a few hectares of habitat should not impact any of the Red Data species significantly.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities could also potentially displace Red Data species through **disturbance**; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in July 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. The closest potential corridors (Corridor 2 and Corridor 3) are approximately 1.2km from the nest at their closest points, which means that while the potential for disturbance is likely to be low, but cannot be ruled out. This would especially be the case if the construction activities, e.g, the construction of new access roads, is required closer than 1.2km from the nest.

9. ASSESSMENT OF IMPACTS ON AVIFAUNA

9.1 Impact assessment methodology

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

9.2 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated using the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

9.3 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact is detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 9-1: Description of terms

NATURE		
This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.

3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
Significance		

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

9.4 Impact ratings tables

IMPACT TABLE 1		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance during **construction** phase*	
Extent	*The impact will only affect the site.*	
Probability	*Impact may occur (between a 25% to 50% chance of occurrence) for some species, particularly the larger ones.*	
Reversibility	*Partly reversible. The construction activities will inevitably cause temporary displacement of some Red Data species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, species should re-colonise the areas which have not been transformed by the footprint. However, the indirect effect of habitat fragmentation could result in lower densities of Red Data species.*	
Irreplaceable loss of resources	*Marginal loss of resources. The displacement of Red Data species is likely to be partial.*	
Duration	*Short term. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, Red Data species should re-colonise the areas which have not been transformed by the footprint, albeit possibly at a lower density.*	
Cumulative effect	*Minor cumulative impact. The Red Data species that occur (or are likely to occur) at the proposed site all have large distribution ranges, the cumulative impact of displacement would therefore be at most locally significant in some instances, rather than regionally or nationally significant (see also Section 11 below).*	
Intensity/magnitude	*Medium. Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.*	
Significance Rating	*Low significance.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-9 (low negative)

IMPACT TABLE 1	
Mitigation measures	• Restrict the construction activities to the construction footprint area. • Do not allow any access to the remainder of the property during the construction period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • Ideally, Corridor 1 or 3 should not be used as the two corridors pose a disturbance risk to an active Martial Eagle nest. • A 1.2km exclusion zone should be implemented around the active Martial Eagle nest on the Aries – Helios 400kV line at -30.517644° 19.550840° in the powerline study area where no construction activity or disturbance should take place, in the event of Corridor 1 or 3 being implemented.

IMPACT TABLE 2		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to habitat destruction during* ***construction*** *phase*	
Extent	*The impact will only affect the site.*	
Probability	*Impact may occur (between a 25% to 50% chance of occurrence) for some species, particularly the larger ones.*	
Reversibility	*Partly reversible. The footprint of the powerline is an inevitable result of the development, but it is likely that Red Data species will still utilise the site.*	
Irreplaceable loss of resources	*Marginal loss of resources. It is likely that Red Data species will still utilise the site.*	
Duration	*Long term. The habitat transformation will be permanent in the footprint of the poles.*	
Cumulative effect	*Moderate cumulative impact. There are several renewable energy developments planned around Loeriesfontein which could result in a significant area of transformed habitat, but only at a local scale, for some species (see also Section 11 below).*	
Intensity/magnitude	*Medium. It is likely that Red Data species will still utilise the site.*	
Significance Rating	*Low significance.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-13 (low negative)
Mitigation measures	• The recommendations of the specialist ecological study must be strictly adhered to, especially as far as rehabilitation of vegetation is concerned. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.	

IMPACT TABLE 5	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Collisions of Red Data species with the powerline in the operational phase*
Extent	*The impact will affect the local area or district*
Probability	*Probable. The impact will likely occur (between 50% - 75% chance of occurrence).*
Reversibility	*Partly reversible. Mitigation measures could reduce the risk of collisions, but not significantly as far as bustards are concerned.*
Irreplaceable loss of resources	*Significant loss of resources.*
Duration	*Long term. The risk of collision will be present for the life-time of the development.*
Cumulative effect	*Moderate cumulative impact. The cumulative impact will depend largely on which species are killed. Depending on the number of Ludwig's Bustards that are killed, the regional impact could be significant (see also Section 11 below).*
Intensity/magnitude	*Medium. The powerline could cause mortality of some Red Data species.*
Significance Rating	*High significance.*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	-51 (high negative)	-48 (medium negative)
Mitigation measures	• The powerline should be marked with BFDs for its entire length on the earth wire of the line, 5m apart, alternating black and white. See APPENDIX D for the type of BFD which is recommended.	

10. SELECTING A PREFERRED ALIGNMENT

All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred, although it is slightly longer by about 6km (see Table 10 -1 below).

Table 10-1: Comparative assessment of powerline and substation options

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
On-site Substation Option 2	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
Linking Substation Option 1	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
Linking Substation Option 2	No preference	The envisaged impact will be similar irrespective of which alternative is used, because of the similarity of the habitat.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	Not preferred	Ideally this option should not be used due to its proximity to the active Martial Eagle nest on the Aries – Helios 400kV line.
Grid Line Option 2	Favourable	The option is acceptable with the necessary mitigation.
Grid Line Option 3	Not preferred	Ideally this option should not be used due to its proximity to the active Martial Eagle nest on the Aries – Helios 400kV line.

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 4	Preferred	• It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions; • About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and • It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

11. CUMULATIVE IMPACTS

A cumulative impact, in relation to an activity, is the impact of an activity that may not be significant on its own but may become significant when added to the existing and potential impacts arising from similar or other activities in the area.

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors. The Scottish Natural Heritage (2005) recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or 'search area' of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the study area.

11.1 Species to be considered

The potential cumulative impacts on the Red Data species listed in Table 7-1 were considered.

11.2 Area considered in the cumulative assessment

The Helios Main Transmission Substation (MTS) approximately 50km north of the town of Loeriesfontein forms the hub of a proposed renewable energy node which is situated within a 40km radius around the

MTS (See Figure 17 below). Within this 40km radius around the MTS, the habitat and land-use (small-stock farming) is very uniform.

Table 11-1 below lists the renewable energy projects which are currently approved or under construction within a 40km radius around Helios MTS.

Table 11-1: List of other proposed and existing renewable projects within a 40km radius around Helios MTS

Project	Current status of EIA/development	Proponent	Capacity	Farm details	Footprint
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 2 of Farm Sous 226	3 200 ha
Loeriesfontein Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 1 & 2 of Farm Aan de Karree Doorn Pan 213	3 453 ha
Hantam PV Solar Energy Facility	Environmental Authorisation issued / Approved under RE IPPPP	Solar Capital (Pty) Ltd	Up to 525MW	RE of Farm Narosies 228	1 338 ha
Orlight Loeriesfontein PV Solar Power Plant	Environmental Authorisation issued	Orlight SA (Pty) Ltd	70MW	Pt 5 of Farm Kleine Rooiberg 227	334 ha
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan 212 Stinkputs 229	6 800 ha
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Leeuwbergrivier No. 1163 • Remainder of the Farm Kleine Rooiberg No. 227	6 674 ha
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Springbok Pan No. 1164 • Remainder of the Farm Springbok Tand No. 215	6 500 ha
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	• Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm	2468 ha

				Hartebeest Leegte No 216	
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	• Remainder of Hartebeest Leegte No 216	3083 ha
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	• Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216	3008
				Total	**36 858h**

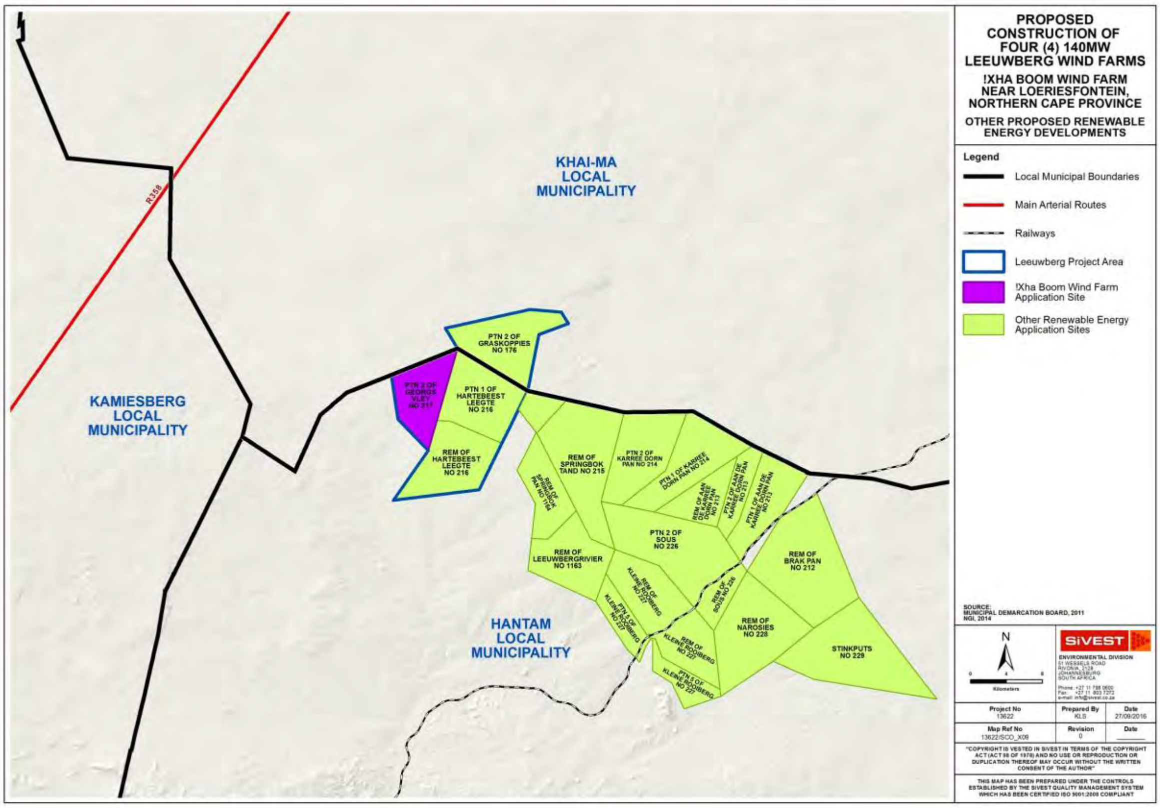

Figure 7: Existing renewable energy applications within a 40km radius around Helios MTS

11.3 Current impacts

Below is a summary of the typical threats currently facing avifauna in the Karoo environment (Marnewick *et al.* 2015):

11.3.1 Overgrazing

This results in a depletion of palatable plant species, erosion, and encroachment by Karoo shrubs. The result is loss of suitable habitat and a decrease in the availability of food for large terrestrial birds, including Red Data species such as Kori Bustard, Karoo Korhaan and Ludwig's Bustard.

11.3.2 Poisoning

Strychnine poison was used extensively in the past to control damage-causing predators, such as Black-backed Jackal *Canis mesomelas* and Caracal *Caracal caracal*, and reduced scavenging raptor populations. The use of poison may be continuing, and the potential impacts on Red Data raptor species such as Martial Eagle has not been confirmed or quantified.

11.3.3 Road-kills

Many birds are commonly killed on roads, especially nocturnal species such as Spotted Eagle-Owl.

11.3.4 Renewable energy developments

Several wind and solar developments have been approved for development within a 40km radius around Helios MTS (see Table 11.1). The combined footprint of these proposed developments is approximately 36 282 hectares[5]. This has implications for several Red Data species, both in terms of collision mortality for some species, especially raptors, and displacement due to permanent habitat transformation, which affects most of the Red Data species to some degree.

11.3.5 Powerlines

Numerous existing and new power lines are significant threats to large terrestrial Red Data species in the Karoo. Power lines kill substantial numbers of all large terrestrial bird species in the Karoo, including threatened species such as Karoo Korhaan, Kori Bustard and Ludwig's Bustard (Jenkins *et al*. 2010; Shaw, J. 2013) There is currently no completely effective mitigation method to prevent collisions. There are currently approximately 130km of Eskom HV lines within a 40km radius around Helios MTS. This figure will increase by at least 100km if all proposed renewable energy developments get to be developed, including the Xha! Boom WEF.

11.3.6 Climate change

Climate change scenarios for the region predict slightly higher summer rainfall by 2050, and increased rainfall variability. Droughts are expected to become more severe. The climate change is predicted to have both positive and negative consequences for Red Data species. Increased summer rainfall could improve survival, and conversely drought years can lower long-term average survival. Large, mainly resident species dependent on rainfall are also more vulnerable to climate change. This would include the slow-breeding Martial Eagle, which also exhibit extended parental care. Severe hailstorms kill many Red Data species and could become more frequent.

11.3.7 Shale gas fracking

[5] This figure refers to the actual infrastructure footprint and not the land parcels, which are naturally much bigger than the area that will be actually developed. This information was obtained through internet searches.

There is a potential threat of shale gas fracking throughout the Karoo. Populations of bird species may be locally reduced through disturbance caused by lights, vibration, vehicles and dust, and may be affected by pollutants in ponds containing contaminated water produced by returned fracking fluids.

11.3.8 Persecution

Although it is difficult to prove, the direct persecution of raptors such as Verreaux's Eagle and Martial Eagle for stock predation is still taking place (R. Visagie pers. comm).

11.4 Methods

The cumulative impact of the proposed grid connection was assessed individually for each Red Data species (see Table 11-2 below).

Table 11-2: Framework for assessing significance of cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account because the receptor/resource is irretrievably compromised, resulting in a fatal flaw.
Major	Effects that may become a key decision-making issue, potential fatal-flaw.
Moderate	Effects that are unlikely to affect the viability of the project, but mitigation might be required.
Minor	Effects which might be locally/site significant, but probably insignificant for the greater study area.
Not Significant	Effects that are within the ability of the resource to absorb such change both at local/site level and within the greater study area.

11.5 Assumptions and limitations: cumulative impacts

The information on proposed WEFs and grid connections in the study area was received from Sivest and from various websites. The assessment was made on this basis, but it cannot be guaranteed that these are the only proposed developments.

11.6 Assessment

See Table 11-3 below for a systematic exposition of the expected cumulative impacts of the proposed Xha! Boom grid connection on Red Data species.

Table 11-3: The expected cumulative impact of the Xha! Boom Grid Connection on Red Data species within the 40km development node.

Priority species	Taxonomic name	Level of current and future impacts on species	Susceptibility to powerline impacts	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Pre-mitigation	Expected combined cumulative impact of existing HV network and proposed renewable projects HV network: Post-mitigation
Karoo Korhaan	*Eupodotis vigorsii*	Low: Powerlines, solar, overgrazing, climate change	Medium	Moderate	Minor
Kori Bustard	*Ardeatis kori*	High: Powerlines,solar, overgrazing, climate change	High	High	Moderate
Lanner Falcon	*Falco biarmicus*	Low: Powerlines, poisoning, road kills, solar, WEF	Low	Low	Not significant
Ludwig's Bustard	*Neotis ludwigii*	High: Powerlines, solar, overgrazing, climate change	High	High	Moderate
Martial Eagle	*Polemaetus bellicosus*	High: Powerlines, persecution, solar, overgrazing, WEFs, climate change	High	Moderate	Minor
Secretarybird	*Sagittarius serpentarius*	High: Powerlines, solar , overgrazing, WEFs, climate change	High	High	Moderate
Sclater’s Lark	*Spizocorys sclateri*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Red Lark	*Calendulauda burra*	Low: Powerlines, solar, overgrazing, climate change	Low	Minor	Not significant
Burchell’s Courser	*Cursorius rufus*	Medium: Solar, overgrazing, WEFs, climate change	Low	Not significant	Not significant
Verreaux's Eagle	*Aquila verreauxii*	High: Powerlines, persecution, solar, overgrazing, WEFs, climate change	High	Moderate	Minor

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be minor to moderate within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

11.7 No-Go Alternative

The no-go alternative will result in the current status quo being maintained as far as the avifauna is concerned. Overall, the very low human population in the study area is definitely advantageous to avifauna in general. The no-go option would be advantageous for the ecological integrity of the study area as far as avifauna is concerned.

12. SUMMARY OF FINDINGS AND CONCLUDING STATEMENT

The proposed Xha! Boom grid connection and associated substations will have potential impacts on Red Data avifauna. The impacts are the following:

- Displacement due to disturbance during construction;
- Displacement due to habitat change and loss; and
- Collisions with the earthwire of the 132kV grid connection

12.1 Displacement due to disturbance during construction

Construction and maintenance activities could potentially displace Red Data species through disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities could be a source of disturbance and could lead to temporary or even permanent abandonment of nests. The most obvious potential issue that need to be addressed in this instance is the active Martial Eagle nest on the Aries - Helios 400kV line near the Helios substation. The nest was active in June 2017, which indicates that the birds have become habituated to the constant traffic on the dirt road that runs 450m from the nest. This is the main access road to Helios Substation, and is also constantly used by construction vehicles active at the Loeriesfontein 2 and Khobab WEFs. While the habituation is a factor to be considered, it would still be preferable to have an alignment as far as possible from the nest as a pre-cautionary measure to limit the potential for displacement during construction of the grid connection. Options 2 and 3 are approximately 1.2km from the nest at their closest point, while Options 1 and 4 are 2km from the nest at their closest point.

The pre-mitigation risk of displacement due to disturbance during the construction phase is rated as low, but could be further reduced through appropriate mitigation.

12.2 Displacement through habitat destruction during the construction phases

In the present instance, the risk of displacement of Red Data species due to **habitat destruction** is likely to be fairly limited given the nature of the vegetation. Very little if any vegetation clearing will have to be done in the powerline servitude itself. The habitat at the proposed Xha! Boom substation sites is common in the greater study area and the transformation of a few hectare of habitat should not impact any of the Red Data species significantly.

The risk of displacement through habitat destruction during construction is rated as low, which could be reduced through appropriate mitigation.

12.3 Collisions of Red Data species with the earthwire of the 132kV grid connection

The most likely Red Data candidates for collision mortality on the proposed 132kV grid connection are Ludwig's Bustard, Karoo Korhaan, both whom have high reporting rates in the study area. Kori Bustard and Secretarybird may also be at risk, although they occur at much lower densities than the previous two species.

The risk of collision mortality through collisions with the earthwire of the 132kV grid connection is rated as high which can be reduced to medium through appropriate mitigation.

12.4 Concluding statement

The proposed Ithemba grid connection will have potential impacts on avifauna, ranging from high to low, prior to the implementation of mitigation. With the implementation of mitigation measures, the high impacts could be reduced to medium, while the low impacts can be further reduced. All four the proposed alignments are situated in the same habitat and are of comparable length. The associated impacts are therefore expected to be very similar in nature and extent. However, when looking very carefully at the four respective alignments, Options 1 and 3 are less favourable due to their proximity to the active Martial Eagle nest near Helios Substation. Option 4 emerges as most preferred:

- It follows the main Loeriesfontein access road and existing HV lines for about a third of the way, thereby reducing the impact of habitat fragmentation, and reducing the risk of collisions;
- About 50% of the alignment is oriented in an east-west direction, which is parallel to the main migration movement of Ludwig's Bustard, therefore reducing the risk of collisions for the species; and
- It never comes closer than 2km from the active Martial Eagle nest on the Aries – Helios 400kV line, which reduces the risk of disturbance to the birds.

Overall, the combined cumulative impacts of the proposed Xha! Boom grid connection and the existing and proposed HV networks on Red Data species, assuming implementation of appropriate mitigation measures, are expected to be moderate to minor within the 40km development node around Helios Substation. The overall cumulative assessment has been produced with a moderate level of certainty.

13. REFERENCES

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APPENDIX A

Avifaunal pre-construction monitoring at the proposed Leeuwberg Wind Energy Facilities:

Overview of methodology

Objectives

The objective of the pre-construction monitoring at the proposed wind projects was to gather baseline data over a period of 12-months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the broader study area and a suitable control area to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the broader study area to measure the potential collision risk with the turbines.

Methods

The monitoring protocol for the sites is designed according to the latest version (2015) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

Monitoring surveys were conducted at the WEF study areas and a control area by four field monitors during the following periods:

- 10 – 23 November 2015
- 23 February – 03 March 2016
- 18 May - 30 May 2016
- 22 August – 1 September 2016

Monitoring was conducted in the following manner:

- Four drive transects were identified on the study area totalling 52.1km and one drive transect in the control site with a total length of 13.7km.
- Two observers travelling slowly (± 10km/h) in a vehicle records all species on both sides of the drive transect. The observers stop at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects are counted three times per sampling session.
- In addition, eleven walk transects of 1km each were identified at the study area, and four at the control site, and counted 8 times per sampling season. All birds are recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1 - 7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
    - Co-ordinates (priority species only).

- Eleven vantage points (VPs) were identified to record the flight altitude and patterns of priority species at the development areas. Two VPs were also identified on the control area. The following variables were recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m);
    - Flight mode (soar; flap; glide; kite; hover); and
    - Flight time (in 15 second-intervals).

The aim with drive transects was primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects were primarily aimed at recording small passerines. The objective of the transect monitoring was to gather baseline data on the use of the development areas by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the November 2014 BLSA list of priority species for wind farms.

Four potential focal points of bird activity, two boreholes and two salt pans, one known as Die Soutkomme and the other as Konnes se Pan, were identified in the greater study area and monitored.

Figure 1 below indicates the area where monitoring was performed.

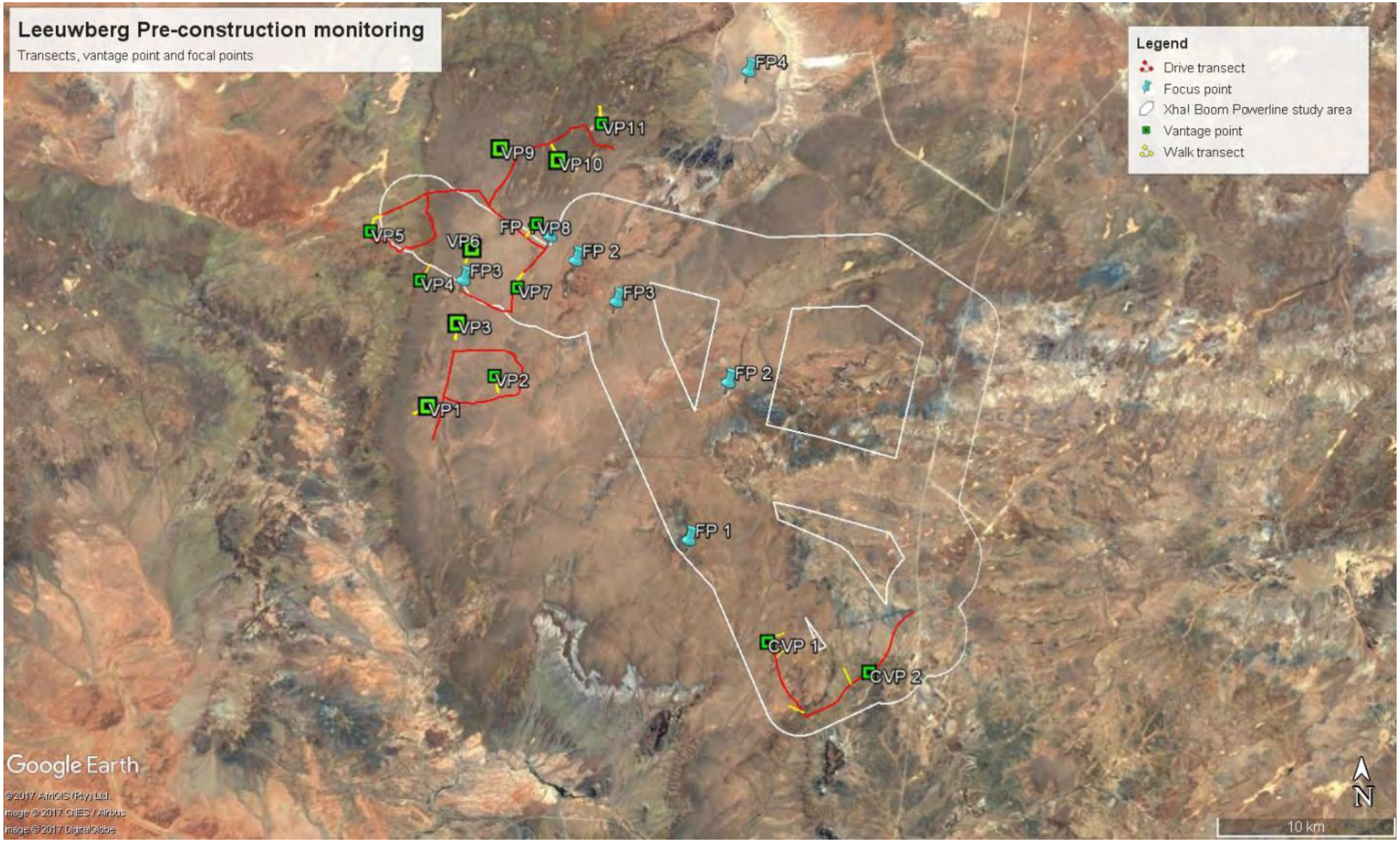

Figure 1: The WEF study area where the pre-construction monitoring was conducted for the proposed Leeuwberg WEFs. The white polygon indicates the boundaries of the powerline study area.

APPENDIX B: BIRD HABITAT

Figure 1: An example of Bushmanland Basin Shrubland at the powerline study area. This is also the dominant habitat in the greater study area.

Figure 2: A typical water point in the powerline study area.

Figure 3: The habitat at the control area, indicating the homogenous nature of the habitat in the greater study area.

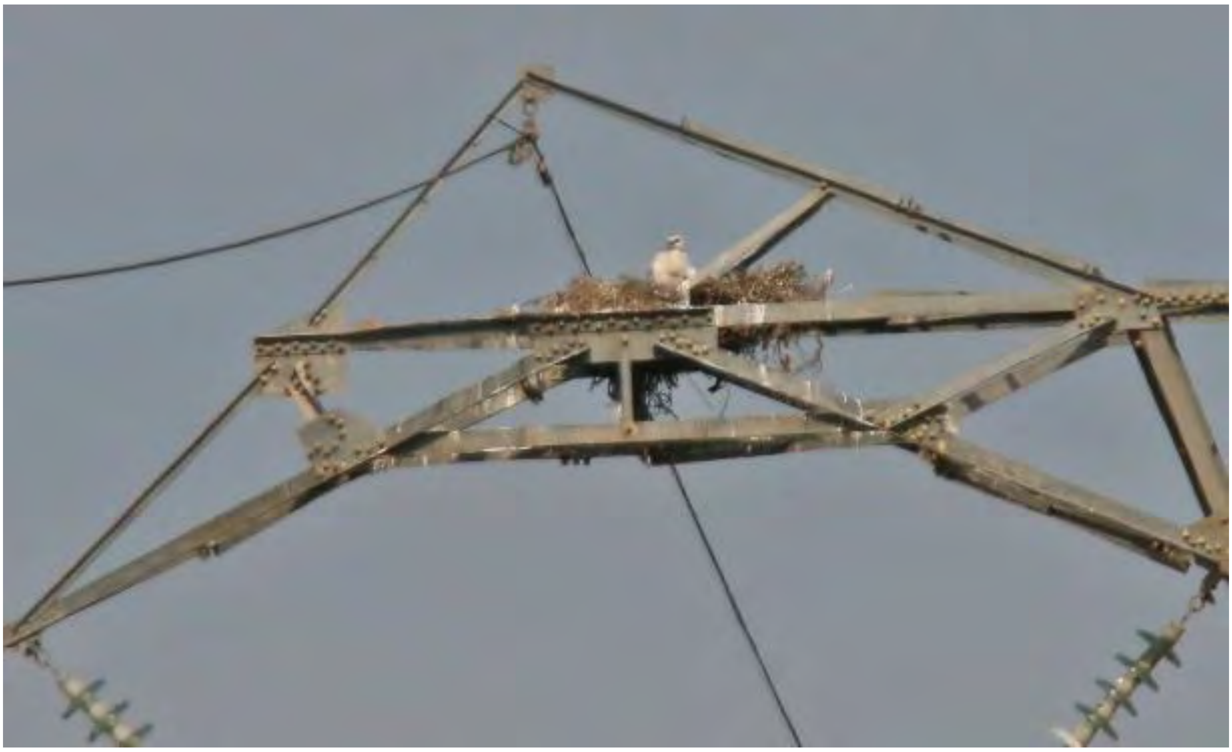

Figure 4: An active Martial Eagle nest on the Aries – Helios 400kV transmission line.

APPENDIX C: SABAP2 SPECIES LIST

Species	**Taxonomic name**
Acacia Pied Barbet	*Tricholaema leucomelas*
African Hoopoe	*Upupa africana*
African Pipit	*Anthus cinnamomeus*
African Red-eyed Bulbul	*Pycnonotus nigricans*
Ant-eating Chat	*Myrmecocichla formicivora*
Barn Swallow	*Hirundo rustica*
Black-chested Snake Eagle	*Circaetus pectoralis*
Black-eared Sparrow-lark	*Eremopterix australis*
Black-headed Canary	*Serinus alario*
Blacksmith Lapwing	*Vanellus armatus*
Black-winged Stilt	*Himantopus himantopus*
Bokmakierie	*Telophorus zeylonus*
Booted Eagle	*Aquila pennatus*
Burchell's Courser	*Cursorius rufus*
Cape Bunting	*Emberiza capensis*
Cape Crow	*Corvus capensis*
Cape Sparrow	*Passer melanurus*
Cape Turtle Dove	*Streptopelia capicola*
Cape Wagtail	*Motacilla capensis*
Cape Weaver	*Ploceus capensis*
Capped Wheatear	*Oenanthe pileata*
Caspian Plover	*Charadrius asiaticus*
Chat Flycatcher	*Bradornis infuscatus*
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*
Common (Steppe) Buzzard	*Buteo vulpinus*
Common Fiscal	*Lanius collaris*
Common Quail	*Coturnix coturnix*
Common Swift	*Apus apus*
Crowned Lapwing	*Vanellus coronatus*
Double-banded Courser	*Rhinoptilus africanus*
Dusky Sunbird	*Cinnyris fuscus*
Eastern clapper Lark	*Mirafra fasciolata*
Egyptian Goose	*Alopochen aegyptiacus*
European Bee-eater	*Merops apiaster*
Fairy Flycatcher	*Stenostira scita*
Familiar Chat	*Cercomela familiaris*
Greater Kestrel	*Falco rupicoloides*

Greater Striped Swallow	*Hirundo cucullata*
Grey Penduline-Tit	*Anthoscopus minutus*
Grey Tit	*Parus afer*
Grey-backed Cisticola	*Cisticola subruficapilla*
Grey-backed Sparrow-lark	*Eremopterix verticalis*
House Sparrow	*Passer domesticus*
Jackal Buzzard	*Buteo rufofuscus*
Karoo Chat	*Cercomela schlegelii*
Karoo Eremomela	*Eremomela gregalis*
Karoo Korhaan	*Eupodotis vigorsii*
Karoo Long-billed Lark	*Certhilauda subcoronata*
Karoo Prinia	*Prinia maculosa*
Karoo Scrub Robin	*Cercotrichas coryphoeus*
Kori Bustard	*Ardeotis kori*
Lanner Falcon	*Falco biarmicus*
Large-billed Lark	*Galerida magnirostris*
Lark-like Bunting	*Emberiza impetuani*
Laughing Dove	*Streptopelia senegalensis*
Layard’s Tit-Babbler	*Parisoma layardi*
Little Swift	*Apus affinis*
Long-billed crombec	*Sylvietta rufescens*
Long-billed Pipit	*Anthus similis*
Ludwig’s Bustard	*Neotis ludwigii*
Malachite Sunbird	*Nectarinia famosa*
Martial Eagle	*Polemaetus bellicosus*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Namaqua Sandgrouse	*Pterocles namaqua*
Northern Black Korhaan	*Afrotis afraoides*
Pale Chanting Goshawk	*Melierax canorus*
Pale-winged Starling	*Onychognathus nabouroup*
Pied Crow	*Corvus albus*
Pied Starling	*Spreo bicolor*
Pririt Batis	*Batis pririt*
Red Lark	*Calendulauda burra*
Red-billed Teal	*Anas erythrorhyncha*
Red-capped Lark	*Calandrella cinerea*
Red-faced Mousebird	*Urocolius indicus*
Red-headed Finch	*Amadina erythrocephala*
Rock Kestrel	*Falco rupicolus*

Rock Martin	*Hirundo fuligula*
Rufous-cheeked Nightjar	*Caprimulgus rufigena*
Rufous-eared Warbler	*Malcorus pectoralis*
Sclater's Lark	*Spizocorys sclateri*
Sickle-winged Chat	*Cercomela sinuata*
South African Shelduck	*Tadorna cana*
Southern Masked Weaver	*Ploceus velatus*
Speckled Pigeon	*Columba guinea*
Spike-heeled Lark	*Chersomanes albofasciata*
Spotted Eagle-Owl	*Bubo africanus*
Spotted Thick-knee	*Burhinus capensis*
Stark's Lark	*Spizocorys starki*
Three-banded Plover	*Charadrius tricollaris*
Tractrac Chat	*Cercomela tractrac*
Verreauxs' Eagle	*Aquila verreauxii*
Western Barn Owl	*Tyto alba*
White-backed Mousebird	*Colius colius*
White-rumped Swift	*Apus caffer*
White-throated Canary	*Crithagra albogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-bellied Eremomela	*Eremomela icteropygialis*

APPENDIX D: BIRD FLIGHT DIVERTERS[6]

DISTRIBUTION
TECHNICAL BULLETIN

3 April 2009

Enquiries: B P Hill
Tel: (011) 871 2397

TECHNICAL BULLETIN: 09 TB – 01
PART: 4 - MV

APPROVED BIRD FLIGHT DIVERTERS TO BE USED ON ESKOMS LINES (MITIGATING DEVICES)

This Technical Bulletin replaces all other Technical Bulletins that were published previously.

The following two flight diverters (mitigating devices) have been successfully installed and successfully tested on an active line in the Colesberg area.

1) EBM Flapper

Buyers guide number DDT 3053

The EBM bird flapper tested for the following:

- Pull down test (spirally moving along the conductor) for squirrel and hare conductor
- Testing for radio interference at 27kv on fox conductor
- Testing for corona at 27kv on fox conductor
- Salt fog test for 1000 hours.

The flapper was installed live line on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device.

From field experience and the testing of the flapper it was decided at the Envirotech work group meeting that this EBM flapper can be used on conductors ranging from 6mm to 24mm on ACSR, AAAC conductors and shield wires.

The EBM Flapper can be attached with a link stick and a standard attachment or by hand from a bucket live line or under dead conditions.

Contact Roger Martin: EBM Tel 011 288 0000

Eskom Distribution
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PRIVATE BAG X1074
GERMISTON 1400

[6] The devices in this appendix are the current (February 2017) recommended devices, but that at the time of construction the most current, Eskom approved devices should be used.

2) Tyco Flight Diverter.

Buyers guide number DDT 3107

The TYCo flight diverter has been used successfully in many places around the world and has been installed on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device. The device is supplied in colours white and grey.

Contact person: Mr Silas Moloko: TIS Tel 011 635 8000

3) Installing Flight Diverters

- Spacing of the bird diverters are to be 5m apart alternating on each phase, for single phase lines the colours would alternate 5m apart on the two lines.
- The flight diverters are to be installed with alternating colours,

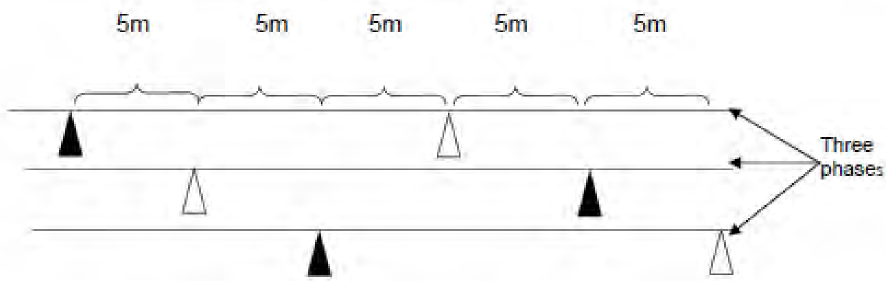

Figure 1

Signed

COMPILED BY:

DATE: **April 2009**
B P Hill
Chief Engineer
IARC

Signed

APPROVED BY:

DATE: **April 2009**
Vinod Singh
Power Plant Technologies Manager
IARC

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Double Loop Bird Flight Diverter

General Recommendation

The Bird Flight Diverter is designed to make overhead lines visible to birds and provides and economic means of reducing the hazard to both lines and birds. For low and medium voltage construction (up to 40kV) it is applied to the phase conductors (bare or jacketed). For high voltage it is used on the earth wire.

The fitting is light in weight, offers little wind resistance and is easily and quickly applied. The positive grip of the fitting on the conductor ensures that it remains in the applied position and cannot move along the span under vibration.

Visibility: The diverter section increases the visibility profile of the cable or conductor to a degree necessary to ensure safety, but avoids undesirably bulky outline.

Spacing: Spacing distances are not critical and will depend upon local conditions. Since wind resistance is very limited, sufficient fittings can be used to ensure adequate visibility without creating stresses on the line. When marking adjacent spans, overall visibility is improved by staggering the application.

We recommend generally a spacing of 10 or 15 metres.

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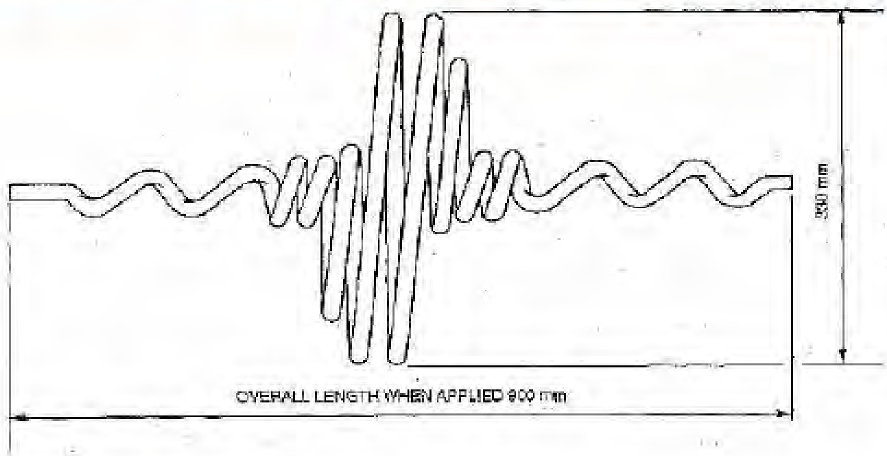
Double Loop Bird Flight Diverter



Material Used: Manufactured from rigid solid high impact polyvinyl chloride, possessing excellent chemical and strength properties and which will retain good physical characteristics within the range of extreme temperatures. Outdoor aging tests indicate that the material does not deteriorate in function or appearance from the effects of severe weather conditions. Industrial fumes and salt water cannot seriously degrade the properties of rigid PVC.

Colour: White or Black

Lay Direction: Bird Flight Diverters are supplied right hand lay for both right hand and left hand lay bare conductors and insulated cables.

CATALOGUE NO.	CONDUCTOR/ E/WIRE DIA. RANGE
BFD 0914/LD2*	9 mm – 14 mm

*Add B or W to denote colour

INDEX

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Appendix 6C

Surface Water Assessment

(Including review letter)

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ecotone
Freshwater Consultants

12 September 2017

To whom it may concern

REVIEW OF REPORT: PROPOSED CONSTRUCTION OF THE FOLLOWING WIND FARMS AND ASSOCIATED LINEAR INFRASTRUCTURE: XHA! BOOM, GRASKOPPIES, ITHEMBA AND HARTEBEEST LEEGSTE

Surface Water Delineation and Assessment Report

1. **Experience of the Peer Reviewer**

Michiel Jonker is the lead freshwater ecology specialist and a founding member of Ecotone Freshwater Consultants. He holds Masters Degrees in Aquatic Health and Environmental Management from the University of Johannesburg, and is a registered Professional Natural Scientist practitioner in the field of freshwater ecology for the past 9 years. Michiel is also an accredited South African Scoring System version 5 (SASS5) practitioner and wetland delineator (Department of Water Affairs). He has extensive experience in aquatic ecology assessments, biomonitoring, impact and wetland assessments nationally and internationally.

2. **Acceptability of the Terms of Reference**

The terms of reference are provided within the introduction as:

- Identify, delineate and classify surface water resources.
- Assessment of watercourses.
- Complete an alternative selection based on proximity to surface water resources.
- Ascertain the legal requirements in relation to surface water resources.
- Complete a pre-construction, construction and cumulative impact assessment.
- Provide mitigation measures.

3. **Methodology**

The methods applied for the following components of the assessment are appropriate in the context of the study:

- Desktop literature review;
- Wetland delineation;
- Buffer determination and
- Impact assessment.

A more detailed assessment will be required for a Water Use License (WUL) application. However, the assumptions and limitations, in this regard, are articulated within the report:

"…Wetland or river health, present ecological status (PES), ecosystem services and the ecological importance (EI)/ecological sensitivity (ES) categories have not been assessed for identified surface water resources. Only

desktop information in terms of PES/EI/ES (where available) from the databases were provided as per the scoping assessment information".

4. Validity of the Findings

The hydrological functioning of the different watercourses is discussed and baseline information is provided in terms of topography, vegetation and soil. The results inform a regional project alternative selection. The main impacts are suitably identified and assessed. The extent of all surface watercourses is identified and are generally considered sensitive. Potential impacts are identified and assessed in terms of loss of habitat, hydrology, geomorphology, water quality and alien vegetation.

5. Suitability of the Mitigation Measures and Recommendations

Mitigation measures provided are relevant and suitable. The main recommendation is to avoid surface watercourses during construction and operations. However, generic mitigation measures are provided for the conceivable instances where activities will occur within or close to surface watercourses.

In instances where impacts on watercourses may not be avoidable the impact assessment will have to be augmented with more site and activity specific information. The author correctly identifies the requirement for a risk assessment in terms Regulation 509 once a final design is available.

6. Appropriateness of Reference Literature

The references applied are appropriate.

7. Additional Comments

No site visit took place as part of the review process.

CURRICULUM VITAE

Name:	Michiel Jonker	**Marital status:**	Single
Date of birth:	25/05/1984	**Driver's license**:	Code 8
ID No.:	840525 5110 085	**Contact No:**	084 585 7479
Place of birth:	Johannesburg, South Africa	**Email:**	michiel@ecotone-sa.co.za
Postal address:	PO Box 84 Florida, Johannesburg, South Africa, 1710		
Experience:	10 Years		

Education

University of Johannesburg

2011 **M. Sc (Environmental Management)**
This is a lectured Masters degree focussing on the concepts and principles of environmental management. The MSc. includes three modules: (1) Environmental management, biosphere and the environment. (2) Environmental management skills and (3) A mini dissertation in related field works.

2009 **M.Sc (Aquatic Health)** ***cum laude***
This Masters study has an ecotoxicological basis. It deals with the effects of androgenic and estrogenic growth-promoting hormones, used in cattle feeding lots, on aquatic freshwater ecosystems. It aims to incorporate biomarkers in fish (metabolomics and cellular energy allocation) as well as studies of general water quality, sediment composition and invertebrate community structures

2006 **B.Sc Honours (Zoology)** ***cum laude***
Related course work: Laboratory and field skills, Philosophy and research methodology, population genetics, project management, mammal diversity, eco-physiology, parasite ecology, ichthyology, research project, biological systems integrity, terrestrial ecology, nature conservation.

2005 **B.Sc (Natural and Environmental Sciences)**
Majors: Geography and Zoology
Minors: Environmental management, botany, chemistry, environmental chemistry, biogeochemistry, statistics, information science
Related course work: Cartography, biogeography, soil science, climatology and geomorphology, economic and urban geography, GIS, Geography of Africa and South Africa, invertebrate and vertebrate diversity, parasitology, ecotoxicology, terrestrial ecology and limnology, animal physiology, economic and ethno-botany, plant diversity, plant-water relations, organic and physical chemistry.

Employment and Work Experience

Feb '08 – Pres **Ecotone Freshwater Consultants CC**
Member and Freshwater Ecologist

Recent projects:

- **ESKOM / EIMS – Arnot Power Station,** Wetland Specialist report **-** Integrated Environmental Impact Assessment Process (Waste Management License Application, Environmental Authorisation Application And Associated Environmental Management Programme) and

Water Use License Application For The New Ash Disposal Facility at Arnot Power Station In Mpumalanga (August 2016-Present).

- **Imperata / AHTech** Aquatic assessment of the Moreletaspruit associated with the Menlyn diesel spill (October 2016).
- **ERM** Environmental Flow assessment, Yiben Dam Project, Sierra Leone (July 2016).
- **SMD / EIMS** aquatic ecology and impact assessment - Scoping and EIA/EMP Report for the proposed expansion of the Kao Diamond Mine, Lesotho (May 2016).
- **Vaalbult Colliery** wetland specialist assessment, proposed road crossing, Carolina, Mpumalanga (February 2016 – Present).
- **EkoInfo** aquatic biomonitoring plan and implementation for the Elands River associated with the Maseve mining operations near Sun City, in the North West Province, (January 2016-present).
- **Exxaro**, Zonderwater Coal Proposal, Wetland Specialist Assessment (November 2013 – April 2016).
- **Dyambyini / ESKOM – Hendrina Power Station,** wetland and aquatic ecology assessment, management and biomonitoring plan for Water Use Licence Authorisation for the Proposed expansion of the Hendrina Ash Disposal Facility and related Power Line infrastructure (March 2016).
- **Delta Mining** wetland assessment and watercourse management plan for mining operations associated with the Proposed Rietkuil operations. Rietkuil, Delmas, Mpumalanga (February 2016).
- **SLR Consulting-** Biodiversity assessment, management and biomonitoring plan for the proposed expansion of the Holfontein Toxic Waste Disposal Facility, Gauteng (January 2016).
- **Envirolutions (Eskom)** Pre-, during- and post construction biomonitoring for pylon constructions crossing smaller tributaries of the Vaal River, Vereeniging, Gauteng (January 2015- present).
- **WPC** Ngonye Falls- 52 MW Hydroelectric Power Plant. Baseline biodiversity study and Environmental Flow Assessment, Zambia (October 2015 to present).
- **Ara-sul** Aquatic baseline assessment of the Sabie River, up- and downstream of Corumana Dam, Kruger National Park and Mozambique (November 2015 to January 2016).
- **EcoGain** Wetland and Impact assessment associated with the proposed Opencast Mining Operation, Delmas (October 2015 to present).
- **Envirolutions** Water quality Assessment, Broadacres Retirement Village, Broadacres Gauteng Province (November 2015).
- **ERM, Ncondezi Coal Mine**, Freshwater Ecology baseline study and Desktop Environmental Flow Assessment, Tete, Mozambique (November 2014 – May 2015).
- Hydrological Alteration-Aquatic Ecology Assessment-**New Largo** (July 2010 - Present).
- **Goliath Gold** Aquatic and impact assessment associated with the proposed de-water of a mine shaft, Heidelberg, Gauteng (January – May 2015).
- **Zambezi River Authority**, Kariba Dam wall upgrade, Freshwater Ecology baseline, impact assessment and Environmental Flow Assessment, Zambia/Zimbabwe (October 2014 - March 2015)
- **Dyambyini / ESKOM - Majuba Power Station**, Wetland Specialist Assessment (December - January 2015).
- **Doogvallei Rail Siding Company (Pty) Ltd**, Aquatic Biomonitoring Assessment of associated drainage lines, Carolina Mpumalanga (September 2012 – January 2015).
- **Pembani Coal**: Aquatic Biomonitoring Assessment, Carolina (March 2012 –January 2015).
- **Kumba Iron Ore**, Wetland and River study for WULa, Thabazimbi, Limpopo (December 2014).

- **FFMES, Cominco Phosphate Mine**, Hinda Project Freshwater Baseline Study and critical habitat assessment, Republic of Congo (March to August 2014).
- **Lidwala**, Majuba Wetland Rehabilitation Proposal, Wetland Specialist Assessment (March-July 2014).
- **Imperata**, NKP Terminal 2, Wetland Monitoring Assessment (June – July 2014).
- **Jeffars and Green,** Thabong Interchange, Wetland Rehabilitation Plan (June 2014).
- **Envirobility**, Sand Quarry, Diepsloot, Wetland Specialist Assessment (March 2014 – May 2014).
- **Lidwala / ESKOM** - **Majuba Power Station**, Wetland Assessment Augmentation, Wetland Specialist Assessment (April 2014).
- **WSP, Kathu CSP Project**, Northern Cape, Wetland Specialist Assessment (January 2014 – April 2014).
- **ERM, Mulungushi Hydropower Project,** Aquatic Specialist (February, 2013).
- **ERM**, **Muchinga Hydropower Stations**, Aquatic Specialist, Zambia (April, 2013).
- **FFMES**, **Exxaro DMC Iron Congo Project**, Aquatic specialist study, Mayoko, Republic of Congo (September 2012).
- **ERM**, Sasol Twistdraai Export Plant, Wetland Specialist Assessment (November 2013 – May 2014).
- **GladAfrica, Centurion Lake Sediment Trap**, Aquatic Specialist Study, Gauteng, South Africa (November, 2012).
- **MSA, Meyerton Waste Water Treatment Works Upgrade**, Aquatic Specialist Study, Gauteng, South Africa (November 2012).
- **ESKOM, Majuba Ash Disposal Facility**, Wetland Specialist Study for the Scoping/EIA, Mpumalanga, South Africa (September, 2012).
- **ESKOM, Tutuka Ash Disposal Facility**, Wetland Specialist Study for the EIA, Mpumalanga, South Africa (September, 2012).
- **FFMES, Sintoukola Project**, Aquatic specialist study, Republic of Congo (May 2012; July 2012).
- **Coffey Environments, Tete Iron Project**, Aquatic specialist study of the Revuboe River, Chiúta and Moatize districts, Tete, Mozambique (March 2012).
- **Shanduka Coal**, wetland and impact assessment for a proposed 400kV line relocation, Middleburg, Mpumalanga (April, 2012).
- **Worldwide Coal Carolina**, aquatic biomonitoring assessment, Carolina, Mpumalanga (March, 2012).
- **Homeland Mining and Energy SA**, proposed Eloff Opencast Mine, specialist wetland assessment (± 1400 ha) just outside the town of Delmas, Mpumalanga (February, 2012).
- **Exxaro MagVanTi Project** -Aquatic Ecology Baseline Study, Limpopo (January, 2012).
- **Shanduka Coal**, wetland and impact assessment of a pan located in the Graspan Colliery, Middleburg, Mpumalanga (January, 2012).
- **African Barrick Gold North Mata Mine** - Aquatic Consultant: Ecotoxicological risk assessment for discharge of treated waste water into the Mara River, North Mara, Tanzania (August, 2011).
- **Moamba Dam Project, Moamba, Mozambique,** Aquatic Consultant- Impacto: Aquatic ecology assessment for proposed (July, 2011).
- Fresh water Ecology **scoping study-Hendrina-Mpumalanga**(May 2011)
- Aquatic Biomonitoring Assessment-Blesbokspruit- **Hydro Testing** (May 2011)
- Aquatic Consultant- Lidwala environmental and engineering consultants: Sanral N14 river/stream crossing aquatic assessment (May 2011).
- Aquatic Consultant- Randwater: Proposed water and treated water residue pipeline near **Lethabo power station** in Vereeniging (May 2011).

- Aquatic Consultant- Anglo Coal: Assessment on non-perennial drainage lines associated with proposed coal mining development near All days in Limpopo (May, 2011).
- Hydro Testing Biomonitoring(KP290+100**) KwaZulu-Natal- Aquatic Ecology Assessment** (Febuary 2011)
- Aquatic Consultant- Riversdale: Aquatic specialists on the **Benga Coal Project**, Tete, Mozambique (January, 2011).
- Aquatic Consultant- Transnet: Aquatic biomonitoring - **Ladysmith pump station oil spill**, Ladysmith, Natal (January, 2011).
- Aquatic Consultant – Imperata – Aquatic assessment for a proposed **Rand Water pipeline** crossing over the Pienaars River near Pretoria (May, 2010).
- Aquatic Consultant – Ekoinfo – Aquatic assessment for a **NuCoal mine** (Vuna colliery) near Middelburg Mpumalanga (March 2010- Current)
- Aquatic Consultant – EcoAgent – A MSA project – Detailed Aquatic assessment for the propped **Veremo Magnetite mine** in the Eastern Bushveld near Stofberg Mpumalanga (May 2010)
- Aquatic Consultant – New Multi Purpose Pipeline (NMPP) a combined Transnet, **Group Five and Spiecapag project** –Aquatic assessment and monitoring of associated river crossings in the Upper Vaal, Thukela and Mvoti Water Management Areas (Ocktober 2009- Current).
- Aquatic Consultant – **Intergraded Landscape Architects** – Raslouw Riparian delineation and aquatic assessment, Johannesburg (November 2009).
- Aquatic Consultant – Ekoinfo – **Klipriviersberg** Full Aquatic assessment (January. 2009)
- Aquatic Consultant – Ekoinfo – **Lonmin** Aquatic biodiversity assessment (January 2009).
- Aquatic Consultant – NSS– Optimum **Coal Fish** diversity assessment (March 2009)
- Aquatic Consultant –NSS – **Rio Tinto Chapudi** proposed coal mine diversity assessment (March 2009).
- Aquatic Consultant – **Lonmin platinum**- aquatic biodiversity assessment and action plan (January, 2009).
- Aquatic Consultant – **SASOL** – aquatic ecosystem impact assessment for proposed pipeline development (January 2009).
- Aquatic Consultant – Arcus Gibb - Aquatic biodiversity assessment for proposed coal **Eskom Mulilo coal mining development** (December 2008).
- Aquatic Consultant – **ESKOM** - Biomonitoring for proposed **Majuba railroad construction** for Eskom (October 2008- current).

Feb 07 – Jan 08 **EnviRoss Environmental Scientific Consultants Cc**
Consultant

- Junior Scientist – Enviross cc - Aquatic macro-invertebrate biodiversity study for proposed feedlot **Mpumalanga** 2007. (November 2007)
- Junior Scientist – Enviross cc - **Tshwane** sewerage works bio-monitoring. (September 2007).
- Junior Scientist – Econ@uj - Ecological state of five estuaries in the **Wild coast** for proposed heavy mineral mining (October 2007).
- Aquatic Consultant – Ekoinfo - Aquatic ecological assessment for proposed golf course development in **North West province for Sun City** (August 2007).
- Junior Scientist – Enviross cc - Firgrove industrial development in **Somerset West** 2007 (July 2007) 2007.
- Junior Scientist – Enviross cc - Aquatic health determination and eco-classification for **ANGLO coal** (Mpumalanga) in 2007 (2007).

- Junior Scientist – Econ@uj - Aquatic health determination and eco-classification for **TOTAL coal** in 2006 (May 2006).
- Junior Scientist – Econ@uj - Aquatic health and fish diversity assessment at **Klipplaat nature reserve**, 2006 (September 2006).
- Technical Assistant - **University of Johannesburg Zoology department** - Aquatic health and biodiversity of the **Crocodile West Marico and Magaliesburg system**, 2007 (February 2007).
- Technical Assistant – Enviross cc - **Owl surveys** (March 2007).
- Project Manager - University of Johannesburg Zoology department - Aquatic health and biodiversity of **lake Chrissie in Mpumalanga**, 2007 (April 2007)
- Technical Assistant - University of Johannesburg Zoology department - PhD study regarding effects of pesticides on the freshwater aquatic health in the **Levubu River in Venda (Limpopo Province)** (February 2008)
- Researcher - University of Johannesburg Zoology department - Presented poster at Zoological society South Africa (ZSSA) in July 2007: Abiotic factors influencing invertebrate community structures in pan and dams in the **Mpumalanga highveld area** (June 2007)

Workshops and Courses

2011 **Tools for Wetland Assessment Short Course**
Department of Environmental Science Rhodes University;
Grahamstown Port Elizabeth

2009 **Environmental Management Systems –WTH Management and Training**
ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg

2008 **Wetland and Riparian Delineation Course**
Accredited wetland delineator
Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF)
Pretoria, South Africa.

2008 **Skippers Course**
License Holder of a Category "R" skippers license

2007 **SASS5 Accredited Practitioner**
Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux
(North West Nature Conservation).

2007 **Multivariate Statistics Training**
Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam

2006 **Advanced 4x4 driving course**

Societies and Accreditations

2009 **The South African Council for Natural Scientific Professions (SACNASP)**
Professional Natural Scientist
Pr. Sci. Nat. (Aquatic Health, Zoological & Ecological Sciences)

Registration number: 400275/12

2009 **Member of the International Association of Impact Assessment-SA (IAIA SA).**

2006 **Member of the Zoological Society of Southern Africa (ZSSA)**

2006 **Member of the Southern African Society of Aquatic Scientists (SASAqS)**

Presentations

Jun 2010 **South African Society of Aquatic Scientists (SASAqS) Congress**
MN Jonker, G. Walsh & JHJ van Vuren
Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.

Oct 2009 **Department of Geography and Energy studies, University of Johannesburg**
MN Jonker, M Sherwood and R Rowles. 2009.
Historical overview of water quality associated with the Blesbokspruit RAMSAR site. Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).

Jul 2007 **Zoological Society of Southern Africa Conference, Potchefstroom.**
MN Jonker
Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.

Publications

1. Van der Zee, J., Walsh., G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occuring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa.*

2. Walsh, G., Jonker. M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noumbi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.
Checklist Journal **10 (4):** 900 - 912.

3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3).**

4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

I, Michiel Jonker, do hereby declare that all the information furnished above is true to the best of my knowledge.

