Appendix D

SPECIALIST REPORTS

Appendix D1

BIODIVERSITY

BASIC ASSESSMENT REPORT:

Ecological study on the potential impacts of the proposed BioTherm Tlisitseng Solar 1 power lines and substation near Lichtenburg in the North West Province

Prepared by

Dr David Hoare
(Ph.D., Pr.Sci.Nat.)

David Hoare Consulting cc
41 Soetdoring Ave
Lynnwood Manor,
Pretoria

for

SiVEST SA (Pty) Ltd
P O Box 2921,
Rivonia. 2128

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REPORT VERSION: 2nd Draft

David Hoare Consulting cc

Biodiversity Assessments, Vegetation Description / Mapping, Species Surveys

DECLARATION OF INDEPENDENCE & SUMMARY OF EXPERTISE

Appointment of specialist

David Hoare of David Hoare Consulting cc was commissioned by SiVEST SA (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed construction of the Tlisitseng Solar 1 power line and substation near Lichtenburg in the North West Province. The consulting services comprise an assessment of potential impacts on the general ecology in the study area by the proposed project.

Details of specialist

Dr David Hoare
David Hoare Consulting cc
Postnet Suite no. 116
Private Bag X025
Lynnwood Ridge, 0040

Telephone:	012 804 2281
Cell:	083 284 5111
Fax:	086 550 2053
Email:	dhoare@lantic.net

Summary of expertise

Dr David Hoare:

- Has majors in Botany and Zoology with distinction from Rhodes University, Grahamstown, an Honours Degree (with distinction) in Botany from Rhodes University, an MSc (cum laude) from the Department of Plant Science, University of Pretoria, and a PhD in Botany from the Nelson Mandela Metropolitan University, Port Elizabeth with a focus on species diversity.
- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995, with working experience in Gauteng, Mpumalanga, Limpopo, North West, Eastern Cape, Western Cape, Northern Cape and Free State Provinces, Tanzania, Kenya, Mozambique and Swaziland.
- Conducted, or co-conducted, over 350 specialist ecological surveys as an ecological consultant. Areas of specialization include general ecology, biodiversity assessments, vegetation description and mapping, plant species surveys and remote sensing of vegetation. Has undertaken work in grassland, thicket, forest, savannah, fynbos, coastal vegetation, wetlands and nama-karoo vegetation, but has a specific specialization in grasslands and wetland vegetation.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with the proponent. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to SiVEST SA (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author’s best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

EXECUTIVE SUMMARY

David Hoare Consulting cc was appointed by SiVEST SA (Pty) Ltd to undertake a general ecology assessment of the study area. This report provides details of the results of the Basic Assessment study, based on a desktop assessment of the study area, mapping from aerial imagery and a field survey of the site. The study area is located in the North West Province approximately 8 km to the north-west of Lichtenburg.

The vegetation type that occurs on site (Carletonville Dolomite Grassland) is classified as Vulnerable, but has a wide distribution and extent. The natural vegetation on the sites is therefore considered from this perspective to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for pans, and as part of a dolomite aquifer recharge zone.

Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following:

- Presence of natural vegetation on site, some of which is of elevated conservation priority.
- Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (possibly occurs on site - individuals seen were not flowering), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.
- Potential presence of one protected plant species, *Harpagophytum procumbens.*
- Potential presence of three protected tree species, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. The tree *Acacia erioloba* occurs in large numbers on site.
- Potential presence of the following animals of potential conservation concern:
  - Brown Hyaena (NT)
  - Honey badger (NT)
  - Southern African Hedgehog (NT)
  - White-tailed Rat (EN)
  - Giant Bullfrog (NT/LC)
  - Kori Bustard (VU),
  - Blue Crane (VU),
  - Secretarybird (NT).
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks (impacts) to the ecological receiving environment are as follows:

1. Impacts on indigenous natural vegetation;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Mortality of sedentary animals;
6. Displacement of mobile fauna;
7. Mortality of birds by collision with vertical infrastructure;
8. Establishment and spread of declared weeds and alien invader plants.

Table 11: Comparison of summarized impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Indigenous natural vegetation	Loss (substation)	-38		-38	
Indigenous natural vegetation	Loss (power lines)	-13		-12	
Protected plant species	Loss of individuals	-11		-9	
Protected trees	Loss of individuals	-14		-13	
Pan depressions	Damage, loss of vegetation	-28		-6	
Sedentary fauna	Loss of individuals	-10		-7	
Bird species of conservation concern	Collision with power lines	-26		-11	
Natural habitat	Invasion by alien invasive plant species leading to habitat loss and/or degradation	-28		-11	
			- 21.0		**-13.4**
			Low Negative Impact		Low Negative Impact

Cumulative impacts of this project in combination with similar projects is likely to be of low significance, with the exception of impacts on pan depressions, which may possibly be moderate due to impacts from other sources.

Substation Alternative 1 is marginally preferred to Alternative 2, which is also favourable. The decision is marginal, but would place the alternative closer to the solar arrays, rather than further to the south of the solar arrays, which would disturb additional areas.

Proposed mitigation measures include shifting power line tower structures, if necessary, to avoid sensitive features, compiling a surface runoff and stormwater management plan, formalising a rehabilitation programme, undertaking a botanical walk-through survey, undertaking search-and-rescue for any appropriate species, obtaining permits for any protected species that will be affected, undertaking a search and rescue of plants that can be rescued, compiling an alien plant management plan and undertaking regular monitoring.

The report concludes that there are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

TABLE OF CONTENTS

INTRODUCTION

Terms of reference and approach

SiVEST SA (Pty) Ltd was appointed to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed BioTherm Tlisitseng 1 power line and substation near Lichtenburg in the North West Province. At this stage, it is proposed that the project will consist of the following components:

- A power line with a voltage of 132kV to the proposed Tlisitseng substation;
- Tlisitseng sub-station.

The purpose of the Basic Assessment is to identify environmental impacts associated with the proposed infrastructure.

On 2 October 2015 David Hoare Consulting cc was appointed by SiVEST SA (Pty) Ltd to undertake a Biodiversity (flora and fauna) assessment of the study area. It was agreed that the study would include the following:

- Conduct a desktop scoping study to broadly describe and characterise the study area in terms of:
    - Vegetation types and/or habitats;
    - National conservation status of major vegetation types;
    - Red Data (threatened and endangered) flora, fauna and avifauna species;
    - The potential presence of trees protected according to the National Forests Act and fauna and flora protected under the National Environmental Management: Biodiversity Act;
    - Important Bird Areas (IBAs) and Critical Biodiversity Areas (CBAs);
    - The general status of vegetation on site; and
    - Potential impact on biodiversity, sensitive habitats and ecosystem functioning.
- Undertake field investigations to assess and confirm the patterns identified during the desktop assessment.
- Compile impact level biodiversity report for the proposed infrastructure including (but not limited to) the following aspects:
    - Introduction;
    - Legislative background as applicable to the proposed activity;
    - Updated environmental baseline;
    - Methodology;
    - Identification and mapping of biodiversity (fauna and flora) sensitive areas within the application site based on field investigation and findings (all sensitive areas within the development site must be provided to SiVEST as shapefiles);
    - Assessment of the significance of the proposed development on flora, fauna and ecology during the Pre-construction, Construction, Operation, Decommissioning Phases (using SiVEST's Impact Assessment Methodology);
    - Findings (maps to be created and shapefiles submitted);
    - Alternatives Assessment (alternatives will be provided);
    - Implications of specialist findings for the proposed development (e.g. permits, licenses, etc.);

    - Cumulative impact identification and assessment;
    - Recommend mitigations measures and provide recommendations in order to minimize the impact of the proposed development on flora, fauna, ecology, etc.; and
    - Conclusion.
- Update and amend the draft report according to SiVEST's comments and resubmit final report for inclusion in the Basic Assessment Report.

This report provides details of the results of the Basic Assessment. The findings of the study are based on a desktop assessment of the study area, mapping from aerial imagery and a field survey of the site.

METHODOLOGY

The assessment is to be undertaken in a single phase. This report provides a description of the site and assessment of the activity.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically <u>focus on red flags and/or potential fatal flaws</u>. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)

Species of conservation concern

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

Red List plant species
Determining the conservation status of a species is required in oder to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the IUCN Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo et al. 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (http://redlist.sanbi.org/). According to the website of the Red List of Southern African Plants (http://redlist.sanbi.org/), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: http://www.iucnredlist.org*. The South African assessment is used in this study.

The purpose of listing Red List species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (http://posa.sanbi.org) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Protected trees
Regulations published for the National Forests Act (Act 84 of 1998) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in

order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list was obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (http://sibis.sanbi.org/) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there. The site was searched for these species during the field survey and any individuals or concentrations noted.

Other protected species
National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*

This legislation contains lists of species that are protected. These lists were scanned in order to identify any species thathave a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, it was stated that it was considered possible that they could occur on site.

There is additional legislation that provides lists of protected species, but the legislation to which these are attached deal primarily with harvesting or trade in listed species and do not specifically address transformational threats to habitat or individuals. This includes the following legislation:

- *CITES: Convention on the Trade in Endangered Species of Wild Fauna and Flora*.

Red List animal species
Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997, Monadjem et al. 2010). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitats available at each of the proposed sites. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

Species probability of occurrence
Some species of plants may be cryptic, difficult to find, rare, ephemeral or generally not easy to spot while undertaking a survey of a large area. An assessment of the possibility of these species occurring there was therefore provided. For all threatened or protected flora that occur in the general geographical area of the site, a rating of the likelihood of it

occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain shrubland on shallow soils overlying sandstone);
- DEFINITE: species found in habitats on site.

Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 1: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act,	• CBA 1 areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) • High value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	populations of threatened species.
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	• CBA 2 “critical biodiversity areas”. • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
		services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• CBA 2 "corridor areas". • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH. The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services. CBA2 "irreplaceable biodiversity areas" would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.
3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 "corridor areas" would qualify for inclusion into this class.

Limitations and exclusions

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.
- This study excludes invertebrates and avifauna.

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.

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 shown in Table 2.
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

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 should be detailed.

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: Description of terms

NATURE

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.		
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.

Table 2: Impact table format

IMPACT TABLE FORMAT	
Environmental parameter	*A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water*
Issue/Impact/Environmental Effect/Nature	*A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water*
Extent	
Probability	*A brief description indicating the chances of the impact occurring*
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*
Duration	*A brief description of the amount of time the*

	proposed activity is likely to take to its completion
Cumulative effect	*A brief description of whether the impact will be exacerbated as a result of the proposed activity*
Intensity/magnitude	*A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily*
Significance rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMPR.*	

DESCRIPTION OF STUDY AREA

Location

The study site is situated approximately 8 km north-west of Lichtenburg in the Ngaka Modiri Molema District of the North West Province (Figure 1). The site falls within the quarter degree grid 2626AA.

The project site near Lichtenburg has been identified through pre-feasibility studies conducted by BioTherm based on an estimation of the solar energy resource as well as weather, dust, dirt, and surface albedo. Grid connection and land availability were also important initial considerations. The project currently consists of two possible substation positions and a single power line corridor (these options are shown in Figure 2).

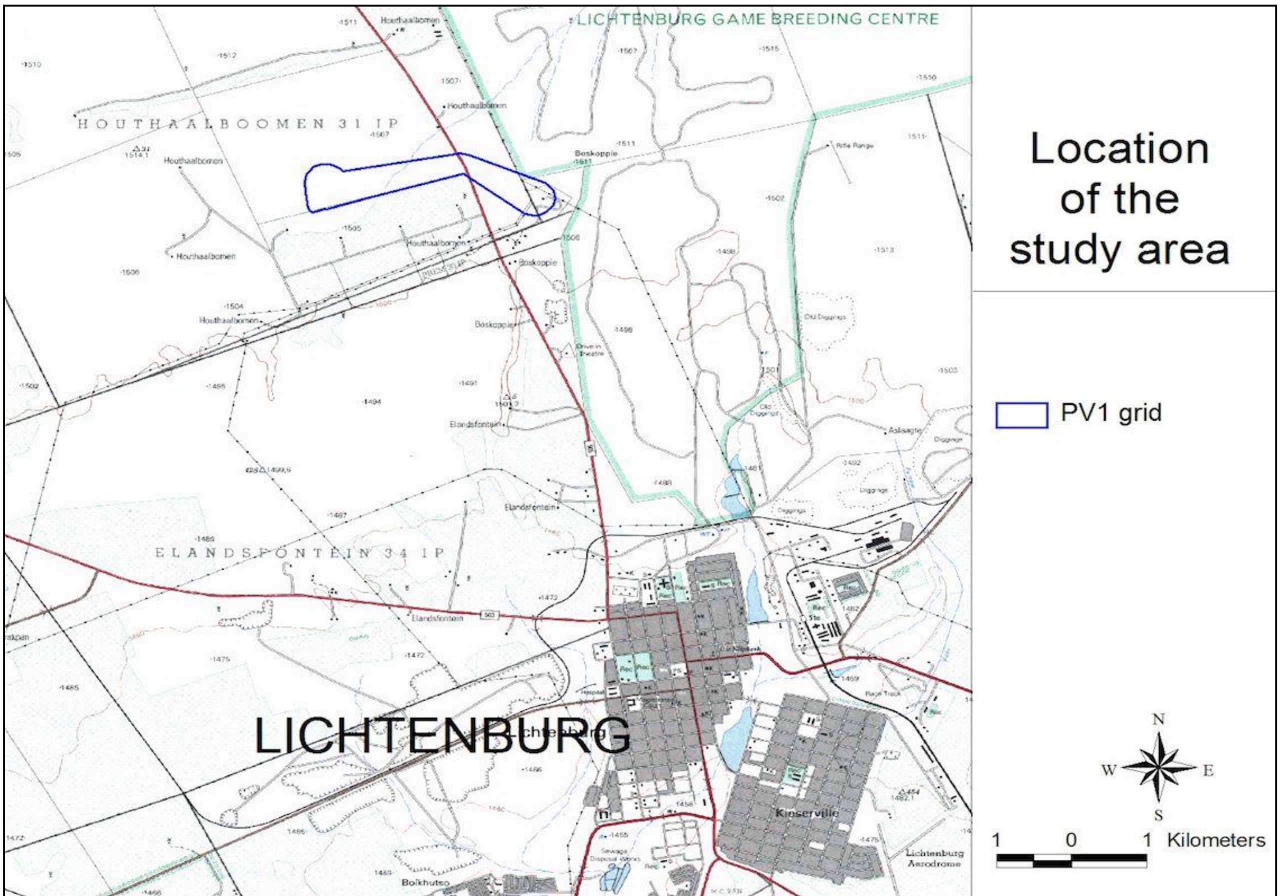

Figure 1: Location of the study area.

Topography

The study site is situated in an almost flat landscape. The elevation varies from approximately 1511 m above sea level to 1515 m above sea level, a height gain of only 4 m over a distance of 2.6 km, a gradient of shallower than 1:650.

Land types and soils

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There is a single land type in the study area, the Fa landtype (Land Type Survey Staff, 1987).

The F-group of land types refer to pedologically young landscapes that are not predominantly rock and nor predominantly alluvial or aeolian and in which the dominant soil-forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. The soil forms that epitomise these processes are Glenrosa and Mispah. However, exposed rock and soils belonging in almost any of the other 39 soil forms may be found in these land types. The Fa landtype refers to land in which lime in the soil is not encountered regularly in any part

Figure 2: Aerial image of the study area.

of the landscape (MacVicar et al. 1974). The soils on site are therefore expected to be shallow and probably rocky.

Climate

The climate is semi-arid. Rainfall occurs in summer and autumn with very dry winters. Mean annual rainfall is about 500 mm per year. All areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be dry / semi-arid. Frost is frequent to very frequent in winter and summer temperatures can get hot with a mean monthly maximum temperature of over 36°C in January.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that the study consists of natural vegetation, classified as "grassland". The 1:50 000 topocadastral map of the site and a Google image of the site (Figure 2) show essentially the same pattern, with the addition of the edges of two large centre-pivot fields in the northern part of the corridor and the Mookodi Substation at the southern end.

Broad vegetation types of the region

The sites fall within the Grassland Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). This map shows one vegetation type occurring within the area of interest, Carletonville Dolomite Grassland. This vegetation type is described in more detail below.

Carletonville Dolomite Grassland

Carletonville Dolomite Grassland is found mainly in the North-West Province but also in Gauteng and marginally in the Free State Province. It is found in the region of Potchefstroom, Ventersdorp and Carletonville, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in Gauteng Province. Carletonville Dolomite Grassland is characterised by slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species.

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver *et al*. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver *et al*. 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

The vegetation type occurring in the study area (Table 2) is classified as Vulnerable (Driver *et al*. 2005; Mucina *et al*., 2006) and is therefore flagged as being of potential conservation concern.

Table 1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver *et al*. 2005 and Mucina *et al*. 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al*. 2005; Mucina *et al*., 2006	**Draft Ecosystem List (NEMBA)**
Carletonville Dolomite Grassland	24	3	24	Vulnerable	Not listed

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. Carletonville Dolomite Grassland is not listed in the "National List of Ecosystems that are Threatened and need of protection" (GN1002 of 2011).

Biodiversity Conservation Plans

The North-West Province Biodiversity Sector Plan 2015 (obtained from bgis.sanbi.org) provides maps that show Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the Province. This classified the natural vegetation of the Province according to conservation value in decreasing value, as follows:

1. Protected
2. CBA1
3. CBA2
4. ESA1

5. ESA2
6. Other natural
7. Degraded

This map shows that the a large proportion of the site (the western half) is within an area classified as ESA1 and a small piece at the eastern extent is within an area classified as CBA2 (see Figure 3).

Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there is an area 20 km to the north-west of the project study area that has been identified as priority areas for inclusion in future protected areas. This particular component of the landscape is considered to be of high biodiversity value by National Parks, but the proposed project does not affect this area at all.

Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have

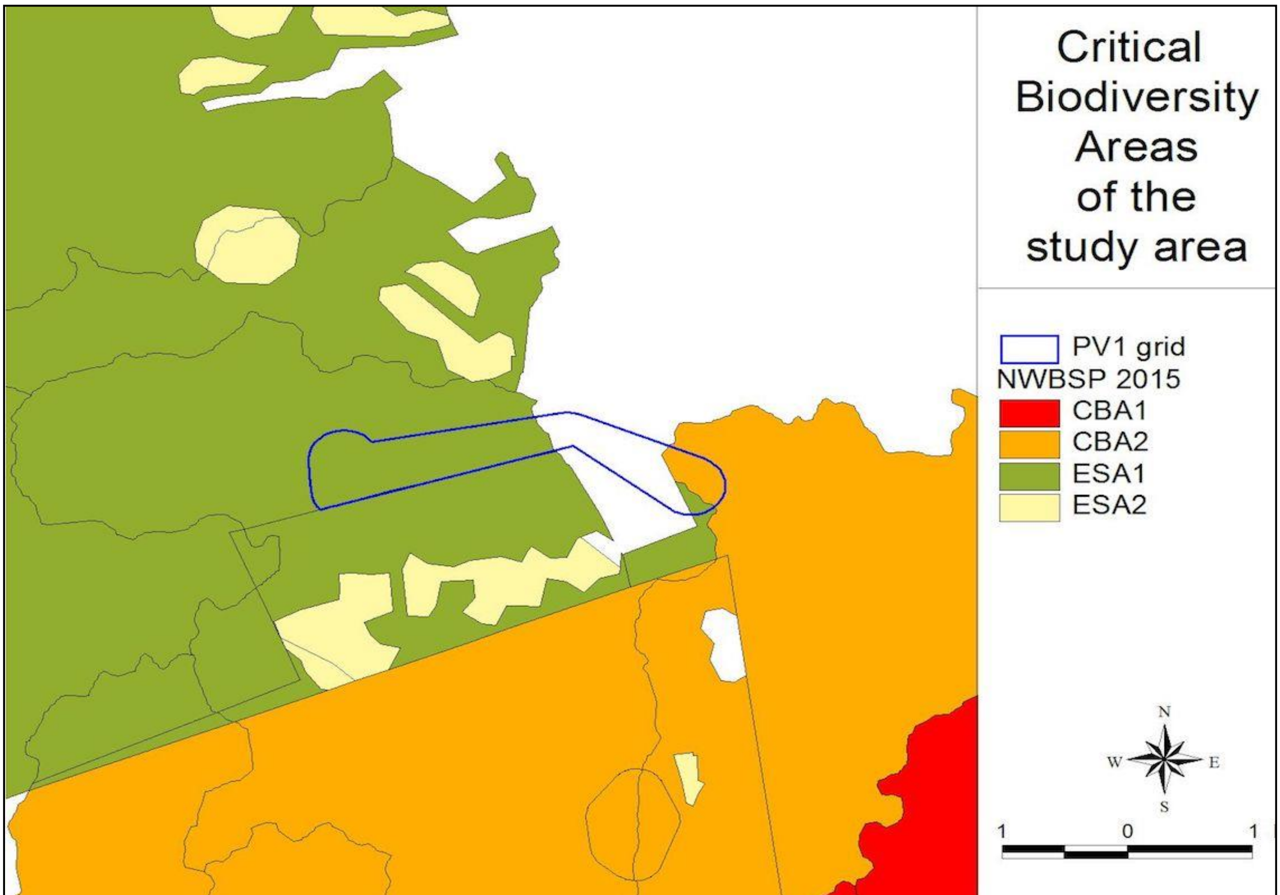

Figure 3: Biodiversity Conservation Assessment for the study area.

not been recorded in these grids are also listed.

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened (see Table 3 for explanation of categories). *Boophone disticha* is found in dry grassland and rocky areas. The species has been recorded in grid in which the site is located in the type of habitat that is found on site. One individual was near to the corridor and based on the habitat present on site there is a probability that more individuals occur there. *Crinum macowanii* is found in mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats. The species has been recorded in grid in which the site is located in the type of habitat that is probably found on site and the possibility of it occurring in the study area is therefore considered to be high. A species of *Crinum* was recorded in nearby areas, but it is unknown which species this is until flowering material is found. *Brachystelma incanum* is found in sandy loam soils in bushveld. Such habitat does not strictly occur on site, although there are occasional bush-clumps that may be suitable. The species has been previously recorded in the grid to the north of the site and there is therefore the possibility that it occurs on site. *Cleome conrathii* is found in stony quartzite slopes, usually in red sandy soil, in grassland or deciduous woodland, at all aspects. It is possible that it could also occur on site, but was not seen there.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	**Definition**	**Class**
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

Red List animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in Appendix 3.

There are 93 mammal species that have a geographical distribution that includes the study area, of which nine are listed in a conservation category of some level (see Appendix 3). Of the listed species, there are three of low conservation concern and one of high conservation concern that could occur in available habitats in the study area (see Appendix 4 for habitat requirements of listed species). These are the Brown Hyaena, the Honey Badger and Southern African Hedgehog. All of these species are classified nationally as near threatened (NT), but globally as Least Concern. They are, therefore, of relatively low conservation concern in comparison to more threatened species found in other parts of the country. The Honey Badger and the Hedgehog are protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. The species of high conservation concern that could occur on site is the White-tailed Rat (*Mystromys albicaudatus*), listed as Endangered. The White-tailed Rat is restricted to savannas and grasslands of South Africa and Swaziland. They tend to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night. They apparently require black loam soils with good cover (Coetzee & Monadjem 2008). It has been previously recorded in the grid in which the study area is located (Friedmann & Daly 2004, http://vmus.adu.org.za). The survey capture rate for this species is very low, suggesting that there are low numbers of the species (Coetzee & Monadjem 2008). Information sources suggest that there is a likelihood of this species occurring on site, although, if it does occur there, it is likely to be at a low density.

There are a total of 17 frog species with a geographical distribution that includes the study area (see Appendix 3). The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is listed as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit.

There are a total of 58 reptile species with a geographical distribution that includes the study area. There is one reptile species of conservation concern that has a distribution that includes the study area, the Southern African Python. This species is not listed in a threat category, but is protected under the National Environmental Management: Biodiversity Act.

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 5. One plant species that appears on this list that could potentially occur in the general region, although thay have not previously been recorded in the grids of the study area, is *Harpagophytum procumbens*.

Harpagophytum procumbens occurs in Angola, Botswana, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. Within South Africa this species occurs in the Northern Cape, North West, Free State, and Limpopo Provinces and the largest populations are found in the communally owned areas of the North West Province and the north eastern parts of the Northern Cape. The species is found in well drained sandy habitats in open savanna and woodlands. It has not been previously recorded in this grid in which the site is located and may be outside the scattered geographic range of the species. However, it is considered possible, but unlikely that this species could occur on site due to habitat conditions found there relative to the species requirements.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. There are three that have a geographical distribution that includes the study site, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. There are a number of others that have a geographical distribution that ends close to the study site, including *Sclerocarya birrea* subsp. *caffra*, *Prunus africana*, *Pittosporum viridiflorum* and *Erythrophysa transvaalensis*. There is therefore a small possibility that they could also occur on site if suitable habitat occurs there.

Acacia erioloba (Camelthorn / Kameeldoring) is found in savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops. This species occurs in moderate numbers in areas affected by the proposed project. Two individuals were seen on site without specifically looking for them. There is therefore probably a much greater number that occurs there.

Boscia albitrunca (Shepherd's Tree / Witgatboom / !Xhi) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species could potentially occur on site in areas affected by the proposed project. No individuals were seen on site, but one individual was recorded nearby.

Combretum imberbe (Leadwood / Hardekool / Motswere) is found in bushveld and mixed woodland, often in alluvial soils along dry and active river beds. This species could potentially occur on site in areas affected by the proposed project, although the habitat on site does not appear from the desktop assessment to be suitable. No individuals were seen during the field survey.

Erythrophysa transvaalensis (Transvaal Red Balloon / Rooiklapperboom / Mofalatsane) grows on the rocky slopes of hills, often amongst boulders. This species has a limited distribution in South Africa occurring in Gauteng, Limpopo and the North West Province. It was first thought to be endemic to syenite hills in the Pilanesburg National Park, but is found in a wider area. It is considered unlikely that it occurs on site. No individuals were seen there.

Pittosporum viridiflorum (Cheesewood / Bosboekenhout / Mosetlela) is widely distributed in the eastern half of South Africa, occuring from the Western Cape up into tropical Africa and beyond to Arabia and India. It grows over a wide range of altitudes and varies in form from one location to another. *Pittosporum viridiflorum* grows in tall forest and in scrub on the forest margin, kloofs and on stream banks. No such habitat occurs on site and it is considered unlikely that this species occurs there. No individuals were seen there.

Prunus africana (Bitter Almond / Bitteralmandelhout / Mogohloro) is found in evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m. The species is listed as Vulnerable in the Red List of South African plants. Based on habitat requirements, it is not expected that it occurs there. No individuals were seen there.

Sclerocarya birrea subsp. *caffra* (Marula / Maroela / Morula) is widespread in Africa from Ethiopia in the north to KwaZulu-Natal in the south. In South Africa it is more dominant in the Baphalaborwa area in Limpopo. It occurs naturally in various types of woodland, on sandy soil or occasionally sandy loam. No individuals were seen there and the habitat on site is considered to not be typical of the habitat in which the species usually occurs.

Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).According to this Act, "*a person may* *not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in Appendix 6, marked with the letter "N". This includes the following species: Roan Antelope, Black Wildebeest, Reedbuck, Cape Clawless Otter, Brown Hyaena, Spotted-necked Otter, Honey Badger, Leopard, Cape Fox, Southern African Hedgehog, Southern African Python, Giant Bullfrog, Blue Crane, Martial Eagle, Lesser Kestrel, Black Stork, Cape Vulture, Lappet-faced Vulture and White-backed Vulture.

Due to habitat and forage requirements and the fact that some species are restricted to game farms and/or conservation areas, only the Brown Hyaena, Black-footed Cat, Honey Badger, Leopard, Cape Fox and the Giant Bullfrog have a likelihood of occurring on site. All of these species are mobile animals that are likely to move away in the event of any activities on site disturbing them. They are therefore unlikely to be affected by the proposed development of the solar power facility and associated infrastructure.

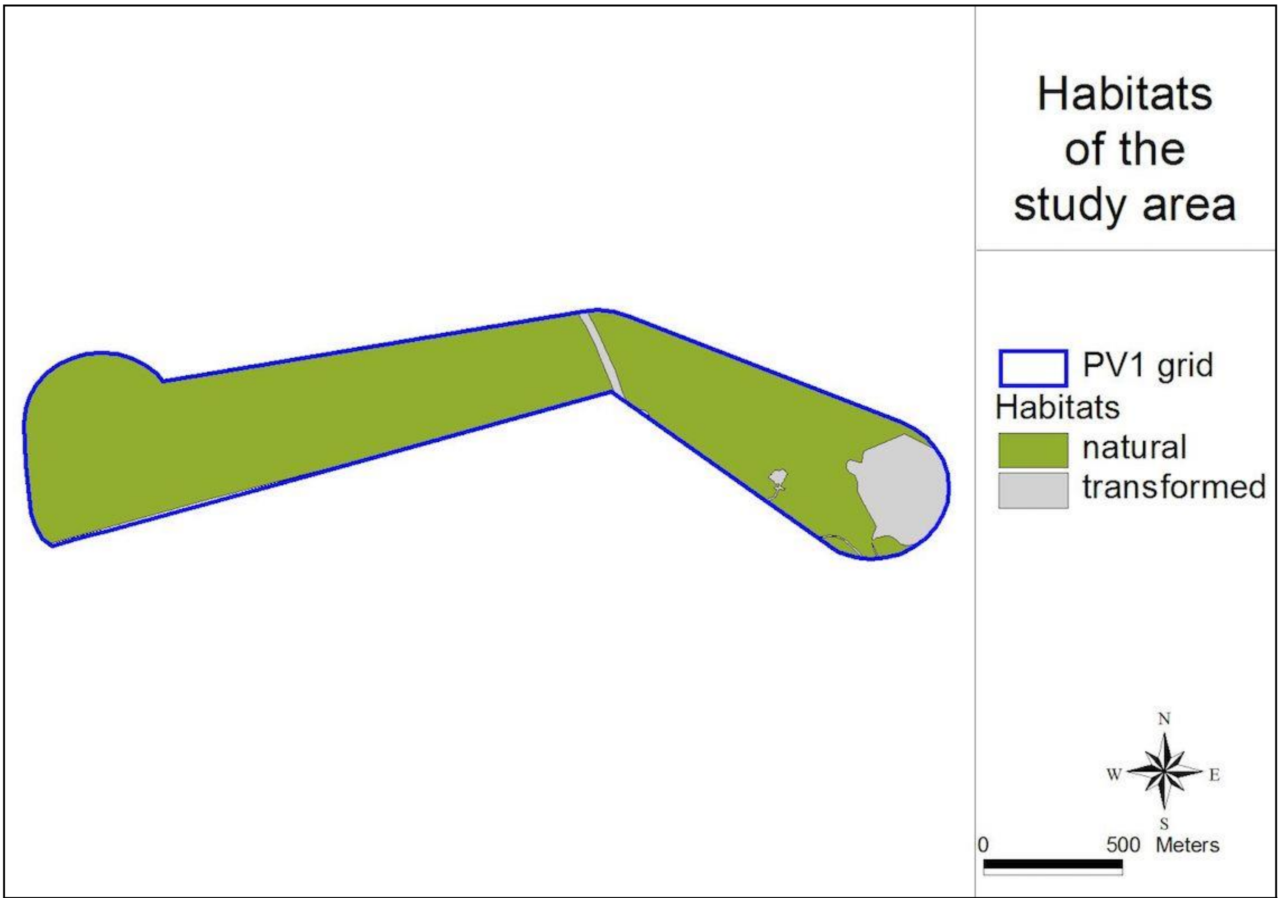

Figure 4: Main habitats of the study area.

Important Bird Areas

The study area is not within an Important Bird Area (IBA). The nearest IBAs are the Botsolano Nature Reserve IBA, which is 70 km away to the north-west, the Barberspan & Leeupan IBA, which is 70 km away to the south-west and the Magaliesberg IBA, which is 100 km away to the east.

Habitats on site

Aerial imagery indicates that most of the site consists of natural vegetation (grassland called Carletonville Dolomite Grassland). This was confirmed from the field survey, but with the addition of scattered trees and bushclumps. The distribution of main habitats on site, as identifiable from aerial imagery, is shown in Figure 4.

Watercourses

The study area contains no watercourses / drainage lines that are visible from aerial imagery or from the Surveyor-General's 1:50 000 topocadastral map. No drainage areas or water features were observed on site during the field survey.

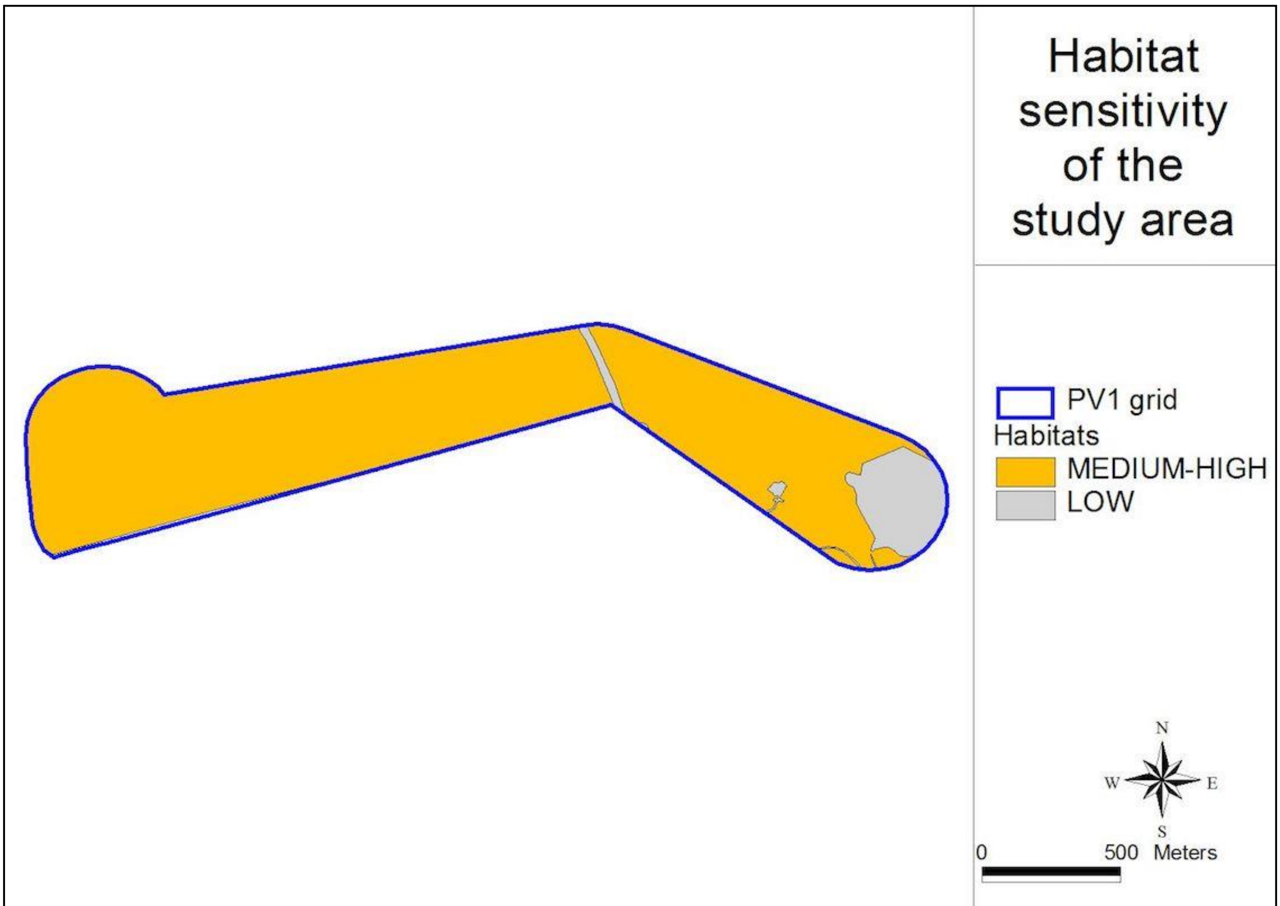

Figure 5: Potentially sensitive areas of the study area.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 5. The information provided in the preceding sections was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area.

These factors have been taken into account in evaluating sensitivity within the study area. The sensitivity classification is as follows:

1. MEDIUM-HIGH: The majority of the study area is classified as having medium sensitivity (see Figure 5). These are areas of natural vegetation which may harbour features of conservation concern (listed or protected plants and/or animals), as well as falling within C-Plan Ecological Support Areas and being part of a vegetation type classified as Vulnerable.
2. LOW: Transformed areas are classified as having low sensitivity (see Figure 5). These are areas in which no intact natural habitat still remains.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

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

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied." ,
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection

Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

The Environmental Impact Assessment (EIA) Regulations include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (R544 of 2010),
- Listing Notice 2: activities that require seeping and environmental impact report (EIR) (R545 of 201 0),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (R546 of 2010).

Activity 12 in Listing Notice 3 relates to the clearance of 300m^2 of more of vegetation, which will trigger a basic assessment within any critically endangered or endangered ecosystem listed in terms of S52 of the Biodiversity Act. This means any development that involves loss of natural habitat in a listed critically endangered or endangered ecosystem is likely to require at least a basic assessment in terms of the EIA regulations.

It is important to note that while the original extent of each listed ecosystem has been mapped, a basic assessment report in terms of the EIA regulations is triggered only in remaining natural habitat within each ecosystem and not in portions of the ecosystem where natural habitat has already been irreversibly lost.

GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

National Water Act (Act 36 of 1998)

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

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

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

National Veld and Forest Fire Act (Act No. 101 of 1998)

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

Other Acts

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Marine Living Resources Act (Act No. 18 of 1998)
- Sea Birds and Seals Protection Act (Act No. 46 of 1973)
- Lake Areas Development Act (Act No. 39 of 1975)
- Mountain Catchment Areas Act (Act No. 63 of 1970)
- Integrated Coastal Zone Management Act (Act No. 24 of 2008)

ASSESSMENT OF POTENTIAL IMPACTS

Description of potential impacts

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest and/or woodland and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from **construction** of the proposed power line are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with **operation** of the proposed facility, as follows:

- Maintenance of surrounding vegetation as part of management of the power line.
- Animal collisions with infrastructure, especially flying animals.

- Invasion of habitats by alien plants as a consequence of disturbance.

Potential issues for the general study area

A summary of the potential ecological issues for the study area is as follows:

- Presence of natural vegetation on site, some of which is included in Provincial CBA areas and is therefore of potentially high conservation priority.
- Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (probably occurs on site), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.
- Potential presence of one protected plant species, *Harpagophytum procumbens.*
- Potential presence of three protected tree species, *Acacia erioloba* (occurs in large numbers on site), *Combretum imberbe* and *Boscia albitrunca* (occurs in adjacent habitats).
- Potential presence of the some animals of potential conservation concern:
    - Brown Hyaena (NT)
    - Honey badger (NT)
    - Southern African Hedgehog (NT)
    - White-tailed Rat (EN)
    - Giant Bullfrog (NT/LC)
    - Kori Bustard (VU),
    - Blue Crane (VU),
    - Secretarybird (NT).
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks to the ecological receiving environment are therefore the following:

1. Loss of indigenous natural vegetation during construction;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Impacts on pan depression areas;
6. Mortality of populations of sedentary species during construction (terrestrial and aquatic);
7. Displacement of populations of mobile species (terrestrial);
8. Mortality of bird species of concern due to secondary factors, such as collisions with overhead power lines;
9. Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.

Planning Phase impacts

There are no impacts that are likely to be created as a result of project planning.

Construction Phase impacts

Impact 1: Impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable in the scientific literature. However, natural habitat on site has been identified as being of importance in the Provincial Conservation Assessment. Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned.

Table 4a: Impact table for Impact 1 for power lines.

Loss of indigenous natural vegetation		
Environmental parameter	*Indigenous natural vegetation*	
Issue/Impact/Environmental Effect/Nature	*Loss, degradation or fragmentation of vegetation.*	
Extent	*The impact will affect natural vegetation on site and possibly in immediately surrounding areas.*	
Probability	*The impact will probably happen.*	
Reversibility	*Reversible to some degree for power lines because of the limited local footprint. Secondary vegetation will probably never resemble the original vegetation found on site.*	
Irreplaceable loss of resources	*Some loss of resources will occur.*	
Duration	*The impact will be medium-term due to the fact that local impacts will soon recover through natural successional processes.*	
Cumulative effect	*Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.*	
Intensity/magnitude	*Low. Vegetation will continue to function.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	3	3
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-13 (low negative)	-12 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity:* *1. Compile a rehabilitation programme.* *2. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.*	

Table 4b: Impact table for Impact 1 for both substation options.

Loss of indigenous natural vegetation	
Environmental parameter	*Indigenous natural vegetation*
Issue/Impact/Environmental Effect/Nature	*Loss, degradation or fragmentation of vegetation.*
Extent	*The impact will affect natural vegetation on site and*

	possibly in immediately surrounding areas.
Probability	*The impact will definitely happen.*
Reversibility	*Irreversible in human timeframes, since natural successional processes cannot compensate for complete local loss of habitat and diversity. Secondary vegetation will probably never resemble the original vegetation found on site.*
Irreplaceable loss of resources	*Significant loss of resources will occur.*
Duration	*The impact will be permanent (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.)*
Cumulative effect	*Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.*
Intensity/magnitude	*Medium. Regional vegetation will continue to function.*
Significance rating	*Medium negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-38 (medium negative)	-38 (medium negative)
Mitigation measures	*The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity:* *1. Compile a rehabilitation programme.* *3. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.*	

Impact 2: Impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened

Table 5: Impact summary table for Impact 2 for all infrastructure components.

Loss of individuals of listed plants	
Environmental parameter	*Listed plants, as per Red & Orange List.*
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*
Extent	*The impact will affect local populations or individuals of the affected species.*
Probability	*The impact will probably happen.*
Reversibility	*Partly reversible. Individuals can be rescued or else*

	cultivated to replace lost specimens.
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*
Duration	*The impact will be medium-term.*
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*
Significance rating	*Low negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-10 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any listed plants.* 3. *Near threatened and Declining plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the probability as well as the cumulative effect.* 4. *If any listed plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.* 5. *If any threatened species are found (only Brachystelma incanum listed for this area), the infrastructure layout would need to be adjusted to allow in situ conservation of affected plants as well as a suitable buffer zone. An Ecological Management Plan would need to be compiled to manage the locality where it occurs.*	

Impact 3: Impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site.

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site. No individuals were found on site during the field survey and, based on an assessment of available habitat on site, it is considered unlikely that any occur there. This potential impact will therefore not occur and is not assessed further.

There are a number of species that may be protected according to provincial legislation. The possible presence of these on site is unknown due to the dry conditions at the time of the survey. There is therefore a possibility that additional protected species may occur there and that they may be detected at a later stage of the project. The assessment below is therefore based on this possibility.

Table 6: Impact summary table for Impact 3 for all infrastructure components.

Loss of individuals of protected plants		
Environmental parameter	*Protected plants, as per NEM:BA and provincial legislation.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*	
Duration	*The impact will be medium-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 6. *A pre-construction walk-through survey will be required to locate any protected plants.* 7. *Plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect.* 8. *If any protected plants are located during the pre-construction survey, a Plant Rescue*	

	Plan would be required to manage the process of attempting to rescue such individuals.

Impact 4: Loss of individuals of protected trees

There are three protected tree species that could occur on site, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. Whether these species occur on site or not is unknown until a site evaluation has been undertaken.

Table 7: Impact summary table for Impact 4 for all infrastructure components.

Loss of individuals of protected trees		
Environmental parameter	*Protected trees, as per National Forests Act.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact will definitely happen.*	
Reversibility	*Irreversible. Individuals are not possible to be rescued.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that occurs on site is relatively common throughout its range although a large number of individuals were seen to occur on site.*	
Duration	*The impact will be permanent.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	5
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any protected trees and record information about each specimen.*	

Impact 6: Mortality of populations of sedentary species

There are five animal species of conservation concern that could potentially be affected by the proposed project:

1. Brown Hyaena (NT),
2. Honey badger (NT),
3. Southern African Hedgehog (NT),
4. White-tailed Rat (EN),
5. Giant Bullfrog (NT/LC).

Three of these species, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog, are relatively sedentary and therefore considered to be potentially vulnerable to habitat loss, as related to this project.

Table 8: Impact summary table for Impact 6 for all infrastructure components.

Loss of populations of sedentary animals		
Environmental parameter	*Species of conservation concern*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals/populations.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals may be rescued and translocated.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that potentially occur on site have very wide geographical ranges.*	
Duration	*The impact will be short-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur throughout their range.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-10 (low negative)	-7 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any individuals and move them to surrounding habitats.*	

Impact 7: Displacement of mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. Mobile species of conservation concern (two sedentary species are discussed for the previous impact) that could potentially be affected by the proposed project are as follows:

1. Brown Hyaena (NT)
2. Honey badger (NT).

These are all highly mobile terrestrial species with a large home range and the ability to travel long distances in short periods of time. For these species, they may be locally displaced, but this will have little effect on the overall range of any of these species nor is it expected that any overall impacts will result from local displacement. This potential impact is therefore not assessed further.

Operational Phase impacts

Impact 8: Mortality of birds by collision with vertical infrastructure

During operation, flying species could potentially suffer mortality by collisions with vertical infrastructure, especially infrastructure with low visibility, such as power lines.

The species most affected by loss of individuals are species that are already threatened in their general range by other factors. These species appear on various Red Lists. Species that are not threatened are unlikely to be significantly negatively affected by loss of habitat, since they are generally widespread and/or catholic in their requirements. Also, there are certain groups of birds, the large, low-flying species (bustards, cranes, etc.) that are most at risk from power lines.

Table 9: Impact summary table for Impact 8 for power lines (both options).

Mortality of individuals due to collisions with power lines		
Environmental parameter	*Threatened bird species*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect individuals on site and possibly in immediately surrounding areas.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Preventative measures could reduce mortality to below replacement levels.*	
Irreplaceable loss of resources	*Marginal loss of resources will occur.*	
Duration	*The impact will be long-term.*	
Cumulative effect	*Medium cumulative impact. Cumulative effects will be minor.*	
Intensity/magnitude	*Medium. May impact on population processes.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-11 (low negative)
Mitigation measures	*Visibility devices could be placed on overhead powerlines, if necessary. This will reduce the probability slightly, but not to an extent that it will*	

	change the impact rating scores. The mitigation measure is therefore not required unless monitoring identifies this as an issue during operation.