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SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS PTY (LTD)

Proposed Construction of the Xha! Boom Substation, Linking Station and associated 132kV Grid Line near Loeriesfontein, Northern Cape Province

Surface Water Impact Assessment Report

Issue Date: 12th December 2017
Revision No.: 3
Project No.: 13622

Date:	12th December 2017
Document Title:	Proposed Construction of the Xha! Boom Substation, Linking Station and associated 132kV Grid Line near Loeriesfontein, Northern Cape Province – Surface Water Impact Assessment Report
Author:	Shaun Taylor
Revision Number:	3
Externally Reviewed by:	Michiel Jonker (Pr. Sci. Nat) Registration Number: 400275/12
Approved:	Andrea Gibb
Signature:	
For:	SiVEST Environmental Division

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Proposed Construction of the Xha! Boom Substation, Linking Station and 132kV Grid Line near Loeriesfontein, Northern Cape Province – Surface Water Impact Assessment Report

Specialist:	SiVEST South Africa (Pty) Ltd		
Contact person:	Shaun Taylor		
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E-mail:	andreag@sivest.co.za		

The specialist appointed in terms of the Regulations

I, **Shaun Taylor**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST Environmental

Name of company (if applicable)

12th December 2017

Date

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations (2017) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations (2017)		Clause	Page in Report
Appendix 6 – Section 1	(1)	A specialist report prepared in terms of these Regulations must contain —	N/a
	(a)	details of –	N/a
		(i) the specialist who prepared the report; and	Page 7, Appendix A
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Page 7, Appendix A
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Page ii-iii
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Page 1
	(cA)	An indication of the quality and age of base data used for the specialist report;	Page 12-13 & 21-22
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Page 21-61
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Page 6 & 22
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Page 12-17
	(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Page 22-42
	(g)	An indication of any areas to be avoided, including buffers;	Page 22-42
	(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Page 22-42
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Page 6-7
	(j)	A description of the findings and potential implications of such findings on the impact of the	Page 22-42

		proposed activity, including identified alternatives on the environment or activities;	
	(k)	Any mitigation measures for inclusion in the EMPr;	Page 42-61
	(l)	Any conditions for inclusion in the environmental authorization;	Page 63-64
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Page 42-64
	(n)	A reasoned opinion –	N/a
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Page 63-64
		(iA) regarding the acceptability of the proposed activity or activities; and	Page 63-64
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Page 42-61 & 63-64
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Included in Environmental Impact Report
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Included in Environmental Impact Report
	(q)	Any other information requested by the authority.	Included in Environmental Impact Report
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/a

MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE XHA! BOOM SUBSTATION, LINKING STATION AND ASSOCIATED 132KV GRID LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

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PROPOSED CONSTRUCTION OF THE XHA! BOOM SUBSTATION, LINKING STATION AND ASSOCIATED 132KV GRID LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, namely the Xha! Boom substation, linking station and an associated 132kV grid line near Loeriesfontein in the Northern Cape Province (hereafter referred to as the 'proposed development'). The proposed development is aimed at feeding electricity generated by Mainstream's proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

In terms of the Environmental Impact Assessment (EIA) Regulations (8th December 2014) promulgated under Sections 24 and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), various aspects of the proposed development are considered to fall within the ambit of listed activities which may have an impact on the environment, and therefore require environmental authorization (EA) from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities. It has therefore been identified that a Basic Assessment (BA) process is to be followed for the proposed development.

SiVEST Environmental Division have subsequently been appointed as the independent surface water specialist consultant to undertake the surface water impact assessment for the proposed development. The surface water report will provide information obtained at a desktop level (where applicable) as well as findings from the infield groundtruthing, verification and delineation exercise. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), the anticipated legislative implications and requirements, identification of the potential environmental impacts that could be associated with the proposed development, potential cumulative impacts of other surrounding proposed developments, proposed mitigation measures to minimize any potential impacts, a comparative assessment of alternatives and finally, specialist recommendations based on the proposed alternative layouts.

1.1 Legislative Context

1.1.1 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on watercourses and wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- A river or spring;
- A natural channel in which water flows regularly or intermittently; and
- A wetland, lake or dam into which, or from which, water flows.

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quantity of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- Rehabilitation of the water resource.

In the context of the proposed development and implications towards surface water resources potentially occurring on the study site, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- Less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- Harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body (for example, the excavation of a wetland or changes to the morphology of a water body) can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of **Section 19** of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

1.1.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management, 1998 (Act No. 107 of 1998) (NEMA) was created essentially to establish:

- Principles for decision-making on matters affecting the environment;
- Institutions that will promote co-operative governance; and
- Procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in **Chapter 1 Section 2**, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the EIA Regulations (2006, 2010, 2014 and 2017 as amended) were promulgated in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for Environmental Authorisation subject to a BA or EIA process is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, potential impacts / issues as a result of the proposed development on surface water resources are addressed later in this report (**Section 7 & 8**).

1.2 Definition of Surface Water Resources as Assessed in this Study

Using the definition of a surface water resource under the NWA, this study will include a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows.

1.2.1 Wetlands

The lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland as, “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydrogeomorphic units (HGM units). **Ollis *et al*. (2013)** have described a number of different wetland hydrogeomorphic forms which include the following:

- Channel (river, including the banks): a linear landform with clearly discernable bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a “river”.
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a “river”.
- Depression: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
- Flat: a Level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat.
- Hillslope seep: a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

1.2.2 Riparian Habitat

Riparian habitats may potentially occur in the study area. Riparian habitats (also known as riparian areas or zones) include plant communities usually adjacent to or along natural channels that are affected by surface and subsurface flows (**DWAF, 2005**). Riparian habitats can be found on the edges of lakes, or drainage lines but are more commonly associated with channelled flowing systems like streams and rivers. Riparian habitats can also be associated with wetlands that are similarly associated with streams and rivers. These are defined as riparian wetlands.

1.2.3 Watercourses

According to the NWA, a watercourse falls within the ambit of a ‘water resource’. For watercourses however, the following is relevant:

- A river or spring; and
- A natural channel in which water flows regularly or intermittently.

Watercourses may be perennial or non-perennial in nature. Moreover, non-perennial watercourses can encompass seasonal or ephemeral watercourses (including drainage lines) depending on the climate and other environmental constraints.

Any of the above mentioned wetland forms, riparian habitats or watercourses may occur within the study area. The types of surface water resources identified are addressed later in the report (**Section 6**).

1.3 Assumptions and Limitations

This short term once-off surface water assessment has only focused on the identification and delineation of surface water resources within the proposed development area. Identification and delineation of surface water resources in the wider area outside of the proposed development area have not been undertaken.

Given the timing and short term, once-off nature of the assessment, the assessment should not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence within the surface water resources.

Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (**NFEPA, 2011**) database. This database is a national level database and some smaller surface water resources may not be identified if the database. Additionally, mainly wetlands with permanent inundation are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles may not be included. The fieldwork component was included in the assessment to verify the desktop database information in order to address these shortcomings.

Surface water resources were initially identified and delineated at a desktop level. These were then groundtruthed and verified in the field work phase. The initial delineations undertaken at a desktop level were refined following findings made in the field work phase.

A Global Positioning System (GPS) device was used to groundtruth surface water resources as well as for delineation purposes. The GPS is expected to be accurate from 5m up to 15m depending on meteorological conditions.

Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor have water quality, hydrological or groundwater studies been included.

Wetland or river health, present ecological status (PES), ecosystem services and the ecological importance (EI)/ecological sensitivity (ES) categories have not been assessed for identified surface water resources. Only desktop information in terms of PES/EI/ES (where available) from the databases were provided as per the scoping assessment information.

Application of the **DWAF (2005 & 2008)** delineation guidelines are limited for the delineation of drainage lines and pan wetlands in arid and semi-arid regions due to the intermittent nature of flow which is poorly accommodated in the methodology, and application thereof.

Avi-fauna in general are known to frequent surface water resources regularly, or in some cases can live in these habitats on a longer more permanent basis. Impacts to avi-fauna therefore may fall within the scope of a surface water assessment from an ecological perspective. However, as a separate independent avifaunal assessment has been undertaken for the proposed development, the assessment of potential impacts as related to avi-fauna have not been included in this assessment. It is therefore assumed that all avi-faunal impacts (including that related to waterfowl associated with wetlands and other surface water resources) will have been adequately covered in the avi-faunal impact assessment.

1.4 Specialist Credentials

This surface water assessment has been undertaken by Shaun Taylor from SiVEST. Shaun Taylor has a Master's (MSc) Qualification in Aquatic Health. Shaun has undertaken numerous surface water (wetland) delineations, present ecological state determinations, wetland ecosystem service assessment as well as ecological importance and sensitivity classifications for projects countrywide as well as a number of short training courses. Shaun has certification in the wetland training course on delineation, legislation and rehabilitation of wetlands and riparian habitats from the University of Pretoria. A full CV and delineation certificate is attached as **Appendix A**. In addition, following best practice, an external peer review has been undertaken by Mr. Michiel Jonker (*Pr. Sci. Nat.* Registration Number: 400275/12) of Ecotone Freshwater Consultants (CV also attached – **Appendix A**).

2 PROJECT NEED AND DESIRABILITY

The negative environmental impacts of using fossil fuels are well documented. In addition to depleting fossil fuels, the processes often result in large pollution risks. The Government of South Africa has committed to contributing to the global effort to mitigate greenhouse emissions.

According to the White Paper on the Promotion of Renewable Energy and Clean Energy Development (2002), the Government has committed to develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

In response to this goal, Mainstream are proposing to establish Wind Farms near Loeriesfontein in the Northern Cape Province.

The overall objective of the project is to generate electricity to feed into Eskom's national electricity grid by means of renewable energy technologies.

3 PROJECT TECHNICAL DESCRIPTION

The proposed Xha! Boom Substation is located approximately 70km north of Loeriesfontein in the Northern Cape Province and straddles the boundary between the Hantam and Khai-Ma Local Municipalities (**Figure 1**). The application site as shown on the locality map below (**Figure 2**). The key components of the project are detailed below.

3.1 Project Technical Details

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely Xha! Boom Substation), as well as a 132kV Linking Substation and a 132kV grid line. The aim of this development is to feed electricity generated by the proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the "proposed Xha! Boom Substation")
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV grid line from the proposed Xha! Boom Substation, via the proposed Linking Substation to Helios substation, approximately 33km south-east of the proposed Xha! Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A grid line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed grid line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

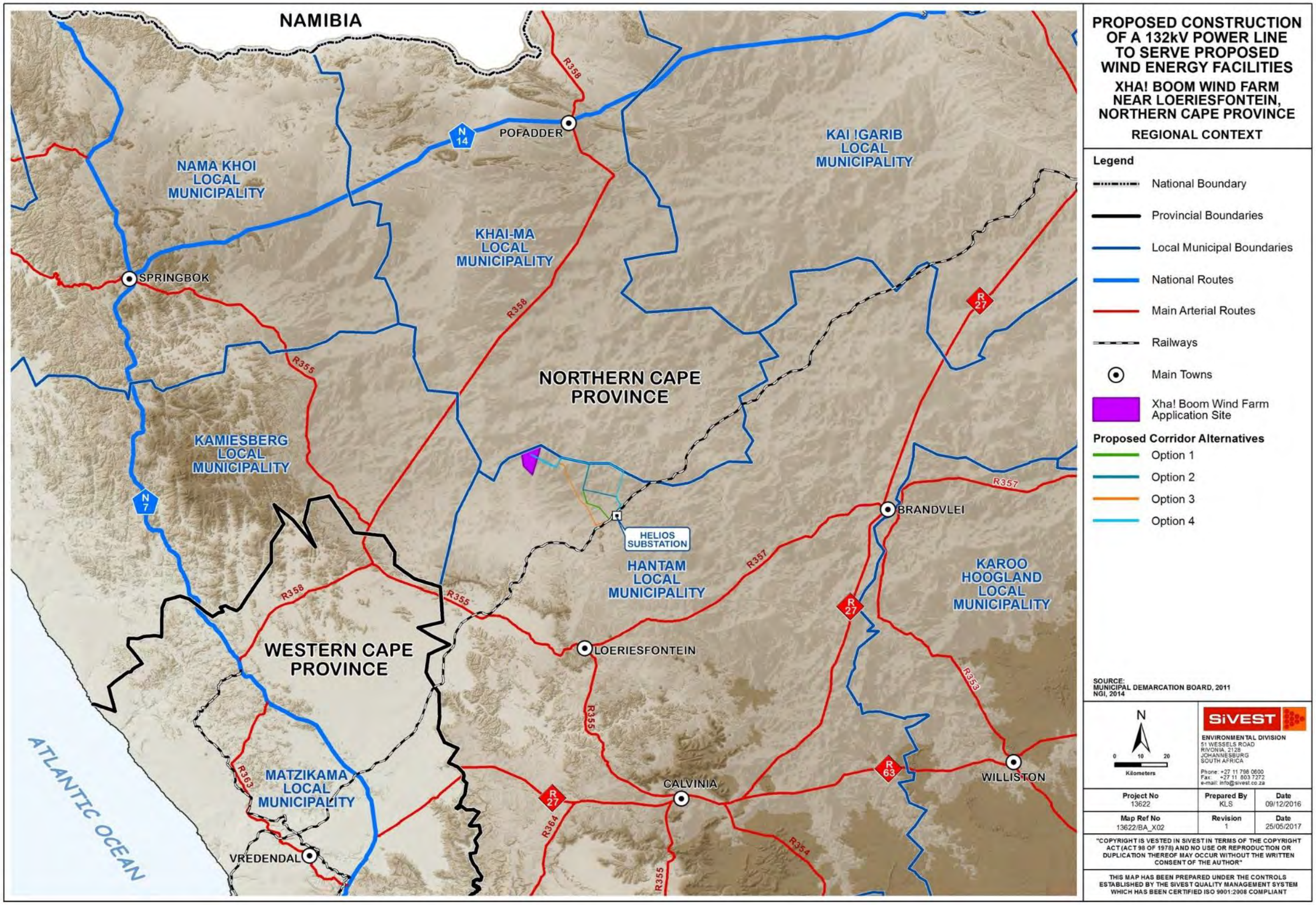

Figure 1. Regional Context Map

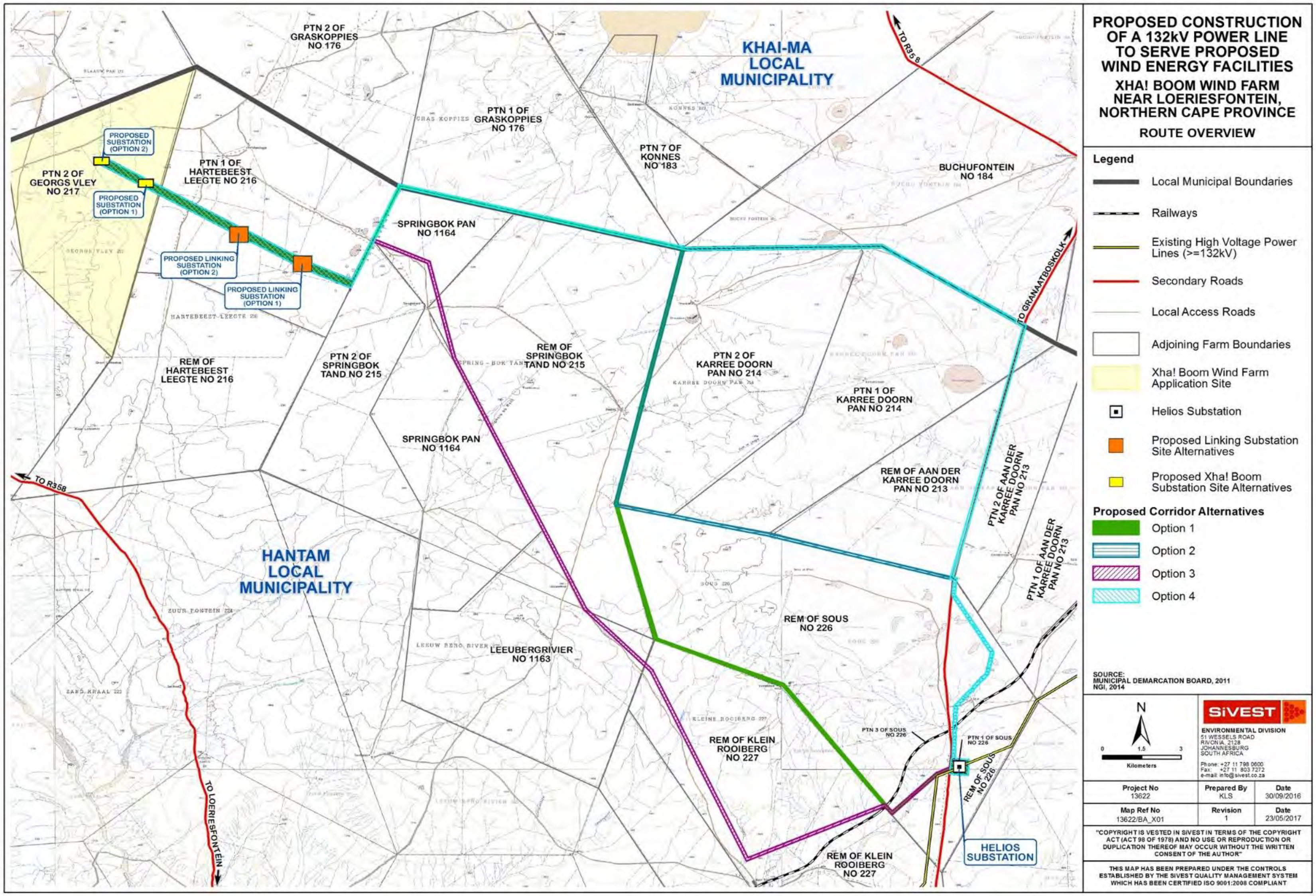

Figure 2. Locality Map

It should be noted that two (2) alternative sites for the proposed on-site Xha! Boom Substation as well as the proposed Linking Substation that have been assessed during the BA, in conjunction with four (4) grid line corridor alternatives.

The proposed grid line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures (**Figure 3**) for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the grid line.

Figure 3. Tower Type

3.2 Alternatives

In terms of the NEMA and the EIA Regulations, feasible alternatives are required to be considered during the EIA Process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The proposed Xha! Boom Wind Farm (part of a separate on-going EIA process) application site, proposed Xha! Boom Substation site and associated 132kV grid line corridor route alternatives are shown in the locality map above (**Figure 2**). The following alternatives will therefore be considered and investigated as part of this assessment:

- Two (2) alternative on-site locations for the proposed on-site 132kV Xha! Boom Substation options;
- Two (2) alternative locations for the proposed linking substation options;
- Four (4) alternative grid line options for the proposed 132kV grid line;
- The “No-go” Alternative.

3.2.1 No-go Alternative

The ‘no-go’ alternative is the option of not establishing the proposed development. South Africa is currently under immense pressure to generate electricity to accommodate for the additional demand which has been identified. With the current global focus on climate change, the government is exploring alternative energy sources in addition to coal fired power stations. Although wind power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind energy facility and the associated substation, linking station and grid line would be detrimental to the mandate that the government has set to promote the implementation of renewable power. It is a suitable sustainable solution to the energy crisis and this project would contribute to this solution. This proposed development will aid in achieving South Africa’s goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

4 METHODOLOGY

4.1 Database Identification and Desktop Delineations of Surface Water Resources

The first step in the surface water assessment was to undertake a desktop assessment of any surface water features from available databases. This was undertaken using Geographic Information System (GIS) software. The software ArcView developed by ESRI was used. The collection of data source information encompassed (but is not limited to) 1:50 000 topographical maps (digital), the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database, the Northern Cape and National Environmental Potential Atlas **(ENPAT, 2000)** database, the South African National Biodiversity Institute (SANBI): C.A.P.E. Fine-Scale Biodiversity Plan **(SANBI, 2007)** database and the SANBI Vegetation Map (**SANBI, 2006**).

Utilising these resources, wetlands and any other surface water resources identified were then scrutinized against surface water resources identified and delineated at a desktop level from satellite imagery **(Google Earth™)**. The verified and desktop delineated surface water resources were then highlighted for the in-field impact phase of the assessment. The supplementary use of satellite imagery allowed for other potentially overlooked surface water resources, not contained within the above mentioned databases, to be identified and earmarked for ground-truthing in the field work component.

4.2 Field-based Surface Water Resources Delineation Techniques

4.2.1 Wetlands

Wetland delineations are based primarily on soil wetness indicators. For an area to be considered a wetland, redoximorphic features must be present within the top 50cm of the soil profile (**Collins, 2005**). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen depleted) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered 'hydric soils'. Redoximorphic features typically occur in three types (**Collins, 2005**):

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix;
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles).
- These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
  - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site were assessed according to the **DWAF (2005; 2008)** guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". According to the **DWAF (2005 & 2008)** guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) **(Collins, 2005)**. Three other indicators (vegetation, soil form and terrain unit) are typically used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

Importantly, it must be recognised that there can be up to three saturation zones to every wetland including a permanent zone, seasonal zone and the temporary zone. Each zone is differentiated based on the degree and duration of soil saturation. The permanent zone usually reflects soils that indicate saturation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate saturation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of saturation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (**DWAF, 2005**). It must be noted that not all wetlands will have all three saturation zones. In arid and semi-arid regions, wetlands are often only associated with temporary saturation zones or temporary and seasonal saturation zones, thereby lacking the permanent zone.

Vegetation identification was based on identifying general plant species within the wetland boundaries focusing on the occurrence of hydrophytic (water loving) wetland vegetation. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are **(DWAF, 2005)**:

- Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
- Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
- Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
- Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

The actual delineation process essentially entailed drawing soil samples, at depths between 0-50 cm in the soil profile, using a soil augur. This is done in order to determine the location of the outer edge of the temporary zone for wetlands. The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. Where the appropriate wetland soil form is of interest, soil samples are drawn up to a depth of 1.2 metres (where possible).

Where a wetland was identified, a conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system for mapping purposes. A GIS shapefile was created to represent the boundaries of the delineated wetlands or other surface water resources.

4.2.2 Riparian Habitat

In terms of watercourses and riparian habitats, the **DWAF (2005)**, the assessment for riparian habitats requires the following aspects to be taken into account:

- Topography associated with the watercourse;
- Vegetation; and
- Alluvial soils and deposited material.

The topography associated with a watercourse can comprise (but not always limited to) the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat. However, the riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the species from the adjacent terrestrial area (**DWAF, 2005**).

Riparian habitats are usually associated with alluvial soils (relatively recent deposits of sand, mud or any type of soil sediment) (**DWAF, 2005**). This indicator is not commonly viewed as the primary indicator but rather as a supplementary indicator to confirm either topographical or vegetation indicators, or both.

Where riparian habitats occur, the above mentioned indicators were used to identify the outer edge. A GPS was used to record the points taken in the field.

4.2.3 Drainage Lines

In terms of drainage lines or pathways, there are no official methodologies or guidelines for delineating drainage lines in the country. As such, the environmental indicators used to identify riparian habitats (such as topography associated with a watercourse, alluvial soils and deposited materials, and vegetation), which also form integral biophysical components of drainage lines were used to identify these temporary conduits for run-off.

Where drainage lines are present, it is possible to determine the hydrological regime which provides information on the functionality of the systems. **Ollis *et al* (2013)** maintain that the hydrological regime can be characterised by the frequency and duration of flow (i.e. perenniality), classified as follows:

- Perennial – flows continuously throughout the year in most years;
- Non-perennial – does not flow continuously throughout the year, although pools may persist. Can be subdivided as follows:
    - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;
    - Intermittent – water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;

    - Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.
- Unknown – for rivers where the flow type is not known.

Additionally, once identified, it is possible to classify rivers into three channel types. The channel types are based on the changing frequency of saturation of soils in the riparian zone which can be classified *inter alia* as follows **(DWAF, 2005)**:

- A Section – Least sensitive watercourses in terms of impacts on water yield from the catchment. They are situated in the unsaturated zone and do not have riparian habitats or wetlands. Not as hydrologically sensitive as B and C Sections;
- B Section – In the zone of the fluctuating water table and only have baseflow at any point in the channel when the saturated zone is in contact with the channel bed. Baseflow is intermittent in this section, with flow at any point in the channel dependent on the current height of the water table. The gradient of the channel bed is flat enough for deposition of material to take place and initial signs of flood plain development may be observed.
- C Section – Always in contact with the zone of saturation and therefore always have baseflow. These are perennial streams with flow all year round, except perhaps in times of extreme droughts. Channel gradients in these sections are very flat and a flood plain is usually present.

4.3 Surface Water Buffer Zones

A wetland buffer zone is typically an area of vegetated, un-developed land surrounding a wetland that is maintained to protect, support and screen wetland flora and fauna from the disturbances associated with neighbouring land uses. As wetlands and aquatic habitats are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of this habitat unit that could potentially emanate from terrestrial-based activities. Ultimately, buffer zones are typically required to protect and minimise the edge impacts to wetlands.

Although buffers are considered vitally important to the functioning of wetland systems through the provision of the abovementioned services, the determination of the minimum buffer widths to effectively protect and sustain different wetland processes and functions has proven difficult. The minimum wetland buffer width required to maintain the integrity of a wetland is the product of a number of factors:

- The sensitivity of the wetland flora and fauna to edge effects (noise, light, alien plants and direct human disturbances), sediment pollution, water pollution and/or increased surface water inputs;
- The specific lifecycle and habitat requirements of the wetland flora and fauna present within the wetland;
- The disturbance intensity of the proposed neighbouring land use in terms of noise, light, alien plants and/or direct human disturbances;
- The disturbance intensity and risk of sediment and/or water pollution associated with the proposed neighbouring/adjacent land use;

- The ability of the proposed buffer to capture sediment and/or remove and filter pollutants before reaching the wetland; and
- The ability of the proposed buffer to dissipate and infiltrate the surface runoff before reaching the wetland.

Depending on the type of land use or development proposed, an appropriate buffer zone to protect wetlands **(DWAF, 2005)** and other surface water resources should be applied to delineations. As such, consideration of the above factors (including the flow drivers, water quality, geomorphology, habitat and biota of the surface water resources) in relation to potential impacts as a result from the proposed development were taken into account in determination of an appropriate buffer zone.

4.4 Impact Assessment Method

Current and potential impacts will be identified based on the proposed development and potential impacts that may result for the construction, operation and decommissioning of the proposed development. The identified potential impacts will be evaluated using an impact rating method (**Appendix B**). This is addressed in **Section 9**.

5 GENERAL STUDY AREA

The proposed development is generally accessible via a dirt road off Granaatboskolk which can be accessed via the R357 which leads to Loeriesfontein. Land cover in the area is mainly vacant land used for grazing purposes but also includes salt mining, railways and various renewable energy developments (both solar and wind). A map indicating the land cover classes of the general area for the proposed development are provided in **Figure 4** below.

According to **Mucina and Rutherford (2006)**, the proposed development site falls within the Nama-Karoo Biome. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas. The development site can be found within the Bushmanland bioregion. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed development can therefore be found within the Bushmanland Basin Shrubland and Western Bushmanland Klipveld vegetation units (**Figure 5**). The description of Vegetation and Landscape Features, Geology and Soils, Climate and Conservation as contained in **Mucina and Rutherford (2006)** are provided below for this vegetation unit.

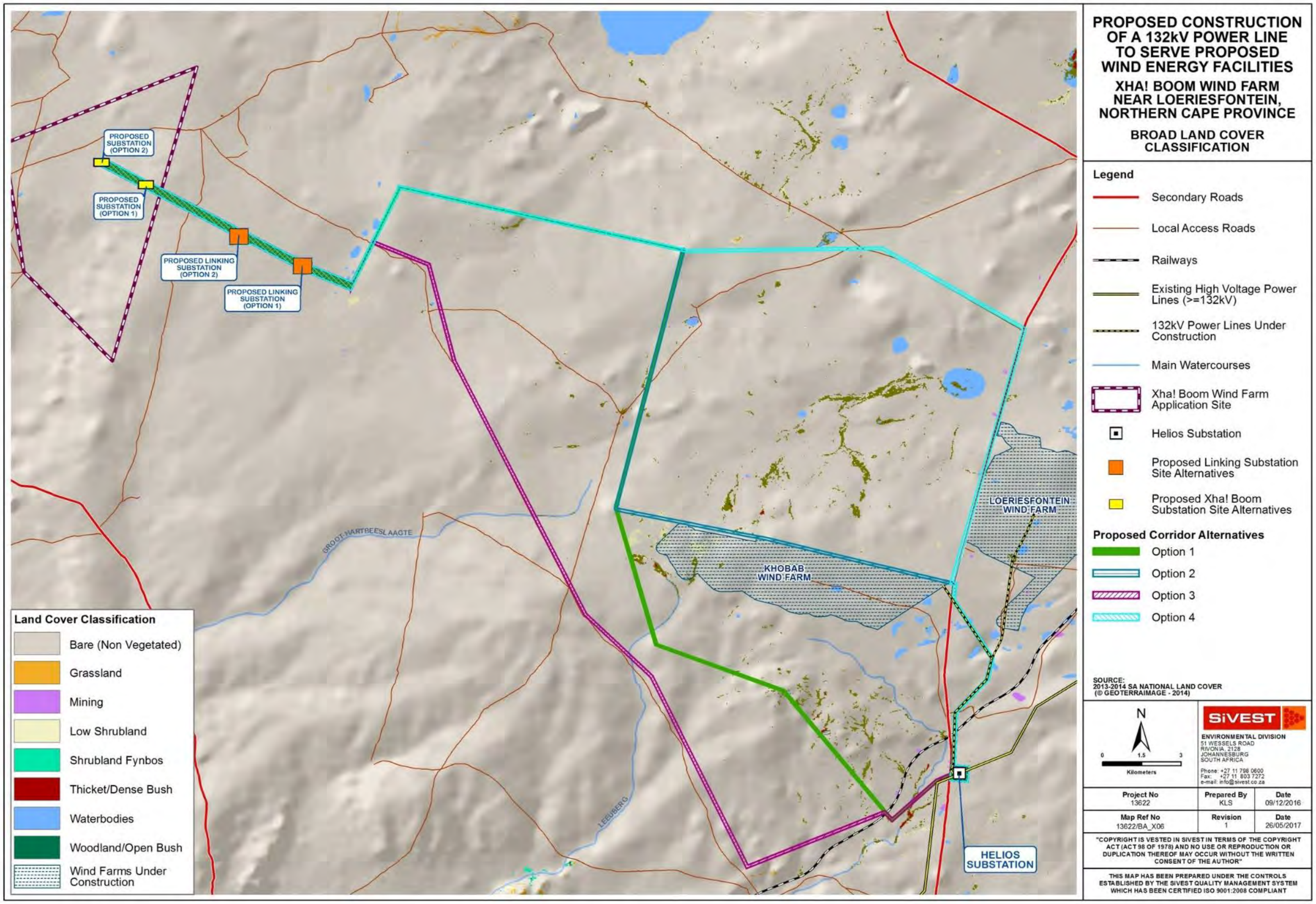

Figure 4: Land Cover Map

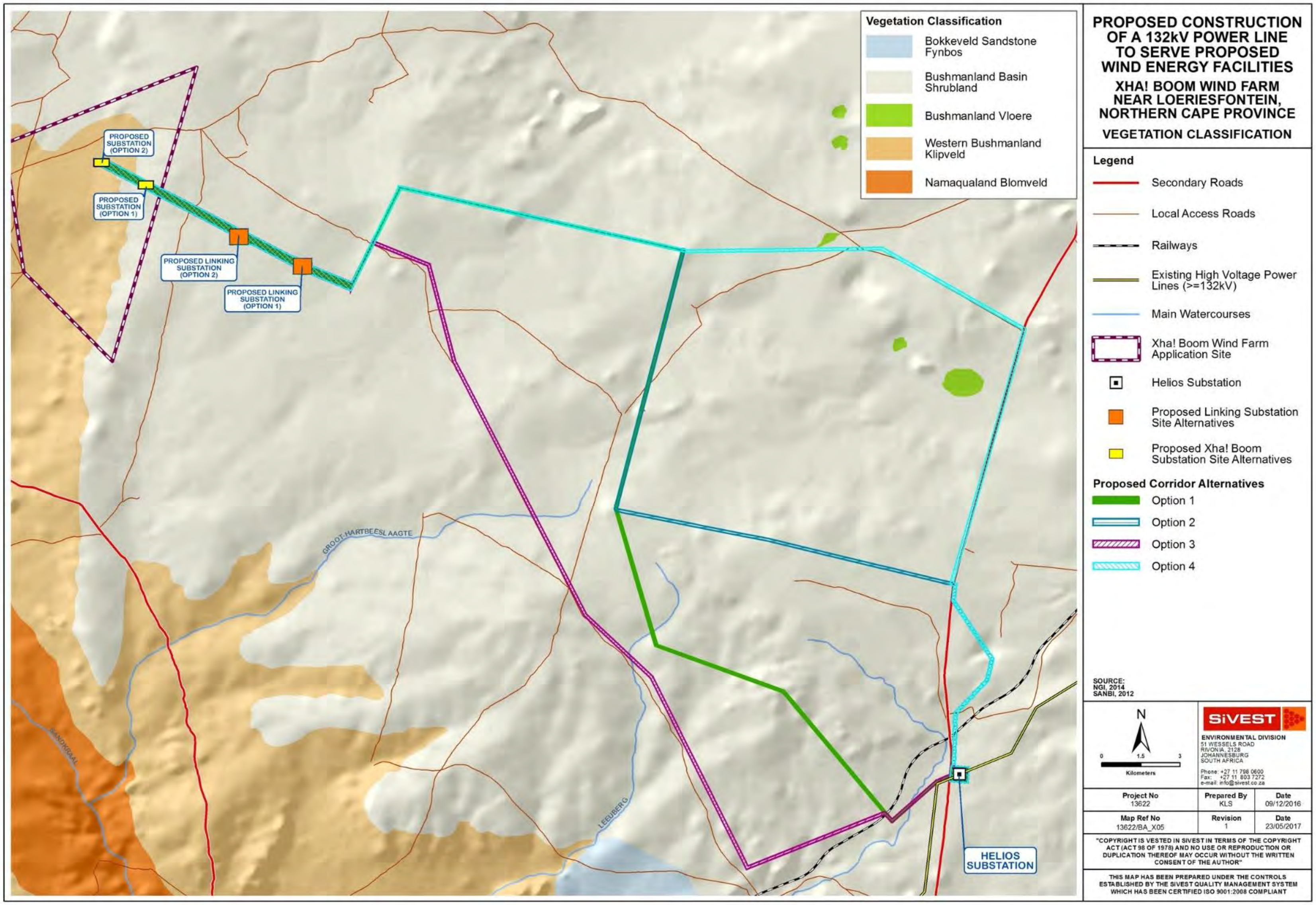

Figure 5: Vegetation Unit Map

5.1 Bushmanland Basin Shrubland Vegetation Unit

The vegetation and landscape features of the Bushmanland Basin Shrubland are characterised by slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), “white” grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*.

The geology and soils comprise of mudstones and shales of Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of early Karoo age, dominate. About 20% of rock outcrop is formed by Jurassic intrusive dolerite sheets and dykes. Soils are shallow Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high.

Rainfall occurs in late summer and early autumn. Mean Annual Precipitation (MAP) ranges from about 100-200m. Mean maximum and minimum monthly temperatures in Brandvlei are 39.6^{o}C and -2.2^{o}C for January and July, respectively. Corresponding values for Van Wyksvlei are 39.5^{o}C and -4.6^{o}C.

The conservation status of the vegetation unit is described as least threatened (Target 21%). None of the unit is conserved in statutory conservation areas. No signs of serious transformation are present, but scattered individuals of *Prosopis* sp. occur in some areas (e.g. in the vicinity of the Sak River drainage system), and some localised dense infestation form closed “woodlands” along the eastern border of the unit with Northern Upper Karoo (east of Van Wyksvlei). Erosion is moderate (56%) and low (34%).

5.2 Western Bushmanland Klipveld

The vegetation and landscape features are characterised by very sparsely populated plains with a desert appearance (rocky pavements built of rounded, dark-coloured rocks and boulders) supporting succulent dwarf shrubs (*Aridaria*, *Drosanthemum Eberlanzia*, *Phyllobolus*, *Psilocaulon*, *Rushcia*), with microphyllous non-succulent shrubs (*Aptosium*, *Pentzia*) and drought-tolerant grasses.

The geology and soils consist of Hutton and Mispah soils over Karoo Sequence sediments (mostly Dwyka diamictite and Ecca shale). The rocky pavements of rounded boudlers, which characterise this area, are palaeo-river terraces of the palaeo-Orange River, which is presumed to have flowed south through this area (approximately 22 million years ago). Fc (Glenrosa and Mispah soil forms) land type covers the entire region.

The climate of the vegetation unit is identified as a very dry region with a Mean Annual Precipitation (MAP) of only 90mm (range 70-100mm) and erratic (almost desert-like) rainfall. Slight peak in precipitation in winter, hardly any in December and January, consistent with the classification of this unit in winter-rainfall Succulent Karoo Biome. Potential evaporation exceeds 2660mm. Overall Mean Annual Temperature (MAT) 16-17º C, with clear maxima in December to January. Mean maximum and minimum monthly temperatures in Kliprand are 36º C and -2º C for January and July, respectively. Incidence of frost is relatively high (25 days, range 20-40 days) due to its land-locked position and high altitude generating effect of thermal continentality.

The conservation status of the vegetation unit is described as least threatened (Target 18%). None conserved in statutory conservation areas. No signs of large scale transformation or invasion of alien plants. Erosion is high (70%) and moderate (12%).

6 FINDINGS OF ASSESSMENT

6.1 Surface Water Database Information

In terms of the **National ENPAT (2002)** database, the proposed development study site is completely within the Berg Olifants Water Management Area (WMA) (**Figure 6**). Moreover, the proposed development is therefore also within the Olifants – Cape Primary Catchment. At a finer level of detail, the Xha! Boom Wind Farm site traverses two (2) quaternary catchments including E31A and E31C.

In terms of the **NFEPA (2011)** database, there are six (6) natural depression wetlands, one (1) natural seep wetland and one (1) natural flat wetland. Therefore, eight (8) wetlands in total were identified. None of the identified wetlands are considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). A WETFEPA is a wetland that is earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy.

Three (3) episodic rivers / streams were identified in both the **Northern Cape ENPAT (2000)** and **NFEPA (2011)** databases. These include the Hartbeeslaagte, Leeuberg and Klein-Rooiberg. All are classified as Class B: Largely Natural systems in terms of the Present Ecological Status (PES) according to the **NFEPA (2011)** database. However, the more recent **DWA (2014)** database provides more detail for each system as follows:

- Hartbeeslaagte – PES B; Ecological Importance (EI) Moderate; Ecological Sensitivity (ES) Moderate;
- Leeuberg – PES B; EI Moderate; ES Moderate;
- Klein-Rooiberg – PES B; EI Moderate; ES High.

The **Northern Cape ENPAT (2000)** database also however identifies an additional tributary to the Leeuberg episodic stream. Furthermore, additional drainage lines were also identified on the 1:50 000 topographical maps.

6.2 Surface Water In-field Delineation Information

The in-field wetland delineation assessment took place from the 6th to the 8th of December 2016 as well as the 8th to the 9th June 2017. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the proposed development area. The refined results for the proposed development are as follows:

- Five (5) Depression Wetlands;
- Twenty six (26) Major Drainage Lines including Klein-Rooiberg, Leeuberg and Hartbeeslaagte (drainage line with a channel width >5m);
- One hundred and eighty (180) Minor Drainage Lines (drainage lines with a channel width <5m).

The refinement of the surface water resources as stated above are presented in **Figure 7** to **Figure 9** below. A more detailed description of the environmental attributes (indicators) of the surface water resources characteristics is provided in the sub-sections below.

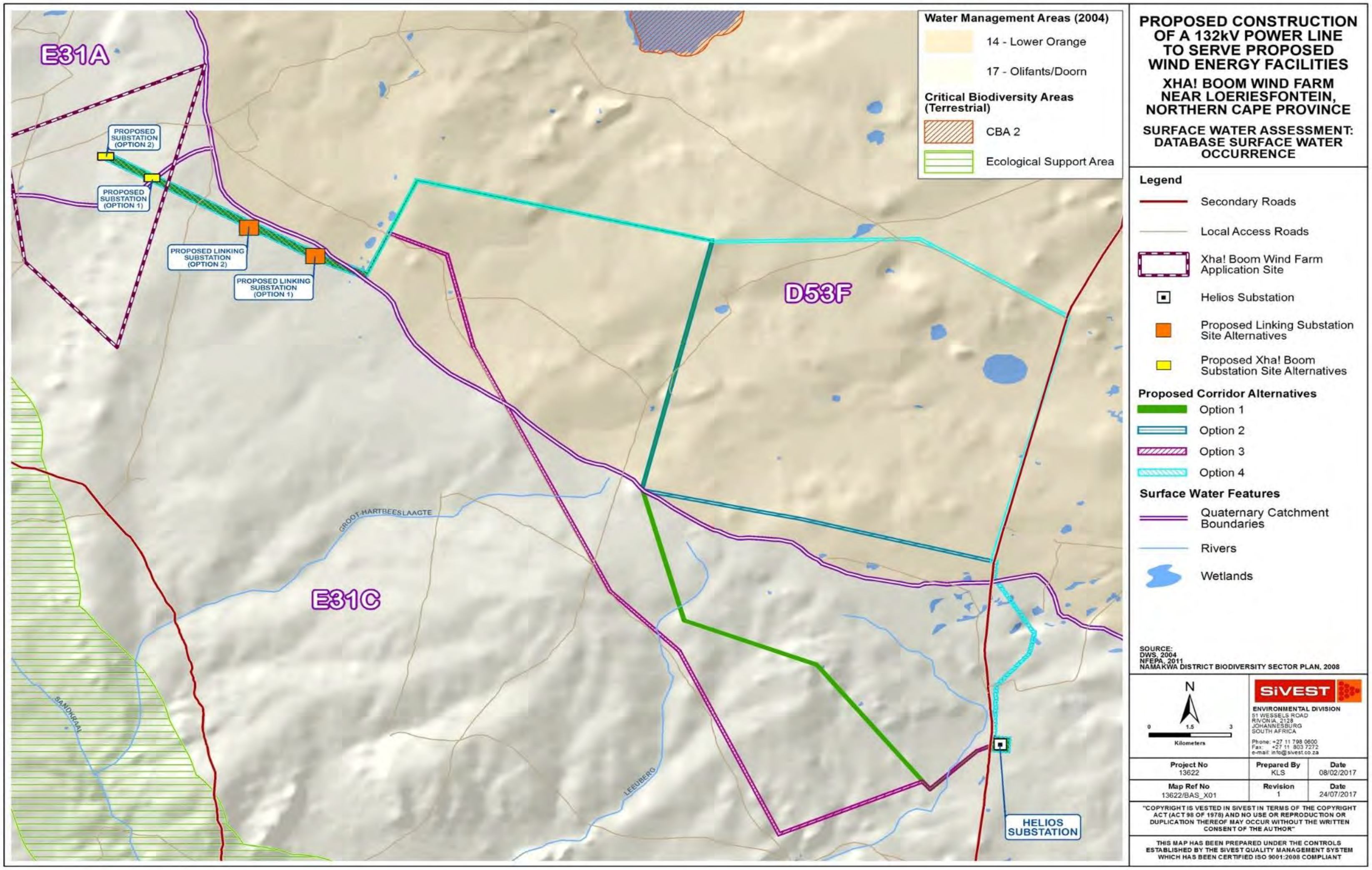

Figure 6: Database Surface Water Occurrence Map

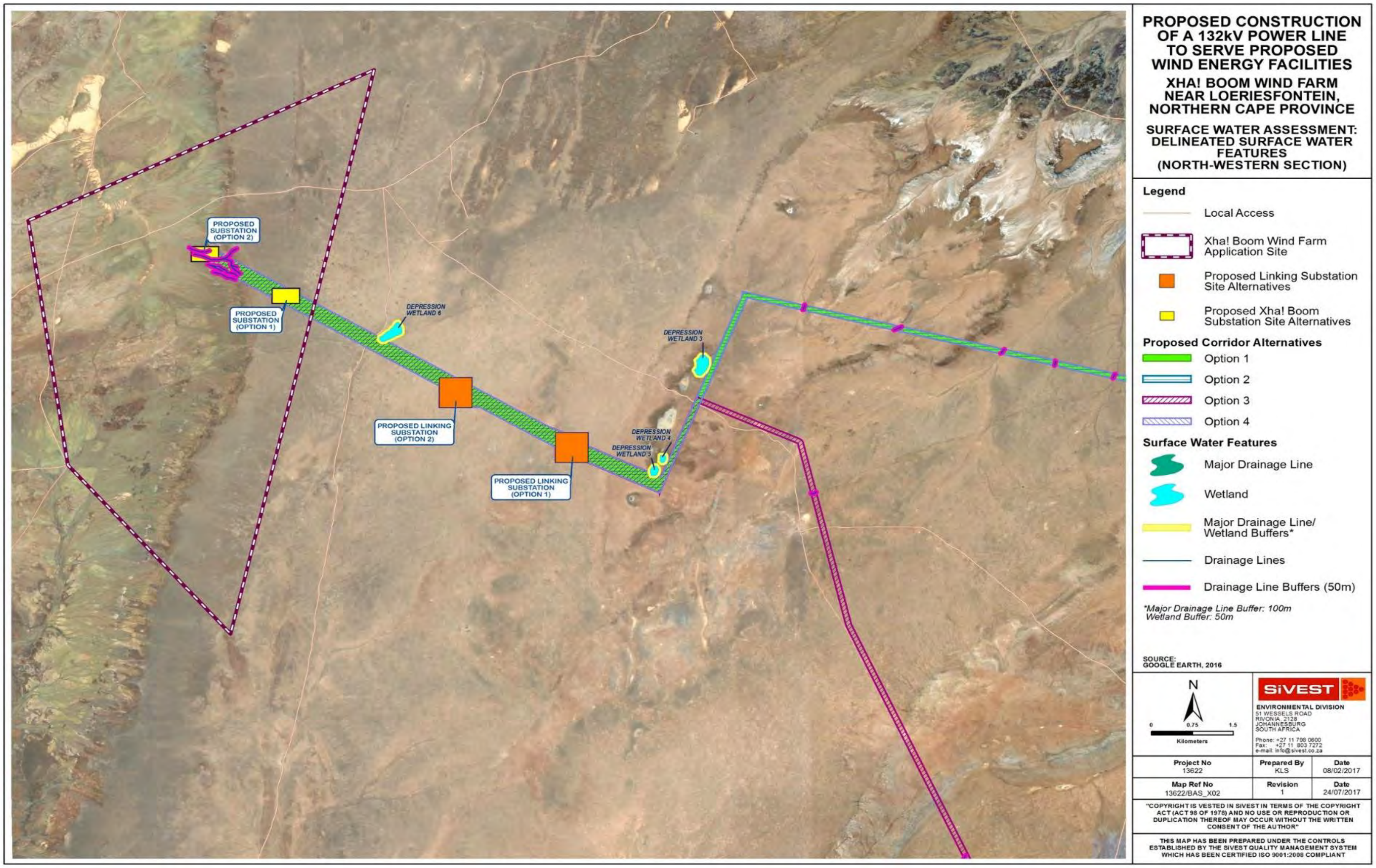

Figure 7: Surface Water Delineation Map (North-western Section)

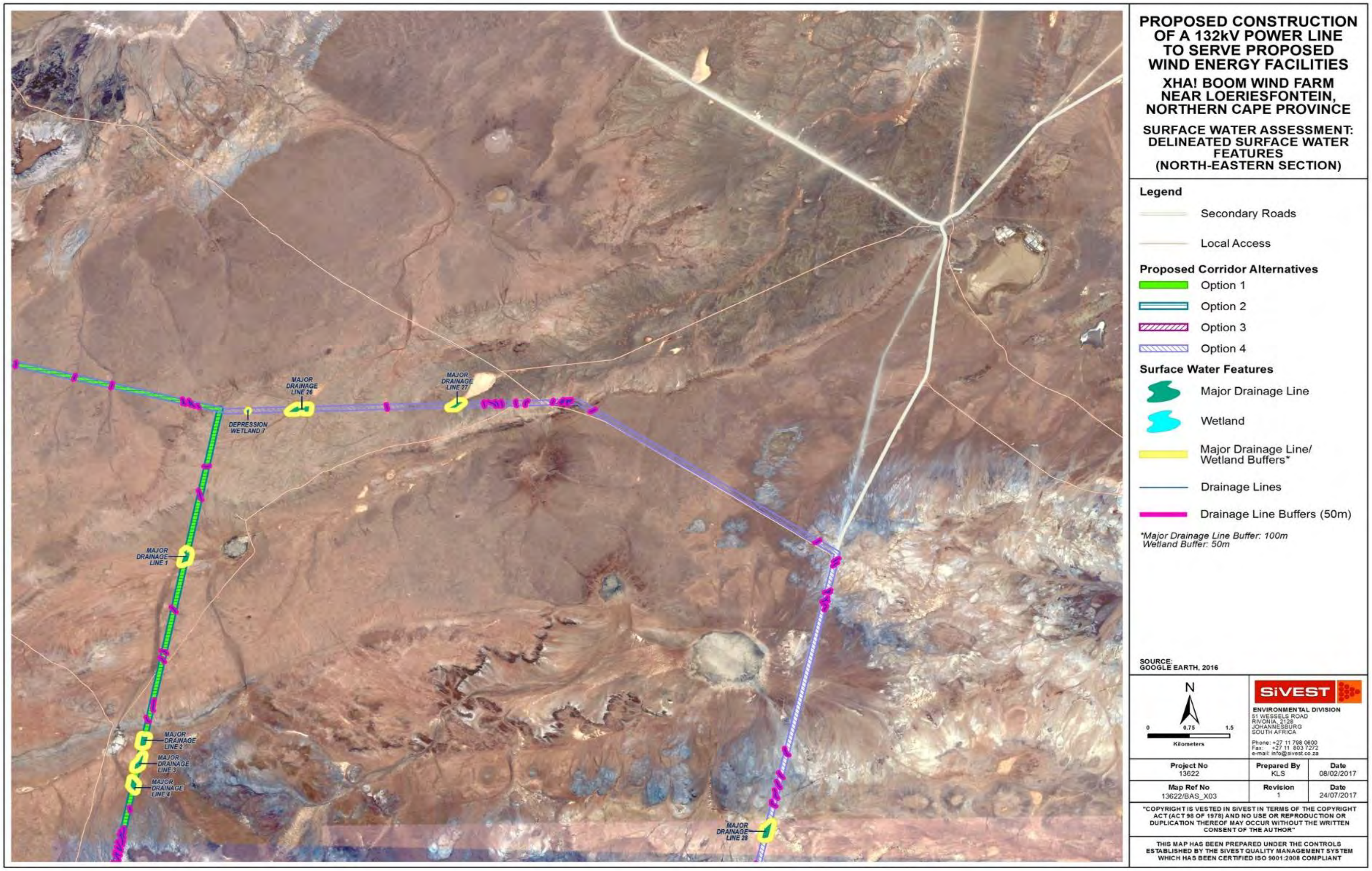

Figure 8: Surface Water Delineation Map (North-eastern Section)

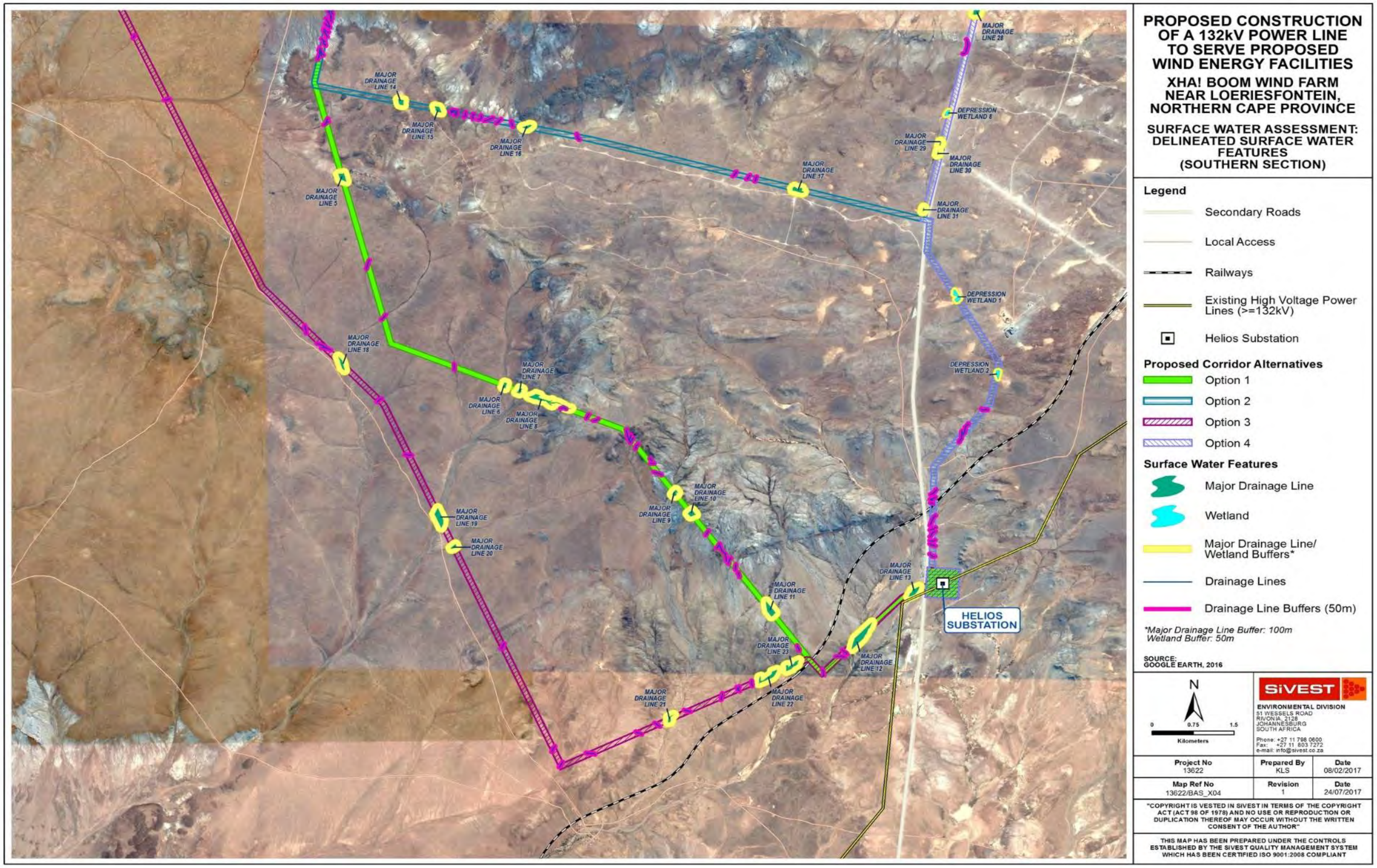

Figure 9: Surface Water Delineation Map (Southern Section)

6.2.1 Channels (Minor Drainage Lines)

6.2.1.1 Topography Associated with the Watercourses

The study region is characterized by varied topography. Linking Station 2 located on a ridgeline which runs from south to north and bisects the initial sections on the grid option alternatives. Other areas beyond this point in the north-west, are relatively flat (**Figure 10**) to gently undulating. Low ridges and undulating terrain become more characteristic in the eastern and south eastern areas. The direction of drainage is dependent on the local topography and can flow in any direction. Drainage mainly begins as first order streams that either lead to central relatively large depression wetlands, or eventually flow and link to larger river systems downstream (i.e. Klein Rooiberg, Leeuberg and Hartbeeslaagte). The minor drainage lines therefore serve as tributaries of which many are first and second order streams or A-section reaches. The minor drainage lines are considered A-section reaches due to the lack of a saturation zone. The drainage lines are presumed to mainly flow episodically during and briefly after rainfall events. Hence, all minor drainage lines were identified as ephemeral watercourses. The minor drainage line channels have variable lengths, but are no more than 5m wide. The channels are weakly defined in the upper reaches but become more incised downstream.

Figure 10: Relatively Flat Terrain in the North Western Area of the Study Region where Minor Drainage Lines were identified.

According to **Lanz (2017)**, soils across the study area are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. As the depth of soils on the proposed development area are relatively shallow, flow is predominantly via surface run-off. Therefore, limited sub-surface flow takes place, with the exception only where the composition and depth of the soil profile permits infiltration in thicker permeable soil profiles (i.e. valley bottom areas). Soil erosion potential is therefore also limited due to shallow soil depth (**Figure 11**). Overall however, erosion was very limited. Relatively good growth of a mixture of both herbaceous and graminoid species keep soils intact. Minor erosion is restricted to the channels of the drainage lines, mainly in the south eastern areas of the study area.

Figure 11: Example of a Minor Drainage Line with Limited Channel Incision

6.2.1.2 Alluvial Soils and Deposited Materials

Generally, fine to sandy particles are found within the minor drainage lines. However, the grain size of sediments can increase to gravel sized sediments (**Figure 12**) which presumably are transported from the surrounding landscape via overland flow into the drainage lines. Following flows, driven by rainfall events, sediments are deposited along the length within the drainage lines. Deposited sediments were therefore evident at the time of the assessment. All drainage lines were however dry during the site investigation, indicating the ephemeral nature of the drainage lines.

Figure 12: Example of Gravel Sized Alluvial Sediments within a Minor Drainage Line

6.2.1.3 Vegetation

According to **Todd (2017)**, the main driver of vegetation pattern in the study area is the substrate. **Todd (2017)** elaborates that on the gravel and stony soils, the vegetation consists of open shrub-dominated vegetation typical of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by *Stipagrostis* species characteristic of Bushmanland Arid Grassland. As such, large parts of the site including the Ithemba study area is dominated by so called “white grasses” and is clearly representative of the Bushmanland Arid Grassland vegetation type. However, the Bushmanland Basin Shrubland is considered the dominant habitat type along large sections of the grid line corridors. In consideration of the above, the drainage lines in the northern areas of the study site were found to be dominated by shrubland vegetation species including a mixture of low sturdy and spiny (and sometimes also succulent) shrubs. **Todd (2017)** states that taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. Graminoid species were also present directly within and along the banks of the drainage lines. The most notable grasses found in the northern drainage lines were that of the *Stipagrostis* family. Conclusively, **Todd (2017)** states that, although the drainage lines are not well developed (which can be ascribed to aridity of the area), they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events.

Figure 13: Example of Low and Sturdy Spinescent Vegetation Species typical of the Bushmanland Basin Shrubland Vegetation Type inhabiting a Minor Drainage Line

6.2.1.4 Comment on Ecological Condition of the Minor Drainage Lines

Overall, the drainage lines appeared to be in a largely natural condition. Existing impacts affecting the drainage lines are mainly due to grazing and anthropogenic (dirt road and fencing) impacts. Minor signs of erosion were evident. Drainage lines were also generally well vegetated along the channel banks as well as instream in some instances.

6.2.2 Channel (Major Drainage Lines)

6.2.2.1 Topography Associated with the Watercourse

The major drainage lines were found toward the mid-way to end sections of the grid line corridors. As such, the topography associated with the major drainage lines are generally characterised by low ridges and undulating terrain in the eastern and south eastern areas. Again, the direction of drainage is dependent on the local topography and can flow in any direction. The major drainage lines were found to be more well-developed reaches (particularly the Klein Rooiberg, Leeuberg and Hartbeeslaagte) downstream of numerous first order streams found higher in the drainage network. The major drainage lines were not in flow during both assessment periods and are therefore also considered to be ephemeral, only flowing temporarily during and briefly after heavy rainfall events.

The major drainage lines are relatively broad in extent, reaching a channel width of typically 100-200m. The widest drainage line crossing a grid line corridor however reached approximately 450m. Some major drainage lines are characterized by broad valley bottoms which open up into bare and exposed plains where overland flows wash through into more densely vegetated areas further downstream. The major drainage lines with open wash areas tend to however lack clearly defined channels. As such, the reaches of the delineated major drainage lines are considered an A-section reach due to the lack of a distinct channel and visible saturation zone (**Figure 14**). However, despite the more defined channels associated with incised macro channel banks, these systems are located relatively high up in the respective catchments and also lack a visible saturation zone. Therefore, the Klein Rooiberg, Leeuberg and Hartbeeslaagte as well as all other identified major drainage lines are also a representative of A-section reaches.

Figure 14: Image of the Major Drainage Line with Poorly Developed Channel

6.2.2.2 Alluvial Soils and Deposited Materials

The alluvial soils and deposited materials are highly similar to the sediments found in the minor drainage lines consisting of a mixture of fine-sandy-gravel sized grains that are deposited following flows driven by rainfall events.

6.2.2.3 Vegetation

The vegetation in the major drainage lines were found to be highly similar to that found in the minor drainage lines. As previously mentioned, the drainage lines in the northern areas of the study site were found to be dominated by shrubland vegetation species including a mixture of low sturdy and spiny (and sometimes also succulent) shrubs. As such, the vegetation consisted of a mixture of taller spinescent shrubs (*Lycium pilifolium* and *Rhigozum trichotomum*) and *Stipagrotis* (particularly *Stipagrostis namaquensis*) species. Once again, the importance of the drainage lines are reiterated in terms of the higher cover and productivity of these areas which are important for fauna forage and habitat availability, as well as performing an important hydrological role through regulating flow following occasional strong rainfall events **(Todd, 2017)**.

6.2.2.4 Comment on Ecological Condition of the Major Drainage Line

Overall, the major drainage lines appeared to be in a largely natural condition. Similar existing impacts affecting the minor drainage lines were found to also affect the major drainage line. The existing impacts included mainly grazing impacts and anthropogenic impacts (dirt roads and fences). The major drainage lines were also generally well vegetated along the channel banks as well as instream in some instances.

6.2.3 Depression (Pan) Wetlands

6.2.3.1 Terrain and Wetland Soil Characteristics

The depression wetlands identified can be divided into two sub-groups, namely saline and non-saline depression wetlands. The first sub-group includes a cluster of depression wetlands which can be found within 2km of Linking Substation Option 1. Only one (1) of the depression wetlands belonging to the cluster of wetlands is in the common grid line corridor shared by all alternative options. This depression wetland was found to be linked geologically to a ridgeline west of the wetlands. The wetlands are therefore wedged on the eastern side of the ridgeline (**Figure 15**).

Figure 15. Saline Depression Wetland Wedged alongside a Ridgeline

The second sub-group of wetlands includes the non-saline depression wetlands. A total of four (4) non-saline depression wetlands were identified mainly on relatively flat to gently undulating terrain. Two wetlands (2) are located in grid line option 2 which is also common to grid line option 4, whilst the remaining two (2) depression wetlands can be found within grid corridor option 4. In general, climate and landscape characteristics create favorable drainage conditions resulting in depression formations. The depression wetlands did not appear to be saline as no salt precipitation was evident at the surface (**Figure 16**).

Figure 16: Non-saline Depression Wetland

Aside from salt precipitation at the surface, soil samples drawn from the saline depression wetland revealed that the topsoil could be attributed to an Orthic A horizon. Meanwhile, the sub-soil showed typical mottling signatures in the form of red iron oxide mottling. The presence of this sub-soil may be said to be representative of a Soft Plinthic B horizon. Black mottling signatures were also evident indicating a degree of manganese concentration in the sub-soils (**Figure 17**). It must also be stated that these soils appeared to exhibit a higher clay content. The Westleigh Soil Form could therefore be attributed to these wetlands. Soil sampling was limited by rock depth (approximately 60-80cm).

Figure 17: Salt Precipitation at the Surface (left) and Red Iron and Black Manganese Accumulations observed in the Sub-soils of a Saline Wetland

In terms of the non-saline wetlands, soil samples drawn revealed fine-grained to sandy particles within a light brown matrix. Soils were relatively shallow (>0.5m). No distinct signs of wetness could however be observed (**Figure 18**). It was therefore considered that the chemical constituency of these particular soils are not considered conducive to the formation of typical wetland hydrogeomorphic (reduction and mottling) characteristics found in the saline wetlands. It may well be that the geochemical constituency of the sediment particles, coupled with high pH and the physico-chemical characteristics of the soils may mask the formation of the typical mottling characteristics observed in wetlands in other parts of the country. This is a limitation not expressed in the **DWAF (2005 & 2008)** guideline for delineation of wetlands.

Figure 18: Sub-soils from a Soil Sample Drawn from a Non-saline Depression Wetland

Overall, the prevailing climate acts as a constraint to the time that water is available or the duration of saturation (hydroperiod) for the both the saline and non-saline wetlands. The wetlands are therefore rainfall driven and consequently temporary in nature. High temperatures, low rainfall and high evaporation rates in the region contribute to limited hydroperiod of the wetlands. For the saline depression wetland near the Option 1 Linking Substation, these factors also play a role in combination to the geology and soil composition of the area contributing to the salinity status of the wetlands. Given the prevailing climate and characteristics of the soils, the wetlands were deemed to be temporary in nature.

6.2.3.2 Wetland Vegetation

Vegetation within the wetlands varied from no vegetation in the core areas of the saline wetland, to relatively dense coverage of the non-saline wetlands consisting of mainly shrubland vegetation. It was identified that salinity could be linked to the degree of vegetation occurrence. **Todd (2017)** identifies three wetland habitat types for the depression wetlands in the region including non-saline pans with a bare center and fringed by taller woody vegetation; non-saline pans vegetated by *Athanasia minuta* (**Figure 19**) and saline pans that are not vegetated. Of these wetland vegetation types, the wetlands within the grid line corridors include two types. These being the non-saline pans vegetated by *Athanasia minuta* and saline pans that are not vegetated. **Todd (2017)** further states that the depression wetlands which are not saline and are vegetated in the centre by *Athanasia minuta* additionally may include species such as *Lycium pumilum*, *Salsola glabrescens*, *Salsola aphylla*, *Rhigozum trichotomum*, *Parkinsonia africana*, *Psilocaulon coriarium* and *Osteospermum* *armatum* around the fringes. He furthermore states that, the saline pans are not vegetated on account of the salt present, but are nevertheless ecologically important as they support a variety of temporary water organisms when they contain water (**Todd, 2017**).

In this respect, the depression wetlands are important for the maintenance of biodiversity. Given that the depression wetlands are temporary in nature, these system are therefore highly variable ecosystems which undergo changes in physical and chemical characteristics regularly. As such, variations are brought about in changes in substrate, inundation cycles, local climate and physical dimension of the wetland(s). Consequently, the invertebrate fauna that inhabit these environments have various physiological, behavioural and structural adaptations, enabling their survival in a constantly changing environment. Important organisms of concern that may potentially occur in these wetlands, is that of the class *Branchiopoda* (and the order *Anostraca*). These species survive desiccation through production of an egg bank which is resistant to desiccation, hatching after lying dormant during the dry phase under favorable conditions when inundation takes place. With this in mind, impacts such as sedimentation could result in preventing hatching after rainfall.

Figure 19: Depression Wetland colonised by *Athanasia minuta*

6.2.3.3 Comment on the Ecological Condition of the Depression Wetlands

The pan wetlands were observed to be in a largely natural condition. Prevailing impacts that were found to affect the wetlands include mainly grazing impacts. Depression wetlands near to Helios Substation were found to be additionally affected by anthropogenic (dirt roads, grid lines and fences) impacts.

6.3 Surface Water Buffer Zones

When determining the buffer zones for drainage lines and wetlands, critical factors that need to be considered as a result of the proposed development include the ecological drivers of these hydrological features.

The primary threats related to the proposed substation, grid lines and service / access roads are mainly during the construction phase. Particularly, the potential impacts include increased run-off, erosion and sediment inputs. Additional potential threats include geomorphological impacts due to compaction as a result of direct physical degradation from vehicular activity, soil contamination from vehicles and machinery, as well as related water quality impacts from oil and fuel spills and / or leakages from vehicles and machinery. Given this, increased run-off will have impacts on the hydrology of the surface water resources in terms of alteration of flood peaks. Clearing of vegetation can also affect the surface roughness of the catchment thereby also contributing to accelerated surface run-off, consequent sedimentation and erosion of surface water resources. Sedimentations and erosion impacts can affect the geomorphological integrity of the surface water resources. In terms of contamination impacts, leakages and spill of hazardous substances such as fuels and oils can affect the water quality and contaminate soils of the surface water resources following transportation of these substances and liquids in surface run-off following rainfall events. Potential negative impacts to the biota and vegetation inhabiting the surface water resources may result in affecting the biodiversity and overall ecological functioning of the surface water resources.

For the operation phase, degradation impacts as a result of vehicle movement is a concern. Compaction impacts and degradation of vegetation associated with the surface water resources is the main concern for this impact from a surface water perspective. Compaction impacts negatively impacts on the geomorphological integrity of the surface water resources potentially causing alteration of the physical conditions of the soil as well as making surface water resources vulnerable to erosion. Additionally, storm water run-off impacts can be anticipated due to the increased hard and impermeable surfaces to be constructed. As such, accelerated run-off can impact on the hydrology of the surface water resources. Moreover, erosion and sedimentation risks can also be associated with increased run-off and need to be taken into consideration.

Given the above, a buffer zone of 100m for the major drainage line and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the factors above so as to limit potential direct and indirect impacts on the surface water resources as far as practically possible.

7 COMPARATIVE ASSESSMENT

As previously mentioned, two (2) on-site substation and two (2) linking station alternative site locations as well as four (4) grid line corridor alternatives have been investigated for the proposed development. These alternatives have been comparatively assessed in order to determine the preferred alternative from a surface water perspective.

The following factors were taken into account when comparatively evaluating the proposed alternatives:

- Size and number of potentially impacted surface water resource(s) in the proposed alternative;
- Proximity to the nearest surface water resource(s);
- The location of any surface water resources present and the ability of the proposed development to be constructed out of, around or away from any nearby surface water resources;
- Number of sub-catchments affected; and
- Existing impact factors (such as existing infrastructure, roads and impacted land).

In terms of the first criteria, the size and number of surface water resources within an alternative area was relevant. The more surface water resources that are present and the greater the area each occupies, it is likely that the impact of the proposed development will be greater.

The second criteria to consider is proximity of the proposed development positioning to any nearby surface water resources. The type of surface water resource and the distance of the proposed development to it will have a bearing on whether there may be direct or indirect impacts that could affect it.

The third criteria assesses whether the proposed development may be able to be constructed with surface water resources present. It may be possible for the proposed development to be constructed if there are few surface water resources present and the facility component or infrastructure is repositioned to avoid the surface water feature or may be able to span the surface water feature.

The fourth criteria assesses the number of sub-catchment areas that will be affected by the proposed development. The sub-catchments include the surface water specific local catchment areas for the endorheic systems as well as the general quaternary catchment areas containing one or more surface water features. Where more sub-catchment areas are affected (both directly / indirectly), more potential contamination pathways may be present thereby influencing the extent and severity of impact.

The final criteria of significance, when selecting the most suitable alternative, is existing infrastructure (grid lines, roads, railways etc.) and impacted land (agricultural fields, urban areas etc.). Disturbance to an existing impacted area is likely to be less than if undisturbed, or where less impacted land is affected.

The preference ratings for the onsite substation site alternatives are provided in **Table 1** below. The alternatives are rated as being either preferred (the alternative will result in a low surface water impact / reduce the surface water impact), not-preferred (the alternative will result in relatively high surface water impact / increase the surface water impact), favourable (the surface water impact will be relatively insignificant) or no preference (the alternative will result in equal impacts). This is shown in the key below.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 1: Surface Water Comparative Assessment Table

Alternative	**Preference**	**Reasons (incl. potential issues)**
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	Preferred	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources include a several minor drainage lines located approximately 600m on the opposite side of a ridgeline (watershed). Drainage therefore does not lead from the substation alternative location towards these drainage lines. Indirect impacts are therefore negligible since the ridgeline acts as a physical barrier to the drainage lines. The potential for direct and indirect impacts is negligible considering the physical barrier and distance to these nearby (<600m) surface water resources. This option is therefore preferred.
On-site Substation Option 2	Not Preferred	Two (2) drainage lines are found directly within the footprint of this

Alternative	Preference	Reasons (incl. potential issues)
		alternative site. Moreover, six (6) additional minor drainage lines can be found within 200m of the alternative site. The potential for direct and indirect impacts is moderate to high considering the location of the proposed substation as well as the proximity to nearby (<200m) surface water resources. This option is therefore not preferred.
Linking Substation Option 1	Favourable	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources are the cluster of saline depression wetlands, of which the nearest saline depression wetland within the common grid line corridor for all alternatives is located approximately 1,1km to the east. The potential for indirect impacts is minimal to considering the distance to the depression wetland. This option is therefore favourable.
Linking Substation Option 2	Preferred	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources are the cluster of saline depression wetlands, of which the nearest saline depression wetland within the common grid line corridor for all alternatives is located approximately 3,5km to the south east. The potential for indirect impacts is very minimal considering the distance to the depression wetland. This option is therefore preferred.
GRID LINE CORRIDOR ALTERNATIVES		

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 1	Favourable	There is one (1) depression wetland, thirteen (13) major drainage lines and sixty five (65) drainage lines within grid line option 1. A total of seventy nine (79) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.
Grid Line Option 2	Favourable	There are three (3) depression wetlands, eight (8) major drainage lines and sixty nine (69) drainage lines within grid line option 2. A total of eighty (80) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.
Grid Line Option 3	Preferred	There is one (1) depression wetland, eight (8) major drainage lines and twenty eight (28) drainage lines within grid line option 3. A total of thirty seven (37) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the

Alternative	Preference	Reasons (incl. potential issues)
		number and types of surface water resources that may potentially be affected, this option is considered to be preferred.
Grid Line Option 4	Favourable	There are five (5) depression wetlands, six (6) major drainage lines and sixty one (61) drainage lines within grid line option 4. A total of seventy two (72) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.

Based on the above assessment, the preferred options include the following:

- **On-site Substation Option 1**
- **Linking Substation Option 2**
- **Grid Line Option 3**

The above preferred options were chosen given the fewer amount of surface water resources to be directly and indirectly affected as well as to ability of the grid line to avoid / span potentially affected surface water resources.

8 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

This section will identify and contextualise each of the potential impacts on the identified surface water resources within the context of the proposed development. This section will rate these potential impacts according to an impact rating system (see **Appendix B** for a full methodology and description of the impact rating system), determine the effect of the environmental impact and provide recommendations towards mitigating the anticipated impact. The identification and rating of impacts will be undertaken for the construction, operation and de-commissioning phase of the proposed development.

8.1 Construction Phase Potential Impacts

8.1.1 Loss of Wetland and Riparian Habitat

There are a number of direct impacts during the construction phase that can potentially have an adverse effect on the identified and delineated surface water resources habitat. These include construction of the substation, lay-down area and grid line pylons directly or in close proximity to surface water resources and the associated buffer zones (<50m of wetland and drainage lines buffer zones and within 100m of major drainage lines), clearing of drainage line or wetland vegetation, human degradation to surface water resources habitat during construction activities, and vehicle degradation by compaction during movement.

Firstly, placement of the construction lay-down area as well as grid line pylons directly within or within close proximity to surface water resources habitat can have impacts in terms of removal of vegetation and / or indirect edge impacts. Removal of vegetation will degrade the condition of the wetlands and expose the soil leaving the wetlands vulnerable to erosion. Additionally, disturbance due to construction activities may provide opportunities for pioneer and / or alien species to colonise the wetlands.

The substation and construction lay-down area particularly will need to be cleared of all vegetation and ideally flattened to establish the electrical infrastructure, temporary site offices, and storage areas for waste (temporary), vehicles, materials and machinery, respectively. Here removal of vegetation and edge impacts will degrade the state of vegetation associated with the surface water resources. With regards to clearing vegetation in general for the grid line pylons and access / future service roads, the areas where the pylons will need to be placed will need to be cleared of vegetation in order for the foundations to be established. Additionally, vegetation clearing will need to take place where roads are to be established for transport of workers and materials and may potentially be used as future service roads for maintenance in the future.

Ultimately, removal of vegetation associated with surface water resources in these areas will result in loss of habitat. Moreover, degradation caused by movement of vehicles within the drainage line(s) and wetland habitat will likely result in degradation of habitat due to compaction when vehicles move through surface water resources. Lastly, human degradation specifically can take the form of physical direct degradation such as lighting fires in or near the drainage lines and / or wetlands, as well as directly damaging or removing wetland vegetation. Disturbance and potential removal of drainage line and / or wetland vegetation may therefore occur.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 2** below.

Table 2. Rating for Potential Construction Impacts to Surface Water Resources Habitat

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of drainage line and wetland habitat	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**Designation of Highly Sensitive Areas** The wetlands and drainage lines must be designated as "highly sensitive" and any impact must be limited to the minimum possible extent. All wetlands and drainage lines to be directly affected must be visibly demarcated prior to construction activities taking place. The demarcation of wetlands and drainage lines must be visible and last for the duration of the construction activities. **Avoidance of Direct Impacts to Surface Water Resources** The construction lay-down area must not be situated directly within or within a proximity of 500m from any wetlands and / or drainage lines or within a 100m from any major drainage lines adhering to the stipulated buffer zones.	

	The potential future access / service roads must be planned to route around and not directly through surface water resources as far as practically possible. Where this is not possible, a Right of way (RoW) will need to be established. **Establishment of Road Access Areas** For general access to erect the pylons for the grid line, existing roads are to be used as far as possible. No roads are to be routed through any wetlands and / or drainage lines (including buffer zones) as far as practically possible. Where this is not possible however, and where no other access exists to the desired construction areas, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly. A single access route or road access area is then to be established before construction takes place, if required. This should be planned to cross perpendicularly through any drainage line(s). For wetlands, the road access area must be planned for minimal impact on wetlands (i.e. shortest route, not routed through the core of the wetlands, minimal destruction of habitat etc.). The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings and / or similar design crossings using the stream / wetland bed as part of the road can be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to access proposed construction areas during construction the construction phase only. Where the access route will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, this design should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing and / or similar design crossings, little to no modification of the stream banks or wetland will be required where banks are low (approximately

	1,2m) for drainage lines or topography is flat for wetlands, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line and / or wetland. However, where modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction. For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line and / or wetland beds. The weak substrate layer will need to be excavated an infilled by the rock or gravel material to the same level of the original drainage line or wetland bed. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support. Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction. In general, the width of the road access areas must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The road access areas must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings, vegetation should not be totally cleared across the entire road access areas. Rather, only the vehicle tracks should be cleared. Remaining vegetation can be kept trimmed to

	below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated. Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary and permanent ford crossings and / or similar design crossings. Additionally, rehabilitation will need to take place if and where required. Overall, no wetlands and or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road access areas are only permissible after rainfall events once flows have ceased. Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the road access areas of the wetland and drainage lines due soil instability factors. Construction workers are only allowed in the designated road access areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation. **Control of Alien and Invasive Vegetation in Surface Water Resources** Control of alien and invasive vegetation within surface water resources will be required. Where alien and invasive vegetation encroachment / colonization takes place, these areas are to be cleared as soon as practically possible. Clearing should take place by means of mechanical removal, either by physically pulling or slashing and clearing of unwanted alien and invasive vegetation near or within the surface water resources. Monitoring of alien and invasive vegetation should be undertaken in accordance with the

	environmental compliance monitoring during the construction phase. **Emergency Measures** Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons and variable winds that the region experiences, it is recommended that a fire management and emergency plan is compiled. A suitably qualified health and safety officer must compile the fire management and emergency plan for the operation and maintenance phase of the project. **Post-construction Rehabilitation** Rehabilitation of the road access areas that will not be used as service roads for maintenance activities following the construction period will be required post-construction. Ideally, the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation has re-established where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped to the pre-existing natural state. **Buffer Zone Specific Mitigation Measures** During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as "sensitive" and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is directly within the buffer zone. The demarcation of the buffer zones must be visible and last for the duration of the construction activities. See above for same access (road access area) mitigation measures to be implemented within buffer zones.

8.1.2 Impacts to the Geomorphology of Surface Water Resources

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the surface water resources and the nearby surrounding areas is likely to result in exposing the soil, leaving the ground susceptible to wind and water erosion particularly during and after rainfall events. Due to the climate of the study area (generally arid with sudden sporadic rainfall) soil erosion, as a consequence of the proposed development, is a possibility. A further impact due to erosion and potential storm water run-off impacts is increased run-off and sedimentation to surface water resources. Increased run-off can erode channels more easily, whilst an increased load of deposited sediments can smother vegetation and change flow paths / dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Soil compaction due to vehicle and worker movement within the access road areas within the surface water resources is another distinct possibility. This is likely to take place during the construction phase of the proposed development. Vehicles (heavy and light) will require access to the designated construction areas.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 3** below.

Table 3. Rating for Potential Construction Impacts to the Geomorphology of the Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of the soils associated with the drainage lines and wetlands	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2

Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**General Mitigation Measures** Apply same mitigation measures stipulated in **Section 7.1.1** above in terms of the following: ▪ Designation of Highly Sensitive Areas ▪ Establishment of Access Road Areas ▪ Avoidance of Direct Impact to Surface Water Resources ▪ Emergency Measures ▪ Post-construction Rehabilitation ▪ Buffer Zone Specific Mitigation Measures **Preventing Increased Run-off, Erosion and Sedimentation Impacts** – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future. In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to prevent erosion in susceptible construction areas. Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated above) are to be implemented as and where required.	

8.1.3 Impacts to Soil and Water in Surface Water Resources

With the movement of vehicles and personnel potentially in surface water resources, there is the possibility of soil and water contamination. Soil contamination may take place as a result of oil, fuel leakages and / or cement spills from the vehicles passing in close proximity or directly within surface water resources. Similarly, where and when surface water is present, water contamination from the same source may result. In addition, other amenities and / or storage of substances may also lead to both soil and water contamination either directly or indirectly. Where temporary toilets for workers are placed within the buffer zones, indirect contamination may result where leakages from temporary toilet units drain into surface water resources. Moreover, direct soil and water contamination can take place where temporary toilets are placed directly in surface water resources and where leakage takes place.

In terms of other substances, fuel, paints and oil in storage areas may similarly spill, leak and drain directly within surface water resources where these substance and liquids are stored and or used directly in surface water resources. Indirectly, soil and water contamination may equally take place where storage areas are situated within buffer zones and spills of leaks take place. Furthermore, run-off from storage areas can also accumulate such hazardous liquids and drain into surface water resources. Lastly, from a construction point of view specifically, mixing cement and cleaning construction tools in the wetland can affect the water quality of the wetland.

Altering the chemical composition of the soil and water disrupts the natural baseline condition to which organisms and vegetation have adapted to in order to survive. Contamination of water and soil may affect the functionality of organisms and vegetation, even potentially leading to death. Importantly, altering the chemical composition of water is considered pollution and must be prevented in terms of the NWA.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 4** below.

Table 4. Rating for Potential Construction Impacts to the Soil and Water Contamination Impacts to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the contamination of the soils and water associated with the drainage lines and wetlands	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1

Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**General Mitigation Measures** Apply same mitigation measures stipulated in **Section 7.1.1** above in terms of the following: ▪ Designation of Highly Sensitive Areas ▪ Establishment of Road Access Areas ▪ Avoidance of Direct Impact to Surface Water Resources ▪ Emergency Measures ▪ Post-construction Rehabilitation ▪ Buffer Zone Specific Mitigation Measures **Preventing Soil and Water Contamination** No vehicles are to be allowed in the highly sensitive and sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles and machinery are not to be allowed into any drainage sensitive and highly sensitive areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive and sensitive areas. Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available and fire extinguishers. Storage areas for fuel, oil, paints and other hazardous substance are not to be stored directly within surface water resources or the associated buffer zones. These substances	

	must also be contained in bunded areas with a capacity of at least 110%. No “long drop” toilets are allowed on the construction site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must not be placed directly within any surface water resource(s) or the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. No cement mixing is to take place in any surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive and sensitive areas.

8.1.4 Impacts to Fauna associated with Surface Water Resources

The possibility of impacts to fauna associated with surface water resources may occur during the construction phase. Fauna are often hunted, trapped, killed or eaten by workers for various reasons.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 5** below.

Table 5. Rating for Potential Construction Impacts to the Fauna associated with Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Major / Minor Drainage Lines and Wetlands
Issue/Impact/Environmental Effect/Nature	Impacts to fauna associated with drainage lines and wetlands
Extent	*Site*
Probability	*Possible*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Marginal loss of resources*

Duration	*Medium term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced to an even lower level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 22 (low negative)	- 6 (low negative)
Mitigation measures	**Preventing Impacts to Fauna Associated with Drainage lines and Wetlands** No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed, may not be killed. Additionally, these animals are to be relocated outside the road access or construction areas, within relative close proximity where they were found.	

8.2 Operation Phase Potential Impacts

8.2.1 Impacts to the Geomorphology and Hydrology of Surface Water Resources

Vehicle access to the substation/linking station sites and infrastructure (such as roads, cables and grid lines etc.) in and / or through and / or over (grid lines spanning) surface water resources. It is therefore important that access routes / future service roads are not planned and constructed within surface water resources as far as practically possible. However, where this is required and the relevant environmental authorization and water use license is obtained, access routes and service roads for vehicles in or through surface water resources may be susceptible to soil compaction and consequent erosion impacts. Regular vehicle movement in surface water resources can compact the soil affecting the hydrology of the surface water resources. Similarly, regular movement from vehicles can flatten the ground surface making it a preferential flow path for storm water and thereby becoming susceptible to accelerated run-off which may result in progressive erosion. Compaction from vehicles can also create incisions which may induce donga erosion over time.

With the above in mind, stormwater and erosion control management will be important so that where impacts to surface water resources are permitted, stormwater and erosion is controlled so as not to drastically alter the hydrology and structural integrity and sediment regime of the potentially affected surface water resources. Altering the hydrology of the surface water resources can disrupt the drainage dynamics of the landscape. Likewise, long term erosion of surface water resources compromises the structural integrity of the surface water resources and can lead to long term degradation and possibly failure.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 6** below.

Table 6. Impacts to the Geomorphology of Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Major / Minor Drainage Lines and Wetlands
Issue/Impact/Environmental Effect/Nature	Impacts associated with the geomorphological and hydrological impacts associated with the drainage lines and wetlands
Extent	*Site*
Probability	*Probable*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Significant loss of resources*
Duration	*Long term*
Cumulative effect	*Medium cumulative impact*
Intensity/magnitude	*High*

Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 45 (medium negative)	- 24 (low negative)
Mitigation measures	**Minimising Vehicle Damage to the Surface Water Resources** Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones. Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as ford crossings, stormwater flow pipes, culverts, culvert bridges etc.) be submitted to the relevant environmental and water departments for approval prior to construction. Internal access and services roads authorised in sensitive areas will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall the roads will need to be checked for erosion. Rehabilitation measures will need to be employed should erosion be identified. Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the surface water resources. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from	

	a suitably qualified wetland / aquatic specialist must be obtained in this respect should this be required. Control of erosion on the construction site in general must be managed through implementation of an erosion management plan. Erosion and subsequent sedimentation of surface water resources are considered significant impacts in terms of the proposed development that must be managed adequately throughout the operation of the proposed development.

8.3 Decommissioning Phase Potential Impacts

8.3.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar impacts are therefore expected to occur and the stipulated mitigation measures where relevant and appropriate must be employed as appropriate to minimise impacts

8.4 Potential Cumulative Impacts

Cumulative impacts are the combined impacts from different developments / facilities which, in combination, result in significant impacts that may be larger than sum of all the impacts.

The proposed renewable energy developments in the surrounding area (55km radius) outside of the study site are identified in **Table 7** and shown in **Figure 20** below.

It must be noted that surface water resources change from one site to another and can range from a number of surface water resources in one area to very few on a neighbouring property depending on factors such as topography, geology, local rainfall and other environmental factors. Additionally, the characteristics of surface water resources can change along its course where longitudinal hydrological systems are involved. Nonetheless, the most important factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur, these are likely to have an impact downstream to some degree.

Table 7. Renewable Energy Developments Proposed within a 55km Radius of the Graskoppies Substation and Grid Line Study Site

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de

				Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Aan De Karree Doorn Pan No. 213; Portion 1 of the Farm Karree Doorn Pan No. 214; and Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

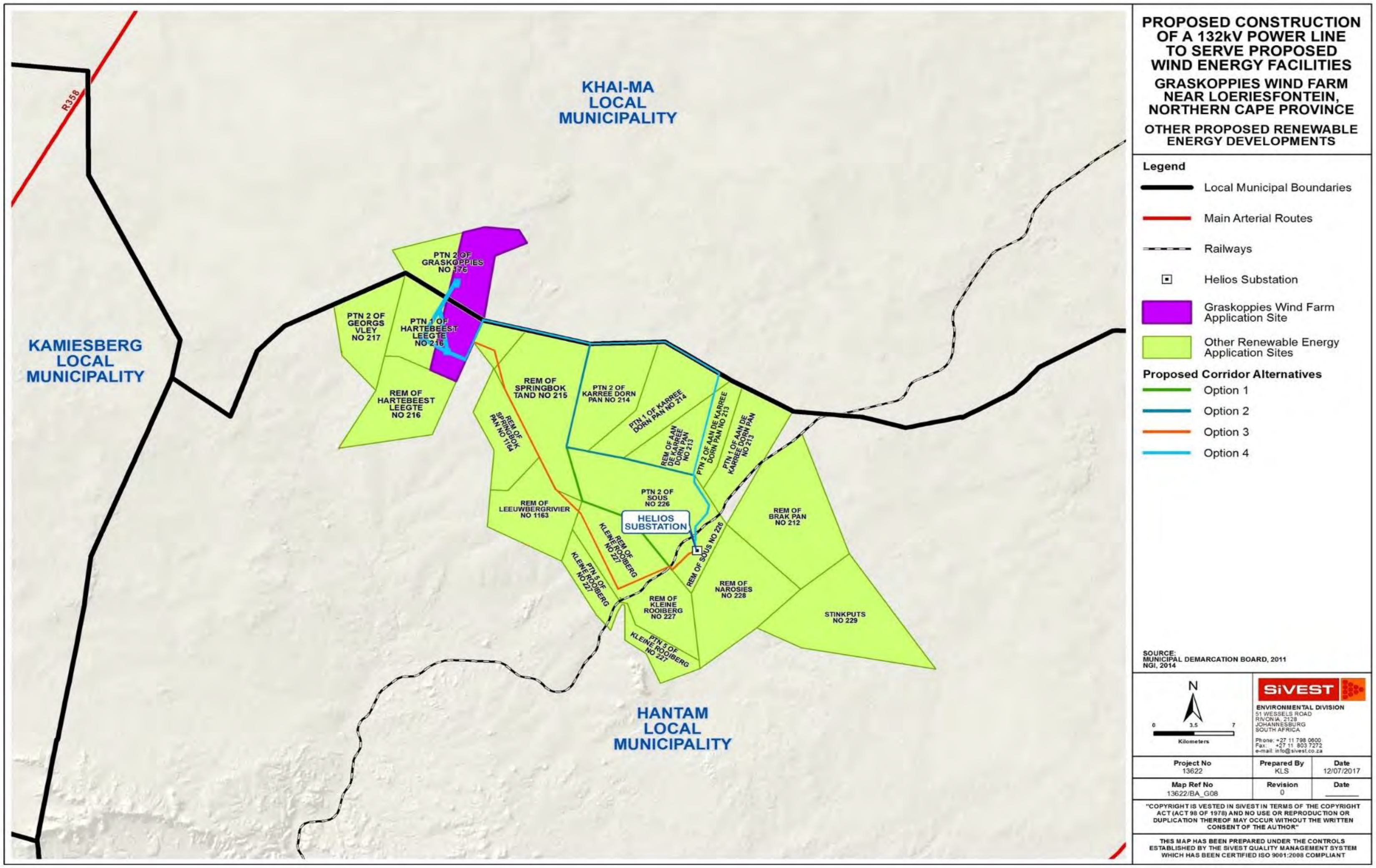

Figure 20. Renewable Energy Facilities Proposed within a 55km Radius of the Xha! Boom Substation, Linking Station and Grid Lines

The main potential cumulative surface water impacts from a catchment perspective in the local area include both potential direct and indirect impacts. Direct impacts include cumulative loss of as well as further degradation of surface water resources due to the footprints of developments encroaching or destroying surface water resources in the greater catchment. The indirect impacts relate mainly to increased run-off, sedimentation and erosion for linear and endorheic hydrological systems. The indirect impacts to hydrological systems (i.e. drainage lines) which are connected across several farm boundaries have a greater risk for potential cumulative impacts from developments upstream.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level.

The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a northern direction, whilst drainage for the Kokerbook 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely.

Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

9 LEGISLATIVE IMPLICATIONS

9.1 National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2014)

In the context of NEMA (1998) and the EIA Regulations (2017), based on the current layout, it is identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 will be triggered due to access / service roads and power lines through surface water resources, thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below.

9.1.1 Environmental Impact Assessment Regulations 2017, Listing Notice 1, GN. 327, Activity 12:

The development of-
(x) buildings exceeding 100 m² in size;
(xii) infrastructure or structures with a physical footprint of 100 m² or more;

where such development occurs-

a) within a watercourse (wetland);
b) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse (wetland); -

Where access / service roads will route directly through of within 32m of any of the identified surface water resources, this activity will be triggered.

9.1.2 Environmental Impact Assessment Regulations 2017, Listing Notice 1, GN. 327, Activity 19:

The infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from-

(I) a watercourse;

Where access / service roads will route directly through any of the identified surface water resources and will be associated with the infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from surface water resources, this activity will be triggered.

9.2 National Water Act, 1998 (Act No. 36 of 1998)

In the context of the NWA (1998) and the proposed development, a "water use" is required to be registered where construction activities will impact directly or indirectly (within the regulated area as per Government Notice 509 of 2016 (No. 40229)) on a water resource. The regulated area as per Government Notice 509 of 2016 (No. 40229) is defined as follows:

- Activities within 500 meter radius of a wetland or pan;
- Activities within the outer edge of the 1:100 year flood line or riparian habitat (whichever is greatest);

- Activities within 100m from the edge of a watercourse (annual bank fill flood bench) in absence of the 1:100 year flood line or riparian habitat.

In this light, a "water use" is defined *inter alia* as follows:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38 (1) of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

In this context, a water use license will be required where any of the above water uses are required for a development. As such, for the proposed development, it has been identified based on the current layout that surface water resources will be affected by construction of access / service roads and power lines. Therefore, water uses (c) and (i) are applicable.

However, once a final layout (including a road plan and grid line, showing tower positions) is available, it is recommended that an assessment using the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229) is undertaken to potentially determine whether a General Authorisation (GA) can be issued in this regard for water uses (c) and (i) instead of undertaking a full water use license application. Should it be identified that the proposed development falls within the Low risk category, a GA registration process may be applicable as opposed to a full water use license application.

10 SPECIALIST RECOMMENDATIONS

Specialist recommendations in terms of the proposed development are as follows:

- All surface water resources and buffer zones must be avoided as far as practically possible in the final layouts (including access / service roads and power lines, including tower positions) to be designed in order to minimise and potentially avoid potential impacts as far as possible.

- Where it is not possible to avoid impacts to surface water resources as a result of roads and power lines, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
- All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.
- With the implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding final access / service road layouts, final grid line routes and tower positions) and therefore, may by environmentally authorised.

11 CONCLUSION

SiVEST has been appointed by Mainstream to undertake a BA and Environmental management Programme (EMPr) for the proposed construction of the Xha! Boom substation, linking station and associated 132kV grid line, near Loeriesfontein in the Northern Cape Province. As part of the BA study, the need to undertake a surface water impact assessment was identified. In this study, a delineation and impact assessment of surface water resources is provided.

Findings from the fieldwork undertaken show that the following surface water resources were identified on the study site:

- Five (5) Depression Wetlands;
- Twenty six (26) Major Drainage Lines including Klein-Rooiberg, Leeuberg and Hartbeeslaagte (drainage line with a channel width >5m);
- One hundred and eighty (180) Minor Drainage Lines (drainage lines with a channel width <5m).

An ecological buffer zone of 100m for the major drainage line and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the potential direct and indirect impacts which may occur, so as to limit these impacts on the surface water resources as far as practically possible.

A comparative assessment was undertaken to determine the environmentally preferred options include the following:

- **On-site Substation Option 1**
- **Linking Substation Option 2**
- **Grid Line Option 3**

The above preferred options were chosen given the fewer amount of surface water resources to be directly and indirectly affected as well as to ability of the grid line to avoid / span potentially affected surface water resources.

It was identified that several potential impacts may affect the surface water resources within the proposed development area during the construction, operation and decommissioning phases as alluded to above. The potential impacts for each phase of the proposed development are summarised as follows:

CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Loss of Wetland and Riparian Habitat	- 42 (medium negative)	- 26 (low negative)
Impacts to the Geomorphology of Surface Water Resources	- 42 (medium negative)	- 26 (low negative)
Impacts to Soil and Water in Surface Water Resources	- 42 (medium negative)	- 26 (low negative)
Impacts to the Fauna associated with Surface Water Resources	- 22 (low negative)	- 6 (low negative)
OPERATION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Impacts to the Geomorphology of Surface Water Resources	- 42 (medium negative)	- 24 (low negative)

It is not anticipated that the proposed development will need to be decommissioned. Should this need to take place, the same impacts as identified for the construction phase of the proposed development can be anticipated. Hence, the same impacts are expected to occur and the stipulated mitigation measures where relevant must be employed to minimise impacts.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a northern direction, whilst drainage for the Kokerbook 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2017), based on the current layout, it has been identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to potential direct impacts due to access / service roads and power lines, thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that based on the current layout, there are a number of surface water resources which may be affected by access / service roads and power lines. Water uses (c) and (i) will therefore be applicable. However, once a final layout (including a road plan and grid line, showing tower positions) is available, it is recommended that an assessment using the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229) is undertaken to potentially determine whether a General Authorisation (GA) can be issued in this regard for water uses (c) and (i) instead of undertaking a full water use license application. Should it be identified that the proposed development falls within the Low risk category, a GA registration process may be applicable as opposed to a full water use license application.

Finally, specialist recommendations include the following:

- All surface water resources and buffer zones must be avoided as far as practically possible in the final layouts (including access / service roads and power lines, including tower positions) to be designed in order to minimise and potentially avoid potential impacts as far as possible.
- Where it is not possible to avoid impacts to surface water resources as a result of roads and power lines, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
- All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.

  With the implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding final access / service road layouts, final grid line routes and tower positions) and therefore, may by environmentally authorised.

12 REFERENCES

1. Collins, N.B., 2005: Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.
2. Department of Water Affairs and Forestry (DWAF), 2005: A practical field procedure for identification and delineation of wetlands and riparian areas (edition 1). DWAF, Pretoria.
3. Lanz, J., 2017: Agricultural and Soils Impact Assessment for Proposed Construction of the Xha! Boom Substations and associated 132kV Power Line near Loeriesfontein, Northern Cape Province.
4. Mucina, L & Rutherford, M. C., 2006: The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
5. Ollis, D. J., Snaddon, C. D., Job, N. M & Mbona, M., 2013: Classification System for Wetlands and other Aquatic Ecosystems in South Africa, User Manual: Inland Systems.
6. Todd, S., 2017: Xha! Boom Wind Farm near Loeriesfontein: Fauna and Flora Specialist EIA Report.

Appendix A:

Specialist Credentials

CURRICULUM VITAE

Name	Shaun Taylor
Profession	Environmental Scientist
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Environmental Scientist: Environmental Division
Date of Birth	02 February 1984
ID Number	8402025020082
Nationality	South African

Education

MSc – Aquatic Health
BSc (Hons) – Geography & Environmental Studies
BA – Geography and Environmental Science

Professional Qualifications

MSc – Aquatic Health, Johannesburg University
Research Project: The physico-chemical and biological characteristics of selected seasonal pans in the Kruger National Park, South Africa

BSc (Hons) – Geography & Environmental Studies, Witwatersrand University (First class)
Research Project: Sitatunga Habitat Suitability in the Okavango Delta, Botswana

BA – Geography & Environmental Science, Monash University South Africa (Distinction)

Certification in Wetland Delineation and Rehabilitation Training Course from the School of Continuing Education, University of Pretoria

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

Employment Record

Oct 2010 – Present (Full-time)	SiVEST SA (Pty) Ltd Environmental Division – Environmental Scientist
Oct 2009 – Mar 2010 (Part-time)	Envirokey cc – Junior Environmental Consultant and GIS support
Aug 2007 – Sep 2009 (Part-time)	Holgate, Meyer and Associates Environmental Management Services – Junior Environmental Consultant

Key Experience

Shaun joined SiVEST in October 2010 and is based in the Johannesburg office in the capacity of an Environmental Scientist.

Shaun has a passion for working in the environmental and water (wetlands) field. From an environmental management perspective, Shaun has completed a number of environmental impact assessments, basic assessments, strategic environmental assessments, environmental management plans/programmes, exemption applications, amendment applications and conducted environmental auditing. Within the water field, Shaun has undertaken water use licensing (WUL) and WUL compliance monitoring for various developments. In terms of specialist work, Shaun has completed numerous wetland and riparian assessments for renewable energy projects, linear projects as well as site specific projects. Shaun has also undertaken several wetland rehabilitation plans for developments.

Through his time at SiVEST, Shaun has acquired the following skills:

- Excellent computer skills (Word, excel, powerpoint etc.);
- Excellent proposal and report writing skills;
- Environmental Impact Assessments;
- Environmental Management Plans/Programmes;
- Environmental Compliance and Auditing;
- Environmental Amendment and Exemption Applications;
- Wetland and riparian assessment techniques (including functional assessments);
- Wetland Rehabilitation Plans;
- Water Use License Applications.

Projects Experience

Shaun is responsible for the following activities: conducting EIA, BA and WULA processes, undertaking amendment and exemption applications, general project management, report writing, proposal writing, invoicing, conducting specialist riparian/wetland delineation and functional assessments, environmental and water related compliance monitoring and auditing. Current and completed projects / activities are outlined in detail below.

STRATEGIC ENVIRONMENTAL ASSESSMENTS

- Molemole Local Municipality Strategic Environmental Assessment, Limpopo Province (2014/2015);
- Blouberg Local Municipality Strategic Environmental Assessment, Limpopo Province (2015/2016).

ENVIRONMENTAL IMPACT ASSESSMENTS

- Mookodi Integration Project Environmental Impact Assessment (2011/2012);
- Noupoort Wind Farm, Northern Cape Province (2011/2012);
- Loeriesfontein Wind Farm and PV Plant, Northern Cape Province (2011/2012);
- Renosterberg Wind Farm and PV Plant near De Aar, Northern Cape Province (2012).

BASIC ASSESSMENTS

- Proposed Installation of a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station, Mpumalanga Province (2011/2012);
- Proposed development of a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);

- Proposed development of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province (2012);
- Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province (2013);
- Wilger 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Limestone 1 – 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Limestone 2 – 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Proposed Tweespruit to Welroux Power Line and Substations, Free State Province (2014/2015);
- Sir Lowry's Pass River Flood Alleviation Project, Western Cape Province (2014/2015);
- Loeriesfontein 70MW Photovoltaic and 132kV Power Line, Northern Cape Province (2015/2016);
- Rooipunt CSP 132kV Power Line and Associated Infrastructure, Northern Cape Province (2016);
- Rooipunt CSP Water Pipeline and Associated Infrastructure, Northern Cape Province (2016);
- Kalkaar CSP 132kV Power Line and Associated Infrastructure, Northern Cape Province (2016).

ENVIRONMENTAL MANAGEMENT PLANS / PROGRAMMES

- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Transmission Infrastructure (2011);
- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Substations (2011);
- Mookodi Integration Project Environmental Management Plan – Transmission Infrastructure and Substations (2011/12);
- Noupoort Wind Farm Environmental Management Programme (2012);
- Environmental Management Programme for a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province (2012);
- Karowe Diamond Mine Environmental Management Plan Review and Update, Boteti District, Botswana (2012);
- Environmental Management Programme for the Frankfort Strengthening Project: 88kV power line from Heilbron (via Frankfort) to Villiers, Free State Province (2013);
- Environmental Management Programme for the Wilger Photovoltaic 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 1 Photovoltaic – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 2 Concentrated Solar Power – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Final Environmental Management Programme for the Khobab 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Loeriesfontein 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Noupoort 80MW Wind Farm, Northern Cape Province (2014);
- Environmental Management Programme for the Tweespruit to Welroux 132kV Power Line and Substations, Free State Province (2014/2015);
- Environmental Management Programme for the Loeriesfontein 70MW Photovoltaic and 132kV Power Line, Northern Cape Province (2015/2016).

AMENDMENT APPLICATIONS

- Loeriesfontein 140MW Wind Farm, Northern Cape Province: Substantive and Minor Amendments (2013/2014);

- Khobab 140MW Wind Farm, Northern Cape Province: Substantive and Minor Amendments (2013/2014);
- Loeriesfontein 50MW Wind Farm, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Loeriesfontein 100MW Solar Photovoltaic Plant, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Noupoort 188MW Wind Farm, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Loeriesfontein 132kV Power Line, Northern Cape Province: Environmental Authorisation Minor Amendment (2015).

ENVIRONMENTAL CONSTRAINTS\FATAL FLAWS

- Social Housing Projects in Sasolburg and Secunda Final Environmental Constraints Analysis Report (2011);
- Establishment of Wind Farms in Northern and Eastern Cape Provinces Environmental Constraints Analysis Report (2011).

ENVIRONMENTAL AND WATER USE LICENSE COMPLIANCE AUDITING

- Environmental Compliance Auditing for the Nigel Substation to Jameson Park (Inland Terminal 2) 88kV power lines – Construction Phase (2011);
- Water Use License Compliance Auditing for Grootvlei Power Station, Mpumalanga Province, South Africa (2012);
- Environmental Compliance Auditing for the Meadow Feeds Standerton Broiler Feed Mill, Mpumalanga Province (2012/2013);
- Kusile Power Station Armcor Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Ash Dump Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Pollution Dams Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Stream Diversion and Water Pipeline Crossings Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Geotechnical Water Use License Compliance Audit, Mpumalanga Province (2015);
- Ga-rankuwa 11kV Underground Power Cable Water Use License Compliance Audit, Gauteng Province (2015/2016);
- Transnet Rail Water Use License Compliance Audit, Northern Cape Province (2014, 2015 & 2016).

WATER USE LICENSES

- Integrated Water Use License Application for the Construction of a CSP and CPV/ PV Plant in De Aar, Northern Cape Province of South Africa (2010);
- Water Use License for Ga-rankuwa Substation, Gauteng Province (2013);
- Water Use License for Klevebank to Dalkieth 88kV Power Line, Gauteng Province (2013);
- Water Use License Application for the Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province (2014/2015);
- Water Use Licensing for the Integrated Polokwane Rapid Public Transport Network, Limpopo Province (2014/2015);
- Water Use License for the Rooipunt Concentrated Solar Power Project, Northern Cape Province (2015);
- Water Use License for the Katulo Tsatsi Solar Park, Northern Cape Province (2015);

- Water Use License for the Limestone Concentrated Solar Power Project, Northern Cape Province (2015);
- Water Use License for the Wilger Photovoltaic Project, Northern Cape Province (2015);
- Water Use License for the Hertzogville Solar Park, Free-State Province (2015);
- Water Use License for the Dwarsrug Wind Farm, Northern Cape Province (2015);
- Water Use License for the Loeriesfontein 70MW Photovoltaic and 132kV Power Line Project, Northern Cape Province (2015);
- Water Use License for the Tweespruit to Driedorp 132kV Power Line, Driedorp Substation and Associated Infrastructure, Free State Province (2016);
- Water Use License for the Redstone Concentrated Solar Power to Olien Substation 132kV Power Line, Northern Cape Province (2016);
- Water Use License for the Victoria West 140MW Wind Farm near Victoria West, Northern Cape Province (2016);
- Water Use License for the Growthpoint Properties (Woodlands Office Park) near Woodmead, Gauteng Province (2016); and
- Water Use License for the Twinsaver Expansion of Facilities, Gauteng Province (2016).

WETLAND AND RIPARIAN DELINEATION AND FUNCTIONAL ASSESSMENTS

- Construction of a Wind Farm in Noupoort, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a Wind Farm in Prieska, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a Wind Farm in Loeriesfontein, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a 132KV Distribution Line from the Kudu Substation to Dorstfontein Substation in Mpumalanga Province: Surface Water Impact Assessment (2010);
- EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Northern Corridor: Eastern Cape Province (2011);
- EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Southern Corridor: Eastern Cape Province (2011);
- Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province, South Africa – Surface Water Assessment – Scoping Phase Assessment (2011);
- Environmental Management Framework for the Mogale City Local Municipality Surface Water Report – Desired State Report: Gauteng Province (2011);
- Proposed Township Development on the Remainder of Portion 27 of the Farm Middelburg and Townsland 287 JS, Mpumalanga Province: Surface Water Assessment (2011);
- Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province, South Africa: Surface Water Impact Assessment (2011);
- Construction of a CSP and a CPV/ PV Plant in Kimberley, Northern Cape Province, South Africa: Surface Water Impact Assessment (2011);
- Proposed Mixed Use Industrial Township Development in the Daspoort Area of Tshwane, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
- Westrand Strengthening Project from Westgate Substation to Hera Substation and Westgate Substation Extension, Gauteng Province, South Africa (2011);
- Mookodi Integration Project 2 Basic Assessment Surface Water Impact Assessment, North West Province, South Africa (2012);
- Wetland Site Investigation Report for Arundo Estate in the Midrand Area, Gauteng Province, South Africa (2011);
- Construction of a Gabion Structure at Waterval Substation in the Midrand Area, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
- Proposed Construction of a Single 400kV Power Line from Borutho to Nzhlele, North West Province, South Africa: Scoping and Impact Surface Water Assessment (2011/2012);

- Proposed Construction of an 88kv Power Line at Palmridge in the Ekurhuleni Metropolitan Municipality, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
- Proposed Construction of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province, South Africa: Surface Water Impact Assessment (2012);
- Proposed Rebuilding of a 88kV Power Line from Henneman Substation to Serfontein Substation near Kroonstad, Free State Province, South Africa: Surface Water Impact and Eco-Services Functional Assessment (2012);
- Proposed Deconstruction and Construction of an 11kV Power Line near Delmas, Mpumalanga Province, South Africa: Wetland Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012);
- Proposed Construction of a Solar Photovoltaic Power Plant near De Aar, Northern Cape Province, South Africa: Surface Water Scoping Assessment (2012);
- Proposed Construction of a Wind Farm near De Aar, Northern Cape Province: Surface Water Scoping Assessment (2012);
- Proposed Construction of a Low Cost Housing Development in the Soutpan area of Tshwane, Gauteng Province, South Africa: Wetland Assessment (2012);
- Proposed Construction of a 132kV Power Line near Kimberley, Northern Cape Province: Surface Water Assessment (2012);
- Proposed Extension of Delmas Substation and Associated Power Lines, Mpumalanga Province, South Africa: Wetland Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012);
- Proposed Construction of a Substation in the Midrand area of Gauteng Province: Wetland Delineation and Impact Assessment (2012);
- Construction of an 88kV Power Line at Lochvaal Kudu in the Emfuleni Municipality, Gauteng Province: Surface Water Impact Assessment and Rehabilitation Plan (2012);
- Proposed construction of an 88kV Power Line from Klevebank Substation to Dalkeith Substation, Gauteng Province: Wetland and Riparian Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012/2013);
- Proposed Construction of an 88kV Power Line from Heilbron Substation to Villiers Substation, Free State Province: Surface Water Impact Assessment (2013);
- Proposed Construction of a 132kV Power Line, Substation and the Extension of Homestead Substation Associated with the 75MW Concentrating Photovoltaic (CPV) / Photovoltaic (PV) Plant (PV 3) on the Farm Droogfontein in Kimberley, Northern Cape Province: Surface Water Assessment (2013);
- Moddershaft Underground to Overhead Cable Replacement of an 11kV Power Line from Moddershaft Substation to a Minisub near Anzac, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Construction of an 11kV Underground Power Cable from Civic Centre to Zola Substation, Gauteng Province: Wetland Assessment (2013);
- Proposed Construction of a Substation on Portion 265 Randjesfontein 405-JR, Gauteng Province; Wetland Delineation and Impact Assessment (2013);
- Proposed Re-build of a Section of the Mathibestad Danhauser 33kV Power Line Network, North West Province: Wetland Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Mathibestad-Danhauser Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Mothutlung North Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Mothutlung South Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Nonyane Madidi North Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Nonyane Swartdam Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Rebuild of a Section of the Existing 33kV Pelly Klipdrift Network, Gauteng and North West Provinces: Surface Water Impact Assessment (2013);

- Proposed Re-build of a Section of the Existing 33kV Zonderwater Kraal Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Hammanskraal Lusthof Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Klipgat Circle Power Line Network, Gauteng Province: Wetland Assessment (2013);
- Proposed Re-build of Sections of the Existing 33kV Erasmus Aviva Power Line Network, Gauteng Province: Surface Water Assessment (2013);
- Proposed Construction of an 11kV Underground Power Cable at the Ga-Rankuwa Substation, Gauteng Province: Wetland Assessment (2013);
- Mamatwan Manganese Mine, Northern Cape Province: Surface Water Assessment (2014);
- Two 5MW Photovoltaic Plants, Free State Province: Surface Water Assessment (2014);
- Dwarsrug Wind Farm, Northern Cape Province: Surface Water Assessment (2014);
- Manzimtoti Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Compensation Flats Development, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Tinley Manor South Road Development, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Ntuzuma Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Esphiva Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Frankfort 132kV Power Line Wetland Walk-down Assessment, Free State Province (2014);
- Proposed Construction of the Esphiva Water Pipeline near Ulundi, KwaZulu-Natal Province: Surface Water Assessment (2014);
- Grootvlei Power Station Wetland Assessment, Mpumalanga Province (2014/2015);
- Proposed Construction of the Embangweni and Bhekabantu Irrigation Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Construction of the Nondabuya and Khwehle Primary Agriculture Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Expansion of the Makhathini Irrigation Scheme, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Construction of the Mbaliyezwe Irrigation Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Mixed Use Development on the Remainder of Portion 27 of the Farm Middelburg Town and Townlands 287 JS, Steve Tshwete Local Municipality in the Mpumlanga Province: Wetland Assessment (2015);
- Proposed Construction of Two Power Lines and Two Substations for the Mainstream Wind Facilities near Beaufort West, Western Cape Province: Surface Water Assessment (2015);
- Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province: Wetland Assessment (2015);
- Proposed Coal Railway Siding at the Welgedacht Marshalling Yard and associated Milder Road Upgrade near Springs, Gauteng Province: Wetland Assessment (2015);
- Proposed Development of a 22kV Medium Voltage Power Line in Mofofutso, North West Province: Surface Water Assessment (2015);
- Mookodi Integration Power Line Project, North West Province: Wetland Walk-down Assessment (2015);
- Proposed Construction of a Coal Loading Facility within the existing Bronkhorstspruit Railway Siding near Bronkhorstspruit, Gauteng Province (2015);
- Proposed Construction of the Two 75MW Tlisitseng Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Tlisitseng Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Two 75MW Sendawo Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Sendawo Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province: Surface Water Assessment (2015);

- Proposed Construction of a 75MW Solar Photovoltaic Power Plant near Dennilton, Limpopo Province: Surface Water Assessment (2015);
- Proposed Construction of the Helena 1, 2 & 3 Photovoltaic Energy Facilities near Copperton, Northern Cape Province: Surface Water Assessment (2015);
- Proposed Construction of a 70MW Photovoltaic Facility and 132kV Power Line near Loeriesfontein, Northern Cape Province: Surface Water Assessment (2015);
- Proposed Construction of the Eureka West 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Eureka East 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Eureka 132kV Power Line near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Aletta 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Aletta 132kV Power Line near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Grasskoppies, Itemba, Xhaboom and Hartebeestleegte 140MW Wind Farms near Loeriesfontein, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the 140MW Beaufort West Wind Farm, near Beaufort West, Northern Cape Province: Surface Water Assessment (2016); and
- Proposed Construction of the 140MW Victoria West Wind Farm near Victoria West, Northern Cape Province: Surface Water Assessment (2016).

<u>WETLAND AND RIPARIAN REHABILIATION / POST-REHABILITATION / AUDITING ASSESSMENTS</u>

- Post-rehabilitation Assessment of Three Wetland Crossing Sites for Chemwes (Pty) Ltd for the Re-working of a Tailings Dam Project near Stilfontein, North West Province (2011);
- Fourways 22kV Feeder Cable Wetland and River Rehabilitation Plan (2011);
- Post-rehabilitation Assessment of the Inland New Multi-Purpose Pipeline in the Mpumalanga and Gauteng Provinces (2012);
- John Ross Highway Wetland Rehabilitation Plan, KwaZulu-Natal Province (2014);
- Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province: Wetland and Riparian Rehabilitation Plan (2015).

ENVIROKEY CC - JUNIOR ENVIRONMENTAL CONSULTANT AND GIS SUPPORT - OCT 2009 – MAR 2010

Responsible for managing basic assessments, report writing, conducting specialist wetland assessments, auditing procedures and GIS mapping. Full list of activities completed available on request.

JUNIOR ENVIRONMENTAL CONSULTANT AUG 2007 – SEP 2009

Responsible for managing basic assessments, report writing, conducting specialist wetland assessments, environmental auditing procedures and GIS mapping. Full list of activities completed available on request.

Conferences and Publications

Taylor, S. R., 2008: A Critical Review of Strategic Environmental Assessment in South Africa and looking towards Future Considerations, presented at the South African Students Geography Conference, University of Cape Town, Cape Town.

Academic and Work Related Achievements

- Awarded Monash Dean's recognition award for outstanding academic results for second semester of 2006;
- Awarded Monash Dean's recognition award for outstanding academic results for first semester of 2007;
- Awarded Monash Dean's recognition award for outstanding academic results for second semester of 2007;
- Awarded Golden Key membership and certificate to the International Honours Society for outstanding academic achievements in undergraduate studies for Monash 2008;
- Awarded Study Sponsorship from Holgate, Meyer and Associates for Honours study in 2008/09;
- Awarded Certificate of Merit from University of Witwatersrand for outstanding work for the course of Honours in 2009/10;
- Awarded Merit Bursary for MSc from the University of Johannesburg 2010 for excellent academic results;
- Numerous short-course certificates (grass identification, wildflower identification, veld management, wetland buffer assessments and water use licensing).