Impact 9: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activites) and negative grazing practices (Zachariades *et al*. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. loss of indigenous vegetation;
2. change in vegetation structure leading to change in various habitat characteristics;
3. change in plant species composition;
4. change in soil chemical properties;
5. loss of sensitive habitats;
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. fragmentation of sensitive habitats;
8. change in flammability of vegetation, depending on alien species;
9. hydrological impacts due to increased transpiration and runoff; and
10. impairment of wetland function.

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for surrounding natural habitats due to the fact that a lot of natural vegetation still remains on site. Control measures could prevent the impact from occurring.

Table 10: Impact summary table for Impact 8 for all infrastructure.

Establishment and spread of declared weeds		
Environmental parameter	*Vegetation and habitat*	
Issue/Impact/Environmental Effect/Nature	*Loss of habitat due to invasion by alien plants*	
Extent	*The impact will affect habitat on site and possibly in immediately surrounding areas.*	
Probability	*The impact will probably happen in the absence of control measures.*	
Reversibility	*Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.*	
Irreplaceable loss of resources	*Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.*	
Duration	*The impact will be long-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Medium. Severe invasion can alter the functioning of natural ecosystems.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact	Post-mitigation impact

	rating	rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (medium negative)	-11 (low negative)
Mitigation measures	*Compile and implement an alien management plan. Undertake regular monitoring to detect alien invasions early so that they can be controlled. Implement control measures.*	

Decommissioning Phase impacts

It is expected that the project will operate for a minimum of twenty years or more (a typical planned life-span for a project of this nature. Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established on site for a very long time. The reality is that it is not possible to determine at this stage whether rehabilitation measures will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it impossible to undertake any assessment to determine possible impacts of decommissioning.

Cumulative impacts

There are a number of renewable energy developments that have been proposed or authorised in the region within a 25 km radius of the Sendawo PV application area. These projects are likely to have a similar impact on the ecological receiving environment as the current project. The cumulative impact of the current project in addition to all these other projects is assessed here. The list of projects is shown in Table 10 and shown in Figure 6.

Table 10: Renewable energy developments proposed within a 20km radius from the Tlisitseng PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tlisitseng 2	14/12/16/3/3/2/890	EIA ongoing	BioTherm Energy	75MW	Portion 25 of the Farm Houthaalboomen No 31
Lichtenburg Solar Park	14/12/16/3/3/3/270	Project has received environmental authorisation	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands No. 27
Watershed Solar Energy Facility Phase 1	14/12/16/3/3/2/556	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Watershed Solar Energy Facility Phase 2	14/12/16/3/3/2/557	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2/1062	Project has received environmental authorisation	South Africa Mainstream Renewable Power Developments (Pty) Ltd	5MW	Portions 9 and 31 of the Farm Hibernia 52

Cumulative Assessment – Motivation for lack of information

Based on the DEA's acceptance of the Final Scoping Report (FSR), the DEA requested that a cumulative environmental impact assessment be conducted including a literature review of other specialist assessments / studies on the neighbouring adjacent properties in order to ascertain any additional cumulative impacts that should be taken into consideration.

In an effort to meet this requirement SiVEST under took every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the above mentioned developments. The steps taken to acquire the relevant documents for the above mentioned projects is detailed below (Table 11):

Table 11: Proposed renewable energy projects in the area, steps taken to obtain the relevant information and documents obtains.

Proposed Development	EAP	Steps taken to obtain relevant documents	Documents Obtained
Tlisitseng 2	SiVEST SA (Pty) Ltd	SiVEST is the EAP for the proposed development. The proposed development Final Scoping Report (FSR) has been accepted by the DEA. Additionally, the specialist impact assessments have been conducted to form part of the Draft Environmental Impact Assessment Report (DEIAR). All the relevant documents were therefore available for the cumulative assessment.	▪ Biodiversity Impact Assessment Report; ▪ Avifaunal Impact Assessment Report; ▪ Surface Water Impact Assessment Report; ▪ Soils and Agricultural potential Impact Assessment Report; ▪ Visual Impact Assessment Report; ▪ Heritage Impact Assessment Report; ▪ Socio-economic Impact Assessment Report; ▪ Geotechnical Impact Assessment Report; and ▪ Traffic Impact Assessment Report
Lichtenburg Solar Park	Africa Geo-Environmental Services (AGES)	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ Proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. ▪ Consulted the SAHRA Website for Heritage and PIA Report (http://sahra.org.za/sahris/cases/lichtenburg-solar-park). ▪ Attempted to download reports from the AGES Website (http://ages-group.com/)	▪ Archaeological Impact Assessment Report ▪ Heritage Impact Assessment Report

		○ Reports were not available for publically available to download ▪ Contacted AGES in an effort to obtain outstanding specialist reports that were not available for public download. ○ AGES responded to SiVEST request for the FBAR and specialist reports noting that the proposed development has not been awarded preferred Bidder Status in terms on the DoE's IPP programme. ○ AGES further stated that they are not in a position to send any of the reports through to SiVEST. However, they were able to provide SiVEST with the locality map for the proposed Lichtenburg Solar Park as well as layout plans. ▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	
Watershed Solar Energy Facility Phase 1	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. FEIR (excluding appendices) was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/heritage-report-watershed-solar-facility). ▪ From the SAHRA website other documents were available to be downloaded.	▪ Watershed PV (phase I and II) FEIR ▪ Visual Scoping Report ▪ Social Scoping report ▪ Draft EMPr (Phase 1) ▪ Draft EMPr (Phase 2) ▪ Archaeological Impact Assessment Report ▪ Background Information Documents ▪ EAs
Watershed Solar Energy Facility Phase 2	Savannah Environmental (Pty) Ltd		

		(http://sahra.org.za/sahris/cases/watershed-solar-energy-facilities-556-557). ▪ Attempted to download reports from the Savannah Environmental Website ○ Reports were not publically available to download. ▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download. ○ Savannah Environmental noted that the project has already been archived and handed over to the developers. ○ Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development.	
Hibernia PV Solar Energy Facility	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. BID was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/aia-paleo-reports-hibernia). ▪ From the SAHRA website other documents were available to be downloaded. FEIR (excluding appendices)was able to be downloaded as a PDF.	▪ Heritage Assessment Report ▪ Final BAR ▪ BID

		http://sahra.org.za/sahris/cases/hibernia-solar-facility-1062). ▪ Attempted to download reports from the Savannah Environmental Website ○ Reports were not publically available to download ▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download. ○ Savannah Environmental noted that the project has already been archived and handed over to the developers. ○ Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development. ▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	

Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012. As a result, many of the documents are not currently publically available to download. Nonetheless, SiVEST was able to source some of information that was available. The information (including specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding renewable energy sites planned that were taken into account by the various specialists is elaborated on below.

Cumulative impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable. This is the same vegetation type that will be affected by many of the other proposed projects (Table 13). Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned. The vegetation type occupies an area in excess of 8 800 km^2, of which just less than 25% has been altered. The total loss of habitat due to all the projects together will be greater than for any single project, so a cumulative effect will occur. However, the area lost in total will be small compared to the total area of the vegetation type and will not result in a change in the conservation status of the vegetation type. The cumulative effect will therefore be low.

Cumulative impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened. Three of the species are relatively widespread, whereas the species listed as Vulnerable is known from a general area that includes the study area. An increased number of projects increases the likelihood of one of the populations being affected, but unless a population is directly affected, there is no cumulative effect.

Cumulative impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site. There are also a number of plant species protected according to Provincial legislation. An increased number of projects will increase the likelihood of protected species being affected as well as the number of individuals likely to be affected. There is therefore a cumulative effect, but this is considered to be low.

Cumulative impacts on protected trees

There are three protected tree species that could occur on site, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. With each additional project that is constructed there will be an increasing likelihood of individuals being affected and the number of individuals affected will increase. There is therefore a cumulative effect. The significance of this effect is, however, likely to be low due to the high number of individuals of each of these species that occurs over their entire geographical range.

Cumulative impacts on populations of sedentary fauna

There are three species of sedentary fauna likely to be impacted by the current project, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog. All three have a relatively wide geographical distribution and loss of some habitat in part of their range will have a minimal effect on the species. The combination of a number of projects will have a cumulative effect, but this is likely to be of low significance.

Cumulative impacts on mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. This effect will be increased if there are a number of projects being constructed at the same time or in quick succession, so the effect is likely to be cumulative. However, the geographical ranges of the species of concern is wide and it is considered that the significance of the effect will be low.

Cumulative impacts due to spread of declared weeds and alien invader plants

There is a moderate possibility that alien plants could be introduced to areas within the footprint

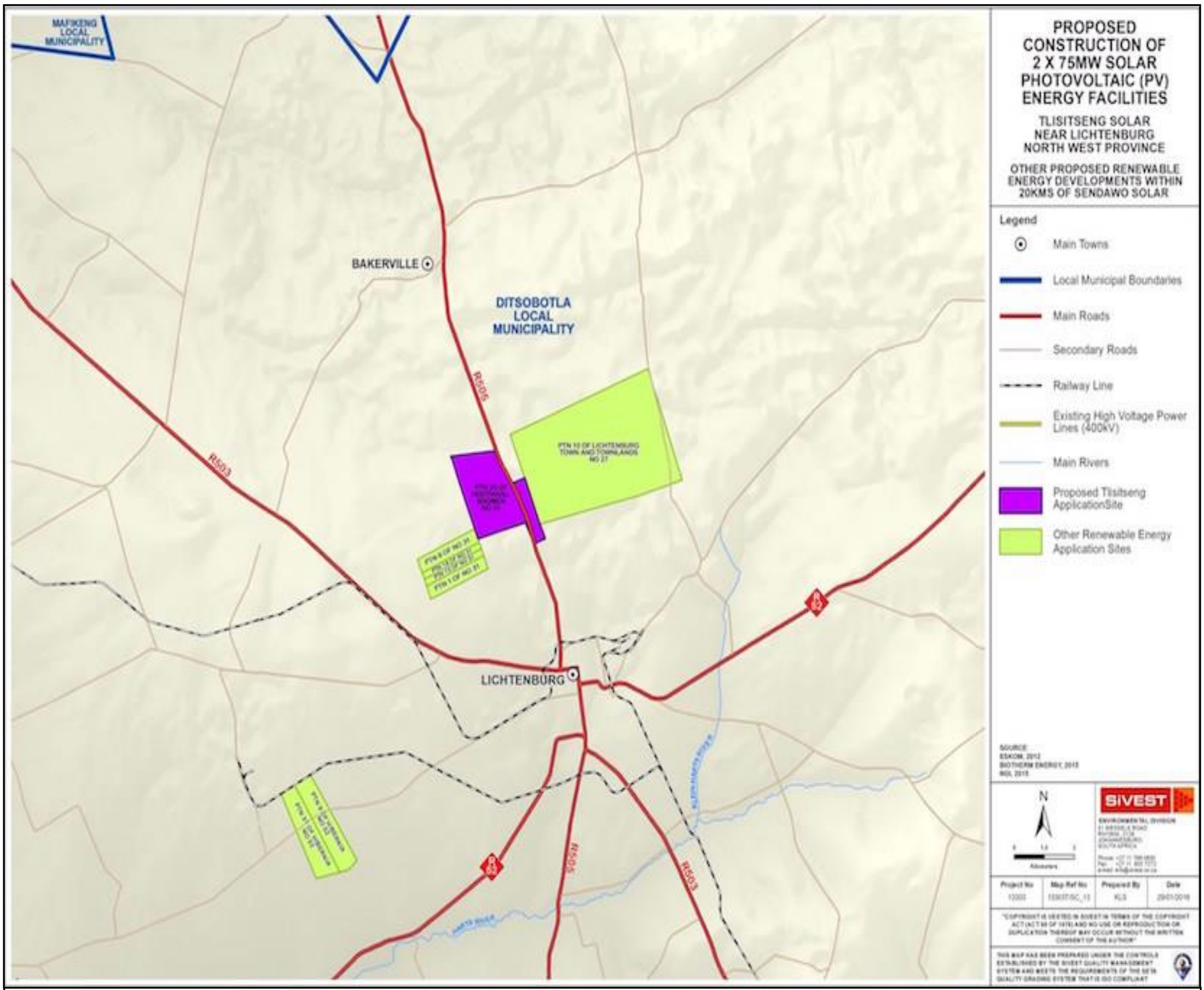

Figure 6: Location of similar projects in the study area near to the current site.

of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen, therefore the effect is cumulative. For the current site, the impact is predicted to be low due to existing impacts on site and the high ability to control any additional impact. The significance will therefore be low, especailly if control measures are implemented.

POSSIBLE MITIGATION MEASURES

This section of the report provides a description of mitigation measures that could be applied to minimize identified impacts for this project. In terms of the location of features of concern, all mitigation measures apply to all components of the project.

The mitigation hierarchy approach

The mitigation hierarchy consists of a number of sequential steps (avoid, mitigate, restore or rehabilitate and offset). This approach enables an infrastructure development project to work towards "no net loss" of biodiversity, and ideally, a net gain. The mitigation hierarchy is defined as:

- **Avoidance**: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.
- **Minimisation**: measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.
- **Rehabilitation/restoration**: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.
- **Offset:** measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

Mitigation measures

Local shifting of components of the infrastructure

Components of the infrastructure can be re-sited to avoid sensitive habitats or features, either partially or completely. This is especially important for avoiding CBA habitats, protected areas and buffer areas. The re-siting can also be used to create buffer areas around sensitive sites in order to protect their ecological integrity. In the case of the current project, there are various pan depressions where it has been recommended that these are not developed and that an appropriate buffer zone is maintained around them. Power line tower structures are relatively easy to microsite in this way.

Surface Runoff and Stormwater Management Plan

The purpose of a Surface Runoff and Stormwater Management Plan is to prevent damage to areas downslope / downstream of the project area. This is an impact avoidance measure. This plan must indicate how all surface runoff generated as a result of the project and associated activities (during both the construction and operational phases) will be managed (e.g. artificial wetlands/stormwater and flood retention ponds) prior to entering any natural drainage system or wetland and how surface water runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions.

Rehabilitation Programme

The purpose of a Rehabilitation Plan is to provide a framework for rehabilitating areas outside of the infrastructure footprint that will be disturbed during the construction of the proposed project. Rehabilitation Programme should be established before operation. The programme must address the rehabilitation of the existing habitats as well as rehabilitation after closure. This Rehabilitation Programme must be approved by the relevant government departments. Rehabilitation can also be undertaken in habitats adjacent to sensitive areas that will not be developed, but that are currently disturbed by existing impacts on site. This will constitute a form of offset. Rehabilitation must include aspects such as undertaking rehabilitation as quickly as possible after disturbance, soil management measures and using native plants during rehabilitation.

Botanical walk-through survey

A preconstruction walk-through survey should be undertaken to list the identity and location of all listed and protected species. The results of the walk-through survey should provide an indication of the number of individuals of each listed species that are likely to be impacted by the proposed development. The botanical walk-through survey is a requirement for various permit applications.

Search and rescue

Search and rescue operation of all listed species within the activity footprint. For each individual plant that is rescued, the plant must be photographed before removal, tagged with a unique number or code and a latitude longitude position recorded using a hand-held GPS device. The plants must be planted into a container to be housed within a temporary nursery on site or immediately planted into the target habitat. If planted into natural habitat, the position must be marked to aid in future monitoring of that plant. Rescued plants housed in temporary nursery may be used in one of two ways: (1) transplanted into suitable natural habitats near to where they were rescued, or (2) used for replanting in rehabilitation areas. Receiver sites must be matched as closely as possible with the origin of the plants and, where possible, be placed as near as possible to where they originated.

Obtain permits for protected plants

It is a legal requirement that permits will be required for any species protected according to National or Provincial legislation. The identity of species affected by such permit requirements can only be identified during the walk-through survey (previous mitigation measure). It is common practice for the authorities that issue the permits to require search and rescue of affected plants. There are a number of individuals of the protected tree, *Acacia erioloba*, that occur on site. The location and condition of each individual tree must be recorded and a permit obtained for the removal of each of these.

Alien plant management plan

It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially within the riparian habitat. An Alien Invasive Programme is an essential component to the successful conservation of habitats and species. Alien species, especially invasive species are a major threat to the ecological functioning of natural systems and to the productive use of land. In terms of the amendments of the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). This programme should include monitoring procedures.

Undertake regular monitoring

Monitoring should be undertaken to evaluate the success of mitigation measures. Monitoring methods must be in accordance with features that need to be monitored and can form part of a monitoring programme to be compiled.

Worker education

Educate workers (permanent staff and contractors) regarding the occurrence of important ecological features and resources in the area and the importance of their protection.

Dust control

Use abatement measures to minimise fugitive dust that could have a negative effect on vegetation and habitats, especially adjacent to sensitive areas and in areas adjacent to the project site.

COMPARISON OF ALTERNATIVES

Tlisitseng 1 Substation

There are two possible locations for the proposed sub-station, Option 1 and Option 2. Both are within natural grasslands, but also within areas that will be affected by the proposed solar project. If the solar project is authorised then it is irrelevant which substation option is selected.

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**
SUBSTATIONS		
Tlisitseng 1 Substation Option 1	**PREFERRED**	Similar habitats and impacts. Closer to PV panels.
Tlisitseng 1 Substation Option 2	**FAVOURABLE**	Similar habitats and impacts. Further from PV panels therefore marginally greater local fragmentation of natural habitat.

DISCUSSION AND CONCLUSIONS

Biodiversity features in the study area

The vegetation type that occurs on site, Carletonville Dolomite Grassland, is classified as Vulnerable, but has a wide distribution and extent. From this perspective, the natural vegetation on the sites is therefore considered to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy, but is within areas identified in Provincial Conservation Plans to be of concervation priority.

Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of four listed plant species, one protected plant species and the potential presence of various animal species of conservation concern. There are also three protected tree (*Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*) that occur in the general region of which one (*Acacia erioloba*) occurs in high numbers in the area, including some individuals that occur on site.

The site is mapped as an Ecological Support Area in terms of most of it being on a dolomite area. These dolomite areas and the associated aquifers are considered to be ecologically important in terms of being groundwater recharge areas.

There are a number of animal species of conservation concern that may occur in habitats within the study area. This includes one frog species, the Giant Bullfrog, and four mammal species (Honey Badger (NT), Brown Hyaena (NT), White-tailed Rat (EN) and Southern African Hedgehog (NT)) and five bird species of conservation concern (Barrow’s Korhaan (VU), Blue Crane (VU), Melodious Lark (NT), Short-clawed Lark (NT) and Secretarybird (NT)). Lists and habitat requirements for these species are provided in the appendices to this report.

Bats do not appear, from this initial assessment, to be of major concern. There is a maximum of three species of low conservation concern that could be affected. All species are listed as Near Threatened in South Africa and globally as Least Concern. The key factor is the presence of roosting habitats nearby, which is of higher concern in areas close to mountainous or rocky hillside topography. There are no such topographical features in close proximity to the project study area.

One protected amphibian species, the Giant Bullfrog, and one protected reptile, the Southern African Python, have a geographical distribution that includes the site. These species are protected according to the National Environmental Management: Biodiversity Act (Act No 10 of 2004). Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The Giant Bullfrog is most likely to be found near seasonal pans or water sources and the Southern African Python in rocky kloofs, usually near water.

The study area consists mostly of natural vegetation, with the exception of a centre-pivot irrigation area under cultivation, which is mapped as transformed. These transformed and degraded areas in the project study area have low sensitivity and conservation value. Most areas have medium-high sensitivity.

Summary of potential impacts

A summary of the potential risks to the ecological receiving environment are therefore the following:

1. Impacts on indigenous natural vegetation;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Mortality of sedentary animals;
6. Displacement of mobile fauna;
7. Mortality of birds by collision with vertical infrastructure;
8. Establishment and spread of declared weeds and alien invader plants.

A summary and comparison between pre- and post-mitigation phases is provided in Table 11 below.

Table 11: Comparison of summarized impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Indigenous natural vegetation	Loss (substation)	-38		-38	
Indigenous natural vegetation	Loss (power lines)	-13		-12	
Protected plant species	Loss of individuals	-11		-9	
Protected trees	Loss of individuals	-14		-13	
Pan depressions	Damage, loss of vegetation	-28		-6	
Sedentary fauna	Loss of individuals	-10		-7	
Bird species of conservation concern	Collision with power lines	-26		-11	
Natural habitat	Invasion by alien invasive plant species leading to habitat loss and/or degradation	-28		-11	
			- 21.0		**-13.4**
			Low Negative Impact		Low Negative Impact

Substation Alternative 1 is marginally preferred to Substation Alternative 2, because the latter is further from the PV arrays and construction of this option will lead to slightly greater local fragmentation of natural habitat. Other than this factor, the two options have a similar effect on the ecological receiving environment and affect similar habitats.

For all potential impacts, the cumulative impacts of this project in combination with similar projects is likely to be of low significance.

Conclusions

There are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

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APPENDICES:

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the general geographical area that includes Copperton.

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Distribution and habitat	Likelihood of occurrence on site
AMARYLLIDACEAE	Boophone disticha	Declining	Dry grassland and rocky areas	**HIGH,** suitable habitat probably occurs
APOCYNACEAE	Brachystelma incanum	VU	Coligny, Lichtenburg and Wolmaransstad. Sandy loam soils in bushveld. Previously recorded in grid to north of site.	**MEDIUM,** suitable habitat may occur
CAPPARACEAE	Cleome conrathii	NT	Stony quartzite slopes, usually in red sandy soil, grassland or deciduous woodland, all aspects.	**MEDIUM,** presence of suitable habitat unknown
AMARYLLIDACEAE	Crinum macowanii	Declining	Mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats.	**HIGH,** suitable habitat probably occurs

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron (Cassine) transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Boscia albitrunca, Combretum imberbe and *Acacia erioloba* have a geographical distribution that coincides with the study areas.

Appendix 3: Animal species with a geographical distribution that includes the study area.

Notes:

1. Species of conservation concern are in red lettering.
2. Species protected according to the National Environmental Management: Biodiversity Act of 2004 (Act 10 of 2000) marked with "N"

Mammals:

Red hartebeest
Springbok
White rhinoceros
[N]Black wildebeest
Blue wildebeest
Blesbok
Black rhinoceros VU
Plains zebra
Giraffe
[N]Roan antelope VU
Klipspringer
Gemsbok
Warthog
Steenbok
[N]Reedbuck
Mountain reedbuck
Common duiker
Eland
Bushbuck
Kudu
Rock hyrax
[N]Cape clawless otter
Water mongoose
Black-backed jackal
Caracal
Yellow mongoose
[N]Black-footed cat
African wild cat
Slender mongoose
Small-spotted genet
Large-spotted genet
[N]Brown hyaena NT
White-tailed mongoose
Striped polecat
[N]Spotted-necked otter NT
[N]Honey badger NT
Banded mongoose
Bat-eared fox
[N]Leopard
African weasel
Aardwolf
Suricate
[N]Cape fox
Natal long-fingered bat NT
Cape serotine bat
Egyptian slit-faced bat
Rusty bat NT
Geoffroy's horseshoe bat NT
Darling's horseshoe bat NT
Flat-headed free-tailed bat
Yellow house bat
Egyptian free-tailed bat
[N]South African hedgehog NT
Reddish-grey musk shrew
Tiny musk shrew
Lesser red musk shrew
Swamp musk shrew
Lesser grey-brown musk shrew
Cape/desert hare
Scrub/savannah hare
Jameson's red rock rabbit
Vervet monkey
Southern lesser galago
Chacma baboon
Red veld rat
Tete veld rat
Namaqua rock mouse
Common mole rat
Grey climbing mouse
Short-tailed gerbil
Woodland dormouse
Rock dormouse
Porcupine
Single-striped mouse
Large-eared mouse
Multimammate mouse
Desert pygmy mouse
White-tailed rat EN
Angoni vlei rat
Vlei rat
Tree squirrel
Springhare
Striped mouse
Pouched mouse
Kreb's fat mouse
Highveld gerbil
Bushveld gerbil
Tree rat
Greater cane rat

Cape ground squirrel
Rock elephant shrew
Aardvark

Reptiles:
Puff adder
Rhombic night adder
Cape cobra
Mozambique spitting cobra
Rinkhals
Highveld garter snake
Boomslang
Vine snake
Southern stiletto snake
Short-snouted whip snake
Kalahari sand snake
Western stripe-bellied sand snake
Striped skaapsteker
Common tiger snake
Herald snake
Black-headed centipede eater
[N]Southern African python
Brown house snake
(Aurora house snake)
Common brown water snake
Mole snake
Two-striped shovel-snout
Spotted bush snake
Western Natal green snake
Common slug-eater
Common wolf snake
Southern file snake
Common egg-eater
Delalande's beaked blind snake
Bibron's blind snake
Peter's worm snake
Incognito worm snake
Southern tree agama
Distant's ground agama
Southern rock agama
Common flap-necked chameleon
Rock monitor
Water monitor
Common rough-scaled lizard
Holub's sandveld lizard
(Spotted sandveld lizard)
Spotted sand lizard
Thin-tailed legless skink
Wahlberg's snake-eyed skink
Sundevall's writhing skink
Cape skink
Speckled rock skink
Variable skink
Yellow-throated plated lizard
Common girdled lizard
Common dwarf gecko
Cape gecko
Marsh terrapin
Lobatse hinged tortoise
Leopard tortoise

Amphibians
Bushveld rain frog
Eastern olive toad
Guttural toad
Western olive toad
Red toad
Bubbling kassina
Banded rubber frog
Snoring puddle frog
Common platanna
Boettger's caco
Common river frog
[N]Giant bullfrog NT
Striped stream frog
Tremolo sand frog
Knocking sand frog
Natal sand frog
Tandy's sand frog

Birds
Apalis Bar-throated
Avocet Pied
Babbler Arrow-marked
Babbler Southern Pied
Barbet Acacia Pied
Barbet Black-collared
Barbet Crested
Batis Chinspot
Batis Pririt
Bee-eater Blue-cheeked
Bee-eater European
Bee-eater Little
Bee-eater Swallow-tailed
Bee-eater White-fronted
Bishop Southern Red
Bishop Yellow-crowned
Bittern Dwarf
Bittern Little
Bokmakierie
Boubou Southern
Brubru
Bulbul African Red-eyed
Bulbul Dark-capped
Bunting Cape

Bunting Cinnamon-breasted
Bunting Golden-breasted
Bunting Lark-like
Buttonquail Small
Buzzard European Honey-
Buzzard Jackal
Buzzard Steppe
Cameroptera Grey-backed
Canary Black-throated
Canary Yellow
Canary Yellow-fronted
Chat Ant-eating
Chat Familiar
Chat Mocking Cliff-
Cisticola Cloud
Cisticola Desert
Cisticola Lazy
Cisticola Levaillant's
Cisticola Rattling
Cisticola Tinkling
Cisticola Wing-snapping
Cisticola zitting
Coot Red-knobbed
Cormorant Reed
Cormorant White-breasted
Coucal Burchell’s
Courser Double-banded
Courser Temminck's
Crake African
Crake Black
Crake Spotted
[N]Crane Blue VU
Crombec Long-billed
Crow Cape
Crow Pied
Cuckoo African
Cuckoo Black
Cuckoo Common
Cuckoo Diderick
Cuckoo Great Spotted
Cuckoo Jacobin
Cuckoo Klaas’s
Cuckoo Levaillant’s
Cuckoo Red-chested
Cuckooshrike Black
Darter African
Dove Cape Turtle-
Dove Emerald-spotted Wood-
Dove Laughing
Dove Namaqua
Dove Red-eyed
Dove Rock
Drongo Fork-tailed
Duck African Black
Duck Comb
Duck Fulvous
Duck Maccoa
Duck White-backed
Duck White-faced
Duck Yellow-billed
Eagle African Fish-
Eagle Black-chested Snake-
Eagle Booted
Eagle Brown Snake-
[N]Eagle Martial VU
Eagle Tawny VU
Eagle Wahlberg’s
Egret Cattle
Egret Great
Egret Little
Egret Yellow-billed
Eremomela Burnt-necked
Eremomela Yellow-bellied
Falcon Amur
Falcon Lanner NT
Falcon Peregrine NT
Falcon Red-footed
Finch Cuckoo
Finch Cut-throat
Finch Red-headed
Finch Scaly-feathered
Firefinch Red-billed
Fiscal Common
Flamingo Greater NT
Flamingo Lesser NT
Flufftail Red-chested
Flycatcher African Paradise
Flycatcher Chat
Flycatcher Fairy
Flycatcher Fiscal
Flycatcher Marico
Flycatcher Spotted
Francolin Coqui
Francolin Crested
Francolin Natal
Francolin Orange River
Go-away-bird Grey
Godwit Black-tailed
Goose Egyptian
Goose Spur-winged
Goshawk Gabar
Goshawk Southern Pale Chanting-
Grebe Black-necked
Grebe Great Crested
Grebe Little
Greenshank Common

Guineafowl Helmeted
Gull Grey-headed
Hamerkop
Harrier African Marsh- VU
Harrier Black VU
Harrier Montagu's
Harrier Pallid NT
Harrier Western Marsh-
Hawk African Harrier-
Helmet-shrike
Heron Black
Heron Black-crowned Night-
Heron Black-headed
Heron Goliath
Heron Green-backed
Heron Grey
Heron Purple
Heron Squacco
Hobby Eurasian
Honeyguide Greater
Honeyguide Lesser
Hoopoe African
Hornbill African Grey
Hornbill Red-billed
Hornbill Southern Yellow-billed
Ibis African Sacred
Ibis Glossy
Ibis Hadeda
Indigobird Purple
Indigobird Village
Jacana African
Kestrel Greater
[N]Kestrel Lesser VU
Kestrel Rock
Kingfisher Brown-hooded
Kingfisher Giant
Kingfisher Half-collared
Kingfisher Malachite
Kingfisher Pied
Kingfisher Striped
Kingfisher Woodland
Kite Black
Kite Black-shouldered
Kite Yellow-billed
Korhaan Barrow's VU
Korhaan Northern Black
Korhaan Red-crested
Lapwing African Wattled
Lapwing Blacksmith
Lapwing Crowned
Lark Eastern Clapper
Lark Fawn-coloured
Lark Melodious NT
Lark Monotonous
Lark Pink-billed
Lark Red-capped
Lark Rufous-naped
Lark Sabota
Lark Short-clawed NT
Lark Spike-heeled
Longclaw Cape
Mannikin Bronze
Martin Banded
Martin Brown-throated
Martin Common House-
Martin Rock
Martin Sand
Moorhen Common
Mousebird Red-faced
Mousebird Speckled
Mousebird White-backed
Myna Common
Neddicky
Nightjar European
Nightjar Fiery-necked
Nightjar Freckled
Nightjar Rufous-cheeked
Oriole Black-headed
Oriole Eurasian Golden
Osprey
Ostrich Common
Owl African Grass- VU
Owl African Scops-
Owl Barn
Owl Marsh
Owl Southern White-faced Scops-
Owl Spotted Eagle-
Owl Verraeux's Eagle-
Owlet Pearl-spotted
Pelican Great White NT
Pelican Pink-backed VU
Petronia Yellow-throated
Pigeon African Green
Pigeon African Olive-
Pigeon Speckled
Pipit African
Pipit Buffy
Pipit Bushveld
Pipit Long-billed
Pipit Plain-backed
Pipit Striped
Plover Caspian
Plover Chestnut-banded NT
Plover Common Ringed
Plover Grey
Plover Kittlitz's

Plover Three-banded
Pochard Southern
Pratincole Black-winged NT
Prinia Black-chested
Prinia Tawny-flanked
Puffback Black-headed
Phytilia Green-winged
Quail Common
Quail Harlequin
Quailfinch African
Quelea Red-billed
Rail African
Robin Kalahari Scrub-
Robin White-browed Scrub-
Robin-Chat Cape
Robin-chat White-throated
Roller European
Roller Lilac-breasted
Roller Purple
Ruff
Sanderling
Sandgrouse Namaqua
Sandpiper Common
Sandpiper Curlew
Sandpiper Marsh
Sandpiper Wood
Scimitarbill Common
Secretarybird NT
Seedeater Streaky-headed
Shelduck South African
Shikra
Shoveler Cape
Shrike Crimson-breasted
Shrike Grey-headed Bush-
Shrike Lesser Grey
Shrike Magpie
Shrike Red-backed
Shrike Southern White-breasted
Snipe African
Snipe Greater Painted- NT
Sparrow Cape
Sparrow Great
Sparrow House
Sparrow Southern Grey-headed
Sparrow-Weaver White-browed
Sparrowhawk Black
Sparrowhawk Little
Sparrowhawk Ovambo
Sparrowlark Chestnut-backed
Sparrowlark Grey-backed
Spoonbill African
Spurfowl Swainson's
Starling Burchell's
Starling Cape Glossy
Starling Pied
Starling Red-winged
Starling Violet-backed
Starling Wattled
Stilt Black-winged
Stint Little
Stonechat African
Stork Abdim's
[N]Stork Black NT
Stork Marabou NT
Stork White
Stork Yellow-billed NT
Sunbird Amethyst
Sunbird Marico
Sunbird White-bellied
Swallow Barn
Swallow Greater Striped
Swallow Lesser Striped
Swallow Pearl-breasted
Swallow Red-breasted
Swallow South African Cliff-
Swallow White-throated
Swamphen African Purple
Swift African Black
Swift African Palm
Swift Alpine
Swift Common
Swift Horus
Swift Little
Swift White-rumped
Tchagra Black-crowned
Tchagra Brown-crowned
Teal Cape
Teal Hottentot
Teal Red-billed
Tern Caspian NT
Tern Whiskered
Tern White-winged
Thick-knee Spotted
Thrush Groundscraper
Thrush Karoo
Thrush Kurrichane
Thrush Short-toed Rock-
Tinkerbird Yellow-fronted
Tit Ashy
Tit Cape Penduline-
Tit Southern Black
Tit-Babbler Chestnut-vented
Turnstone Ruddy
[N]Vulture Cape VU
[N]Vulture Egyptian RE
[N]Vulture Lappet-faced VU

Vulture Palm-nut
[N]Vulture White-backed VU
Wagtail African Pied
Wagtail Cape
Wagtail Yellow
Warbler African Reed-
Warbler Barred Wren-
Warbler Garden
Warbler Great Reed
Warbler Icterine
Warbler Little Rush-
Warbler Marsh
Warbler Rufous-eared
Warbler Sedge
Warbler Willow
Waxbill Black-faced
Waxbill Blue
Waxbill Common
Waxbill Orange-breasted
Waxbill Swee
Waxbill Violet-eared
Weaver Cape
Weaver Red-billed Buffalo-
Weaver Sociable
Weaver Southern Masked-
Weaver Village
Wheatear Capped
Wheatear Mountain
Whimbrel Common
White-eye Cape
Whitethroat Common
Whydah Long-tailed Paradise
Whydah Pin-tailed
Whydah Shaft-tailed
Widowbird Long-tailed
Widowbird Red-collared
Widowbird White-winged
Wood-hoopoe Green
Woodpecker Bearded
Woodpecker Cardinal
Woodpecker Golden-tailed

Appendix 4: Threatened vertebrate species with a geographical distribution that includes the study area.

MAMMALS

Common name	Taxon	Habitat[1]	National status	Global status[2]	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis minor*	Wide variety of habitats, but currently only occurs in game reserves.	VU	CR	**NONE**, only occurs in game reserves
Roan antelope	*Hippotragus equinus*	Medium to tall grassland in open savannah. Only occurs in reserves and on private game farms.	VU	LC	**LOW**, overall geographical distribution includes this area, general habitat is suitable, but only occurs in reserves.
Brown hyaena	*Hyaena brunnea*	All vegetation types, including urban areas. Scavenger.	NT	NT	**HIGH,** within known distribution range, habitat is suitable
Spotted-necked otter	*Lutra maculicollis*	Permanent, unsilted and unpolluted rivers, streams and freshwater lakes, where sufficient numbers of its prey are present.Adequate riparian vegetation is essential to provide cover during periods of inactivity.	NT	LC	**NONE,** within known distribution range, but no suitable habitat
Honey badger	*Mellivora capensis*	Wide variety of habitats. Probably only in natural habitats.	NT	LC	**HIGH**, within known distribution range, habitat is suitable
Natal long-fingered bat	*Miniopterus natalensis*	Occurs widely in the region, but more often in the southern and eastern parts than the arid west. It is predominantly a temperate to sub-tropical species with the core of its distribution in the savannas and grasslands of southern Africa. It is cave-dependent and congregates in huge numbers in suitable sites. Uses separate hibernacula and summer maternity roosts. Females migrate between these caves, which may be up to 150 km apart.	NT	LC	**LOW**, overall geographical distribution includes this area, general habitat is suitable – no caves on site.
Rusty Bat	*Pipistrellus rusticus*	Aerial insectivore that roosts in crevices in trees. It is found in savannah woodland, associated with open water bodies. It is absent from moist miombo woodland and arid savannah. In the Limpopo valley, it is common in mopane woodland where rocky habitat is also present.	NT	LC	**LOW**, overall geographical distribution includes this area, but general habitat is not suitable.
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Caves and subterranean habitats; fynbos, shrubland, grassland, succulent and Nama-karoo; insectivore	NT	LC	**LOW**, overall geographical distribution

					includes this area, general habitat is suitable – no caves on site.
Darling's horseshoe bat	*Rhinolophus darlingi*	Caves and subterranean habitats. Woodland savannah.	NT	LC	**LOW**, overall geographical distribution includes this area, general habitat not suitable – no caves on site.
South African hedgehog	*Atelerix frontalis*	Variety of terrestrial habitats with good ground cover.	NT	LC	**MEDIUM,** within geographical range and suitable habitat probably occurs on site.
White-tailed Rat	*Mystromys albicaudatus*	The white-tailed rat is restricted to savannas and grasslands of South Africa and Swaziland. They tend to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night. They eat vegetable matter such as seeds and have been known to take insects.	EN	EN	**MEDIUM,** within geographical range and suitable habitat probably occurs on site.

[1]Distribution and national status according to Friedmann & Daly 2004.
[2]Global status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

AMPHIBIANS

Common name	Species	Habitat	Status	Likelihood of occurrence
Giant Bullfrog	*Pyxicephalus adspersus*	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT[1] LC[2] Protected (NEMBA)	**MEDIUM**, within known distribution range and partially suitable habitat occurs on site.

[1]Status according to Minter et al. 2004.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

REPTILES

Common name	Species	Habitat	Status[3]	Likelihood of occurrence
None				

[3]Distribution according to Alexander & Marais 2007.
[4]Status according to Alexander & Marais 2007.

BIRDS

Common name	Species	Habitat	Status	Importance of site for species
Blue Crane	*Anthropoides*	Midland and highland grassveld, edge of	VU[1]	LOW, breeding,

Common name	Species	Habitat	Status	Importance of site for species
	paradisea	karoo, cultivated land, edges of vleis. Roosts on ground or in shallow water. Uncommon resident in study area.*Nest*: Scrape on bare ground or rock (klipplaat) in open grassveld, often in moist places; sometimes thinly lined or ringed with pebbles, sheep droppings or bits of plant material.	VU[2] Protected (NEMBA)	MEDIUM, foraging
Martial Eagle	*Polemaetus bellicosus*	The Martial Eagle is widespread but uncommon throughout South Africa and neighbouring countries. It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo and woodland. It relies on large trees (and electricity pylons) to provide nest sites. It is found typically in flat country and is rarer in mountains and forests. One of the main reason it is declining is because of persecution on private land. This species has been recorded from the study area and many surrounding areas. Common resident in study area.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging
Tawny Eagle	*Aquila rapax*	Woodland and savanna to semi-arid savanna or grassland with scattered *Acacia* trees. Uncommon resident in study area.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging
Lanner Falcon	*Falco biarmicus*	Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs available as nest and roost sites, but will use alternative sites (eg trees, electricity pylons, buildings) if cliffs absent. Widespread species, occurring in Afrotropics, Middle East and western Palearctic. Occurs in mountains or open country from semidesert to woodland and agricultural land; also cities (Durban, Harare). Uncommon resident in study area.	NT[1] LC[2]	LOW, breeding, LOW, foraging
Peregrine Falcon	*Falco peregrinus*	Cliffs, mountains, steep gorges; may hunt over open grassland, farmland and forests; rarely enters cities to hunt pigeons. Uncommon non-breeding migrant in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Greater Flamingo	*Phoenicopterus ruber*	Large bodies of shallow water, both inland and coastal; saline and brackish waters preferred.Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Lesser Flamingo	*Phoenicopterus minor*	Larger brackish or saline inland and coastal waters. Common resident in study area.	NT[1] NT[2]	ZERO, breeding, ZERO, foraging
Harrier Black	*Circus maurus*	Grassveld, karoo scrub, mountain fynbos, cultivated lands, subalpine vegetation,	VU[1] VU[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
		semidesert. Endemic to southern Africa. Uncommon non-breeding migrant in study area.Dry grassland, Karoo scrub and agricultural fields.		
Harrier African Marsh-	*Circus ranivorus*	Almost exclusively inland and coastal wetlands. Uncommon resident in study area. Roosts in dense grass or reeds, sometimes communally when not breeding.	VU[1] LC[2]	LOW, breeding, LOW, foraging
Harrier Pallid	*Circus macrourus*	Grasslands associated with open pans or flood plains; also croplands. Uncommon non-breeding migrant in study area.	NT[1] NT[2]	ZERO, breeding, LOW, foraging
Barrow's Korhaan	*Eupodotis barrowii*	Open grassland; sometimes in sparse *Acacia* thornveld. Eggs laid on bare ground. Uncommon to common resident in study area.	VU[1] na[2]	MEDIUM, breeding, MEDIUM, foraging
Melodious Lark	*Mirafra cheniana*	Open climax grassland, sometimes with rocky outcrops, termite mounds or sparse bushes; also cultivated fields of Teff. Nest set into scrape on ground among tall grass. Common resident in study area.	NT[1] NT[2]	MEDIUM, breeding, MEDIUM, foraging
Short-clawed Lark	*Certhilauda chuana*	Open ground in semi-arid scrub of Karee (*Lycium* and *Rhus* species) and Vaalbos *Tarchonanthus camphoratus*; grassland 30-40 cm tall with scattered *Acacia* thorntrees, or taller open grassland in n Transvaal, usually with open patches of shorter grass; fallow lands. Nest is a cup of grass stems, leaves and roots in hollow in ground at base of herb or shrub in overgrazed grassveld. Uncommon resident in study area.	NT[1] LC[2]	MEDIUM, breeding, MEDIUM, foraging
African Grass-Owl	*Tyto capensis*	Long grass, usually near water, vleis, marshes. Uncommon resident in study area.	VU[1] na[2]	ZERO, breeding, LOW, foraging
Great White Pelican	*Pelecanus onocrotalus*	Coastal bays, estuaries, lakes, larger pans and dams. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Pink-backed Pelican	*Pelecanus rufescens*	Coastal bays and estuaries, seldom inland on larger rivers, marshes and floodplains. Uncommon resident in study area.	VU[1] LC[2]	ZERO, breeding, ZERO, foraging
Lesser Kestrel	*Falco naumannii*	Open grassveld, mainly on highveld, usually near towns or farms. Common non-breeding migrant in study area.	VU[1] na[2]	ZERO, breeding, LOW, foraging
Chestnutbanded Plover	*Charadrius pallidus*	Saline lagoons, saline and brackish pans, saltworks, occasionally estuaries and sandy lagoons. Uncommon resident in study area.	NT[1] NT[2]	LOW, breeding, LOW, foraging
Black-winged pratincole	*Glareola nordmanni*	Breeds mainly on alkaline flats and saltpans in river valleys and lake depressions, also on fields and fallow lands devoid of vegetation. Large colonies always near water and damp meadows or marshes overgrown with dense grass; access to drinking water important. In winter	NT[1] NT[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
		quarters, prefers open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems. Attracted to damp ground after rains, also to agricultural activities, incl mowing and ploughing, and to newly flooded grasslands. Common non-breeding migrant in study area.		
Secretarybird	*Sagittarius serpentarius*	Widespread across South Africa, occurring in savanna and open grassland from coastal regions to high altitudes, but avoids thick bush and forest. Sensitive to disturbance and high human population numbers - higher numbers usually found in conservation areas. Common resident in study area.	NT[1] VU[2]	LOW, breeding, MEDIUM, foraging
Greater painted snipe	*Rostratula benghalensis*	Dams, pans and marshy river flood plains. Favours waterside habitats with substantial cover and receding water levels with exposed mud among vegetation, departing when water recedes beyond fringes of vegetation. Rare in seasonally flooded grassland and palm savanna in Ovamboland, Namibia. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Black Stork	*Ciconia nigra*	Feeds in or around marshes, dams, rivers and estuaries; breeds in mountainous regions. Common resident in study area.	NT[1] LC[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Marabou Stork	*Leptoptelos crumeniferus*	Open to semi-arid woodland, bushveld, fishing villages, rubbish tips, lake shores. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Yellow-billed Stork	*Mycteria ibis*	Mainly inland waters; rivers, dams, pans, floodplains, marshes; less often estuaries. Uncommon non-breeding migrant in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Caspian Tern	*Sterna caspia*	Estuaries, marine shores, larger inland dams and pans. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Cape vulture	*Gyps coprotheres*	Wide range of habitats up to ca 3 000 m; closely linked to subsistence communal-grazing areas, where stock losses high. Uncommon resident in study area. Nests on cliff ledges.	VU[1] VU[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Egyptian Vulture		Semidesert and open plains; abattoirs, refuse dumps, seashore; absent from woodland. Rare and vagrant in study area.	RE[1] EN[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Lappet-faced Vulture	*Torgos tracheliotus*	Savanna to desert. Common resident in study area.	VU[1] VU[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
			Protected (NEMBA)	
Whitebacked Vulture	*Gyps africanus*	Savanna and bushveld. Uncommon resident in study area. Nests in tall trees.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging

[1]Status according to Barnes 2000.

[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 8 September 2014.

Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.
(Species from quarter degree grid in which the site is located as well as surrounding grids in which similar vegetation is found)

Abildgaardia ovata (Burm.f.) Kral
Acacia erioloba E.Mey.
Acacia hebeclada DC. subsp. hebeclada
Acacia hereroensis Engl.
Acacia karroo Hayne
Acanthosicyos naudinianus (Sond.) C.Jeffrey
Acrotome inflata Benth.
Aerva leucura Moq.
Alectra sessiliflora (Vahl) Kuntze var. sessiliflora
Andropogon schirensis Hochst. ex A.Rich.
Anthemis cotula L.
Anthephora pubescens Nees
Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum
Antizoma angustifolia (Burch.) Miers ex Harv.
Arctotis venusta Norl.
Aristida canescens Henrard subsp. canescens
Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter
Aristida congesta Roem. & Schult. subsp. congesta
Aristida diffusa Trin. subsp. burkei (Stapf) Melderis
Aristida scabrivalvis Hack. subsp. scabrivalvis
Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis
Aristida vestita Thunb.
Asparagus laricinus Burch.
Barleria macrostegia Nees
Bergia decumbens Planch. ex Harv.
Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia
Berkheya pinnatifida (Thunb.) Thell. subsp. stobaeoides (Harv.) Roessler
Blepharis angusta (Nees) T.Anderson
Blepharis squarrosa (Nees) T.Anderson
Brachiaria marlothii (Hack.) Stent
Brachiaria nigropedata (Ficalho & Hiern) Stapf
Brachiaria serrata (Thunb.) Stapf
Brachystelma foetidum Schltr.
Bulbine abyssinica A.Rich.
Bulbine frutescens (L.) Willd.
Bulbine narcissifolia Salm-Dyck
Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke
Calamagrostis epigejos (L.) Roth var. capensis Stapf
Cannabis sativa L. var. sativa
Celtis africana Burm.f.
Chaenostoma patrioticum (Hiern) Kornhall
Chamaecrista biensis (Steyaert) Lock
Chascanum adenostachyum (Schauer) Moldenke
Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum
Chironia palustris Burch. subsp. palustris
Chloris virgata Sw.
Chlorophytum cooperi (Baker) Nordal
Chrysocoma ciliata L.

Chrysocoma obtusata (Thunb.) Ehr.Bayer
Chrysopogon serrulatus Trin.
Cirsium vulgare (Savi) Ten.
Clematis brachiata Thunb.
Cleome maculata (Sond.) Szyszyl.
Coccinia sessilifolia (Sond.) Cogn.
Commelina africana L. var. krebsiana (Kunth) C.B.Clarke
Commelina livingstonii C.B.Clarke
Commicarpus pentandrus (Burch.) Heimerl
Convolvulus ocellatus Hook.f. var. ocellatus
Convolvulus thunbergii Roem. & Schult.
Corchorus asplenifolius Burch.
Crabbea angustifolia Nees
Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken
Crassula natans Thunb. var. natans
Crinum graminicola I.Verd.
Crinum macowanii Baker
Cucumis myriocarpus Naudin subsp. myriocarpus
Cucumis zeyheri Sond.
Cyanotis speciosa (L.f.) Hassk.
Cymbopogon pospischilii (K.Schum.) C.E.Hubb.
Cynanchum virens (E.Mey.) D.Dietr.
Cynodon dactylon (L.) Pers.
Cynoglossum austroafricanum Hilliard & B.L.Burtt
Cynoglossum lanceolatum Forssk.
Cyperus congestus Vahl
Cyperus marginatus Thunb.
Cyperus rubicundus Vahl
Cyperus sexangularis Nees
Cyphia stenopetala Diels
Deverra burchellii (DC.) Eckl. & Zeyh.
Dianthus mooiensis F.N.Williams subsp. mooiensis var. mooiensis
Dicoma anomala Sond. subsp. anomala
Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña
Digitaria eriantha Steud.
Digitaria sanguinalis (L.) Scop.
Diheteropogon amplectens (Nees) Clayton var. amplectens
Diospyros austro-africana De Winter var. microphylla (Burch.) De Winter
Diospyros lycioides Desf. subsp. lycioides
Dipcadi marlothii Engl.
Dipcadi viride (L.) Moench
Echinochloa holubii (Stapf) Stapf
Ehretia alba Retief & A.E.van Wyk
Elionurus muticus (Spreng.) Kunth
Epilobium hirsutum L.
Eragrostis barbinodis Hack.
Eragrostis biflora Hack. ex Schinz
Eragrostis chloromelas Steud.
Eragrostis curvula (Schrad.) Nees
Eragrostis gummiflua Nees
Eragrostis micrantha Hack.
Eragrostis plana Nees
Eragrostis superba Peyr.

Eragrostis trichophora Coss. & Durieu
Eragrostis x pseud-obtusa De Winter
Eriosema salignum E.Mey.
Euphorbia inaequilatera Sond. var. inaequilatera
Eustachys paspaloides (Vahl) Lanza & Mattei
Falkia oblonga Bernh. ex C.Krauss
Felicia muricata (Thunb.) Nees subsp. muricata
Fingerhuthia africana Lehm.
Flaveria bidentis (L.) Kuntze
Fuirena pubescens (Poir.) Kunth var. pubescens
Galium capense Thunb. subsp. capense
Geigeria aspera Harv. var. aspera
Geigeria brevifolia (DC.) Harv.
Geigeria burkei Harv. subsp. burkei var. burkei
Geigeria burkei Harv. subsp. burkei var. zeyheri (Harv.) Merxm.
Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.
Gnaphalium filagopsis Hilliard & B.L.Burtt
Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus
Grewia flava DC.
Gymnosporia buxifolia (L.) Szyszyl.
Habenaria epipactidea Rchb.f.
Helichrysum callicomum Harv.
Helichrysum harveyanum Wild
Helichrysum nudifolium (L.) Less. var. nudifolium
Hermannia stellulata (Harv.) K.Schum.
Hermannia tomentosa (Turcz.) Schinz ex Engl.
Hermbstaedtia odorata (Burch.) T.Cooke var. odorata
Heteropogon contortus (L.) Roem. & Schult.
Hibiscus trionum L.
Hyparrhenia filipendula (Hochst.) Stapf var. pilosa (Hochst.) Stapf
Hyparrhenia hirta (L.) Stapf
Indigastrum costatum (Guill. & Perr.) Schrire subsp. macrum (E.Mey.) Schrire
Indigastrum parviflorum (B.Heyne ex Wight & Arn.) Schrire subsp. parviflorum var. parviflorum
Indigofera heterotricha DC.
Indigofera oxytropis Benth. ex Harv.
Ipomoea bathycolpos Hallier f.
Ipomoea oblongata E.Mey. ex Choisy
Ipomoea obscura (L.) Ker Gawl. var. obscura
Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. atropurpurea
Kohautia amatymbica Eckl. & Zeyh.
Kohautia caespitosa Schnizl. subsp. brachyloba (Sond.) D.Mantell
Kyllinga alba Nees
Kyphocarpa angustifolia (Moq.) Lopr.
Lantana rugosa Thunb.
Leersia denudata Launert
Leptochloa fusca (L.) Kunth
Lippia scaberrima Sond.
Litogyne gariepina (DC.) Anderb.
Lobelia erinus L.
Lobelia thermalis Thunb.
Loudetia simplex (Nees) C.E.Hubb.
Lycium cinereum Thunb.

Lycium hirsutum Dunal
Marsilea macrocarpa C.Presl
Medicago laciniata (L.) Mill. var. laciniata
Melilotus albus Medik.
Melinis repens (Willd.) Zizka subsp. grandiflora (Hochst.) Zizka
Melinis repens (Willd.) Zizka subsp. repens
Mentha aquatica L.
Microchloa caffra Nees
Microchloa kunthii Desv.
Monsonia burkeana Planch. ex Harv.
Moraea pallida (Baker) Goldblatt
Nananthus vittatus (N.E.Br.) Schwantes
Nemesia fruticans (Thunb.) Benth.
Nidorella hottentotica DC.
Nidorella resedifolia DC. subsp. resedifolia
Nolletia ciliaris (DC.) Steetz
Oenothera glazioviana Micheli
Oenothera rosea L'Hér. ex Aiton
Olea europaea L. subsp. africana (Mill.) P.S.Green
Ophrestia oblongifolia (E.Mey.) H.M.L.Forbes var. oblongifolia
Oropetium capense Stapf
Osteospermum muricatum E.Mey. ex DC. subsp. muricatum
Oxygonum dregeanum Meisn. subsp. canescens (Sond.) Germish. var. canescens
Ozoroa paniculosa (Sond.) R.& A.Fern. var. paniculosa
Pachystigma pygmaeum (Schltr.) Robyns
Panicum coloratum L. var. coloratum
Panicum stapfianum Fourc.
Parinari capensis Harv. subsp. capensis
Paspalum dilatatum Poir.
Pastinaca sativa L.
Pavonia burchellii (DC.) R.A.Dyer
Pearsonia cajanifolia (Harv.) Polhill subsp. cajanifolia
Pelargonium dolomiticum R.Knuth
Pellaea calomelanos (Sw.) Link var. calomelanos
Pentarrhinum insipidum E.Mey.
Phragmites australis (Cav.) Steud.
Plantago lanceolata L.
Plectranthus neochilus Schltr.
Pogonarthria squarrosa (Roem. & Schult.) Pilg.
Pollichia campestris Aiton
Polygala gracilenta Burtt Davy
Polygala hottentotta C.Presl
Polygala producta N.E.Br.
Polygala rehmannii Chodat
Potamogeton pectinatus L.
Pygmaeothamnus zeyheri (Sond.) Robyns var. zeyheri
Ranunculus multifidus Forssk.
Raphionacme hirsuta (E.Mey.) R.A.Dyer
Rhynchosia monophylla Schltr.
Riccia albolimbata S.W.Arnell
Riccia argenteolimbata O.H.Volk & Perold
Rubia petiolaris DC.
Rumex lanceolatus Thunb.

Salvia radula Benth.
Salvia runcinata L.f.
Salvia stenophylla Burch. ex Benth.
Scabiosa columbaria L.
Schizachyrium sanguineum (Retz.) Alston
Searsia pyroides (Burch.) Moffett var. pyroides
Selago densiflora Rolfe
Senecio digitalifolius DC.
Setaria incrassata (Hochst.) Hack.
Setaria nigrirostris (Nees) T.Durand & Schinz
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton
Sida chrysantha Ulbr.
Sida cordifolia L. subsp. cordifolia
Silene undulata Aiton
Solanum lichtensteinii Willd.
Sporobolus festivus Hochst. ex A.Rich.
Sporobolus fimbriatus (Trin.) Nees
Stachys spathulata Burch. ex Benth.
Stipagrostis uniplumis (Licht.) De Winter var. neesii (Trin. & Rupr.) De Winter
Striga elegans Benth.
Striga gesnerioides (Willd.) Vatke
Sutherlandia microphylla Burch. ex DC.
Tarchonanthus parvicapitulatus P.P.J.Herman
Tephrosia longipes Meisn. subsp. longipes var. longipes
Tephrosia lupinifolia DC.
Teucrium trifidum Retz.
Themeda triandra Forssk.
Trachyandra burkei (Baker) Oberm.
Trachyandra laxa (N.E.Br.) Oberm. var. rigida (Suess.) Roessler
Trachypogon spicatus (L.f.) Kuntze
Tragus berteronianus Schult.
Tragus racemosus (L.) All.
Tribulus terrestris L.
Trichodesma angustifolium Harv. subsp. angustifolium
Trichoneura grandiglumis (Nees) Ekman
Trifolium africanum Ser. var. africanum
Tripteris aghillana DC. var. aghillana
Triraphis andropogonoides (Steud.) E.Phillips
Triraphis schinzii Hack.
Tritonia nelsonii Baker
Triumfetta sonderi Ficalho & Hiern
Urelytrum agropyroides (Hack.) Hack.
Urochloa brachyura (Hack.) Stapf
Urochloa panicoides P.Beauv.
Ursinia nana DC. subsp. leptophylla Prassler
Verbena bonariensis L.
Vigna unguiculata (L.) Walp. subsp. stenophylla (Harv.) Maréchal, Mascherpa & Stainier
Viscum verrucosum Harv.
Wahlenbergia denticulata (Burch.) A.DC. var. denticulata
Xanthium spinosum L.
Ziziphus mucronata Willd. subsp. mucronata
Ziziphus zeyheriana Sond.
Zornia milneana Mohlenbr.

Appendix 5: Flora and vertebrate animal species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES
Flora
Adenium swazicum
Aloe pillansii
Diaphananthe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

Reptilia
Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves
Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia
Riverine rabbit
Rough-haired golden mole

ENDANGERED SPECIES
Flora
Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

Reptilia
Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves
Blue crane
Grey crowned crane
Saddle-billed stork
Bearded vulture
White-backed vulture
Cape vulture
Hooded vulture
Pink-backed pelican
Pel's fishing owl
Lappet-faced vulture

Mammalia
Robust golden mole
Tsessebe
Black rhinoceros
Mountain zebra
African wild dog
Gunning's golden mole
Oribi
Red squirrel
Four-toed elephant-shrew

VULNERABLE SPECIES
Flora
Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwilla plumbea
Zantedeschia jucunda

Aves
White-headed vulture
Tawny eagle
Kori bustard
Black stork
Southern banded snake eagle
Blue korhaan
Taita falcon
Lesser kestrel
Peregrine falcon
Bald ibis

Ludwig’s bustard
Martial eagle
Bataleur
Grass owl

Mammalia
Cheetah
Samango monkey
Giant golden mole
Giant rat
Bontebok
Tree hyrax
Roan antelope
Pangolin
Juliana’s golden mole
Suni
Large-eared free-tailed bat
Lion
Leopard
Blue duiker

PROTECTED SPECIES
Flora
Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii
Protea odorata
Stangeria eriopus

Amphibia
Giant bullfrog
African bullfrog

Reptilia
Gaboon adder
Namaqua dwarf adder
Smith’s dwarf chameleon
Armadillo girdled lizard
Nile crocodile
African rock python

Aves
Southern ground hornbill
African marsh harrier
Denham’s bustard
Jackass penguin

Mammalia
Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Spotted hyaena
Black-footed cat
Brown hyaena
Serval
African elephant
Spotted-necked otter
Honey badger
Sharpe’s grysbok
Reedbuck
Cape fox

Appendix D2

AVIFAUNA

BIRD IMPACT ASSESSMENT STUDY

Grid connection for the proposed Tlisitseng Solar 1 Photovoltaic (PV) Project 1 near Lichtenburg in the North-West Province

FEBRUARY 2016

Prepared by:

Chris van Rooyen Consulting
30 Roosevelt Street
Robindale
Randburg
2194
South Africa
Email: vanrooyen.chris@gmail.com

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 Sivest 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 worked performed, specifically in connection with the Environmental Impact Assessment for the proposed grid connection of the Tlisitseng Solar 1 Photovoltaic (PV) Project 1 near Lichtenburg in the North-West Province.

____

Full Name: Chris van Rooyen

Title / Position: Director

RELEVANT EXPERTISE

Chris van Rooyen

Chris has 19 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 more than 160 power line and 30 renewable energy 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 (2013) 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.

EXECUTIVE SUMMARY

Tlisitseng Solar PV will be located approximately 8km north-west of Lichtenburg, in the Ngaka Modiri Molema District of the North West Province. Tlisitseng Solar will consist of two 75MW solar PV facilities, namely Tlisitseng Solar 1 Project (PV) 1 and Tlisitseng Solar 1 Project (PV) 2. The Tlisitseng PV 1 substation will be connected to the existing Watershed Main Transmission substation (MTS) by a proposed 132kV power line. The Watershed Main Transmission substation is located directly adjacent to the proposed PV site. This bird impact assessment report deals with the potential impacts on avifauna of the proposed Tlisitseng Solar 1 PV1 grid connection and substation.

The proposed BioTherm Tlisitseng Solar 1 PV1 132kV grid connection is located in the Grassland endemic avifaunal region with the fourth highest number of avifaunal endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. Within the core study area, high sensitive areas are surface water (boreholes) and a short section of high voltage lines which is used for roosting by Cape Vultures and White-backed Vultures. Within the immediate surroundings beyond the core study area, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. The wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be removed and therefore cease to function as potential focal points for bird activity after the construction of the solar panels.

Potential pre-mitigation impacts on priority avifauna range from medium negative to low negative. All impacts could be reduced to low negative with the implementation of appropriate mitigation. No clear preferred alternative emerged as far as the proposed substation sites are concerned, as both sites are located in the same habitat. No fatal flaws were identified in the course of investigations from an avifaunal perspective, and the proposed development could therefore be authorised, provided all proposed mitigation measures are implemented.

Contents

1. INTRODUCTION & BACKGROUND

Tlisitseng Solar PV will be located approximately 8km north-west of Lichtenburg, in the Ngaka Modiri Molema District of the North West Province. Tlisitseng Solar will consist of two 75MW solar PV facilities, namely Tlisitseng Solar 1 Project (PV) 1 and Tlisitseng Solar 1 Project (PV) 2. The Tlisitseng PV 1 substation will be connected to the existing Watershed Main Transmission substation (MTS) by a proposed 132kV power line. The Watershed Main Transmission substation is located directly adjacent to the proposed PV site. This bird impact assessment report deals with the potential impacts on avifauna of the proposed Tlisitseng Solar 1 PV1 grid connection and substation.

See Figures 1 - 2 below for maps of the study area, indicating the location of the study area and the various grid connection alternatives.

Figure 1: Regional map indicating the location of the proposed Biotherm Tlisitseng PV site.

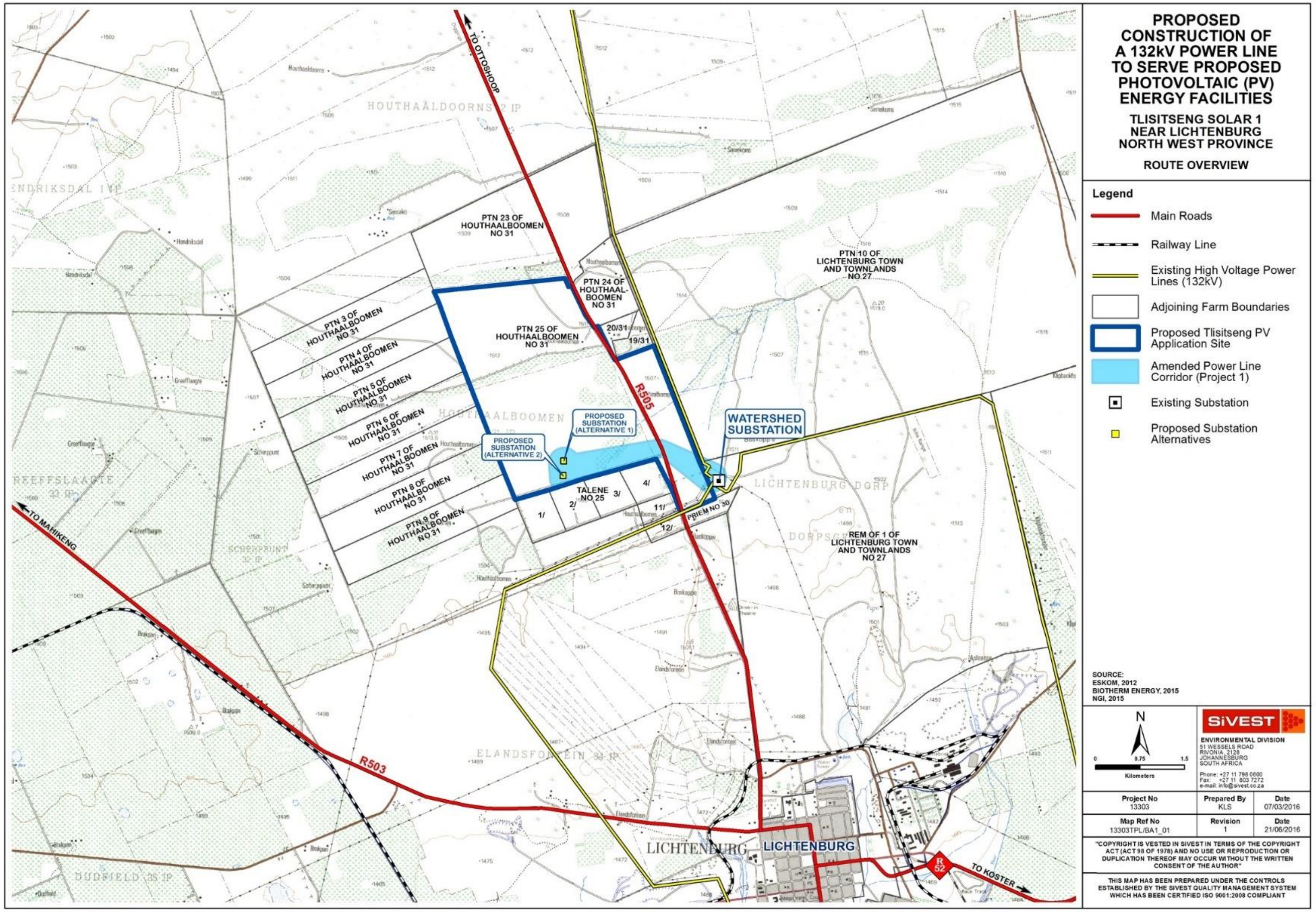

Figure 2: The proposed grid corridor and the position of the Tlisitseng Solar 1 Substation alternatives.

2. TERMS OF REFERENCE

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

- Describe the affected environment;
- Discuss gaps in baseline data;
- List and describe the expected impacts;
- Provide a sensitivity map of the proposed development site from an avifaunal perspective;
- Assess the identified impacts on avifauna;
- Provide recommendations for mitigation

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 a block consisting of nine pentad grid cells within which the proposed solar facilities are situated. The nine pentad grid cells are the following: 2555_2600, 2555_2605, 2555_2610, 2600_2600, 2600_2605, 2600_2610, 2605_2600, 2605_2605, 2605_2610 (see Figure 4). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 62 full protocol cards (i.e. 62 surveys lasting a minimum of two hours each) were completed for this area.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2015.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) 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; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on Important Bird Areas (IBAs).
- Satellite imagery was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- Information on the movement of Cape Vultures in the North-West Province was obtained from Kerri Wolter at Vulpro (Wolter *et al*. 2010).
- Information on the birds actually occurring on the site was obtained from a site visit on 9 November 2015 and a subsequent monitoring programme which was initiated at the proposed two PV sites in November 2015 (see **APPENDIX 1**).

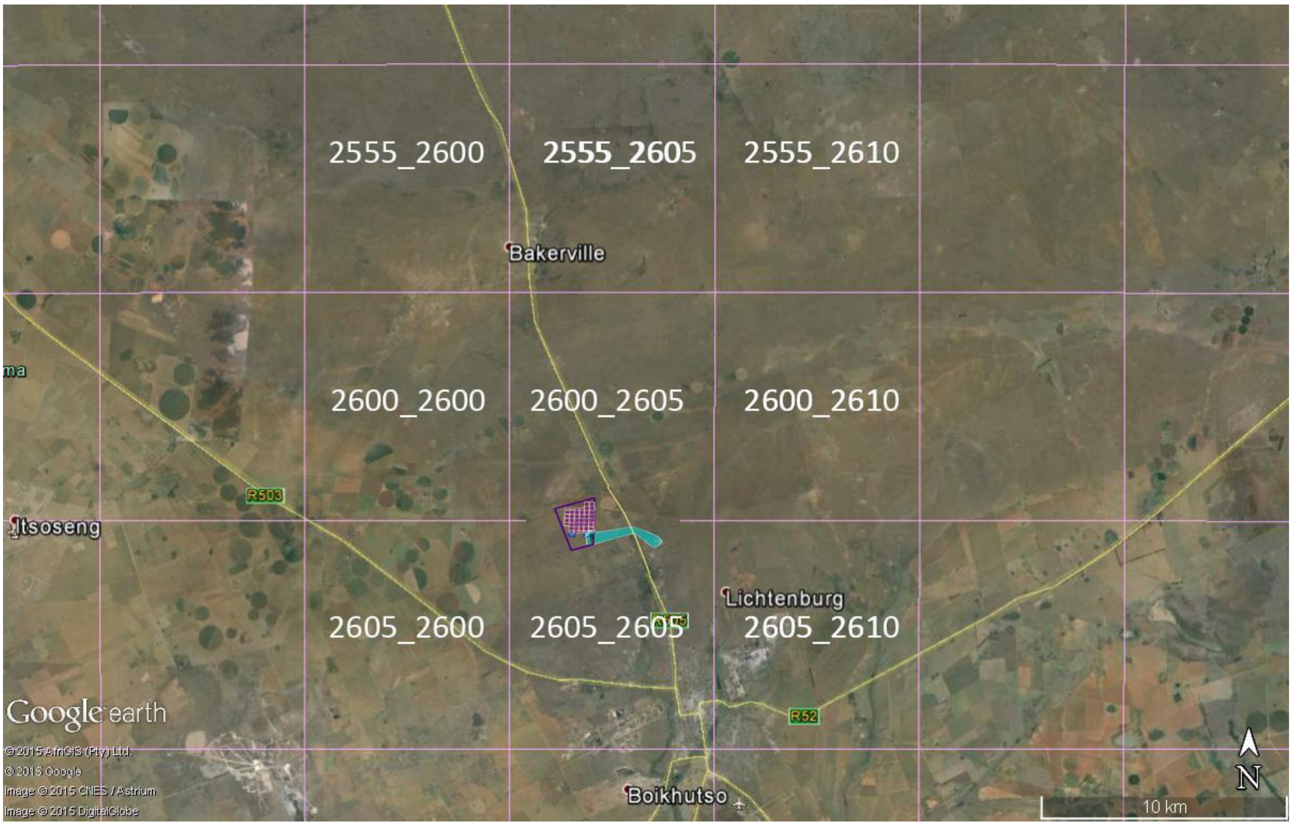

Figure 3: The area covered by the SABAP2 pentads.

4. ASSUMPTIONS & LIMITATIONS

The following assumptions and limitations are applicable in this study:

- A total of 62 full protocol lists have been completed to date to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours each). It was decided to use 9 pentads because the habitat is very uniform, which provides the opportunity to use a larger dataset which is more representative. The SABAP2 data was therefore regarded as a reasonably conclusive snapshot of the avifauna. For purposes of completeness, the list of species that could be encountered was further supplemented with observations from an avifaunal monitoring programme which is being conducted on site as part of the pre-construction monitoring programme for the PV facility.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances. Fortunately, a robust body of research is available on birds and power line interactions, going back more than 30 year. Impacts can therefore be predicted with reasonable certainty.
- The focus of the study is on southern African Red Data species, endemics and near-endemics (referred to in the report as priority species).
- The core study area was defined as the area comprising the proposed power line corridor with a 2km buffer around it.

5. DESCRIPTION OF AFFECTED ENVIRONMENT

5.1 Biomes and vegetation types

The study area is situated in the grassland biome approximately 9km north-west of the town of Lichtenburg in the North-West Province (Harrison *et al.* 1997). The natural habitat in the core study area is highly homogenous and consists of extensive grassy plains, with scattered, stunted mostly *Vachellia* trees and a variety of shrubs. The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026, and the Botsalano Nature Reserve SA024 are located approximately 70km away to the south-west and north-west respectively (Barnes 1998, Birdlife 2014). The study area is too far away from these IBAs to have any direct impact on them. The study area is situated partially within to the 6000ha Lichtenburg Game Breeding Centre which contains an important vulture restaurant, which is situated approximately 4.3km from Watershed MTS. The centre contains good grassland habitat and is a refuge for many grassland avifauna. Within and directly south of the Game Breeding Centre is an extensive network of dams and wetland areas, which is situated approximately 5km from the study area (see Figure 4). The dams and wetlands could potentially attract an abundance of waterbirds, but the water levels are linked to rainfall. During periods of drought the wetlands are dry (pers. obs).

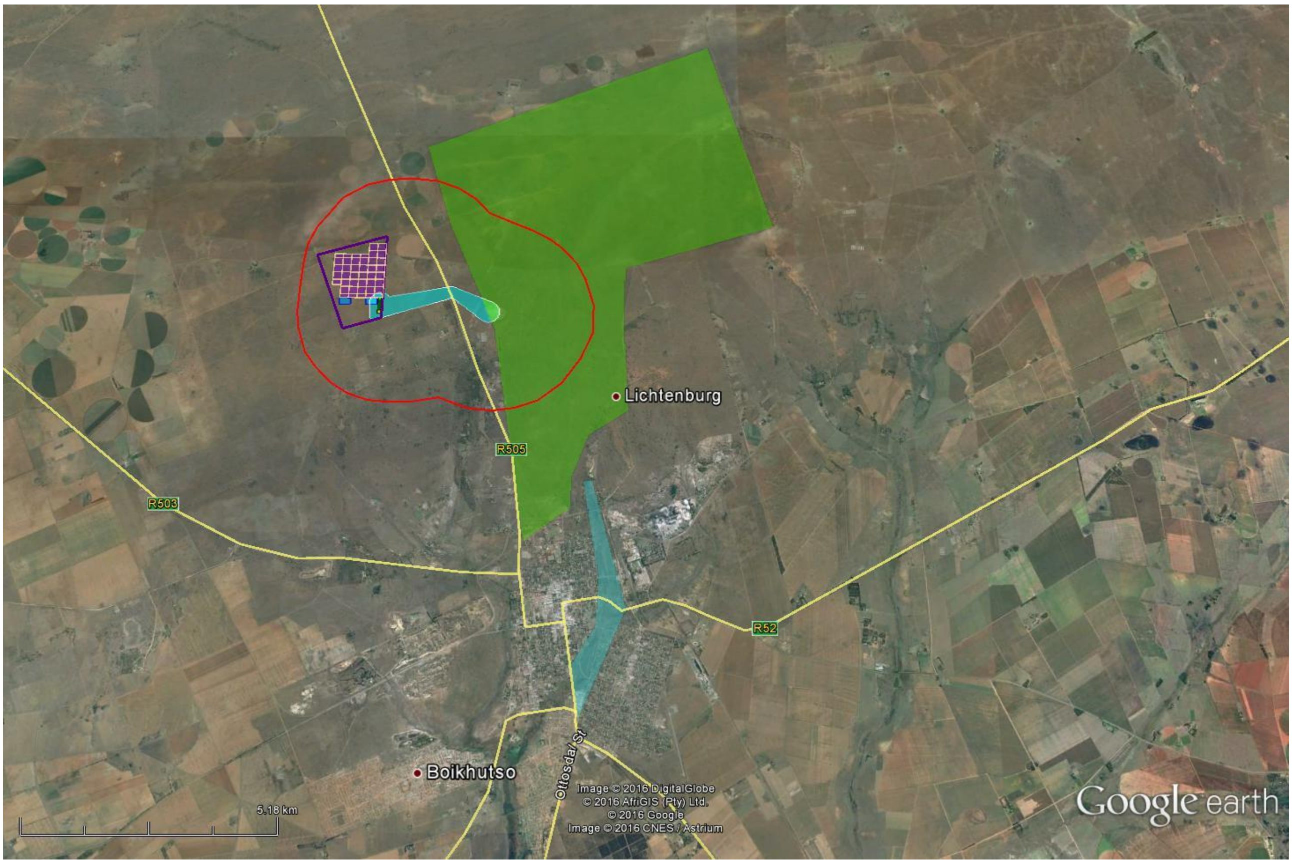

Figure 4: The location of the Lichtenburg Game Breeding Centre (green) and the wetlands (blue) relative to the study area (red outlined polygon).

5.2 Habitat classes and avifauna in the study area

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the natural vegetation, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types.

The following bird habitat classes have been identified at the core study area.

5.2.1 Grassland

The dominant natural vegetation type in the core study area and immediate surroundings is Carltonville Dolomite Grassland. Carltonville Dolomite Grassland occurs on slightly undulating plains dissected by chert ridges. In the study area, small, mostly *Vachellia* trees, and a variety of shrubs are scattered across the landscape. Species-rich grassland forms a complex mosaic pattern dominated by many grass species. Rainfall is in summer with an overall mean annual precipitation of 593mm, with temperatures ranging from very cold with frost in winter to very hot in summer (Mucina & Rutherford 2006).

Priority species that could be found in natural grassland vegetation in the core study area are Cape Sparrow, Scaly-feathered Finch, Yellow Canary, Kalahari Scrub-robin, Red-headed Finch, Black-chested Prinia, Crimson-breasted Shrike, Cape Penduline-Tit, Bokmakierie, Eastern Clapper Lark, Lark-like Bunting, Fiscal Flycatcher, Northern Black Korhaan, White-backed Mousebird, Ant-eating Chat, South African Cliff-swallow, Pied Starling, Orange River White-eye, African Red-eyed Bulbul, Sabota Lark and Spike-heeled Lark. Occasional priority visitors to the study area could include Lanner Falcon, Martial Eagle, Tawny Eagle, Secretarybird, Kori Bustard, Blue Crane, Fairy Flycatcher, Namaqua Sandgrouse, Burchell's Sandgrouse, Southern Pale Chanting Goshawk, Grey-backed Sparrowlark, White-backed Vulture, Lappet-faced Vulture and Cape Vulture.

5.2.2 Surface water

Surface water is of specific importance to avifauna in this relatively arid study area. The core study area contains at least eleven boreholes with water troughs for livestock (see Figure 6). Boreholes with open water troughs are important sources of surface water and are used extensively by various species, including large raptors, to drink and bath. Smaller priority species such as Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse, Pied Starling and Lark-like Bunting congregate in large numbers around water troughs which in turn could attract priority predators such as Southern Pale Chanting Goshawk and Lanner Falcon. The habitat around boreholes (shrubs and trees) often attract other priority species such as Bokmakierie, Kalahari Scrub-robin, Crimson-breasted Shrike, Fiscal Flycatcher, Karoo Thrush, African Red-eyed Bulbul, Orange River White-eye, Fairy Flycatcher and White-backed Mousebird. The water troughs and reservoirs are also attractive to large raptors and vultures, and could attract Martial Eagle, Tawny Eagle, White-backed Vulture, Lappet-faced

Vulture and Cape Vulture, however no large raptors have been observed at boreholes thus far in the course of the monitoring at the PV sites.

The wetland areas indicated in Figure 4 might become relevant in that the waterbirds flying over the study area on their way to the wetlands area might mistake the PV area for surface water and attempt to land on the PV panels (the so-called lake effect) (Kagan *et al.* 2014), which could expose them to collision risk with the proposed 132V grid connection. Priority species that could be at risk are South African Shelduck, Black Stork, Yellow-billed Stork, Greater Flamingo, Lesser Flamingo, Great White Pelican and Marabou Stork.

5.2.3 Agriculture

The core study area contains several agricultural centre-pivots, where a variety of crops are cultivated. Although agricultural lands completely destroy the structure of the original vegetation, some bird species do benefit from this transformation. Blue Crane, Abdim's Stork and Black-winged Pratincole are the priority species most likely to utilise agricultural clearings in the study area. Abdim's Stork and Black-winged Pratincole can occur in flocks of several hundred on irrigated fields, although the species do not seem to occur in large numbers in the area. The clearings could also be utilised by Secretarybirds, but the species is likely to occur sparsely. Thus far none of the species mentioned in this paragraph above have been recorded, which may be an indication of their scarcity in the study area.

5.2.4 High voltage lines

High voltage lines are an important potential roosting and breeding substrate for large raptors and vultures. Existing high-voltage lines are used extensively by large raptors, especially Martial Eagles, but also Tawny Eagles for breeding purposes (Jenkins *et al.* 2006) while Cape Vultures and White-backed Vultures use them extensively as roosts (Wolter *et al.* 2010 pers. obs). Some of the lines in the Lichtenburg Game Breeding Centre are used extensively by Cape, White-backed and Lappet-faced Vultures which are attracted to the vulture restaurant, for roosting (pers. obs).

See Figure 5 below for the location of boreholes and high voltage lines in the study area, and **APPENDIX 2** for a photographic record of the habitat.

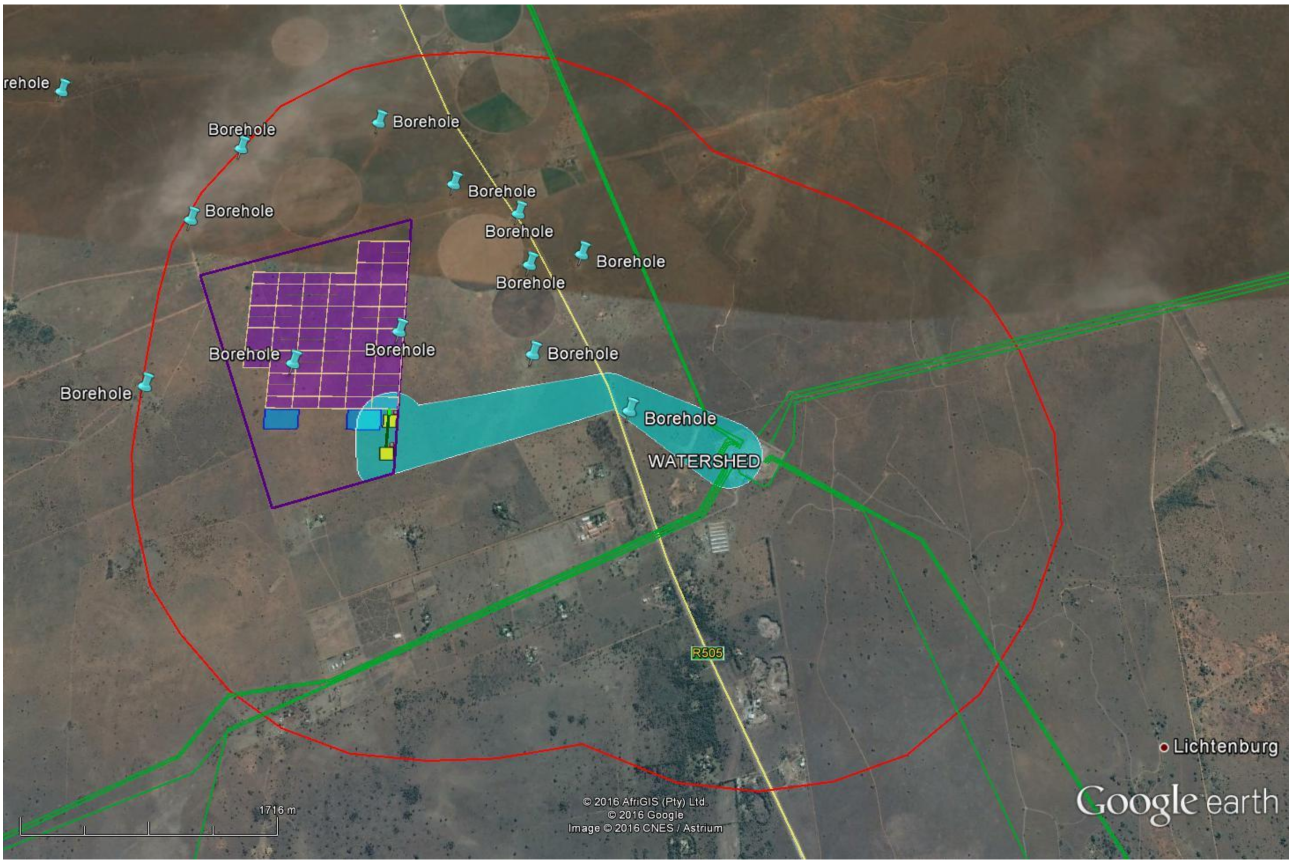

Figure 5: The location of boreholes (blue placemarks) and HV lines (green lines) relative to the study area (red polygon).

5.2.6 Avifauna

An estimated 284 species could potentially occur at the core study area and immediate surroundings (which includes the Lichtenburg Game Breeding Centre and wetland areas south-east of the core study area). Of these, 21 are South African Red Data species, 12 are southern African endemics and 21 are near-endemics. This means that 7.8% of the species that could potentially occur at the core study area and immediate surroundings are Red Data species, and 11.7% are southern African endemics of near-endemics. Southern Africa contains 13 avifaunal endemic regions, namely Western Arid, Woodland, Evergreen Forest, Grassland, Montane, Rocky slopes and cliffs, Fynbos, Marine and Inland Waters (MacLean 1999). Of these regions, Grassland, where the study area is located, contains the fourth highest number of endemics. Overall, the core study area and immediate surroundings potentially contains a total of 33 endemics and near-endemics, which is 20% of the 167 southern African endemics and near-endemics (Hockey *et al.* 2005).

See **APPENDIX 3** for a list of species potentially occurring in the core study area and immediate surroundings. Potential impacts on priority species are listed in Table 1.

Table 1: Priority species potentially occurring at the core study area and immediate surroundings. Red Data species are indicated in red.

EN = Endangered

VU = Vulnerable

NT = Near-threatened

LC = Least concern

End = Southern African Endemic

N-End = Southern African near endemic

Name	Scientific name	National Red Data Status	Global status	Collisions with powerlines	Displacement through disturbance and habitat transformation*
Eagle, Martial	*Polemaetus bellicosus*	EN	VU	x	x
Eagle, Tawny	*Aquila rapax*	EN	LC	x	x
Stork, Yellow-billed	*Mycteria ibis*	EN	LC	x	
Vulture, Cape	*Gyps coprotheres*	EN	VU	x	x
Vulture, Lappet-faced	*Torgos tracheliotus*	EN	VU	x	x
Vulture, White-backed	*Gyps africanus*	EN	VU	x	x
Chat, Ant-eating	*Myrmecocichla formicivora*	End			x
Cliff-swallow, South African	*Hirundo spilodera*	End			x
Flycatcher, Fairy	*Stenostira scita*	End			x
Flycatcher, Fiscal	*Sigelus silens*	End			x
Korhaan, Northern Black	*Afrotis afraoides*	End		x	x
Marsh-harrier, African	*Circus ranivorus*	End		x	
Shelduck, South African	*Tadorna cana*	End		x	
Starling, Pied	*Spreo bicolor*	End			x
Thrush, Karoo	*Turdus smithi*	End			x
White-eye, Cape	*Zosterops virens*	End			x
White-eye, Orange River	*Zosterops pallidus*	End			x
Mousebird, White-backed	*Colius colius*	End			x
Bokmakierie	*Telophorus zeylonus*	N-end			x
Bulbul, African Red-eyed	*Pycnonotus nigricans*	N-end			x
Bunting, Cape	*Emberiza capensis*	N-end			x
Bunting, Lark-like	*Emberiza impetuani*	N-end			x
Canary, Yellow	*Crithagra flaviventris*	N-end			x

Name	Scientific name	National Red Data Status	Global status	Collisions with powerlines	Displacement through disturbance and habitat transformation
Chanting Goshawk, Southern Pale	*Melierax canorus*	N-end		x	x
Clapper-Lark, Eastern	*Mirafra fasciolata*	N-end			x
Finch, Red-headed	*Amadina erythrocephala*	N-end			x
Finch, Scaly-feathered	*Sporopipes squamifrons*	N-end			x
Lark, Eastern Clapper	*Mirafra fasciolata*	N-end			x
Lark, Sabota	*Calendulauda sabota*	N-end			x
Lark, Spike-heeled	*Chersomanes albofasciata*	N-end			x
Penduline – Tit, Cape	*Anthoscopus minutus*	N-end			x
Prinia, Black-chested	*Prinia flavicans*	N-end			x
Sandgrouse, Burchell’s	*Pterocles burchelli*	N-end		x	x
Sandgrouse, Namaqua	*Pterocles namaqua*	N-end		x	x
Scrub-Robin, Kalahari	*Cercotrichas paena*	N-end			x
Shrike, Crimson-breasted	*Laniarius atrococcineus*	N-end			x
Sparrow, Cape	*Passer melanurus*	N-end			x
Sparrowlark, Grey-backed	*Eremopterix verticalis*	N-end			x
Wheatear, Mountain	*Oenanthe monticola*	N-end			x
Bustard, Kori	*Ardeotis kori*	NT	NT	x	x
Courser, Double-banded	*Rhinoptilus africanus*	NT	LC	x	x
Crane, Blue	*Anthropoides paradiseus*	NT	VU	x	x
Falcon, Red-footed	*Falco vespertinus*	NT	NT		
Flamingo, Greater	*Phoenicopterus ruber*	NT	NT	x	
Flamingo, Lesser	*Phoenicopterus minor*	NT	NT	x	
Pratincole, Black-winged	*Glareola nordmanni*	NT	NT		x
Roller, European	*Coracias garrulus*	NT	NT		x
Stork, Abdim's	*Ciconia abdimii*	NT	LC	x	
Stork, Marabou	*Leptoptilos crumeniferus*	NT	LC	x	
Falcon, Lanner	*Falco biarmicus*	VU	LC	x	
Painted-snipe, Greater	*Rostratula benghalensis*	VU	LC		
Pelican, Great White	*Pelecanus onocrotalus*	VU	LC	x	
Secretarybird	*Sagittarius serpentarius*	VU	VU	x	x
Stork, Black	*Ciconia nigra*	VU	LC	x	

6. DESCRIPTION OF EXPECTED IMPACTS

Because of their size and prominence, electrical infrastructures constitute 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). Habitat destruction and disturbance associated with the construction of power lines and other electricity infrastructure (e.g. substations) also constitute an impact on avifauna.

6.1 Electrocutions

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 electrocution risk is largely determined by the pole/tower design. The tower design that has been proposed for this project is the steel monopole (see **APPENDIX 4**).

Clearance between phases on the same side of the 132kV pole structure is approximately 2.2m for this type of design, 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 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.

It is likely that Cape Vultures, White-backed Vultures and Lappet-faced Vultures could forage in the study area where the power lines are proposed, given the close proximity of the vulture restaurant at the Lichtenburg Game Breeding Centre where up to 80 vultures have been observed in the course of the pre-construction monitoring. In addition, there are plenty of livestock in the surrounding area, and should a carcass be available to the birds, they might attempt to roost on the poles. The pole design holds no inherent electrocution risk for other large solitary species such as eagles that could potentially occur in the study area, as they almost never perch together in large numbers next to each other.

Electrocutions at the proposed Tlisitseng 1 substation yard is possible, but should not affect the more sensitive Red List bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting.

6.2 Collisions

Collisions are probably the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). 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 power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

In a recent PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with power 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 1994).

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)."

As mentioned by Shaw (2013) in the extract above, several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. 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.