University of Pretoria

Faculty of Natural and Agricultural Sciences

Department of Botany

This is to certify that

SR Taylor

has successfully completed the

Wetland Training Course on

Delineation, Legislation and Rehabilitation

26 to 30 May 2008

This certificate is awarded with distinction

Course Leader

Operations Manager: CE at UP

90306 2008/08/05 ID: 8402025020082 P000828-01-2008

UNIVERSITY OF JOHANNESBURG

The Council and the Senate of the
UNIVERSITY OF JOHANNESBURG
hereby certify that the degree

MAGISTER SCIENTIAE

with field of study

Aquatic Health

with all its associated rights and privileges
in accordance with the Statute of the
University has been conferred upon

SHAUN TAYLOR

at a congregation of the University

Vice-Chancellor

Registrar

04 OCTOBER 2011
Johannesburg
ID 8402025020082

58185

Curriculum Vitae: **Michiel Jonker**

Name:	Michiel Jonker	**Marital status:**	Single
Date of birth:	25/05/1984	**Driver's license**:	Code 8
ID No.:	840525 5110 085	**Contact No:**	084 585 7479
Place of birth:	Johannesburg, South Africa	**Email:**	michiel@ecotone-sa.co.za
Postal address:	PO Box 84 Florida, Johannesburg, South Africa, 1710		
Experience:	10 Years		

Education

University of Johannesburg

2011 **M. Sc (Environmental Management)**

This is a lectured Masters degree focussing on the concepts and principles of environmental management. The MSc. includes three modules: (1) Environmental management, biosphere and the environment. (2) Environmental management skills and (3) A mini dissertation in related field works.

2009 **M.Sc (Aquatic Health) *cum laude***

This Masters study has an ecotoxicological basis. It deals with the effects of androgenic and estrogenic growth-promoting hormones, used in cattle feeding lots, on aquatic freshwater ecosystems. It aims to incorporate biomarkers in fish (metabolomics and cellular energy allocation) as well as studies of general water quality, sediment composition and invertebrate community structures

2006 **B.Sc Honours (Zoology) *cum laude***

Related course work: Laboratory and field skills, Philosophy and research methodology, population genetics, project management, mammal diversity, eco-physiology, parasite ecology, ichthyology, research project, biological systems integrity, terrestrial ecology, nature conservation.

2005 **B.Sc (Natural and Environmental Sciences)**

Majors: Geography and Zoology

Minors: Environmental management, botany, chemistry, environmental chemistry, biogeochemistry, statistics, information science

Related course work: Cartography, biogeography, soil science, climatology and geomorphology, economic and urban geography, GIS, Geography of Africa and South Africa, invertebrate and vertebrate diversity, parasitology, ecotoxicology, terrestrial ecology and limnology, animal physiology, economic and ethno-botany, plant diversity, plant-water relations, organic and physical chemistry.

Employment and Work Experience

Feb '08 – Pres **Ecotone Freshwater Consultants CC**
Member and Freshwater Ecologist

Recent projects:

- **SMD / EIMS** aquatic ecology and impact assessment - Scoping and EIA/EMP Report for the proposed expansion of the Kao Diamond Mine, Lesotho (May 2016).
- **Vaalbult Colliery** aquatic specialist assessment, proposed road crossing, Carolina, Mpumalanga (February 2016 – Present).
- **EkoInfo** aquatic biomonitoring plan and implementation for the Elands River associated with the Maseve mining operations near Sun City, in the North West Province, (January 2016- present).
- **Exxaro**, Zonderwater Coal Proposal, Wetland Specialist Assessment (November 2013 – Present).
- **Dyambyini** wetland and aquatic ecology assessment, management and biomonitoring plan for Water Use Licence Authorisation for the Proposed expansion of the Hendrina Ash Disposal Facility and related Power Line infrastructure (March 2016).
- **Delta Mining** wetland assessment and watercourse management plan for mining operations associated with the Proposed Rietkuil operations. Rietkuil, Delmas, Mpumalanga (February 2016).
- **SLR Consulting-** Biodiversity assessment, management and biomonitoring plan for the proposed expansion of the Holfontein Toxic Waste Disposal Facility, Gauteng (January 2016).
- **Envirolutions (Eskom)** Pre-, during- and post construction biomonitoring for pylon constructions crossing smaller tributaries of the Vaal River, Vereeniging, Gauteng (January 2015- present).
- **WPC** Ngonye Falls- 52 MW Hydroelectric Power Plant. Baseline biodiversity study and Environmental Flow Assessment, Zambia (October 2015 to present).
- **Ara-sul** Aquatic baseline assessment of the Sabie River, up- and downstream of Corumana Dam, Kruger National Park and Mozambique (November 2015 to January 2016).
- **EcoGain** Wetland and Impact assessment associated with the proposed Opencast Mining Operation, Delmas (October 2015 to present).
- **Envirolutions** Water quality Assessment, Broadacres Retirement Village, Broadacres Gauteng Province (November 2015).
- **ERM, Ncondezi Coal Mine**, Freshwater Ecology baseline study and Desktop Environmental Flow Assessment, Tete, Mozambique (November 2014 – May 2015).
- Hydrological Alteration-Aquatic Ecology Assessment-**New Largo** (July 2010 - Present).
- **Goliath Gold** Aquatic and impact assessment associated with the proposed de-water of a mine shaft, Heidelberg, Gauteng (January – May 2015).
- **Zambezi River Authority**, Kariba Dam wall upgrade, Freshwater Ecology baseline, impact assessment and Environmental Flow Assessment, Zambia/Zimbabwe (October 2014 - March 2015)
- **Dyambyini, Majuba Power Station**, Wetland Specialist Assessment (December - January 2015).
- **Doogvallei Rail Siding Company (Pty) Ltd**, Aquatic Biomonitoring Assessment of associated drainage lines, Carolina Mpumalanga (September 2012 – January 2015).
- **Pembani Coal**: Aquatic Biomonitoring Assessment, Carolina (March 2012 –January 2015).
- **Kumba Iron Ore**, Wetland and River study for WULa, Thabazimbi, Limpopo (December 2014).

- **FFMES, Cominco Phosphate Mine**, Hinda Project Freshwater Baseline Study and critical habitat assessment, Republic of Congo (March to August 2014).
- **Lidwala**, Majuba Wetland Rehabilitation Proposal, Wetland Specialist Assessment (March-July 2014).
- **Imperata**, NKP Terminal 2, Wetland Monitoring Assessment (June – July 2014).
- **Jeffars and Green,** Thabong Interchange, Wetland Rehabilitation Plan (June 2014).
- **Envirobility**, Sand Quarry, Diepsloot, Wetland Specialist Assessment (March 2014 – May 2014).
- **Lidwala**, **Majuba** Wetland Assessment Augmentation, Wetland Specialist Assessment (April 2014).
- **WSP, Kathu CSP Project**, Northern Cape, Wetland Specialist Assessment (January 2014 – April 2014).
- **ERM, Mulungushi Hydropower Project,** Aquatic Specialist (February, 2013).
- **ERM**, **Muchinga Hydropower Stations**, Aquatic Specialist, Zambia (April, 2013).
- **FFMES**, **Exxaro DMC Iron Congo Project**, Aquatic specialist study, Mayoko, Republic of Congo (September 2012).
- **ERM**, Sasol Twistdraai Export Plant, Wetland Specialist Assessment (November 2013 – May 2014).
- **GladAfrica, Centurion Lake Sediment Trap**, Aquatic Specialist Study, Gauteng, South Africa (November, 2012).
- **MSA, Meyerton Waste Water Treatment Works Upgrade**, Aquatic Specialist Study, Gauteng, South Africa (November 2012).
- **Eskom Majuba Ash Disposal Facility**, Wetland Specialist Study for the Scoping/EIA, Mpumalanga, South Africa (September, 2012).
- **Eskom Tutuka Ash Disposal Facility**, Wetland Specialist Study for the EIA, Mpumalanga, South Africa (September, 2012).
- **FFMES, Sintoukola Project**, Aquatic specialist study, Republic of Congo (May 2012; July 2012).
- **Coffey Environments, Tete Iron Project**, Aquatic specialist study of the Revuboe River, Chiúta and Moatize districts, Tete, Mozambique (March 2012).
- **Shanduka Coal**, wetland and impact assessment for a proposed 400kV line relocation, Middleburg, Mpumalanga (April, 2012).
- **Worldwide Coal Carolina**, aquatic biomonitoring assessment, Carolina, Mpumalanga (March, 2012).
- **Homeland Mining and Energy SA**, proposed Eloff Opencast Mine, specialist wetland assessment (± 1400 ha) just outside the town of Delmas, Mpumalanga (February, 2012).
- **Exxaro MagVanTi Project** -Aquatic Ecology Baseline Study, Limpopo (January, 2012).
- **Shanduka Coal**, wetland and impact assessment of a pan located in the Graspan Colliery, Middleburg, Mpumalanga (January, 2012).
- **African Barrick Gold North Mata Mine** - Aquatic Consultant: Ecotoxicological risk assessment for discharge of treated waste water into the Mara River, North Mara, Tanzania (August, 2011).
- **Moamba Dam Project, Moamba, Mozambique,** Aquatic Consultant- Impacto: Aquatic ecology assessment for proposed (July, 2011).
- Fresh water Ecology **scoping study-Hendrina-Mpumalanga**(May 2011)
- Aquatic Biomonitoring Assessment-Blesbokspruit- **Hydro Testing** (May 2011)
- Aquatic Consultant- Lidwala environmental and engineering consultants: Sanral N14 river/stream crossing aquatic assessment (May 2011).
- Aquatic Consultant- Randwater: Proposed water and treated water residue pipeline near **Lethabo power station** in Vereeniging (May 2011).
- Aquatic Consultant- Anglo Coal: Assessment on non-perennial drainage lines associated with proposed coal mining development near All days in Limpopo (May, 2011).

- Hydro Testing Biomonitoring(KP290+100**) KwaZulu-Natal- Aquatic Ecology Assessment** (Febuary 2011)
- Aquatic Consultant- Riversdale: Aquatic specialists on the **Benga Coal Project**, Tete, Mozambique (January, 2011).
- Aquatic Consultant- Transnet: Aquatic biomonitoring - **Ladysmith pump station oil spill**, Ladysmith, Natal (January, 2011).
- Aquatic Consultant – Imperata – Aquatic assessment for a proposed **Rand Water pipeline** crossing over the Pienaars River near Pretoria (May, 2010).
- Aquatic Consultant – Ekoinfo – Aquatic assessment for a **NuCoal mine** (Vuna colliery) near Middelburg Mpumalanga (March 2010- Current)
- Aquatic Consultant – EcoAgent – A MSA project – Detailed Aquatic assessment for the propped **Veremo Magnetite mine** in the Eastern Bushveld near Stofberg Mpumalanga (May 2010)
- Aquatic Consultant – New Multi Purpose Pipeline (NMPP) a combined Transnet, **Group Five and Spiecapag project** –Aquatic assessment and monitoring of associated river crossings in the Upper Vaal, Thukela and Mvoti Water Management Areas (Ocktober 2009- Current).
- Aquatic Consultant – **Intergraded Landscape Architects** – Raslouw Riparian delineation and aquatic assessment, Johannesburg (November 2009).
- Aquatic Consultant – Ekoinfo – **Klipriviersberg** Full Aquatic assessment (January. 2009)
- Aquatic Consultant – Ekoinfo – **Lonmin** Aquatic biodiversity assessment (January 2009).
- Aquatic Consultant – NSS– Optimum **Coal Fish** diversity assessment (March 2009)
- Aquatic Consultant –NSS – **Rio Tinto Chapudi** proposed coal mine diversity assessment (March 2009).
- Aquatic Consultant – **Lonmin platinum**- aquatic biodiversity assessment and action plan (January, 2009).
- Aquatic Consultant – **SASOL** – aquatic ecosystem impact assessment for proposed pipeline development (January 2009).
- Aquatic Consultant – Arcus Gibb - Aquatic biodiversity assessment for proposed coal **Eskom Mulilo coal mining development** (December 2008).
- Aquatic Consultant – **ESKOM** - Biomonitoring for proposed **Majuba railroad construction** for Eskom (October 2008- current).

Feb 07 – Jan 08 **EnviRoss Environmental Scientific Consultants Cc**
Consultant

- Junior Scientist – Enviross cc - Aquatic macro-invertebrate biodiversity study for proposed feedlot **Mpumalanga** 2007. (November 2007)
- Junior Scientist – Enviross cc - **Tshwane** sewerage works bio-monitoring. (September 2007).
- Junior Scientist – Econ@uj - Ecological state of five estuaries in the **Wild coast** for proposed heavy mineral mining (October 2007).
- Aquatic Consultant – Ekoinfo - Aquatic ecological assessment for proposed golf course development in **North West province for Sun City** (August 2007).
- Junior Scientist – Enviross cc - Firgrove industrial development in **Somerset West** 2007 (July 2007) 2007.
- Junior Scientist – Enviross cc - Aquatic health determination and eco-classification for **ANGLO coal** (Mpumalanga) in 2007 (2007).
- Junior Scientist – Econ@uj - Aquatic health determination and eco-classification for **TOTAL coal** in 2006 (May 2006).
- Junior Scientist – Econ@uj - Aquatic health and fish diversity assessment at **Klipplaat nature reserve**, 2006 (September 2006).

- Technical Assistant - **University of Johannesburg Zoology department** - Aquatic health and biodiversity of the **Crocodile West Marico and Magaliesburg system**, 2007 (February 2007).
- Technical Assistant – Enviross cc - **Owl surveys** (March 2007).
- Project Manager - University of Johannesburg Zoology department - Aquatic health and biodiversity of **lake Chrissie in Mpumalanga**, 2007 (April 2007)
- Technical Assistant - University of Johannesburg Zoology department - PhD study regarding effects of pesticides on the freshwater aquatic health in the **Levubu River in Venda (Limpopo Province)** (February 2008)
- Researcher - University of Johannesburg Zoology department - Presented poster at Zoological society South Africa (ZSSA) in July 2007: Abiotic factors influencing invertebrate community structures in pan and dams in the **Mpumalanga highveld area** (June 2007)

Workshops and Courses

2011 **Tools for Wetland Assessment Short Course**
Department of Environmental Science Rhodes University;
Grahamstown Port Elizabeth

2009 **Environmental Management Systems –WTH Management and Training**
ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg

2008 **Wetland and Riparian Delineation Course**
Accredited wetland delineator
Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF)
Pretoria, South Africa.

2008 **Skippers Course**
License Holder of a Category "R" skippers license

2007 **SASS5 Accredited Practitioner**
Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux
(North West Nature Conservation).

2007 **Multivariate Statistics Training**
Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam

2006 **Advanced 4x4 driving course**

Societies and Accreditations

2009 **The South African Council for Natural Scientific Professions (SACNASP)**
Professional Natural Scientist
Pr. Sci. Nat. (Aquatic Health, Zoological & Ecological Sciences)
Registration number: 400275/12

2009 **Member of the International Association of Impact Assessment-SA (IAIA SA).**

2006 Member of the Zoological Society of Southern Africa (ZSSA)

2006 Member of the Southern African Society of Aquatic Scientists (SASAqS)

Presentations

Jun 2010 **South African Society of Aquatic Scientists (SASAqS) Congress**
MN Jonker, G. Walsh & JHJ van Vuren
Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.

Oct 2009 **Department of Geography and Energy studies, University of Johannesburg**
MN Jonker, M Sherwood and R Rowles. 2009.
Historical overview of water quality associated with the Blesbokspruit RAMSAR site. Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).

Jul 2007 **Zoological Society of Southern Africa Conference, Potchefstroom.**
MN Jonker
Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.

Publications

1. Van der Zee, J., Walsh., G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occuring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa.*

2. Walsh, G., Jonker. M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noumbi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.
Checklist Journal **10 (4):** 900 - 912.

3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3).**

4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

I, Michiel Jonker, do hereby declare that all the information furnished above is true to the best of my knowledge.

Michiel Jonker
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SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Mr Michiel Nell Jonker
Registration number: 400275/12

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Zoological Science	**15 August 2012**
Ecological Science	**19 September 2012**
Aquatic Science	**30 January 2013**

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SOUTH AFRICAN POLICE SERVICES

CHANGE WAS NOT MADE TO THE ORIGINAL DOCUMENT.

HANDTEKENING/SIGNATURE

RANG/RANK

15 August 2012

Pretoria

President

Executive Director

Appendix B:

Impact Rating Methodology

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 8**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 8. Example of the significance impact rating table

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		

This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on		

the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.** The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

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Appendix 6D

Soils and Agricultural Potential Assessment

Johann Lanz
Soil Scientist (Pri.Sci.Nat.)
Reg. no. 400268/12

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AGRICULTURAL AND SOILS IMPACT ASSESSMENT FOR PROPOSED CONSTRUCTION OF THE !XHA BOOM SUBSTATIONS AND ASSOCIATED 132kV POWER LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

BASIC ASSESSMENT REPORT

Report by
Johann Lanz

18 July 2017

Johann Lanz
Professional profile

Education

• M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1997
• B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
• BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
• Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

- **Soil Science Consultant** **Self employed** **2002 - present**
  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:
- Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
- Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.
- I have conducted several recent research projects focused on conservation farming, soil health and carbon sequestration.
- I have project managed the development of soil nutrition software for Farmsecure Agri Science.

- **Soil Science Consultant** **Agricultural Consultors International (Tinie du Preez)** **1998 - end 2001**
  Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

- **Contracting Soil Scientist** **De Beers Namaqualand Mines** **July 1997 - Jan 1998**
  Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

Specialist Declaration

I, Johann Lanz, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company: Johann Lanz – Soil Scientist

Professional Registration (including number): SACNASP Reg. no. 400268/12

Date: 18 July 2017

EXECUTIVE SUMMARY

The proposed development is on land zoned and used for agriculture (grazing). South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed development is on land which is of extremely low agricultural potential, and which is only suitable as grazing land.

The key findings of this study are:

- Soils across the study area are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate, of the Coega, Mispah, Glenrosa and Askham soil forms.
- The major limitations to agriculture are the extremely limited climatic moisture availability and the poor soils.
- As a result of these limitations, the study area is unsuitable for cultivation and agricultural land use is limited to low intensity grazing.
- The land capability is classified as Class 7 - non-arable, low potential grazing land. The study area has a very low grazing capacity of 45 hectares per large stock unit.
- There are no agriculturally sensitive areas and no parts of the study area need to be avoided by the development.
- The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance of the development is very small in relation to the available grazing land. The second is the fact that the proposed study area is on land of extremely limited agricultural potential that is only viable for low intensity grazing.
- Six potential negative impacts of the development on agricultural resources and productivity were identified as:
    - Loss of agricultural land use caused by direct occupation of land by the development's footprint of disturbance.
    - Soil Erosion caused by alteration of the surface characteristics.
    - Generation of dust caused by alteration of the surface characteristics.
    - Loss of topsoil in disturbed areas, causing a decline in soil fertility.
    - Degradation of surrounding grazing land due to vehicle trampling.
    - Soil contamination from hydrocarbon spills during construction.
- All impacts were assessed as having low significance.
- The following mitigation measures were recommended:
    - Implement an effective system of storm water run-off control;
    - Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas;
    - Control dust through appropriate dust suppression methods;
    - Strip and stockpile topsoil before disturbance and re-spread it on the surface as soon as possible after disturbance;
    - Manage any sub-surface spoils from excavations in such a manner that they will not bury the topsoil of agricultural land;
    - Minimise road footprint and control vehicle access on designated roads only; and

- Implement effective spillage and waste management system.

- Because of the low agricultural potential, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development.
- Cumulative impact is also assessed as low. Furthermore it is preferable to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.
- There are no conditions resulting from this assessment that need to be included in the environmental authorisation.
- There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts.

Table of Contents

1 INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd are proposing to construct electricity grid infrastructure aimed at feeding electricity generated by Mainstream's proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include:

- Construction of 1 x 33kV/132kV substation (500m x 300m)
- Construction of 1 x 132kV linking substation (600m x 600m)
- Construction of 1 x 132kV power line from the proposed substation, via the proposed linking Substation to Helios substation, approximately 35km south-east of the proposed Xha! Boom Wind Farm (31m wide servitude within a power line corridor of between 100m and 500m wide to allow flexibility when determining the final route alignment).

It should be noted that two alternative sites for the proposed on-site Xha! Boom Substation and the proposed Linking Substation have been assessed during this Basic Assessment (BA), in conjunction with four power line corridor alternatives (see figure 1).

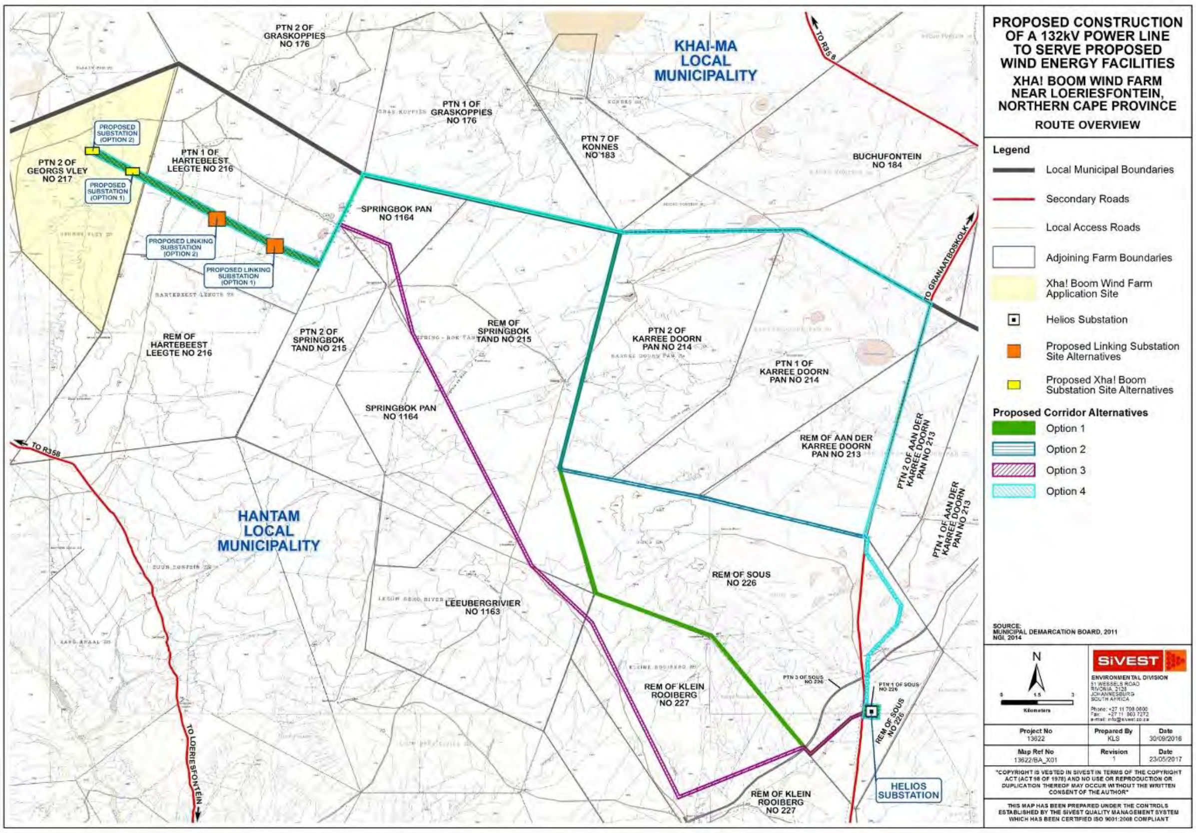

Figure 1. Site locality map.

2 TERMS OF REFERENCE

The terms of reference for the study fulfills the requirements for a soils and agricultural study as described in the National Department of Agriculture's document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011. The study applies an appropriate level of detail for the agricultural suitability and soil variation on site, which, because it is justified (see section 3.1), is less than the standardised level of detail stipulated in the above regulations.

The above requirements may be summarised as:

- Identify and assess all potential impacts (direct, indirect and cumulative) of the proposed development on soils and agricultural potential.
- Describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the study area.
- Describe the climate in terms of agricultural suitability.
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Describe the erosion, vegetation and degradation status of the land.
- Determine the agricultural potential across the study area.
- Determine the agricultural sensitivity to development across the study area.
- Provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

The report also fulfils the requirements of Appendix 6 of the 2014 EIA Regulations as amended in 2017 (See Table 1).

Table 1. Compliance with the Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
• A specialist report prepared in terms of these Regulations must contain ◦ details of- ▪ the specialist who prepared the report; and ▪ the expertise of that specialist to compile a specialist report including a curriculum vita;	Title page CV within report
◦ a declaration that the specialist is independent in a form as may be specified by the competent authority;	At beginning of report
◦ an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 and 2
◦ an indication of the quality and age of base data used for the specialist report;	Section 3.1
◦ a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable	Section 6.6 and 7.3

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
change	
◦ the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.1
◦ a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
◦ details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6.8 and Figure 3
◦ an identification of any areas to be avoided, including buffers;	Section 6.8
◦ a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3
◦ a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
◦ a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section 7 and 8
◦ any mitigation measures for inclusion in the EMPr;	Section 7
◦ any conditions for inclusion in the environmental authorisation;	Section 8
◦ any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
◦ a reasoned opinion- ▪ as to whether the proposed activity or portions thereof should be authorised; ▪ regarding the acceptability of the proposed activity or activities; and ▪ if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 8 Section 8 Section 7
◦ a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3.1
◦ a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
◦ any other information requested by the competent authority.	Not applicable

3 METHODOLOGY OF STUDY

3.1 Methodology for assessing soils and agricultural potential

The assessment was based largely on existing soil and agricultural potential data for the study area. The source of this data was the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, undated). Soil data on AGIS originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years. Satellite imagery of the study area available on Google Earth was also used for evaluation.

The AGIS data was supplemented by a field investigation. This was aimed at ground-proofing the AGIS data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the study area. The field investigation involved a drive and walk over of the study area using assessment of surface conditions and existing excavations and burrows. The field assessment was done on 2 November 2016 for the duration of one day.

Soils were classified according to the South African soil classification system (Soil Classification Working Group, 1991).

It is my opinion that the level of soil mapping detail in the above DAFF requirements (see Section 2) is appropriate for arable land only. It is not appropriate for this study area. Detailed soil mapping has little relevance to an assessment of agricultural potential in this environment, where the agricultural limitations are overwhelmingly climatic, soil conditions are generally poor, and cultivation potential is non-existent. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. Conducting a soil assessment at the stipulated level of detail would be very time consuming and be a waste of that time, as it would add no value to the assessment. The level of soil assessment that was conducted for this report (reconnaissance ground proofing of land type data) is considered more than adequate for a thorough assessment of all agricultural impacts.

An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and therefore the fact that the assessment was done in summer has no bearing on its results.

The field investigation also included a visual assessment of erosion and erosion potential in the study area, taking into account the potential development layout.

Telephonic consultation was done with the proposed wind farm land owner, Mr Hein Burden to get details of farming activities in the study area.

3.2 Methodology for determining impact significance

All potential impacts were assessed in terms of the following criteria:

GEOGRAPHICAL EXTENT This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all

		resources.
DURATION This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.

2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate

		positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

4 ASSUMPTIONS, CONSTRAINTS AND LIMITATIONS OF STUDY

The field investigation for this assessment is considered more than adequate for the purposes of this study (see section 3.1) and is therefore not seen as a limitation.

The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

The study makes the assumption that water for irrigation is not available across the study area. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.

There are no other specific constraints, uncertainties and gaps in knowledge for this study.

5 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Agricultural consent is required for power line servitudes if Eskom is not the applicant. However if they are the applicant, Eskom is currently exempt from agricultural consent for power line servitudes. The registration of a servitude needs to be done per farm portion.

6 BASELINE ASSESSMENT OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 2 of this report.

All the background data on soils and agricultural potential in this report has been obtained from the online Agricultural Geo-Referenced Information System (AGIS), produced by the

Institute of Soil, Climate and Water (Agricultural Research Council, undated).

A satellite image of the study area showing the layout alternatives overlaid on land types is given in Figure 3. Photographs of site conditions are given in Figures 4 to 6.

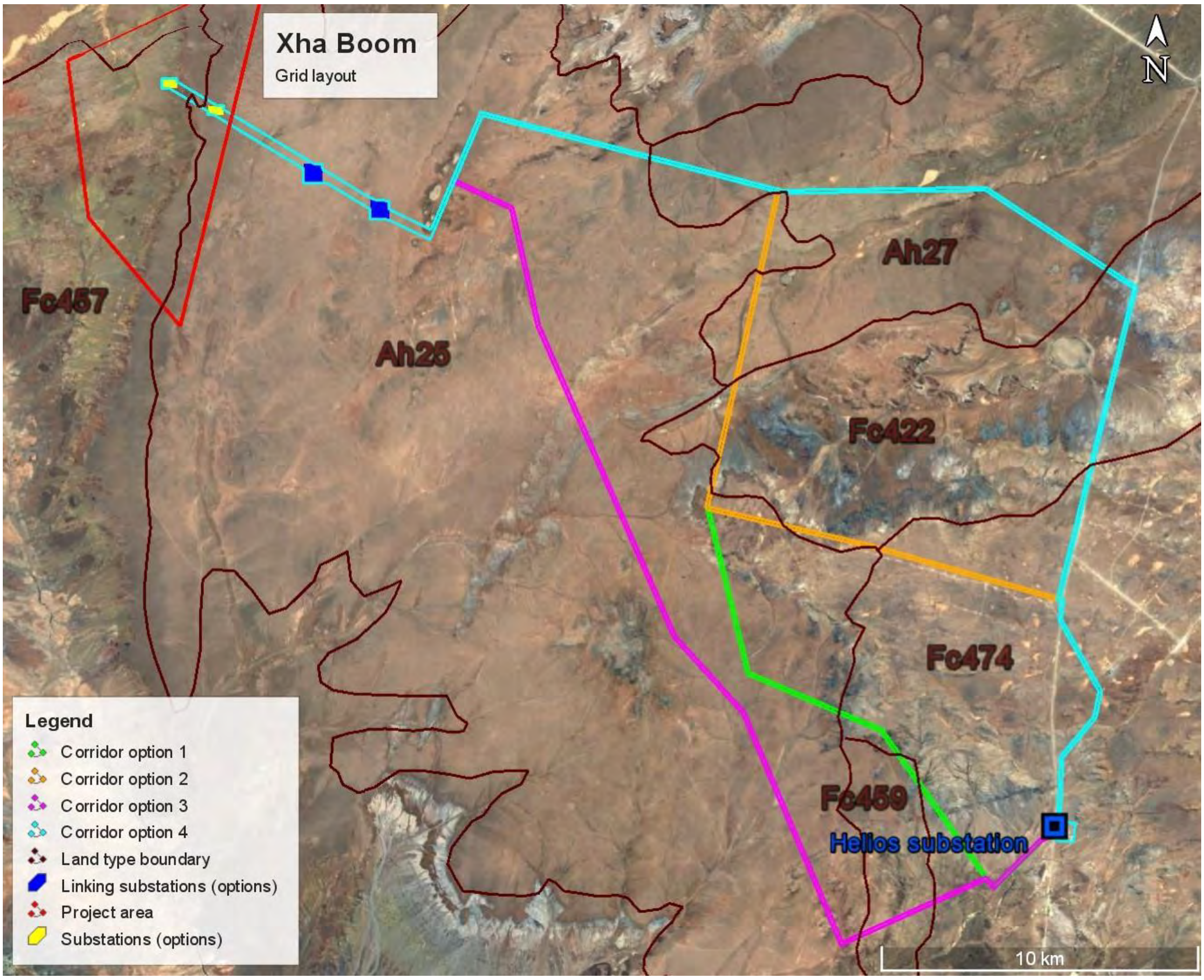

Figure 3. *A satellite image of the study area showing the layout alternatives overlaid on land types.*

6.1 Climate and water availability

Rainfall for the study area is given as a very low 130 mm per annum (The World Bank Climate Change Knowledge Portal, undated). The average monthly distribution of rainfall is shown in Figure 2. One of the most important climate parameters for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. This parameter largely controls what rain fed agriculture (including grazing) is possible within a given environment. Moisture availability is classified into 6 categories across the country (see Table 2). The study area falls into the driest 6th category, which is labelled as a very severe limitation to agriculture.

There are wind pumps with stock watering points in several places across the study area. Water for irrigation is not available across the study area. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.

Table 2. The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

Climate class	Moisture availability (Rainfall/0.25 PET)	Description of agricultural limitation
C1	>34	None to slight
C2	27-34	Slight
C3	19-26	Moderate
C4	12-18	Moderate to severe
C5	6-12	Severe
C6	<6	Very severe

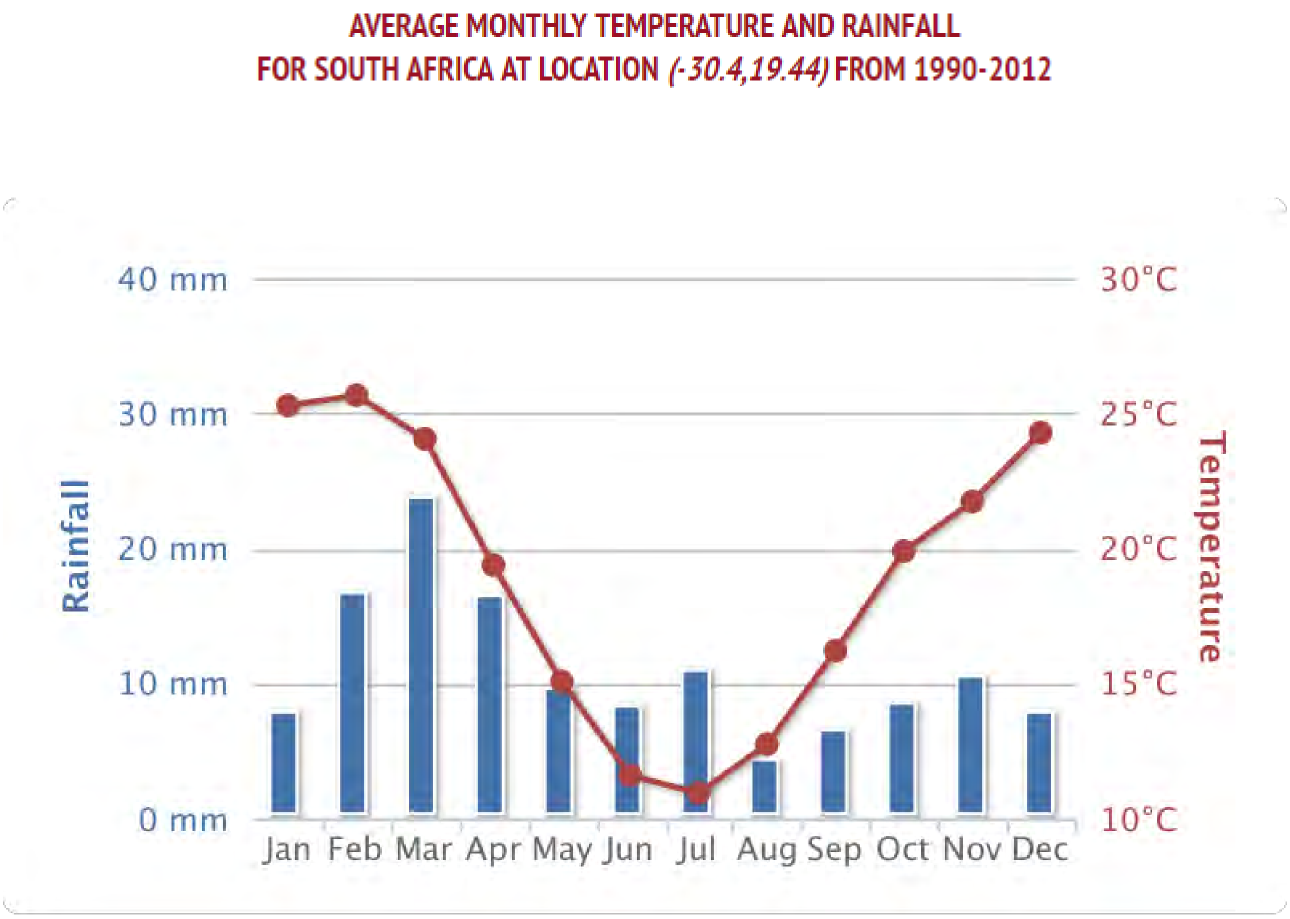

Figure 2. *Average monthly temperature and rainfall for the study area (The World Bank Climate Change Knowledge Portal, undated).*

6.2 Terrain, topography and drainage

The proposed grid infrastructure is located on a terrain unit of plains with some relief at an altitude of between 860 and 940 metres. Slopes across the study area are almost entirely less than 2% but may be greater in a few isolated spots.

The underlying geology is shale of the Ecca and Dwyka Groups of the Karoo Supergroup with tillite of the Dwyka Group and dolerite intrusions.

No perennial drainage features occur on the study area. There are some very indistinct, intermittent drainage lines that may flow temporarily after heavy rains. There are several salt pans and other pan features in the study area.

6.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There are six land types across the study area (see Figure 3). Soils on these land types are similar and are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. The soils would fall into the Lithic and Calcic soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in the Appendix in Table A1. The field investigation confirmed the occurrence of shallow, sandy soils on underlying rock or hard-pan carbonate across the entire study area. The predominant soil forms are Coega, Mispah, Glenrosa and Askham.

Figure 4. *Photograph showing typical landscape and veld conditions on the site.*


Figure 5. *Photograph showing typical landscape and veld conditions on the site.*


Figure 6. *Photograph showing site conditions with example of dolerite outcrops that occur on study area.*

6.4 Agricultural capability

Land capability is defined as the combination of soil suitability and climate factors. The area has a land capability classification, according to the 8 category scale of Class 7 which is non-arable, low potential grazing land. The limitations to agriculture are the extreme aridity and lack of access to water as well as the predominantly shallow, rocky soils. Due to these constraints, agricultural land use is restricted to low intensity grazing only. The natural grazing capacity is given on AGIS as very low, at 45 hectares per animal unit. This is amongst the lowest grazing capacity areas in the country.

6.5 Land use and development on and surrounding the study area

The farm is located in a sheep farming agricultural region, and grazing (sheep and some cattle) is the only agricultural land use on the study area and surrounds. There is no agricultural infrastructure in the study area, apart from fencing into camps and wind pumps with stock watering points.

6.6 Status of the land

The vegetation classification for the study area is Western Bushmanland Klipveld and Bushmanland Basin Shrubland. The vegetation is grazed and very sparse due to a number of years of low rainfall. Natural surface erosion, typical of sparsely vegetated, arid environments, is active but there is no evidence of excessive, accelerated erosion, or other land degradation. The land is classified as having a low to moderate water erosion hazard (class 5), and it is classified as susceptible to wind erosion (class 2b) because sands, as a soil textural class, are dominant.

6.7 Possible land use options for the study area

Due to the extreme aridity constraints as well as the poor soils, agricultural land use is restricted to low intensity grazing only.

6.8 Agricultural sensitivity

Agricultural potential and conditions are very uniform across the study area and the choice of placement of facility infrastructure, including access roads, and transmission lines therefore has minimal influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the study area. From an agricultural point of view, no parts of the study area need to be avoided by the development and there are no required buffers.

7 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

The components of the project that can impact on soils, agricultural resources and productivity are:

- Occupation of the site by the footprint of the facility; and

- Construction activities that disturb the soil profile and vegetation, for example for excavations.

The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance of the electricity grid infrastructure is very small in relation to the available grazing land on the effected farm portions, and all agricultural activities in the study area can continue unaffected under power lines. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing. These factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

From an agricultural impact perspective, land on this study area is ideally suited to renewable energy development because of its very limited production potential. It is agriculturally strategic from a national perspective to steer as much of the country's renewable energy development as possible to such land.

The following are identified as potential impacts of the development on agricultural resources and productivity, and are assessed in table format.

7.1 Impacts associated with all phases of the development - construction, operational, and decommissioning

Environmental parameter: agricultural land (grazing)		
Impact 1: Loss of agricultural land use, caused by direct occupation of land by footprint of development infrastructure and having the effect of taking affected portions of land out of agricultural production (grazing). This applies only to the direct footprint of the development which comprises pylon bases and substations. This represents only an insignificant proportion of the land surface area. During the construction phase there is somewhat more disturbance due to construction activities.		
	Pre-mitigation	**Post-mitigation**
Extent	1 Site	n/a
Probability	4 Definite	n/a
Reversibility	2 Partly reversible	n/a
Irreplaceable loss	2 Marginal	n/a
Duration	3 Long term	n/a
Cumulative effect	1 Negligible	n/a
Intensity	1 Low	n/a
Significance	13 Low negative	n/a
Mitigation measures: none possible		

Environmental parameter: soil		
Impact 2: Erosion due to alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, and the establishment of roads. Erosion will cause loss and deterioration of soil resources. Risk of water erosion is low, but the area is susceptible to wind erosion. Electricity grid infrastructure has a low surface disturbance impact and therefore little erosion impact is expected.		
	Pre-mitigation	**Post-mitigation**
Extent	1 Site	1 Site
Probability	2 Possible	1 Unlikely
Reversibility	2 Partly reversible	2 Partly reversible
Irreplaceable loss	2 Marginal	2 Marginal
Duration	3 Long term	3 Long term
Cumulative effect	1 Negligible	1 Negligible
Intensity	1 Low	1 Low
Significance	11 Low negative	10 Low negative
Mitigation measures: • Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion from occurring there. This should be in place and maintained during all phases of the development. • Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.		

7.2 Impacts associated only with the construction phase of the development

Environmental parameter: soil		
Impact 3: Loss of topsoil caused by poor topsoil management (burial, erosion, etc.) during construction related soil profile disturbance (excavations, disposal of spoils from excavations etc.) and having the effect of loss of soil fertility on disturbed areas after rehabilitation. The very low proportion of surface area that is likely to be impacted, reduces the significance of this impact.		
	Pre-mitigation	Post-mitigation
Extent	1 Site	1 Site
Probability	2 Possible	1 Unlikely

Reversibility	2 Partly reversible	2 Partly reversible
Irreplaceable loss	2 Marginal	2 Marginal
Duration	3 Long term	3 Long term
Cumulative effect	1 Negligible	1 Negligible
Intensity	1 Low	1 Low
Significance	11 Low negative	10 Low negative
Mitigation measures: If an activity will mechanically disturb below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Erosion must be controlled where necessary on topsoiled areas.		

Environmental parameter: veld vegetation (grazing)		
Impact 4: Degradation of veld vegetation beyond the direct development footprint caused by trampling due to vehicle passage, and deposition of dust.		
	Pre-mitigation	Post-mitigation
Extent	1 Site	1 Site
Probability	2 Possible	1 Unlikely
Reversibility	2 Partly reversible	2 Partly reversible
Irreplaceable loss	2 Marginal	2 Marginal
Duration	2 Medium term	2 Medium term
Cumulative effect	1 Negligible	1 Negligible
Intensity	1 Low	1 Low
Significance	10 Low negative	9 Low negative
Mitigation measures: 1. Minimize road footprint and control vehicle access on approved roads only. 2. Control dust as per standard construction site practice.		

Environmental parameter: air quality
Impact 5: Dust generation is likely to result from disturbance of surface and surface

vegetation cover, and consequent exposure to wind erosion. Dust has a negative impact on surrounding veld vegetation, animals and humans. Electricity grid infrastructure has a low surface disturbance impact and therefore little dust impact is expected.		
	Pre-mitigation	Post-mitigation
Extent	1 Site	1 Site
Probability	2 Possible	1 Unlikely
Reversibility	2 Partly reversible	2 Partly reversible
Irreplaceable loss	2 Marginal	2 Marginal
Duration	2 Medium term	2 Medium term
Cumulative effect	1 Negligible	1 Negligible
Intensity	1 Low	1 Low
Significance	10 Low negative	9 Low negative
Mitigation measures: Control dust as per standard construction site measures which may include damping down with water or other appropriate and effective dust control measures. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site.		

Environmental parameter: soil		
Impact 6: Soil contamination can occur from hydrocarbon spillages from construction activities. The very low proportion of surface area that is likely to be impacted and its low consequence for farming activities, reduces the significance of this impact.		
	Pre-mitigation	Post-mitigation
Extent	1 Site	1 Site
Probability	2 Possible	1 Unlikely
Reversibility	2 Partly reversible	2 Partly reversible
Irreplaceable loss	2 Marginal	2 Marginal
Duration	2 Medium term	2 Medium term
Cumulative effect	1 Negligible	1 Negligible
Intensity	1 Low	1 Low
Significance	10 Low negative	9 Low negative
Mitigation measures: Implement effective spillage and waste management system.		

7.3 Cumulative impact

Cumulative impact has been assessed by reviewing the available soil and agriculture specialist reports for all renewable energy developments within 30km of this development. These are shown in figure 7 and Table 3. Of those included in Table 3, only the specialist report for Hantam PV Solar Energy Facility was not available for review. In none of the reviewed reports were there any relevant, additional specialist recommendations or mitigation measures to the ones already included in this report. The conclusion of all reports was that the agricultural impact was of low significance.

The potentially most significant cumulative impact is the loss of agricultural land. However, the impact is low because of the small surface area of impact and the extremely limited agricultural potential of all land in the area, predominantly as a result of climatic limitations, and the fact that there is no particular scarcity of such land in South Africa.

Furthermore it is preferable to incur a cumulative loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development, elsewhere in the country.

The cumulative impact is assessed in detail in table form below.

Environmental parameter: agricultural land (grazing)		
Cumulative Impact: Loss of agricultural land use, caused by direct occupation of land by footprint of the development infrastructure of all renewable energy developments in the surrounding area. This applies to the direct footprint of the developments which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure, including panel areas in the case of PV. This represents only a small proportion of the land surface area.		
	Pre-mitigation	**Post-mitigation**
Extent	2 Local / district	n/a
Probability	4 Definite	n/a
Reversibility	2 Partly reversible	n/a
Irreplaceable loss	2 Marginal	n/a
Duration	3 Long term	n/a
Cumulative effect	2 Low	n/a
Intensity	1 Low	n/a
Significance	15 Low negative	n/a
Mitigation measures: none possible		

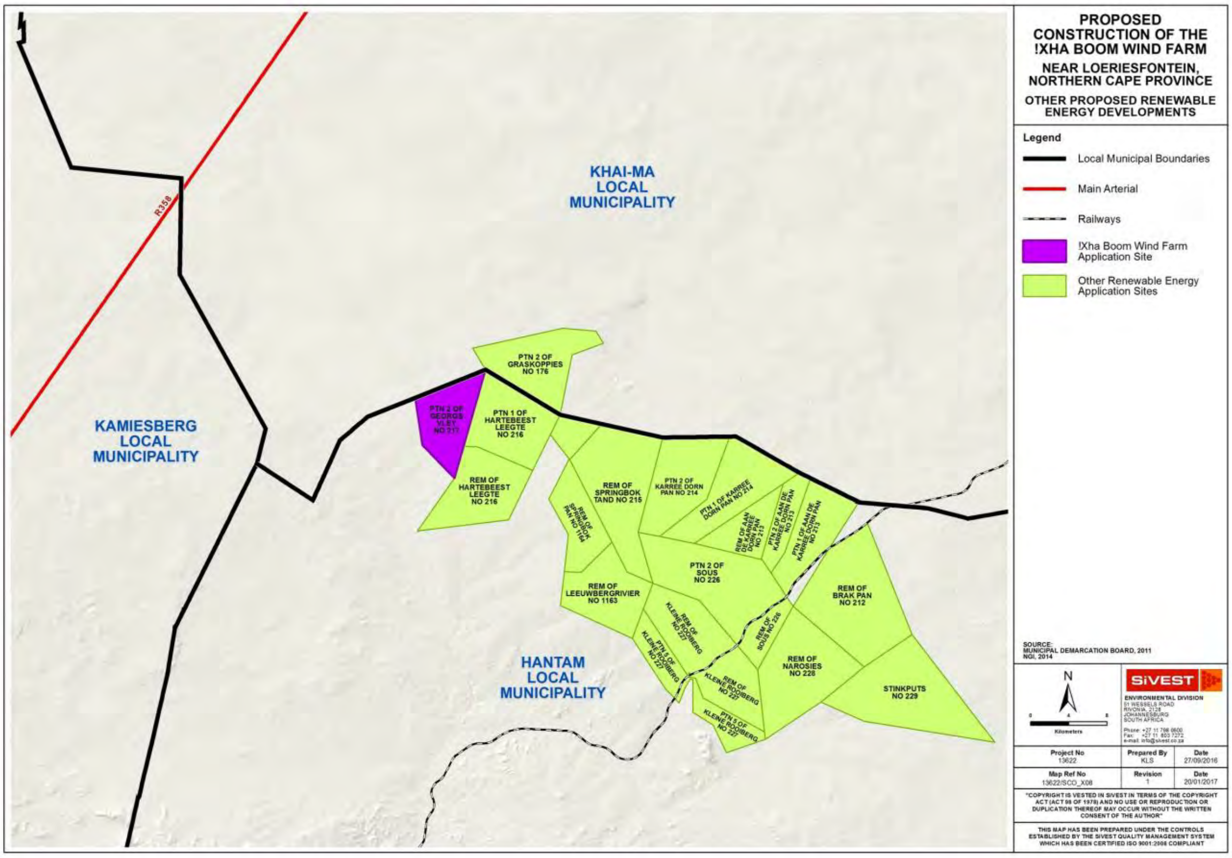

Figure 7. *Map showing all proposed renewable energy developments in proximity to the development considered in this report.*

Table 3. Detail of all proposed renewable energy developments in proximity to the development considered in this report.

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216
Xha! Boom Wind	EIA ongoing	Mainstream	140MW	Portion 2 of

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Farm		Renewable Power		Georg's Vley No 217
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Aan De Karree Doorn Pan No. 213; • Portion 1 of the Farm Karree Doorn Pan No. 214; and • Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

7.4 Comparative assessment of alternatives

The project alternatives being considered at this stage are two alternative locations for the substation; two alternative locations for the linking substation; and four alternatives for the power line route. There are no meaningful differences in terms of agricultural impact between any of these proposed alternatives. Alternatives could be ranked, as an academic exercise, but it has no real meaning, and it is therefore considered more accurate to assess all alternatives as having no preference between them. This is due to the very low agricultural impacts associated with the development, and the fact that agricultural conditions are largely uniform across the area. There is therefore no preference between any of the proposed alternatives, in terms of agricultural impacts. The comparative assessment of these alternatives is tabled below.

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	NO PREFERENCE	Impact is low with no significant differences between the locations
On-site Substation Option 2	NO PREFERENCE	Impact is low with no significant differences between the locations
Linking Substation Option 1	NO PREFERENCE	Impact is low with no significant differences between the locations
Linking Substation Option 2	NO PREFERENCE	Impact is low with no significant differences between the locations
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	NO PREFERENCE	Impact is low with no significant differences between the locations
Grid Line Option 2	NO PREFERENCE	Impact is low with no significant differences between the locations
Grid Line Option 3	NO PREFERENCE	Impact is low with no significant differences between the locations
Grid Line Option 4	NO PREFERENCE	Impact is low with no significant differences between the locations

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

The no-go alternative anticipates changes to the agricultural environment that would occur in the absence of the proposed development. Potential such changes are that due to continued low rainfall in the area in addition to other economic and market pressures on farming, the agricultural enterprises will be under increased pressure in terms of economic viability.

There is no preference in terms of agricultural impact between the electricity grid infrastructure development and the no-go alternative. However because the electricity grid infrastructure is intimately connected to the wind farm development, with its positive economic impacts on agriculture, the wind farm development is the preferred alternative over the no-go.

8 CONCLUSIONS

The proposed electricity grid infrastructure is located on land zoned and used for agriculture (grazing). South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of potentially arable land. The assessment has found that the footprint of disturbance of the development will only impact agricultural land which is of extremely low agricultural potential and is unsuitable for cultivation.

The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance of the electricity grid infrastructure is very small in relation to the available grazing land on the effected farm portions, and all agricultural activities in the study area can continue unaffected under power lines. The second is the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing. These factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

There are no agriculturally sensitive areas that need to be avoided by the development. There are no conditions resulting from this assessment that need to be included in the environmental authorisation.

Because of the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which should preclude authorisation of the proposed development.

There is no difference and therefore no preference between the proposed alternatives, in terms of agricultural impacts. The identified agricultural impacts are loss of agricultural land use; soil erosion; generation of dust; loss of topsoil; degradation of grazing; and hydrocarbon contamination.

No additional investigation of agricultural issues is required for the Environmental Impact Assessment of the proposed development.

9 REFERENCES

Agricultural Research Council. Undated. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at http://sdwebx.worldbank.org/climateportal/

APPENDIX 1: SOIL DATA

Table A1. Land type soil data for the study area.

Land type	Land capability class	Soil series (forms)	Depth (cm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Fc457	7	Clovelly	20-40	4-10	6-15	ca, R	27
		Mispah	5-15	3-8		ca, R	21
		Glenrosa	20-40	15-25	20-35	ca, R	18
		Glenrosa	15-30	6-10	10-15	ca, R	11
		Oakleaf / Dundee	70-100	6-10	10-15	ca, cs	9
		Swartland	15-40	10-15	15-35	ca, cs	7
		Valsrivier	70-100	10-15	15-35	cs	2
		Rock outcrop	0			R	2
		Hutton		3-6	3-6	ca, R	1
Ah25	7	Hutton	5-15	3-6	4-10	ca, R	34
		Clovelly	5-15	3-6	4-10	ca, R	27
		Glenrosa	5-15	3-6	4-10	so, ca	10
		Mispah	10-20	3-6		ca, R	8
		Rock outcrop	0			R	8
		Swartland	15-35	5-10	25-35	so	8
		Dundee	>100	3-6	4-10	R	6
Fc422	7	Rock outcrop	0			R	24
		Mispah	1-15	3-6		ca	14
		Clovelly	15-40	6-10	6-15	ca	12
		Oakleaf / Dundee	50->120	10-45	7-46		10
		Glenrosa	15-35	6-10	10-15	R, so	10
		Oakleaf	20-40	6-15	10-15	ca, R, so	8
		Hutton	15-40	6-10	6-15	ca	8
		Mispah	1-10	5-8		R, ca	8
		Katspruit	30-60	6-15	10-30	ca, R	4
Fc474	7	Glenrosa / Oakleaf	30-40	6-10	6-15	ca, R	29
		Mispah / Glenrosa	10-30	6-10	6-15	R, ca	25
		Clovelly	20-40	3-7	3-10	ca, R	16
		Hutton	20-40	3-7	3-10	ca, R	15
		Oakleaf	40-60	15-25	20-35	R, ca	12
		Rock outcrop	0			R	4

Land type	Land capability class	Soil series (forms)	Depth (cm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Fc459	7	Rock outcrop	0			R	24
		Mispah	1-10	2-6		ca	19
		Mispah	1-10	2-6		R	19
		Glenrosa	2-15	2-7	3-8	R	17
		Clovelly	30-70	2-8	3-8	R, ca	10
		Hutton	30-70	2-8	3-8	R, ca	9
		Oakleaf / Dundee	>120	4-8	5-10		4

Land capability classes: 7 = non-arable, low potential grazing land;

Depth limiting layers: R = hard rock; ca = hardpan carbonate; so = partially weathered bedrock.

Appendix 6F
Visual Assessment
(Including review letter)

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30 August 2017
489025

Mr. S. Jacobs
SiVEST
PO Box 2921
Rivonia
2128

Attention: Mr. S. Jacobs

Dear Mr. Jacobs

Peer review of the Graskoppies, Hartebeest Leegte, Ithemba and !Xha Boom Grid Project Visual Impact Assessments, Northern Cape Province, Visual Impact Assessment Report

SiVest Report: 13622: Revision #1

SiVEST (Pty) Ltd. (SiVEST) is undertaking a Basic Assessment (BA) processes for:

1) The construction of a 33kV/132kV on-site substation, a 132kV Linking Substation and an associated 132kV power line to the Helios Main Transmission Substation.

As part of the Environmental Authorisation process, a Visual Impact Assessment (VIA) is required for the construction and operational activities at the facility. As SiVEST is the primary environmental practitioner for the environmental assessments and VIA an external peer review is required.

This letter constitutes the peer review conducted by SRK Consulting (South Africa) (Pty) Ltd. (SRK).

1. Summary of Review

It must be noted that this review was focussed primarily on the content of the SiVEST VIA Report, and did not focus on formatting or grammatical errors. Some recommendations for grammatical review have however been made in the final report reviews.

SRK's review has been guided by the NEMA 2014 EIA Regulations, Government Notice (GN) R982 of 04 December 2014, whereby all specialist studies undertaken as part of an EIA, are required to comply with Appendix 6 of the notice. This is presented in Table 1, overleaf.

SRK is of the opinion that the VIA Report, compiled by SiVEST is fair and that the methodology used was transparent and well stated. There is a substantial focus on potential sensitive viewers, with care taken to attempt to identify sensitive viewers that could potentially be affected by the project.

In terms of the NEMA 2014 EIA Regulations, all specialist studies are required to comply with Appendix 6 of the notice. Table 1 summarises the legal requirements for all specialist studies, as well as an indication of the relevant Section of this report which complies with the requirement.

Table 1: Legal Requirements for Specialist Studies

Legal Requirement		Relevant Section in Specialist study
(1)	A specialist report prepared in terms of these Regulations must contain details of:	
(a)	The specialist who prepared the report; and	**Present**
	The expertise of that specialist to compile a specialist report including curriculum vitae.	**Missing**
(b)	A declaration that the specialist is independent in a form as may be specified by the competent authority.	**Present**
(c)	An indication of the scope of, and the purpose for which, the report was prepared.	**Present Section 1**
(d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	**Date is mentioned, but season is not**
(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process.	**Present Section 1.4**
(f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	**Present Section 2**
(g)	An identification of any areas to be avoided, including buffers.	**Present Section 2 and Section 3**
(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	**Present (various sections)**
(i)	A description of any assumptions made and any uncertainties or gaps in knowledge.	**Present Section 1.3**
(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment.	**Present (Section 4 and Section 5)**
(k)	Any mitigation measures for inclusion in the EMPR. *Note that an EMPR has three levels of impact management:* *Impact management action;* *Impact management outcome; and* *Impact management objective.*	**Present Section 4**
(l)	Any conditions/aspects for inclusion in the environmental authorisation.	**Present (Section 4)**
(m)	Any monitoring requirements for inclusion in the EMPR or environmental authorisation.	**Present (Section 4)**
(n)	A reasoned opinion[1] (Environmental Impact Statement)-	**Present Section 6**
	As to whether the proposed activity or portions thereof should be authorised.	**Present Section 6**
	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPR, and where applicable, the closure plan.	**Present (Section 4 and Section 6)**
(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report.	**N/A**
(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto.	**N/A**
(q)	Any other information requested by the competent authority.	**N/A**

[1] Also include a summary of the impacts.

Some additional recommendations for improving the report were identified during the review process. These are listed below:

1. Comments made with reference to dust suppression mitigation. In the context of the remoteness of the development and the existing conditions, dust may not be an overarching problem. Comments and suggestions regarding dust and dust suppression is made in the report comments document.
2. Some text in the report may not be relevant or too emotive; these recommendations are made in the report.
3. Some text is repetitive and can be summarised, notes are made in the text.

Additional comments for the reports have been compiled in separate Word Document submitted to SiVEST on 30 August 2017:

- **SRK Report: 489025_SRK_Review_13622_Grasskoppie Grid_BA_Visual Report_20170830**

Should you have any queries regarding the review or comments made in the reviewed document, please do not hesitate to contact Mr. Keagan Allan, SRK (031 279 1200).

Yours faithfully,

SRK Consulting (South Africa) (Pty) Ltd

Mr. K. Allan (Pr. Sci. Nat.)
Senior GIS Specialist

Mr. W. Jordaan (Pr. Sci. Nat.)
Partner

SOUTH AFRICA MAINTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

Proposed Construction of the !Xha Boom On-site IPP Substation, Linking Substation and Associated 132kV Power Line near Loeriesfontein, Northern Cape Province

Visual Impact Assessment Report - Basic Assessment

Issue Date: 21 November 2017
Version No.: **1**
Project No.: 13622

Date:	20 July 2017
Document Title:	Proposed Construction of the !Xha Boom Substation, Linking Substation and Associated 132kV Power Line near Loeriesfontain, Northern Cape Province: Visual Impact Assessment Report – Basic Assessment
Author:	**Stephan Jacobs** B.Sc. (Hons) Environmental Management & Analysis (UP) BSc Environmental Sciences (UP) **Kerry Schwartz** BA (Geography), University of Leeds
Version Number:	#1
Checked by:	**Andrea Gibb** (internal review) B.Sc. (Hons) Environmental Management (UNISA) BSc Landscape Architecture *Cum Laude* (UP) **Keagan Allan** Pr. Sci. Nat., MSc. Geographical Sciences
Approved:	Tarryn Curtis
Signature:	
For:	SiVEST Environmental Division

For full details and the expertise of the specialists that compiled / checked this report refer to Appendix H of the Draft Basic Assessment Report (DBAR).

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	To be confirmed
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Proposed Construction of the !Xha Boom On-site IPP Substation, Linking Substation and associated 132kV Power Line near Loeriesfontein, Northern Cape Province

Specialist:	**SiVEST SA (Pty) Ltd**		
Contact person:	Stephan Jacobs		
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Professional affiliation(s) (if any)	None		

Project Consultant:	**SiVEST SA (Pty) Ltd**		
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Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	andreag@sivest.co.za		

The specialist appointed in terms of the Regulations

I, **Stephan Jacobs**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST SA (Pty) Ltd

Name of company (if applicable)

20 July 2017

Date

The specialist appointed in terms of the Regulations

I, ___________ **Andrea Gibb** _________________, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST SA (Pty) Ltd

Name of company (if applicable)

20 July 2017

Date

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations (2017) Requirements for Specialist Reports (Appendix 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	**Section 1.4**. Specialist CV's are included in **Appendix B**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Page 3 - 4**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 1**
(cA) an indication of the quality and age of base data used for the specialist report;	**Section 1.5** **Section 2**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Section 2** **Section 3** **Section 4**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Section 1.3** **Section 1.5.1**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Section 1.5**
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**Section 2** **Section 4**
(g) an identification of any areas to be avoided, including buffers;	**Section 2.6** **Section 2.7**
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Section 2.7**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 1.3**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	**Section 4** **Section 5**
(k) any mitigation measures for inclusion in the EMPr;	**Section 4.6**
(l) any conditions for inclusion in the environmental authorisation;	**N/A**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Section 4.5** **Section 4.6**
(n) a reasoned opinion—	

i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	**Section 6.1**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**Feedback regarding the visual environment is based on the public participation process and is included in Environmental Impact Report.**
(p) any other information requested by the competent authority	**No information regarding the visual study has been requested from the competent authority.**
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	**N/A**

SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE !XHA BOOM SUBSTATION, LINKING SUBSTATION AND ASSOCIATED 132kV POWER LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

VISUAL IMPACT ASSESSMENT REPORT - BASIC ASSESSMENT

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Appendix A: Impact Rating Methodology
Appendix B: Specialist CVs

GLOSSARY OF TERMS

ABBREVIATIONS

BA	Basic Assessment
DBAR	Draft Basic Assessment Report
DM	District Municipality
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
FBAR	Final Basic Assessment Report
GIS	Geographic Information System
I&AP	Interested and/or Affected Party
IPP	Independent Power Producer
kV	Kilovolt
LM	Local Municipality
MTS	Main Transmission Substation
MW	Megawatt
NGI	National Geo-spatial Information
OHL	Overhead Line
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SANBI	South African National Biodiversity Institute
VIA	Visual Impact Assessment
VR	Visual Receptor

DEFINITIONS

Anthropogenic feature: An unnatural feature as a result of human activity.

Aspect: Direction in which a hill or mountain slope faces.

Cultural landscape: A representation of the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (World Heritage Committee, 1992).

Power line route: The alignment followed by the proposed power line or power line alternatives.

Power line corridor: The 500m wide power line route assessed during the BA in order to allow for flexibility when determining the final route alignment. Ultimately the 31m wide power line servitude would be routed within the 500m wide corridor.

Sense of place: The unique quality or character of a place, whether natural, rural or urban. It relates to uniqueness, distinctiveness or strong identity.

Scenic route: A linear movement route, usually in the form of a scenic drive, but which could also be a railway, hiking trail, horse-riding trail or 4x4 trail.

Sensitive visual receptors: An individual, group or community that is subject to the visual influence of the proposed development and is adversely impacted by it. They will typically include locations of human habitation and tourism activities.

Study area: The study area or visual assessment zone is assumed to encompass a zone of 5km from the outer boundary of the power line corridor. This is also referred to as the visual assessment zone.

Vantage point: A point in the landscape from where a particular project or feature can be viewed.

Viewpoint: A point in the landscape from where a particular project or feature can be viewed.

Viewshed: The geographical area, based entirely on topography, from where an object / structure would be visible, i.e. the zone of visual influence. The viewshed defines the outer boundary of a visual envelope, usually along crests and ridgelines.

Visual assessment zone: The visual assessment zone is assumed to encompass a zone of 5km from the outer boundary of the power line corridor. This is also referred to as the study area.

Visual character: The physical elements and forms and land use related characteristics that make up a landscape and elicit a specific visual quality or nature. Visual character can be defined based on the level of change or transformation from a completely natural setting.

Visual contrast: The degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would be in conformity with the land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape.

Visual envelope: A geographic area, usually defined by topography, within which a particular project or other feature would generally be visible.

Visual exposure: The relative visibility of a project or feature in the landscape.

Visual impact: The effect of an aspect of the proposed development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.

Visual receptors: An individual, group or community that is subject to the visual influence of the proposed development but is not necessarily adversely impacted by it. They will typically include commercial activities and motorists travelling along routes that are not regarded as scenic.

Visual sensitivity: The inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (visual character), spatial distribution of potential receptors, and the likely value judgements of these receptors towards the new development, which are usually based on the perceived aesthetic appeal of the area.

SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE !XHA BOOM SUBSTATION, LINKING SUBSTATION AND ASSOCIATED 132kV POWER LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

VISUAL IMPACT ASSESSMENT REPORT - BASIC ASSESSMENT

1 INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, namely the !Xha Boom Substation, a 132kV Linking Substation and an associated 132kV power line near Loeriesfontein in the Northern Cape Province (hereafter referred to as the 'proposed development'). The proposed development is aimed at feeding electricity generated by Mainstream's proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid. SiVEST South Africa (Pty) Ltd (hereafter referred to as SiVEST) have been appointed by Mainstream to undertake the Basic Assessment (BA) for the proposed development. As part of the BA studies conducted for the proposed development, the need to undertake a visual impact assessment (VIA) has been identified. During the BA, a desktop assessment of the visual environment within the study area was undertaken (with field based verification) in order to characterise the area and broadly identify all the potential visual impacts and issues relating to the proposed development. This visual assessment focuses on the potential sensitive receptor locations, and provides an assessment of the magnitude and significance of the visual impacts associated with the proposed development. The main deliverable of this study is the generation of maps indicating visual receptors within the various distance bands and this report indicating the findings of the study.

1.1 Project Description

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site Independent Power Producer (IPP) substation (namely !Xha Boom Substation), as well as a 132kV Linking Substation and a 132kV power line. The aim of this development is to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid via Helios Substation.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the “proposed !Xha Boom Substation”)
- Construction of 1 x 132kV Linking Substation
- Construction of 1 x 132kV power line from the proposed !Xha Boom Substation, via the proposed Linking Substation to Helios substation, approximately 35kms south-east of the proposed !Xha Boom Wind Farm.

The size of the proposed !Xha Boom Substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. Two (2) alternative sites for each substation type have been identified for assessment during the BA process.

In addition, four (4) power line corridor alternatives have been identified for assessment during the BA process. These corridors are as follows:

- Corridor Option 1: Approximately 52.2kms in length
- Corridor Option 2: Approximately 52.8kms in length
- Corridor Option 3: Approximately 47.0kms in length
- Corridor Option 4: Approximately 53.4kms in length

Each of these corridors are between 100m and 300m wide to allow flexibility when determining the final route alignment. The proposed power line however only requires a 31m wide servitude which will be positioned within the corridor. The proposed power line development comprises a series of towers located approximately 170m to 250m apart, the exact location of which will be determined during the final design stages of the power line. The type of towers being considered at this stage include self-supporting suspension monopole structures (**Figure 1**) for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will be high enough to ensure minimum overhead line clearances from buildings and surrounding infrastructure.

Figure 1: Tower Type

1.2 Site Location

The proposed development will be located approximately 68km north of Loeriesfontein in the Northern Cape Province within the Hantam Local Municipalities (**Figure 2**).

The proposed 33/132kV!Xha Boom On-site IPP Substation will be located on Portion 2 of the Farm Georgs Vley No 217, while the proposed Linking Substation will be located on Portion 1 of the Farm Hartebeest Leegte No 216. The !Xha Boom Wind Farm application site, as well as the proposed substation site alternatives and the 132kV power line corridor route alternatives are shown in the route overview map below (**Figure 3**).

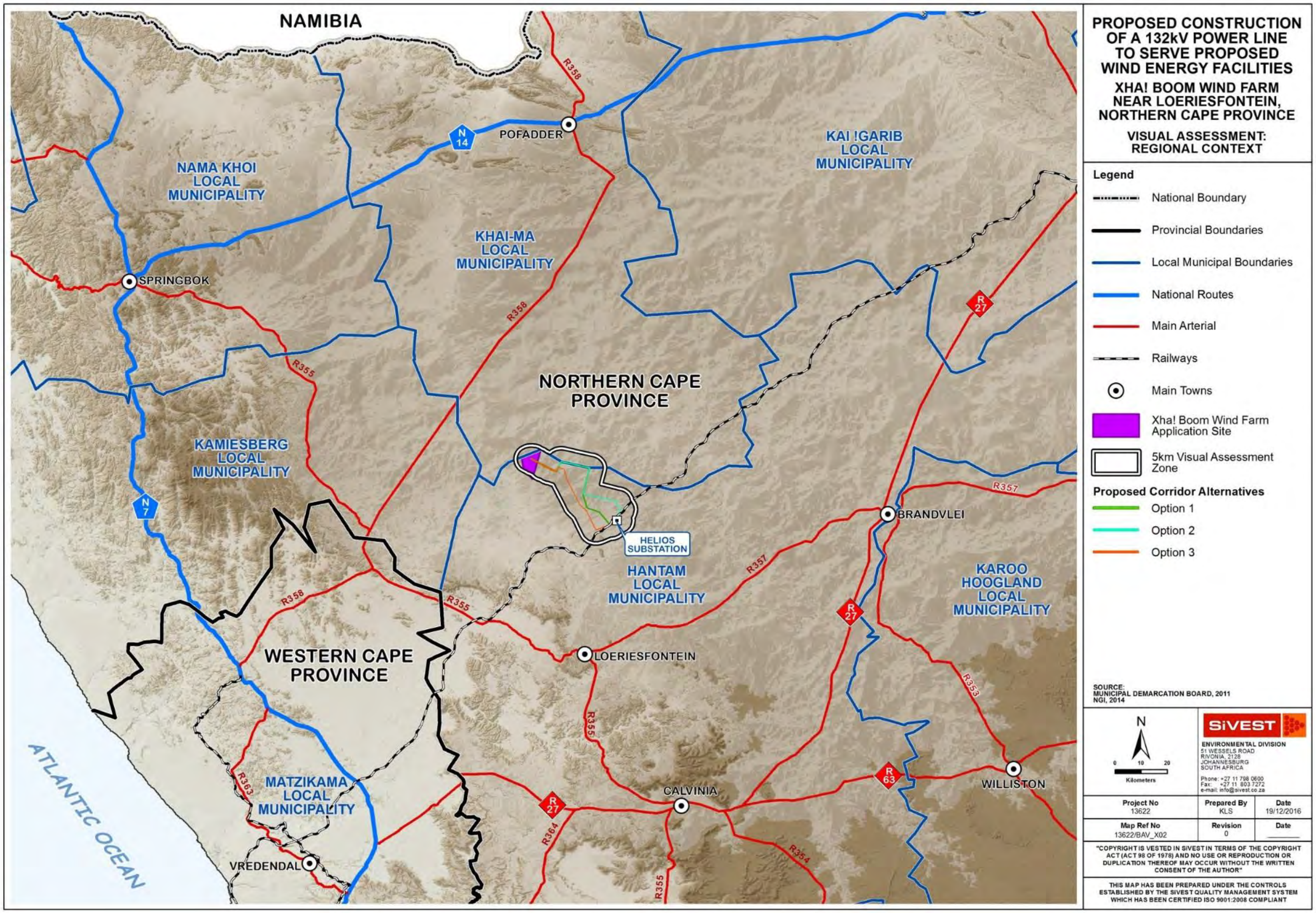

Figure 2: Regional Context Map

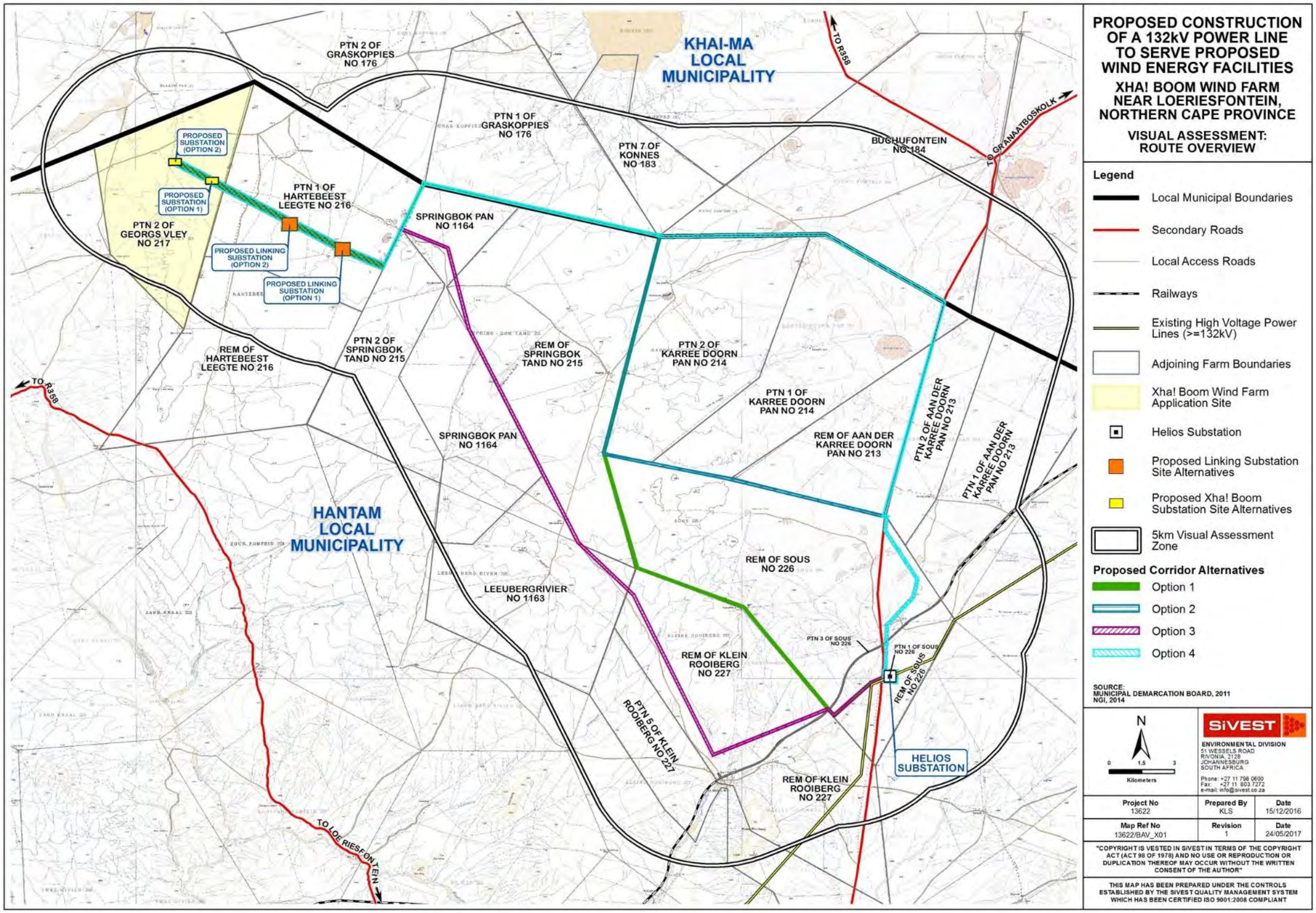

Figure 3: Route Overview Map

1.3 Assumptions and Limitations

- The identification of visual receptors has been based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential receptors within the study area. Thereafter a site visit was undertaken from the 05th to the 09th of December 2016 in order to verify the sensitive visual receptors within the study area and assess the visual impact of the development from these receptor locations where possible. Due to the extensive area covered by the study area, a number of broad assumptions have been made in terms of the sensitivity of the receptors to the proposed development. It should be noted that not all receptor locations would necessarily perceive the proposed development in a negative way. This is usually dependent on the use of the facility and the economic dependency on the scenic quality of views from the facility. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities and scenic locations within natural settings. The presence of a receptor in an area potentially affected by the proposed development does not therefore necessarily mean that a visual impact will be experienced.

- On-site substations and power lines are very large structures by nature and could impact on receptors that are located relatively far away, particularly in areas with very flat terrain. Given the nature of the receiving environment and the height of the proposed development, the study area or visual assessment zone is assumed to encompass a zone of 5km from the proposed development– i.e. all areas within a 5km radius of the power line corridor and/or substation site alternatives. This 5km limit on the visual assessment zone was applied because distance is a critical factor when assessing visual impacts and although the proposed power line may still be visible beyond 5km, the degree of visual impact would diminish considerably. As such the need to assess the impact on potential receptors beyond this distance would not be warranted.

- Due to the varying scales and sources of information as well as the fact that only 20m contours were available to establish the Digital Terrain Model (DTM); maps and terrain models may have minor inaccuracies. As such, only large scale topographical variations have been taken into account and minor topographical features or small undulations in the landscape may not be depicted on the DTM.

- During the site visit, it was observed that a few of the farmsteads / residential dwellings identified via desktop means (i.e. Google Earth) have been abandoned and no one is currently residing within them. As such no further assessment was undertaken from these locations and they were eliminated from the list of potentially sensitive receptor locations for the purpose of this study.

- Due the extensive area covered by the study area, the extensive number of farmsteads and residential dwellings located within the study area and access limitations during the site visit access, the impact rating assessment of the proposed development on the potentially sensitive visual receptor locations was undertaken primarily via desktop means. Although the use of these farmsteads / residential dwellings could not be established during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed substations and power line and were assessed as part of the VIA.

- No viewsheds were generated during this visual study, as the topography within the study area is relatively flat and no detailed contours were available. Within this context, minor topographical features, vegetative screening, or man-made structures would be important factors which influence the degree of visibility, but would not be reflected in the viewsheds.

- A matrix has been developed to assist in the assessment of the potential visual impact at each receptor location. The limitations of quantitatively assessing a largely subjective or qualitative type of impact should be noted. The matrix is relatively simplistic in considering three main parameters relating to visual impact, but provides a reasonably accurate indicative assessment of the degree of visual impact likely to be exerted on each receptor location by the proposed substations and power line. The matrix should therefore be seen as a representation of the likely visual impact at a receptor location.

- The assessment of receptor-based impacts has been based on the power line corridor and substation site alternatives provided by the proponent. It is recognised however that the exact route of the power line within the corridor has not been determined, and as such the final routing of the proposed power line may result in greater or lesser visual impacts on receptor locations.

- Visualisation modelling has not been undertaken for the proposed development as the power line route alignment within the corridor and tower locations have not been established.

- No feedback related to the visual environment has been received during the BA phase public participation processes. Should any feedback be received, this report will be updated accordingly.

- Operational and security lighting will be required for the substations proposed within the development footprint. At the time of undertaking the visual study no information was available regarding the type and intensity of lighting required and therefore the potential impact of lighting at night has not been assessed at a detailed level. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have been provided.

- Most rainfall within the area occurs from November to March, during the late summer months. It should be noted that the fieldwork was undertaken at the beginning of December 2016, during early summer. During winter months up until early summer, the visual impact of the proposed development may be greater, particularly from farmhouses surrounded by tall deciduous trees. As such, the surrounding vegetation is expected to provide less potential screening than in the late summer months.

- The weather conditions in the study area also have certain visual implications and are expected to affect the visual impact of the proposed development to some degree. As mentioned above, the fieldwork was undertaken during the early summer months which are characterised by clear weather conditions. In these clear weather conditions the contrast of the power line towers with the surrounding environment would be greater than the contrast on a cloudy day. As such, the weather conditions during the time of the study area were taken into consideration when undertaking the impact rating for each identified sensitive and potentially sensitive receptor locations (**section 4.2**).

1.4 Specialist Credentials

This VIA has been undertaken by Andrea Gibb and Stephan Jacobs from SiVEST. Andrea Gibb has 9.5 years' work experience and specialises in undertaking visual impact and landscape assessments, by making use of ArcGIS technology and field surveys.

Stephan joined SiVEST in May 2015 and holds the position of Graduate Environmental Consultant in the Johannesburg office. Stephan specialises in the field of Environmental Management and has been involved in undertaking of field work and the compilation of reports for specialist studies such as visual impact assessments.

Full CVs are attached as **Appendix B**. In addition, following best practice, an external peer review was undertaken by Mr. Kegan Allan (*Pr. Sci. Nat., MSc. Geographical Sciences*) of SRK Consulting (CV also attached – **Appendix B**).

1.5 Assessment Methodology

1.5.1 Field work and photographic review

A four (4) day site visit was undertaken between the 5th and the 9th of December 2016 (early summer). The study area was visited in order to;

- verify the landscape characteristics identified via desktop means;
- classify the study area into zones of visual contrast;
- capture photos of the proposed study area;
- verify the sensitivity of visual receptor locations identified via desktop means;
- eliminate receptors that are unlikely to be influenced by the proposed development;
- identify any additional visually sensitive receptor locations within the study area; and
- assist with the impact rating assessment from visually sensitive receptor locations.

1.5.2 Physical landscape characteristics

Physical landscape characteristics such as topography, vegetation and land use are important factors which influence the visual character and visual sensitivity of the study area. Baseline information about the physical characteristics of the study area was initially sourced from spatial databases provided by the National Geo-spatial Information (NGI), the South African National Biodiversity Institute (SANBI) and the South African National Land Cover Dataset (Geoterraimage – 2014). The characteristics identified via desktop means were later verified during the site visit.

1.5.3 Identification of sensitive receptors

Google Earth imagery was used in conjunction with field investigation to identify and assess visual receptor locations within the study area, such as residences, which may potentially be sensitive to visual impacts associated with the proposed development.

1.5.4 Impact Assessment

A rating matrix was used to evaluate objectively the significance of the visual impacts associated with the proposed development, both before and after implementing mitigation measures. Mitigation measures were identified (where possible) in an attempt to minimise the potential visual impact of the proposed development. The rating matrix made use of a number of different factors including geographical extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect and intensity, in order to assign a level of significance to the visual impact of the project. A separate rating matrix was used to assess the visual impact of the proposed development on the sensitive receptor locations, as identified. This matrix is based on the distance of a receptor from the proposed development, the presence of screening factors and the degree to which the proposed development would contrast with the surrounding environment from a particular location. Thereafter, the proposed corridor and substation site alternatives were comparatively assessed, in order to ascertain the preferred alternatives from a visual perspective.

1.5.5 Consultation with I&APs

Continuous consultation with Interested and Affected Parties (I&APs) undertaken during the public participation process (PPP) will be used to help establish how the proposed development will be perceived from the various receptor locations and the degree to which the impact will be regarded as negative. Although I&APs have not as yet provided any feedback in this regard, the report will be updated to include relevant information as and when it becomes available.

2 VISUAL BASELINE ASSESSMENT

The physical and land use related characteristics are outlined below as they are important factors affecting the visibility of a development and contributing to the visual character of the study area. Defining the visual character is an important part of assessing visual impacts as it establishes the visual baseline or existing visual environment in which the development would be constructed. The visual impact of a development is measured against this visual baseline by establishing the degree to which the development would contrast with or conform to the visual character of the surrounding area. The inherent sensitivity of the area to visual impacts or visual sensitivity is thereafter determined, based on the visual character, economic importance of the scenic quality of the area, inherent cultural value of the area and presence of visual receptors.

2.1 Topography

The topography across much of the study area is characterised by a flat to gently undulating landscape with gentle slopes, typical of much of the Karoo (**Figure 4**). There are however areas of localised hilly topography characterised by the presence of small hills / ridges / koppies (**Figure 5**). In the wider area, the Klein and Groot Rooiberg and Leeuwberg koppies are significant features of the landscape, forming an areas of localised hilly topography to the south and south-west of the proposed development. It should however be noted that only the Klein Rooiberg koppie is located inside the visual assessment zone.

In the eastern sector of the study area, the presence of a number of pans signals that the topography is very flat and thus very poorly drained.

Maps showing the topography and slope characteristics in the study area are provided in **Figure 6** and **Figure 7** below.

Figure 4: View of the typically flat to gently undulating terrain found within the study area


Figure 5: View of localised hills / ridges/ koppies found in the wider visual assessment zone.

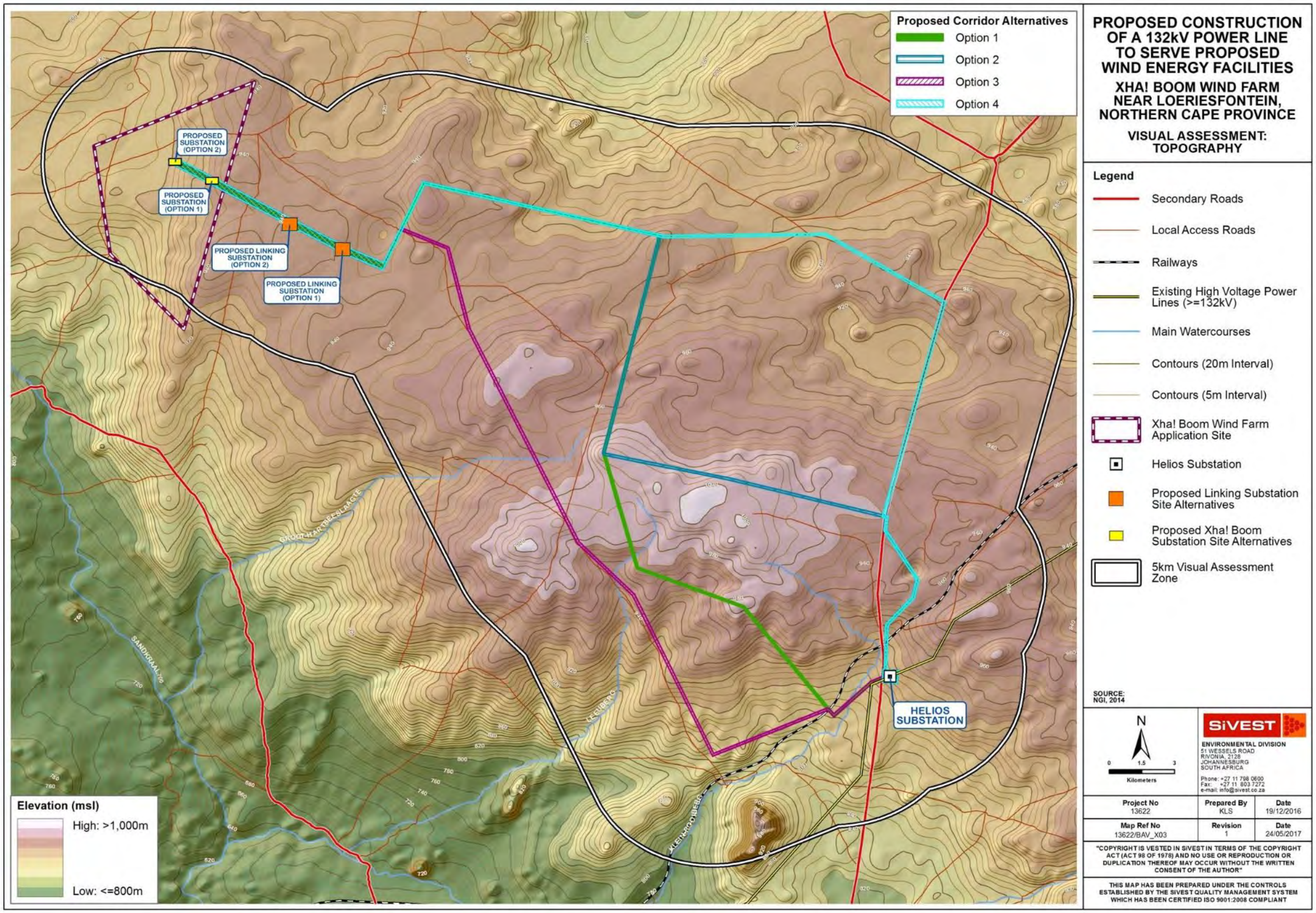

Figure 6: Map showing topography within the study area

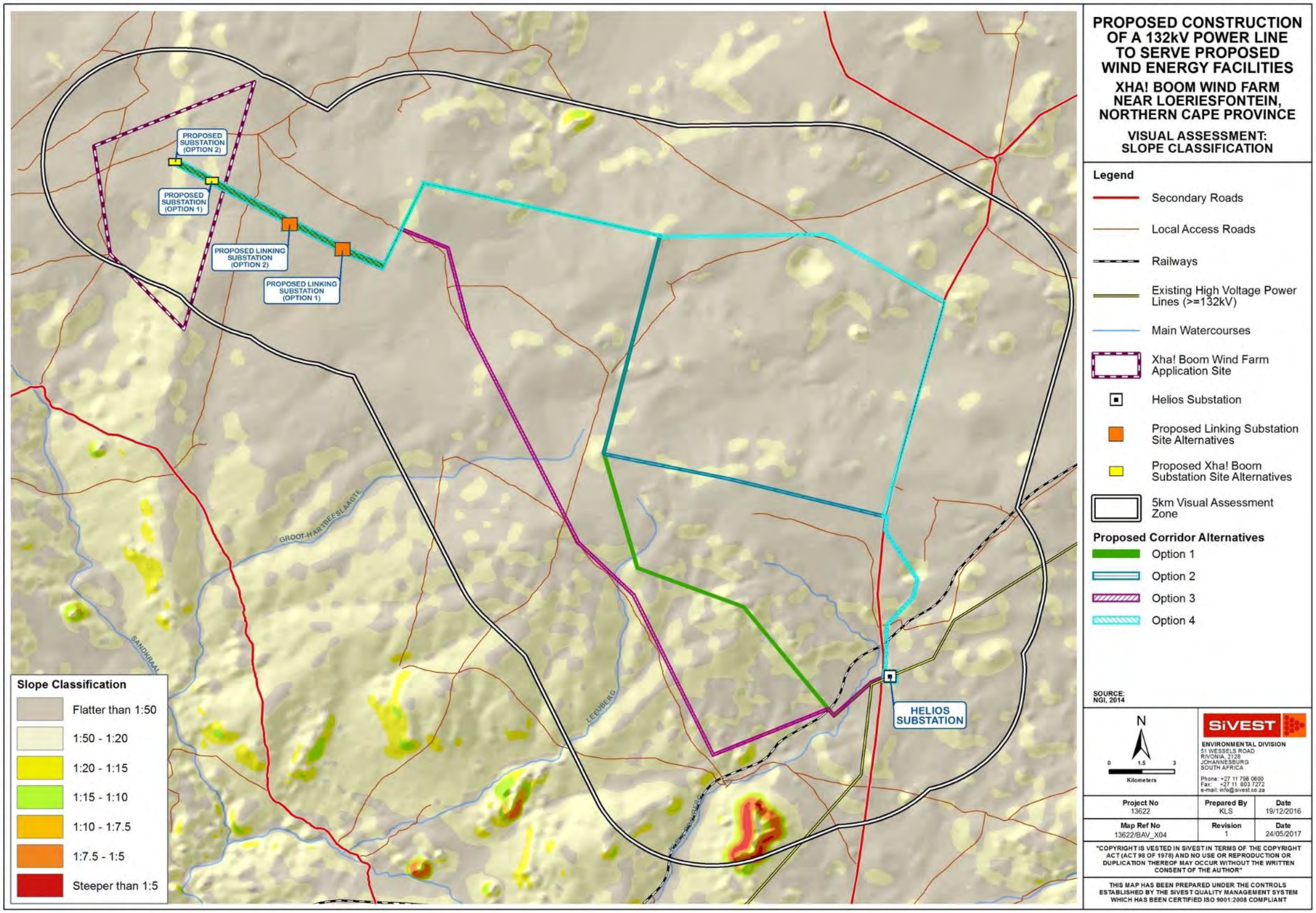

Figure 7: Map showing the slope within the study area

2.1.1 Visual Implications

The flat terrain that occurs across most of the study area results in generally wide-ranging vistas throughout the study area (**Figure 8**), and the horizon is usually visible across an entire 360º arc of the viewer. The only exception to this flat topography is the presence of the localised hills / ridges / koppies in parts of the wider visual assessment zone as well as the range of hills located some distance to the south and south-west of the proposed development which are expected to shield views of the proposed development to a degree.

Figure 8: Generally wide-ranging vistas found throughout the study.

2.2 Vegetation

According to the National Geo-spatial Information (NGI) (2014) and the South African National Biodiversity Institute (SANBI) (2012), the dominant vegetation class across the study area is Bushmanland Basin Shrubland (**Figure 9**) which is characterised by dwarf shrubland dominated by a mixture of low sturdy and spiny shrubs. The aridity of the area has restricted the vegetation to low shrubs around 30-40 cm in height, distributed uniformly across the landscape, except in areas of disturbance where patches of bare earth occur (**Figure 10**) (Mucina & Rutherford, 2006). Western Bushmanland Klipveld occurs in the north-western portion of the study area, while Bokkeveld Sandstone Fynbos is present on the south-western boundary.

Bushmanland Vloere occurs in and around the salt pans scattered across the eastern half of the study area, and is largely characterized by dwarf shrubs with some loose thicket evident is some areas.

Some tree species (some relatively large and some low) can however also be found within certain parts of the study area (**Figure 11**). In certain areas, man has had an impact on the natural vegetation, especially around some farmsteads, where over many years' tall exotic trees and other typical garden plants have been established (**Figure 12**).

A map showing vegetation classification is provided in **Figure 13** below.

Figure 9: Typical vegetation cover found across most of the study area.

Figure 10: Patches of bare earth in the study area.

Figure 11: Examples of the tree species found in parts of the study area.

Figure 12: Example of tall trees that have been established around a farmhouse**.**

2.2.1 Visual Implications

The natural short vegetation cover will offer no visual screening. Parts of the visual assessment zone are however characterised by the presence of some tree species which occur naturally in some areas zone and are expected to contribute to the overall natural character of the study area as well as provide some form of screening from the proposed development. In addition, tall exotic trees may effectively screen the proposed development from farmhouses, where these trees occur in close proximity to the farmhouse and are located directly in the way of views to the proposed development.

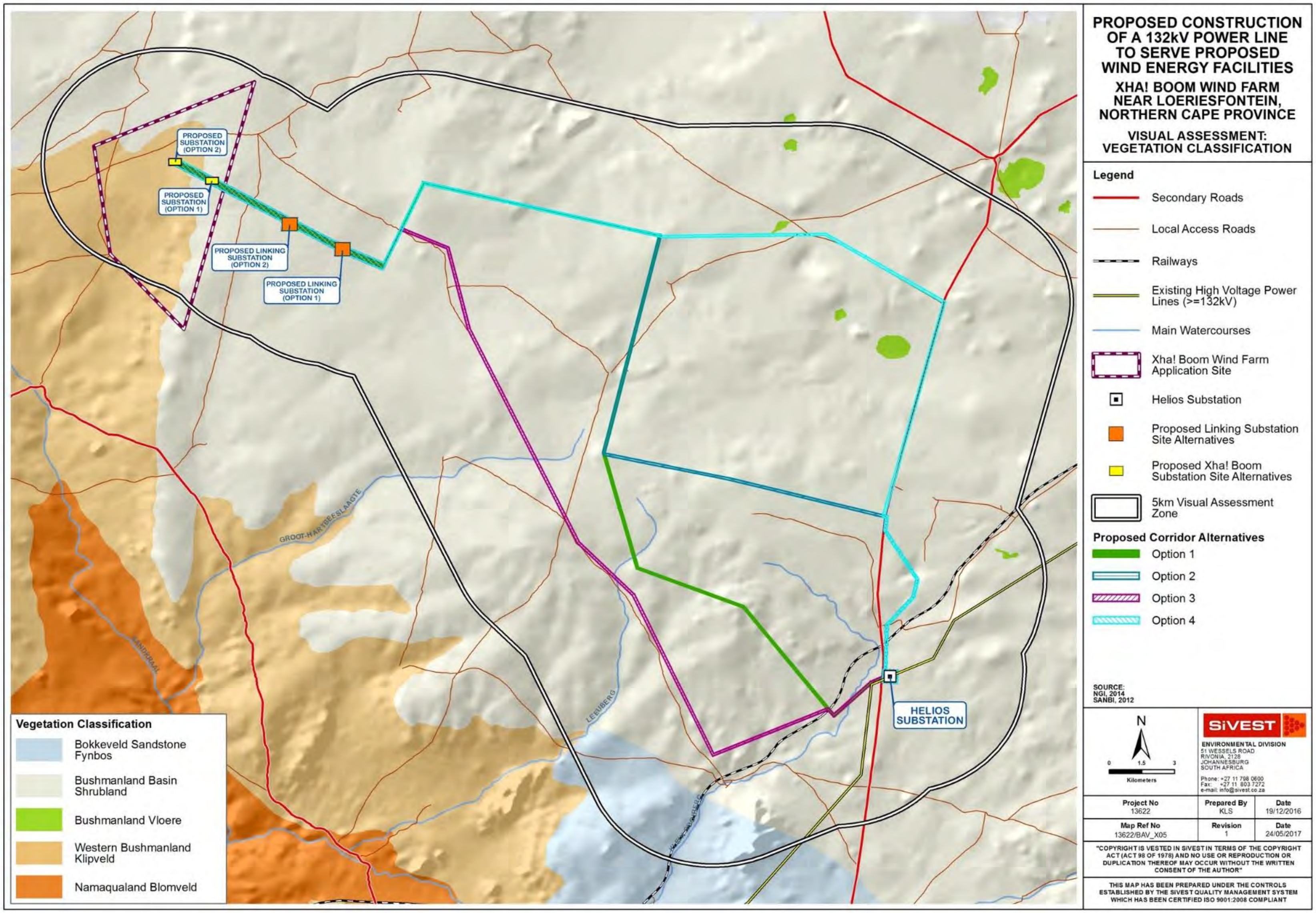

Figure 13: Map showing the vegetation classification within the study area

2.3 Land Cover

According to the South African National Land Cover (2013-2014) from Geoterraimage (2014), much of the land cover in the wider study area is classified as bare (non-vegetated) with some isolated patches of grassland, low shrubland, thicket and woodland in evidence mainly in the south-western sector of the study area (**Figure 23**). Sheep farming (**Figure 14**) is the dominant activity in the study area although the arid nature of the climate restricts stocking densities. As a result, farms in the area are relatively large and isolated farmsteads are scattered across the area resulting in a very low density of rural settlement. The area is therefore regarded as largely uninhabited and the natural vegetation has been retained across most of the study area

Built form in much of the of the study area is limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines and boundary fences and the closest built up area is the small town of Loeriesfontein approximately 69km south of the site. It should be noted that the study area is also characterised by the presence of certain pastoral elements (**Figure 15**). These elements can be found throughout the study area and are typically present in areas where sheep farming is taking place. The study area is however traversed by a secondary road, known locally as the Granaatboskolk Road, which links Loeriesfontein with Granaatboskolk some 38kms north-east of the study area. In addition, a railway line crosses the southern section of the study area, running in a south-west to north east direction (**Figure 16**).

Limited human influence on the landscape is evident in the eastern section of the study area where small-scale mining/quarrying activities occur, mostly scattered along the Granaatboskolk Road and the railway line.

Built form and human influence on the landscape become more evident in the southern sector of the study area where several high voltage power lines feed into the Helios 400kV Main Transmission Substation (MTS) (**Figure 17**). The tall steel structures of the Substation, as well as the high voltage power line towers are highly visible from various parts of the study area (**Figure 18**). Also present in this area are the the Khobab and Loeriesfontein Wind Farms (**Figure 19**) which are presently under construction, as well as the on-site Khobab IPP substation which had already been constructed during the time of the in-field investigation (**Figure 20**). In addition, the construction camp area for the Khobab Wind Farm is also situated within this part of the study area, within close proximity to the Helios Substation (**Figure 21**). It should however be noted that during the time of the in-field investigation it was noted that the Khobab Wind Farm was still in the early stages of construction and no turbines had been erected (**Figure 22**). Each of these developments includes some 61 wind turbines with associated infrastructure as well as 132kV grid connections to Helios Substation. All of this development in combination is resulting in a significant level of transformation of the natural environment in this part of the study area.

A map showing the land cover classification within the study area has been provided in **Figure 23.**

Figure 14: Typical view of sheep farming activities in the study area.

Figure 15: Example of typical pastoral elements which can be found within parts of the study area, especially in areas where sheep farming is taking place. These elements are expected to give the surrounding area a more pastoral feel.

Figure 16: View of railway line which traverses the study area.

Figure 17: View of Helios Substation.

Figure 18: High voltage power lines feeding into Helios Substation.

Figure 19: Wind turbines at Loerisfontein Wind Farm

Figure 20: View of the on-site Khobab IPP Substation which had already been constructed during the time of the in-field investigation.

Figure 21: View of the Khobab Wind Farm construction camp area which is situated within the visual assessment zone, within close proximity to the Helios Substation.

Figure 22: View of the construction activities associated with the proposed Khobab Wind Farm. During the time of the in-field investigation it was noted that this wind farm was still in the early stages of construction and no turbines had thus been erected.

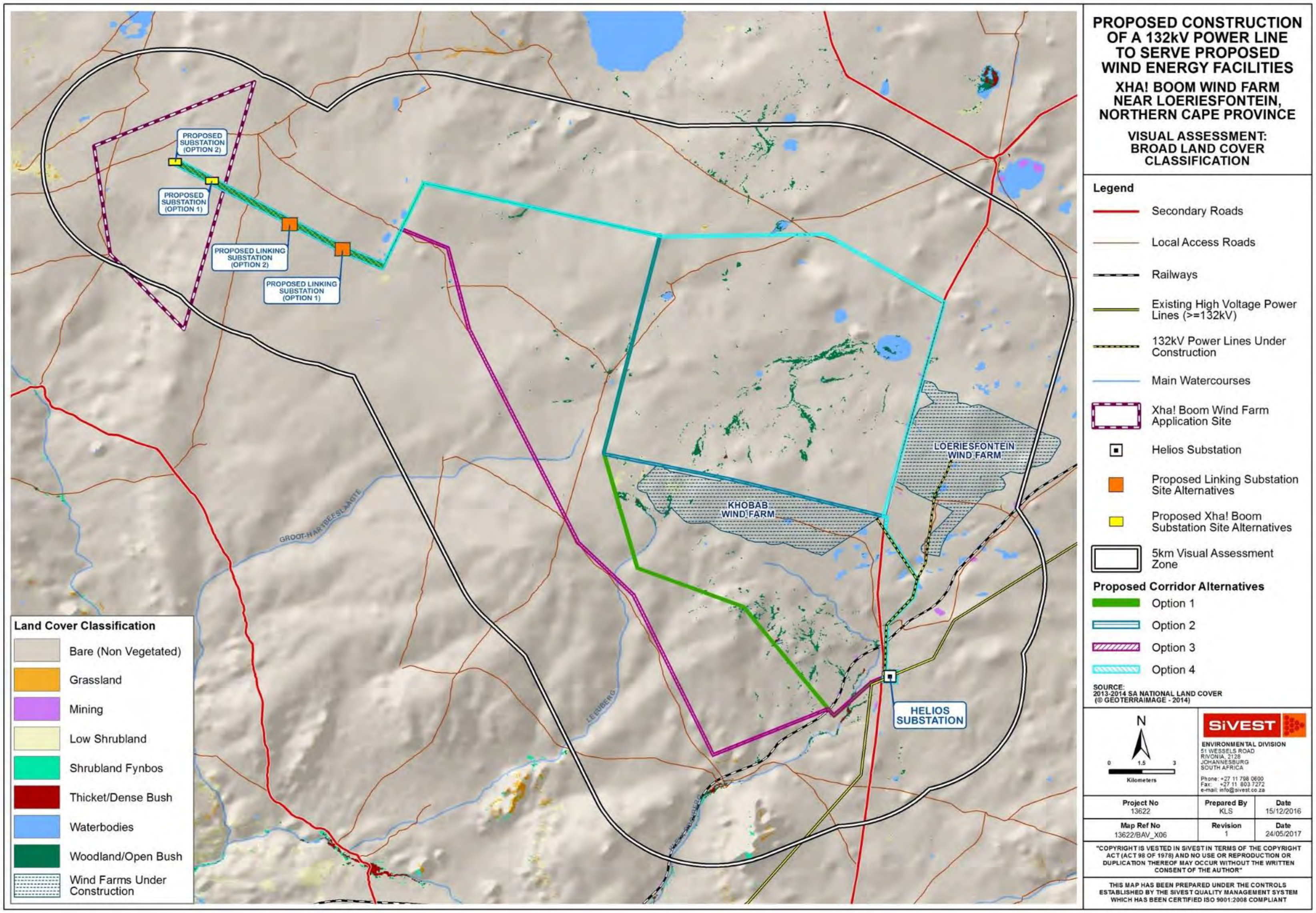

Figure 23: Map showing the land cover classification within the study area

2.3.1 *Visual Implications*

The general lack of human habitation and associated human infrastructure across much of the study area has a distinct impact on the sense of place, giving the area a largely natural, rural feel (**Figure 24**). The pastoral elements which are present in parts of the study area, especially where sheep farming occurs, are however expected to give the surrounding area a more pastoral feel.

Figure 24: Typical natural or scenic visual character found across much of the study area

High levels of human transformation are however evident in the south-eastern sector of the study area in the form of Helios Substation and associated high voltage power lines as well as the Khobab and Loeriesfontein Wind Farms which are presently under construction. As previously mentioned, the on-site Khobab IPP substation and the construction camp area for the Khobab Wind Farm can also be found within this part of the study area, within close proximity to the Helios Substation.

The influence of the level of human transformation on the visual character of the area is described in more detail below.

2.4 Visual Character

The physical and land cover related characteristics of the study area contribute to its overall visual character. Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as electrical infrastructure.

The majority of the study area is considered to have a natural (almost vacant) visual character and there is minimal human habitation and associated infrastructure. In addition, the predominant land use (sheep farming) has not transformed the natural landscape and the area has thus largely retained its natural rural character. It should however be noted that there are some pastoral elements in the area which are expected to give the surrounding area a more pastoral feel. As mentioned above, built infrastructure across much of the study area is limited to isolated farmhouses, gravel farm access roads and farm boundary fences, although there is some quarrying activity in the north-eastern portion of the study area.

The relatively low density of human transformation throughout much of the area is an important component contributing to the largely natural visual character of the study area. This is important in the context of potential visual impacts associated with the proposed development of substations and power lines as introducing this type of development could be considered to be a degrading factor in this context particularly if no existing electrical infrastructure is located nearby.

There are however significant anthropogenic elements in the study area including the Granaatboskolk Road, the railway line, high voltage power lines and Helios Substation. In addition, there are two (2) wind farms presently under construction in the study area, namely Khobab and Loeriesfontein 2. The on-site Khobab IPP substation and the construction camp area for the Khobab Wind Farm can also be found within the study area, within close proximity to the Helios Substation. These facilities and their associated infrastructure consist of very large structures which are highly visible, significantly altering the visual character and baseline in the study area and resulting in a more industrial-type visual character in this part of the study area.

It is important to note that several renewable energy developments (solar and wind) are being proposed in the surrounding area. These facilities and their associated infrastructure typically consist of very large structures which are highly visible. The presence of these renewable energy developments (if constructed) will thus further transform the current visual character and lessen the degree to which the proposed development would contrast with the elements and form in the surrounding environment.

2.5 Cultural, Historical and Scenic Value

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of ‘cultural landscape’ is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). The cultural landscape concept is relatively new in the heritage conservation movement across the world. In 1992 the World Heritage Committee adopted the following definition for cultural landscapes:

Cultural landscapes represent the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

According to the Committee's Operational Guidelines Cultural Landscapes can fall into three (3) categories

i) "a landscape designed and created intentionally by man";

ii) an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";

iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The greater area surrounding the proposed development site is also an important component when assessing visual character. The area can be considered to be typical of a Karoo or “platteland” landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa. Much of South Africa’s dry Karoo interior consists of wide open, uninhabited spaces sparsely punctuated by widely scattered farmsteads and small towns. Traditionally the Karoo has been seen by many as a dull, lifeless part of the country that was to be crossed as quickly as possible on route between the major inland centres and the Cape coast, or between the Cape and Namibia. However, in the last couple of decades this perception has been changing, with the launching of tourism routes within the Karoo, and the promotion of tourism in this little visited, but extensive part of South Africa. In a context of increasing urbanisation in South Africa’s major centres, the Karoo is being marketed as an undisturbed getaway, especially as a stop on a longer journey from the northern parts of South Africa to the Western and Eastern Cape coasts. Examples of this may be found in the relatively recently published “Getaway Guide to Karoo, Namaqualand and Kalahari” (Moseley and Naude-Moseley, 2008). The exposure of the

Karoo in the national press during 2011, as part of the debate around the potential for fracking (hydraulic fracturing) mining activities, has brought the natural resources, land use and lifestyle of the Karoo into sharp focus. Many potential objectors stress the need to preserve the environment of the Karoo, as well as preserve the 'Karoo Way of Life', i.e. the stock farming practices which are highly dependent on the use of abstracted ground water (e.g. refer to the Treasure Karoo Action Group website http://treasurethekaroo.co.za/). Although the small town of Loeriesfontein may be used by tourists as a stop-over destination, the proposed development is located approximately 68km to the north of the town and would therefore not influence these visitors. None of the roads passing near the proposed development are considered to be tourism routes.

The typical Karoo landscape can also be considered a valuable 'cultural landscape' in the South African context. Although the cultural landscape concept is relatively new, it is becoming an increasingly important concept in terms of the preservation and management of rural and urban settings across the world (Breedlove, 2002).

The typical Karoo landscape consisting of wide open plains, and isolated relief, interspersed with isolated farmsteads, windmills and stock holding pens, is an important part of the cultural matrix of the South African environment. The Karoo farmstead is also a representation of how the harsh arid nature of the environment in this part of the country has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small Karoo towns such as Loeriesfontein, engulfed by an otherwise rural environment, form an integral part of the wider Karoo landscape. As such, the Karoo landscape as it exists today has value as a cultural landscape in the South African context. In the context of the types of cultural landscape listed above, the Karoo cultural landscape would fall into the second category, that of an organically evolved, "continuing" landscape.

The study area, as visible to the viewer, represents a typical Karoo cultural landscape. This is important in the context of potential visual impacts associated with the proposed development of a power line and substation. Introducing this type of development is not considered to be a significant degrading factor in the context of the natural Karoo character of the study area, as electrical infrastructure forms part of the typical form present within the Karoo landscape (**Figure 25**).

Figure 25: View of a typical Karoo landscape, which includes electrical infrastructure (Kay, 2014)

2.6 Visual Sensitivity

Visual Sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e. topography, landform and land cover), spatial distribution of potential receptors, and the likely value judgements of these receptors towards a new development (Oberholzer, 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the area SiVEST has developed a matrix based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer, 2005).

Based on the criteria in the matrix (**Table 1**), the visual sensitivity of the area is broken up into a number of categories, as described below:

i) **High** - The introduction of a new development such as the erection of an on-site substation or power line would be likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptors

ii) **Moderate** - Presence of receptors, but due to the nature of the existing visual character of the area and likely value judgements of receptors, there would be limited negative perception towards the new development as a source of visual impact.

iii) **Low** - The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

The table below outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area.

Table 1: Environmental factors used to define visual sensitivity of the study area

FACTORS	**RATING**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pristine / natural character of the environment										
Presence of sensitive visual receptors										
Aesthetic sense of place / scenic visual character										
Value to individuals / society										
Irreplaceability / uniqueness / scarcity value										
Cultural or symbolic meaning										
Scenic resources present in the study area										
Protected / conservation areas in the study area										
Sites of special interest present in the study area										
Economic dependency on scenic quality										
Local jobs created by scenic quality of the area										
International status of the environment										
Provincial / regional status of the environment										
Local status of the environment										
**Scenic quality under threat / at risk of change										

**A rating above '5' for this factor will trigger the need to undertake an assessment of cumulative visual impacts.

Low							**Moderate**							**High**
10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**

Based on the above factors, the study area is rated as having a moderately-low visual sensitivity. This is mainly due to the relatively uninhabited character of the area. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. As described below, very few potentially sensitive receptors are present in the study area. Although no formal protected areas or leisure / nature-based tourism activities exist within the study area, the area would still be valued as a typical Karoo cultural landscape.

As previously mentioned, there are two (2) wind farms under construction in the study area, and several other renewable energy facilities (solar and wind) are proposed in the study area. As such, an assessment of the cumulative impact is discussed in **section 4.3** below.

Although the area is associated with a moderately low visual sensitivity, it should be stressed that the concept of visual sensitivity has been utilised indicatively to provide a broad-scale indication of the likelihood that the area would be sensitive to the visual impacts. This is based on the physical characteristics of the study area, economic activities within the study area and land use that predominates. This does not mean that high visual impacts could not potentially be experienced in areas of low visual sensitivity. The potential presence and perception of sensitive receptors as discussed below must also be taken into account.

2.7 Sensitive and Potentially Sensitive Visual Receptor Locations

A sensitive receptor location is defined as a location from where receptors would potentially be adversely impacted by a proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described above, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the proposed substations and 132kV power line into a 'view', which may affect the 'sense of place'. The identification of sensitive receptors is typically undertaken based on a number of factors which include:

- the visual character of the area, especially taking into account visually scenic areas and areas with a natural visual character;
- the presence of leisure-based (esp. nature-based) tourism or sites with historical and cultural value in an area;
- the presence of sites / routes that are valued for their scenic quality and sense of place;
- the presence of homesteads / farmsteads in largely natural settings where the development may influence the typical character of their views; and
- feedback from interested and affected parties, as raised during the public participation process conducted as part of the BA study.

A distinction must be made between a receptor location and a sensitive receptor location. Receptor locations are sites from where the proposed on-site substations and 132kV power line may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities, scenic sites and residential dwellings in natural settings.

Generally, the visibility of the development would diminish exponentially over distance. As such, the proposed development would be more visible to receptors located within a short distance and these receptors would experience a higher adverse visual impact than those located at a moderate or long distance from the proposed development. The distance of a sensitive receptor location from the proposed development site was taken into account when rating the visual impact of the proposed development on these potential receptors.

In order to account for this, distance bands were used to assign zones of visual impact from the proposed development site. Based on the height and scale of the project, as well as the investigations undertaken during the fieldwork, the radii chosen to assign these zones of visual impact are as follows:

- 0 < 500m (high impact zone);
- 500m < 2km (moderate impact zone);
- 2km < 5km (low impact zone); and
- >5km (Negligibly low impact zone)

A total number of nineteen (19) scattered farmsteads / homesteads which house the local farmers as well as their farm workers were identified within the study area. These dwellings are regarded as potentially sensitive visual receptors as they are located in a mostly rural setting and the proposed development will likely alter natural vistas experienced from these dwellings. The degree of visual impact experienced will vary from one inhabitant to another, as it is largely based on the viewer's perception. Factors influencing the degree of visual impact experienced by the viewer include the following:

- Value placed by the viewer on the natural scenic characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression toward a less polluted future) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical Karoo character of the surrounding area.

As far as possible, each potentially sensitive visual receptor that was identified via desktop means was visited to determine the current use of the facility and assist with rating the impact of the proposed development from the location. However, due to the extensive area covered by the study area and access limitations during the site visit, it was not possible to verify the status of all the identified potentially sensitive receptor locations. As such, the impact rating assessment of the proposed development on the potentially sensitive visual receptor locations was undertaken primarily via desktop means. Although the use of these farmsteads / residential dwellings could not be established during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were assessed as part of the VIA. As mentioned above, nineteen (19) potentially sensitive visual receptors were identified within the study area. No sensitive visual receptor locations with tourism significance were identified within the study area. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area.

Table 2 below provides details of the potentially sensitive places that have cultural and symbolic importance that were identified within the study area.

It should be noted that a few of the farmsteads / homesteads which were identified via desktop means were excluded as potentially sensitive receptor locations for the purposes of this visual study as it was discovered during the time of the site visit that these were uninhabited and/or abandoned. No further assessment was undertaken from these abandoned farmsteads / homesteads as it was assumed that no individuals currently live in these farmsteads / homesteads and therefore no visual impact will be experienced from these locations.