Thus visual field topographies which have evolved primarily to meet visual challenges associated with foraging may render certain bird species particularly vulnerable to collisions with human artefacts, such as power lines and wind turbines that extend into the otherwise open airspace above their preferred habitats. For these species placing devices upon power lines to render them more visible may have limited success since no matter what the device the birds may not see them. It may be that in certain situations it may be necessary to distract birds away from the obstacles, or encourage them to land nearby (for example by the use of decoy models of conspecifics, or the provision of sites attractive for roosting) since increased marking of the obstacle cannot be guaranteed to render it visible if the visual field configuration prevents it being detected. Perhaps most importantly, the results indicate that collision mitigation may need to vary substantially for different collision prone species, taking account of species specific behaviours, habitat and foraging preferences, since an effective all-purpose marking device is probably not realistic if some birds do not see the obstacle at all (Martin & Shaw 2010).

Despite speculation that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos *et al.* 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Hoogstad 2015 pers.comm ; Sporer et al. 2013; Barrientos *et al.* 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos *et al.* 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A recent study 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 in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos *et al.* 2011). Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. 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).

A potential impact of the proposed Tlisitseng Solar 1 132kV grid connection is collisions with the earth wire of the proposed line. 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 6 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.

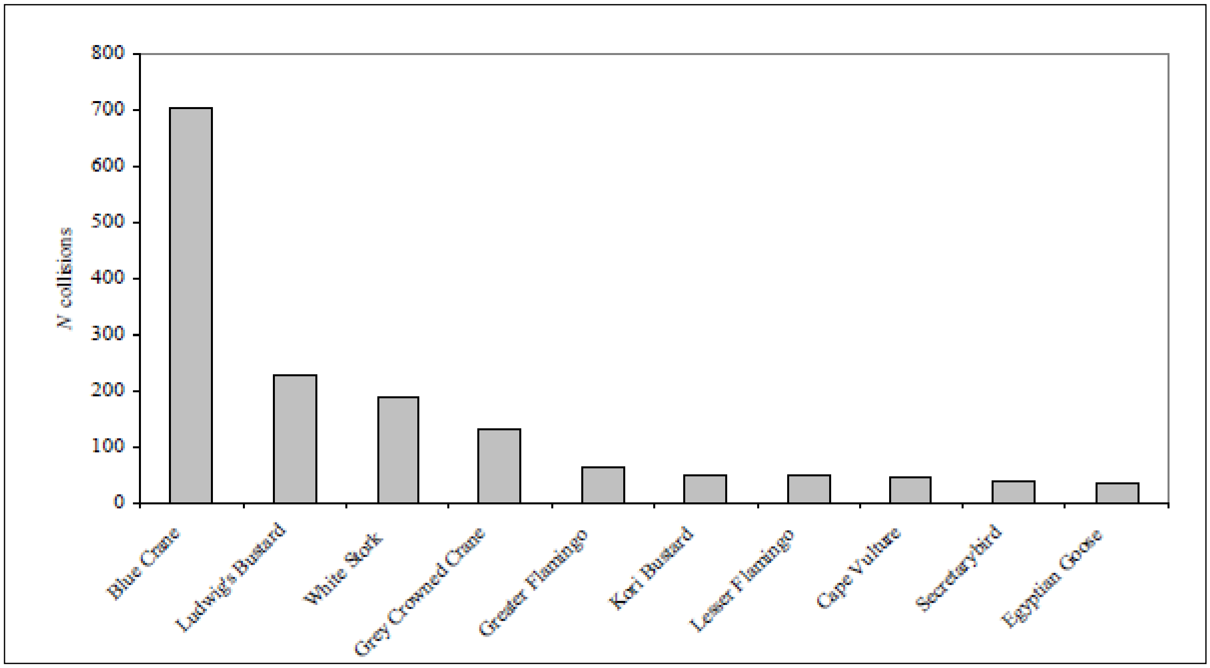

Figure 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

Priority species other than waterbirds that could potentially be at risk of the collisions with the earth wire of the proposed 132kV grid connection include Cape Vulture, White-backed Vulture, Lappet-faced Vulture, Tawny Eagle, Kori Bustard, Martial Eagle, Marabou Stork, Northern Black Korhaan, Namaqua Sandgrouse, Burchell's Sandgrouse, Blue Crane, Abdim's Stork, Double-banded Courser and Secretarybird. The proposed alignment is not situated in any obvious flight path or close to any major focal point of bird activity. There is one borehole within the corridor but it is unlikely to be a major attraction for larger, collision-prone species as it is situated directly next to the R505 which is a busy tar road. The only real risk of vulture collisions would be if a carcass becomes available within a few hundred metres from the power line and the birds descend rapidly. In such an instance the birds are focused on the carcass and in the process may be less attuned to obstacles like power lines. However, such a scenario would be exceptional, as the birds habitually feed at the vulture restaurant. In general therefore it is expected that collisions are likely to be a fairly rare event and of a random spatial and temporal nature.

If the "lake effect" draws in priority waterbirds, South African Shelduck, Maccoa Duck, Greater Flamingo, Lesser Flamingo, Great White Pelican, Black Stork and Yellow-billed Stork could potentially be at risk, as well as sandgrouse. The extent to which this may be possible is impossible to gauge at this stage, as very little data is available on the phenomenon world-wide (Kagan *et al.* 2012), which means any finding in this respect is inevitably speculative at this stage. The presence of the wetlands south of the study area means that periodic influxes of waterbirds are possible in the greater study area, which may heighten the risk of collisions. This necessitates the application of the pre-cautionary principle on the assumption that there is a possible collision risk associated with the "lake effect".

6.3 Displacement due to habitat transformation and disturbance associated with the construction of the 132kV grid connection and Tlisitseng substation

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. As a rule, 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 could 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.

Apart from direct habitat destruction, the above mentioned construction and maintenance activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests.

In the present instance, the construction of the 132kV power line is likely to have a limited transformation impact on the habitat, due to the nature of the vegetation. It is envisaged that very little vegetation clearing will have to be performed. The footprint of the power line is limited and it will not have a major displacement impact on priority species. As far as disturbance is concerned, this should be a temporary impact and very site specific. The vultures roosting on the HV lines in the Lichtenburg Game Breeding Centre should not be at risk of displacement as the construction activities would take place at least 1.5km away from the closest roosting vultures (pers. obs).

It is also not envisaged that significant numbers of priority species will be permanently displaced from the study area by the habitat transformation and disturbance that will take place at any of the two proposed the sites for the Tlisitseng substation. The two substation alternatives are not located near to any sensitive focal points of bird activity, nor is the habitat particularly sensitive (disturbed grassland). The priority species that will be directly affected by the loss of habitat are the birds breeding and foraging in the area that will be taken up by the substation. These are likely to be made up of smaller, non-Red List passerine species.

In summary, the combined disturbance and habitat transformation impact of the Tlisitseng Solar 1 substation and 132kV grid connection should not materially threaten the local or regional populations of any priority species, due to the relatively small size of the development footprint and the temporary nature of the disturbance associated with the construction of the infrastructure. It should however be noted that the impacts of the electricity infrastructure should not be viewed in isolation, but in conjunction with the proposed PV development. The combined, cumulative impact of the PV development and the associated electricity infrastructure is more significant, and any future assessment should take cognisance of that.

7. IMPACT TABLES

The EIA 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.

7.1 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 shown in the table below.

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.

7.2 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:

- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact has been 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:

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 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. While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or significant) in the same geographical area, and occurring at the same time, result in a cumulative impact that is collectively significant.		
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.

7.3 Impact Assessments

7.3.1 Construction Phase

CONSTRUCTION: 132KV POWER LINE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the 132kV power line.*
Extent	*Site = 1 The displacement impact should only affect priority species at a site level*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 Once the construction activity ceases, the source of displacement will be removed and the priority species should be able to utilise the habitat again.*
Irreplaceable loss of resources	*Marginal loss of resources = 2 It should only affect small, non-threatened species.*
Duration	*Short term = 2 the impact and its effects will last for a relatively short construction period and a limited recovery time after construction, thereafter it will be largely negated.*
Cumulative effect	*High = 4 The cumulative displacement effect of the power line in combination with substation and PV arrays will be high within the study area.*
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*
Significance Rating	*14 x 2 = 28 Negative low impact*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-26 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

CONSTRUCTION: TLISITSENG SOLAR 1 SUBSTATION ALT 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the substation.*
Extent	*Site = 1 The displacement impact will be restricted to the site.*
Probability	*Possible = 3 The impact will possibly occur.*
Reversibility	*Irreversible = 4 The impact will not be reversible*
Irreplaceable loss of resources	*Marginal loss of resources = 2 The impact on priority species will result in a marginal loss of resources at a site level*
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*
Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with power line and PV arrays will be high within the study area.*

Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*17 x 1 = 17* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-16 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	
CONSTRUCTION: TLISITSENG SOLAR 1 SUBSTATION ALT 2		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the substation.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Possible = 3 The impact will possibly occur.*	
Reversibility	*Irreversible = 4 The impact will not be reversible*	
Irreplaceable loss of resources	*Marginal loss of resources = 2The impact on priority species will result in a marginal loss of resources at a site level*	
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*	

Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with the power line and PV arrays will be high within the study area.*	
Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*17 x 1 = 17* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-16 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

7.3.2 *Operational Phase*

OPERATION: COLLISIONS WITH THE 132KV POWER LINE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Collisions of priority species with the proposed 132kV line.*
Extent	*Regional = 3 The collision mortality may affect local populations of some highly mobile priority species e.g. Greater Flamingo.*
Probability	*Probable = 3 The impact will likely occur.*

Reversibility	*Partly reversible = 2 mitigation will reduce the impact but not eliminate it.*
Irreplaceable loss of resources	*Significant loss of resources = 3.*
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*
Cumulative effect	*Medium = 3 The cumulative effect of the collision mortality on the power line in combination with the substation and PV arrays will be medium within the study area.*
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*
Significance Rating	*17 x 2 = 34* *Negative medium impact*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-34 (medium negative)	-28 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *The line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, 5m apart, alternating black and white. See* ***APPENDIX 4*** *for the type of BFD which is recommended.*	

OPERATION: ELECTROCUTION ON THE 132KV POWER LINE AND SUBSTATION	
Environmental Parameter	*Avifauna*

Issue/Impact/Environmental Effect/Nature	*Electrocutions of priority species on the proposed 132kV line and in the substation.*	
Extent	*Regional = 3 The electrocution mortality may affect local populations of some highly mobile priority species e.g. Cape Vulture.*	
Probability	*Possible = 2 The impact may occur.*	
Reversibility	*Completely reversible = 1 the impact can be reversed with mitigation.*	
Irreplaceable loss of resources	*Significant loss of resources = 3.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*Medium = 3 The cumulative effect of the electrocution mortality on the power line in combination with the displacement impact of PV arrays and the collision and electrocution mortality on the existing power lines will be medium within the study area.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*15 x 2 = 30* *Negative medium impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	2
Probability	2	1
Reversibility	1	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-24 (low negative)
Mitigation measures	• *An Eskom approved bird friendly pole design must be used (**APPENDIX 5**) incorporating a bird perch, to provide safe perching substrate for birds well above the dangerous hardware.* • *Substation hardware is often too complex for blanket, pro-active mitigation. It is rather recommended that if on-going impacts are recorded once operational, site specific mitigation be applied reactively. This is an acceptable approach since Red List bird species are unlikely to frequent the substation and be electrocuted.*	

7.3.3 De-commissioning Phase

DE-COMMISSIONING: 132KV POWER LINE		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line.*	
Extent	*Site = 1 The displacement impact should only affect priority species at a site level*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 Once the de-commissioning activity ceases, the source of displacement will be removed and the priority species should be able to utilise the habitat again.*	
Irreplaceable loss of resources	*Marginal loss of resources = 2 It should only affect small, non-threatened species.*	
Duration	*Short term = 2 the impact and its effects will last for the period of a relatively short de-commissioning period and a limited recovery time after de-commissioning, thereafter it will be largely negated.*	
Cumulative effect	*High = 4 The cumulative displacement effect of the power line in combination with the substation and PV arrays will be high within the study area.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*14 x 2 = 28 Negative low impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-26 (low negative)

Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*

DECOMMISIONING: TLISITSENG SOLAR 1 SUBSTATION		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the substation.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Probable = 3 The impact will possibly occur.*	
Reversibility	*Reversible = 1 Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources = 2The impact on priority species will result in a marginal loss of resources at a site level*	
Duration	*Short term = 2 the impact and its effects will last for the period of a relatively short de-commissioning period and a limited recovery time after de-commissioning, thereafter it will be largely negated.*	
Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with the power line and PV arrays will be high within the study area.*	
Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*12 x 1 = 12* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2

Reversibility	1	1
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-13 (low negative)	-12 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

7.4 Impact Summary

The impacts were summarised and a comparison made between pre and post mitigation phases as shown in Table 2 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity was averaged. A comparison was then made to determine the effectiveness of the proposed mitigation measures. The comparison identified critical issues related to the environmental parameters. Both substation alternatives have identical ratings (see table 3).

Table 2: Comparison of summarised impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Rating post mitigation
Avifauna	Displacement by power line construction	-28 (low negative)	-26 (low negative
	Displacement by the substation construction	-17 (low negative)	-16 (low negative)
	Collisions with powerline	-34 (medium negative)	-28 (low negative)
	Displacement by power line de-commissioning	-28 (low negative)	-26 (low negative)
	Displacement by the substation de-commissioning	-13 (low negative)	-12 (low negative)
	Average	**23.6 (low negative)**	**21.6 (low negative)**

The 2010 EIA regulations also specify that alternatives must be compared in terms of impact assessment.

Table 3 below sets out the comparative assessment of the various alternatives.

Table 3: Comparison of alternatives

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

Comparative Assessment of Alternatives – Tlisitseng 1 Grid

Alternative	Preference	Reasons
SUBSTATION		
Alternative 1	No preference	The alternative will result in equal impacts
Alternative 2	No preference	The alternative will result in equal impacts

8. CUMULATIVE IMPACTS

The renewable energy developments which are proposed within a 25km radius around the site are listed in Table 4 below (see also Figure 7):

Table 3: Renewable energy developments proposed within a 25km radius from the Tlisitseng Solar 1 PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Matrigenix Renewable Energy Project	14/12/16/3/3/3 /270	Scoping and EIA processes underway	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands 27
Watershed Solar Energy Facility	14/12/16/3/3/2 /557	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2 /1062	Project has received environmental authorisation	South Africa Mainstream Renewable Power Developments (Pty) Ltd	**UNKNOWN**	Portions 9 and 31 of the Farm Hibernia 52

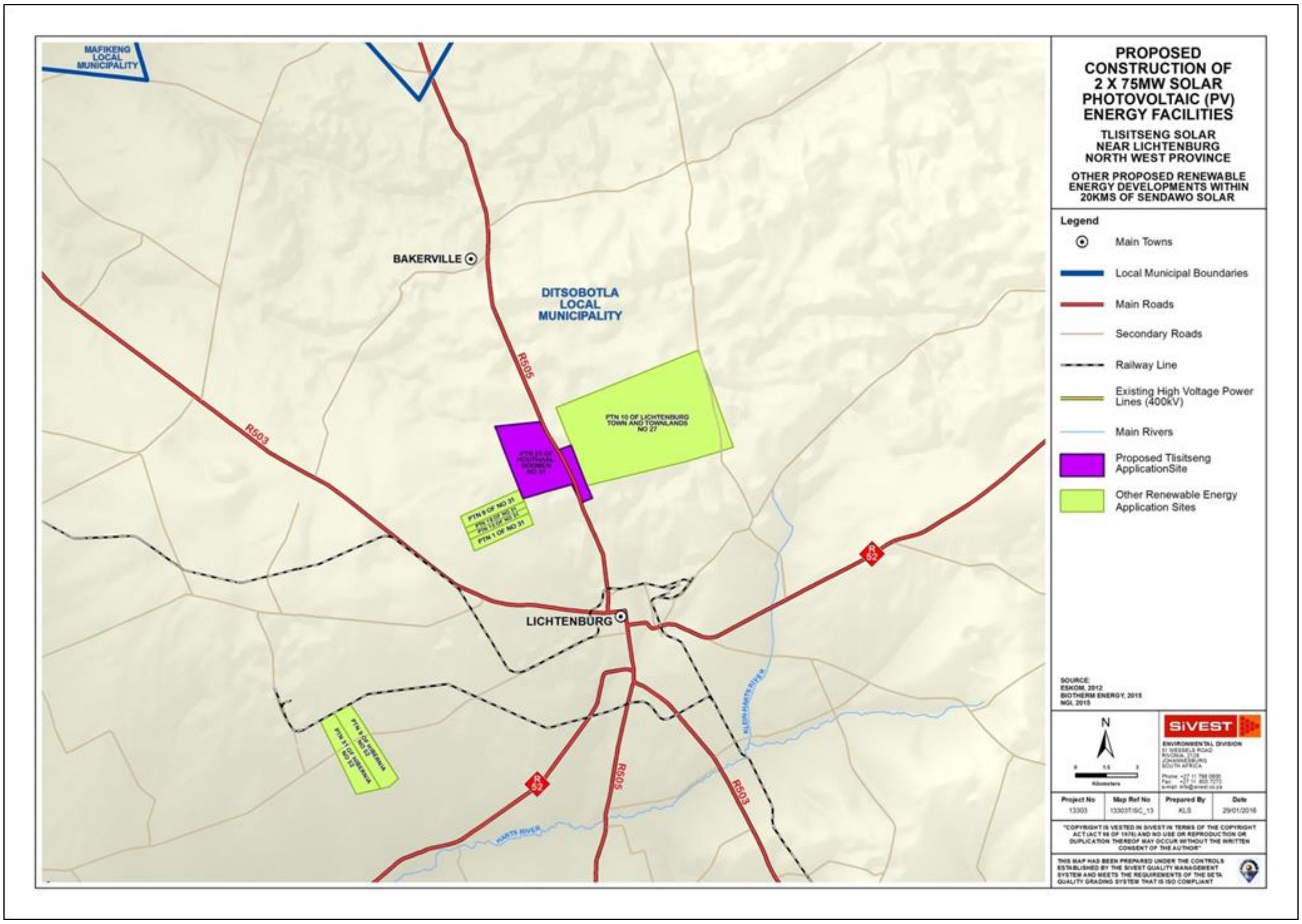

Figure 7: Renewable energy developments proposed within a 25km radius from the proposed Tlisitseng Solar 1 PV application site

The total surface area in a 25km radius around the proposed development amounts to approximately 194 874ha. The combined area taken up by the proposed renewable energy developments, including the Tlisitseng Solar 1 PV 1 and 2 projects, amounts to approximately 11 980ha. This is approximately 6% of the total amount of habitat available within the 25km radius. The existing high voltage lines within a 25km radius run into hundreds of kilometres, and will increase slightly by about 3.2km if the proposed 132kV grid connection is added. There are definitely problems with vulture mortality within the Lichtenburg Game Breeding Centre, at least five White-backed Vultures were killed by power lines in the reserve since January 2016.[1] If all the proposed renewable energy projects are actually constructed, it will significantly increase the total length of high voltage lines within the 25km radius. The potential cumulative impact of displacement and especially direct mortality of priority species linked to the proposed 132kV grid connection, in combination with the existing and planned power line network in this area, is therefore rated as **medium- high** within a 25km radius, on the assumption that all the projects which are currently proposed within this radius are actually constructed.

[1] This information was provided in February 2016 by the reserve manager Mr. Neels Lourens, to Mr. Kevin Lavery, the field worker who is doing the per-construction monitoring at the proposed Tlisitseng PV sites.

9. SENSITIVITY MAP

The core study area is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring in the study area, the study area should be regarded as moderately sensitive from an avifaunal perspective. Within the study area and immediately beyond it, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. Figure 8 below indicates areas of high sensitivity. It is important to note that the sensitivity of the study area could be influenced by the PV development itself, in that the construction of the solar panels could result in the relocation of boreholes from the study area. The sensitivity map in Figure 8 does not take into account the potential removal of the boreholes.

10. CONCLUSIONS

The proposed BioTherm Tlisitseng Solar 1 PV1 132kV grid connection is located in the Grassland endemic avifaunal region with the fourth highest number of avifaunal endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. Within the core study area, high sensitive areas are surface water (boreholes) and a short section of high voltage lines which is used for roosting by Cape Vultures and White-backed Vultures. Within the immediate surroundings beyond the core study area, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. The wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be removed and therefore cease to function as potential focal points for bird activity after the construction of the solar panels.

Potential pre-mitigation impacts on priority avifauna range from medium negative to low negative. All impacts could be reduced to low negative with the implementation of appropriate mitigation. No clear preferred alternative emerged as far as the proposed substation sites are concerned, as both sites are located in the same habitat. No fatal flaws were identified in the course of investigations from an avifaunal perspective, and the proposed development could therefore be authorised, provided all proposed mitigation measures are implemented.

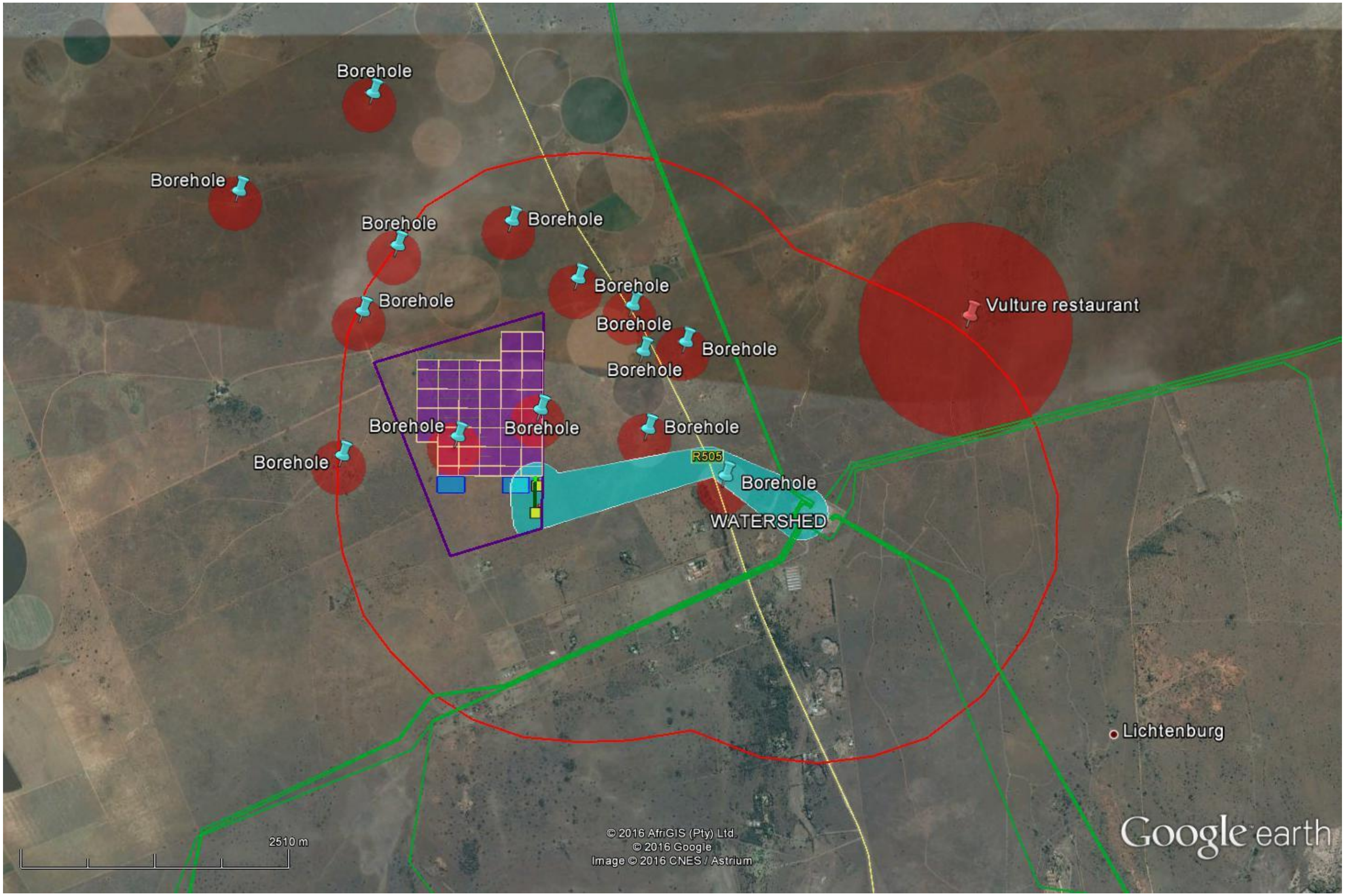

Figure 8: Sensitivity map of the study area. Red areas indicate high sensitivity.

11. RECOMMENDATIONS

See impact tables above under Section 7.

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APPENDIX 1 PRE-CONSTRUCTION MONITORING

BIRD MONITORING AT TLISITSENG SOLAR ENERGY FACILITIES

1. Objectives

The objective of the pre-construction monitoring at the proposed Tlisitseng Solar Facilities was to gather baseline data over a period of six months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the solar farm sites to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the solar farm sites to measure the potential impact on flight activity of the solar farm.

2. Methods

The monitoring protocol for the site is designed according to the draft version (November 2015) of Birdlife South Africa *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins et.al).*

Monitoring surveys were conducted at the proposed PV sites by one field monitor during November 2015, January 2016 and February 2016.

Monitoring was conducted in the following manner:

- Two walk transects of 1km each were identified at the PV sites and counted 8 times per sampling session. All birds were 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 (calm; moderate; strong);
    - 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).

- One vantage point (VP) was identified to record the flight altitude and patterns of priority species. A total of 12 hours per sampling session was spent doing vantage point watches. 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. >200m; medium i.e. 20m – 200m; low i.e. <20m);
  - Flight mode (soar; flap; glide; kite; hover); and
  - Flight time (in 15 second-intervals).

The objective of the transect monitoring was to gather baseline data on the use of the site 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 PV arrays, and to see how flight behaviour is influenced by the PV arrays. Waterbirds, raptors, South African Red Data species and Southern African endemics and near-endemics were classified as priority species.

No potential focal point of bird activity was identified at the proposed site itself. The closest potential focal point of bird activity is the vulture restaurant in the former Lichtenburg Game Breeding Centre which is located adjacent to the proposed development approximately 2.2km from the eastern boundary.

All incidental sightings of priority species at the core study area and immediate surroundings were also recorded.

Figure 1 below indicates the area where monitoring was performed. Appendix 3 indicates all avifaunal species recorded during the pre-construction monitoring.

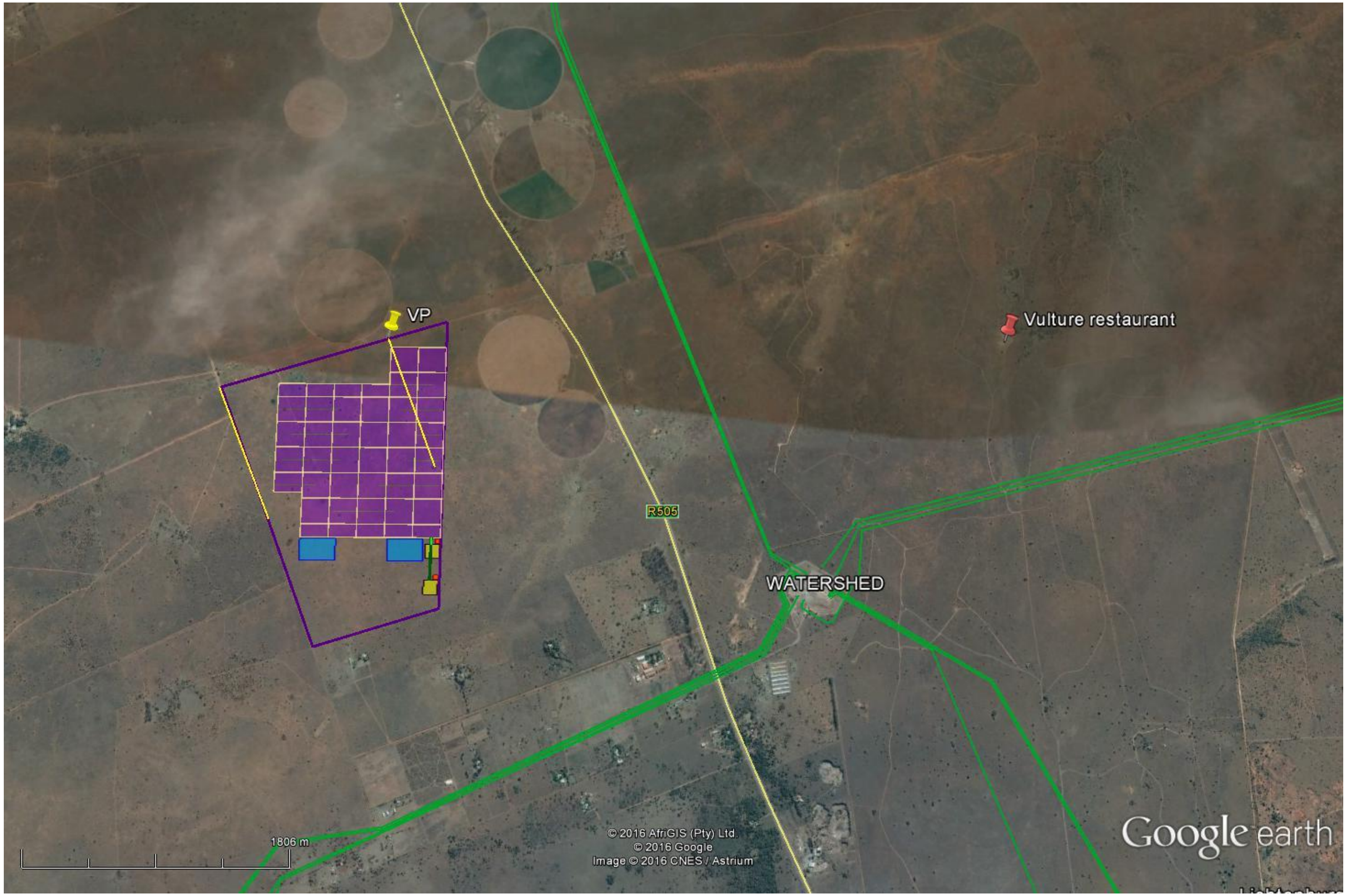


Figure 1: Area where monitoring was performed, with position of VP (yellow placemark), focal point (red placemark) and walk transects (yellow lines).

APPENDIX 2 BIRD HABITATS

Figure 1: Typical grassland habitat in the study area (Carltonville Dolomite Grassland)

Figure 2: Irrigated lands in the study area

Figure 3: The vulture restaurant in the Lichtenburg Game Breeding Centre with the Watershed MTS in the background.

Figure 4: Existing high voltage lines in the study area.

APPENDIX 3: SPECIES THAT COULD POTENTIALLY OCCUR AT THE CORE STUDY AREA AND IMMEDIATE SURROUNDINGS (priority species highlighted in yellow)

Species	Scientific name
Babbler, Southern Pied	*Turdoides bicolor*
Barbet, Acacia Pied	*Tricholaema leucomelas*
Barbet, Black-collared	*Lybius torquatus*
Barbet, Crested	*Trachyphonus vaillantii*
Batis, Pririt	*Batis pririt*
Bee-eater, European	*Merops apiaster*
Bee-eater, Little	*Merops pusillus*
Bee-eater, Swallow-tailed	*Merops hirundineus*
Bishop, Southern Red	*Euplectes orix*
Bishop, Yellow-crowned	*Euplectes afer*
Bokmakierie	*Telophorus zeylonus*
Brubru	*Nilaus afer*
Bulbul, African Red-eyed	*Pycnonotus nigricans*
Bunting, Cinnamon-breasted	*Emberiza tahapisi*
Bunting, Golden-breasted	*Emberiza flaviventris*
Bunting, Lark-like	*Emberiza impetuani*
Bustard, Kori	*Ardeotis kori*
Buzzard, Steppe	*Buteo vulpinus*
Canary, Black-throated	*Crithagra atrogularis*
Canary, Yellow	*Crithagra flaviventris*
Chat, Anteating	*Myrmecocichla formicivora*
Chat, Familiar	*Cercomela familiaris*
Cisticola, Desert	*Cisticola aridulus*
Cisticola, Levaillant's	*Cisticola tinniens*
Cisticola, Rattling	*Cisticola chiniana*
Cisticola, Zitting	*Cisticola juncidis*
Cliff-swallow, South African	*Hirundo spilodera*
Coot, Red-knobbed	*Fulica cristata*
Cormorant, Reed	*Phalacrocorax africanus*
Cormorant, White-breasted	*Phalacrocorax carbo*
Coucal, Burchell's	*Centropus burchellii*
Courser, Burchell's	*Cursorius rufus*
Courser, Double-banded	*Rhinoptilus africanus*
Crake, Black	*Amaurornis flavirostris*
Crombec, Long-billed	*Sylvietta rufescens*
Crow, Pied	*Corvus albus*
Cuckoo, Diderick	*Chrysococcyx caprius*
Cuckoo, Jacobin	*Clamator jacobinus*
Cuckoo, Klaas's	*Chrysococcyx klaas*
Darter, African	*Anhinga rufa*
Dove, Laughing	*Streptopelia senegalensis*
Dove, Namaqua	*Oena capensis*

Dove, Red-eyed	*Streptopelia semitorquata*
Dove, Rock	*Columba livia*
Drongo, Fork-tailed	*Dicrurus adsimilis*
Duck, African Black	*Anas sparsa*
Duck, Comb	*Sarkidiornis melanotos*
Duck, Maccoa	*Oxyura maccoa*
Duck, Mallard	*Anas platyrhynchos*
Duck, White-faced	*Dendrocygna viduata*
Duck, Yellow-billed	*Anas undulata*
Eagle, Martial	*Polemaetus bellicosus*
Eagle-owl, Spotted	*Bubo africanus*
Egret, Cattle	*Bubulcus ibis*
Egret, Great	*Egretta alba*
Egret, Little	*Egretta garzetta*
Egret, Yellow-billed	*Egretta intermedia*
Eremomela, Yellow-bellied	*Eremomela icteropygialis*
Falcon, Amur	*Falco amurensis*
Finch, Red-headed	*Amadina erythrocephala*
Finch, Scaly-feathered	*Sporopipes squamifrons*
Firefinch, Red-billed	*Lagonosticta senegala*
Fiscal, Common (Southern)	*Lanius collaris*
Fish-eagle, African	*Haliaeetus vocifer*
Flycatcher, Chat	*Bradornis infuscatus*
Flycatcher, Fairy	*Stenostira scita*
Flycatcher, Fiscal	*Sigelus silens*
Flycatcher, Marico	*Bradornis mariquensis*
Flycatcher, Spotted	*Muscicapa striata*
Francolin, Orange River	*Scleroptila levaillantoides*
Goose, Egyptian	*Alopochen aegyptiacus*
Goose, Spur-winged	*Plectropterus gambensis*
Goshawk, Gabar	*Melierax gabar*
Goshawk, Southern Pale Chanting	*Melierax canorus*
Grebe, Great Crested	*Podiceps cristatus*
Grebe, Little	*Tachybaptus ruficollis*
Guineafowl, Helmeted	*Numida meleagris*
Hamerkop	*Scopus umbretta*
Harrier-Hawk, African	*Polyboroides typus*
Heron, Black-headed	*Ardea melanocephala*
Heron, Green-backed	*Butorides striata*
Heron, Grey	*Ardea cinerea*
Heron, Purple	*Ardea purpurea*
Honeyguide, Greater	*Indicator indicator*
Honeyguide, Lesser	*Indicator minor*
Hoopoe, African	*Upupa africana*
Hornbill, African Grey	*Tockus nasutus*
Hornbill, Southern Yellow-billed	*Tockus leucomelas*

Ibis, African Sacred	*Threskiornis aethiopicus*
Ibis, Glossy	*Plegadis falcinellus*
Ibis, Hadeda	*Bostrychia hagedash*
Indigobird, Village	*Vidua chalybeata*
Kestrel, Greater	*Falco rupicoloides*
Kestrel, Lesser	*Falco naumanni*
Kestrel, Rock	*Falco rupicolus*
Kingfisher, Brown-hooded	*Halcyon albiventris*
Kingfisher, Giant	*Megaceryle maximus*
Kingfisher, Malachite	*Alcedo cristata*
Kingfisher, Pied	*Ceryle rudis*
Kite, Black-shouldered	*Elanus caeruleus*
Kite, Yellow-billed	*Milvus aegyptius*
Korhaan, Northern Black	*Afrotis afraoides*
Korhaan, Red-crested	*Lophotis ruficrista*
Lapwing, Blacksmith	*Vanellus armatus*
Lapwing, Crowned	*Vanellus coronatus*
Lark, Eastern Clapper	*Mirafra fasciolata*
Lark, Fawn-coloured	*Calendulauda africanoides*
Lark, Red-capped	*Calandrella cinerea*
Lark, Rufous-naped	*Mirafra africana*
Lark, Sabota	*Calendulauda sabota*
Lark, Spike-heeled	*Chersomanes albofasciata*
Longclaw, Cape	*Macronyx capensis*
Mannikin, Bronze	*Spermestes cucullatus*
Martin, Brown-throated	*Riparia paludicola*
Martin, Rock	*Hirundo fuligula*
Moorhen, Common	*Gallinula chloropus*
Mousebird, Red-faced	*Urocolius indicus*
Mousebird, White-backed	*Colius colius*
Myna, Common	*Acridotheres tristis*
Neddicky	*Cisticola fulvicapilla*
Night-Heron, Black-crowned	*Nycticorax nycticorax*
Ostrich, Common	*Struthio camelus*
Owl, Barn	*Tyto alba*
Owl, Marsh	*Asio capensis*
Owlet, Pearl-spotted	*Glaucidium perlatum*
Palm-swift, African	*Cypsiurus parvus*
Paradise-flycatcher, African	*Terpsiphone viridis*
Paradise-whydah, Long-tailed	*Vidua paradisaea*
Penduline-tit, Cape	*Anthoscopus minutus*
Pigeon, Speckled	*Columba guinea*
Pipit, African	*Anthus cinnamomeus*
Pipit, Buffy	*Anthus vaalensis*
Pipit, Plain-backed	*Anthus leucophrys*
Plover, Kittlitz's	*Charadrius pecuarius*

Plover, Three-banded	*Charadrius tricollaris*
Pochard, Southern	*Netta erythrophthalma*
Prinia, Black-chested	*Prinia flavicans*
Pytilia, Green-winged	*Pytilia melba*
Quail, Common	*Coturnix coturnix*
Quailfinch, African	*Ortygospiza atricollis*
Quelea, Red-billed	*Quelea quelea*
Reed-warbler, Great	*Acrocephalus arundinaceus*
Robin-chat, Cape	*Cossypha caffra*
Roller, European	*Coracias garrulus*
Roller, Lilac-breasted	*Coracias caudatus*
Roller, Purple	*Coracias naevius*
Ruff	*Philomachus pugnax*
Sandgrouse, Burchell's	*Pterocles burchelli*
Sandgrouse, Namaqua	*Pterocles namaqua*
Sandpiper, Common	*Actitis hypoleucos*
Sandpiper, Curlew	*Calidris ferruginea*
Sandpiper, Marsh	*Tringa stagnatilis*
Sandpiper, Wood	*Tringa glareola*
Scimitarbill, Common	*Rhinopomastus cyanomelas*
Scrub-robin, Kalahari	*Cercotrichas paena*
Secretarybird	*Sagittarius serpentarius*
Shelduck, South African	*Tadorna cana*
Shrike, Crimson-breasted	*Laniarius atrococcineus*
Shrike, Lesser Grey	*Lanius minor*
Shrike, Red-backed	*Lanius collurio*
Snake-eagle, Black-chested	*Circaetus pectoralis*
Snake-eagle, Brown	*Circaetus cinereus*
Snipe, African	*Gallinago nigripennis*
Sparrow, Cape	*Passer melanurus*
Sparrow, Great	*Passer motitensis*
Sparrow, House	*Passer domesticus*
Sparrow, Southern Grey-headed	*Passer diffusus*
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*
Sparrowlark, Grey-backed	*Eremopterix verticalis*
Sparrow-weaver, White-browed	*Plocepasser mahali*
Spoonbill, African	*Platalea alba*
Spurfowl, Swainson's	*Pternistis swainsonii*
Starling, Burchell's	*Lamprotornis australis*
Starling, Cape Glossy	*Lamprotornis nitens*
Starling, Wattled	*Creatophora cinerea*
Stilt, Black-winged	*Himantopus himantopus*
Stint, Little	*Calidris minuta*
Stonechat, African	*Saxicola torquatus*
Stork, Abdim's	*Ciconia abdimii*
Stork, Black	*Ciconia nigra*

Sunbird, Marico	*Cinnyris mariquensis*
Sunbird, White-bellied	*Cinnyris talatala*
Swallow, Barn	*Hirundo rustica*
Swallow, Greater Striped	*Hirundo cucullata*
Swallow, Red-breasted	*Hirundo semirufa*
Swallow, White-throated	*Hirundo albigularis*
Swamphen, African Purple	*Porphyrio madagascariensis*
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*
Swift, African Black	*Apus barbatus*
Swift, Bradfield's	*Apus bradfieldi*
Swift, Little	*Apus affinis*
Swift, White-rumped	*Apus caffer*
Tchagra, Brown-crowned	*Tchagra australis*
Teal, Cape	*Anas capensis*
Teal, Red-billed	*Anas erythrorhyncha*
Thick-knee, Spotted	*Burhinus capensis*
Thrush, Groundscraper	*Psophocichla litsipsirupa*
Thrush, Karoo	*Turdus smithi*
Thrush, Olive	*Turdus olivaceus*
Tit, Ashy	*Parus cinerascens*
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*
Turtle-dove, Cape	*Streptopelia capicola*
Wagtail, Cape	*Motacilla capensis*
Warbler, Willow	*Phylloscopus trochilus*
Waxbill, Black-faced	*Estrilda erythronotos*
Waxbill, Blue	*Uraeginthus angolensis*
Waxbill, Common	*Estrilda astrild*
Waxbill, Violet-eared	*Granatina granatina*
Weaver, Sociable	*Philetairus socius*
Wheatear, Capped	*Oenanthe pileata*
White-eye, Cape	*Zosterops virens*
White-eye, Orange River	*Zosterops pallidus*
Whydah, Pin-tailed	*Vidua macroura*
Whydah, Shaft-tailed	*Vidua regia*
Widowbird, Long-tailed	*Euplectes progne*
Wood-hoopoe, Green	*Phoeniculus purpureus*
Woodpecker, Cardinal	*Dendropicos fuscescens*
Woodpecker, Golden-tailed	*Campethera abingoni*
Wren-warbler, Barred	*Calamonastes fasciolatus*

APPENDIX 4 BIRD FLIGHT DIVERTERS

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.

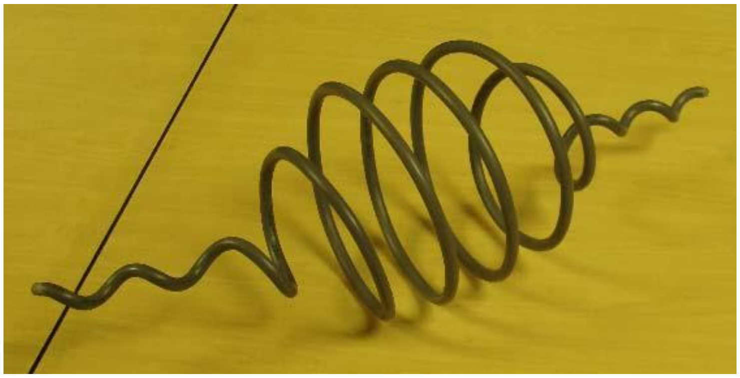
Contact Roger Martin: EBM Tel 011 288 0000

Eskom Distribution

DISTRIBUTION TECHNOLOGY (FAX 011-871-2352)
PRIVATE BAG X1074
GERMISTON 1400

2

2) Tyco Flight Diverter.