Table 2: Visual receptor locations identified within the study area.

Name		**Proximity to proposed Substation Site or Power Line Corridor**	**Visual Impact Zone**
*VR13	Farmstead/Homestead	Approx. 2.6km from Power Line Corridor 1, 2, 3 and 4	Low
**VR18	Farmstead/Homestead	Approx. 3.0km from Power Line Corridor 1, 2, 3 and 4	Low
VR25	Farmstead/Homestead	Approx. 200m from Power Line Corridor Option 1	High
VR27	Farmstead/Homestead	Approx. 1.6km from Power Line Corridor Option 3	Moderate
VR28	Farmstead/Homestead	Approx. 2.2km from Power Line Corridor Option 3	Low
VR29	Farmstead/Homestead	Approx. 2.2km from Power Line Corridor Option 3	Low
VR30	Farmstead/Homestead	Approx. 2.2km from Power Line Corridor Option 3	Low
VR31	Farmstead/Homestead	Approx. 2.2km from Power Line Corridor Option 3	Low
VR32	Farmstead/Homestead	Approx. 800m from Power Line Corridor Option 1 and 2	Moderate
VR33	Farmstead/Homestead	Approx. 700m from Power Line Corridor Option 4	Moderate

Name		Proximity to proposed Substation Site or Power Line Corridor	Visual Impact Zone
VR34	Farmstead/Homestead	Approx. 180m from Power Line Corridor Option 2 and 4	High
VR35	Farmstead/Homestead	Approx. 1.2km from Power Line Corridor Option 3	Moderate
VR36	Farmstead/Homestead	Approx. 1.2km from Power Line Corridor Option 3	Moderate
VR37	Farmstead/Homestead	Approx. 1.6km from Power Line Corridor Option 3	Moderate
VR38	Farmstead/Homestead	Approx. 1.5km from Power Line Corridor Option 3	Moderate
VR39	Farmstead/Homestead	Approx. 4.2km from Power Line Corridor Option 4	Low
VR40	Farmstead/Homestead	Approx. 4.5km from Power Line Corridor Option 4	Low
VR41	Farmstead/Homestead	Approx. 4km from Power Line Corridor Option 4	Low
VR43	Farmstead/Homestead	Approx. 4.6km from Power Line Corridor Option 4	Low

* *According to the Noise Specialist (with the Public Participation Practitioner's advice), this receptor was confirmed as a house which is used very temporary (one night) on occasion. There is also single room present for a shepherd (De Jager, 2017).*

***According to the Noise Specialist (with the Public Participation Practitioner's advice), this receptor was confirmed as a farmstead / homestead which is owned by a Mr Kallie van Zyl (De Jager, 2017). No further information was however provided with regards to this receptor.*

It should be noted that, as mentioned above, it was not possible to verify the status of all the identified potentially sensitive receptor locations. As such it is possible that some of the structures identified by desktop means may not, in reality, be potentially sensitive receptors. Although the use of these receptors could not be established during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were assessed as part of the VIA. In light of the above, the impact rating assessment of the proposed development on the potentially sensitive visual receptor locations was undertaken primarily via desktop means.

In many cases, roads along which people travel are considered to be sensitive receptor locations. Road infrastructure in the study area largely comprises gravel access roads used primarily by local farmers. The southern sector of the study area is however traversed by the Granaatboskolk Road, a secondary road which connects the town of Loeriesfontein with Granaatboskolk to the north. This road is not part of any scenic tourist route and is not specifically valued or utilised for its scenic or tourism potential. As such, there are no visually sensitive roads within the study area.

The visually sensitive and potentially sensitive receptor locations in relation to the zones of visual impact are indicated in **Figure 26** below.

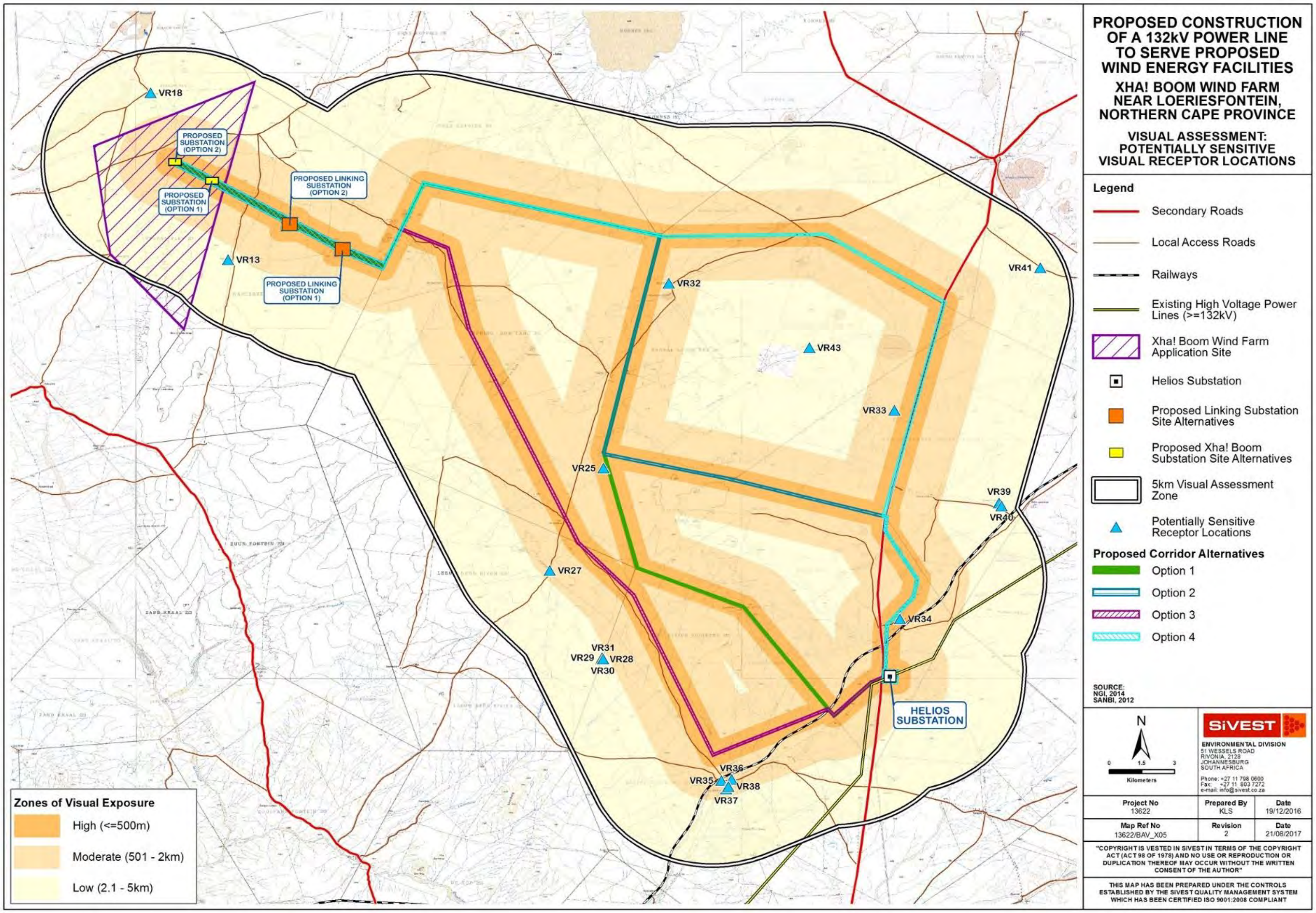

Figure 26: Potentially sensitive visual receptors in the study area.

3 TYPICAL VISUAL IMPACTS ASSOCIATED WITH ON-SITE SUBSTATIONS AND POWER LINES

In this section, the typical visual issues / impacts related to the establishment of on-site substations and a 132kV power line as proposed are discussed.

Power line towers and on-site substations are by their nature very large objects and thus highly visible. The standard tower height of the proposed 132kV power line is approximately 25m (equivalent in height to an eight storey building). Although a pylon/tower structure would be less visible than a building, the height of the structure means that the pylon would still typically be visible from a considerable distance. A 132kV power line consists of a series of pylons/towers spaced approximately 170m to 250m apart in a linear alignment, thus increasing its visibility.

The degree of visibility of an object informs the level and intensity of the visual impact, but other factors also influence the nature of the visual impact. The landscape and aesthetic context of the environment in which the object is placed, as well as the perception of the viewer are also important factors. In the context of the 132kV power line, the type of tower used as well as the degree to which the towers would impinge upon or obscure a view is also a factor that will influence the experience of the visual impacts.

As described above, power lines and substations are not features of the natural environment, but are rather representative of human (anthropogenic) alteration of the natural environment. Thus when placed in a largely natural landscape, a substation and/or power line can be perceived to be highly incongruous in this context. The height and linear nature of the power line will exacerbate this incongruity within a natural landscape, as the towers may impinge on views within the landscape. In addition, the practice of clearing any taller vegetation from areas within the power line servitude can increase the visibility and incongruity of the power line. In a largely natural, bushier setting, vegetation clearance will cause fragmentation of the natural vegetation cover, thus making the power line more visible and drawing the viewer’s attention to the power line servitude.

As mentioned above, the viewer’s / receptor’s perception of the development is also very important, as certain receptors may not consider the development of substation and/or power line to be a negative visual impact. The scenic / aesthetic value of an area and the prevalent land use practices also tend to affect people’s perception of whether a substation and/or power line is an unwelcome intrusion, and this in turn will determine the sensitivity of the identified receptors to the proposed development.

Power lines and substations are often perceived as visual impacts in areas where value is placed on the scenic or aesthetic character of the area, and where activities, which are based upon the enjoyment of, or exposure to, the scenic or aesthetic features of the area are practiced. Sensitivity to visual impacts is typically most pronounced in areas set aside for conservation of the natural environment (such as protected natural areas or conservancies), or in areas in which the natural character or scenic beauty of the area attracts visitors (tourists) to the area. Residents and visitors to these areas may perceive substations and/or power lines to be an unwelcome intrusion that would degrade the natural character and scenic beauty of the area, and which would potentially even compromise the practicing of tourism activities in the area.

Conversely, the presence / existence of other anthropogenic objects associated with the built environment may influence the perception of whether a substation and/or power line is a visual impact. Where industrial-type built-form exists, (such as renewable energy facilities, roads, railways and other power lines and substations), the visual environment could be considered to be “degraded” and thus the introduction of a new power line and substation into this setting may be considered to be less of a visual impact than if there was no existing built infrastructure visible.

Other factors, as listed below, can also impact the nature and intensity of a potential visual impact associated with a substation and power line:

- The location of a substation and power line in the landform setting – i.e. in a valley bottom or on a ridge top. In the latter example the substation and/or power line would be much more visible and would “break” the horizon;
- The presence of macro- or micro-topographical features, such as buildings or vegetation that would screen views of the substation and power line from a receptor location;
- The presence of existing substations and power lines in the area and alignment in relation to these substations and power lines; and
- Temporary factors such as weather conditions (presence of haze, rainfall or heavy mist) which would affect visibility.

4 IMPACT ASSESSMENT

4.1 Visual Compatibility / Contrast

The visual compatibility of the proposed development refers to the degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would be in conformity with the land use, settlement density, structural scale, form and pattern of elements that define the structure of the surrounding landscape. Visual compatibility is an important factor to be considered when assessing the impact of the development within a specific context. A development that is incongruent with the surrounding area may change the character of the landscape and could have a significant visual impact on key scenic views within the study area. Where a development corresponds with the surrounding environment the development would be easily absorbed by the surrounding environment and would result in little or no change in the visual character of the area.

As previously mentioned, the proposed development includes the construction of a 132kV on-site substation (namely the !Xha Boom Substation), a 132kV Linking Substation and a 132kV power line and associated infrastructure which required to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid. In general, the proposed development would not be consistent with the prevailing pastoral land use within the surrounding area. However, the existing anthropogenic elements in parts of the study area are expected to lessen the degree to which the proposed development would be considered incongruent with the surrounding landscape. As mentioned above, the presence of other built-form such as roads, railways, high voltage power lines and substations would influence the degree to which a new power line and substation would visually contrast with the elements already present within the landscape. Where existing electrical infrastructure is present the visual environment would already be visually 'degraded' and thus the introduction of a new power line or substation in this setting would result in less visual contrast than if no existing built infrastructure were visible.

The existing electrical infrastructure and industrial form within the study area, includes several high voltage power lines, the Helios MTS, road and rail infrastructure as well as some scattered small-scale quarrying activities. In addition, the Khobab and Loeriesfontein Wind Farms are presently under construction in this area, each these facilities comprising some 61 wind turbines with associated substations, ancillary buildings and internal roads. It should also be noted that the on-site Khobab IPP substation has already been constructed in this area, while the construction camp area for the Khobab Wind Farm is also situated within this area, within close proximity to the Helios Substation. These elements have already degraded the natural environment to some extent and will significantly reduce the visual impact as the proposed development would be in conformity with these elements. It is also important to note that the substations and power line are being proposed to serve the proposed !Xha Boom Wind Farm and as such the substation and power line would only be constructed if this Wind Farm is developed. The proposed development would therefore be dwarfed by the large number of wind turbines, thus significantly reducing the likely visual contrast of the proposed substations and power line.

Several other renewable energy facilities are proposed to be constructed within close proximity to the proposed development and could significantly alter the visual baseline within the study area, further reducing the visual contrast of the proposed power line and substations, if constructed. This is discussed further in **Section 4.3** below.

4.2 Receptor Impact Rating

In order to assess the potential visual impact of the proposed development on the sensitive / potentially sensitive receptor locations listed above, a matrix has been developed (**Table 3**), and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor location away from the proposed development (zones of visual impact);
- Presence of potential screening factors (topography, vegetation etc.); and
- Visual contrast of the development with the landscape pattern and form.

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive / potentially sensitive receptor location in this context. It should be noted that this rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. Experiencing of visual impacts is however a complex and qualitative phenomenon, and thus difficult to quantify accurately. The matrix should therefore be seen as a representation of the likely visual impact at a receptor location. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact.

Table 3: Visual assessment matrix used to rate the impact of the proposed development on sensitive / potentially sensitive visual receptors

	VISUAL IMPACT RATING			
VISUAL FACTOR	**HIGH**	**MODERATE**	**LOW**	**OVERRIDING FACTOR: NIL**
Distance of receptor away from proposed development	0 < 500m **Score: 3**	500m < 2km **Score: 2**	2km < 5km **Score: 1**	5km <
Presence of screening factors	Limited or no screening factors – development highly visible **Score: 3**	Screening factors likely to partially obscure the development **Score: 2**	Screening factors likely to obscure most of the development **Score: 1**	Screening factors completely block any views towards the development, i.e. the development is not within the viewshed
Zone of Visual Contrast	**High:** The development would contrast highly with the typical land use and/or pattern and form of human elements (infrastructural form). Typically a natural / pastoral environment with low-density rural infrastructure present (low voltage power lines and farm boundary fences). **Score: 3**	**Moderate:** The development would contrast moderately with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Typically areas within close proximity to other prominent infrastructure (high voltage power lines and railway lines) and within intensive agricultural lands / cultivated fields. **Score: 2**	**Low:** The development would correspond with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Presence of urban form and industrial-type infrastructure. The area is not highly valued or sensitive to change (e.g. the outskirts of urban and built-up areas). **Score: 1**	

4.2.1 Distance

As described above, distance of the viewer / receptor location away from the development is an important factor in the context of experiencing of visual impacts. A higher impact rating has thus been assigned to receptor locations that are located closer to proposed development. Beyond 5km, the visual impact would be virtually nil, as the development would appear to merge with the elements on the horizon.

The radii chosen to assign the zones of visual impact are as follows:

- 0 < 500m (high impact zone);
- 500m < 2km (moderate impact zone);
- 2km < 5km (low impact zone); and
- >5km (Negligibly low impact zone)

4.2.2 Screening factors

The presence of screening factors is as important in this context as the distance away from the development. Screening factors can be vegetation, buildings and topography. For example, a grove of trees located between a receptor location and an object could completely shield the object from the receptor location. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is in close proximity, but not in its viewshed. As such, the complete screening of the development has also been assigned an overriding nil impact rating, as the development would not impose any impact on the receptor.

4.2.3 Zones of visual contrast

The degree to which the proposed development would appear to contrast with the surrounding land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape is also considered in the matrix. Visual contrast is an important factor to be considered when assessing the impact of the proposed development from a specific location, as a development that appears to contrast with the visual backdrop may change the visual character of that landscape. This could have a significant visual impact on potentially sensitive visual receptors within the study area.

Land use and visual character in the surrounding landscape was assessed to determine the level of transformation and the degree to which the proposed development would appear to be visually compatible with the surrounding environment when viewed from a particular location. In the context of this proposed development, the presence or absence of existing electrical infrastructure, dense settlement or other urban built-up form were important factors influencing the level of visual contrast. For example, if the development was located adjacent to an existing substation or power line it would result in significantly less visual contrast. The development site was therefore classified into the following zones of visual contrast:

- **High –** undeveloped / natural / rural areas;
- **Moderate –**
    - within 500m of existing power lines and Helios Substation;
    - within 500m of rail infrastructure, and
    - between 1.5 - 3km from existing windfarms;
- **Low –** within 1.5km of Khobab and Loeriesfontein Wind Farms.

The outcome of the visual contrast classification in relation to the sensitive / potentially sensitive visual receptor locations is provided in **Figure 27** below.

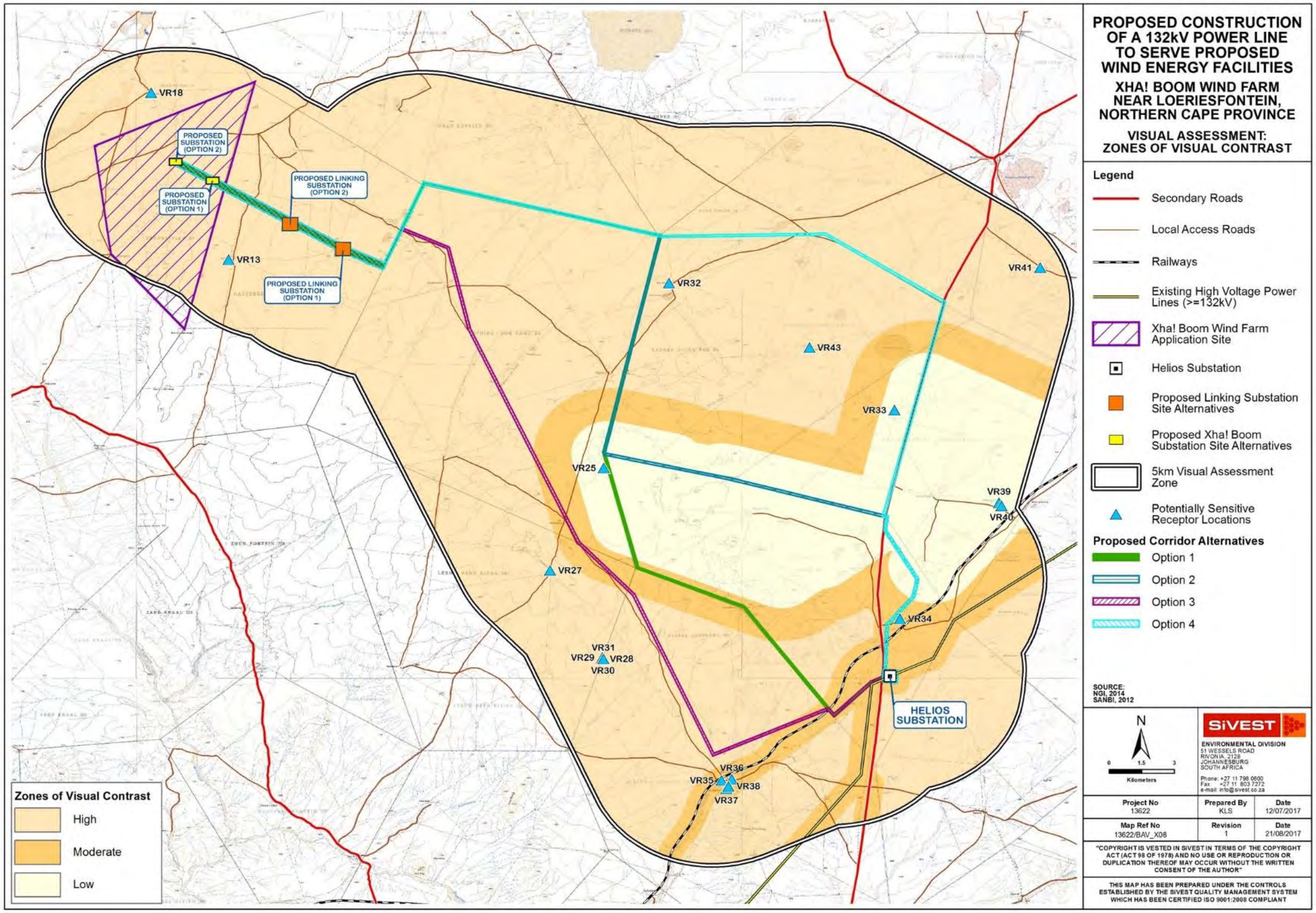

Figure 27: Zones of Visual Contrast

Table 4 below presents the results of the visual impact matrix

Categories of impact:

Rating	Overall Score
High Visual Impact	8-9
Moderate Visual Impact	5-7
Low Visual Impact	3-4
Negligible Visual Impact	(overriding factor)

Table 4: Visual impact of the proposed development on sensitive / potentially sensitive visual receptors within the study area

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR13	Low (1)	High (3)	High (3)	MODERATE
VR18	Low (1)	High (3)	High (3)	MODERATE
VR25	High (3)	High (3)	Low (1)	MODERATE
VR27	Moderate (2)	High (3)	High (3)	HIGH
VR28	Low (1)	High (3)	High (3)	MODERATE
VR29	Low (1)	High (3)	High (3)	MODERATE
VR30	Low (1)	High (3)	High (3)	MODERATE
VR31	Low (1)	High (3)	High (3)	MODERATE
VR32	Moderate (2)	High (3)	High (3)	HIGH
VR33	Moderate (2)	High (3)	Low (1)	MODERATE
VR34	High (3)	High (3)	Moderate (2)	HIGH
VR35	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR36	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR37	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR38	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR39	Low (1)	Moderate (2)	Low (1)	LOW
VR40	Low (1)	Moderate (2)	Low (1)	LOW
VR41	Low (1)	Moderate (2)	High (3)	MODERATE
VR43	Low (1)	High (3)	High (3)	MODERATE

As previously mentioned, a few of the farmsteads / homesteads identified via desktop means were excluded as potentially sensitive receptor locations for the purposes of this study as during the time of the site visit it appeared as if these were uninhabited and/or abandoned. No further assessment was undertaken from these farmsteads / homesteads as it was assumed that no individuals currently live in these farmsteads / homesteads and therefore no visual impact will be experienced from these locations. In addition, it was not possible to verify the status of all the identified potentially sensitive receptor locations. As such it is possible that some of the structures identified by desktop means may not, in reality, be potentially sensitive receptors. Although the use of these farmsteads / residential dwellings could not be established during the field investigation, they were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were assessed as part of the VIA. In light of the above, the impact rating assessment of the proposed development on the potentially sensitive visual receptor locations was undertaken primarily via desktop means.

As indicated above, the proposed development would result in a moderate visual impact on all but five (5) of the potentially sensitive visual receptor locations within the study area (14 in total). It is important to note that the proposed development would result in a high visual impact on three (3) of the potentially sensitive receptor locations identified within the study area, namely VR 27, VR 32 and VR 34. In addition, the proposed development would result in a low visual impact on two (2) of the potentially sensitive receptor locations identified within the study area, namely VR 39 and VR 40.

4.3 Cumulative Visual Impact

Although it is important to assess the visual impacts of the proposed development itself, it is equally important to assess the cumulative visual impact that could materialise in the area should other large scale developments and in particular renewable energy facilities (both wind and solar) be granted environmental authorisation to proceed and are ultimately constructed. Cumulative impacts are the impacts from different developments / facilities which may, in combination, result in significant impacts that may be larger than the sum of all the impacts combined.

The renewable energy developments that are being proposed in the surrounding area, are specified in **Table 5** and **Figure 28** below.

Table 5: Renewable energy developments planned in close proximity to the proposed power line and substations

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Remainder of Hartebeest Leegte No 216

Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	▪ Remainder of the Farm Aan De Karree Doorn Pan No. 213; ▪ Portion 1 of the Farm Karree Doorn Pan No. 214; and ▪ Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued,	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

	however the project is no longer active.			

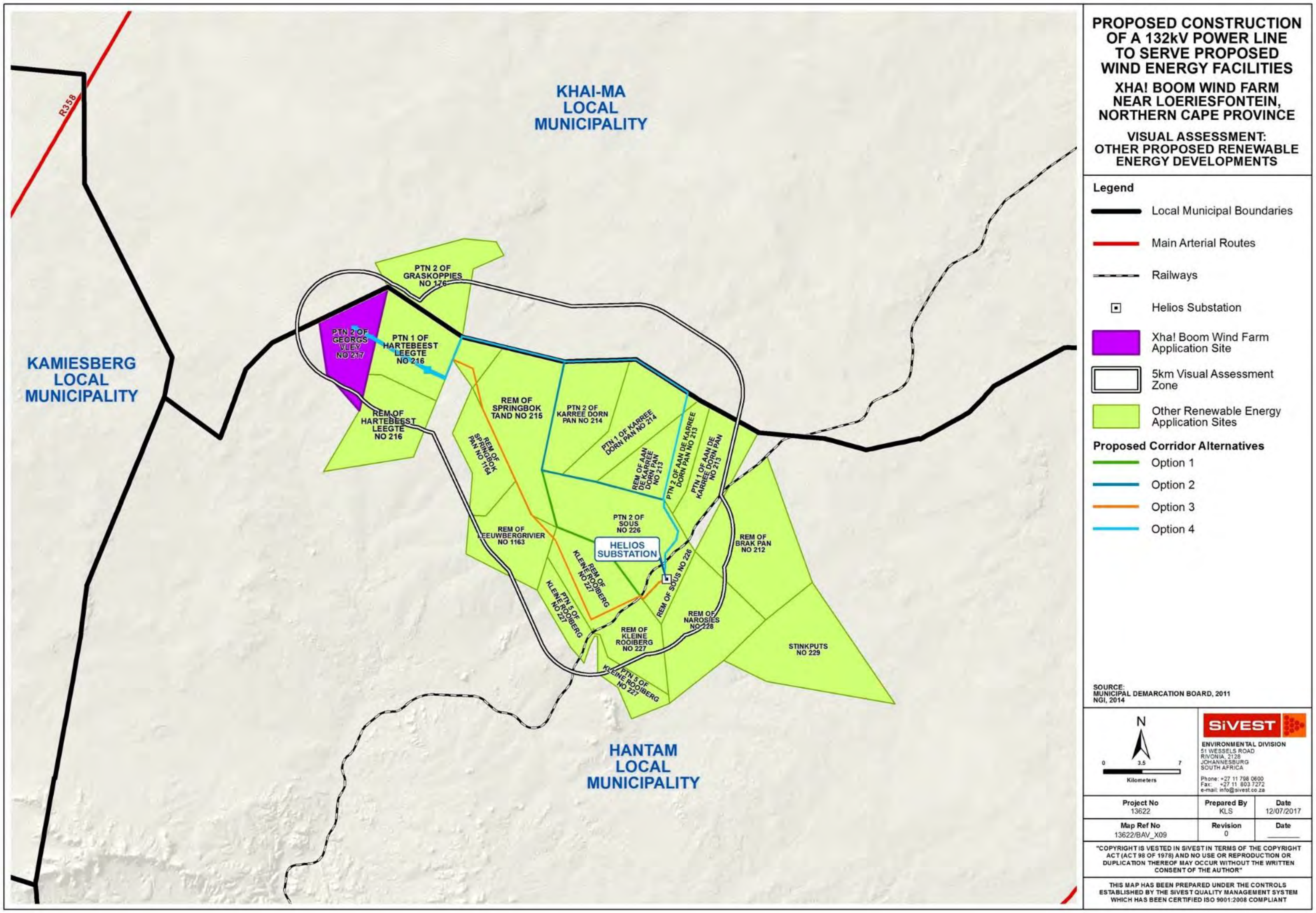

Figure 28: Renewable energy development application sites in close proximity to the study area.

These renewable energy developments and their potential for large scale visual impacts could significantly alter the sense of place and visual character within the study area, once constructed. The cumulative visual impact experienced from each potentially sensitive visual receptor location will depend on the number of proposed renewable energy developments and their associated electrical infrastructure within viewing distance of the receptors. As mentioned above, the height of the development in combination with distance from the receptor are critical factors when assessing visual impacts. As such, solar energy facilities are unlikely to result in visual impacts beyond 5km, while wind energy facilities are unlikely to result in visual impacts beyond 8km and as such the degree of visual impact on receptors beyond these distances would be considered to be insignificant. On this basis, renewable energy developments constructed on all of the above mentioned sites, except for the farm Stinkputs No 229 which accommodates a portion of the Dwarsrug Wind Farm, will be within viewing distance of most of the potentially sensitive receptor locations identified within the study area. However, it is envisaged that the biggest cumulative impact would be the change in the visual character within the study area due to the presence of these large scale industrial-type developments. These facilities will therefore significantly alter the visual baseline within the study area, thereby reducing the visual impact of the proposed power line on the surrounding potentially sensitive receptor locations. The impact of the proposed power line would therefore be outweighed by the impact of the other renewable energy developments being proposed and/or constructed in the surrounding area.

4.4 Night-Time Impacts

The visual impact of lighting on the nightscape is largely dependent on the amount of existing light present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely have a significant impact on the nightscape. In contrast, introducing light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed development.

Much of the study area is uninhabited and as a result, relatively few light sources are present. At night, the study area is characterised by a picturesque dark starry sky and the visual character of the night environment is considered to be mostly ‘unpolluted’ and pristine. The town of Loeriesfontein is also too far away to have an impact on the night scene. It must however be noted that security lighting at the Helios Substation and at the site offices for the Khobab and Loeriesfontein Wind Farms are prominent light sources in the study area. Additional impacts on the night scene are expected to emanate from the substations and ancillary buildings at these Wind Farms once constructed as they will also require lighting for security and operational reasons. Other prominent light sources within the study area at night are largely restricted to isolated lighting from the surrounding farmsteads and residential dwellings, as well as transient light from passing cars travelling along the Granaatboskolk Road.

Operational and security lighting at night will be required for the proposed on-site !Xha Boom Substation as well the proposed Linking Substation. The type and intensity of lighting required was unknown at the time of writing this report and therefore this assessment of the potential night-time impact of the development is based on the general effect that additional light sources will have on the ambient nightscape.

Although the area is not generally renowned as a tourist destination, the natural dark character of the nightscape will be sensitive to the impact of additional lighting at night, particularly from nearby farmhouses. The operational and security lighting required for the proposed development is likely to intrude on the nightscape and create glare, which will contrast with the extremely dark backdrop of the surrounding area. Existing night time views from sensitive / potentially sensitive receptors are characteristic of a relatively dark night scene with some visible light sources, these including Helios Substation and security lighting associated with Khobab and Loeriesfontein Wind Farms.

As a result, lighting impacts from the proposed on-site !Xha Boom Substation and the proposed Linking Substation will marginally increase the existing light pollution in the surrounding area. It should also be noted that the substation and power line will only be constructed if the proposed !Xha Boom Wind Farm (part of a separate on-going EIA process) is developed as well. Operational and security lighting at night will be required for the wind farm in addition to permanent aviation lights or red aircraft warning lights on the top of each wind turbine, creating a network of red lights in the dark night-time sky. The lighting impacts from the proposed on-site !Xha Boom Substation and the proposed Linking Substation would therefore be dwarfed by the glare and contrast of the lights associated with the wind farm. As such, the substations are not expected to result in significant lighting impacts.

4.5 Visual Impact Summary

4.5.1 Access Roads

As previously mentioned, there are no main or arterial roads in close enough proximity to the proposed development. The study area is however traversed by a secondary road, known locally as the Granaatboskolk Road, which links the town of Loeriesfontein with Granaatboskolk some 38kms north-east of the study area.

A network of gravel roads will be constructed to provide access to the proposed power line for maintenance work. Roads are typically only associated with significant visual impact if they traverse sloping ground on an aspect that is visible to the surrounding area. Considering the flat nature of the terrain on the site, it is likely that the visual impact associated with these roads would be limited to the impact of clearing the vegetation. However, if these roads are not maintained correctly during the construction phase, construction vehicles travelling along the gravel access roads could expose surrounding farmstead to dust plumes.

4.5.2 Power Line

Power lines consist of a series of tall towers which make them highly visible. Power lines are not features of the natural environment, but are representative of anthropogenic transformation. Thus when placed in largely natural landscapes, they will be perceived to be highly incongruous in this setting. Conversely, the presence of other anthropogenic elements associated with the built environment, especially other power lines, may result in the visual environment being considered to be 'degraded' and thus the introduction of a new power line into this setting may be less of a visual impact than if there was no existing built infrastructure visible.

Power lines are anthropogenic elements that are not uncommon in the landscape, in both built-up and natural rural settings. The visual impact of a power line would largely be related to the physical characteristics of the area, land use and the spatial distribution of potential receptors. When combining this with the likely value judgements of visual receptors, the visual impact of the proposed power line can be determined. In areas, where the power line would contrast with the surrounding area it may change the visual character of the landscape and be perceived negatively by visual receptors.

As previously mentioned, four (4) power line corridor alternatives are being assessed, linking the proposed on-site !Xha Boom Substation, via the proposed Linking Substation, with Helios Substation some 35kms to the south east. All of the proposed power line corridor alternatives traverse parts of the study area which have remained largely natural. The south-eastern sector of the study area however has already been degraded / transformed to some degree by the presence of existing electrical infrastructure and industrial form, including high voltage power lines, Helios Substation and the Khobab and Loeriesfontein Wind Farms presently under construction.

A summary of the visual impact of the proposed power line corridor alternatives, in relation to the physical characteristics, land use, visual character, presence of visual receptors and existing power lines or other infrastructure in the surrounding landscape, is discussed in **Table 6** below. These factors have been investigated in order to determine the degree to which the proposed power line corridor would be visually compatible with the surrounding environment and to determine its overall visual impact.

Table 6: Visual impact summary of the proposed power line corridor alternatives in relation to surrounding environment

Physical and Land Use Characteristics	Visual Character	Visual Contrast	Presence of Visual Receptors	Overall Visual Impact
Topography: The proposed power line is expected to be visible from much of the study area due to the largely flat terrain and wide-ranging vistas in the study area. The localised hills / koppies in parts of the study area would offer some localized visual screening, however the topographical undulations would offer minimal visual screening. **Vegetation:** The natural short shrub-like vegetation cover which dominates most of the study area results in wide-ranging vistas across most of the study area. Parts of the study area are however characterised by tree species (both naturally occurring and artificial) which are expected provide localised screening from the proposed development.	Most of the study area is considered to have a natural (almost vacant) visual character resulting from minimal human habitation and associated infrastructure. The predominant land use (sheep farming) has not transformed the natural landscape and thus the natural rural character has been retained across much of the study area. There are however some pastoral elements in the area which are expected to give the surrounding area a more pastoral feel. Typical anthropogenic elements and built infrastructure in the rural parts of the study area include isolated farmhouses, gravel access roads, boundary fences and telephone poles. The visual	The area is largely natural or rural / pastoral in character and the prevailing land use (i.e. sheep farming) has retained the natural vegetation across much of the study area. As such the development would not be consistent with the prevailing pastoral land use within the surrounding area. However, the existing anthropogenic elements in parts of the study area are expected to lessen the degree to which the proposed development would be considered incongruent with the surrounding landscape. The presence of road and rail infrastructure in the south-eastern parts of the study area introduces distinct linear elements into the landscape. In this setting,	Approximately nineteen (19) potentially sensitive visual receptors were identified within viewing distance (5km) of the power line corridor. All of these are believed to be scattered farmsteads / homesteads / residential dwellings. It must be noted that only two (2) of the potentially sensitive visual receptors identified are located within the 'High' Visual Exposure zone (i.e. within 500m of the nearest proposed power line corridor alternative). Seven (7) potentially sensitive receptors are located in the 'Moderate' Visual Exposure zone (i.e. between 500m and 2km of the nearest power line corridor alternative) while the remaining ten (10) receptors are located more than 2km	Due to the fact that most of the visual receptors identified are located in either Moderate or Low zones of visual exposure, distance from the proposed power line corridors, and the presence of existing anthropogenic elements (such as the road and rail infrastructure, Helios Substation and associated high voltage power lines and Khobab and Loeriesfontein Wind Farms), the visual impact resulting from the proposed power line is rated as moderate. Refer to **Section 4.6** for the overall visual impact rating.

Land use: Much of the assessment area is characterised by natural unimproved vegetation with sheep farming being the dominant activity. A major portion of the study area is very sparsely populated, with relatively little human-related infrastructure in evidence. The southern sections of the study area are however characterised by greater human influence in the form of rail and electrical infrastructure as well as the Khobab and Loeriesfontein Wind Farms presently under construction. These anthropogenic elements are expected to alter the visual character of the study area and as such the visual contrast of the proposed power line would be reduced in these degraded areas.	character is more transformed in the southern and south-eastern parts of the study area due to the presence of the Granaatboskolk Road, rail infrastructure, Helios Substation and associated high voltage power lines. In addition, significant transformation is occurring in the south-eastern section of the study area with the construction of the Khobab and Loeriesfontein Wind Farms.	the development of a new power line would contrast only moderately with the surrounding environment. It is also important to note that the south-eastern sections of the study area are characterised by greater human influence in the form of Helios Substation with associated high voltage power lines and the Khobab and Loeriesfontein Wind Farms presently under construction. These anthropogenic elements are expected to alter the visual character of the study area thus reducing the visual contrast of the proposed development.	from the nearest corridor alternative.	

4.5.3 On-site Substations

Two (2) new substations are proposed in conjunction with the 132kV power line development, namely the 33/132kV on-site IPP substation (!Xha Boom Substation) and a Linking Substation. The proposed !Xha Boom substation, located at the western-most end of the power line corridor, will serve to transform or 'step-up' the voltage of electricity generated by the proposed !Xha Boom Wind Farm to feed into the National Grid. The proposed Linking Substation will be located south-east of the proposed !Xha Boom Substation within the power line assessment corridor.

In isolation, the proposed substations may be considered to be visually intrusive, but as these substations are intended to serve the proposed !Xha Boom Wind Farm (part of a separate on-going EIA process), they would only be constructed in conjunction with the proposed wind farm development. When viewed from the surrounding area, the substations would likely form part of the wind farm complex and would therefore be dwarfed by the large number of wind turbines comprising the wind farm. As such, the substations are not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

4.6 Overall Visual Impact Rating

The BA requires that an overall rating for visual impact be provided to allow the visual impact to be assessed alongside other environmental parameters. SiVEST has developed an impact rating matrix for this purpose. The tables below present the impact matrix for visual impacts associated with the proposed construction and operation of the 33/132kV on-site !Xha Boom Substation, the Linking Substation and the 132kV power line with associated infrastructure.

Please refer to **Appendix A** below for an explanation of the impact rating methodology.

4.6.1 Planning

No visual impacts are expected during planning.

4.6.2 Construction

Table 7: Rating of visual impacts of the proposed !Xha Boom Substation, Linking Substation and 132kV power line (including associated infrastructure) during construction

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. A network of gravel access roads will be required in order to provide access to the proposed power line and substation sites. Considering the largely flat nature of the terrain in the study area, it is likely that the visual impact associated with these roads would be limited to the impact resulting from the clearing of vegetation. However, if these roads are not maintained correctly during the construction phase, maintenance vehicles travelling along these roads could increase dust emissions and create dust plumes. The increased traffic on the gravel roads and the dust plumes could therefore also create a visual impact and may evoke negative sentiments from surrounding viewers. It should however be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to internally contribute to the overall visual impact from the proposed development. The visual intrusion of the construction activities associated with the proposed substations and power line could adversely affect farmsteads / homesteads within the visual assessment zone. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, the temporary stockpiling of soil during construction may alter the generally flat landscape and wind blowing over these disturbed areas could result in dust which would have a visual impact. Vegetation clearance required for the construction of the proposed substations is expected to increase dust emissions and alter the natural character of the surrounding area, thus creating a visual impact.
Extent	Local / District (2)

Probability	Probable (3)	
Reversibility	Completely reversible (1)	
Irreplaceable loss of resources	Marginal loss (2)	
Duration	Short term (1)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-24 (negative low)	-20 (negative low)
Mitigation measures	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Limit the number of vehicles and trucks travelling to and from the proposed site, where possible. ▪ If dust plumes become an issue, dust suppression techniques must be implemented on gravel access roads utilised during construction, where possible. ▪ If dust plumes become an issue, dust suppression must be implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles.	

	▪ Select the power line and substation site alternatives that will have the least impact on visual receptors. ▪ Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil.

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.6.3 Operation

Table 8: Rating of visual impacts of the proposed !Xha Boom Substation, Linking Substation and 132kV power line (including associated infrastructure) during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The proposed on-site !Xha Boom Substation, Linking Substation and 132kV power line could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. This is especially true for the power line towers, which are tall structures and will most likely be visible for greater distances. However, where existing power lines are present the visual environment would already be visually 'degraded' and thus the introduction of a new power line in this setting may be considered to be less of a visual impact than if no existing built infrastructure were visible. A network of gravel access roads will be required in order to provide access to the proposed power line and to the substations. Considering the largely flat nature of the terrain within the study area, it is likely that the visual impact associated with these roads would be limited to the impact resulting from the clearing of vegetation. However, if these roads are not maintained correctly, vehicles travelling along the gravel access roads could increase dust emissions and create dust plumes. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. . It should however

	be noted that the existing roads which can be found around the project site are also gravel. As such, the proposed gravel access roads are not expected to internally contribute to the overall visual impact from the proposed development. Security and operational lighting at the proposed substations could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the proposed !Xha Boom Substation, the Linking Substation and the 132kV power line could also adversely affect farmsteads / homesteads within the visual assessment zone.	
Extent	Local/district (2)	
Probability	Definite (4)	
Reversibility	Barely reversible (3)	
Irreplaceable loss of resources	Marginal (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Medium negative impact **After mitigation measures:** Medium negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-34 (negative medium)	-34 (negative medium)
Mitigation measures	▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ Where possible, limit the amount of security and operational lighting present at the on-site substation. ▪ Where possible, limit the number of maintenance vehicles using access roads.	

	▪ Ensure that dust suppression techniques are implemented on gravel access roads utilised during operation, where possible. ▪ Non-reflective surfaces should be utilised where possible.

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.6.4 Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

5 COMPARATIVE ASSESSMENT OF ALTERNATIVES

As previously mentioned, four (4) power line corridor alternatives (Options 1-4) are being investigated in order to provide grid access via Helios Substation. In addition, two (2) on-site substation site alternatives, and two (2) linking substation site alternatives are being investigated at this stage, namely !Xha Boom Substation Options 1 and 2, Linking Substation Options 1 and 2.

The preference rating for each alternative is provided in **Table 9** below. The alternatives are rated as follows as preferred, not-preferred, favourable or no-preference.

The degree of visual impact and rating has been determined based on the following factors:

- The location of the power line or on-site substation site in relation to areas of high elevation, especially ridges, koppies or hills;
- The location of the power line or on-site substation site in relation to sensitive receptor locations; and
- The location of the power line or on-site substation site in relation to areas of natural bushveld vegetation (clearing site for the development worsens the visibility).

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 9: Comparative Assessment of Alternatives

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
!Xha Boom Substation Option 1	Favourable	Two (2) potentially sensitive visual receptors can be found within 5km of !Xha Boom Substation Option 1, these being VR 13 and VR 18. Both of these receptors are more than 3kms from the substation site and therefore in the low impact zone. There is no notable preference between the two (2) options and both are considered to be favourable. In addition, the proposed substation would form part of the proposed !Xha Boom Wind Farm and would be dwarfed by the large number of wind turbines that would be visible.
!Xha Boom Substation Option 2	Favourable	Two (2) potentially sensitive visual receptors are located within 5kms of !Xha Boom Substation Option 2, these being VR 13 and VR 18. Both of these receptors are more than 3kms from the substation site and therefore in the low impact zone. There is however no notable preference between the two (2) options and both are considered to be favourable. In addition, the proposed substation would form part of the proposed !Xha Boom Wind Farm and would be dwarfed by the large number of wind turbines that would be visible.
LINKING SUBSTATION ALTERNATIVES		
Linking Substation Option 1	Favourable	There is only one (1) potentially sensitive visual receptor located within 5km of the proposed Linking

Alternative	Preference	Reasons (incl. potential issues)
		Substation Option 1, this being VR 13 which is approximately 4.2kms from the substation site and therefore in the low impact zone. Although Substation Option 1 is located further from the potentially sensitive receptor, there is no notable preference between the two (2) options and both are considered to be favourable.
Linking Substation Option 2	Favourable	As with Option 1, there is only one (1) potentially sensitive visual receptor located within 5km of the proposed Linking Substation Option 2, this being VR 13 which is approximately 2.5kms from the substation site and therefore in the low impact zone. Although Substation Option 2 is located closer to the potentially sensitive receptor, there is no notable preference between the two (2) options and both are considered to be favourable.
POWER LINE CORRIDOR ALTERNATIVES		
Power Line Corridor Option 1	Favourable	A total of eleven (11) potentially sensitive visual receptors are located within 5kms of Option 1. Of these, one (1) receptor is within 500m of the corridor (i.e. high impact zone), this being VR 25. One (1) receptor (namely VR 32) is also located in the moderate impact zone (between 500m and 2km) and the remaining nine (9) are located in the low impact zone (between 2km and 5km). It should be noted that VR 25 is relatively close to Khobab Wind

Alternative	Preference	Reasons (incl. potential issues)
		Farm and is thus located in an area already undergoing significant visual transformation. Much of the route alignment for Option 1 traverses areas which have remained largely natural, although a section of the route passes within 1km of the Khobab Wind Farm where the landscape is undergoing significant transformation. Visual impacts are likely to be negligible in these transformed areas, and although the development overall is expected to alter the character of the surrounding area to some degree, visual impact associated with this option is expected to be moderate. Option 1 is therefore considered favourable.
Power Line Corridor Option 2	Preferred	A total of eight (8) potentially sensitive visual receptors are located within 5kms of Power Line Corridor Option 2. Of these, one (1) receptor is within 500m of the corridor (i.e. high impact zone), this being VR 34. Two (2) receptors (namely VR 25 and VR 32) are located in the moderate impact zone (between 500m and 2km) and the remaining five (5) are located in the low impact zone (between 2km and 5km. Although Option 2 traverses some areas which have remained largely natural, much of the route alignment passes through areas which are undergoing considerable visual transformation as a result of the development of the Khobab and

Alternative	Preference	Reasons (incl. potential issues)
		Loeriesfontein Wind Farms. As such, the visual impact associated with this option is expected to be negligible. As Option 2 has the least number of potentially sensitive receptors within 5kms of the corridor, this is considered to be the preferred option from a visual perspective.
Power Line Corridor Option 3	Not preferred	A total of thirteen (13) potentially sensitive visual receptors are located within 5kms of Power Line Corridor Option 3. None of these are located within 500m of the corridor. Five (5) receptors are however located in the moderate impact zone (between 500m and 2km) and the remaining eight (8) are located in the low impact zone (between 2km and 5km). Most of the route alignment for Option 3 traverses areas which have remained largely natural with few anthropogenic elements in evidence. As such, the development of a power line along this route alignment is expected to alter the character of the surrounding area to some degree and to have a significant visual impact in these untransformed parts of the study area. As such, Option 3 is not preferred from a visual point of view.
Power Line Corridor Option 4	Favourable	A total of nine (9) potentially sensitive visual receptors are located within 5kms of Power Line Corridor Option 4. Of these, one (1)

Alternative	Preference	Reasons (incl. potential issues)
		receptor is within 500m of the corridor (i.e. high impact zone), this being VR 34. One (1) (1) receptor (namely VR 33) is also located in the moderate impact zone (between 500m and 2km) and the remaining seven (7) are located in the low impact zone (between 2km and 5km). Although Option 4 traverses some areas which have remained largely natural, much of the route alignment passes through areas which are undergoing considerable visual transformation as a result of the development of the Khobab and Loeriesfontein Wind Farms with associated infrastructure. As such, the visual impact associated with this option is expected to be negligible. Option 4 is therefore considered favourable from a visual point of view.

6 CONCLUSIONS

The Visual Impact Assessment (VIA) conducted for the proposed development has demonstrated that much of the study area has a largely natural, untransformed visual character, although there are some pastoral elements in the area which are expected to give the surrounding area a more pastoral feel. Significant anthropogenic elements are however present, particularly in the south-eastern section of the study area where road and rail infrastructure, combined with the Helios Substation and associated high voltage power lines have altered the natural visual character of the surrounding area to some extent. Further transformation and landscape degradation is occurring in this sector of the study area as a result of the Khobab and Loeriesfonetin Wind Farms which are presently under construction. In addition, there are several renewable energy developments (solar and wind) proposed within the study area and, once constructed, these facilities and their associated infrastructure will significantly alter the visual character and baseline in the study area resulting in a more industrial-type visual character. The proposed development is therefore not expected to have a significant visual impact within these above-mentioned parts of the study area.

Due to the dominant livestock (i.e. sheep) rearing practices and relatively limited human habitation in the surrounding area, no sensitive visual receptors (such as Guesthouses and other tourism facilities) were identified within the study area. A total of nineteen (19) scattered farmsteads / homesteads were however identified within the study area as potentially sensitive visual receptors due to their location in a largely rural setting as well as the fact that they are used to house the local farmers as well as their farm workers. Upon investigation it was established that the proposed substation and power line development would have a moderate visual impact on fourteen (14) of these receptors and a low visual impact on two (2) of these receptors. It should however be noted that the proposed development is expected to result in a high visual impact on three (3) of the potentially sensitive receptor locations identified within the study area, namely VR 27, VR 32 and VR 34.

It must be noted that the Granaatboskolk Road road (which traverses the visual assessment zone) is not considered to be a visually sensitive road as it does not form part of any scenic tourist routes and is not specifically valued or utilised for its scenic or tourism potential.

The overall significance of the visual impacts resulting from of the proposed development during construction and operation was assessed according to SiVEST's impact rating matrix in order to allow the visual impact to be assessed alongside other environmental parameters. The impact assessment revealed that overall the proposed development would have a low negative visual impact during construction and a medium negative visual impact during operation, with a number of mitigation measures available.

As part of the VIA, the proposed power line corridor alternatives and substation site alternatives were also comparatively assessed. The comparative assessment of alternatives revealed that both site alternatives for the proposed !Xha Boom Substation are favourable and there is no notable preference between the two (2) options from a visual perspective. Similarly, both site alternatives for the proposed Linking Substation are favourable and there is no preference for either site. With regard to the proposed power line corridor alternatives, the comparative assessment revealed that Power Line Corridor Option 2 would be the preferred option from a visual perspective, while Power Line Corridor Options 1 and 4 were deemed to be favourable. In addition, it was deemed that Power Line Corridor Option 3 is not preferred from a visual point of view.

Overall it can be concluded that the visual impact of the proposed development would be reduced due to the lack of sensitive visual receptors present. However, it is expected that the proposed development would alter the largely natural / scenic character of the study area and contrast moderately with the typical land use and/or pattern and form of human elements present. It should also be noted that several renewable energy developments (both wind and solar) are being proposed within close proximity to the proposed development. These renewable energy developments would reduce the overall natural / scenic character of the study area, however they would increase the cumulative visual impacts, should some or all of these developments be granted environmental authorisation (EA) to proceed, receive a license and be constructed.

6.1 Visual Impact Statement

It is SiVEST's opinion that the visual impacts are not significant enough to prevent the project from proceeding and that an EA should be granted. It should be noted that no visually sensitive receptors with tourism significance have been identified within the study area. A total number of nineteen (19) potentially sensitive visual receptors were however identified. These included scattered farmsteads / homesteads which house the local farmers as well as their farm workers. These dwellings are regarded as potentially sensitive visual receptors as they are located within a mostly rural setting and the proposed development will likely alter natural vistas experienced from these dwellings. From a visual impact perspective, only three (3) of the potentially sensitive visual receptors (namely VR 27, VR 32 and VR 34) are expected to experience a high degree of visual impact from the proposed development. In addition, the proposed development is expected to alter the largely natural / scenic character of the study area and contrast significantly with the typical land use and/or pattern and form of human elements present as the study area is largely natural / scenic and untransformed. The existing anthropogenic elements already present in the study area have however already altered the natural character of the surrounding environment to a degree and are expected to lower the visual contrast of the proposed development with the surrounding area. SiVEST is therefore of the opinion that the visual impact associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

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Appendix A

IMPACT RATING METHODOLOGY

IMPACT RATING METHODOLOGY

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 1: Example of the significance impact rating table.

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.

3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		

1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Appendix B

SPECIALIST CVs

M07/16

CURRICULUM VITAE

Andrea Gibb

Name Andrea Gibb

Profession Environmental Practitioner

Name of Firm SiVEST SA (Pty) Ltd

Present Appointment Environmental Practitioner and Visual Specialist: Environmental Division

Years with Firm 6 Years

Date of Birth 29 January 1985

ID Number 8501290020089

Nationality South African

Education

Matriculated 2003, Full Academic Colours, Northcliff High School, Johannesburg, South Africa

Professional Qualifications

BSc (Hons) Environmental Management (University of South Africa 2008-2010)
Coursework**:** Project Management, Environmental Risk Assessment and Management, Ecological and Social Impact Assessment, Fundamentals of Environmental Science, Impact Mitigation and Management, Integrated Environmental Management Systems & Auditing, Integrated Environmental Management, Research Methodology.
Research Proposal**:** Golf Courses and the Environment

BSc Landscape Architecture (with distinction) (University of Pretoria 2004-2007)
Coursework: Core modules focused on; design, construction, environmental science, applied sustainability, shifts in world paradigms and ideologies, soil and plant science, environmental history, business law and project management.
Awards: Cave Klapwijk prize for highest average in all modules in the Landscape Architecture programme, ILASA book prize for the best Landscape Architecture student in third year design, Johan Barnard planting design prize for the highest distinction average in any module of plant science.

ArcGIS Desktop 1 (ESRI South Africa December 2010)
Environmental Impact Assessment (EIA) 2014 Legal Regime Workshop (Imbewu 2015)

Employment Record

Aug 2010 – to date	SiVEST SA (Pty) Ltd: Environmental Practitioner
Jan 2008 – July 2010	Cave Klapwijk and Associates: Environmental Assistant and Landscape Architectural Technologist
Feb 2006 – Dec 2006	Cave Klapwijk and Associates: Part time student

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Fluent	Fluent	Fluent

CURRICULUM VITAE

Andrea Gibb

Key Experience

Specialising in the field of Environmental Management and Visual Assessment.

Andrea joined SiVEST in August 2010 and holds the position of Environmental Practitioner in the Johannesburg Office. She has 8.5 years' work experience and specialises in managing large scale multifaceted EIAs and Basic Assessment (BAs), primarily related to renewable energy generation and electrical distribution. She also specialises in undertaking visual impact and landscape assessments. She has extensive experience in overseeing public participation and stakeholder engagement processes and has been involved in environmental baseline assessments, fatal flaw / feasibility assessments and environmental negative mapping / sensitivity analyses. From a business and administrative side, Andrea is actively involved in maintaining good client relationships, mentoring junior staff and maintaining the financial performance of the projects she leads.

Skills include:

- Project Management (MS Project)
- Environmental Impact Assessment (EIA)
- Basic Assessment (BA)
- Public Participation Management
- Visual Impact Assessment (VIA)
- Landscape Assessment
- Strategic Environmental Planning
- Documentation / Quality Control
- Project Level Financial Management

Projects Experience

Aug 2010 – to date

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) / BASIC ASSESSMENT (BA)

- EIA for the proposed development of the Tlisitseng 1 and 2 75MW Solar Photovoltaic (PV) Energy Facilities near Lichtenburg, North West Province.
- EIAs for the proposed development of the Sendawo 1, 2, and 3 75MW Solar PV Energy Facilities near Vryburg, North West Province.
- EIA for the proposed construction of the Sendawo Common Collector Substation and power line near Vryburg, North West Province.
- EIA for the proposed construction of the Aletta 140MW Wind Energy Facility near Copperton, Northern Cape Province.
- Application for an Amendment of the Environmental Authorisation (EA) for the proposed construction of the 100MW Limestone Solar Thermal Power Project near Danielskuil, Northern Cape Province.
- Applications for the Amendment of the EAs for the proposed construction of three 75MW solar PV facilities near Prieska, Northern Cape Province.
- Applications for the Amendment of the EAs for the proposed construction of the 75MW Arriesfontein and Wilger Solar Power Plants near Danielskuil, Northern Cape Province.
- Completion and submission of the final EIA report for the proposed Rooipunt PV Solar Power Park Phase 1 and proposed Rooipunt PV Solar Power Park Phase 2 near Upington, Northern Cape Province.
- EIAs for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- EIA for the proposed construction of the Nokukhanya 75MW Solar PV Power Plant near Dennilton, Limpopo Province.
- EIA for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.

- BA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province.
- BA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province.
- BA for the proposed Construction of the SSS1 5MW Solar PV Plant on the Western Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province.
- BA for the proposed Construction of the SSS2 5MW Solar PV Plant on the Eastern Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the proposed Bophirima Substation to the existing Schweizer-Reneke Substation, North West Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the Mookodi Substation to the existing Magopela Substation, North West Province.
- BA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province.
- Amendment of the Final Environmental Impact Report for the Proposed Mookodi 1 Integration Project near Vryburg, North West Province.
- BA for the proposed 132kV power line and associated infrastructure for the proposed Redstone Solar Thermal Energy Plant near Lime Acres, Northern Cape Province.
- BA for the proposed construction of a 132kV power line and substation associated with the 75MW PV Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province.
- BA for the proposed establishment of a Learning and Development Retreat and an Executive Staff and Client Lodge at Mogale's Gate, Gauteng Province.
- Application for an Amendment of the EA to increase the output of the proposed 40MW PV Facility on the farm Mierdam to 75MW, Northern Cape Province.
- BA for the proposed construction of a power line and substation near Postmasburg, Northern Cape Province.
- BA for the proposed West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng.
- EIA for the proposed construction of a wind farm and PV plant near Prieska, Northern Cape Province.
- Public Participation assistance as part of the EIA for the proposed Thyspunt Transmission Lines Integration Project – EIA for the proposed construction of 5 x 400kV transmission power lines between Thyspunt to Port Elizabeth, Eastern Cape Province.
- EIA assistance for the proposed construction of three Solar Power Plants in the Northern Cape Province.
- Public Participation as part of the EIA for the proposed Delareyille Kopela Power Line and Substation, North West Province.
- Public Participation as part of the EIA for the Middelburg Water Reclamation Project, Mpumalanga Province.