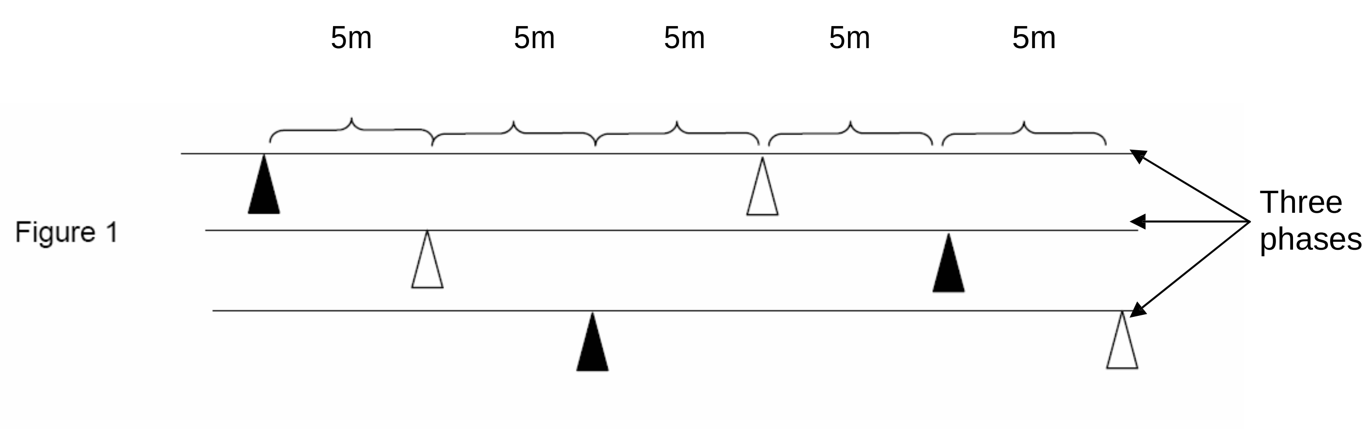
<u>Buyers guide number DDT 3107</u>

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,



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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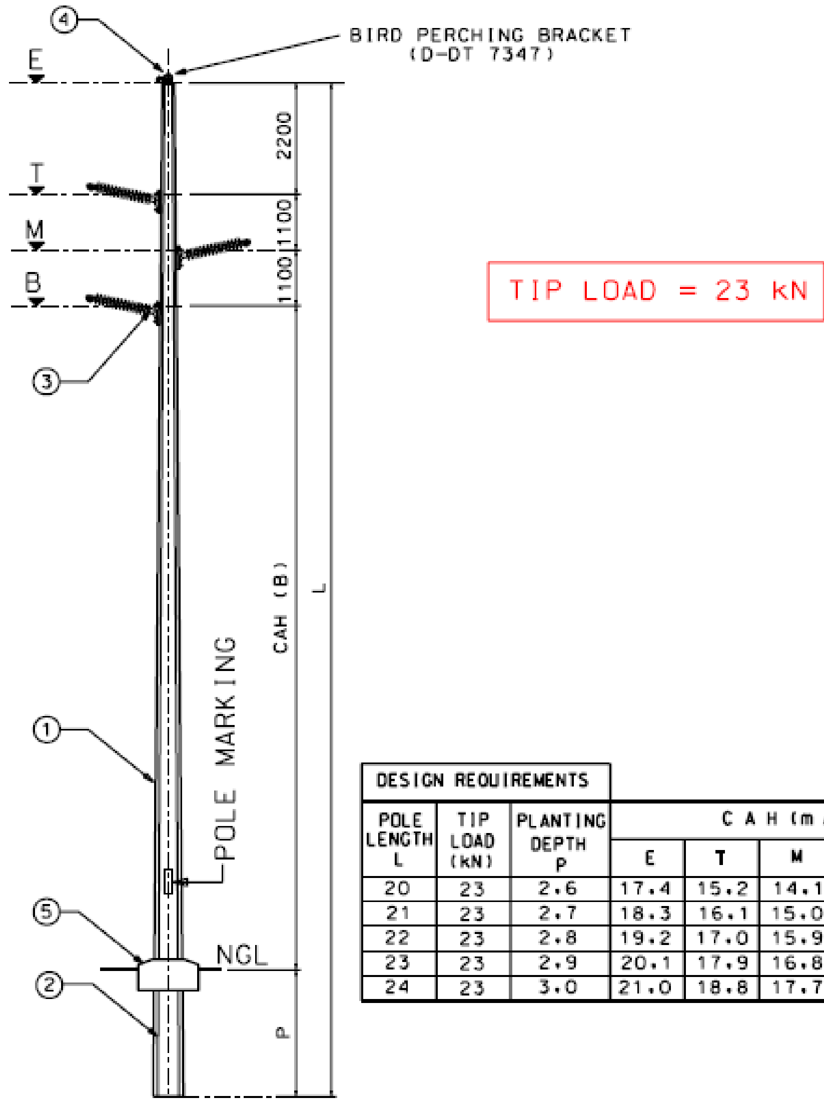
APPENDIX 5 BIRD FLIGHT DIVERTERS



DESIGN REQUIREMENTS						
POLE LENGTH L	TIP LOAD (kN)	PLANTING DEPTH P	C A H (m AGL)			
			E	T	M	B
20	23	2.6	17.4	15.2	14.1	13.0
21	23	2.7	18.3	16.1	15.0	13.9
22	23	2.8	19.2	17.0	15.9	14.8
23	23	2.9	20.1	17.9	16.8	15.7
24	23	3.0	21.0	18.8	17.7	16.6

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED, REFERENCES REV'D, GENERAL REVISION	SLR	RAB	AB	JUNE 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY
RETICULATION/SUB-TRANSMISSION LINES
88/132KV S/C INTERMEDIATE STRUCTURE
GENERAL ARRANGEMENT

D-DT 7611	SET	SHEET	REVISION
	2	1	2

A4L

Appendix D3

SURFACE WATER

BIOTHERM ENERGY (PTY) LTD

Proposed Construction of the Tlisitseng 1 Substation and associated 132kV Power Line near Lichtenburg, North West Province

Surface Water Impact Assessment Report

Issue Date: 5th September 2016
Revision No.: 2
Project No.: 13303

Date:	5th September 2016
Document Title:	Proposed Construction of the Tlisitseng 1 Substation and associated 132kV Power Line near Lichtenburg, North West Province - Surface Water Impact Assessment Report
Author:	Shaun Taylor
Revision Number:	2
Checked by:	Andrea Gibb
Approved:	Rebecca Thomas
Signature:	RThomas
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, 2010

PROJECT TITLE

Proposed Construction of the Tlisitseng 1 Substation and associated 132kV Power Line near Lichtenburg, North West Province.

Specialist:	Shaun Taylor		
Contact person:	Shaun Taylor		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	0727794899
Telephone:	0117980691	Fax:	0118037272
E-mail:	shaunt@sivest.co.za		
Professional affiliation(s) (if any)	South African Wetland Services (SAWS)		

Project Consultant:	SiVEST		
Contact person:	Andrea Gibb		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 587 6525
Telephone:	011 798 0600	Fax:	011 803 7272
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)

5th September 2016

Date

BIOTHERM ENERGY (PTY) LTD

PROPOSED CONSTRUCTION OF THE TLISITSENG 1 SUBSTATION AND ASSOCIATED 132KV POWER LINE NEAR LICHTENBURG, NORTH WEST PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

Contents **Page**

LIST OF FIGURES

BIOTHERM ENERGY (PTY) LTD

PROPOSED CONSTRUCTION OF THE TLISITSENG 1 SUBSTATION AND ASSOCIATED 132KV POWER LINE NEAR LICHTENBURG, NORTH WEST PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as “BioTherm”) are proposing to construct a Solar Photovoltaic (PV) development, including the associated substations and 132kV power lines, located near Lichtenburg, in the North West Province (hereafter referred to as the “proposed development”). Tlisitseng Solar will consist of two (2) 75MW solar PV facilities, namely Tlisitseng Solar 1 and Tlisitseng Solar 2, as well as a substation and an associated 132kV power line which will connect each of the PV facilities to the proposed Tlisitseng substations. There will therefore be two substations and two 132kV power lines in total for the project.

In terms of the Environmental Impact Assessment (EIA) Regulations (08 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 authorisation from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

It has been identified that an EIA process is to be followed for the PV project components which will require scoping and impact phase assessments for the proposed Tlisitseng 1 and 2 PV developments. It must be noted that each respective PV facility will be treated separately for the purpose of the EIA processes. Additionally, the substation and 132kV power line for each PV facility will be undertaken as separate Basic Assessment (BA) processes. This report will focus on the BA of the Tlisitseng 1 substation and 132kV power line.

This report will provide information obtained at a desktop level as well as detailed information obtained as a result of on-site fieldwork undertaken to verify and groundtruth desktop findings in the desktop assessment. The fieldwork information will also include any additional findings that were not identified in the desktop assessment where relevant. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), comparative assessment of the alternatives to be considered, the anticipated legislative requirements, the potential environmental impacts that could be associated with the proposed development and other surrounding developments respectively from a surface water perspective and finally specialist recommendations.

SiVEST Environmental Division has been appointed as the independent surface water specialist consultant to undertake the surface water assessment for the two Tlisitseng Solar PV facilities as well as two 132kV power lines and substations proposed for each PV facility, near Lichtenburg in the North West Province. Note again, however, that this report will only include findings on the Tlisitseng 1 substation and 132kV power line. Associated studies for the remaining project components have been compiled in separate reports for the relevant impact and basic assessments.

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 rivers, streams 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 Environmental Impact Regulations (2006, 2010 and 2014 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 Basic Assessment (BA) or Environmental Impact Assessment (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, implications and potential impacts / issues of the proposed development on potentially affected surface water resources are addressed later in this report (**Section 8 & 9**).

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

For wetlands specifically, 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 are 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 study has only focused on the identification and in-field delineation of surface water resources within the proposed development area. Delineation of surface water resources in the wider areas were not undertaken.

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

Wetland or river health, ecosystem services and the ecological importance/sensitivity have also not been assessed for identified surface water resources.

As an avifaunal assessment is being carried out for this project, impacts as related to waterfowl are not included in this report. It is assumed that potential impacts to waterfowl as included in the avi-faunal assessment.

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, BioTherm are proposing to establish a Solar PV developments, including the associated substation and 132kV power line near Lichtenburg, in the North West 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: TLISITSENG SOLAR PV DEVELOPMENTS

3.1 Project Location

The Tlisitseng Solar PV developments (PV facilities, Tlisitseng substations and associated 132kV power lines) will be located approximately 8km north-west of Lichtenburg, within the Ngaka Modiri Molema District Municipality of the North West Province. The Tlisitseng Solar development will consist of two (2) 75MW solar PV facilities, namely Tlisitseng Solar 1 and Tlisitseng Solar 2 on the following farm:

- Farm Houthaalboom 31, portion number 25.

Grid connections for the proposed Tlisitseng Solar PV Facilities will be to the proposed Tlisitseng substation. The Tlisitseng substation will be connected to the existing Watershed Main Transmission substation by the proposed 132kV power line. The Watershed Main Transmission substation is located approximately 2.4km to the south-east of the application site.

The project site has been identified through pre-feasibility studies conducted by BioTherm based on an estimation of the solar energy resource as well as weather, topography, dust, dirt, snow and surface albedo. Grid connection, land availability and site access were also important initial considerations. The North West Province in South Africa has the highest solar irradiation potential after the Northern Cape. The project site receives an annual global horizontal irradiation of approximately 2120 kWh/ m2/year.

The application site and proposed grid connections with regards to the Tlisitseng 1 substation and associated 132kV power line located near Lichtenburg are shown in the locality map (Figure 1).

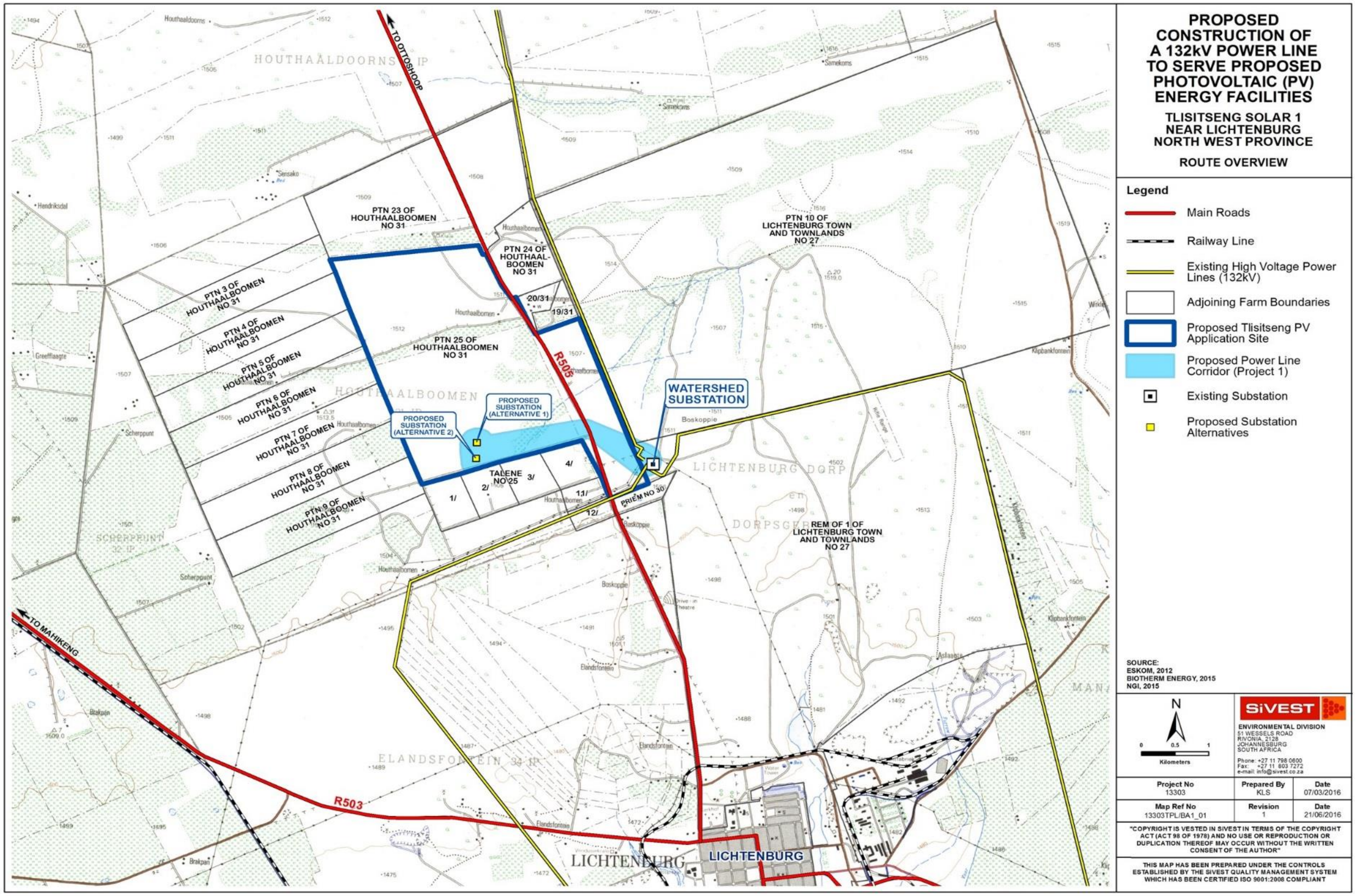


Figure 1. Proposed Tlisitseng 1 Substation and associated 132kV Power Line Study Area

3.2 Tlisitseng 1 Substation and 132kV Power Line Technical details

It is anticipated that the proposed Tlisitseng 1 PV solar development will include the construction/development of an on-site substation (namely Tlisitseng 1 substation), as well as a 132kV power line, which will aim at connecting the proposed Tlisitseng 2 PV facility to the national grid. The proposed development will include the following components/factors:

- Grid connection for the proposed Tlisitseng 1 Solar PV facility will be to the proposed Tlisitseng 1 substation;
- The proposed Tlisitseng 1 substation will occupy a footprint area of approximately 6.25ha;
- The capacity of the proposed on-site substation is anticipated to be up to 132kV;
- A power line(s) of up to 132kV is also proposed and will run from the proposed on-site substation (Tlisitseng 2 substation) to the existing Watershed Main Transmission substation;
- The proposed 132kV power line will have a servitude width of approximately 31m;
- The point of connection is approximately 2.5km from Eskom's existing Watershed Main Transmission Substation;
- An Onsite switching substation with grid transformer(s) for voltage step up to a high voltage of up to 132kV. The switching Station will be a common substation connecting multiple phases of the project to Eskom Watershed Main Transmission Substation;
- The Watershed Main Transmission substation is located approximately 2km to the south-east of the greater application site;
- The type of power line towers which are being considered at this stage include self-supported suspension (518H) or 0°-45° angle strain (518C) tower types. The height will vary based on the terrain, but will ensure minimum OHL line clearances with buildings and surrounding infrastructure;
- Power line towers are expected to be situated approximately 250m apart, depending on the terrain;
- Access roads; and
- Administration, control and warehouse buildings.

3.3 Alternatives

In terms of the NEMA and the EIA Regulations, feasible alternatives are required to be considered during the BA process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The following alternatives will be considered as part of this report:

- Site Location Alternatives for the proposed Tlisitseng 1 substation which will consider two (2) different location alternatives including:
  - Tlisitseng 1 Substation Option 1; and
  - Tlisitseng 1 Substation Option 2.
- The No-go Alternative.

4 METHODOLOGY

The first step in the surface water assessment was to identify and delineate the geographic boundaries of any potential surface water features at a desktop level using various information sources. 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) the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database, the North West and National Environmental Potential Atlas **(ENPAT, 2000)** database as well as the National Biodiversity Assessment **(SANBI, 2012)** database. The use of Google Earth™ imagery supplemented these data sources.

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

4.1 Field-based Surface Water Resources Delineation Techniques

4.1.1 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)** guidelines, “A practical field procedure for the identification and delineation of wetlands and riparian areas”. According to the **DWAF (2005)** 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.

It must be recognised that there are normally three zones to every wetland including the 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 inundation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate inundation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of inundation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation **(DWAF, 2005)**.

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. The GPS is expected to be accurate from 5 up to 15 metres depending on meteorological conditions. A GIS shapefile was created to represent the boundaries of the delineated wetlands or other surface water resources.

4.1.2 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 (but not always limited to) comprise the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat.

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.

4.1.3 Drainage Pathways

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 surface water run-off.

4.2 Surface Water Buffer Zones

Depending on the type of land use or development proposed, an appropriate buffer zone to protect wetlands (and any other surface water resource) should also be delineated **(DWAF, 2005)**. Buffer zones are typically required to protect and minimise edge impacts to wetlands or any other surface water resource. As such, professional judgement and academic research was used to produce a scientifically informed buffer zone for surface water resources identified in the study area.

4.3 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 A)**. This is addressed in **Section 9**.

5 GENERAL STUDY AREA

The proposed greater application site for the Tlisitseng Solar development will be located approximately 8km north of Lichtenburg, within the Ngaka Modiri Molema District Municipality of the North West Province. The project site has a relatively flat topography which is regarded suitable for the development of a solar PV facility. The solar PV facilities will be located on the following farm:

- Farm Houthaalboom 31, portion number 25.

Specifically, grid connections for the proposed Tlisitseng 2 Solar development will from the proposed Tlisitseng 1 substation. The Tlisitseng 1 substation will be connected to the existing Watershed Main Transmission substation by a proposed 132kV power line. The project therefore has access to the national grid via the existing Watershed Main Transmission substation which is located approximately 2.4km from the application site.

The Tlisitseng 1 substation and 132kV power line development site is easily accessible as the tarred R505 road transects the farm and connects to the N14 national road which leads to the R503 in Lichtenburg. Importantly, the R505 bisects Portion 25 of the Farm Houthaalboom 31 into two with an area west of the R505 and an area east of the R505. The area west of the R505 is where the proposed Tlisitseng 1 Substation alternative sites and the power line corridor are located. The surrounding land use within the direct proximity of the development site comprises predominantly of vacant land, existing cultivations (agriculture) and mining.

A map indicating the land use of the area surrounding the site proposed for the Tlisitseng 1 substation and associated 132kV power line has been provided in **Figure 2** below**.**

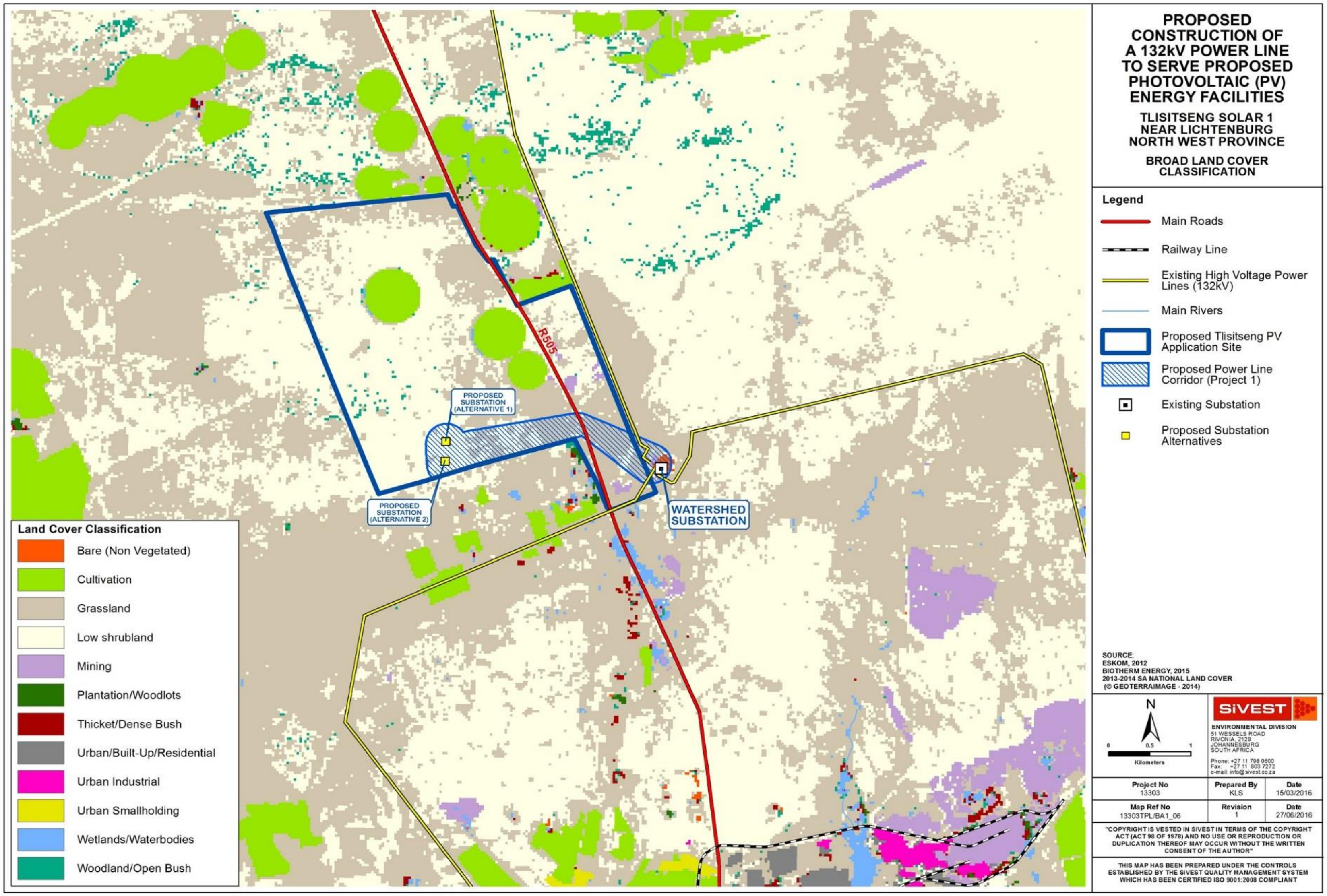


Figure 2. Land Use Map

According to **Mucina and Rutherford (2006)**, the proposed development site for the Tlisitseng 1 substation and associated 132kV power line falls within the Grassland 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 Dry Highveld Grassland 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 Tlisitseng 1 substation and associated 132kV power line development site can therefore be found within the Carletonville Dolomite Grassland vegetation unit (**Figure 3**). 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.

5.1 Carleton Dolomite Grassland

The vegetation and landscape features of the Carletonville Dolomite Grassland vegetation unit are characterised by slightly undulating plains dissected by prominent rocky chert ridges as well as species-rich grasslands which form a complex mosaic pattern dominated by many species.

The geology and soils of this vegetation unit are characterised by Dolomite and chert of the Malmani Subgroup (Transvaal Supergroup) which support mostly shallow Mispah and Glenrosa soil forms typical of the Fa land type. It must be noted that the landscapes of this vegetation unit are dominated by the Fa land type. In addition, deeper red to yellow apedal soils (Hutton and Clovelly forms) also occur sporadically and represent the Ab land type.

The climate is characteristic of a warm-temperate, summer-rainfall region with overall Mean Annual Precipitation (MAP) of approximately 593mm. Temperatures in summer are high with severe, frequent frost occurring in winter.

The conservation status of the vegetation unit is described as vulnerable. A small extent is conserved, in statutory (Sterkfontein Caves-part of the Cradle of Humankind World Heritage Site, Oog Van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifansvlei and Groenkloof) and in at least six (6) private conservation areas. Almost a quarter of this vegetation unit has already been transformed by cultivation, urban sprawl, mining activity and the building of the Boskop and Klerkskraal Dams. In addition, erosion in this unit varies from very low (84%) to low (15%).

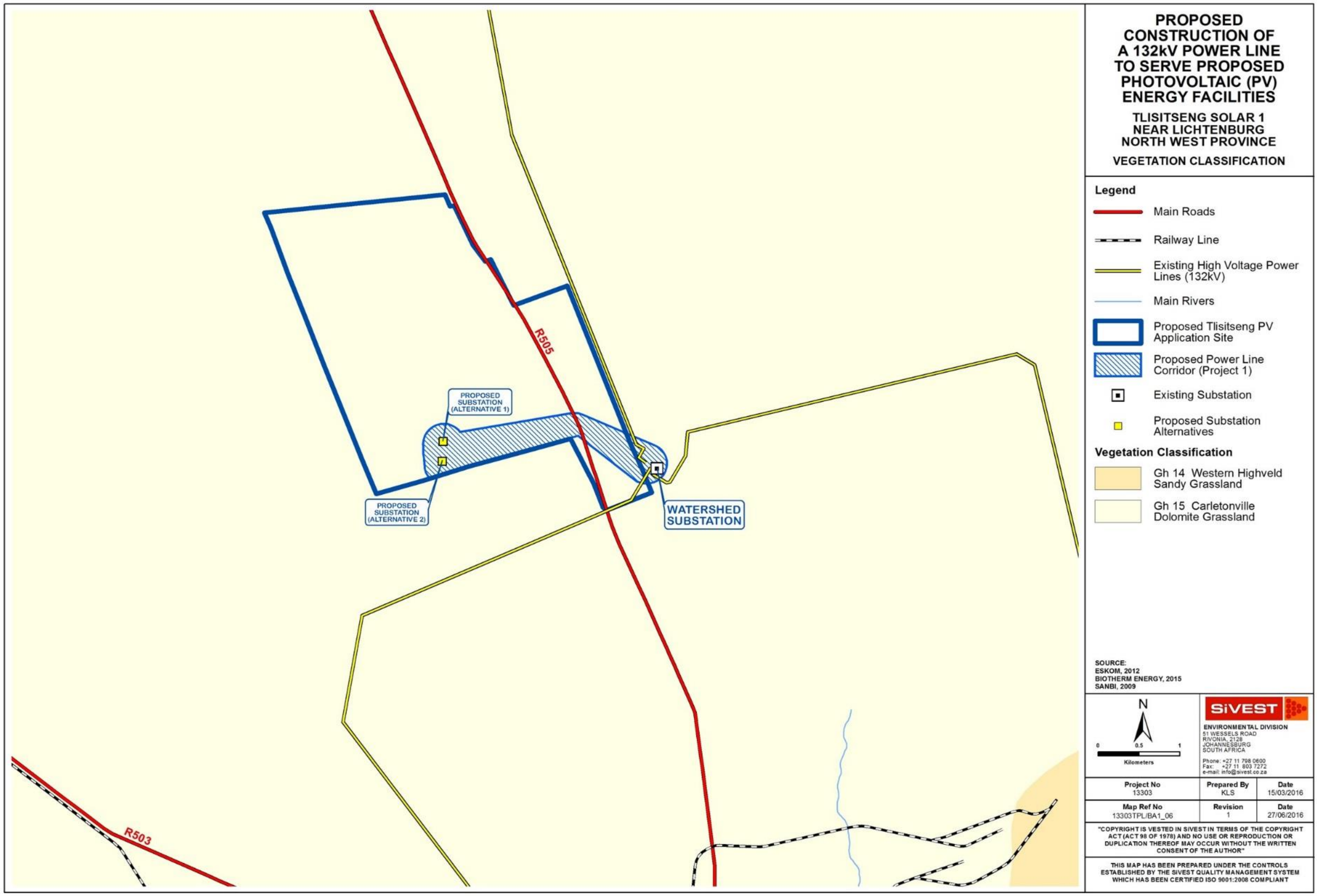


Figure 3. Vegetation Unit Map

6 FINDINGS OF ASSESSMENT

6.1 Desktop Findings

In terms of the **National and North West ENPAT (2000)** databases, both substation alternatives (Tlisitseng 1 Substation Alternative 1 and 2) as well as the 132kV power line corridor are found within the Lower Vaal Water Management Area. These respective substation alternatives and the power line corridor was further found to be situated within the Vaal Primary Catchment. More specifically, the substation and power line corridor alternatives are found within the C31A quaternary catchment.

In terms of surface water resources within the Tlisitseng 1 Substation and Powerline corridor, it was found that there are no wetlands within these areas (**Figure 4**).Only one watercourse was identified from the consulted databases which appeared to be flowing in a north easterly direction originating from the southern boundary of the site. This feature was investigated in the fieldwork component of the assessment below.

6.2 In-field Investigations and Delineations for the Application Site

The in-field wetland delineation assessment took place from the 1st to 2nd of December 2015. 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 greater application site. The results are displayed in **Figure 5**.

Following the fieldwork, no wetlands, watercourses nor any other surface water resources were identified in the proposed substation alternative sites and/or the power line corridor. Only one small wetland (depression) was identified within the greater Proposed Tlisitseng Solar Application site, approximately 35m to the east of the R505. As such, this wetland is sufficiently distanced so as not to be affected by the proposed power line development.

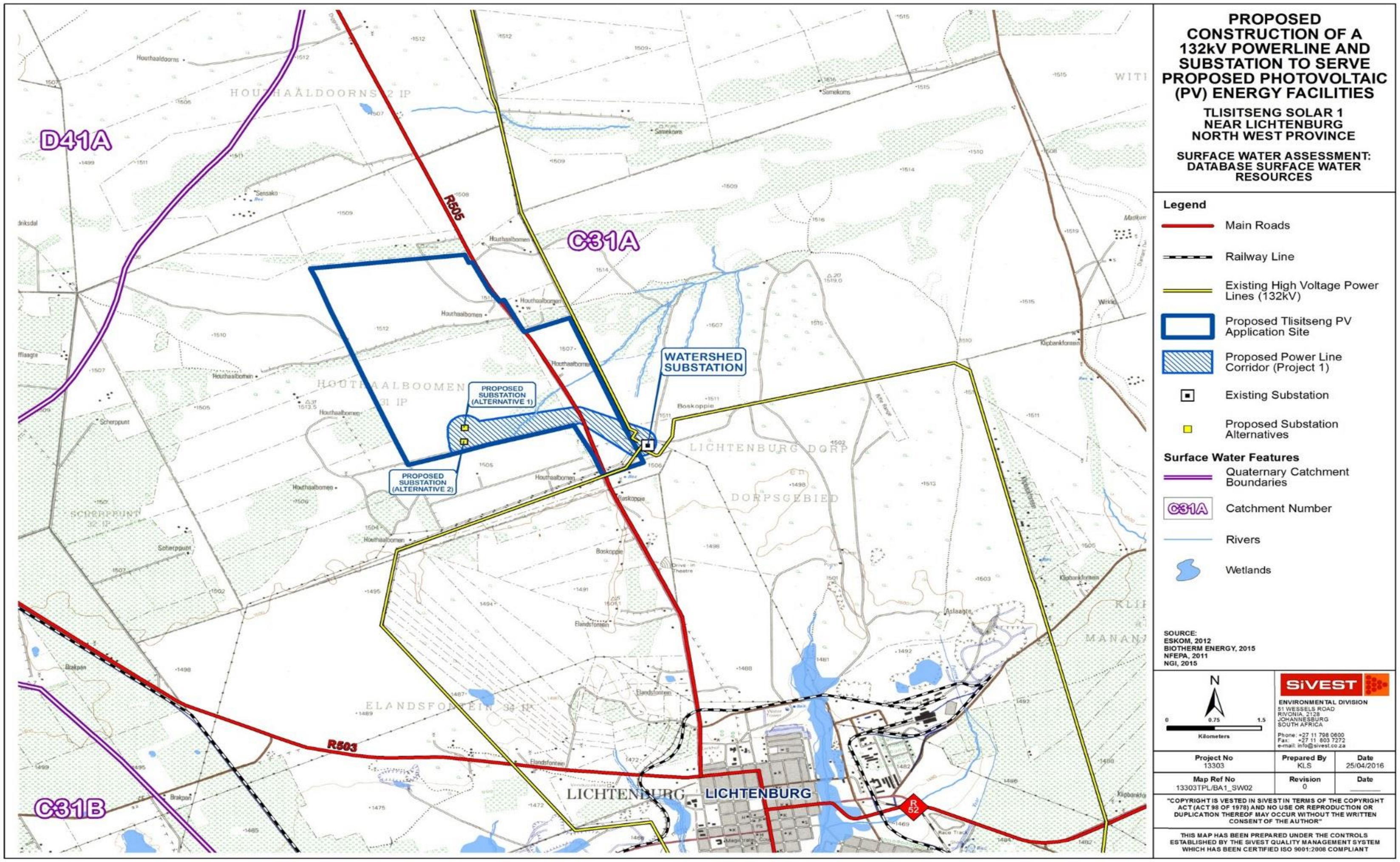


Figure 4. Tlisitseng 2 Substation and Power Line Corridor Database Surface Water Map

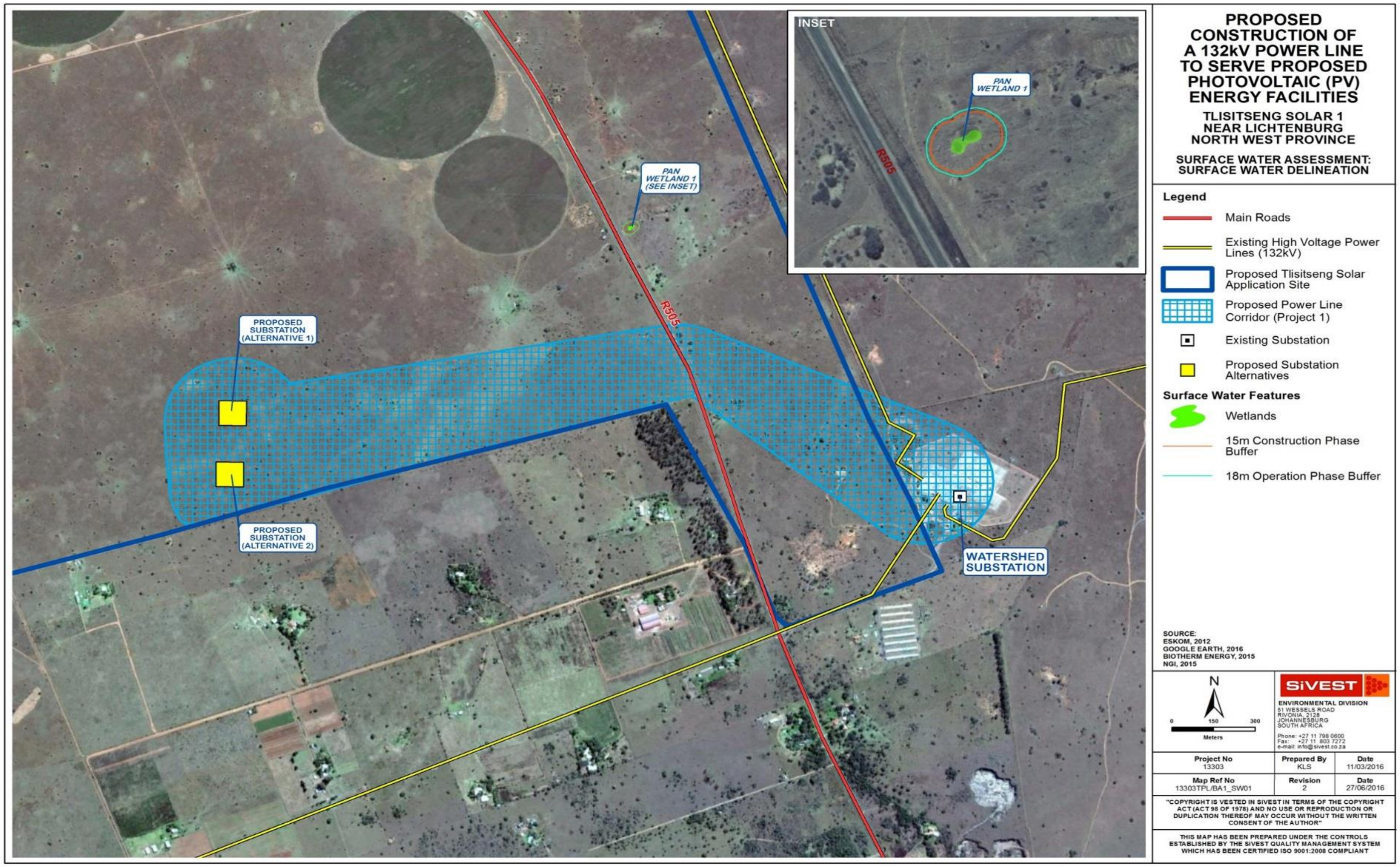


Figure 5. Tlisitseng 2 Substation and Power Line Corridor Surface Water Delineation Map

6.3 Surface Water Buffer Zones

As no wetlands or any other surface water resources were identified within the Proposed Power Line Corridor, no buffer zones are applicable.

7 ALTERNATIVES COMPARATIVE ASSESSMENT

Substation alternative sites have been investigated for the proposed solar PV 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; 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 focuses on 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. In this instance, maneuverability of the site layout may only also be possible should any surface water resources be located on the boundary of the proposed development area under consideration.

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

The logic for each criteria was applied in the assessment 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

Alternative	**Preference**	**Reasons**
SUBSTATION		
Tlisitseng 1 Substation Option 1	No preference	Both alternatives are suitable for the placement of the substation from a surface water perspective as there are no wetlands or watercourses within any of the two alternative sites nor within close proximity (500m) to any surface water resources in the nearby area. There is no preference between the two alternative sites and both are suitable for the location of the Substation.
Tlisitseng 1 Substation Option 2	No preference	Both alternatives are suitable for the placement of the substation from a surface water perspective as there are no wetlands or watercourses within any of the two alternative sites nor within close proximity (500m) to any surface water resources in the nearby area. There is no preference between the two alternative sites and both are suitable for the location of the Substation.

8 LEGISLATIVE IMPLICATIONS

8.1 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 (2014), no activities will be triggered from a surface water perspective as these are no surface water resources within the proposed development area for the substation and power line corridor.

8.2 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 where construction activities will impact on a water resource. In this light, “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, no water uses will be triggered from a surface water perspective as these are no surface water resources within the proposed development area for the substation and power line corridor.

9 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED TLISITSENG 1 SUBSTATION AND ASSOCIATED 132KV POWER LINE

From a surface water resource perspective, as there are no wetlands or watercourses in the Proposed Power Line Corridor of the project, there are no potential impacts anticipated.

9.1 Cumulative Impacts

From a surface water resource perspective, as there are no wetlands or watercourses in the proposed development areas for this component of the project, there are no potential cumulative impacts anticipated.

10 SPECIALIST RECOMMENDATIONS

None required, as there are no surface water resources present in the Proposed Power Line Corridor of the project.

11 CONCLUSIONS

A surface water delineation and impact assessment is provided in this report for the proposed development. Investigations were based on a method for delineating wetlands and riparian habitat as per the **DWAF 2005** guidelines. Ultimately, it was found that there are no surface water resources in the Proposed Power Line Corridor. As such, the comparative assessment yielded no preference as to a preferred location between the proposed substation alternative sites. Both were viewed as suitable from a surface water perspective as there would be no potential impacts. Accordingly, in terms of potentially applicable environmental and water related legislature, no listed activities and/or water uses will be triggered for the proposed development. No potential impacts or cumulative impacts are therefore anticipated. From a surface water perspective, there are no concerns with respect to the Proposed Power Line and Substation development.

12 REFERENCES

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Appendix A

Environmental Impact Assessment Methodology

The EIA 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.

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 shown in table below.

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

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 should be 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:

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 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.

SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Shaun Taylor
Cell No.: +27 72 779 4899
Email: shaunt@sivest.co.za

Appendix D4

SOILS AND AGRICULTURE

EIA REPORT

On contract research for

SiVEST

SOIL INFORMATION FOR GRID CONNECTIONS FOR SITE 1 OF THE PROPOSED TLISITSENG SOLAR ENERGY PLANT, NEAR LICHTENBURG, NORTH WEST PROVINCE

By

D.G. Paterson (Pr. Sci. Nat. 400463/04)

Report No. GW/A/2016/07b

February 2016

ARC • LNR

ARC-Institute for Soil, Climate and Water,
Private Bag X79, Pretoria 0001, South Africa

Tel (012) 310 2500 Fax (012) 323 1157

DECLARATION

I hereby declare that I am qualified to compile this report as a registered Natural Scientist and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

D G Paterson
February 2016

CONTENTS **Page**

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SiVEST to undertake a soil investigation near Lichtenburg, in the North West Province, where a solar power (PV) project is proposed. The objectives of the study are;

- To obtain all existing soil information and to produce a soil map of the specified area as well as

- To assess broad agricultural potential and the impacts thereon.

2. SITE CHARACTERISTICS

2.1 Location

An area was investigated lying approximately 10 km to the north of the town of Lichtenburg. The area lies between 26^{o} 03' and 26^{o} 06' S and between 26^{o} 05' and 26^{o} 09' E. Within this area, two separate possible sites for the establishment of the solar power project have been identified. For each of the possible sites, one or more proposed grid connections, consisting of a substation within the site and power lines to connect the PV plant to the existing Watershed substation to the south-east, have been identified.

This report deals with the proposed grid connection corridor for ***Site 1***, which is identified in orange on the locality map (Figure 1). The two proposed substation sites are shown in black and green. The PV sites themselves are also shown, but not coloured in.

2.2 Terrain

The area lies at a height of approximately 1 500 metres above sea level. The area slopes very gently (<2%) to the south-west). No permanent drainageways are present in the vicinity.

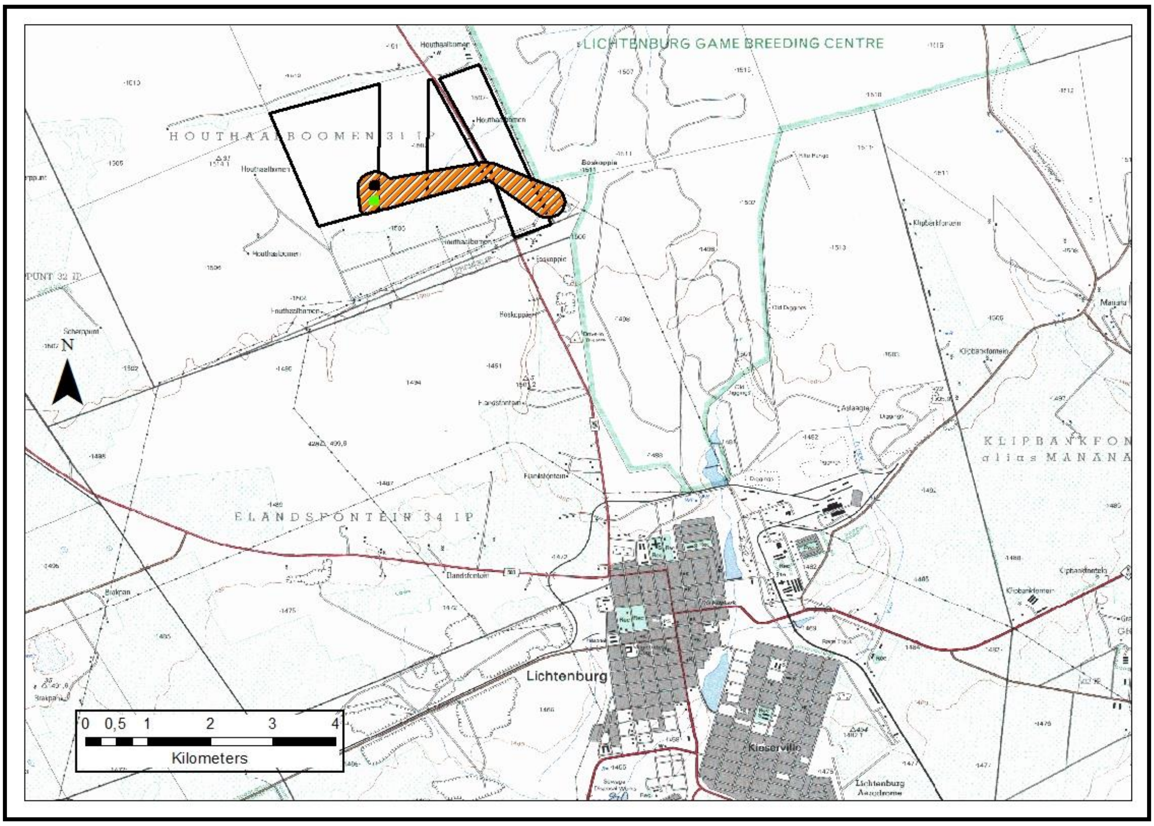

Figure 1 Locality map

2.3 Climate

The climate of the study area (Kotze & Lonergan, 1984) can be regarded as warm to hot with moist summers and dry winters. The long-term average annual rainfall is 545 mm, of which 452 mm, or 83%, falls from October to March. The average evaporation over the same period is 2 335 mm. Temperatures vary from an average monthly maximum and minimum of 31.1ºC and 16.2ºC for January to 17.6ºC and 2.0°C for July respectively. The extreme high temperature that has been recorded is 36.0°C and the extreme low –4.1ºC.

2.4 Parent Material

The geology of the area comprises dolomite of the Malmani Formation (Geological Survey, 1984).

The distribution of the geological units in the area is shown in Figure 2.

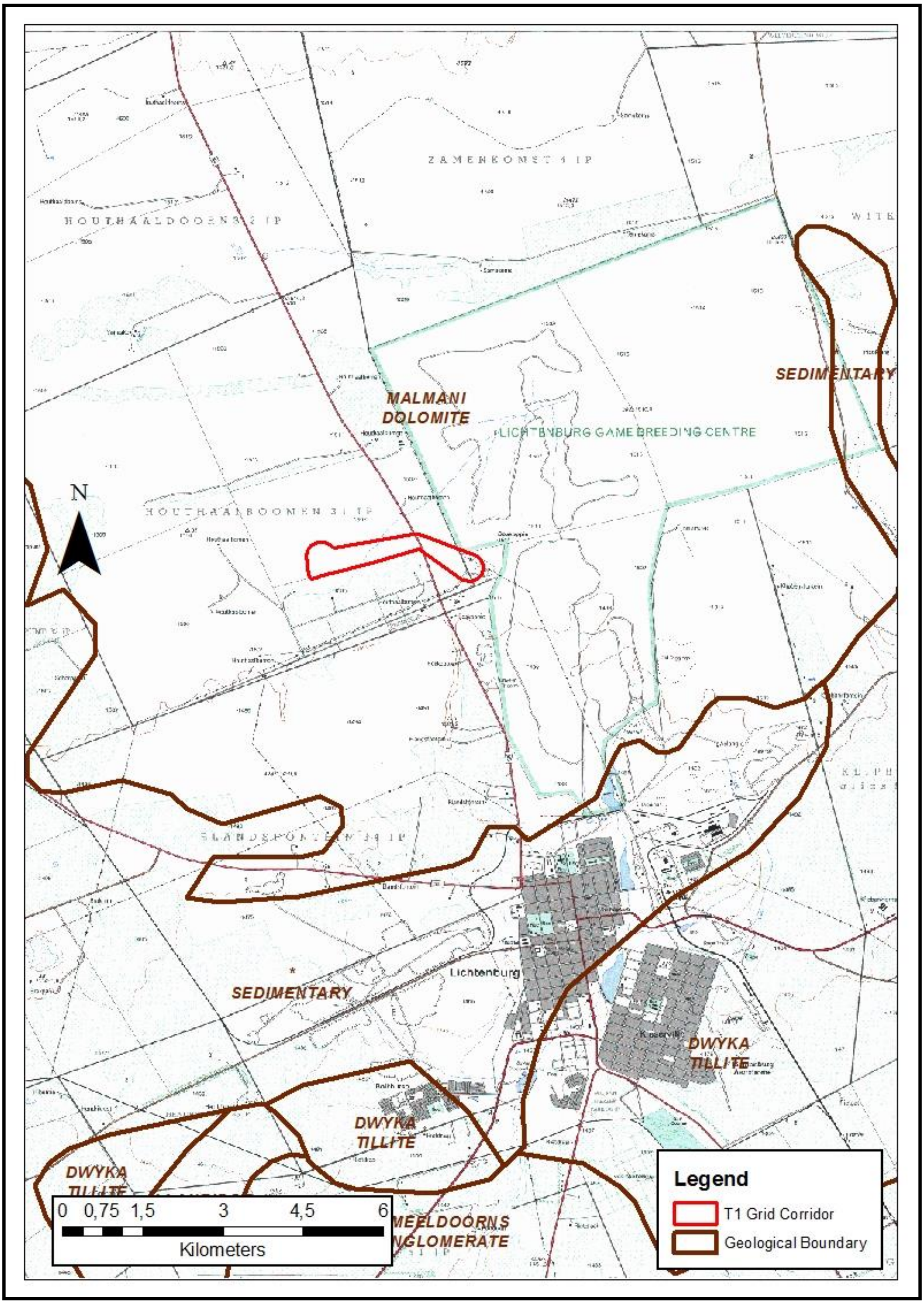

Figure 2 Geology

3. METHODOLOGY - SOILS

Existing soil information was obtained from the map sheet 2626 West Rand (Bruce & Schoeman, 1978) from the national Land Type Survey, published at 1:250 000 scale.

For this second (EIA) phase of the study, a field trip (in conjunction with other specialists) was carried out whereby the soils at various localities within the area were investigated using a hand-held soil auger, in order to carry out a ground-truthing exercise. A reference grid of 250 x 250 m was established, using a GPS to locate points in the field, and selected points were visited to carry out a soil observation. This involved describing the main soil characteristics at each point, as well as classifying the soil according to the South African soil classification system (Soil Classification Working Group, 1991).

4. SOIL PATTERN

The desk-top study indicated that the soils in the vicinity of the project were generally shallow to very shallow (<500 mm), usually sandy loam and calcareous, overlying either rock or cemented hardpan calcrete. Some rock outcrops occur in places in the landscape. However, some areas of deeper red soils, which will have a higher agricultural potential, can also occur.

The soil investigation confirmed this, with virtually all of the soils observed being less than 450 mm onto hard or weathering rock. The soils are reddish-brown to brown, structureless to weakly structured and belong to the Mispah, Glenrosa and Hutton soil forms (Soil Classification Working Group, 1991).

Only at one observation point, L135, was a red Hutton soil of approximately 1 000 mm deep observed.

The location of the points in the vicinity of the proposed grid connection corridor for Tsilitseng PV 1 that were visited during the field trip is shown in Figure 3. The PV site is shown in yellow, with the grid corridor in red and the proposed substation sites in black and green.

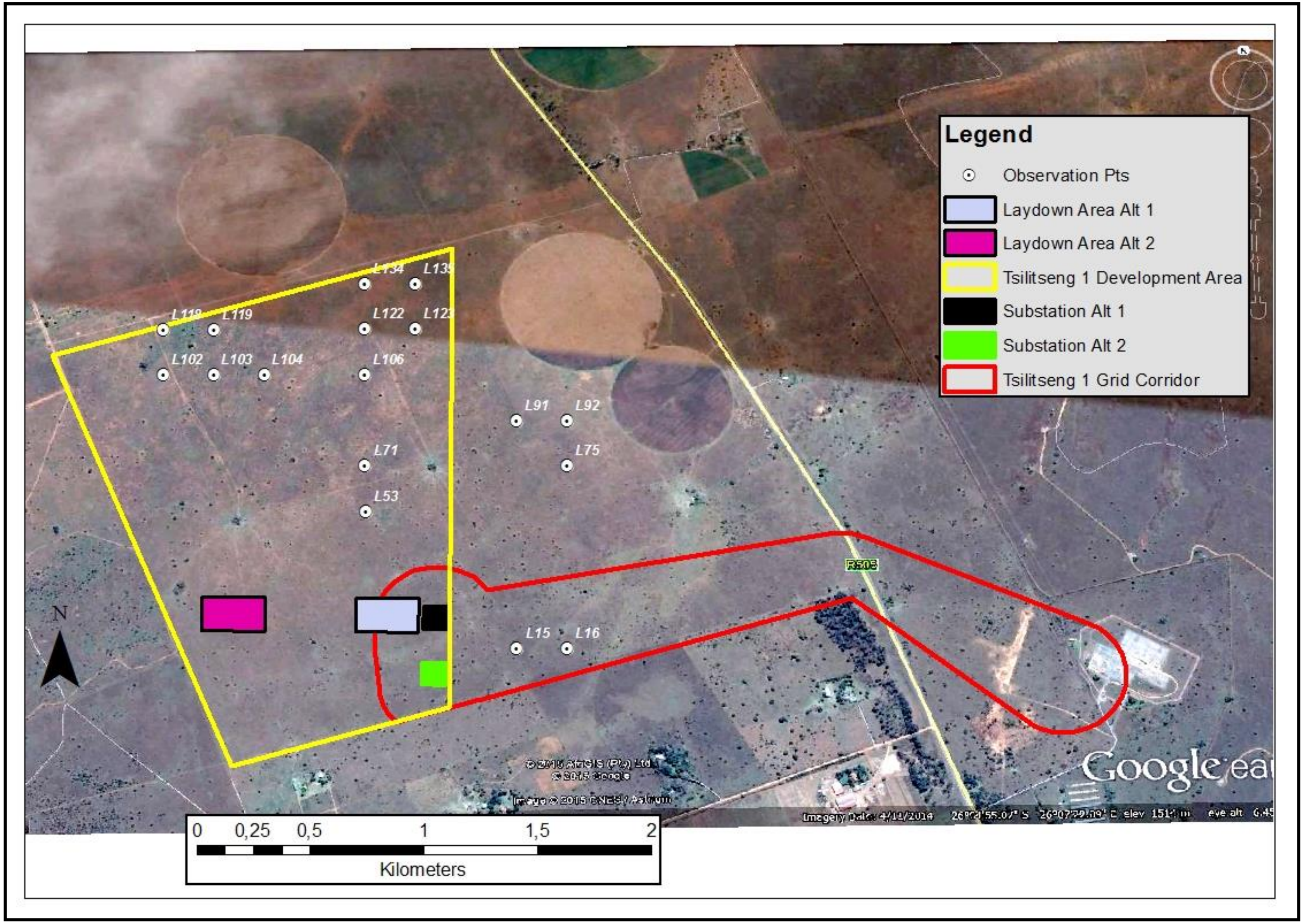

Figure 3 Soil observation points

5. AGRICULTURAL POTENTIAL

Although there are deeper soils in the vicinity (as evidenced by the centre pivot fields to the north), the soil observations around both proposed substations all showed shallow soils, and there is no evidence of cultivation along the rest of the corridor. Due to time and other organizational constraints, it was not possible to investigate all of the soils along the corridor as well as across the proposed PV site.

The climatic parameters (Section 2.3) mean that this part of North West is well suited for grazing but here the grazing capacity is relatively low, around 12 ha/large stock unit (ARC-ISCW, 2004).

5.1 Land Use

The land use in the area is dominantly grazing, but with limited areas of cultivation, some under irrigation as classified by the National Land Cover (Thompson, 1999).

6. IMPACTS

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.

6.1 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 shown in Table 1.

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

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Table 1: Description of terms

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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.		
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This describes the chance of occurrence of an impact		
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This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
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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).
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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.
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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:

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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
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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 impact can be summarized as follows:

Table 4 Rating of impacts (loss of potential)

IMPACT TABLE FORMAT		
Environmental Parameter	***Soil resources and associated agricultural potential***	
Issue/Impact/Environmental Effect/Nature	***The loss of agriculturally productive soil due to the establishment of the infrastructure of the PV project***	
Extent	*Confined to the **site only***	
Probability	*It is **probable** that impacts will occur*	
Reversibility	*The impact will in all probability be **partly** to **completely reversible** if the infrastructure is removed.*	
Irreplaceable loss of resources	***No loss** of irreplaceable resources.*	
Duration	***Long term**, for the operational life of the project*	
Cumulative effect	***Negligible to no** cumulative effects*	
Intensity/magnitude	***Low** to **medium** – not to any significant degree.*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	**-22 (negative low)**	**-10 (negative low)**

IMPACT TABLE FORMAT	
Mitigation measures	Due to the generally low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced.

Table 5 Rating of impacts (erosion hazard)

IMPACT TABLE FORMAT		
Environmental Parameter	***Increased hazard of soil erosion***	
Issue/Impact/Environmental Effect/Nature	***The loss of topsoil by being exposed to wind action due to construction processes***	
Extent	*Confined to the* ***site only****, but possibly in the broader vicinity, if not mitigated*	
Probability	*It is* ***probable*** *that impacts will occur*	
Reversibility	*The impact will in all probability be* ***partly*** *to* ***completely reversible*** *if the infrastructure is removed.*	
Irreplaceable loss of resources	***No loss*** *of irreplaceable resources.*	
Duration	***Long term****, for the operational life of the project*	
Cumulative effect	***Possible medium*** *cumulative effects*	
Intensity/magnitude	***Medium*** *– not to any significant degree, though some modification is possible*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	**-42 (negative medium)**	**-9 (negative low)**
Mitigation measures	The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish. The loamy nature of the soils means that if	

IMPACT TABLE FORMAT	
	exposed, there is only a small hazard of soil removal by wind erosion, especially in the drier winter months. However, to combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.

6.3 Cumulative Impacts

The main cumulative impact would be as a result of the fact that several solar power generation projects are planned in the vicinity of Lichtenburg (seven projects within an approximate 20 km radius). The ***soils*** on each site would not have an impact on any other site, but there would be a potential of increased dust production as a result of construction activities, especially in the drier months, when wind can cause soil particles to become detached from the bare soil surface. The main mitigation measures would include ensuring that the topsoil remains moist if possible, and that the construction footprint is as small as possible, with minimum soil surface disturbance due to construction activities.

Table 6 Comparative Assessment of Alternatives – Tlisitseng 1 PV

Alternative	Preference	Reasons
SUBSTATION and O&M Building		
Alternative 1	No preference	Shallow soils, low agricultural potential
Alternative 2	No preference	Shallow soils, low agricultural potential
LAYDOWN AREA		
Alternative 1	No preference	Shallow soils, low agricultural potential
Alternative 2	No preference	Shallow soils, low agricultural potential

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Appendix D5

HERITAGE

BIOTHERM ENERGY (PTY) LTD

TLISITSENG PROJECT - TLISITSENG 1 SUBSTATION AND POWER LINE

Heritage Impact Assessment

Issue Date: 12 July 2016
Revision No.: 2
Project No.: 13303

Date:	12 07 2016
Document Title:	Heritage Impact Report
Author:	Wouter Fourie
Revision Number:	1
Checked by:	
For:	SiVEST Environmental Division

Executive Summary

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of two 75MW solar photovoltaic (PV) energy facilities near Lichtenburg, North West Province. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

The Heritage Impact Assessment has shown that the proposed Tlisitseng Solar projects does have heritage resources present on the property. This has been confirmed through archival research, evaluation of aerial photography of the sites and a field survey.

HERITAGE RESOURCES

No heritage resources related to the archaeological and historical time period were identified.

Palaeontology

The study area is underlain by Vaalian aged dolomite of the Monte Christo Formation, Chuniespoort Group. Stromatolites are known to occur within these deposits and more modern fossiliferous Caenozoic cave breccias have been recorded associated with carst formation in the dolomite.

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded. Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

Palaeontology mititigation

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded.

- Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs.
- Site visits as stipulated in the management tables will include an initial 2-day site visit and then fortnightly during construction.

- Such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Impact Summary

Table 1 provides a summary of the projected impact rating for this project on heritage resources.

Table 1 - Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	9	Negative Low Impact	9	Positive Low Impact
Palaeontology	Impact during construction	63	Negative	57	Positive

Comparative Assessment of Alternatives – Tlisitseng 1 Substation and Power Line

An assessment of the two Substation of Options indicates that none of the two will have an impact on heritage resources and thus no preference for either exists.

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
SUBSTATION		
Alternative 1	**NO PREFERENCE**	No impact on heritage resources
Alternative 1	**NO PREFERENCE**	No impact on heritage resources

Cumulative impacts

An evaluation of the possible cumulative impacts from the combined solar projects in the area (Table 7 and **Figure 8**) on heritage resources has shown that the biggest envisaged impact could be on the palaeontological heritage of the area with the Watershed Solar Energy facility just northwest of this proposed development increasing the possibility of impacts on the breccias that could occur in the area.

Though with the implementation of mitigation measures these impacts could be transformed into a positive impact through the discovery of previously unknown fossils and the subsequent study of such fossil finds adding to the academic knowledge of the palaeontological resources of the study area.

Conclusion

The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMP will provided the necessary actions to address any impacts on heritage resources.

BIOTHERM ENERGY (PTY) LTD

HERITAGE SCOPING REPORT

Contents Page

Appendices

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of two 75MW solar photovoltaic (PV) energy facilities near Lichtenburg, North West Province. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites, finds and sensitive areas that may occur in the study area for the EIA study. The Heritage Impact Assessment (HA) aims to inform the Environmental Impact Assessment in the development of a comprehensive Environmental Management Plan to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

PGS Heritage (PGS) compiled this Heritage Impact Report.

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing the HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

Jessica Angel, holds a Masters degree in Archaeology and is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).

A palaeontological Impact Assessment was commissioned and completed bt Dr Gideon Groenewald (2016)

1.3 Assumptions and Limitations

Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage feature or objects not included in the inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make

an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well.
The survey was conducted over 2 days over the extent of the total footprint area. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.

The fieldwork that covered the Tlisitseng solar PV application site is an area of 10.3 square kilometres.

A total of 1 heritage site was marked within the application site over the extent of the fieldwork.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage Resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, and MPRDA legislation. In the latter cases, the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Sections of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

Refer to **Appendix A** for further discussions on heritage management and legislative frameworks

Table 2 Terminology

Acronyms	***Description***
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PSSA	Palaeontological Society of South Africa
ROD	Record of Decision
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
iii. wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
iv. features, structures and artefacts associated with military history, which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age, between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance, such as the caves with archaeological deposits identified close to both development sites for this study.

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

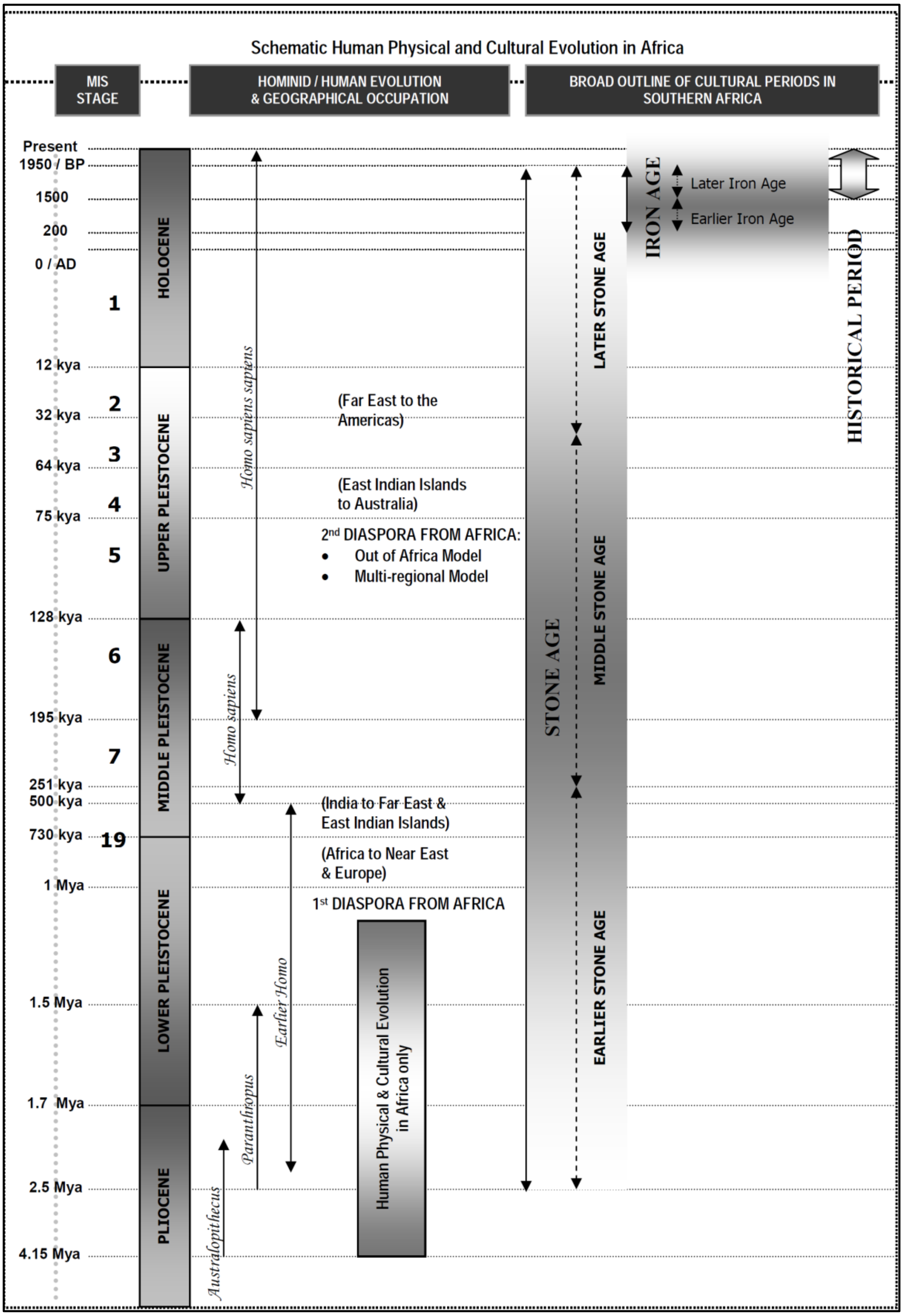

Figure 1 - Human and Cultural Timeline in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

The proposed project is located within the North West Province approximately 6km north of Lichtenburg. It falls within the Ngaka Modiri Molema District (Figure 2).

Figure 2 - Tlisitseng Solar 1 – Grid Locality

The application site is approximately 1000ha however the buildable area will be significantly smaller than this and will be determined by sensitive areas identified during the HIA of the EIA. Tlisitseng Solar will consist of two (2) 75MW solar PV facilities, namely Tlisitseng Solar 1 and Tlisitseng Solar 2. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

Panels will be either fixed axis mounting or single axis tracking solutions, and will be either crystalline silicon or thin film technology. In addition to the PV panels each project will consist of:

- An onsite switching station, with the transformers for voltage step up from medium voltage to high voltage;
- The panels will be connected in strings to inverters and inverter stations will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers;
- DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers.
- The 22-33kV cables will be run underground in the facility to a common point before being fed to the onsite switching station where the voltage will be stepped up to 132kV.

- A power line with a voltage of 132kV to the proposed Tlisitseng substation;
- A laydown area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- A car park and fencing; and
- Administration, control and warehouse buildings.

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

PGS compiled this Heritage Assessment Document as part of the Heritage Impact Assessment (HIA) report for the proposed Tlisitseng Solar facilities. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

3.1.1 Scoping Phase

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

3.1.2 Impact Assessment Phase

Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by a qualified archaeologist, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

Appendix B, outlines the Plan of study for the Heritage Impact Assessment process, while **Appendix C** provides the guidelines for the impact assessment evaluation that will be done during the EIA phase of the project.

4 BACKGROUND RESEARCH

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an Internet literature search was conducted and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

4.1 Previous Studies

A search of the SAHRIS (SA Heritage Resources Information System) database identified the following Heritage Impact Assessment (HIA) and Palaeontological Impact Assessment (PIA) reports for the study area and general surrounding region:

- Heritage Impact Assessment for the proposed rerouting of four existing 132kv power lines at the Eskom Watershed Substation, Lichtenburg, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, North-West Province. PGS Heritage (Pty) Ltd

- Cultural Heritage Resources Impact Assessment of Portion 151 Of Lichtenburg Town and Townlands 27 IP (Lichtenburg Extension 10), North West Province. Dr Udo Küsel. African Heritage Consultants CC. Prepared for Lockeport Projects (Pty) Ltd. July 2008

- Heritage Impact Report for the Proposed 88kv Power Line from Watershed Substation, Lichtenburg, to the Mmabatho Substation, North West Province. J van Schalkwyk. Prepared for Arcus Gibb. November 2008.

- Cultural Heritage Resources Impact Assessment of a Feedlot on the Farm Kalkfontein, Lichtenburg District, North West Province. Dr Udo Küsel. African Heritage Consultants CC. Prepared for EkoInfo CC. May 2011.

- Heritage Impact Assessment for the Proposed Lichtenburg Solar Park, North-West Province. Compiled for Africa Geo-Environmental Services (AGES) by Marko Hutten, Hutten Heritage Consultants. May 2012.

- Lichtenburg Solar Park, North West Province - Palaeontological Impact Assessment. Prof. Bruce Rubidge. Prepared for AGES (Pty) Ltd. July 2012.

The above-noted studies identified the following sites:

4.1.1 Archaeological and Historical Sites:

- No sites dating to the Stone Age were identified in the region of the study area
- No sites dating to the Iron Age were identified in the region of the study area.
- A number of features dating to the historic period were identified in the region surrounding the study area. This includes the remains of an old house in Bakerville, and a number of cemeteries. However, none of these sites is located within or adjacent to the study area.

4.1.2 Palaeontological sites:

The PIA for the Watershed Substation upgrade, which is located immediately southeast of the study area, noted the following:

> *"The study area is underlain by Vaalian aged Chert-rich Dolomites of the Monte Christo Formation, Malmani Subgroup, Chuniespoort Group, Transvaal Sequence. The Monte Christo Formation begins with an erosive breccia and continues with stromatolitic and oolitic platformal dolomites.*
>
> *Stromatolites are recorded from the dolomite layers. Highly fossiliferous Caenozoic cave breccias are also known to occur within the dolomite layers, but are not mapped individually. These fossiliferous deposits often contain more recent mammal and hominid fossils, e.g. in the Cradle of Humankind."*

Figure 3 - Geology of the study area (in purple)

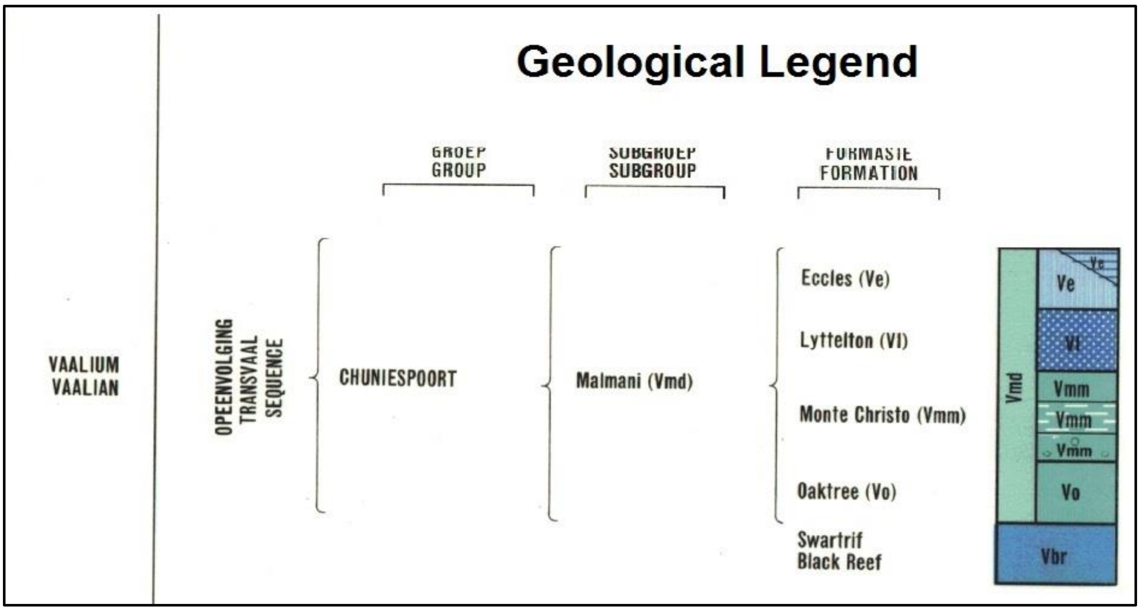

Figure 4 - Geological legend for Figure 3

4.2 Archival findings

The aim of the archival background research is to identify possible heritage resources that could be encountered during the fieldwork, as summarised in **Table 3**.

Table 3 - Summary of History of Lichtenburg Town and Surrounding Area

DATE	DESCRIPTION
2.5 million to 250 000 years ago	**The Earlier Stone Age (ESA)**. The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age is known as the Acheulean and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulean phase dates back to approximately 1.5 million years ago. The rock engraving site at Bosworth Farm, near Klerksdorp also contains many stone artefacts (lithics) which date to over one million years ago (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites). No sites are known in or near the study area.
250 000 to 40 000 years ago	**The Middle Stone Age (MSA)**. The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique. No sites are known in the vicinity of the study area.
40 000 years ago to the historic past	The **Later Stone Age (LSA)** is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (microliths). The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the wider vicinity of the study area (Bergh, 1998). See below for two well-known sites in the greater vicinity of the study area.
Rock Art	**Thaba Sione**: this site is located in the middle of Thaba Sione town, some 60km south-west of Mmabatho. The site contains over 559 engravings located on rocks and boulders. The engravings are dominated by depictions of rhinoceros – some have been rubbed smooth. There are also buffalo, eland, shamanic human figures, wildebeest and a rare lizard. The site is still important today to local Tswana people and is used by the Zion Christian Church as a rain-making centre. (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites) **Bosworth Farm**: this site is located some 22km north-west of Klerksdorp on the Bosworth Farm property. It is a large site with over 400 San and Khoe (herder) rock engravings. There many depictions of human figures as well as animals: a charging rhinoceros, a large elephant, a flight of birds. There are also many geometric motifs. The site also has many stone artefacts (lithics) which date to over one million years ago. Bosworth is one of South Africa's 12 Rock Art sites formally protected under the National Heritage Resources Act (25 of 1999). (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites)
AD 200 - 900	**Early Iron Age (EIA)**. Known sites in the region include Kruger Cave near Rustenburg and Broederstroom near Hartebeespoort Dam. Both sites are located to the east of the

DATE	DESCRIPTION
	study area and date to approximately 460 AD (Mason 1974). No recorded sites were located within the study area during the desktop study.
AD 900 - 1300	**Middle Iron Age (MIA)**. No recorded sites were located during the desktop study.
AD 900 - 1840	**Late Iron Age (LIA)**. Various well-known sites from this period are located in the greater North-West Province, including the stone walled complexes at Buispoort and Braklaagte, the Makgame megasite, the 18th century capital at Kaditshwene and the copper mines at Dwarsberg in the Madikwe Game Reserve. These sites date to between the 15th and 19th centuries and record the arrival and development of the early Moloto Sotho-Tswana speakers (Boeyens, 2003).
	Four groups are of importance in the study area. These are the Bakolobeng, Batloung, Banogeng, and the Barolong. The following information was derived from a study conducted by the Lichtenburg Museum under P. M. Ntamu, 1996. The origins of the tribes of the Lichtenburg area follows (Fourie, 2009). *The Bakolobeng*: Oral sources indicate that the Bakolobeng originated from Tsaong near Silverkrans. Chief Kelly Molete concurs with Breutz's informants that the Bakolobeng were led through the present Kwena-Reserve of Botswana by Chief VI Molete-wa-Modikwagae in about 1769 or 1770, and later moved to Tsaong. Around 1830, they experienced a difficult period, which began with the death of their Chief, Kgosi VIII Molete when the Ndebele Group attacked them. This period of Difagane was also characterised by the Bakolobeng's flight to Thaba 'Nchu (in the Free State) and to Dimawe (Klerksdorp District) were they joined other refugees like the Batloung and Banogeng. After 1837, the Thaba 'Nchu Group of the Bakolobeng returned and settled temporarily at Bodumatau (Lichtenburg District) until they came into contact with Hermannsburg Mission. *Batloung:* They are also known as Batlhako, because they were originally with the Batlhako when they departed from the present Pretoria District and migrated to the areas of Rustenburg in about 1650. Oupa Mogorosi, one of the oldest informants, stated that: "... (they) departed from Mabalstadt along with Baphiring ... who controlled a section of people who were later to settle at Putfontein." Breutz's informants hold that in about 1750, the Batloung became an independent chiefdom and went to settle at Dipakane, in the Klerksdorp area. The Batloung later went to stay in a farm at Gruisfontein, accompanied by Rev Schnell of the Hermannsburg Lutheran Mission. At that time the Tribe was so scattered that one section was at Bodibe (Polfontein) and other places in the district. The idea of buying a farm as their ultimate settlement brought them together. *Banogeng:* According to oral sources collected by Breutz, the Banogeng are believed to be an ancient branch of the Digoja, i.e. forerunners of the Batswana Tribes who passed the Mafikeng area in small clan units. They are believed to be related to the Bakubung,

DATE	DESCRIPTION
	Bataung and the Barolong Tribes, who originally shared the same totem; Tholo (Kudu) with them. For reasons better known to themselves; the Banogeng were destroyed and separated even before the period of Mzilikatzi attacks, except for remnants who stayed in the Lichtenburg District. The Ndebele continued to pose a threat to them so that they fled to Dimawe in the District of Klerksdorp. Here they merged with refugees from Baphiring, Batloung and Bakolobeng Tribes. Except for those who were assimilated into the already mentioned tribal groups, Ramosiane attempted to gather the remains of the Banogeng. They stayed at Kolong (Rietfontein) until 1960 when the tribe applied for its recognition and the re-establishment of the tribe. *The two Barolong tribes:* There are presently so many Barolong Tribes whose origin has been attributed to the first Chief Morolong, and the second Chief Noto. It is interesting to note that the totems, Tholo (Kudu) and Tshipi (Iron), were respectively taken from the names of the Chiefs mentioned. In his book, "History of the Batswana", Natal, 1989, Breutz indicate that "the first Tswana Tribe to come to South Africa under the rule of a Chief were the Barolong who arrived sometime between 1 200 and 1 300 or earlier". These migrations which continued even beyond the years 1450 and 1700 made the divisions of the Batswana Tribes like the Bahurutshe and the Bakwena more conspicuous. From 1823 - 1830, several Barolong Tribes fled from their Tribal land in the Transvaal as a result of Bataung raids and the Mzilikazi raids. Towards the end of the eighteenth century, the Barolong had divided into four groups, under Rratlou, Rrapulana, Seleka and Tshidi. The first two groups, namely the Barolong Boo-Ratlou and the Barolong Boo-Rapulana came to stay in the District of Lichtenburg. The Barolong Boo-Rapulana's residence was Lotlhakane (Rietfontein) in the Lichtenburg District. In 1882 moved to Bodibe (Polfontein) in the District of Lichtenburg. The last of the Barolong Boo-Ratloung, Chief Noto Moswete and his tribe were moved to Kopela.
AD 1873	**Historical period** The town of Lichtenburg: Hendrik Adriaan Greeff was born on the farm Lichtenburg close to Durbanville in the Cape Province. He became a hunter and started to frequent the then ZAR area. Greef settled in the late 1860 on the farms Doornfontein and Kaalplaats. Potchefstroom was the closest trading centre and approximately 150 km or "14 uur rijdens te paarde" away. A need for a town with a church and shops became stronger and Greeff and the Boers in the area saw Doornfontein with its abundant water, firewood and building material as the designated place. In 1865 the first application for town establishment was addressed to the House of Assembly, signed by 132 males in the area, and they started compiling a number of town regulations. Greeff wanted to name the town Lichtenburg, a name that he carried from his birth and because he wanted it to be a town whose light would shine over the area, not just with regard to hospitality and prosperity, but also in respect of religion. In 1868 the name "Lichtenberg", (a mistake still commonly made) appeared on the official map of the SAR, but the House of Assembly did not react yet. The men met again

DATE	DESCRIPTION
	to discuss the town regulations and to obtain an appeal on speedy proclamation from the House of Assembly. The well-known Voortrekker savant, JG Bantjes, also established himself in Lichtenburg and signed the regulation as witness. Eventually Lichtenburg was officially proclaimed as town in mid-winter on 25 July 1873 by Pres. TF Burgers. (Lichtenburg Museum, 2009; cited in Fourie 2009).
1900-1902	**Boer War** During the Boer War the town of Lichtenburg was occupied by a British garrison of 620 men under the command of Lieutenant-Colonel CGC Money. The market square was turned into a fortified redoubt and strong pickets and sangars on the outskirts of town. On 3 March 1901, General De la Rey planned to attack the town with the help of General Cilliers and Commandant Lemmer and their followers, amounting to 1200 men. An attacking force of between 300-400 men was to assault the town. Due to the marshy terrain and a premature charge by General Liebenberg, the attack was repulsed with equal loses on both sides (Cloete, 2000).
Diamond Rush 1927	**Diamond Rush 1927** The Lichtenburg area is known for the 1926-27 diamond rush. In December 1924, a diamond of 3 carats was discovered by the Voorendyk family on the farm Elandsputte. Initial prospecting in 1925 produced a high yield of diamonds and the area was proclaimed as a “diggings” in February 1926. By 1945 a total of 104 diggings were proclaimed on 13 farms. It was the richest public diggings in the world, with the biggest gathering of diggers in history. A shanty town rose within a year or two, which housed in the region of 150 000 people, about 5 times as big as Lichtenburg today. Bakers, called after the owner Albert Baker, and later known as Bakerville, was the "main town". Here the houses and shacks stood ‘cheek by jowl’ for several kilometers. In the business centre there were as many as 250 diamond buyers' offices, as well as about 60 cafes, shops, barbers, butcheries and other businesses (Lichtenburg Museum, 2009). Bakerville is situated 10 kilometers to the north of Houthaalboomen, the proposed development farm for this project.

5 IMPACT ASSESSMENT

5.1 Field work findings

5.1.1 Methodology

Fieldwork was conducted on the application site of the Tlisitseng Solar PP Project from 1-2 December 2015. The methodology focused of a tracked walkthrough of the foot print areas of proposed PV project application area. An accredited professional archaeologist, Miss Jessica Angel, completed the fieldwork. The fieldwork was done on foot and by vehicle.

It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.

The field work that covered the Tlisitseng Solar 1 grid and substation areas, application site is an area of 10.3 square kilometers.

A total of 1 heritage related site was marked within the application site over the extent of the fieldwork.

5.1.2 Description of area

The study area and surrounds is characterised by low vegetation growth dispersed over fairly flat terrain. Dominating the surface area are vast exposed pebble layers usually associated with low rises in the landscape. Drainage lines and flat surface are characterised by red sand cover in between the exposed pebble layers.

Figure 5 – View of general area

Figure 6 – General view of the area

5.1.3 Finds

No heritage finds were made in the corridor

5.1.4 PV footprint – Mitigation:

No further mitigation required

5.1.5 Palaeontological findings

During the fieldwork period of the Palaeontological Assessment (Groenewald, 2016) several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded (Table 4). Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

Table 4 - Photographic observations during fieldwork session

Photo	GPS station no (Fig. 9) and coordinates	Description	Picture
1	(062) -26° 05' 21.9" 26° 08' 15.3"	Deep soils on dolomite. No outcrop. No fossils observed. Landscape indicate old river bed with river gravels and boulders of dolomite and chert.	
2	(062) -26° 05' 21.9" 26° 08' 15.3"	Micro-stromatolite structures in dolomite and chert layers. Boulders not in situ	
3	(072) -26° 05' 16.8" 26° 08' 24.8"	Micro-stromatolites in possible outcrop, covered in shallow soil. Geotechnical reports will indicate possible exposure of these fossils during excavation for foundations	
4	(032) -26° 05' 32.3" 26° 08' 28.5"	Aardvark. burrow into deep Hutton soils. No outcrop, no fossils observed	

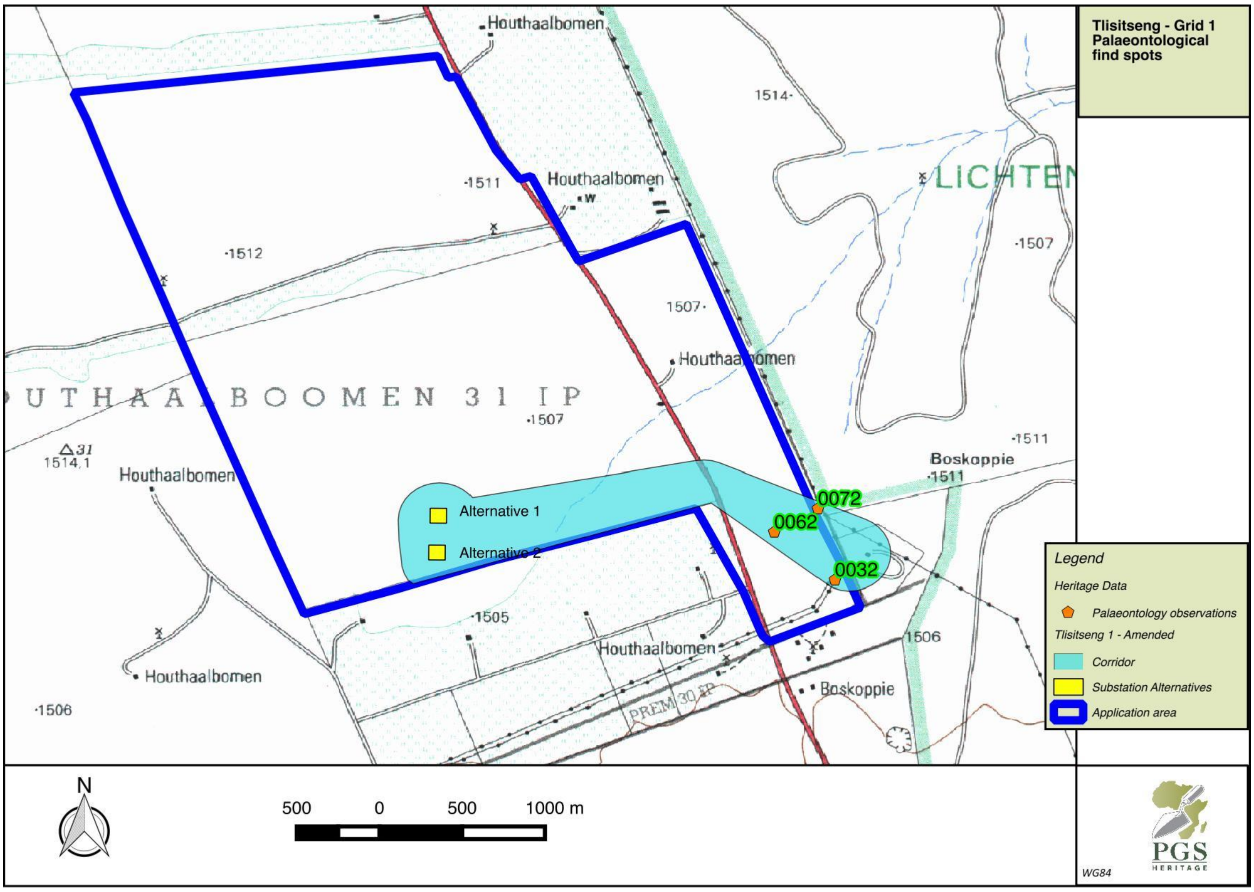

Figure 7 – Palaeontological find spots

5.2 Assessment

5.2.1 Heritage sites and finds

The fieldwork findings have shown that the study area is characterized by a background scatter of Stone Age artefacts, Several small structures and a cemetery.

It must be kept in mind that the fieldwork could in no way identify all archaeological sites within the development footprint and as such the fieldwork has shown that the possibility of encountering other Stone Age archaeological site is extremely high.

The following set of tables provide an assessment of the impact on heritage resources within the development footprint.

Table 5 - Rating of impacts – chance finds

IMPACT TABLE	
Environmental Parameter	*Heritage Resources*

Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified heritage resources and specifically Stone Age archaeological sites. As well as the impact on the identified archaeological sites*	
Extent	*Will impact on the footprint area of the development*	
Probability	*The fieldwork has shown that such a predicted impact will definitely occur*	
Reversibility	*Due to the nature of archaeological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*	
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*	
Duration	*The impact on heritage resources such as archaeological sites will be permanent*	
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on archaeological sites the cumulative impact is seen as having a medium negative impact.*	
Intensity/magnitude	*The large scale impact on archaeological sites and will require mitigation work.*	
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as high pre-mitigation. This can be attributed to the very definite possibility of encountering more archaeological sites as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	1	1
Reversibility	2	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-9 (negative low Impact)	-9 (negative low impact)

Mitigation measures	*General management guidelines to be implemented*

5.2.2 Palaeontology

The fieldwork findings have shown that the study area is characterised by a background scatter of Stromatolites in all the dolomite boulders on site and some areas have remains of cave breccia but no in situ outcrops were recorded.

It must be kept in mind that the fieldwork could in no way identify all palaeontological sites within the development footprint and as such the fieldwork has shown that the possibility of encountering possible cave breccias during geotechnical investigation is relatively high.

The following set of tables provide an assessment of the impact on palaeontological heritage resources within the development foot print

Table 6 - Rating of Impacts and Chance finds

IMPACT TABLE	
Environmental Parameter	*Palaeontological Resources*
Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified heritage resources and specifically Palaeontological sites. As well as the impact on the identified palaeontological sites*
Extent	*Will impact on the footprint area of the development*
Probability	*The fieldwork has shown that such a predicted impact will definitely occur*
Reversibility	*Due to the nature of palaeontological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*
Duration	*The impact on heritage resources such as palaeontological sites will be permanent*
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on palaeontological sites the cumulative impact is seen as having a medium negative impact.*
Intensity/magnitude	*The large scale impact on palaeontological sites might require mitigation work.*

Significance Rating	*The overall significance rating for the impact on heritage resources is seen as very high pre-mitigation. This can be attributed to the very high possibility of encountering more palaeontological sites during geotechnical investigations. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	3	2
Reversibility	4	3
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	-63 (high negative)	57 (high positive)
Mitigation measures	*Mitigation through palaeontological excavations and collection if Geotechnical Survey indicates necessity for mitigation* *Monitoring during construction by palaeontologist if fossils are exposed during excavation of more than 1.5m of soil cover*	

5.3 Cumulative impacts

A large number of solar projects are proposed and some have been approved and is currently in construction around the study area (Table 9).

The need for the implementation of the recommended mitigation measures is of great importance and must be seen in the context of the large areas to be impacted by the construction activity. By implementing the mitigation measures the cumulative effect will be reducing from a High to a Medium negative impact rating.