VISUAL IMPACT ASSESSMENT (VIA)

- VIA (Scoping Phase) for the proposed construction of a 3000MW Wind Farm and associated infrastructure near Richmond, Northern Cape Province.
- VIA for the proposed construction of a power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces.
- VIA for the proposed construction of a power line and associated infrastructure for the proposed Rooipunt Solar Thermal Power Plant near Upington, Northern Cape Province.
- VIAs (Impact Phase) for the proposed construction of the Sendawo 1, 2 and 3 solar PV energy facilities near Vryburg, North West Province.

- VIA (Impact Phase) for the proposed construction of the Sendawo substation and associated power line near Vryburg, North West Province.
- VIAs (Impact Phase) for the proposed construction of the Tlisitseng 1 and 2 solar PV energy facilities near Lichtenburg, North West Province.
- VIA for the proposed construction of the Tlisitseng substation and associated 132kV power line near Lichtenburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Sendawo substation and associated power line near Vryburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Sendawo 1, 2 and 3 solar PV energy facilities near Vryburg, North West Province.
- VIA (Scoping Phase) for the proposed construction of the Tlisitseng 1 and 2 solar PV energy facilities near Lichtenburg, North West Province.
- Visual recommendations for Phase 1 of the proposed Renishaw Estate Mixed Use Development, KwaZulu-Natal Province.
- VIA for the proposed Tinley Manor South Banks Development, KwaZulu-Natal Province.
- VIAs (Impact Phase) for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- VIA (Scoping Phase) for the proposed construction of the Helena 1, 2 and 3 75MW Solar PV Energy Facilities near Copperton, Northern Cape Province.
- Visual Due Diligence Report for the possible rapid rail extensions to the Gauteng network, Gauteng Province.
- Visual Status Quo and Constraints Report for the possible rapid rail extensions to the Gauteng network, Gauteng Province.
- VIA for the proposed agricultural components of the Integrated Sugar Project in Nsoko, Swaziland.
- VIA for the proposed Tweespruit to Welroux power lines and substation, Free State Province.
- VIA for the proposed construction of the Nokukhanya 75MW Solar PV Power Plant near Dennilton, Limpopo Province.
- VIA (Impact Phase) for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed amendment to the authorised power line route from Hera Substation to Westgate Substation, Gauteng Province.
- VIA (Impact Phase) for the Eastside Junction Mixed Use Development near Delmas, Mpumalanga Province.
- VIA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province.
- VIA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province.
- VIA (Scoping Phase) for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province.
- VIA for the proposed Rorqual Estate Development near Park Rynie on the South Coast of KwaZulu Natal.
- VIA (Scoping Phase) for the proposed construction of a Coal-fired Power Station, Coal Mine and Associated Infrastructure near Colenso, KwaZulu-Natal Province.
- VIA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province.
- VIA for the proposed construction of the Duma transmission substation and associated Eskom power lines, KwaZulu-Natal Province.
- VIA for the proposed construction of the Madlanzini transmission substation and associated Eskom power lines, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Normandie substation to Hlungwane substation, Mpumalanga and KwaZulu-Natal Provinces.
- VIA for the proposed construction of the Nzalo transmission substation and associated Eskom power lines, KwaZulu-Natal Province.

- VIA for the proposed construction of the Sheepmoor traction substation with two 20MVA transformer bays and a new associated 88kV turn-in power line, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Uitkoms substation to Antra T-off, Mpumalanga Province.
- VIA for the proposed rebuild of the 88kV power line from Umfolozi substation to Eqwasha traction substation including an 88kV turn-in power line to Dabula traction substation, Kwazulu-Natal Province.
- VIA for the proposed construction of the new 88/25kV Vryheid traction substation with two 20MVA transforma bays and a new associated 88kV turn-in power line, KwaZulu-Natal Province.
- VIA for the proposed construction of a 132kV power line and substation associated with the 75MW PV Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province.
- VIA (Impact Phase) for the proposed Construction of a Solar PV Power Plant near De Aar, Northern Cape Province.
- VIA for the (Impact Phase) proposed Construction of the Renosterberg Wind Farm near De Aar, Northern Cape Province.
- VIA for the (Impact Phase) proposed Construction of the Renosterberg Solar PV Power Plant near De Aar, Northern Cape Province.
- VIA for the proposed construction of a 132kV power line for the Redstone Thermal Energy Plant near Lime Acres, Northern Cape Province.
- VIA for the proposed Mookodi Integration phase 2 132kV power lines and Ganyesa substation near Vryburg, North West Province.
- VIA for the proposed 132kV power lines associated with the PV Plants on Droogfontein Farm near Kimberley, Northern Cape Province.
- VIA (Scoping phase) for the Eastside Junction Mixed Use Development near Delmas, Mpumalanga Province.
- VIA for the proposed development of a learning and development retreat and an executive and staff lodge at Mogale’s Gate, Gauteng Province.
- VIA for the proposed construction of a substation and 88kV power line between Heilbron (via Frankfort) and Villiers, Free State Province.
- Visual Status Quo Assessment for the Moloto Development Corridor Feasibility Study in the Gauteng Province, Limpopo Province and Mpumalanga Province.
- VIA the West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng.
- VIA for the proposed construction of a wind farm and solar photovoltaic plant near Loeriesfontein, Northern Cape Province.
- Visual sensitivity mapping exercise for the proposed Mogale’s Gate Expansion, Gauteng.
- VIA (Scoping Phase) for the proposed Renosterberg Solar PV Power Plant and Wind Farm near De Aar, Northern Cape Province.
- Scoping level VIAs for the proposed construction of three Solar Power Plants in the Northern Cape Province.
- VIAs for the Spoornet Coallink Powerline Projects in KZN and Mpumalanga.
- Visual Constraints Analysis for the proposed establishment of four Wind Farms in the Eastern and Northern Cape Province.
- VIA (Scoping Phase) for the proposed development of a solar energy facility in De Aar, Northern Cape.
- VIA (Scoping Phase) for the proposed development of a solar energy facility in Kimberley, Northern Cape.

STRATEGIC ENVIRONMENTAL PLANNING

- Assistance with the Draft Environmental Management Framework for the Mogale City Local Municipality, Gauteng Province.
- Sensitivity Negative Mapping Analysis for the proposed Mogale’s Gate Development, Gauteng Province.

OTHER

Jan 2008 – July 2010

Environmental management, research, report writing, and landscape design for several development projects:

- Report writing, coordination and public participation for several BAs.
- Planting design (including rehabilitation) in accordance with natural ecological processes, endemic species and appropriate techniques.
- Graphic presentations and mapping for several VIAs and landscape architectural designs, including three-dimensional imagery.

Feb 2006 – Dec 2006

Landscape Architectural drafting, rendering and planting design for a variety of projects including the Oprah Winfrey Academy for girls and the New UNISA Student Entrance Building.

Name	Stephan Hendrik Jacobs
Profession	Environmentalist
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Graduate Environmental Consultant
Years with Firm	Joined May 2015
Date of Birth	28 May 1991
ID Number	9105285065080
Nationality	South African

Education

Pretoria Boys High, Pretoria, South Africa, Matriculated 2009.

Professional Qualification

- BSc Hons Environmental Management and Analysis, (Post Graduate) University Of Pretoria Honours (2014).
- BSc Environmental Sciences (Undergraduate) University Of Pretoria (2012-2013)

Employment Record

May 2015 – current	SiVEST SA (Pty) Ltd – Graduate Environmental Consultant
Nov 2014 – Feb 2015	Sodwana Bay Fishing Charters – Assistant Manager
Oct 2014 – Mar 2015	Ufudu Turtle Tours – Tour Guide

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Excellent	Excellent	Excellent
Afrikaans	Good	Good	Good

Key Experience

Stephan joined SiVEST in May 2015 and holds the position of Graduate Environmental Consultant in the Johannesburg office.

Stephan specialises in the field of Environmental Management and has been involved in the compilation of Environmental Impact Assessments (EIAs) and Basic Assessments (BAs). Stephan has also assisted extensively in the undertaking of field work and the compilation of reports for specialist studies such as surface water and visual impact assessments. Stephan also has experience in Environmental Compliance and Auditing and has acted as an Environmental Control Officer (ECO) for several infrastructure projects.

Stephan has been educated and achieved his degrees (BSc and BSc Hons) at the University of Pretoria in Environmental Sciences (Environmental Management & Analysis).

Throughout his time at SiVEST, Stephan has acquired the following skills:

- Strong computer skills (Work, excel, powerpoint etc);
- Strong Proposal and report writing skills;
- Report compilation skills for Environmental Impact Assessments (EIAs) and Basic Assessments (BAs);

- Report compilation skills for Environmental Management Plans/Programmes (EMPr);
- Compilation and conducting Visual Impact Assessments;
- Assisting in Surface Water / Wetland Delineations and Assessments.

Key experience includes:
- Environmental Impact Assessment (EIA) of small, medium and large-scale infrastructure projects,
- Basic Assessment (BA), of small, medium and large-scale infrastructure projects,
- Environmental Management Plans (EMPr), of small, medium and large-scale infrastructure projects,
- Proposal and tender compilation,
- Environmental Compliance and Auditing (ECO);
- Various site inspections, and
- Visual Impact Assessments (Field work and report compilation).

Projects Experience

Stephan is responsible for the following activities: report writing, proposal writing, assisting in specialist surface water delineation and functional assessments, assisting in visual impact assessments and environmental compliance and auditing procedures. Current and completed projects / activities are outlined in detail below:

- Environmental Control Officer (ECO) for the Polokwane Integrated Rapid Public Transport System (IRPTS), Limpopo Province.

- Basic Assessment (BA) for the construction of a Non-Motorised Transport (NMT) Training and Recreational Park adjacent to the Peter Mokaba Stadium in Polokwane, Limpopo Province.

- Basic Assessment (BA) for the Proposed Expansion of the Tissue Manufacturing Capacity at the Twinsaver Kliprivier Operations Base, Gauteng Province.

- Environmental Control Officer (ECO) for Phase 1 and Phase 2 of the Newmarket Retail Development, Gauteng Province.

- Environmental Review of the Xakwa Coal Operations, adjacent to the proposed Eastside Junction Development.

- Environmental Due Diligence for the Woodlands and Harrowdene Office Parks in Woodmead, Gauteng Province.

- Visual Impact Assessment for the Helena Solar PV Plant, Northern Cape Province.

- Visual Impact Assessment for the Nsoko Msele Integrated Sugar Project, Swaziland.

- Visual Impact Assessments for the proposed construction of the Sendawo Solar 1, Sendawo Solar 2 and Sendawo Solar 3 Photovoltaic (PV) Energy Facilities near Vryburg, North West Province.

- Visual Impact Assessments for the proposed construction of the Sendawo Substation and Associated 400kV Power Line near Vryburg, North West Province.

- Visual Impact Assessments for the proposed construction of the Tlisitseng Solar 1 and Tlisitseng Solar 2 Photovoltaic (PV) Energy Facilities near Lichtenburg, North West Province.

- Visual Impact Assessment for the proposed construction of the 3000MW PhilCo Green Energy Wind Farm and Associated Infrastructure near Richmond, Northern Cape Province.

- Visual Impact Assessment for the proposed construction of the Aletta 140MW Wind Energy Facility neat Copperton, Northern Cape Province.

- Visual Impact Assessment for the proposed construction of the Eureka 140MW Wind Energy Facility and associated Infrastructure near Copperton, Northern Cape Province.

- Visual Impact Assessment for the proposed construction of the Eureka 400kV Substation and 400kV Power Line neat Copperton, Northern Cape Province.

- Basic Visual Impact Assessments for the proposed construction of the Tlisitseng 1 and Tlisitseng 2 Substations and Associated 132kV Power Lines near Lichtenburg, North West Province.

- Basic Visual Impact Assessment for the proposed construction of up to a 132kV Power Line and Associated Infrastructure for the Rooipunt Solar Thermal Power Plant near Upington, Northern Cape Province.

- Basic Visual Impact Assessment for the proposed construction of up to a 132kV Power Line and Associated Infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberly, Free State and Northern Cape Provinces.

- Surface Water Assessment for the Steve Thswete Local Municipality, Mpumalanga Province.

- Surface Water Delineation and Assessment for the proposed coal Railway Siding at the Welgedacht Marshalling Yard and associated Milner Road Upgrade near Springs, Ekurhuleni Metropolitan Municipality.

Keagan Allan

Senior Scientist

Profession	Senior Scientist & GIS Specialist
Education	BSc Geographical Science – 2003 BSc (Hons) Geographical Science and Environmental Management – 2004 MSc Geographical Science (Cum Laude) – 2007
Registrations/ Affiliations	Registered Professional Natural Scientist (Pr.Sci.Nat), South African Council for Natural Scientific Professions (SACNASP), 400185/13 IAIA South Africa
Awards	Won Best Poster at the 2010 IAIAsa Conference – Poster Applications of GIS in EMF.

Specialisation

Geographical Information Systems and Remote Sensing

Expertise

Keagan Allan has been involved in the field of Geographical Information Systems (GIS) for the past 8 years. His expertise includes:

- Geographical Information Systems (GIS), more specifically data collection and manipulation; modelling of various spatial data for Visual Impact Assessments and Ground Water management and database management.
- Visual Impact Assessment Specialist – using GIS and modelling to conduct Visual Impact Assessments (VIAs) for large scale mining and industrial developments.
- GIS Development – using Visual Basic scripting to develop tools for use within the ESRI ArcMap environment.
- GIS in Environmental Management Frameworks – using Visual Basic in conjunction with GIS techniques to generate information for use in the GIS reporting in an EMF study.
- Remote Sensing (RS) more specifically the use of remotely sensed images in the classification of various land use types.

Employment

Jul 2008 – Present	SRK Consulting, Environmental Scientist, Westville
Feb 2008 – Jun 2008	Haley Sharpe, Assistant Tourism Planner, Southern Africa
Feb 2007 – Aug 2007	UKZN, Cartographic Technician, Pietermaritzburg

Languages

English – read, write, speak
Afrikaans – read, write, speak

Publications

1. ALLAN, K., EMANUAL, P., and MORRIS, J. (2010) Poster Presentation: Applications of GIS in EMF, IAIAsa Conference, Pretoria, August, 2010.
2. ALLAN, K. (2015) Paper Presentation: Environmental Management in the 21st Century: Combining Environmental Processes and GIS Technologies, IAIAsa Conference, KwaZulu-Natal, August 2015.

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Appendix 6G

Socio-Economic Assessment

CONSTRUCTION OF UP TO 132KV POWER LINE AND SUBSTATION FOR THE !XHA BOOM WIND FARM, NEAR LOERIESFONTEIN IN THE NORTHERN CAPE PROVINCE

SOCIO-ECONOMIC BASIC ASSESSMENT

JULY 2017

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26 July 2017

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Brief profile: Elena Broughton is a senior professional and the manager of the Innovation & Sustainable Development Unit at Urban-Econ. She has extensive knowledge in various fields of economic development that includes 13 years of experience in undertaking socio-economic impact assessment studies for a variety of private clients spanning the mining, manufacturing, energy, infrastructure, and retail sectors. She also acted as a peer reviewer in a number of socio-economic impact assessment studies and completed a few strategic socio-economic impact assessments. Her involvement in the field allowed her to develop a sound understanding of the South African environmental legislation and developmental policies and equipped her with a widespread knowledge of socio-economic implications and benefits of various new developments.

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Brief profile: Zimkita Nkata is a Junior Development Economist in the Innovation and Sustainable Development Unit at Urban-Econ. She recently joined the company after her 5-month internship with the Council for Scientific and Industrial Research (CSIR) in Waste Management. At this job, most of her work entailed a project management role and overseeing role over waste management related grant projects. She completed her BSc degree, at Rhodes University in 2014 specialising in Environmental Science and Economics. She then went on to complete her BScHons degree in Environmental Science at the same institution. Since her time at Urban-Econ she has been exposed to a number of Socio-Economic Impact Assessment studies for Renewable Energy developments which has enhanced and developed her working skills in Environmental Impact Assessment studies in general.

DECLARATION OF INDEPENDENCE

I, Elena Konstantinovna Broughton, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signed:

Date: 26 July 2017

DECLARATION OF INDEPENDENCE

I, Zimkita Nkata, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
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Signed: Date: 26 July 2017

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ACRONYMS AND ABBREVIATIONS

BA	Basic Assessment
CAGR	Compounded Average Growth Rate
CSP	Concentrated Solar Power
DM	District Municipality
ED	Enterprise Development
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GDP-R	Gross Domestic Product per Region
GGP	Gross Geographic Product
I&AP's	Interested and Affected Parties
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
IPAP	Industrial Policy Action Plan
LED	Local Economic Development
LM	Local Municipality
MLL	Minimum Living Level
MW	Megawatt
NC	Northern Cape
NDP	National Development Plan
NGPF	New Growth Path Framework
PGDS	Provincial Growth & Development Strategy
PV	Photovoltaic
RE	Renewable Energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SED	Socio-economic Enterprise Development
SDF	Spatial Development Framework
WTP	Willingness to Pay

1 INTRODUCTION

This document is prepared by **Urban-Econ Development Economists** as requested by **SiVEST Environmental** on behalf of **Mainstream Renewable Power South Africa (Pty) Ltd** (hereafter referred to as Mainstream) to undertake a socio-economic basic assessment study for the **proposed construction of the 33kV/132kV on-site substation, a 132kV linking substation, and an associated 132kV power line** for the !Xha Boom Wind Energy Facility near Loeriesfontein in the Northern Cape province. The socio-economic study is conducted as part of the basic assessment (BA) process managed by SiVEST Environmental.

1.1 Scope of the Study

The purpose of the socio-economic basic assessment is to determine the potential socio-economic implications of the proposed project activities and to advise on the most beneficial alternative to be implemented. The study forms part of the specialist input into the basic assessment report that is outlined by SiVEST Environmental. The basic assessment report addresses the impacts as set out in the guidelines outlined in the Environmental Impact Assessment Regulations of 2014. The purpose of the socio-economic basic assessment study is as follows:

- To undertake a policy review and assess the alignment of the proposed project with the national, provincial and local socio-economic policies, with a focus on the compatibility of the project with the spatial planning, development objectives, and land use management plans of the respective authorities.
- To create a socio-economic profile for the study area using both secondary and primary data. The guidelines for the basic assessment specifically call for information on the level of unemployment and skills available in the local community as well as the economic profile of the local municipality.
- To identify and analyse the potential socio-economic value of the proposed project and associated components thereof and to recommend the preferred alternative considering the socio-economic characteristics.
- To evaluate the potential positive impacts versus any negative socio-economic effects that may ensue as a result of the change in status quo of the affected and benefiting communities and economies.

1.2 Project Content, Location and Study Area Delineation

The proposed project involves the development of the 132kV on-site substation, a 132kV linking substation and an associated 132kV power line. The size of the proposed on-site substation will be approximately 500m x 300m, while the linking substation will be approximately 600m x 600m. The width of the proposed power line corridor will be between 100m and 500m wide. According to the project proponent, the proposed power line requires a 31m wide servitude, which will be placed within the corridor.

The proposed power line will include a series of towers that will be 170m to 250m apart. At this stage, the considered power lines will include various self-supporting suspension monopole structures. The steel monopole structures are expected to be between 18 and 25m in height (this will be largely dependent on the terrain). The exact location of the towers is not yet finalised and will only be determined during the final stages of the power line.

The proposed construction of the on-site substation, linking substation and associated power line serves the purpose of connecting to the !Xha Boom Wind Energy Facility to the national grid via the Eskom Helios substation near Loeriesfontein in the Northern Cape province to allow for the evacuation of electricity generated by the wind facility. Thus, the proposed project consists of the following main activities:

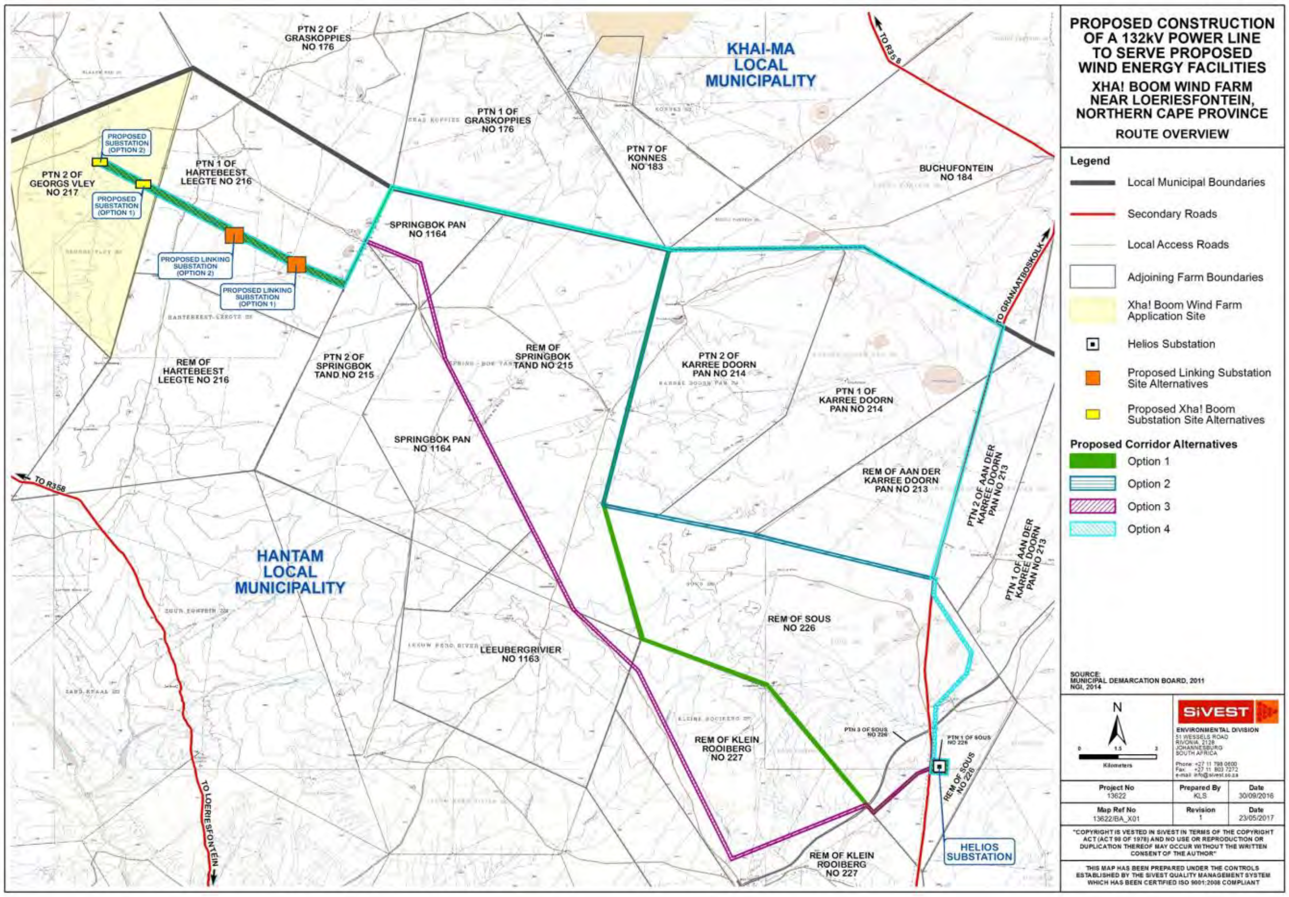
- Construction of 1x 132 kV substation (referred to as the “proposed !Xha Boom Substation”)
- Construction of 1x 132 kV linking substation
- Construction of 1x 132 kV power line from the proposed !Xha Boom Substation, via the linking substation to Helios substation approximately 33km south-east of the proposed !Xha Boom Wind Farm.
- Four corridor routes have been proposed for the 132kV power line. These corridors will serve as alternatives to each other for the comparative assessment exercise.

The four power line corridor alternatives include the following:

- Corridor 1 (Green): 52.2km
- Corridor 2 (Blue): 52.8km
- Corridor 3 (Pink): 47.0km
- Corridor 4 (Light blue): 53.4km

Considered project alternatives

Three sets of alternatives are considered, i.e. on-site substation alternatives (two possible locations), linking substation alternatives (two possible locations) and power line route alternatives (four possible options). These are represented in Map 1-1 below.



Map 1-1: Substation alternatives & power line route alternatives

Project location and study area delineation

The proposed project is to be located approximately 68km north of Loeriesfontein in the Northern Cape province. It forms part of the Namakwa DM and lies within the borders of the Hantam and Khai-Ma LMs. The on-site substation alternatives, on-site linking substations and the four power line corridor alternatives fall within the bounds of both municipalities.

The **zone of influence** of the project is envisaged to be limited to the farm portions that will be directly affected by the footprint of the substations and power line. The list of the farm portions included in the zone of influence includes:

Table 1-1 Farm portions included in zone of influence

Farm Portion	Farm Name	Farm no.	Type
2	Georges Vley	217	Directly affected
1	Hartebeestleegte	216	Directly affected
1	Graskoppies	176	Directly affected
1	Konnes	183	Directly affected
0	Springbok Pan	1164	Directly affected

Farm Portion	Farm Name	Farm no.	Type
0	Buchufontein	184	Directly affected
2	Springbok Tand	215	Directly affected
Rem	Springbok Tand	215	Directly affected
2	Karree Doorn Pan	214	Directly affected
1	Karree Doorn Pan	214	Directly affected
Rem	Aan Der Karree Doorn Pan	213	Directly affected
2	Aan Der Karree Doorn Pan	213	Directly affected
0	Leeubergrivier	1163	Directly affected
Rem	Klein Rooiberg	227	Directly affected
Rem	Sous	226	Directly affected

1.3 Methodology

The methodology employed in conducting the study comprised of three steps as illustrated in Figure 1-1.

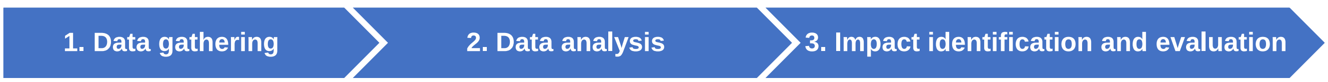


Figure 1-1: Methodology

The following paragraphs briefly describe each step.

Step 1: Data gathering

Impact assessment requires the knowledge of the socio-economic environment that will be affected by the proposed project and envisaged expenditure on the project during both the construction and operational phases. In order to create a comprehensive understanding of the socio-economic environment that might be affected by the proposed developments, a socio-economic profile of the study areas as well as the zone of influence was developed.

Step 2: Data analysis

A description of the study area and the zone of influence is given in terms of selected socio-economic variables. The developed profile is used to interpret the impacts and measure the extent of socio-economic impacts that could be derived from the proposed activities in the context of the local, provincial and national economies. It includes the analysis of parameters such as population size and household numbers; structure and growth of the economy; and labour force and the employment situation.

Step 3: Impact identification and evaluation

This step includes the description and evaluation of socio-economic impacts that could be expected during the construction and maintenance phases of the proposed substations and power lines. Firstly, alternatives will be compared against each other and the preferred option which renders the least negative impact on the socio-economic environment is identified. Secondly, the anticipated impacts associated with the preferred alternative are analysed and evaluated following the methodology prescribed by the environmental consultant (refer to Annexure A).

1.4 Data gathering and consultation process

The project made use of both secondary and primary data.

Secondary data gathering

Secondary data was sourced from the following databases and documents:

- Stats SA Census, 2011
- Quantec Research Standardised Regional Data, 1995-2013
- Integrated Development Plans (IDPs)
  - Namakwa District Municipality Integrated Development Plan (2015-2016)
  - Hantam Local Municipality Integrated Development Plan (2015-2020)
  - Khai-Ma Local Municipality Integrated Development Plan (2011)
- Spatial Development Frameworks (SDFs)
  - Northern Cape Spatial Development Framework (2012)
  - Namakwa District Spatial Development Framework (2012)
  - Hantam Local Municipality Spatial Development Framework (2010)
    Khai-Ma Local Municipality Spatial Development Framework (2011)
- Provincial strategic documents
  - Northern Cape Provincial Growth and Development Strategy (2011)
  - Northern Cape Local Economic Development Framework (2011)

Primary data gathering

The main purpose of the primary data collection exercise was to gain insight into the socio-economic characteristics of the zone of influence. Therefore, the primary data gathering exercise focused on engaging with interested and affected parties (I&APs) through telephonic interviews and e-mail communication. Initial contact was done through telephonic communications, which took place the 10^{th} - 12^{th} of July 2017.

Table 1-2: Information on contacted interested and affected parties (I&APs)

Farm Portion	Contact Person	Means of interview
Portion 2 of Georges Vley Farm No.217	Farm owner	Telephone interview 10/07/2017
Portion 1 of Hartebeestleegte Farm No.216	Farm owner	Telephone interview 10/07/2017
Portion 1 of Konnes Farm No.183	Farm owner	Telephone interview 10/07/2017
		E-mail correspondence 12/07/2017
Portion 1 of Graskoppies Farm No.176	Farm owner	Telephone interview 10/07/2017
		E-mail correspondence 12/07/2017
Portion 2 of Karree Doorn Pan Farm No.215	Farm owner	Telephone interview 10/07/2017
Portion 1 of Karree Doorn Pan Farm No.214	Farm owner	Telephone interview 10/07/2017
Remainder of Aan Der Karree Doorn Pan Farm No. 213	Farm owner	Telephone interview 10/07/2017
		E-mail correspondence 12/07/2017
Portion 2 of Aan Der Karree Doorn Pan Farm No.213	Farm owner	Telephone interview 10/07/2017

Farm Portion	Contact Person	Means of interview
Remainder of Klein Rooiberg Farm No.227	Farm owner	Telephone interview 10/07/2017
Remainder of Sous Farm No.226	Farm owner	Telephone interview 10/07/2017

Although the most desirable outcome is reaching all the affected landowners, the following table outlines the I&APs that it was not possible to engage with for various reasons. In order to address the possible gap in knowledge, the review of the feedback received from the I&APs after the submission of the scoping (i.e. during public comment period) was relied on. This was to allow the tracing of any outstanding concerns that the owners of these farm portions may have had with respect to the project. It should therefore be noted that no concerns or issues were raised by these parties during the public comment period that followed the submission of the scoping report.

Table 1-3: I&APs that could not be contacted

I&AP	Reason for non-engagement
Portion 0 of Springbok Pan Farm No. 1164	Contact details not provided
Remainder of Springbok Tand Farm No.215	No answer on given contact details
Portion 2 of Springbok Tand Farm No. 215	No answer on given contact details
Portion 0 of Leeubergrivier Farm No. 1163	Contact details not provided
Rem of Klein Rooiberg Farm No. 227	No answer on given contact details

1.4 Assumptions, limitations and gaps in knowledge

- The secondary data sources used to compile the socio-economic baseline (demographics, dynamics of the economy), although not exhaustive, can be viewed as being indicative of broad trends within the study area.
- The study was done with the information available to the specialist within the time frames and specified budget.
- Project-related information supplied by the environmental practitioner and the client for the purpose of this analysis is assumed to be reasonably true.
- It is assumed that the project description and infrastructure components as discussed above are reasonable accurate. These details were used to assess the potential impacts.
- Possible impacts, as well as stakeholder responses to these impacts, cannot be predicted with complete accuracy, even when circumstances are similar and these predictions are based on research and years of experience, taking the specific set of circumstance into account.
- With regard to the interviews undertaken the following assumptions are made:
  - Questions asked during the interviews were answered accurately.
  - The degree of the perceived possible significance of concerns raised by some of the respondents were rated by them truthfully.
  - That the attitudes of the respondents towards the project will remain reasonably stable over the short to medium terms.

- The focus on the primary data collection was on those parties that were perceived to be the most sensitive to the proposed project. As such, it is believed that the study was able to identify the most significant impacts and assess the most pertinent issues.

2 POLICY REVIEW

A policy review plays an integral role in the early stages of a project. The review provides a high-level indication of whether a project is aligned with the goals and aspirations of the developmental policy within a country and at a local level. Furthermore, the analysis signposts any red flags or developmental concerns that could jeopardise the development of the project and assists in amending it and preventing costly and unnecessary delays.

The following government strategic documents applicable to the delineated study areas were examined:

- National: (South Africa)
    - New Growth Path Framework (NGPF) (2010)
    - National Development Plan (NDP) 2030 (2011 – 2030)
    - Integrated Resource Plan (IRP) 2010-2030 promulgated in 2011
    - Industrial Policy Action Plan (IPAP2) (2012/2013 – 2014/2015)

- Regional: Northern Cape province
    - Northern Cape Provincial Spatial Development Framework (2012)
    - Northern Cape Municipal Local Economic Development Framework (2011)
    - Northern Cape Provincial Growth and Development Strategy (2011)

- Local: Namakwa District Municipality, Hantam and Khai-Mai Local Municipalities
    - Namakwa District Spatial Development Framework 2012
    - Namakwa District Municipality Integrated Development Plan 2015-2016
    - Hantam Local Municipality Local Economic Development Strategy 2011
    - Hantam Local Municipality Integrated Development Plan 2015-2020
    - Hantam Local Municipality Rural Spatial Development Framework 2010
    - Khai-Ma Local Municipality Integrated Development Framework 2012-2017
    - Khai-Ma Local Municipality Spatial Development Framework 2011

National context

The expansion of South Africa's renewable energy capacity generation is expected to play a vital role in consolidating energy security, mitigating climate change and stimulating economic growth to improve the general standard of living of all South Africans. Developing the renewable energy (RE) industry is one of the national priorities as per the following policies and strategies:

- **New Growth Path Framework** (NGPF): At the forefront of the government action plan is the creation of decent employment opportunities through the support of labour-intensive sectors and assurance of long-term economic growth. To ensure sustained job creation prospects, government has placed further emphasis on the promotion of local industrial capacity and skills development in advanced industries. Because of this, the New Growth Path Framework (NGPF) states that the diversification of the national economy is vital to improving both the rate of absorption as well as the gross domestic product (GDP) growth rate and has thus set a target to stimulate employment by five million new jobs by the year 2020. As such, the development of the RE sector is particularly identified to have a potential to play an important role in creating decent work opportunities. Targets for RE also open up major new opportunities for investment and employment in manufacturing new energy technology as well as in construction (Department of Economic Development, 2010).

- The **National Development Plan** (NDP): To successfully overcome the triple threat challenge of poverty, unemployment, and inequality posed to the country, the NDP encourages all regions to seize the advantage of natural resources endowed to them. This, however, must be achieved in a sustainable and equitable manner**.** For the goals embedded within the policy to be met, the proposed path toward developing a green economy is of critical importance. In line with international protocol and ambitions, the NDP acknowledges South Africa's dependence on fossil fuel based energy production as a key challenge, and this has placed further emphasis on the need to transition toward a low-carbon economy. To achieve this, the NDP seeks to ensure that half of all new electricity generating capacity is provided through renewable energy resources (National Planning Commission, 2011)**.**
- **Integrated Resource Plan** (IRP): The IRP**,** which was promulgated in 2011, was established with the purpose of serving as a living plan to monitor South Africa's forecast electricity capacity by the year 2030. Since the IRP's establishment, the government has committed itself to producing 8 400 MW from wind by the year 2030. The path to achieving this goal then led to the establishment of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) which is essentially the key vehicle for securing electricity capacity from the private sector for renewable energy as well as non-renewable sources. Currently, the three ministerial determinations have called for a procurement of 13 125 MW of renewable energy from IPPs; of this, 6 360 MW has been allocated to wind energy projects. In consideration of the four and a half bidding windows that have already been achieved, 3 346 MW has already been awarded to existing wind projects. This has resulted in the possibility of 3 013 MW to be allocated to more renewable energy projects thus creating opportunities for projects such as the one under analysis to be established.
- **Industrial Policy Action Plan** (IPAP): Both the Integrated Resource Plan and the Industrial Policy Action Plan (IPAP) specify that 21 500 MW of renewable energy capacity should be established by 2030. This capacity will be primarily derived from wind and solar technologies, which will serve to reduce the country's heavy reliance on energy derived from coal-intensive non-renewable resources thus significantly reducing greenhouse gas emissions.

The review of the national policies suggests that the proposed !Xha Boom substation and powerlines agrees and is in alignment with national developmental priorities insofar as it will assist in achieving the set target for electricity generation using renewables and contributing to the development of human capital.

Provincial context

- **Northern Cape Provincial Growth and Development Strategy** (NC PGDS): Developing new energy sources through the adoption of energy applications that are in correlation with the

Provinces' natural resource endowment are at the forefront of the provincial strategy. The provision of electricity through renewable energy sources is also seen as a reliable way to promote and accelerate economic growth within the Province through ensuring that key industry users at critical locations improve their competitiveness. Although there is sufficient reason towards investing in the use of renewable energy in the Province, it is essential that potential developments be considerate of the tourism industry component of the Province.

The Northern Cape province has had an average annual growth of 17% in national visitors as well as 25% annual growth of international visitors during the 2001-2011 period, resulting in a total tourism contribution of 6% toward the provincial gross geographic product (GGP) (Dennis Moss Partnership, 2012). This highlights that tourism is a key sector in the Northern Cape that has the potential to grow, transform and diversify the provincial economy. This means that extra care should be taken in ensuring that renewable energy developments do not result in a negative impact on the tourism potential of the Province, nor do they interfere with the region's natural environment.

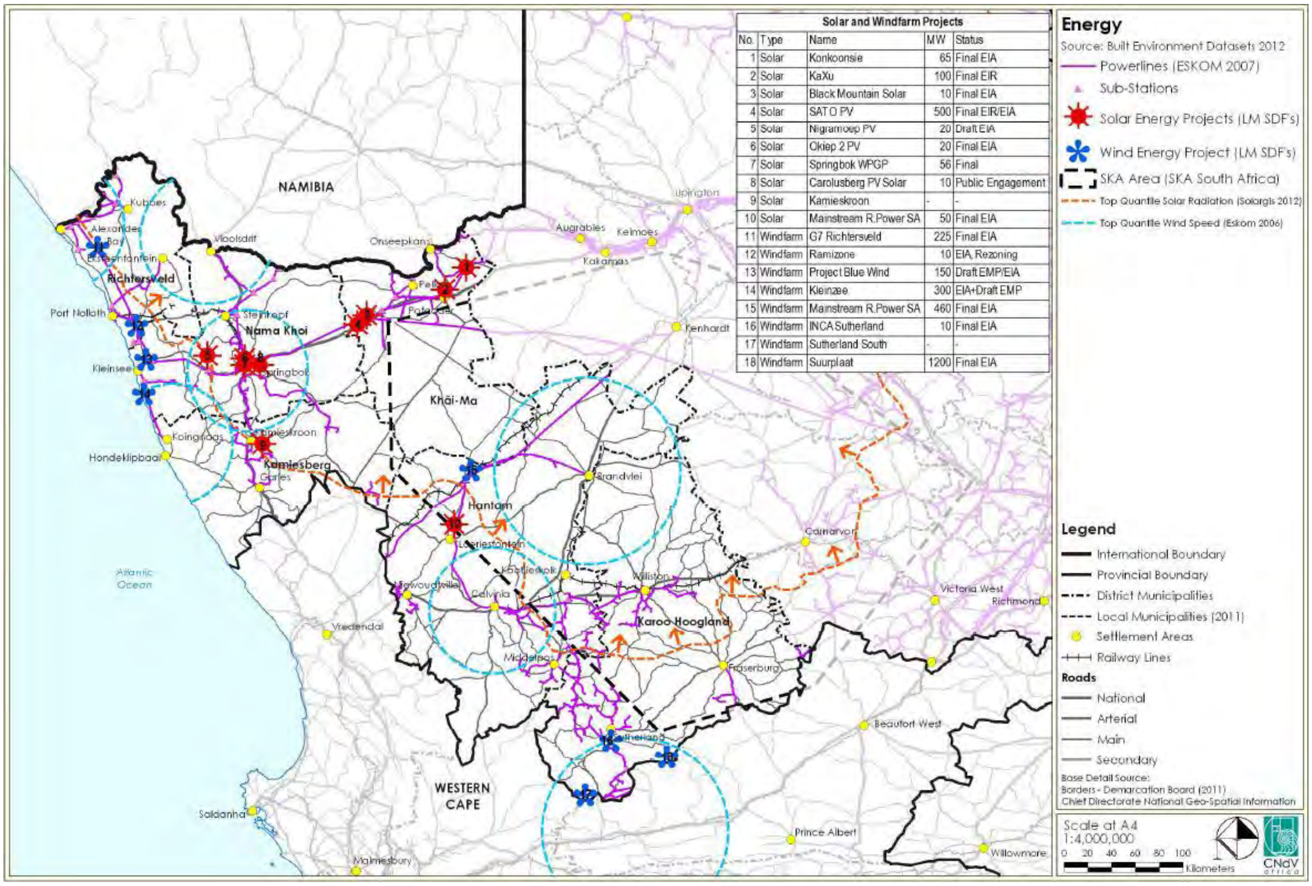
- **Northern Cape Municipal Local Economic Development Framework** (NC LED)**:** In South, just over a third (37%) of the population reside in rural areas. Linked to this, the provision of a mix of alternative energy sources is thus important so as to make affordable and adequate energy available to developing communities. To achieve this, there needs to be a sufficient optimal exploitation of renewable sources. As a result of this, the Department of Minerals and Energy has embarked on several national, provincial and local level wind and solar energy systems. The Namakwa District, in particular, has potential for both wind and solar electricity generating capacity developments such as the one under analysis (Northern Cape Province, 2011).

Provincial policies promote the development of the renewable energy projects, which in turn implies the promotion of the development of the associated infrastructure such as substations and powerlines, particularly if these projects are capable of also facilitating the development of the local tourism industry or if they at least do not prevent the industry from realising its potential.

Local context

Although much of the focus within district and local municipalities relates to the development and delivery of basic services, infrastructure, agriculture and tourism, the development of a green economy remains to be seen as an additional fundamental pillar of growth. Thus, in like manner with the national and provincial policies, the district and local municipalities have placed considerable emphasis on the prioritisation and promotion of renewable energy resources within their boundaries. The Namakwa District Municipality, Khai-Ma and Hantam Local Municipalities have developed strategies to extract growth and development potential from such investments.

- **Namakwa Integrated Development Plan** (IDP): This plan sets out to utilise natural resources in the Province by optimally utilising and managing resources in each sector; this includes the growing realisation of investing in more renewable energy based development. The Namakwa DM has a competitive advantage in the energy sector as wind, solar, wave, nuclear and natural gas energy plants have all been identified as suitable investments in the area. Amongst other sectors, such as agriculture and tourism, renewable energy is thus prioritised. Several large-scale renewable energy projects have already been included in the IDP of the district. These are also depicted on Map 2-1 below. The district also recognises the importance of the agriculture and tourism industries in the area and promotes their development and transformation, especially eco-heritage. This and other projects that are under investigation are outlined in the following map extracted from the districts' spatial development framework (Namakwa DM, 2014).



Solar and Windfarm Projects				
No.	Type	Name	MW	Status
1	Solar	Konkoonsie	65	Final EIA
2	Solar	KaXu	100	Final EIR
3	Solar	Black Mountain Solar	10	Final EIA
4	Solar	SATO PV	500	Final EIR/EIA
5	Solar	Nigramoep PV	20	Draft EIA
6	Solar	Okiep 2 PV	20	Final EIA
7	Solar	Springbok WPGP	56	Final
8	Solar	Carolusberg PV Solar	10	Public Engagement
9	Solar	Kamieskroon	-	-
10	Solar	Mainstream R.Power SA	50	Final EIA
11	Windfarm	G7 Richtersveld	225	Final EIA
12	Windfarm	Ramizone	10	EIA, Rezoning
13	Windfarm	Project Blue Wind	150	Draft EMP/EIA
14	Windfarm	Kleinzee	300	EIA+Draft EMP
15	Windfarm	Mainstream R.Power SA	460	Final EIA
16	Windfarm	INCA Sutherland	10	Final EIA
17	Windfarm	Sutherland South	-	-
18	Windfarm	Suurplaat	1200	Final EIA

Map 2-1: Renewable projects in Namakwa (CNdV, 2012)

- **Hantam LM Integrated Development Plan and Khai-Ma LM Integrated Development Plan (IDP)**: Considering the location of the site relative to the Hantam and Khai-Ma Local Municipalities, the review of the strategic policies therefore highlights the importance of improving the living standards of the citizens of the municipalities as being amongst the top priorities of local government. Stimulating and strengthening the economy through various sector development interventions is envisioned to be one of the means to achieve this. Based on the composition and natural resource endowment of these municipalities, particular developmental priority is given to the agriculture and tourism sectors. Although flower tourism is seasonal in the Hantam LM, eco-tourism has been recently seen as the main growth stimulant for the regional economy. At the same time, the agricultural sector provides the most employment opportunities in the municipal area, thus, making it the backbone of the Hantam LM (Hantam IDP, 2015). The above suggests that the tourism and agricultural sectors should be preserved, and all effort needs to be made in order to ensure that no new development results in the loss of these activities.

Considering the information above, it is clear that local government prioritises the improvement of service delivery and living standards of its residents through the adequate provision of basic services. The proposed substations and power lines will not directly contribute to the above-mentioned objective since the electricity generated by the wind farm will be evacuated to the national grid. However, the proposed project is likely to have an indirect contribution to the above as it will enable investments into the local economy. Importantly, the project does not raise any red flags or implies contradictions with the local government developmental objectives.

3 BASELINE INFORMATION

This chapter examines key socio-economic characteristics of the study area, as per the delineation provided. This is essential as it provides both qualitative and quantitative data related to the communities and economies under observation, creating a baseline against which the impacts can be assessed.

3.1 Study area's composition and locational factors

Spatial context and regional linkages

Geographically, the **Northern Cape** is the largest province located within South Africa with an area of 372 889km^2 equating to approximately 30.6% of South Africa's spatial composition. Despite having the largest surface area, the Northern Cape is the least populated province in South Africa with a population of 1.1 million people equating to 2.2% of the national population (Stats SA, 2011).

The proposed Substations and power lines falls within the **Namakwa DM** which is situated on the western part of the Northern Cape province and is the largest municipality of the five main municipal districts of the Province covering an area of 126 900km^2 (34%) of the total provincial landmass. Although it is the largest district geographically, the Namakwa DM is sparsely populated with a population of 115 842 people, which comprises 10.11% of the total province population (Stats SA, 2011).

In the Namakwa DM, the project lies within the borders of the Hantam LM and the Khai-Ma LM. The **Hantam LM** is an inland municipality which lies to the west of the Namakwa DM and is located 140km from Springbok. The Hantam LM covers an area of 36 128km^2 and has a population of 21 581 people (Stats SA, 2011). The municipality is known for its wide, open spaces, striking mountain ranges and nature reserves filled with a vast array of indigenous plants and bulbs (Hantam IDP, 2015). The main attractions of the area are, therefore, the floral displays, hiking and the natural environment. Hantam municipality is also furnished with four conservation areas, namely Ooorlogskloof Nature Reserve, Hantam National Botanical Gardens, Tanique Karoo National Park and the Akkerdam Nature Reserve (Umsebe Development Planners, 2010).

With a total surface area of 16 627km^2, the **Khai-Ma LM** is situated along the north-western part of the Namakwa DM and is a sparsely populated region with 12 466 people. The Khai-Ma LM is bordered by Namibia on the north, the ZF Mgcawu LM on the east and, the Nama-Khoi LM on the west. Urban nodes surrounding the local municipality include Poffadder town, as the main centre; Aggeneys; Pella; Witbank and Onseepkans. Although the surrounding area of the region has a low grazing potential, a vast amount of extensive land in Khai-Ma is predominantly used for livestock farming (Umsebe Development Planners, 2010).

3.1 Sense of place, history, and cultural aspects

The closest town to the proposed 132kV substations and 132kV powerline is Loeriesfontein. This is a small rural service centre town that lies within a basin surrounded by mountains and is situated to the north-west of the town of Calvinia. Loeriesfontein was built around a general store in the year 1894 by a British bible salesman, Frederick Turner (Hantam IDP, 2015). The town has a population of 2 746 people, which has grown by 12.4% since the year 2001. Loeriesfontein town covers a total surface area of 34.45km^2 and has a population density of 80 people/km^2 (Stats SA, 2011).

The south-western part of Leoriesfontein forms part of Namaqualand, which is a region popular for its spring flowers and its wide variety of diverse vegetation (Hantam IDP, 2015). Loeriesfontein town also houses the Gannabos (Quiver) Forest, which is home to the world's largest colony of the *Aloe Dichotoma* species (Umsebe Development Planners, 2010). During spring, the town is flooded with tourists attracted by the spring flowers. The town also boasts its Windmill museum, which is one of only two in the world. Sheep farming and salt mining are the predominant activities within and around Loeriesfontein town (Umsebe Development Planners, 2010).

3.2 Demographic Profile

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills and determines the demand for the production output. Examining population dynamics is essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

Population demographics

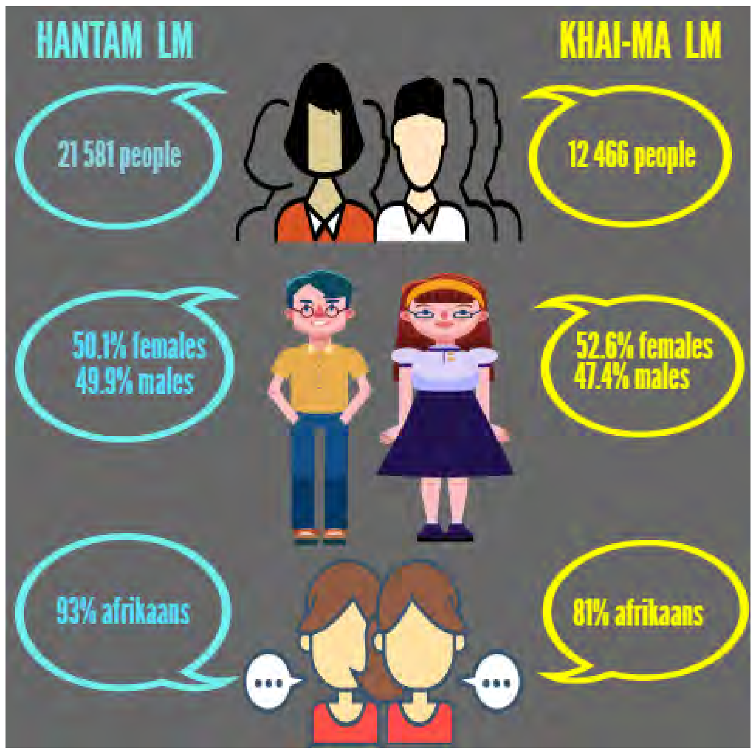


Figure 3-1: Hantam and Khai-Ma LM population dynamics

As previously noted, the **Hantam LM** has a population of 21 581 individuals accounting for 18.6% of the total population of the Namakwa DM. In comparison to the year 2001, the population of the Hantam LM has increased by 6.6%. Within the local municipality, 80% of the people reside in urban areas whilst the rest occupy farms. In total, the Hantam LM has 6 341 households with a household density of 0.14km^2 (Stats SA, 2011). The majority of the people in the Hantam LM reside in the city centre, which is Calvinia town; thus, only a small percentage of people reside in other smaller surrounding towns such as Loeriesfontein (13%) (Stats SA, 2011). Over 90% of the residents in the municipality, as well as the nearby towns (Loeriesfontein and Brandvlei), speak Afrikaans as a first language, with the dominant race being coloured people (82%) and white people lagging behind at 11%. The Hantam LM's population consists of 50.1% males and 49.9% females. The largest group of people falls under those aged between 35 and 64 years of age. In this LM, the youth (15-34 years) encompass about 29.1% of the total population. Only 28% of Hantam residents are married, whilst 54% have never been married (Stats SA, 2011).

Loeriesfontein, being the closest town to the !Xha Boom Substation project site, only has 806 households in total resulting in a household density of 23.3 km^2. The majority (94.3%) of people have access to formal housing whilst the rest either live in houses or flats in a backyard (0.87%) or in informal dwellings (4.12%). A huge portion of people living in Loeriesfontein are coloured (86%), followed by white people at 11.54% whilst black people equate to 1.9% of the total population. Afrikaans is the main language spoken as more than 90% of the people cited it as their first language; only 0.4% residents speak English whilst 0.5% speak Setswana (Stats SA, 2011). Only 26.5% residents are married, whilst 56.9% have never married.

Although Loeriesfontein is a relatively small town, residents and farm owners stated that since the introduction of renewable energy projects in the area, namely Khobab and Loeriesfontein 2 wind farms, the town has experienced an influx of people either in an attempt to find employment or to seize economic opportunities brought by the wind farms.

The **Khai-Ma LM**, on the other hand, has a smaller population of 12 466 people; this accounts for 10.7% of the total population of the Namakwa DM. Although the population has increased by 6.2% from 11 692 people in 2001, it is still only almost two-thirds of the Hantam population (Stats SA, 2011). Most residents within the Khai-Ma LM reside in the urban areas (81%) whilst some reside on farms (17%). The total number of households in the Khai-Ma LM is 3 796, resulting in a household density of 0.22km^2. Just over 80% of the residents speak Afrikaans in the municipality (Stats SA, 2011). Coloured people equate to three-quarters of the total population with black people (18%) being the second dominant race. Only 24% of the Khai-Ma LM residents are married whilst 64% have never been married. In like manner with the Hantam LM, the Khai-Ma LM has more males (52.6%) than females (47.4%) with the largest population also falling within 35 and 64 years of age. Although this is the case, this local municipality, however, has a youth population (15-34 years) that is just over a third (36.8%) of the total population (Stats SA, 2011).

Health demographics

The process of assessing and monitoring the level of health in a particular area is beneficial as it provides useful information on the development as well as human welfare of an area. Over the last 15 years, in comparison to the rest of South Africa and the Northern Cape Province, the effect of HIV has been less severe on the DM and LMs. AIDS-related deaths have also been following a similar pattern.

In the year 2015, the **Hantam LM** reported a total of 956 people living with HIV, which equates to 4.5% of the total LM population. Although the number of HIV-positive people for the Namakwa DM (4.9%) is close to that of the LM (4.5%), national and provincial HIV infected percentage levels are much higher, as they are at 11.4% and 7.3%, respectively.

Table 3-1: Population, HIV positive, AIDS and other deaths (2015)

Indicator	South Africa	Northern Cape	Namakwa DM	Hantam LM	Khai-Ma LM
Population	54 956 509	1 175 780	116 834	21 371	11 805
HIV positive	6 248 908	86 146	5 702	956	673
AIDS deaths	206 761	2 360	113	20	7
Other deaths	444 866	9 729	1 159	213	98

The **Khai-Ma LM** had a slightly higher percentage of people living with HIV (5.7%). AIDS-related deaths at the national, provincial, regional, and local context are relatively low as they range from a range of 0.1-0.4%. In a period of 15 years (2000-2015), people living with the HIV illness in the Hantam LM had increased by 695 people whilst residents living in the Khai-Ma LM with the same illness increased by 463 within the same period.

Although the prevalence of HIV/Aids in **Loeriesfontein town** isn't clear, during the site visit and telephonic interviews conducted with various stakeholders it was revealed that construction workers employed to develop wind farms in the area, namely Khobab and Loeriesfontein 2, mingle with young females and this has since resulted in a sharp increase in the rate of teenage pregnancies. The presence of construction workers in the area has also resulted in several social ills such as the use of alcohol and drug abuse. Although interviewed residents agree that this has always been a norm in the town, they have also alluded to the fact that the social ills have exacerbated in the last few years, correlating with the period of establishment of the two wind farms. One such example is the increase in the number of liquor licences applied for as well as an increase in the number of young school girls who interact with construction workers resulting in unwanted pregnancies.

Crime demographics

In the **Hantam LM**, 816 serious crimes were reported; of these, a total amount of 760 were community reported crimes whilst 56 of them were detected by the police. Common assault was the most frequently reported crime with 207 cases, followed by property-related crime with 154 cases and assault with the intention to harm with 125 cases. The total number of serious crimes equates to 17% of the district reported crimes and 1.41% of the provincial reported crime cases. Although the use of alcohol and drugs has increased in Loeriesfontein town, crime levels have been stable and have not resulted in any criminal activities that can be directly linked to the heavy influx of people.

In 2015, the **Khai-Ma LM** had less crime-related occurrences, as only a total of 285 serious crimes were reported. The most commonly reported crimes are similar to trends noted in the Hantam LM but are at less severe rates with common assault reported to have had 69 cases, property related crime with 52 cases and assault with the intent to harm with 46 cases. Crimes reported in Khai-Ma LM equates to 6% of the cases reported at the district level and only 0.5% of the provincial reported crimes.

Table 3-2: Crimes reported by crime type (2015)

Types of crime	South Africa	Northern Cape	Namakwa DM	Hantam LM	Khai-Ma LM
Serious crimes	2 209 068	57 817	4 782	816	285
➢ **Community reported crimes**	2 068 261	54 724	4 212	760	255
➢ **Crimes dependent on police action for detection**	140 807	3 093	570	56	30

3.3 Economy

The structure of the economy and the composition of employment provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The **Hantam LM** is a relatively small economy valued at R1 184 million in current prices. In total, the economy of the Hantam LM equates to 11.1% of the Namakwa District's gross domestic product per Region (GDP-R) which was valued at R10 696 million in current prices (Quantec, 2016). The contribution of the LM to the Province as a whole is significantly low as it only accounts for 1.64% of the Northern Cape province. As outlined in Figure 3-2 below, the Hantam LM economy has been manifesting a fluctuating growth rate revealing its sensitivity to external shocks related to national and global changes. For instance, the Hantam economy was adversely affected by the 2008 global recession as presented in Figure 3-2. Although this was the case, the economy began slowly recovering between the 2010-2011 period. Overall, between the 1995-2011 period, the Hantam LM economy grew at a compounded annual growth rate (CAGR) of 3.19%.