Table 7 - Renewable energy developments proposed within a 20km radius from the proposed Tlisitseng PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Matrigenix Renewable Energy Project	14/12/16/3/3/3/270	Scoping and EIA processes underway	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands 27
Watershed Solar Energy Facility	14/12/16/3/3/2/557	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2/1062	Project has received environmental authorisation	South Africa Mainstream Renewable Power Developments (Pty) Ltd	**UNKNOWN**	Portions 9 and 31 of the Farm Hibernia 52

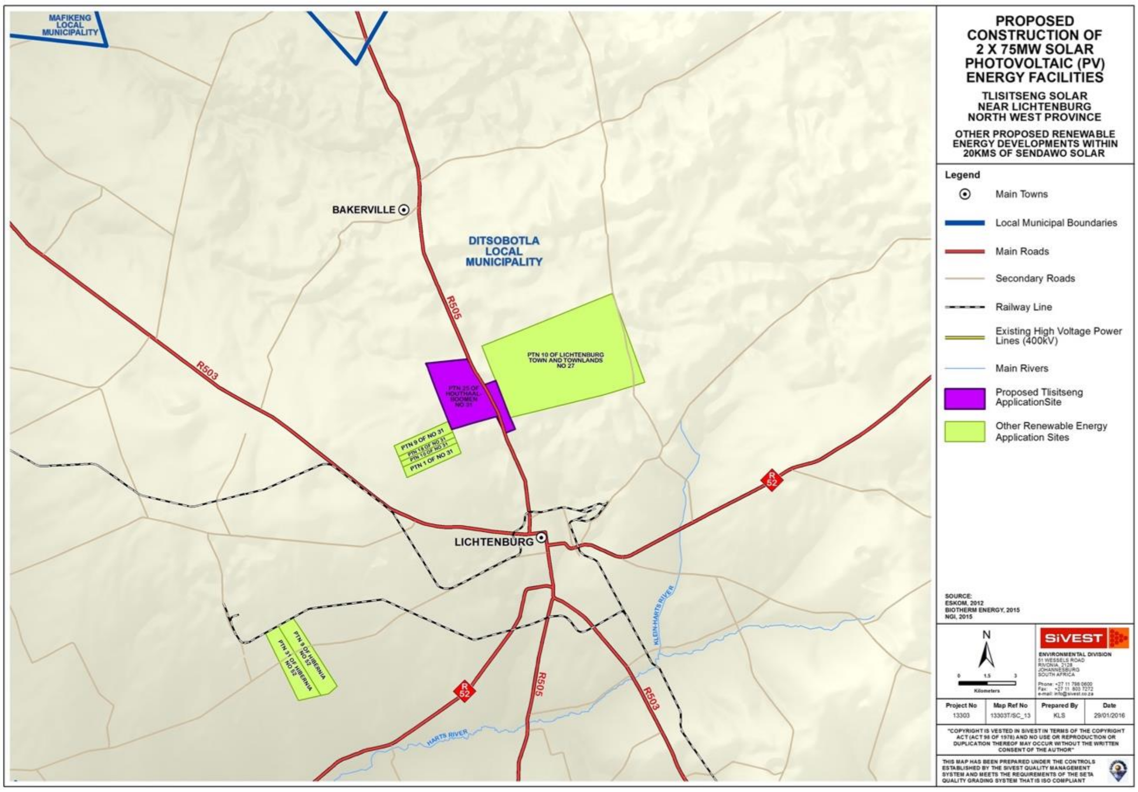

Figure 8 - Geographical position of renewable energy developments proposed within a 20km radius from the proposed Tlisitseng PV application site

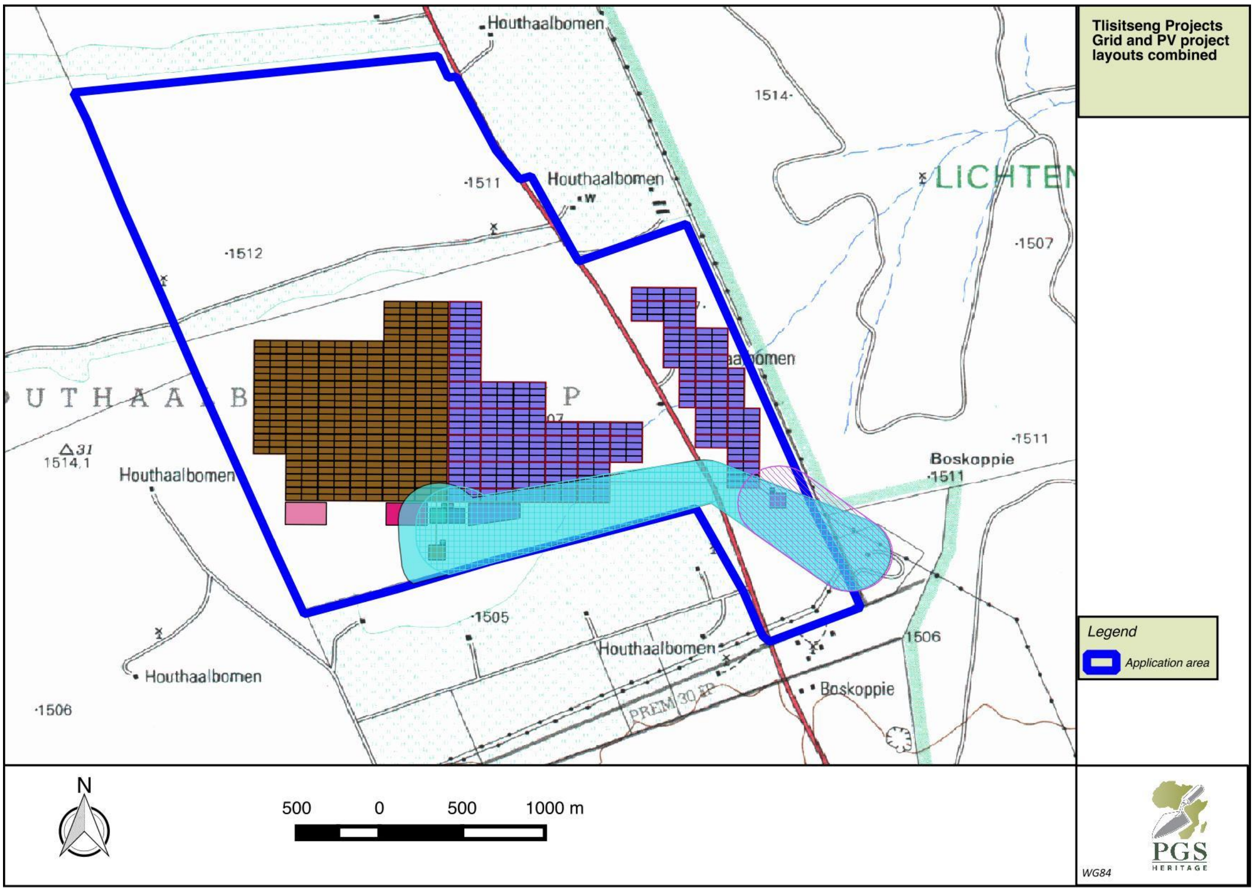

Figure 9 - Combined project options for the Tlisitseng PV facilities

5.4 Impact Summary

Table 8 provides a summary of the projected impact rating for this project on heritage resources.

Table 8 - Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	9	Negative Low Impact	9	Positive Low Impact
Palaeontology	Impact during construction	63	Negative	57	Positive

5.5 Comparative Assessment of Alternatives – Tlisitseng 1 Substation and Power Line

An assessment of the two Substation of Options indicates that none of the two will have an impact on heritage resources and thus no preference for either exists.

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
SUBSTATION		
Alternative 1	**NO PREFERENCE**	No impact on heritage resources
Alterative 2	**NO PREFERENCE**	No impact on heritage resources

6 MANAGEMENT GUIDELINE

6.1 Heritage Management Plan for EMP implementation

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible heritage finds in induction prior to construction activities take place – Refer to Section 9 of this report	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R10 000**
C	Implement mitigation for identified sites	Pre-construction	Pre-Construction	Applicant ECO Archaeologist	Once off	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Completion of mitigation measures and obtain destruction permit	**Approximately R300 000**

6.2 Palaeontological Management Plan for EMP implementation

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible [palaeontological heritage finds in induction prior to construction activities take place – Refer to Section 5 of this report referring to geotechnical reports	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible palaeontological heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R10 000**
C	Monitoring of construction activities by palaeontologist if indicated after completion of geotechnical report	Construction	During construction	Applicant ECO Palaeontologist	Palaeontologist (Initial 2-day site visit. Then Fortnightly during construction)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Palaeontologist Monthly Checklist/Report	**Monthly R40-50 000**

7 HERITAGE MANAGEMENT GUIDELINES

7.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-
   - (a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
   - (b) the construction of a bridge or similar structure exceeding 50m in length;
   - (c) any development or other activity which will change the character of a site-
     - (i) exceeding 5 000 m^2 in extent; or
     - (ii) involving three or more existing erven or subdivisions thereof; or
     - (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
     - (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
   - (d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
   - (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

   This survey and evaluation must include:
   - (a) The identification and mapping of all heritage resources in the area affected;
   - (b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
   - (c) An assessment of the impact of the development on such heritage resources;
   - (d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
   - (e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:

   a. Heritage;
   b. Graves;
   c. Archaeological finds; and
   d. Historical Structures.

   This module must be tailor made to include all possible finds that could be expected in that area of construction.

   Possible finds include:

   a. Open air Stone Age scatters, disturbed during vegetation clearing. This will include stone tools.
   b. Palaeontological deposits such as bone, and teeth in fluvial riverbank deposits.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.
5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.
7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.
8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.
10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

Table 9 - Roles and responsibilities of archaeological and heritage management when heritage resources are discovered during operations

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites, when discovered.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into the employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites (when discovered). The client with the specialist needs to agree on the scope and activities to be performed	The client	Environmental Consultancy and the Archaeologist
When a specialist/archaeologist has been appointed for mitigation work on discovered heritage resources, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

7.2 All phases of the project

7.2.1 Archaeology

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the prospecting phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological monitoring programme.

In the case where archaeological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological material, a buffer of at least 20 meters should be implemented.
- If archaeological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the material permit must be applied for from SAHRA under Section 35 of the NHRA.

7.2.2 Palaeontology

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area. It is essential that the information gathered during the Geotechnical investigations for developments be made available to the Heritage Practitioner and Palaeontologist to assess the possibility of exposing bedrock with fossils where excavations will exceed 1.5m or where gravity surveys indicate possible karst topography in dolomitic terrains.

It is possible that cultural material, including palaeontological finds, will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the prospecting phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological and palaeontological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological and palaeontological monitoring programme.

In the case where archaeological or palaeontological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological or palaeontological material, a buffer of at least 20 meters should be implemented.
- If archaeological and palaeontological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist or

palaeontologist be contacted to evaluate the find. To remove the material a permit must be applied for from SAHRA under Section 35 of the NHRA.

7.2.3 Graves

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 50 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a permit must be applied for from SAHRA (Section 36 of the NHRA) and other relevant authorities (National Health Act and its regulations). The local South African Police Services must immediately be notified of the find.
- Where it is recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation;
iii. Newspaper notices indicating the intent of the relocation;
iv. A permit from the local authority;
v. A permit from the Provincial Department of Health;
vi. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
vii. An exhumation process that keeps the dignity of the remains intact;
viii. The whole process must be done by a reputable company that is well versed in relocations;
ix. The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

8 CONCLUSIONS AND RECOMMENDATIONS

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of two 75MW solar photovoltaic (PV) energy facilities near Lichtenburg, North West Province. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

The Heritage Impact Assessment has shown that the proposed Tlisitseng Solar projects does have heritage resources present on the property. This has been confirmed through archival research, evaluation of aerial photography of the sites and a field survey.

8.1 Heritage resources

No heritage resources related to the archaeological and historical time period were identified.

Palaeontology

The study area is underlain by Vaalian aged dolomite of the Monte Christo Formation, Chuniespoort Group. Stromatolites are known to occur within these deposits and more modern fossiliferous Caenozoic cave breccias have been recorded associated with carst formation in the dolomite.

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded. Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

8.1.1 Palaeontology mititigation

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded.

- Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs.
- Site visits as stipulated in the management tables will include an initial 2-day site visit and then fortnightly during construction.
- Such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

8.2 Impact Summary

Table 8 provides a summary of the projected impact rating for this project on heritage resources.

Table 10 - Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	9	Negative Low Impact	9	Positive Low Impact
Palaeontology	Impact during construction	63	Negative	57	Positive

8.3 Comparative Assessment of Alternatives – Tlisitseng 1 Substation and Power Line

An assessment of the two Substation of Options indicates that none of the two will have an impact on heritage resources and thus no preference for either exists.

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
SUBSTATION		
Alternative 1	**NO PREFERENCE**	No impact on heritage resources
Alternative 1	**NO PREFERENCE**	No impact on heritage resources

Cumulative impacts

An evaluation of the possible cumulative impacts from the combined solar projects in the area (Table 7 and **Figure 8**) on heritage resources has shown that the biggest envisaged impact could be on the palaeontological heritage of the area with the Watershed Solar Energy facility just northwest of this proposed development increasing the possibility of impacts on the breccias that could occur in the area.

Though with the implementation of mitigation measures these impacts could be transformed into a positive impact through the discovery of previously unknown fossils and the subsequent study of such fossil finds adding to the academic knowledge of the palaeontological resources of the study area.

8.4 Conclusion

The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMP will provided the necessary actions to address any impacts on heritage resources.

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Appendix A

LEGISLATIVE PRINCIPLES

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus, developers will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix C

Heritage Assessment Methodology

The section below outlines the assessment methodologies utilised in the study.

The Heritage Impact Assessment (HIA) report to be compiled by PGS Heritage (PGS) for the proposed Tlisitseng Solar projects will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
  - Density of scatter (dispersed scatter)
    - Low - <10/50m^2
    - Medium - 10-50/50m^2
    - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 11: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

Appendix C

Impact Assessment Methodology to be utilised during EIA phase

Methodology for Impact Assessment

The EIA 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.

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 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

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 should be 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 12: Description

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 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.

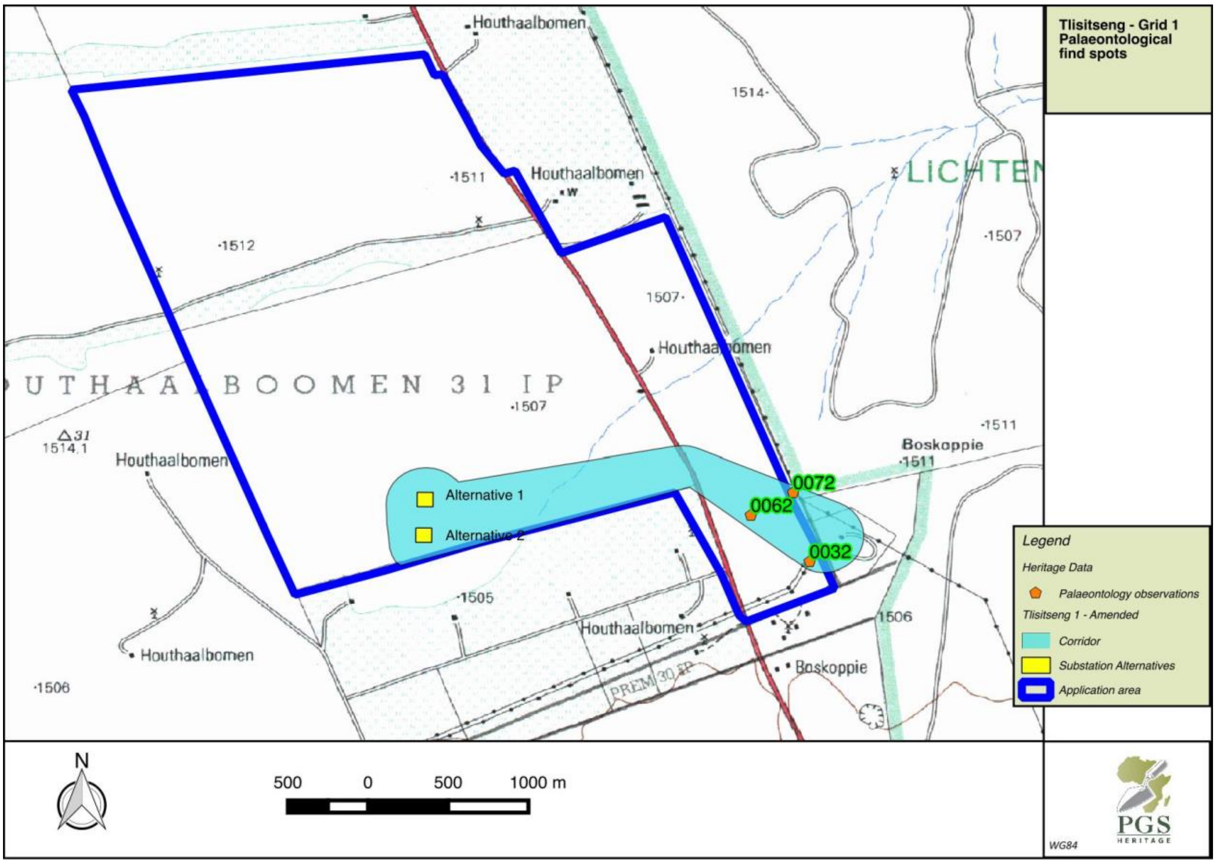
The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic, which can be measured and assigned a significance rating.

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.

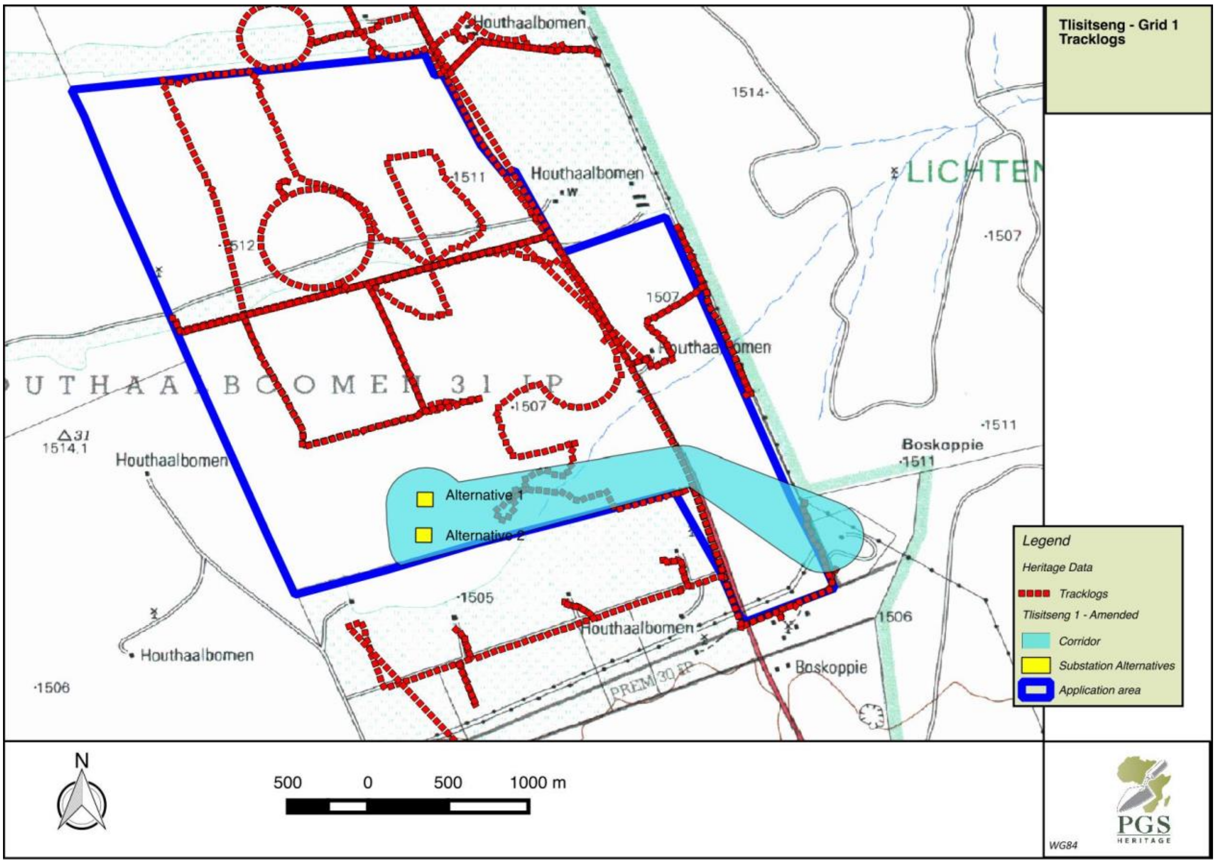
The 2010 regulations also specify that alternatives must be compared in terms of impact assessment.

Appendix D

Heritage Maps



Tlisitseng - Grid 1
Palaeontological find spots
Houthaalbomen
1514
1511
LICHTEN
1512
1507
HOUTHAALBOOMEN 31 IP
31
1514.1
1511
Boskoppie
Alternative 1
Alternative 2
0072
0062
0032
1505
1506
PREM 30 IP
Legend
Heritage Data
Palaeontology observations
Tlisitseng 1 - Amended
Corridor
Substation Alternatives
Application area
N
500
0
500
1000 m
PGS
HERITAGE
WG84



Tlisitseng - Grid 1
Tracklogs
Houthaalbomen
1514
1511
LICHTEN
1512
1507
HOUTHAALBOOMEN 31 IP
31
1514.1
1511
Boskoppie
Alternative 1
Alternative 2
1505
1506
PREM 30 IP
Legend
Heritage Data
Tracklogs
Tlisitseng 1 - Amended
Corridor
Substation Alternatives
Application area
N
500
0
500
1000 m
PGS
HERITAGE
WG84

Appendix D6

PALAEONTOLOGY

BIOTHERM ENERGY (PTY) LTD

TLISITSENG PROJECT - TLISITSENG 1 SUBSTATION AND POWER LINE

Palaeontological Assessment Report

Issue Date: 13 July 2016
Revision No.: 2
Project No.:

Date:	13 07 2016
Document Title:	Palaeontological Assessment Report
Author:	Gideon Groenewald
Revision Number:	0
Checked by:	
For:	SiVEST Environmental Division

Executive Summary

PGS Heritage was appointed by SiVEST Environmental Division to undertake a Heritage Impact Assessment (HIA) Study that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of Tlisitseng Solar 75MW solar photovoltaic (PV) energy facilities near Lichtenburg, Northern Cape Province. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

Palaeontological resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Palaeontological Scoping Report has shown that the proposed Tlisitseng Solar project may have palaeontological resources present on the property. This has been confirmed through archival research and evaluation of Satellite images and geological maps of the sites.

Evaluation of satellite images has indicated that the entire area proposed for development is very highly sensitive from a palaeontological perspective Figure 8).

The fieldwork that covered the Tlisitseng Solar site as well as the proposed power line corridors with an evaluation field of 20 meters for small finds (10 meters either side of the palaeontologists) and 100 meters for larger finds such as sinkholes and possible cave breccias (50 meters either side of the palaeontologists).

A total of a 3 photographic observations were logged (Table 5) of which all the stromatolites were not in situ and the possible cave breccias will only be confirmed after completion of the geotechnical investigations.

Find spots

No outcrops of dolomite with significant stromatolites structures nor any significant finds of cave breccias were recorded during the fieldwork investigation. All significant finds will only be confirmed after completion of the geotechnical surveys (Table 5).

Mitigation

The EAP and ECO of the project must be informed of the slight possibility that significant stromatolites structures and cave breccias might be exposed during excavation of foundations deeper than 1.5m. Field observation indicated that most most the development site is underlain by deep soils and gravel deposits with a low significance for palaeontological heritage.

Sites

During the fieldwork on 17 February 2016 no confirmed palaeontological heritage sites were identified in both the PV sites as well as all the proposed Power line corridors.

Power line sites - *Mitigation:*

- No further mitigation for Palaeontological heritage is recommended before completion of geotechnical surveys. If any significant stromatolites structures or cave breccias are however observed, the palaeontologist must be informed immediately for appropriate action.
- Site visits as stipulated in the management tables will include an initial 2-day site visit and then fortnightly during construction.

Impact Summary

Table 1 provides a summary of the projected impact rating for this project on palaeontological heritage resources, with comparison of sites in Table 3. Key to preferences is given in Table 2.

Table 1: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	62		57	
Palaeontological Heritage	High Negative	High Negative	High Negative Impact	High Positive	High Positive

Comparative Assessment for Tlisitseng Solar Grid 1

Key

Table 2 Key to results of preference

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 3 Preference of sites

Alternative	Preference	Reasons
SUBSTATION		
Alternative 1	NO PREFERENCE	No palaeontological heritage resources identified
Alternative 1	NO PREFERENCE	No palaeontological heritage resources identified

BIOTHERM (Pty) Ltd – Tlisitseng 1 Substation and Power Line

PALAEONTOLOGICAL HERITAGE ASSESSMENT REPORT

Contents Page

Appendices

1 INTRODUCTION

PGS Heritage was appointed by SiVEST Environmental Division to undertake a Heritage Impact Assessment (HIA) Study that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of Tlisitseng Solar 75MWsolar photovoltaic (PV) energy facilities near Lichtenburg, Northwest Province. This report addresses the Tlisitseng Solar 1 132kV power line to connect the PV facilities to the proposed Tlisitseng substation.

1.1 Scope of the Study

The aim of the study is to identify possible palaeontological heritage sites, finds and sensitive areas that may occur in the study area for the EIA study. The Palaeontological Impact Assessment (PIA) aims to inform the Environmental Impact Assessment in the development of a comprehensive Environmental Management Plan to assist the developer in managing the discovered palaeontological heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

PGS Heritage (PGS) compiled this Heritage Impact Assessment Report.

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing the HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

This report was commissioned by PGS Heritage and was completed by Dr Gideon Groenewald, an accredited Palaeontologist.

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African

Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years). Dr Groenewald was accompanied by Mr David Groenewald (BS Hons Palaeontology, Wits Univiersity) and experienced fieldworker.

1.3 Assumptions and Limitations

Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the palaeontological heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage features or objects not included in the inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to exposing of stromatolites structures as well as cave breccias.

The survey was conducted over 1 day over the extent of the total footprint area by Dr Gideon Groenewald and David Groenewald on 17 February 2016. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the palaeontological heritage character of the area.

The fieldwork that covered the Tlisitseng Solar site as well as the proposed power line corridors covered the whole area by vehicle and on foot, with specific observations recorded as a photographic database (**Table 2**). Detailed observation of outcrops were considered as highly important whereas loose gravel and boulders were recorded as representative examples of stromatolites structures which were out of situ observations. **No obvious cave breccias or sink holes were observed and the presence of these highly sensitive structures need to be confirmed during detailed geophysical investigations for possible sink hole structures on dolomitic terrains or karts topography.**

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998

ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage Resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…". The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA legislation. In the latter cases, the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Sections of these Acts relevant to heritage (Fourie, 2008, Groenewald et al 2014).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

Refer to **Appendix A** as well as the recommendations and discussions in the Desktop Surveys and Scoping report for Palaeontological Impacts (Internal Report, 2015) for further discussions on heritage management and legislative frameworks

1.5 Terminology

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
iii. wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
iv. features, structures and artefacts associated with military history, which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age, between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance, such as the caves with archaeological deposits identified close to both development sites for this study.

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

1.6 Abbreviations

Table 4 Acronyms

Acronyms	***Description***
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
CCS	Cryptocrystalline silicate
DEA	Department of Environmental Affairs
DoE	Department of Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HV	High Voltage
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
PV	Photovoltaic
ROD	Record of Decision
SPV	Special Purpose Vehicle
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

2 TECHNICAL DESCRIPTION

Tlisitseng Solar PV will be located approximately 8km north-west of Lichtenburg, in the Ngaka Modiri Molema District of the North West Province. The application site is approximately 1000ha however the buildable area will be significantly smaller than this and will be determined by sensitive areas identified during the Scoping Phase of the EIA. Tlisitseng Solar will consist of two (2) 75MW solar PV facilities, namely Tlisitseng Solar 1 and Tlisitseng Solar 2. Additionally, 132kV power lines will connect the PV facilities to the proposed Tlisitseng substation (Figure 1).

2.1 PV Project Components

Panels will be either fixed axis mounting or single axis tracking solutions, and will be either crystalline silicon or thin film technology. In addition to the PV panels each project will consist of:

- An onsite switching station, with the transformers for voltage step up from medium voltage to high voltage;
- The panels will be connected in strings to inverters and inverter stations will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers;
- DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers.
- The 22-33kV cables will be run underground in the facility to a common point before being fed to the onsite switching station where the voltage will be stepped up to 132kV.
- A power line with a voltage of 132kV to the proposed Tlsitseng substation;
- A laydown area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- A car park and fencing; and
- Administration, control and warehouse buildings.

2.2 Solar Field

Solar PV panels are usually arranged in rows or ‘arrays’ consisting of a number of PV panels. The area required for the PV panel arrays will likely need to be entirely cleared or graded. Where tall vegetation is present, this vegetation will be removed from the PV array area.

Approximately 300 000 solar PV panels will be required per project for a total export capacity of 75MW. Support structures will be either fixed axis mounting or single axis tracking solutions and the modules will be either crystalline silicon or thin film technology. The solar PV panels are variable in size, and are affected by advances in technology between project inception and project realisation. The actual size of the PV panels to be used will be determined in the final design stages of the project. The PV panels are mounted onto metal frames which are usually aluminium. Rammed or screw pile foundations are commonly used to support the panel arrays (Figure 2).

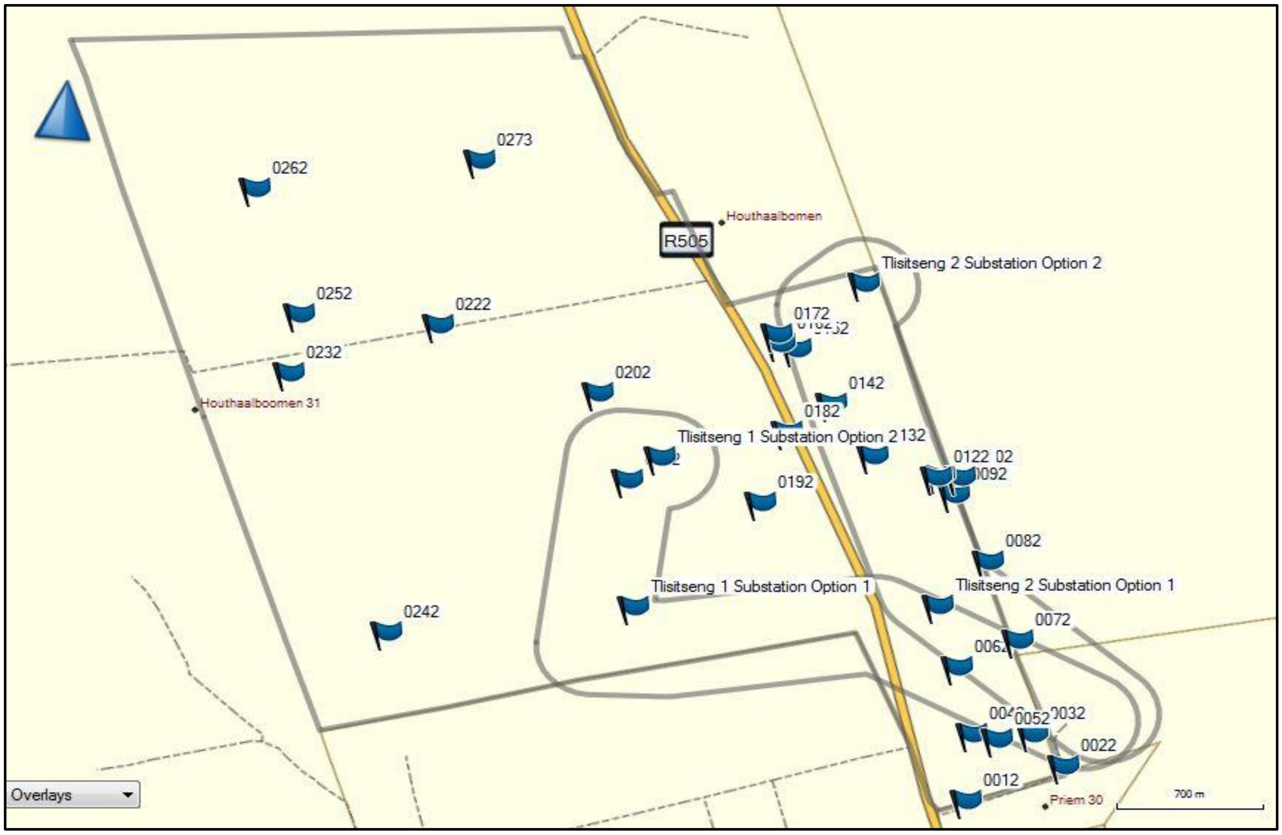


Figure 1 - Study area with indication of observation points as described in Table 5

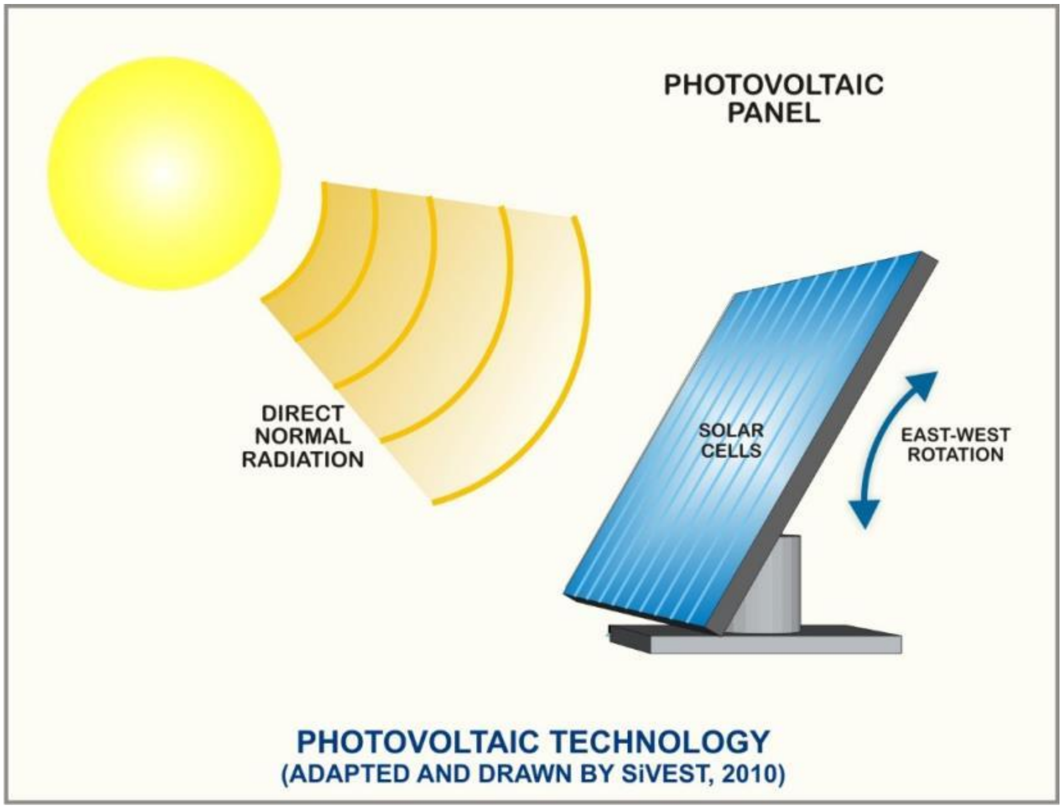


Figure 2 - Example of a Photovoltaic Panel with tracking capability.

2.3 Associated Infrastructure

2.3.1 Electrical Infrastructure

The solar PV panel arrays are connected to each other in strings, which are in turn connected to inverters. For a 75MW size facility, typically 2MW inverter stations which are containerised stations housing 2x1MW inverters and 1x2MVA transformers will be used; therefore approximately 43 inverter stations will be required throughout the site for the proposed solar PV energy facility (Figure 3). DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers. The 22-33kV cables will be run underground in the facility to a common point before being fed to the onsite substation and switching station where the voltage will typically be stepped up to 132kV. A Power line with a voltage of up to 132kV will run from the onsite substation to the existing Tlisitseng substation. The distance will be about 4km.

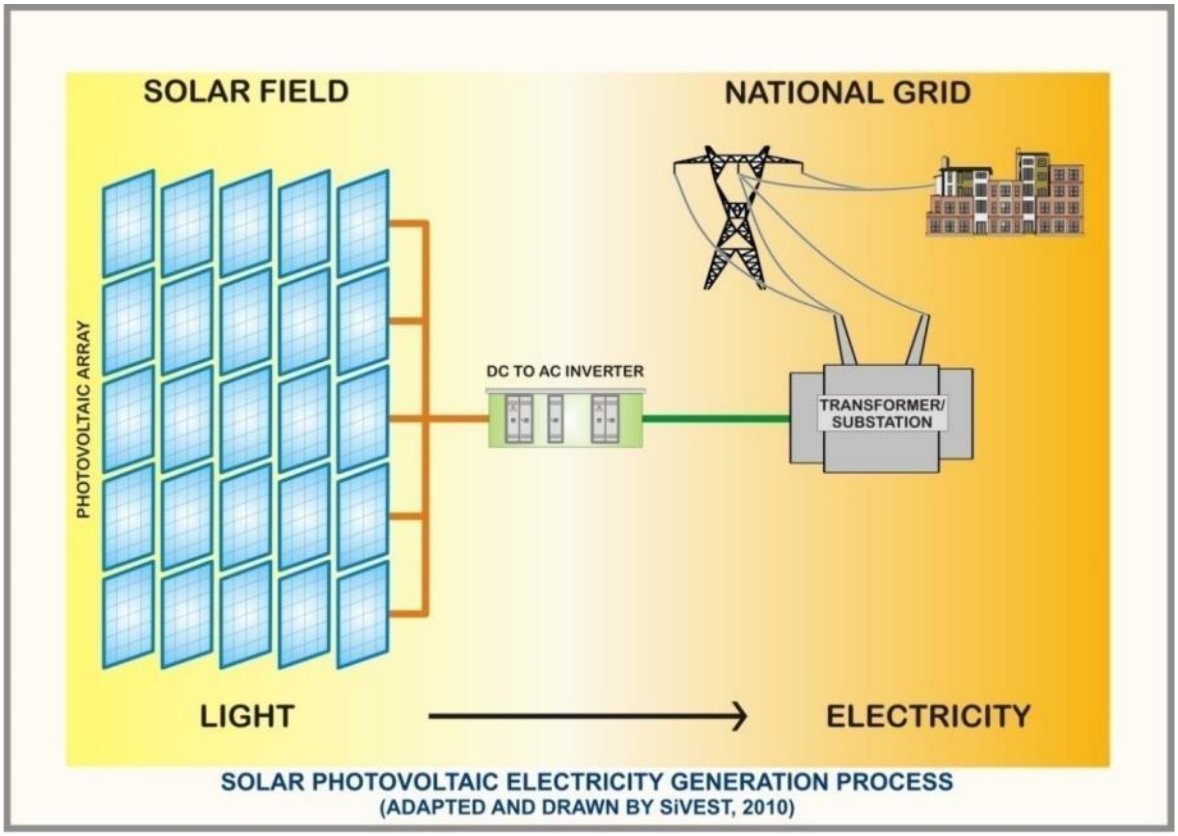


Figure 3 - PV process

2.3.2 Buildings

The solar field will require onsite buildings, which will be used in the daily operation of the plant and includes an administration building (office). The buildings will likely be single storey buildings, which will be required to accommodate the following:

- Control room
- Workshop
- High Voltage (HV) switchgear
- Mess Room
- Toilets
- Warehouse for storage
- Car park and fencing around the project

2.3.3 Construction Lay-down Area

A general construction lay-down area will be required for the construction phase of the proposed solar PV energy facility. The size of this area is yet to be determined, but 3 to 5 hectares is likely.

2.3.4 Other Associated Infrastructure

Other associated infrastructure includes the following:

- Access roads and internal roads;
- A car park; and
- Fencing around the project.

2.4 Alternatives

Due to the limited space available as well as the constraints of the sensitive areas, two alternative PV panel layouts were identified. The final proposed layout is to be assessed following the fieldwork investigations.

Two alternative corridors for the power line routes were proposed and a single corridor 2 selected (**Figure 4**).

Figure 4 - Power line route corridor

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Palaeontological Heritage Site significance

PGS Heritage (PGS) compiled this Palaeontological Heritage Assessment Document as part of the Heritage Impact Assessment (HIA) report for the proposed Tlisitseng Solar facilities. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

3.1.1 Scoping Phase

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

3.1.2 Impact Assessment Phase

Step II – Physical Survey: On Wednesday 17 February 2016, a Phase 1 PIA Survey survey was conducted by vehicle and on foot through the proposed project area by two qualified palaeontologists, Dr Gideon Groenewald and David Groenewald. The survey aimed at locating and documenting any palaeontological sensitive information falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant palaeontological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

Appendix B, outlines the Plan of study for the Heritage Impact Assessment process, while **Appendix C** provides the guidelines for the impact assessment evaluation that was used during the EIA phase of the project.

4 BACKGROUND RESEARCH

The examination of heritage databases, historical data and cartographic resources (1:250 000 scale geological map 2626 WEST-RAND) represents a critical additional tool for locating and identifying palaeontological heritage resources and in determining the historical and cultural context of the study area. Relevant topographic maps and satellite imagery were studied (Scoping Report and Desktop PIA report, Groenewald, 2015).

4.1 Previous Studies

Researching the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that the proposed area falls in very highly sensitive palaeontological heritage regions due to the very high possibility of finding significant stromatolites structures as well as Quaternary aged cave breccias with possible homonin fossil remains.

4.1.1 Findings from the studies

Palaeontology

The following map (Figure 5) is an extract from the palaeontological desktop study completed by Groenewald (2015) for the proposed solar project on the farm Houthaalbomen 31 comprising a large part of the study area. The map indicates the main geological units as indicated on the map:

The study area is underlain by Vaalian aged Monte Christo Formation of the Malmani Subgroup, Chuniespoort Group of the Transvaal Supergroup (Figure 5)

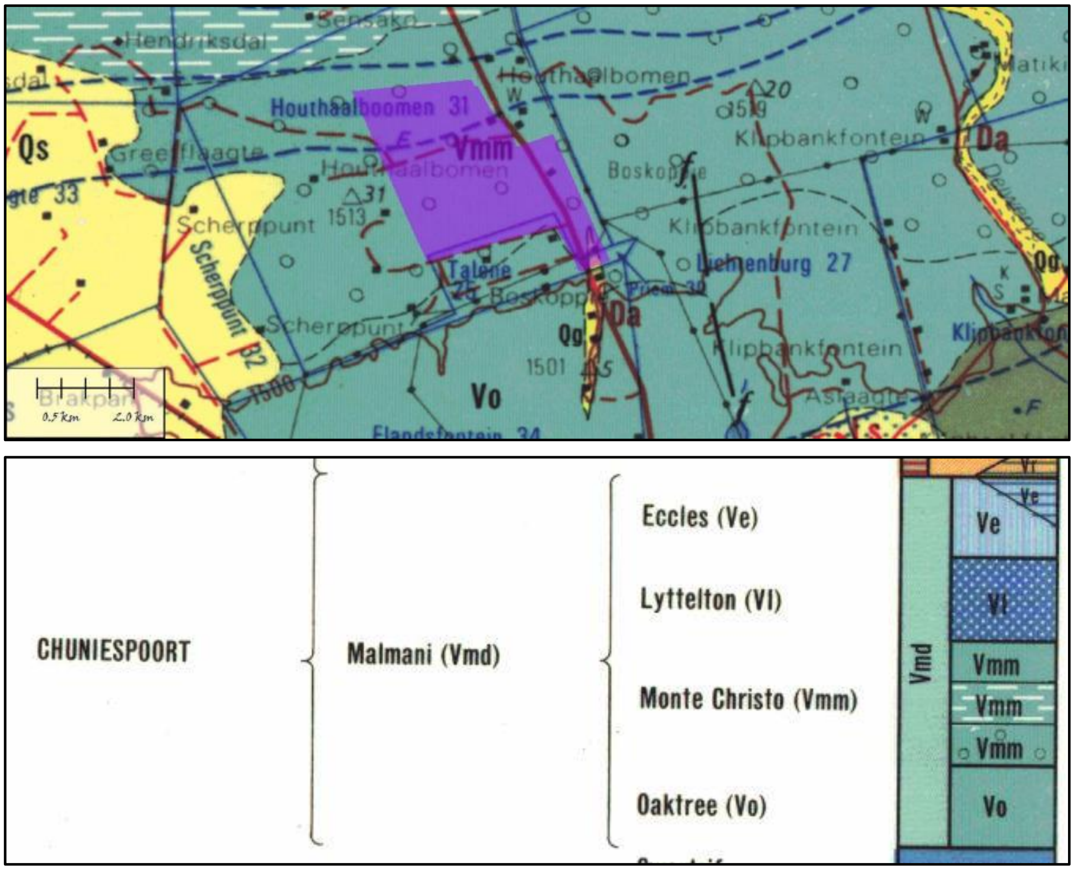


Figure 5 - Geological Map of study area

5 PALAEONTOLOGY OF THE AREA

5.1 Transvaal Supergroup

5.1.1 Chuniespoort Group, Malmani Subgroup

The dolomites of the Malmani subgroup contain a range of shallow marine and lacustrine stromatolites (some very large), oolites, and pisolites in carbonates, filamentous and coccoid organic walled microfossils such as cyanobacteria in siliciclastics and carbonates, as well as cherts.

Dolomite areas are allocated a Very High Palaeontological Sensitivity due to presence of cast topography and possible cave breccias with potential Homonin fossils. Diverse Late Pliocene to Pleistocene (Makapanian, Cornelian, Florisian) mammalian biotas, including several extinct Hominins (spp. of *Australopithecus, Paranthropus, Homo*), micromammals, reptiles (lizards), frogs, birds, land snails, coprolites, stone and bone artefacts, plant remains (e.g. petrified wood, palynomorphs). A number of very important fossiliferous cave sites are for example present in Cradle of Humankind near Klerksdorp (Gauteng & North West)

Monte Christo Formation

The Vaalian aged Monte Christo Formation is a chert-rich dolomite with stromatolite structures and oolitic chert layers. Recording of these structures contributes significantly to our understanding of the palaeo-environments in this part of South Africa.

Groenewald (2015), indicated that the, "*The very high fossiliferous potential of the Monte Christo Formation, warrants an allocation of a Very High palaeontological sensitivity to the areas underlain by the rocks of the this formation. All the areas underlain by Dolomite have a very high potential of containing cave breccias with highly sensitive fossil remains including remains of Homonin fossils*." (Figure 6)

Figure 6 - Very High Sensitivity for Palaeontological heritage for entire site with all alternatives and power line corridors

5.1.2 *Possible finds*

Evaluation of historical data, geological map and satellite images has indicated that the entire study area might have fossils associated with the dolomitic terrain (Figure 6).

To be able to compile a heritage management plan to be incorporated into the Environmental Management Plan the following further work will be required for the EIA.

- Palaeontological assessment of the area after completion of the geotechnical investigations to identify possible cave breccias and possible sites of sink hole formations.

6 IMPACT ASSESSMENT

6.1 Field work findings

6.1.1 Methodology

Fieldwork was conducted on the two proposed PV developments of the Tlisitseng Project on 17 February 2016. The methodology focused of a tracked drive- and walkthrough of the foot print areas of proposed PV project as well as the two proposed power line corridors from the site to the Tlisitseng substation. An accredited professional palaeontologist, Dr Gideon Groenewald, assisted by David Groenewald, completed the fieldwork. All the fieldwork was done by vehicle and on foot and consisted of several kilometres of tracked field walking through the proposed development areas (**Figure 7**)

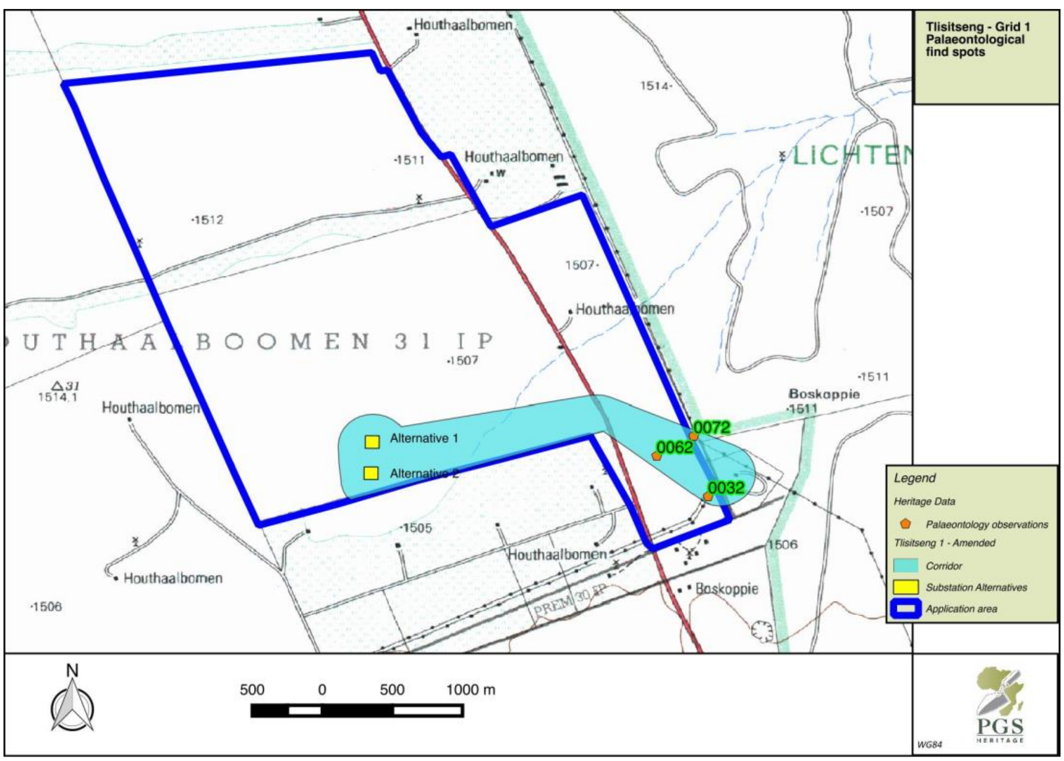


Figure 7 - Observation sites of photographic recordings for palaeontological heritage. See Table 5

All the palaeontological remains observed were associated with loose boulders on site and no significant outcrop was recorded (Table 5). Without access to the results of the geotechnical investigations it is not possible to assess the possible presence of sinkholes or potential cave deposits.