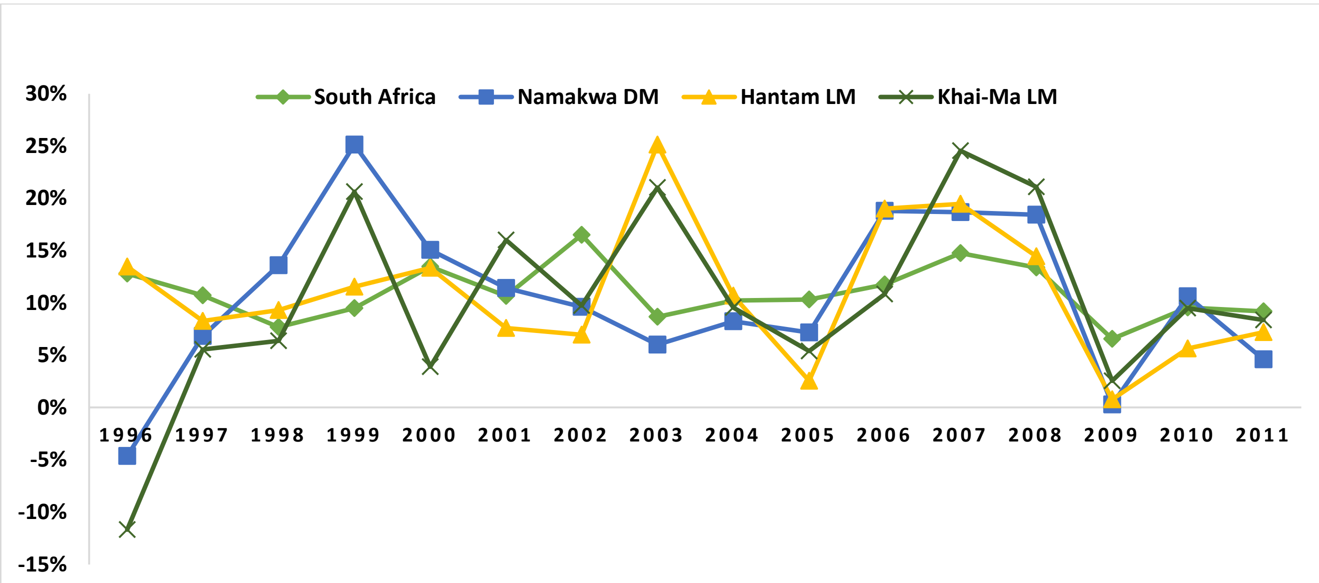


Figure 3-2: Regional economic GDP-R historical trends (Quantec, 2016)

The economy of the **Khai-Ma** LM lags behind the Hantam economy with a total size of R939 million in current prices (Quantec, 2016). This contribution accounts for 8.8% of the district's economy and 1.3% of the Province's economy. The Khai-Ma LM experienced similar growth patterns with Hantam, as it experienced stagnation in the year 2009 after the global recession and began recovering shortly after. At constant prices, the 16-year period (1995-2011) CAGR for Khai-Ma LM equates to 2.44%.

According to the Hantam LED Framework (2011), economic development ought to be sustainable. Ensuring that it is sustainable entails strengthening and diversifying the economy through a range of sectors such as the primary, secondary and tertiary sector which should cater for all consumer and business needs. Due to the fact that 72% of the GDP-R of the **Hantam LM** is generated by the tertiary sector, this LM is a service economy with prominent sub-sectors such as general government (13%); transport and communication (16%); as well as wholesale, retail, and trade (25%). A contributing factor to this is most likely the numerous government departments that are situated in Calvinia town as it serves as the main seat and administrative town of the Hantam LM (Hantam IDP, 2015). On the other end of the spectrum, within the primary sector, agriculture is the main contributor to GDP-R as it equates to 18% of the Hantam economy.

Although the mining industry currently has a very low contribution to the economy, 80% of the world's gypsum reserves lie just outside Loeriesfontein town; thus, an opportunity exists for salt and gypsum mining in the region as salt pans at Dwaggas Pit also employ 30 permanent workers (Umsebe Development Planners, 2010).

Since the start of the construction of Khobab and Loeriesfontein 2 wind farms, the informal hospitality industry in the town of Loeriesfontein has boomed as construction workers have been in need for accommodation in town. To meet the increased demand in accommodation, the majority of the town's residents have transformed their backyards and availed their garages for rent purposes.

In conjunction with the 20-year old wind museum in the town, the recently established wind farms have also added value to the tourism component of the area. Due to the influx of people in the town, the economic impact has been positive for the town; as a result of this, food and fuel sales have spiralled, increasing businesses' gross revenues and profits in an unprecedented manner. Further positive investments are expected to trickle down to the Loeriesfontein community when the surrounding wind farms start investing 5% of the generated profits in the community, which will take place in eight to nine years.

In the **Khai-Ma LM,** the primary sector contributes the highest percentage (67%) to the municipal GDP-R. Within the primary sector, mining and quarrying is the prominent industry with a contribution of 51%, whilst the agriculture industry contributes 15% to the overall economy. The high percentage contribution of the mining industry is most likely due to the presence of various minerals - such as zinc, copper, lead, granite, and quartz - within the municipal area (Umsebe Development Planners, 2010). Mining activity is thus exacerbated by the existence of the Black Mountain mine in Aggeneys town as well as the gypsum mine in Pofadder town. The second contributor to the GDP-R of the Khai-Ma LM is the tertiary sector with a contribution of 28%. Within the tertiary sector, the most imminent industries are general government (10%), transport and communication (6%) as well as wholesale and retail trade, catering, and accommodation (6%).

3.4 Labour Force and Employment Structure

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being.

Labour force composition

During the year 2011, the total working population of the **Hantam LM** consisted of 13 680 people, within this figure, the total labour force only equated to 7 004 people. As outlined in Table 3-3 below, a percentage of 3.4% of people is described as discouraged job seekers, which typically refers to a group of people who are capable of searching for employment but have become discouraged and are no longer looking for employment. The difference between the number of people employed (6 122) and unemployed (882) in the region results in an unemployment rate of 12.6%, which is relatively low in comparison to the national and provincial unemployment rates (29.7% and 27.4%), respectively. Within the Hantam region, Loeriesfontein town has a slightly higher unemployment rate of 14.7% (Stats SA, 2011).

Although only 100-150 local residents are currently employed by the nearby wind farms, the impact of increased employment levels in **Loeriesfontein** has been significant; this is so because in the past the town was heavily reliant on income from extensive farming. However, in the event that agricultural farms undergo expansion, employment levels usually remain the same as farming in the area largely comprises of livestock farming, which is not very labour-intensive. However, with that being said, the prevalence of drug abuse has restricted the number of locals that can be employed as the impact of the drugs is said to result in a lack of personal motivation.

In the **Khai-Ma LM**, the total working population consisted of 8 541 people with a labour force equating to 5 889 people. In 2011, about 4% of people were recorded as discouraged jobseekers. The Khai-Ma LM has a relatively higher unemployment rate of 20.9% (Stats SA, 2011).

Table 3-3: National, Provincial & Regional Labour Force Profile

Town/settlement	Working age	Labour force			Discouraged job seekers	Unemployment rate
		Employed	Unemployed	Total		
South Africa	33928806	13254829	5586624	18841453	1848720	29,7%
Northern Cape	736205	284202	107379	391581	40170	27,4%
Namakwa DM	76579	33713	8455	42168	4258	20,1%
Hantam LM	13860	6122	882	7004	475	12,6%
Loeriesfontein	1767	680	117	797	33	14,7%
Khai-Ma LM	8541	4660	1229	5889	327	20,9%

(Stats SA, 2011)

Employment structure

As depicted in Figure 3-3 below, within the working age population (15-64 years) of the **Hantam LM**, about 60% of the individuals are employed in the formal sector whilst 21% are employed in the informal sector. Employment opportunities provided by private households equate to approximately 17% of the Hantam working population. Within the Hantam LM, Loeriesfontein town employed the least people in the formal sector resulting in it being the dominant job creator in the informal sector. In the **Khai-Ma LM**, more employment is offered in the formal sector whilst only a minority of people work in the informal sector. Similar patterns can be observed for the provision of employment by private households within the LM as well as the towns.

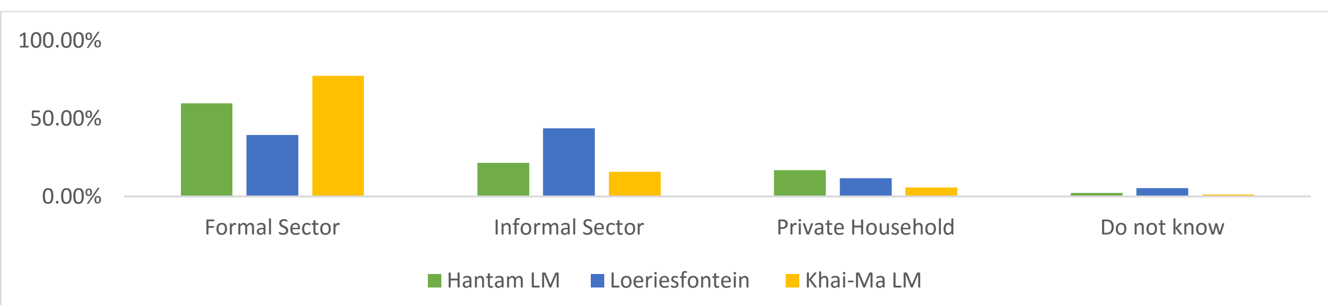


Figure 3-3 : Hantam LM regional employment by sector (Stats SA, 2011)

Within the formal sector, only 14% of people of the Hantam LM's working population are considered to be skilled, whilst the majority (30%) of the people either occupy jobs that require semi-skilled or low-skilled individuals. The rest of the working population (27%) is employed in the informal sector. In the Khai-Ma LM, very few individuals (10%) within the working population are considered skilled. Instead, similar to the Hantam LM, the majority of people are semi-skilled and lowly-skilled (Quantec, 2016). Twenty percent (20%) of the people within the LM are occupied in the informal sector. As it can be noted in Table 3-4 below, employment percentages by skill level for the local municipalities (Hantam and Khai-Ma) are relatively similar to the district's skill level percentages.

Table 3-4: Employment sector and compensation by skill level (2015)

Skills	Employment sector & compensation by skill level					
	Namakwa DM		Hantam LM		Khai-Ma LM	
	Employment	%	Employment	%	Employment	%
Formal: skilled	5092	14%	987	14%	446	10%
Formal: Semi-skilled	11151	32%	2004	29%	1613	36%
Formal: Low-skilled	9917	28%	2077	30%	1536	34%
Informal	8962	26%	1849	27%	879	20%

(Quantec, 2016)

In the Hantam LM, the tertiary sector is the largest contributor to formal and informal employment with 60% share of all employment provided in the municipality. As depicted in Table 3-5 below, such employment consists of opportunities working in wholesale and trade (18%), finance and business services (7%), general government (17%) as well as community, social and personal services with 15%. Although the Hantam LM is dominated by the services sector, within the primary sector, agriculture employs the largest number of people (29%). The secondary sector makes very little contribution to employment services as it only accounts for 10% of the Hantam working population.

In contrast, the Khai-Ma LMs labour force is dominated by the primary sector, equating to 54% of the municipal working age population. Within this sector, half of the total employment within the municipality is provided by the agriculture industry. The tertiary sector is the second largest contributor to job creation in the Khai-Ma LM; within this sector, prominent industries include general government (12%) and wholesale and retail trade (12%). The secondary sector lags with a contribution of 10% to the working population.

Table 3-5: Employment by economic services in region (2015)

Economic sector	Employment by area					
	Namakwa DM		Hantam LM		Khai-Ma LM	
	Employment	**%**	**Employment**	**%**	**Employment**	**%**
Agriculture, forestry & fishing	7948	23%	1972	29%	2220	50%
Mining and quarrying	783	2%	2	0%	175	4%
Manufacturing	1384	4%	140	2%	335	7%
Electricity, gas & water	152	0%	20	0%	4	0%
Construction	2760	8%	564	8%	114	3%
Wholesale and retail trade, catering, and accommodation	7016	20%	1253	18%	517	12%

Economic sector	Employment by area					
	Namakwa DM		Hantam LM		Khai-Ma LM	
	Employment	%	Employment	%	Employment	%
Transport, storage, and communication	1138	3%	218	3%	64	1%
Finance, insurance, real estate, and business services	2689	8%	493	7%	178	4%
General government	6269	18%	1200	17%	557	12%
Community, social and personal services	4983	14%	1055	15%	310	7%
Industry employment total	**35122**	**100%**	**6917**	**100%**	**4474**	**100%**

3.5 Income

In order to improve the living standards of residents in terms of to the minimum living level (MLL), which broadly refers to the minimum monthly income needed to sustain a household, the Khai-Ma SDF stipulates that a greater disposable income per household is required. Linked to this point, economic development is thus seen as an essential pathway to raising the living standards and general well-being of residents (Umsebe Development Planners, 2010).

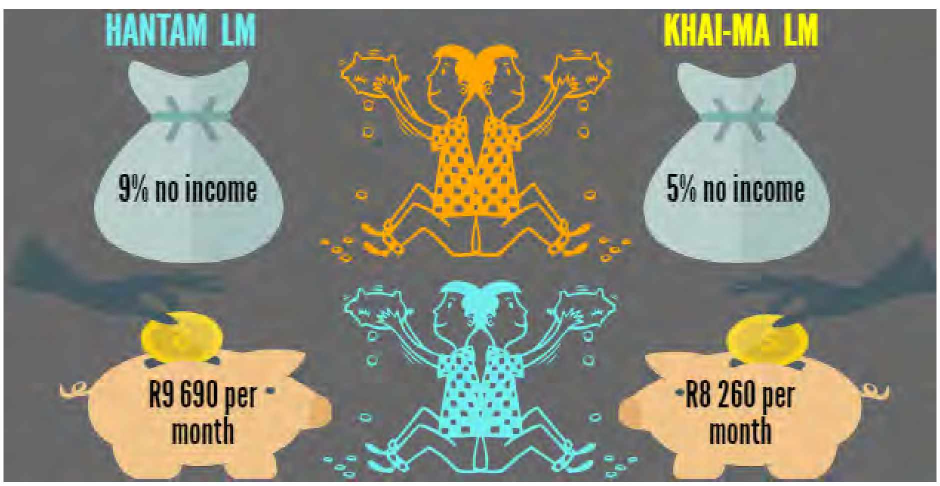


Figure 3-4: Hantam and Khai-Ma LM household income distribution (Stats SA, 2011) (Quantec, 2016)

The average household annual income in the **Hantam LM** is R116 276 in 2016 prices; this implies an average household monthly income of R9 690. The monthly income for Loeriesfontein is R10 620; these figures are relatively higher than the provincial average income, which is R8 521 per month. As highlighted in Table 3-6 below, 9% of households do not have a regular amount of income in both the Hantam LM and Loeriesfontein town which is on par with the national and provincial levels, where the proportion of people who do not receive any form of income equated to 9% and 7% respectively. In the Hantam LM, 54% of people fell below the poverty line as they earned less than R3 200 per month.

The main source of income in the municipality is the agricultural sector - predominantly sheep farming and rooibos tea. The second largest income contributor is the community employment sector - particularly the social and personal services industry.

Subsequent to the establishment of the two wind farms in the area, new economic opportunities in **Loeriesfontein** town have emerged. Public transport has benefitted as a result of the increased demand for the transportation of workers to and from construction sites. Cleaning services have also provided work opportunities for unemployed individuals whilst informal trading amongst residents has also increased and has stimulated further income and job creation in the town. Wind farm construction companies either pay their workers once a month or every fortnight; this has resulted in more money in circulation as the purchasing power of local residents also increased. This is important as it may assist in reducing the number of people living below the poverty line. Upon consultation, one farmer went to the extent of sharing that poverty levels have been slightly alleviated in the Loeriesfontein town.

The average household annual income in the **Khai-Ma LM** was R99 144 in 2016 prices; this equated to an average household monthly income of R8 262. The main source of income in Khai-Ma is the Black Mountain Mine situated in Aggeneys town as well as several government departments. Commercial farmers depend on incomes generated from their farms. The rest of the residents are either dependent on the government grant or they earn a living by providing housekeeping and gardening services (Umsebe Development Planners, 2010).

Table 3-6: Household per monthly income group (2011)

Indicator	Namakwa DM	Hantam LM	Loeriesfontein	Khai-Ma LM
No income	8%	9%	9%	5%
R1 – R3 200	54%	57%	61%	62%
R3 201 – R6 400	14%	12%	12%	10%
R6 401– R12 800	12%	11%	10%	13%
R12 801– R25 600	7%	6%	4%	6%
R25 601– R51 200	2%	2%	2%	1%
>R51 200	4%	3%	3%	2%

(**Stats SA, 2011)**

3.6 Access to services and state of local built environment

Access to shelter, water, electricity, sanitation, and other services are indicators that assist in determining the standard of living of the people in the area under investigation. Infrastructure and the state of local infrastructure is another indicator to contemplate when considering living standards. The availability of social and economic infrastructure including roads, educational facilities, and health facilities further indicates the nature of the study area, which is valuable in developing a complete profile of the circumstances in which communities are living. These measurements create a baseline against which the potential impacts of the proposed project can be assessed.

3.6.1 Settlement profile

In comparison to the national population density (42 people/km^2), the Hantam LM is characterised by a low density of people per square kilometre. It is also relatively lower than the district (0.91 people/ km^2)

and provincial (3.07 people/ km^2) density. Although population densities for the LM are significantly low (0.59 people/ km^2), as outlined in **Table 3-7** below, Loeriesfontein town has a higher population density of 79.69 people/km^2 making it the most densely populated area between the three areas under analysis.

Table 3-7: Population density of Hantam and Khai-ma LM (2011)

Indicator	Towns in the Hantam & Khai-Ma LM's		
	Hantam LM	Loeriesfontein	Khai-Ma LM
Population total	21581	2746	12466
Area (Sq. Km)	36128.07	34.45	16627.9
Population density	0.59	79.69	0.74

(Stats SA, 2011)

The Khai-Ma LM also has a relatively low population density with only 0.74 people/km^2, making it a sparsely populated region. Most people in the Khai-Ma LM are situated in the urban areas or in agricultural clusters along the Orange River, which also provides opportunities for water sport and recreation as well as resort development (Umsebe Development Planners, 2010)

3.6.2 Access to Housing and Basic Services

With respect to basic service provision and housing, the Namakwa DM is responsible for assisting and ensuring that local municipalities provide adequate housing to inhabitants in their jurisdiction. The current level of access to various basic services in the municipality are as follows:

Housing

During the year 2011, housing shortages in the **Hantam LM** were an acute problem. In the Hantam LM, 94% of houses had access to formal housing (i.e. a house made of brick or a concrete structure on a separate yard). Towns of the Hantam LM followed a similar path with Loeriesfontein having 94% access to formal housing (Stats SA, 2011). Amongst other pressing developments of the municipality, new housing unit developments have been identified by the Hantam SDF (Umsebe Development Planners, 2010). In comparison to the Hantam LM, the **Khai-Ma LM** residents had less access to formal housing, as only 74% of inhabitants resided in formal housing structures (Stats SA, 2011).

Access to water

In the **Hantam LM,** more than 90% of the households have access to piped water either inside their dwellings or yards. This includes residents living in Loeriesfontein town. More than 95% of water for the Hantam LM as well as for nearby towns is supplied by a regional or local water scheme operated by the municipality. In the **Khai-Ma LM**, more than 90% of households have access to piped water either in their dwellings or yards. A very low percentage of people do not have any type of access to piped water in the Khai-Ma LM.

Access to sanitation

Although the Spatial Development Framework suggests that almost all households in the **Hantam LM** had access to flush toilets in 2011 (Umsebe Development Planners, 2010), statistics show that just over three quarters (76%) of households in Hantam LM have access to flush toilets, either connected to the sewerage or to a septic tank. Whilst the Hantam LM believes to have eradicated the bucket system (Umsebe Development Planners, 2010), 3.1% of residents rely on the bucket latrine system whilst 0.9%

do not have any form of access to any form of sanitation (Stats SA, 2011). Just over half of Loeriesfontein residents utilise flush toilets. The **Khai-Ma LM** has the same proportion of people who have access to flush toilets as the Hantam LM, with 6% of people not having access to any type of sanitation.

Access to electricity

In the **Hantam LM**, only urban areas are provided with electricity whilst the rural areas depend on other sources (Umsebe Development Planners, 2010). Slightly more than three-quarters (77%) of households in the municipality have access to electricity for lighting whilst only 15% and 7% of people use candles and solar power for lighting, respectively (Stats SA, 2011). Similar trends can be noted when assessing the towns of the municipality, as more than 90% of Loeriesfontein town residents have access to electricity. One of the objectives of the municipality is to improve the living standards of its residents by implementing opportunities for bulk infrastructure development (Urban-Econ Development Economists, 2011). Although the SDF highlights electricity as one of the sectors experiencing backlogs in the **Khai-Ma LM**, 90% of households in the municipality use electricity for lighting whilst the rest use 7% candles and 2% use solar power. Development objectives premised on the optimisation of resources relating to bulk infrastructure such as electricity remains a goal for the municipality (Umsebe Development Planners, 2010).

3.6.3 Transport infrastructure

The transport sector plays a vital role in meeting the objectives of economic development, access to employment opportunities, and social infrastructure (Dennis Moss Partnership, 2012). As a result of this, industrial development ought to take the mode of transport utilised by the labour force of a particular region into consideration. This means that new economic developments should not be situated far from the pick-up or drop-off points of various means of transport (Urban-Econ Development Economists, 2011). In 2001, just over a third (36.8%) of people in the Hantam LM travelled to work or school by foot. The rest of the people used public transport (4.92%) whilst others made use of bicycles (1.39%) and their own transport facilities (5.12%) (Stats SA, 2001). Using the R55 gravel road, the distance between Calvinia and Loeriesfontein is 86km, whilst travelling from Calvinia to Brandvlei requires the utilisation of the R27 tar surface road for approximately two hours and 30 minutes.

The **Hantam LM** is traversed by several regional roads and encompasses two transport corridors (Umsebe Development Planners, 2010):

- Niewoudtville-Calvinia-Williston corridor: consisting of the R63 tar road and railway link among Calvinia, Williston and Carnarvon, which links Gauteng and the Western Cape
- Nieuwoudtville-Calvinia-Brandvlei-Kenhardt corridor: consisting of the R27 tar road leading from Cape Town to Upington, which provides a shortcut alternative to the route via Springbok and is often used by trucks particularly during the grape season. Considering that this is the main route in the region, it is essential that this road is maintained as it is of economic importance to the area.

The **Khai-Ma** IDP places emphasis on the need for local communities to have adequate access to services through the provision of sufficient transport infrastructure. Although the Khai-Ma LM recognises the need for sufficient transport facilities, about 30% of people walked home either to and from work or school. The second most utilised mode of transport is public transport in the form of buses, trains, and taxis (Umsebe Development Planners, 2010).

As derived from the above, there is currently no national road that passes through the Hantam municipal area. Due to the influx of people and heavy load traffic in the Hantam LM as well as nearby towns, the main route (R27) in the area, which is also the only tarred road connecting Nieuwoudtville and Brandvlei via Loeriesfontein, has been rapidly deteriorating and needs to be frequently maintained.

With respect to water availability in the area, consultations with farm owners revealed that the affected farm portions do not have any direct access to water as it is a scarce resource in the area. To prevent water shortage impacts, some farmers in the area have reservoirs within their property or use water tanks to store water

3.6.4 Social and Recreational Infrastructure

More often than not, residents require access to social services and shared community experiences in order to create a sense of belonging to an area. Access to sufficient social infrastructure such as schools, universities, medical facilities also plays a significantly important role in maintaining the social contact within communities. Whereas, a lack of social infrastructure results in a number of inconveniences and triggers long-term community dissatisfaction. Throughout the country, district, and local municipal level, government therefore has the mandate and responsibility to provide and build adequate facilities such as schools, hospitals, police stations, post offices safety as well as recreational amenities.

Social and recreational infrastructure provision within the Hantam and Khai-Ma LM is depicted below:

Figure 3-5: Hantam and Khai-Ma LM social and Recreational Infrastructure

4 PROFILE OF THE ZONE OF INFLUENCE

There are approximately 15 farm portions located in the zone of influence of the power line alternatives and on-site and linking substations site options. The following table indicates the farm options that may be affected by these alternatives.

Table 4-1: Zone of influence of power line and substation alternatives (portion and farm name)

Farm Portion	Power lines				On-site substation		Linking substation	
	O1	O2	O3	O4	Alt 1	Alt 2	Alt 1	Alt 2
Portion 2 of Georges Vley Farm No.217								
Portion 1 of Hartebeestleegte Farm No.216								
Portion 1 of Graskoppies Farm No.176								
Portion 1 of Konnes Farm No.183								
Portion 0 of Buchufontein Farm No.184								
Portion 0 of Springbok Pan Farm No.1164								
Portion 2 of Springbok Tand Farm No.215								
Rem of Springbok Tand Farm No.215								
Portion 2 of Karree Doorn Pan Farm No.214								
Portion 1 of Karree Doorn Pan Farm No.214								
Rem of Aan Der Karree Doorn Pan Farm No.213								
Portion 2 of Aan Der Karree Doorn Pan Farm No.213								
Portion 0 of Leeubergrivier Farm No.1163								
Rem of Klein Rooiberg Farm No.227								
Rem of Sous Farm No.226								

Given the information gathered through the telephonic interviews with the I&APs, the following can be summarised with respect to the zone of influence applicable to each alternative and substation site options:

Table 4-2: Zone of influence of power line alternatives and substations alternatives

Alternative		Brief Overview
Power line option	Option 1 (Green)	• May affect up to nine farm portions but does not cut across any farm portions • Cuts across the Sishen-Saldanha Railway line • Follows the farm portion boundary of the currently under construction Khobab wind farm for 16km
	Option 2 (Blue)	• May affect up to eleven farm portions • Cuts across the Sishen-Saldanha Railway line
	Option 3 (Pink)	• May affect up to seven farm portions • The shortest route in terms of kilometres • Directly cuts across four of the affected farm portions • Cuts across the Sishen-Saldanha Railway line
	Option 4 (Light blue)	• May affect up to thirteen farm portions • The longest route in terms of kilometres • Follows the R358 route for about 10km • Cuts across the Sishen-Saldanha Railway line • Will follow the border of the currently under construction Loeriesfontein 2 wind farm for about 8km • Cuts across the currently under construction Khobab wind farm for about 8km • Directly cuts across one farm portion

Alternative		Brief Overview
On-site Substation alternative	Alternative 1	• Will affect one farm portion • Will be located on farm used for commercial sheep farming • Will be located on same farm as the proposed !Xha Boom wind facility
	Alternative 2	• Will affect one farm portion • Will be located on farm used for commercial sheep farming • Will be located on same farm as the proposed !Xha Boom wind facility
Linking Substation alternative	Alternative 1	• Will affect one farm portion • Will be located on farm used for commercial sheep farming
	Alternative 2	• Will affect one farm portion • Will be located on farm used for commercial sheep farming

The engagement with the I&APs suggested that majority of the local land owners did not have any objections to the proposed substations and powerline. Most of the property owners highlighted their understanding of the importance of renewable energy projects in the context of South Africa. With this being said, there were some concerns expressed regarding the uncertainty of the path that would be followed by the power line. Such concerns were linked to the need to understand whether the proposed power line would affect the fencing on the farms. In addition, the presence of similar renewable energy developments that currently traverse the surrounding farm portions can also be used as an indication to further deduce that the landowners do not have any major concerns related to the establishment of the project.

5 SOCIO-ECONOMIC IMPACT EVALUATION

The following sections discuss the socio-economic impacts that the proposed power line and substations are envisaged to create, considering the knowledge of the potentially affected socio-economic environment related to each alternative and option. Based on feedback collected during the interviews with I&APs as well as the information about the proposed activities. The following potential impacts were identified and will be analysed further in the section.

- Impact 1: Stimulation of the economy and employment during the construction
- Impact 2: Increased risk of threat to personal safety and livestock theft during the construction phase
- Impact 3: Impact on sense of place
- Impact 4: Impact on service infrastructure

5.1 Impact 1: Stimulation of the economy and employment during construction

The process of constructing power lines and developing substations is often associated with the need to acquire various goods such as steel products, electrical components, cables, bricks, cement, etc. In the event that the required material is purchased locally, i.e. within South Africa, the production of the respective businesses supplying the goods will increase. In addition to this, the erection of the power lines and substation development will require the project proponent to source construction supporting activities/businesses who will facilitate the whole process. The outcome of the spending that will occur as a result of the procurement of the mentioned material and the hiring of construction services will result in the stimulation of the national economy as well as the local district (where inputs or services are procured).

The costs associated with the construction of the on-site substation and linking substation will be the same regardless the power line route chosen. With respect to the construction of the power line, though, the opposite is true. This is so because although the cost per kilometre of the power line is the same (i.e. estimated at R3mil/km), the power line route alternatives considered for the project are of different length and will therefore result in a differing capital expenditures. Therefore, the longer the route, the greater the expense of the power line erection, which ultimately results in a greater capital injection in national and local economies. Considering the length of different routes mentioned earlier in the report, Option 1, 2 and 4 appear to be the preferred options from an economic perspective. Option 3 is also an acceptable option, but since its length is significantly shorter than the other route alternatives, it is a favourable option from the perspective of economic stimulus and job creation.

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option
On-site Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option

Alternative	Preference	Reasons (incl. potential issues)
Linking Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option
Linking Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	**PREFERRED**	• 52.2km in length • R156.6mil in investment This alternative is associated with one of the highest investment requirements and will lead to one of the highest economic benefits.
Grid Line Option 2	**PREFERRED**	• 52.8km in length • R158.4mil in investment This alternative is associated with one of the highest investment requirements and will lead to one of the highest economic benefits.
Grid Line Option 3	**FAVOURABLE**	• 47km in length • R141mil in investment This alternative is associated with the shortest route for power line and, therefore, will result in the smallest economic benefit during construction
Grid Line Option 4	**PREFERRED**	• 53.4km in length • R160.2mil in investment From the economic perspective, this alternative is associated with the highest investment requirements and will lead to the highest economic benefits.

Production and temporary employment creation during construction	
Environmental Parameter	Production in the national and local economy and employment associated with these activities.
Issue/Impact/Environmental Effect/Nature	Investment in construction of the power line and the substation will lead to procurement of goods and services and will result in creation of employment opportunities for the members of the local communities and nationally.
Extent	The impact will affect the entire country.
Probability	The impact will likely occur (between 50% and 75% chance of occurrence.

Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Short-term. The impact will only last for the duration of the construction period (12 months and above).	
Cumulative effect	Considering the nature of the proposed development and the fact that the area that the proposed development will be in is already imbued with a presence of a number of RE projects; it is highly unlikely that it will result in a significant cumulative effect. This is so because of the size of the project as well as the expected coinciding nature of the all RE projects.	
Intensity/magnitude	The impact is rated as positive low.	
Significance rating	**Prior to mitigation measures:** Positive low impact **After mitigation measures:** The rating remains the same.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	+12 (Positive Low)	+12 (Positive Low)
Mitigation measures	• To increase the profitability of the project and ensure the trickling down effect to the local economy, the project proponent must source the materials and equipment in South Africa. • Where feasible (i.e. in cases where the appointed individuals match the skills required), the proponent is to ensure the employment of local labour. • Ensure effective lines of communication and disseminate as much information to local communities regarding the project and employment opportunities for contracting small businesses. Although the proposed mitigation measures could increase the positive impact on the local economy, it would not change the overall total impact. Therefore, the ratings for the impact will remain the same.	

5.2 Impact 2: Increased risk of threat to personal safety and livestock theft during construction phase

The erection of power lines and substations' development is expected to increase the movement and presence of people in and around the farms. Based on the information given by the project proponent, ±70% of the jobs will be allocated to local community members. As a result of this, the increased presence of people around the farms will not only increase the threat to the personal safety of landowners, but it will also result in the increased risk of livestock theft due to high exposure to people during construction. Linked to this, one of the interviewed I&APs (landowner of Portion 2 of Farm Graskoppies no.176) expressed that although he has no concerns with the erection of the power lines and development of substations, he was concerned about the possibility of the power lines affecting his fencing which he uses to control the sheep from wandering about, thus increasing the risk of losing the stock and their exposure to theft. To alleviate this impact, farms that will be affected by the construction of the power line must practice strict access control, and rules made by the farmers regarding access to their properties must also be adhered to.

Regarding the power line alternatives, the most preferred alternative would be the option that affects the least farm portions and is also the shortest, as this reduces the level of risk and exposure (in terms of time) of farmers to crime-related activities such as burglaries and livestock theft, whilst the least preferred option would be the alternative that affects the most farms. In the case of the proposed facility, the route that affects the least farm portions and by coincidence is also the shortest route is corridor option 3. However, although option 3 affects the least farms and is also the shortest route, it also directly cuts across four farms, which is in this case used as a proxy to determine the extent of the landowners' exposure to life-threatening occurrences. Due to this, option 3 will most probably result in a low-medium impact to landowners and will therefore be listed as the preferred option (which highlights that the alternative will result in a low impact).

With respect to the on-site and linking substation alternatives, no differentiation can be made as the impact will remain the same despite the alternative chosen.

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option
On-site Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option
Linking Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option
Linking Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option
GRID LINE CORRIDOR ALTERNATIVES		

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 1	**FAVOURABLE**	Except for option 3, no differentiation can be made between this alternative and option 2. This power line option is 52.2km and will affect nine farm portions.
Grid Line Option 2	**FAVOURABLE**	Except for option 3, no differentiation can be made between this alternative and option 1. This power line option is 52.8km and will affect eleven farm portions.
Grid Line Option 3	**PREFERRED**	The alternative is the shortest route (47km) and is likely to lead to a shorter period of exposure to the risk as it affects seven farm portions which is the least in comparison to option 1,2 and 4.
Grid Line Option 4	**NO PREFERENCE**	This power line option is the longest route (53.4km) and will therefore affect the highest number of farm portions (thirteen), thus increasing the exposure to risk and livestock theft. It is the least preferred among the other options, but no issues could be identified to make it "not preferred".

Increased risk of threat to personal safety and livestock theft during construction	
Environmental Parameter	Threat to personal safety and security of assets such as livestock.
Issue/Impact/Environmental Effect/Nature	Increased foot traffic in and around the farms is expected to increase the risk of local landowners to criminal activities.
Extent	The impact will affect the site.
Probability	The impact will likely occur (between 50% to 75% chance of occurrence).
Reversibility	The impact is partly reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Short term. The effects of the impact (increased risk to personal safety) will only last for the duration of the construction phase.
Cumulative effect	If approved, the building of the proposed project will occur during the building of the !Xha Boom wind farm and will most probably coincide with the simultaneous development of other projects that have received environmental authorisation or are at the EIA stage. This means that the cumulative effect of this project will not result in any significant changes and will therefore be low.
Intensity/magnitude	Low. Though it is uncertain, it is possible that the people employed for the development of the !Xha Boom wind farm will

	be the same people employed for the construction of the power line. If this is the case, then the intensity of the impact will be barely perceptible.	
Significance rating	Negative low	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-10 (Negative Low)	-9 (Negative Low)
Mitigation measures	• Minimise the possibility of attracting a number of people in search for employment in the vicinity of the farms by ensuring clear communication regarding the project. • Engage with property owners prior to the developing of the substations and erection of the power line to ensure that the expectations (rules) of the farmers regarding access to farms are understood and effectively adhered to. • Construction workers must be thoroughly informed of the rules made by farmers and be made to understand the accompanying consequences. • Implement controlled access to farm properties where the power line and substations will be built and will ensure that the construction workers are on site during reasonable working hours. Although the proposed mitigation measures will minimise the negative impact, it will not change the total impact; therefore, the rating significance remains the same.	

5.3 Impact 3: Impact on the sense of place

According to the plans of the project proponent regarding the development of the substations as well as the erection of the power lines, the connection of the wind turbines will require the use of buried medium voltage cables except where a technical assessment of the proposed design suggests overhead lines as the more appropriate option. Overhead lines often make more sense over rivers and gullies. As such, where overhead lines are required, the use of H-pole tower types will be used.

In light of the above, the proposed power lines and substations can be expected to result in a change in the sense of place in the area. This is mostly because the infrastructural components mentioned above, as well as the construction of internal access roads, temporary construction laydown areas, administration and maintenance buildings, will all be built in an area that is relatively undeveloped and will further increase the development footprint of the project. Although this is the case, the establishment of other proposed renewable energy facilities in the vicinity makes it reasonable to assume the future presence of similar power lines. Currently, two wind farms and one solar PV plant have been approved under the RE IPPPP whilst four other projects (three wind farms and one solar PV plant) have received environmental authorisation whilst an additional six projects (all wind farms) are currently at the environmental impact assessment (EIA) stage (including the !Xha Boom wind farm energy facility). Therefore, considering the presence of other proposed facilities, regardless of their current status of development, the landscape of the area is most likely to change significantly. However, in view of the nature of the proposed developments, none of them will alter the landscape to such an extent of completely affecting the current land-use of the area, which is predominantly commercial sheep farming, or alter the rural nature of the locality.

During the interviews with the I&APs, only one farm owner (Portion 2 of Farm Karree Doorn Pan no.214) expressed a preference that the chosen power line alternative rather follow his farm boundary on the northerly side (power line corridor option 4) as opposed to the farm boundary along the west (power line corridor option 2). The reason for the preference toward option 4 is because the farm boundary on the west (which is corridor option 2) has a bushveld which is of notable importance to the farmer. This farmer's particular concern also stemmed from the fact that Eskom already has a servitude running across his farm.

In light of the envisaged changes to the landscape as well as the concerns raised, the impact of the proposed 132 kV power line and 132 kV substations is expected to be negligible.

From the outlook of the erection of the power line route options, only route options 1 and 2 are equally acceptable. This is so because although option 3 affects the least farms, it directly cuts across four of the farm properties. While option 4 affects the most properties, it is also the only option that follows the route of a regional road for about 10km whilst also cutting across the farm portion with the currently under construction Khobab wind farm. Based on this information, there is no differentiation between options 3 and 4 as they are both associated with a higher impact on the sense of place.

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
On-site Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Linking Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Linking Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	**FAVOURABLE**	This alternative is expected to be associated with the lowest impact, similar to option 2.
Grid Line Option 2	**FAVOURABLE**	This alternative is expected to be associated with the lowest impact, similar to option 1.

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 3	**NO PREFERENCE**	Similar to option 4, this option is also expected to result in one the highest impacts. However, no differentiation between this alternative and option 4 is suggested.
Grid Line Option 4	**NO PREFERENCE**	This alternative is associated with the higher impact as it affects the most farm portions and is likely to affect a greater sensitive group. However, no differentiation between this alternative and option 3 is suggested.

Impact on the sense of place		
Environmental Parameter	Sense of place.	
Issue/Impact/Environmental Effect/Nature	The addition of physical infrastructure will change the landscape and alter the sense of place of farm owners.	
Extent	The impact will affect the local area.	
Probability	The impact will certainly occur (greater than 75% chance of occurrence).	
Reversibility	The impact is expected to be reversible during the decommissioning phase.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	The impact will most probably last past the operation phase.	
Cumulative effect	With the construction of other power lines and substations, the cumulative effect of this project is expected to be low.	
Intensity/magnitude	Considering the expected occurrence of other power lines from the currently under construction wind farms, the intensity of this impact is barely perceptible.	
Significance rating	Negative low	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	4	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-13 (Negative Low)	-12 (Negative Low)
Mitigation measures	• Implement mitigation measures recommended by the relevant specialist (i.e. visual). • Deconstruct the power line and substations once the wind facility is decommissioned.	

5.4 Impact 4: Impact on service infrastructure

Considering that the whole aim of the proposed substations and power line erection is to feed electricity generated at the wind farm into the national electricity grid, the establishment of these facilities will assist in increasing the capacity of the national grid. Accompanying benefits of the connection of the proposed facility to the national grid also includes the simultaneous greening of the economy (through the reduction of the use of coal for electricity production) whilst strengthening the national supply of electricity.

The impact will be the same regardless of the power line route chosen and substation alternatives; thus, no preference between these alternatives can be determined.

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
On-site Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Linking Substation Option 1	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Linking Substation Option 2	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Line Option 1	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Grid Line Option 2	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Grid Line Option 3	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.
Grid Line Option 4	**NO PREFERENCE**	No differentiation between this and the other option, equally acceptable.

Impact on service infrastructure	
Environmental Parameter	Electricity distribution infrastructure.
Issue/Impact/Environmental Effect/Nature	The proposed 132 kV power line and substation will allow the evacuation of generated electricity at the proposed !Xha Boom facility to the national grid.
Extent	The impact will affect the entire country.
Probability	The impact will certainly occur (greater than 75% chance of occurrence).
Reversibility	The impact is reversible.

Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Effect of the impact will extend beyond the operation phase.	
Cumulative effect	The impact would result in negligible to no cumulative impacts.	
Intensity/magnitude	Medium. The impact will feed 235 MW to the national grid.	
Significance rating	Positive medium	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	+30 (Positive Medium)	+30 (Positive Medium)
Mitigation measures	• No enhancement measures proposed.	

6 CUMULATIVE EFFECT ANALYSIS

The development of numerous RE facilities in the same area has the potential to result in positive cumulative impacts. Such impacts often include the creation of employment opportunities for the local community, skills development as well as the creation of local business opportunities. However, negative impacts such as the change in sense of place as a result of the development footprint of the various projects cannot be ignored.

The area chosen for the proposed development has a notable presence of RE projects. Although such RE projects highlight the suitability of the area, all projects are at different stages of application. Currently, only two of these projects, namely Khobab and Loeriesfontein 2 wind farms, are under construction whilst the Solar Capital Orange PV facility is in the approval and financing stage. See Figure 6-1.

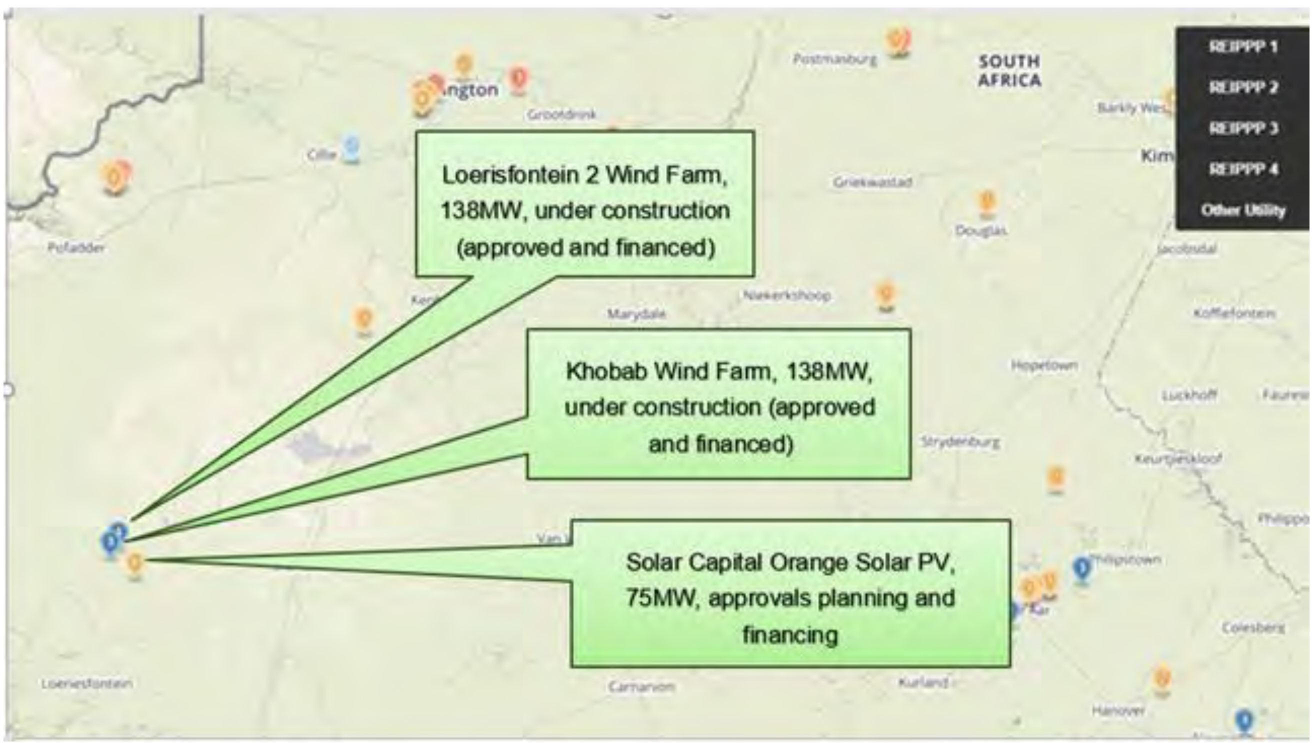


Figure 6-1: Map of approved for construction RE projects in the area

In the event that more than one RE facility is built in the immediate vicinity of the !Xha Boom Substation facility, both positive and negative impacts are likely to be amplified. As illustrated in Table 6-1, almost all the projects listed below are located in close proximity to the !Xha Boom Substation facility. Furthermore, four of the ten projects have received environmental authorisation whilst the rest (six projects) are at the environmental impact assessment (EIA) stage.

Table 6-1: Projects under investigation or proposed for development as part of RE IPPPP

Development	Current status of development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation Issued	Mainstream Renewable Power	140MW	Rem of Farm Brak Pan 212 & Stinkputs No. 229

Development	Current status of development	Proponent	Capacity	Farm details
Graskoppies Wind farm	Environmental Impact Assessment (EIA) underway	Mainstream Renewable Power	235MW	• Pt2 of Graskoppies Farm No.176 • Pt1 of Hartebeest Leegte Farm No.16
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation Issued	Mainstream Renewable Power	100MW	Pt 2 of Farm Aan de Karree Doorn Pan No. 213
Hantam PV Solar Energy Facility	Environmental Authorisation Issued	Solar Capital (Pty) Ltd.	75MW	Rem of Narosies No.228
Hartebeest Leegte Wind Farm	Environmental Impact Assessment (EIA) underway	Mainstream Renewable Power	235MW	• Rem of Hartebeest Leegte Farm No.216
Ithemba Wind Farm	Environmental Impact Assessment (EIA) underway	Mainstream Renewable Power	235MW	• Pt2 of Graskoppies Farm No.176 • Pt1 of Hartebeest Leegte Farm No.16
PV Solar Power Plant	Environmental Authorisation Issued	BioTherm Energy	70MW	Pt 5 of Farm Kleine Rooiberg No. 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investment No. 1788 (Pty) Ltd (BVI)	240MW	• Rem of Farm Leerbergrivier No. 1163 • Rem of Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investment No. 1788 (Pty) Ltd (BVI)	240MW	• Rem of Farm Springbok Pan No. 1164 • Rem of Farm Springbok Tand No. 215
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investment No. 1788 (Pty) Ltd (BVI)	240MW	• Rem of Farm Ann De Karree Doorn Pan No.213; • Portion 1 of the Farm Karree Doorn Pan No.214 • Portion 2 of Farm Karree Doorn Pan No.214
Wind Farm	Environmental Authorisation Issued,	Mainstream Renewable Power	50MW	• Portion 1 of the Farm Aan de

Development	Current status of development	Proponent	Capacity	Farm details
	however project is no longer active			Karree Doorn Pan 213

6.1.1 Literature review sources

The following documents were reviewed in relation to the above-mentioned projects to identify the potential cumulative effect of the proposed development considering the existing and planned projects in the area.

Table 6-2: Reviewed literature concerning the selected developments in the area

Development	Reviewed report	Author	Date of release
Dwarsrug Wind Farm	Socio-economic Impact Study	Urban-Econ Development Economists	May 2015
Khobab Wind Farm	Socio-economic Impact Assessment Report	Master-Q Research	2 May 2012
Loeriesfontein 2 Wind Farm	Socio-economic Impact Assessment Report	Master-Q Research	2 May 2012
Loeriesfontein PV3 Solar Energy Facility	Socio-economic Impact Assessment Report	Master-Q Research	2 May 2012
Graskoppies Wind Farm	Socio-economic Impact Assessment Scoping Report	Urban-Econ Development Economists	November 2016
Hantam PV Solar Energy Facility	Not Available	N/A	N/A
Hartebeest Leegte Wind Farm	Socio-economic Impact Assessment Scoping Report	Urban-Econ Development Economists	November 2016
Ithemba wind farm	Socio-economic Impact Assessment Scoping Report	Urban-Econ Development Economists	November 2016
PV Solar Power Plant	Draft Environmental Management Programme	Digby Wells	15 September 2015
Kokerboom 1 Wind Farm	Final Scoping Report	Aurecon	December 2016
Kokerboom 2 Wind Farm	Final Scoping Report	Aurecon	December 2016
Kokerboom 3 Wind Farm	Final Scoping Report	Aurecon	December 2016
Wind Farm	Socio-economic Impact Assessment Report	Master-Q Research	2 May 2012

6.1.2 Identification of cumulative effects

The following table summarises the key socio-economic impacts that were identified and analysed by other specialists for the above-mentioned projects. The table indicates the rating of the identified socio-economic impacts as proposed by the other specialists in their respective studies, and based on the combination of these ratings indicates the importance of the socio-economic impact from a cumulative effect perspective. Only cumulative effects that are expected to reach high-importance level are included in further analysis.

Table 6-3: Reviewed literature concerning similar developments and impact rating

Capital	Environmental parameter	Description/Impact	Rating by specialist	Identified importance
Natural capital	Agricultural activities in zone of influence	**Dwarsrug wind Farm:** Impact on agricultural activities on the directly affected farms due to movement of vehicles and workers, and established infrastructure.	Low negative	Low-medium negative
		Kokerboom 1,2 & 3 wind farms: Transforming the land to industrial use will result in the loss of agricultural land.	Low negative	
	Access to resources for sustainable livelihood	**Loeriesfontein PV3 Solar Energy Facility, Wind farm, Khobab wind farm, Loeriesfontein 2 wind farm:** Site access and clearance of land can result in long-term loss of land, resulting in a change in access to resources to sustain livelihoods.	Low negative	
Human capital	Temporary employment creation	**Dwarsrug wind Farm:** The establishment of the wind farm will create employment opportunities from direct, indirect and induced impacts.	Low positive	Medium-high positive
		Khobab & Loeriesfontein 2 wind farms Unemployed residents will benefit from being trained and receiving employment.		
		Loerisfontein PV3 Solar Energy Facility and Wind Farm: It is estimated that the development will create a few temporary jobs.		
		Graskoppies, Ithemba, Hartebeest Leegte , Kokerboom 1,2 & 3 wind farms During the establishment of a wind farm, large numbers of workers are required for the duration of the construction phase**.**	Medium Positive	
Social capital	Skills development	**Dwarsrug wind Farm:** Long-term skills transfer and skills development will take place as a result of the establishment of the project.	Medium positive	Medium-high positive
		Graskoppies, Ithemba & Hartebeest Leegte wind farms: Skills development can be expected to be enhanced as those who will receive employment will either be improving an existing skill or acquiring a new skill.	High positive	
		Khobab & Loeriesfontein 2 wind farms: The developer is most likely to include foreign experts to encourage knowledge transfer.	Low positive	
		Kokerboom 1,2 & 3 wind farms: There are many unemployed individuals who will benefit from being trained in a specific skill and employed.	Medium positive	
	Investment in local community	**Dwarsrug wind farm:** Project owners are required to spend a portion of their turnover on the upliftment of the community where the project is located.	Medium positive	High Positive

Capital	Environmental parameter	Description/Impact	Rating by specialist	Identified importance
		Graskoppies, Ithemba & Hartebeest Leegte wind farms: Part of the IPPPP; project owners are required to allocate a percentage of the projects' revenue towards community development.	High positive	
	Demographic changes	**Graskoppies, Ithemba, Hartebeest Leegte & Dwarsrug wind farms:** An influx in migrant workers and an increase in jobseekers is expected to ensue.	Medium negative	Medium negative
		Koekerboom 1,2 & 3 Wind farms: The establishment of these wind farms presents attractive job opportunities.	Low negative	
	Social pathologies	**Dwarsrug wind farm:** Increase in foot traffic results in an increase in social ills such as poor health, substance abuse, prostitution, etc.	Medium negative	Medium-high negative
		Graskoppies, Ithemba, Hartebeest Leegte wind farms: The increase in the number of construction workers is expected to cause a further increase in social pathologies.	High negative	
Cultural & Spiritual capital	Socio-cultural: Health and Safety	**Khobab & Loeriesfontein 2 wind farm** Construction workers employed by the developer increase the average number of men in the vicinity thus increasing the incidence of communicable diseases.	High negative	High negative
		Koekerboom 1,2 & 3 Wind farms: Impact of heavy vehicles including damage to roads, safety and health.	Low negative	
Physical capital	Sustainable increase in production & Temporary stimulation of GDP-R	**Dwarsrug, Graskoppies, !Xha Boom & Hartebeest Leegte wind farms:** The initial capital injection will set of a range of value-adding activities resulting in the stimulation of GDP-R and long-term production.	High positive	High positive
	Added pressure on infrastructure	**Graskoppies, Ithemba, Hartebeest Leegte & Dwarsrug wind farms:** An increase in the number of people in Loeriesfontein could create additional pressure on the local municipality and aggravate service provision related challenges**.**	Medium negative	Medium negative
Financial capital	Establishment of informal hospitality industry	**Graskoppies, Ithemba & Hartebeest Leegte wind farms** Formation of an informal hospitality industry as a result of the increased demand for accommodation.	Medium positive	Medium positive
	Increased household income & standard of living	**Dwarsrug wind farm:** New jobs that will be created will result in increased household income for benefitting individuals**.**	High positive	High positive
		Graskoppies, Ithemba & Hartebeest Leegte wind farms: Increase in household income is expected to accrue due to job creation as well as skills development.	Low positive	

Capital	Environmental parameter	Description/Impact	Rating by specialist	Identified importance
Political & Institutional capital	Increase in government revenue	**Dwarsrug wind farm:** Government obtains its revenue by collecting taxes and rates from the country's citizens and business.	Low positive	Medium positive
		Graskoppies, Ithemba & Hartebeest Leegte wind farms: Government obtains its revenue from collecting taxes and rates from the country's residents and business.	Medium positive	
		Wind Farm & Loeriesfontein PV3 Solar Energy Facility: Increased central and local tax income.	Low positive	

The Department of Environmental Affairs and Tourism's guidelines (DEAT, 2004) suggest that the identification of cumulative effects should focus on important and meaningful issues as "it is not practical to analyse the cumulative effects of an action on every environmental receptor". Furthermore, it is advised that the analysis should focus on "what is needed to ensure long-term productivity or sustainability of the resource" (DEAT, 2004).

Considering the range of socio-economic impacts predicted to ensue as a result of other planned developments in the area, only one negative cumulative effect was identified, which is expected to be of some concern. This cumulative effect is the envisaged changes to health and safety (specifically infectious diseases such as STIs including HIV/AIDS) of the local communities, and specifically the residents of the town of Loeriesfontein.

However, **the possible addition of the proposed development** (!Xha Boom Substation and powerline development) to the RE projects approved under the REIPPPP, those that have already received environmental authorisation, as well as the ones at the EIA stage **is not expected to result in any significant changes to the identified impacts in the literature review**. This is due to the size and nature of the proposed development relative to the other developments planned and already implemented in the area.

7 CONCLUSION

Mainstream Renewable Power South Africa (Pty) Ltd proposes the establishment of a 132 kV power line and associated substations of which the purpose will be to connect to the !Xha Boom wind farm energy facility to the national grid to evacuate electricity generated by that facility. The infrastructure will be located 33km south-east of the proposed !Xha Boom Wind Farm in Loeriesfontein town in the Northern Cape province. Four different route alternatives for power lines, two alternatives for the on-site substation and two linking substation alternatives are considered.

The relevant national, provincial, and local government policies reveal that the development of RE technologies is strongly supported by government. It is seen as the means to diversify the energy mix in the country, achieve climate change commitments, and stimulate economic development in the country while creating new employment opportunities. As such, the assessment of the proposed project revealed that the stimulation of the economy, job creation and improved service infrastructure are among the positive impacts that can ensue from the proposed project during both construction and operational phase. According to the Hantam IDP, the economy of the Hantam LM is characterised by heavy dependence on the primary sector, low education and skill levels. Therefore, the introduction of the proposed development is expected to benefit the local municipality specifically due to its small economic base and large unemployment rate.

The following table provides the summary of the identified positive and negative impacts before and after mitigation.

Table 7-1: Summary of construction & operation phase impacts

Impact	Significance rating with no mitigation	Post mitigation significance rating
Impact 1: Stimulation of the economy and creation of temporary employment during construction	+12 (positive low)	+12 (positive low)
Impact 2: Increased risk of threat to personal safety and livestock theft during construction	-10 (negative low)	-9 (negative low)
Impact 3: Impact on the sense of place	-13 (negative Low)	-12 (negative Low)
Impact 4: Impact on service infrastructure	+30 (positive Medium)	+30 (positive Medium)

Presented in Table 7-2 below is the comparative review of the proposed alternatives and options for the for the power line route and substations.

Table 7-2: Summary of comparative assessment exercise

Impact	Power line option			
	Option 1	Option 2	Option 3	Option 4
Impact 1: Stimulation of the economy and creation of temporary employment during construction	PREFERRED	PREFERRED	FAVOURABLE	PREFERRED
Impact 2: Increased risk of threat to personal safety and livestock theft during construction	FAVOURABLE	FAVOURABLE	PREFERRED	NO PREFERENCE

Impact	Power line option			
	Option 1	Option 2	Option 3	Option 4
Impact 3: Impact on the sense of place	**FAVOURABLE**	**FAVOURABLE**	**NO PREFERENCE**	**NO PREFERENCE**
Impact 4: Impact on service infrastructure	**NO PREFERENCE**	**NO PREFERENCE**	**NO PREFERENCE**	**NO PREFERENCE**

Based on the above, the following can be recommended:

- **Substation route alternative**: In all instances (impacts) related to the substation alternatives (both on-site and linking substations), no preferences were identified for any of the alternatives.
- **Power line route option**: Considering the identified potential negative and positive impacts, corridor option 3 (pink) appears to be slightly more preferred among the four alternatives. Although it will result in the lowest economic benefits to the national and local economy, such benefits would be temporary and would not be significant regardless of the route option chosen. Importantly, Option 3 affects the least farms and is associated with the shortest power line length. Option 1 and 2 are considered favourable and are slightly more preferred than Option 4 from the reviewed socio-economic impacts perspective. However, considering that the owner of the Portion 2 of Farm Karree Doorn Pan no. 214 raised an objection against Option 2 and expressed a preference for Option 4 (refer to section 5.3), it would be advisable to consider Option 1 and Option 4 before selecting Option 2.

ANNEXURE A: IMPACT RATING CRITERIA AND METHODOLOGY

The rating system will be applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts will be consolidated into one rating. In assessing the significance of each issue, the following criteria is used:

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact has different scales and, as such, bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.

2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short-term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium-term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long-term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects.
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects.
3	Medium Cumulative impact	The impact would result in minor cumulative effects.
4	High Cumulative Impact	The impact would result in significant cumulative effects.
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The assessment of alternatives followed the next criteria:

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

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