6.1.2 Sites

During the fieldwork most of the areas have no outcrop and only a few loose blocks contained well-defined stromatolites, albeit not in situ.

Table 5 Photographic observations during fieldwork session (See Figure 7)

Photo	GPS station no (Fig. 7) and coordinates	Description	Picture
1	(062 -26° 05' 21.9" 26° 08' 15.3"	Deep soils on dolomite. No outcrop. No fossils observed. Landscape indicate old river bed with river gravels and boulders of dolomite and chert.	
2	(062) -26° 05' 21.9" 26° 08' 15.3"	Micro-stromatolite structures in dolomite and chert layers. Boulders not in situ	

3	(072) -26° 05' 16.8" 26° 08' 24.8"	Micro-stromatolites in possible outcrop, covered in shallow soil. Geotechnical reports will indicate possible exposure of these fossils during excavation for foundations	 [WF1]
4	(032) -26° 05' 32.3" 26° 08' 28.5"	Aardvark. burrow into deep Hutton soils. No outcrop, no fossils observed	

Mitigation:

- Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs.
- Such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

6.2 Assessment

The fieldwork findings have shown that the study area is characterised by a background scatter of Stromatolites in all the dolomite boulders on site and some areas have remains of cave breccia but no in situ outcrops were recorded.

It must be kept in mind that the fieldwork could in no way identify all palaeontological sites within the development footprint and as such the fieldwork has shown that the possibility of encountering possible cave breccias during geotechnical investigation is relatively high.

The following set of tables provide an assessment of the impact on palaeontological heritage resources within the development foot print

Table 6 Rating of Impacts and Chance finds

IMPACT TABLE	
Environmental Parameter	*Palaeontological Resources*
Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified heritage resources and specifically Palaeontological sites. As well as the impact on the identified palaeontological sites*
Extent	*Will impact on the footprint area of the development*
Probability	*The fieldwork has shown that such a predicted impact will definitely occur*
Reversibility	*Due to the nature of palaeontological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*
Duration	*The impact on heritage resources such as palaeontological sites will be permanent*
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on palaeontological sites the cumulative impact is seen as having a medium negative impact.*
Intensity/magnitude	*The large scale impact on palaeontological sites might require mitigation work.*
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as very high pre-mitigation. This can be attributed to the very high possibility of encountering more palaeontological sites during geotechnical investigations. The implementation of the recommended heritage mitigation measures will address the envisaged*

	impacts and reduce the overall rating to a low impact rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	3	2
Reversibility	4	3
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	-63 (high negative)	57 (high positive)
Mitigation measures	*Mitigation through palaeontological excavations and collection if Geotechnical Survey indicates necessity for mitigation* *Monitoring during construction by palaeontologist if fossils are exposed during excavation of more than 1.5m of soil cover*	

6.3 Cumulative Assessment

A large number of solar projects are proposed and some have been approved and is currently in construction around the study area (Table 8).

The need for the implementation of the recommended mitigation measures is of great importance and must be seen in the context of the large areas to be impacted by the construction activity. By implementing the mitigation measures the cumulative effect will be reduce from a High to a Medium negative impact rating.

Table 7 Renewable energy developments proposed within a 20km radius from the proposed Tlisitseng PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Matrigenix Renewable Energy Project	14/12/16/3/3/3/270	Scoping and EIA processes underway	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands 27
Watershed Solar Energy Facility	14/12/16/3/3/2/557	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2/1062	Project has received environmental authorisation	South Africa Mainstream Renewable Power Developments (Pty) Ltd	**UNKNOWN**	Portions 9 and 31 of the Farm Hibernia 52

6.4 Impact Summary

Table 8 provides a summary of the projected impact rating for this project on heritage resources.

Table 8 Projected Impact ratings for the palaeontological resources on site

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Palaeontological resources	Impact during construction	63	High Negative Impact	57	High Positive

6.5 Comparative Assessment for Tlisitseng Solar

Key

Table 9 Key to the comparative assessment of sites

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 10 Summary of alternatives

Alternative	**Preference**	**Reasons**
SUBSTATION		
Alternative 1	NO PREFERENCE	No significant palaeontological heritage resources identified before geotechnical report is available
Alternative 2	NO PREFERENCE	No significant palaeontological heritage resources identified before geotechnical report is available

7 MANAGEMENT GUIDELINE

7.1 Heritage Management Plan for EMP implementation

Table 11 Mitigation measures proposed

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible [palaeontological heritage finds in induction prior to construction activities take place – Refer to Section 5 of this report referring to geotechnical reports	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible palaeontological heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R10 000**
C	Monitoring of construction activities by palaeontologist if indicated after completion of geotechnical report	Construction	During construction	Applicant ECO Palaeontologist	Palaeontologist (Initial 2-day site visit. Then Fortnightly during construction)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Palaeontologist Monthly Checklist/Report	**Monthly R40-50 000**

8 HERITAGE MANAGEMENT GUIDELINES

8.1 All phases of the project

8.1.1 Palaeontology

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area. It is essential that the information gathered during the Geotechnical investigations for developments be made available to the Heritage Practitioner and Palaeontologist to assess the possibility of exposing bedrock with fossils where excavations will exceed 1.5m or where gravity surveys indicate possible karst topography in dolomitic terrains.

It is possible that cultural material, including palaeontological finds, will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the prospecting phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological and palaeontological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological and palaeontological monitoring programme.

In the case where archaeological or palaeontological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological or palaeontological material, a buffer of at least 20 meters should be implemented.
- If archaeological and palaeontological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist or palaeontologist be contacted to evaluate the find. To remove the material a permit must be applied for from SAHRA under Section 35 of the NHRA.

9 CONCLUSIONS AND RECOMMENDATIONS

Palaeontological Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Scoping Report (Desktop PIA study) has shown that the proposed Tlisitseng Solar project may have palaeontological heritage resources present on the property. This has been confirmed through archival research and evaluation of aerial photography of the sites. Confirmation of actual presence of significant finds will only be possible after the completion of the geotechnical surveys for this project.

Evaluation of geological maps and satellite imagery has indicated the entire development area that may be sensitive from an archaeological perspective.

The fieldwork that covered the Tlisitseng Solar site as well as the proposed power line corridors covered the entire area with an evaluation field of 20 meters for small finds (10 meters either side of the palaeontologist) and 100 meters for larger finds such as possible sinkholes and cave breccias sites with tree growths (50 meters either side of the palaeontologist). Planted maize fields were excluded from the surveys due to the fact that fossils will not be visible.

9.1 Find spots

Local scree material and blocks of dolomite were inspected for fossils and all finds were recorded as photographic records (Table 5). No outcrop of bedrock with fossils was recorded and sites with cave breccia were recorded in areas where chert breccia was obviously present in the loose material. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.

Mitigation:

- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas;

- Field assessment indicated the presence of both stromatolites structures and cave breccia but all the observed examples were out of situ;
- Any excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas;
- If any excavation or collection of fossils are recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Due to the large number of boulders with stromatolites present on site it is recommended that an palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites.

9.2 Sites

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded (Table 2). Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

Power line sites - *Mitigation:*

- Where required the sites identified from the geotechnical reports will then need mitigation measures developed that will need to be completed before construction can commence;
- Site visits as stipulated in the management tables will include an initial 2 day site visit and then fortnightly during construction.
- Such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

9.3 Impact Summary

Table 14 provides a summary of the projected impact rating for this project on heritage resources.

Table 12: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Palaeontological resources	Impact during construction	63	High Negative Impact	57	High Positive

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average

Palaeontological resources	Impact during construction	63	High Negative Impact	57	High Positive

9.4 Comparative Assessment for Tlisitseng Solar Grid 1

Key

Table 13 Key to comparative assessments

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 14 Comparative assessments

Alternative	Preference	Reasons
SUBSTATION		
Alternative 1	NO PREFERENCE	No significant palaeontological heritage resources identified before geotechnical report is available
Alternative 2	NO PREFERENCE	No significant palaeontological heritage resources identified before geotechnical report is available

10 REFERENCES

GROENEWALD, GH., GROENEWALD SM. AND GROENEWALD DP. 2014. Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces. Internal Palaeotechnical Reports, SAHRA.

GROENEWALD GH. 2015. Palaeontological Desktop Assessment for the proposed Tlisitseng Solar PV. Internal Report, PGS Heritage (Pty) Ltd.

Appendix A

LEGISLATIVE PRINCIPLES

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus, developers will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix C

Heritage Assessment Methodology

The section below outlines the assessment methodologies utilised in the study.

The Heritage Impact Assessment (HIA) report compiled by PGS Heritage (PGS) for the proposed Helena 1 Solar projects will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.
- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.
- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
    - Density of scatter (dispersed scatter)
        - Low - $<10/50m^2$
        - Medium - $10\text{-}50/50m^2$
        - High - $>50/50m^2$
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 15: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

Appendix C

Impact Assessment Methodology to be utilised during EIA phase

The EIA 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.

10.1 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 shown in Table 3.

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.

10.2 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 should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

10.2.1 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 16 Classification of sensitivity ratings

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 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.

Table 17 Impact Assessment

The table below is to be represented in the Impact Assessment section of the report.

IMPACT TABLE FORMAT		
Environmental Parameter	*A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water*	
Issue/Impact/Environmental Effect/Nature	*A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water*	
Extent	*A brief description of the area over which the impact will be expressed*	
Probability	*A brief description indicating the chances of the impact occurring*	
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*	
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*	
Duration	*A brief description of the amount of time the proposed activity is likely to take to its completion*	
Cumulative effect	*A brief description of whether the impact will be exacerbated as a result of the proposed activity*	
Intensity/magnitude	*A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMP.*	

10.3 Impact Summary

The impacts will then be summarized and a comparison made between pre and post mitigation phases as shown in Table 4 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison will then be made to determine the effectiveness of the proposed mitigation measures. The comparison will identify critical issues related to the environmental parameters.

The table below is to be represented in the Executive Summary of the report.

Table 18 Executive Summary

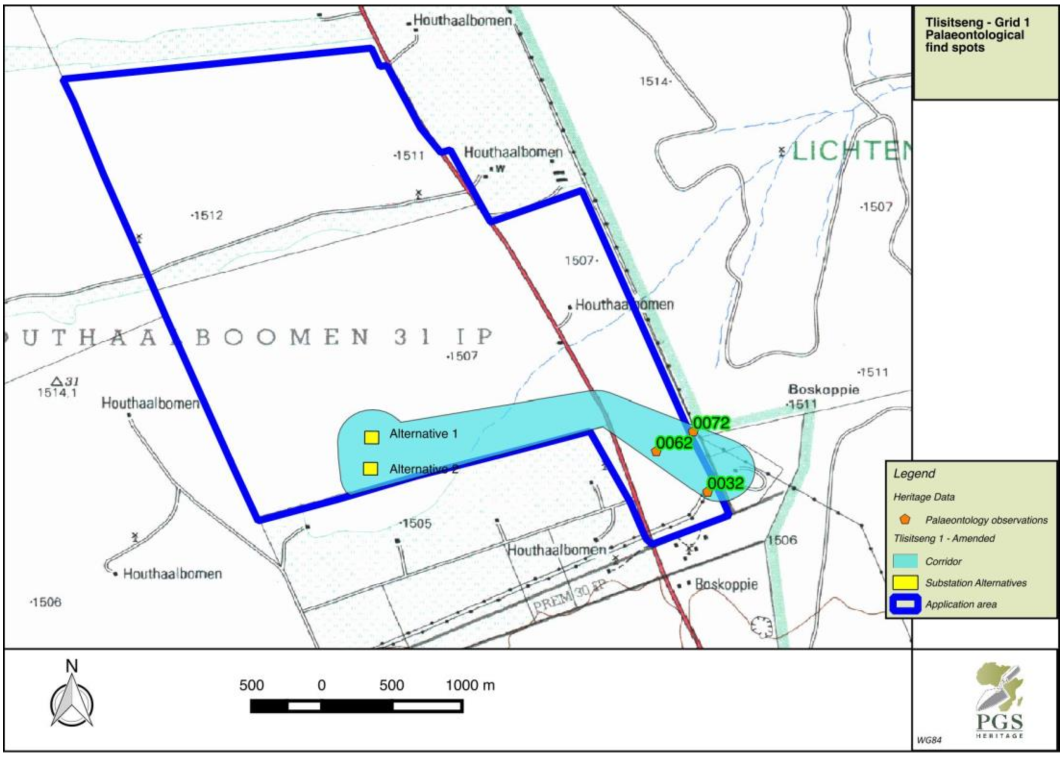
Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Surface water	Erosion	43		16	
	Oil spills	22		22	
	Alteration of aquatic biota	16		3	
			- 0.0		**-0.0**
			Low Negative Impact		Low Negative Impact

Finally, the 2010 regulations also specify that alternatives must be compared in terms of impact assessment. Hence all alternatives will need to be comparatively assessed.

Appendix D

Palaeontological Heritage Map

Figure 8 Palaeontological Sensitivity of Tlisitseng PV Solar Study Area



Tlisitseng - Grid 1
Palaeontological
find spots
Houthaalbomen
1514
LICHTEN
1511
1512
1507
1507
HOUTHAALBOOMEN 31 IP
1507
Houthaalbomen
1511
Boskoppie
1511
△31
1514,1
Houthaalbomen
0072
0062
0032
Alternative 1
Alternative 2
1505
Houthaalbomen
1506
Houthaalbomen
Boskoppie
PREM 30 IP
1506
Legend
Heritage Data
Palaeontology observations
Tlisitseng 1 - Amended
Corridor
Substation Alternatives
Application area
N
500 0 500 1000 m
PGS
HERITAGE
WG84

Appendix D7

VISUAL

BIOTHERM ENERGY PTY (LTD)

Proposed Construction of the Tlisitseng 1 Substation and Associated 132kV Power Line near Lichtenburg, North West Province

Visual Impact Assessment Report - Basic Assessment

Issue Date: 02 march 2017
Revision No.: **3**
Project No.: 13303

Date:	02 March 2017
Document Title:	Proposed Construction of the Tlisitseng 1 Substation and Associated 132kV Power Line near Lichtenburg, North West Province: Visual Impact Assessment Report – Basic Assessment
Author:	**Stephan Jacobs** B.Sc. (Hons) Environmental Management & Analysis (UP) BSc Environmental Sciences (UP)
Revision Number:	#2
Checked by:	**Andrea Gibb** (internal review) B.Sc. (Hons) Environmental Management (UNISA) BSc Landscape Architecture *Cum Laude* (UP) **Keagan Allan** – SRK Consulting (South Africa) (Pty) Ltd (peer review) Pr. Sci Nat
Approved:	Kelly Tucker
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:	
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 Tlisitseng 1 Substation and Associated 132kV Power Line near Lichtenburg, North West Province

Specialist:	**SiVEST SA (Pty) Ltd**		
Contact person:	Stephan Jacobs		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 737 2114
Telephone:	011 798 0677	Fax:	011 803 7272
E-mail:	stephanj@sivest.co.za		
Professional affiliation(s) (if any)	None		

Project Consultant:	**SiVEST SA (Pty) Ltd**		
Contact person:	Andrea Gibb		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 587 6525
Telephone:	011 798 0638	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)

09 March 2016

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)

19 April 2016

Date

BIOTHERM ENERGY PTY (LTD)

PROPOSED CONSTRUCTION OF THE TLISITSENG 1 SUBSTATION AND ASSOCIATED 132kV POWER LINE NEAR LICHTENBURG, NORTH WEST PROVINCE

VISUAL IMPACT ASSESSMENT REPORT - BASIC ASSESSMENT

Contents Page

List of Figures

List of Tables

Appendices

GLOSSARY OF TERMS

ABBREVIATIONS

BA	Basic Assessment
DM	District Municipality
EIA	Environmental Impact Assessment
I&AP	Interested and/or Affected Party
kV	Kilovolt
LM	Local Municipality
MTS	Main Transmission Substation
OHL	Overhead Line
NGI	National geo-spatial information
SANBI	South African National Biodiversity Institute
VIA	Visual Impact Assessment

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 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.

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 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 conform 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.

BIOTHERM ENERGY PTY (LTD)

PROPOSED CONSTRUCTION OF THE TLISITSENG 1 SUBSTATION AND ASSOCIATED 132kV POWER LINE NEAR LICHTENBURG, NORTH WEST PROVINCE

VISUAL IMPACT ASSESSMENT REPORT - BASIC ASSESSMENT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) are proposing to construct a 132kV on-site substation, namely Tlisitseng 1 Substation, and associated 132kV power line near Lichtenburg in the North West Province (hereafter referred to as the ‘proposed development’). The proposed development is aimed at connecting BioTherm’s proposed Tlisitseng Solar 1 photovoltaic (PV) energy facility (part of separate on-going EIA process) onto Eskom’s national grid at the existing Watershed Main Transmission substation (MTS). SiVEST South Africa (Pty) Ltd (hereafter referred to as SiVEST) have been appointed by BioTherm to undertake the Basic Assessment (BA) for proposed construction of the 132kV on-site Tlisitseng 1 Substation, 132V power line and associated infrastructure. 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 in order to characterise the area and broadly identify all the potential visual impacts and issues relating to the proposed development. This visual assessment undertaken during the BA focuses on the potential sensitive receptor locations, and provides an assessment of the magnitude and significance of the visual impacts associated with the proposed 132kV on-site Tlisitseng 1 Substation and associated 132kV power line. 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 the construction / development of a 132kV on-site substation (namely Tlisitseng 1 Substation), as well as a 132kV power line, which will aim at connecting the proposed Tlisitseng solar 1 PV energy facility (part of separate on-going EIA process) to Eskom's national grid. The proposed development will include the following components/factors:

- Construction of an on-site substation with a capacity of up to 132kV (referred to as Tlisitseng 1 substation) occupying a footprint area of approximately 2.25ha;
- Construction of a power line with a capacity of up to 132kV routed between the new proposed on-site Tlisitseng 1 substation and the existing Watershed MTS;
- The proposed 132kV power line will have a servitude width of approximately 31m;
- An on-site switching substation with grid transformer(s) for voltage step up to a high voltage of up to 132kV. The switching station will be a common substation connecting multiple phases of the project to the Watershed MTS;
- Access roads; and
- Administration, control and warehouse buildings.

The 132kV power line will consist of a series of towers located approximately 250 to 400m apart, depending on the terrain. It is proposed that the steel lattice tower type (518H and 518C), would predominantly be used for the proposed power line in combination with other towers, as required (e.g. guyed 'vee' suspension towers). The steel lattice tower type is approximately 28m in height. The height will vary based on the terrain, but will ensure minimum Overhead Line (OHL) clearances with buildings and surrounding infrastructure.The exact location of the towers will be determined during the final design stages of the power line.

Drawings of the tower type are indicated in **Figure 1** below.

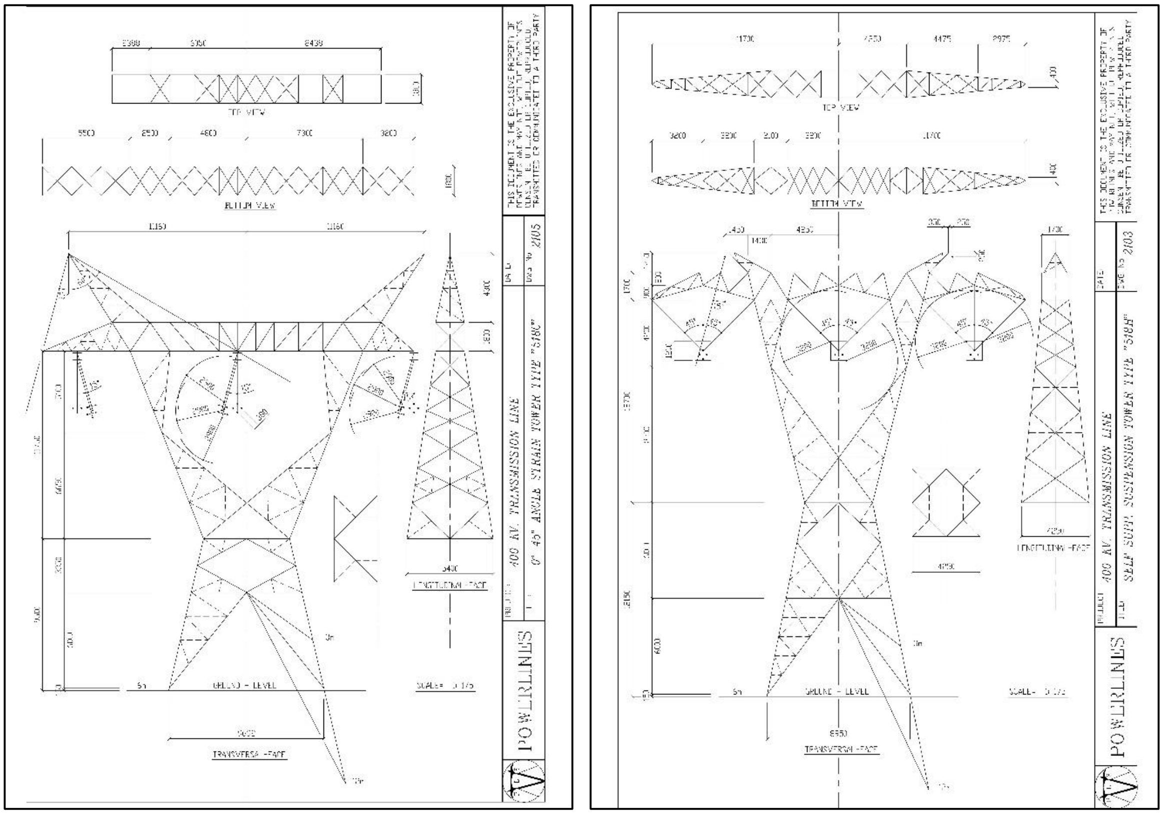


Figure 1: Proposed Steel Lattice Tower Types

1.2 Site Location

The proposed development site for the 132kV on-site Tlisitseng 1 Substation and 132kV power line will be located within the North West Province, approximately 6km north-west of Lichtenburg. It falls within the Ditsobotla Local Municipality that forms part of the Ngaka Modiri Molema District Municipality (**Figure 2**).

The application site for the proposed 132kV on-site Tlisitseng 1 Substation is located on Portion 25 of the Farm Houthaalboomen No 31, which is approximately 1000ha in extent.

As previously mentioned, grid connection for the proposed Tlisitseng solar 1 PV energy facility (part of separate on-going EIA process) will be to the existing Watershed MTS via a proposed 132kV power line. The Watershed MTS is located immediately adjacent to the south-east boundary of the PV facility application site. It should also be noted that the proposed 132kV power line will be either 1.9 or 2.9km in extent, depending on which substation alternative is chosen as the preferred option. The PV facility application site, proposed 132kV on-site Tlisitseng 1 Substation site and 132kV power line corridor route are shown in the locality map below (**Figure 3**).

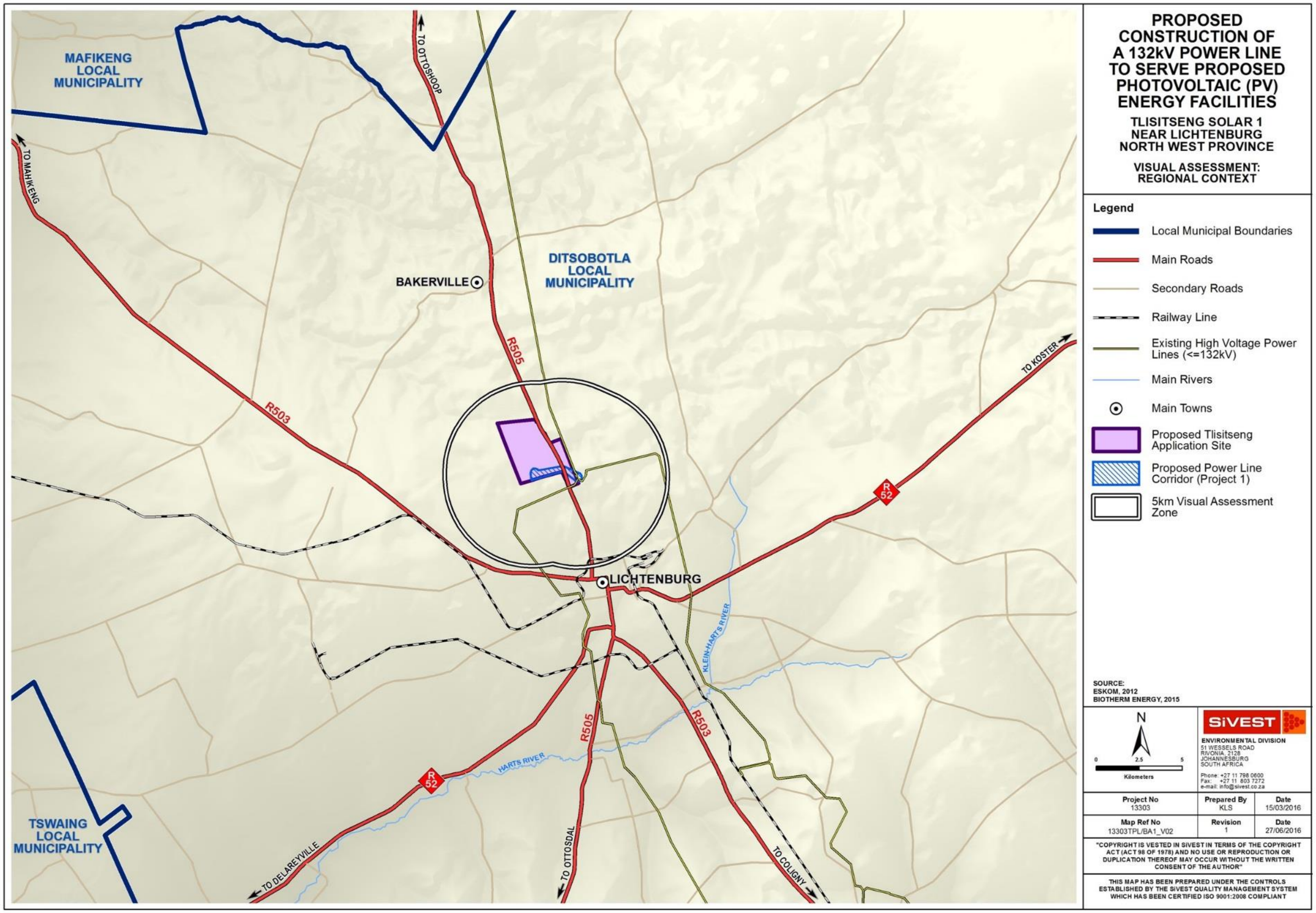


Figure 2: Regional Context Map

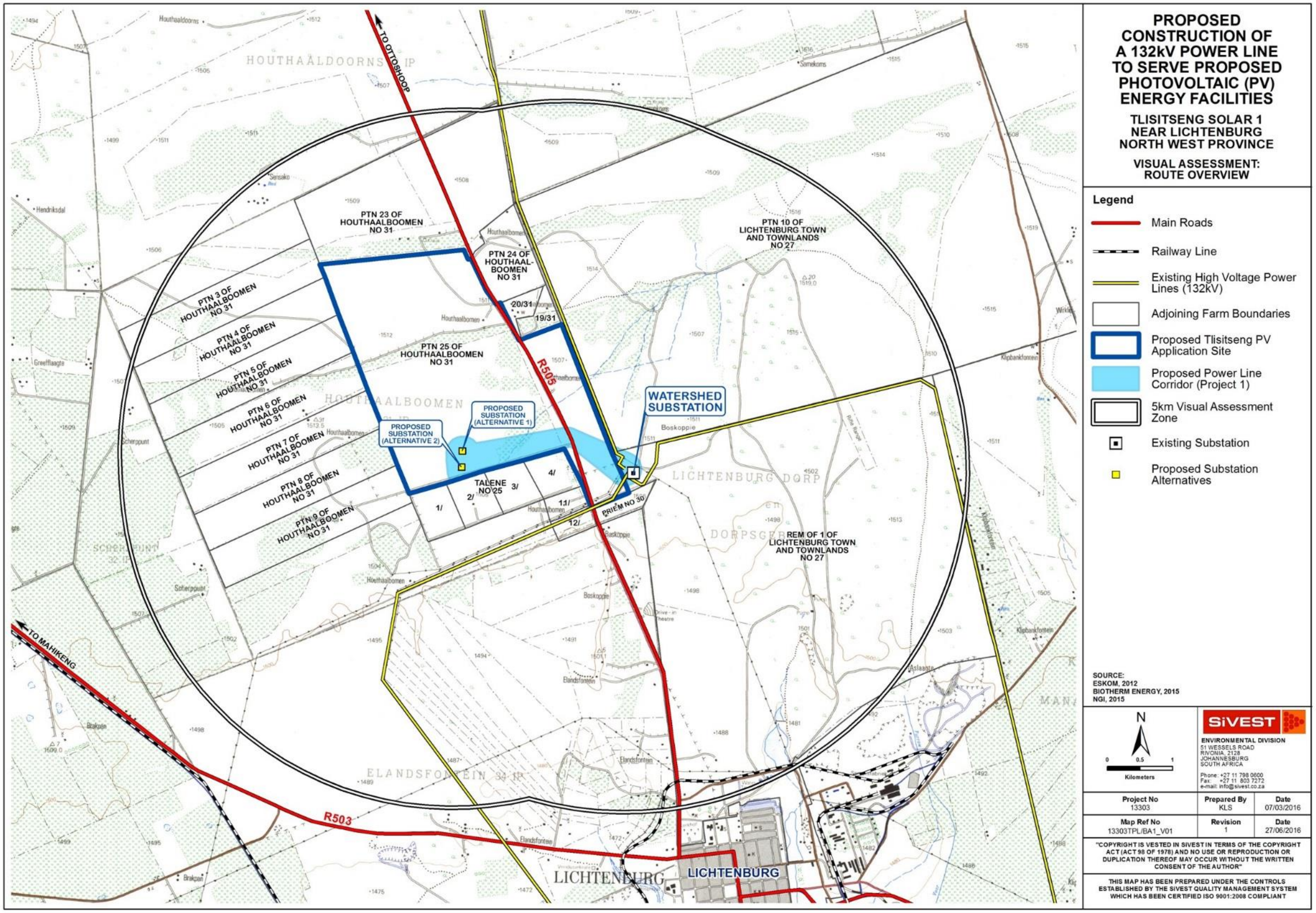


Figure 3: Locality Map

1.3 Assumptions and Limitations

- Given the nature of the receiving environment and the height of the proposed substation, power lines and associated infrastructure, 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. The 5km radius was assigned as distance is a critical factor when assessing visual impacts and although the proposed development may still be visible from areas outside the 5km radius, the degree of visual impact would diminish considerably. Thus the need to assess the impact on potential receptors outside the visual assessment zone would not be warranted.

- Due to the extensive number of farmsteads and residential dwellings located within 5km of the power line corridor, which could potentially be sensitive to the proposed development, the identification and impact assessment rating on potentially sensitive visual receptor locations was based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potentially sensitive receptor locations within the study area. Thereafter a site visit was undertaken to assist with rating the impact of the proposed development from each potentially sensitive visual receptor location and to eliminate receptors that are unlikely to be influenced by the proposed development. This involves establishing the visual character and level of transformation within the study area, classifying the study area into zones of visual contrast and identifying screening factors within the study area.

- It should be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. A number of broad assumptions were made in terms of the sensitivity of the receptors to the proposed development. This is usually dependent on the use of the facility and the economic dependency on the natural / untransformed 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 residential dwellings within natural / rural settings. Therefore, not all receptor locations would necessarily perceive the proposed development in a negative way.

- 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 would influence the degree of visibility and which would not be factored in by 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 substation 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 depending on this 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 due to budget limitations. Should the need for visualisation modelling be proven by stakeholder / I&AP feedback, then this will be able to be incorporated into this assessment.

- The feedback regarding the visual environment received from the public participation process and as part of the social impact assessment to date has been incorporated into this report. Any additional feedback relevant to the visual environment received will be incorporated into further drafts of this report.

- Operational and security lighting will be required for the proposed on-site substation and associated infrastructure 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 April during the summer months. Therefore as the fieldwork was undertaken in December during the summer season the surrounding vegetation can be expected to provide the maximum potential screening. During winter months the visual impact of the proposed development may therefore be greater, particularly from farmhouses surrounded by tall deciduous trees.

1.4 Assessment Methodology

1.4.1 Field work and photographic review

From the 1st to the 2nd of December 2015 (summer), the study area was visited in order to;

- identify the landscape characteristics;
- classify the study area into zones of visual contrast;
- capture photos of the proposed study area;
- verify the potentially sensitive visual receptor locations previously identified via desktop means;
- eliminate receptors that are unlikely to be influenced by the proposed development; and
- identify any additional visually sensitive receptor locations within the study area.

1.4.2 Physical landscape characteristics

A site visit and digital information from spatial databases such as the National Geo-spatial Information (NGI), the South African National Biodiversity Institute (SANBI) and the South African National Land Cover (Geoterraimage – 2014) were sourced to provide baseline information on the topography, vegetation and land use in the study area. These physical landscape characteristics are important factors which influence the visual character and visual sensitivity of the study area.

1.4.3 Identification of sensitive receptors

During the field investigation, potentially sensitive visual receptor locations within the study area, such as residences, were identified and assessed as they may be potentially sensitive to the visual impacts associated with the proposed development. It must be noted that Google Earth imagery was used to assist with identifying and assessing these potentially sensitive receptor locations.

1.4.4 Impact Assessment

A rating matrix was used to objectively evaluate 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 substation site alternatives were comparatively assessed, in order to ascertain the preferred alternative from a visual perspective.

1.4.5 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 by 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 contributing to the visibility of a development and 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 according to this visual baseline by establishing the degree to which the development would contrast or conform with 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 within and in the immediate vicinity of the proposed 132kV on-site Tlisitseng 1 Substation and 132kV power line development sites is characterised by a flat to gently undulating landscape sloping very gradually down in a south-easterly direction.

A representation of the typical views from the proposed 132kV on-site Tlisitseng 1 Substation site has been provided in **Figure 4** below.

Figure 4: View from the proposed Tlisitseng 1 Substation application site showing the typically flat to gently undulating terrain within the study area

The topography in the wider study area is largely characterised by level plains with little noticeable relief and very gradual slopes (**Figure 5**). In general, the study area slopes down in a southerly direction towards the town of Lichtenburg.

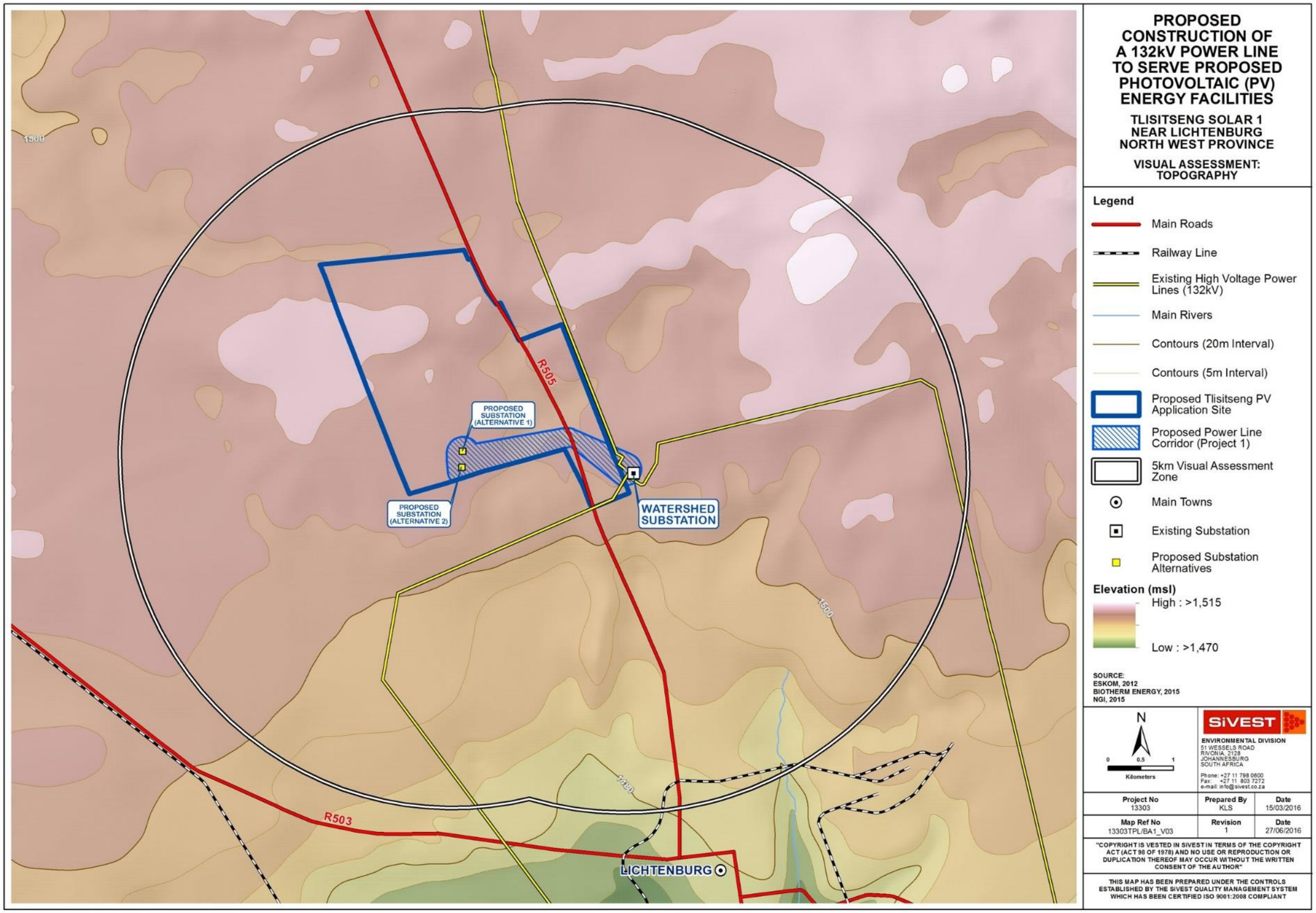


Figure 5: Topography within the study area

2.1.1 Visual Implications

The very flat nature of the topography is a strong factor influencing the types of vistas typically present in the study area, as there are few areas of rising ground to block views and limit viewsheds. As a result, typically wide-ranging vistas are experienced within the study area, especially from locally higher elevations.

2.2 Vegetation and land cover

The study area is covered by the Carlton Dolomite Grassland vegetation type (**Figure 7**), which is characterised by low shrubland with an open tree layer and species-rich grasslands. In certain areas, has anthropogenic activities have had an impact on the natural vegetation. This is evident around farmsteads, where over many years tall exotic trees and other typical garden vegetation have been established. Much of the study area is however still charaterised by natural low shrubland and grassland (**Figure 6**) with limited transformation.

Figure 6: Typical vegetation cover within the study area

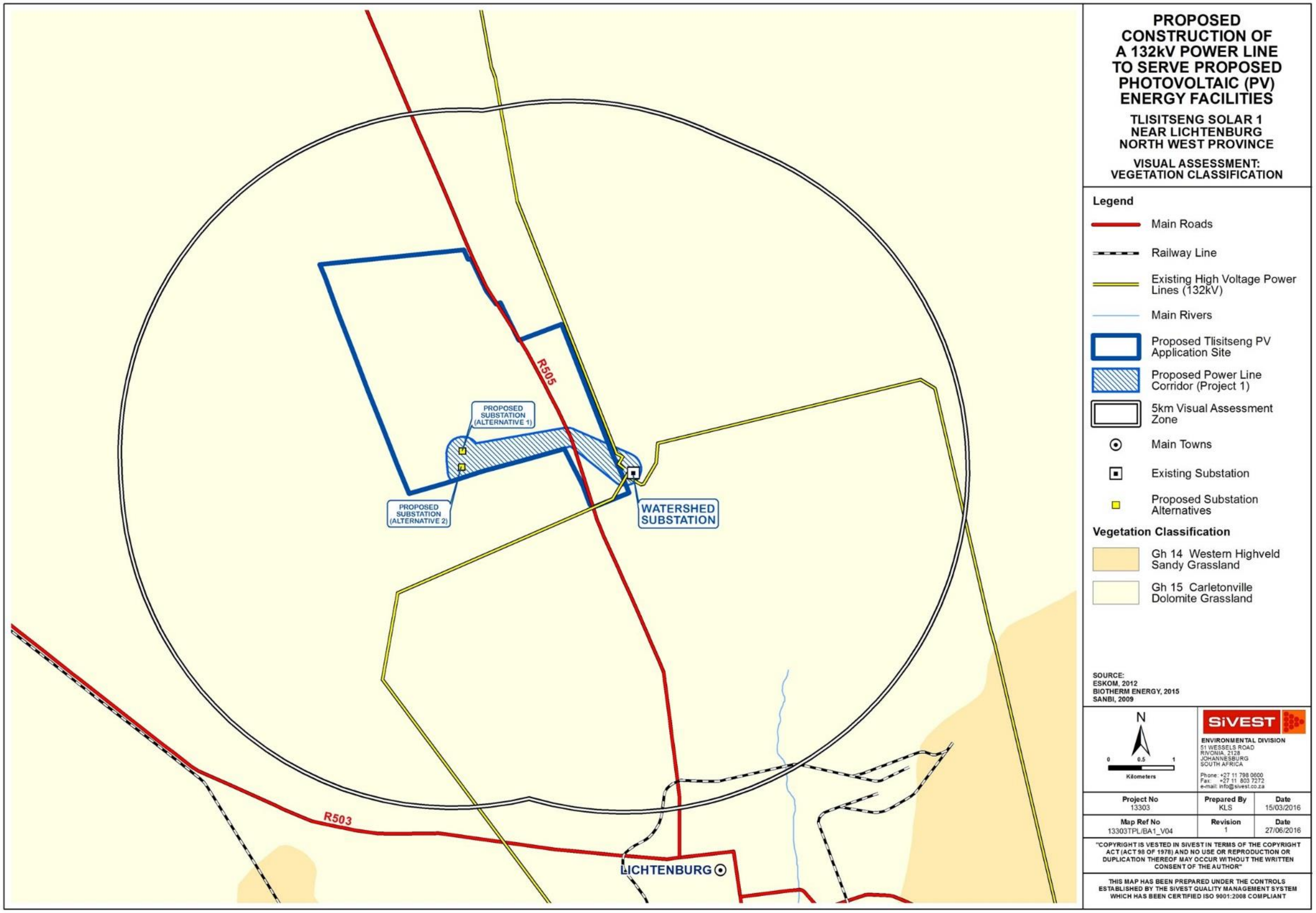


Figure 7: Vegetation within the study area

Much of the assessment area is characterised by natural unimproved vegetation (**Figure 13**). Cultivated land is largely concentrated on the western boundary of the study area, with smaller, scattered patches of cultivation evident throughout the study area (**Figure 8**). Maize is the main crop produced in the area with both dryland and irrigated farming practises in evidence.

Figure 8: Typical view of cultivated land which can be found scattered throughout the study area. Cultivated land is however largely concentrated on the western boundary of the study area.

Built form, in areas where cultivation occurs, is limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines, windmills, fences and the remnants of old workers' dwellings.

Figure 9: Typical built form present in areas where cultivation occurs

Human influence is also visible in the form of the R505 main road which traverses the study area in a north-west to south-east direction (**Figure 10**) as well as electricity transmission infrastructure comprising of three (3) 132kV power lines feeding into the Watershed MTS. It must be noted that the tall steel structures that make up the Watershed MTS, as well as the tall steel towers of the existing 132kV power lines, are visible from various parts of the study area (**Figure 11**). In addition, there are some relatively small scale mining/quarrying activities in the study area.

Figure 10: R505 main road which traverses the study area in a north-west to south-east direction

Figure 11: Tall steel structures that make up the Watershed MTS, as well as the tall steel towers of the existing 132kV power lines that run to the Watershed MTS, which can be seen from various parts of the study area

The closest built-up area is the agricultural town of Lichtenburg, which is located on the southern boundary of the study area, with only a small portion of the town lying just inside the 5km radius. Urban development on the outskirts of Lichtenburg comprises a mix of commercial, light/service industrial and residential development (**Figure 12**) as well as road and rail infrastructure largely concentrated on the eastern side of the R505 main road.

Figure 12: Outskirts of the town of Lichtenburg which comprises a mix of commercial, light/service industrial and residential development

A large portion of the study area situated to the east of the R505 has been demarcated as the Lichtenburg Game Breeding Centre, a largely untransformed area which was previously operated by the National Zoological Gardens of South Africa. This game breeding centre was mainly aimed at furthering the breeding programmes of endangered species already in place by the National Zoo, as well as supplementing the populations of local and international zoos. It must however be noted that at present, the game breeding centre is no longer operated by the National Zoological Gardens of South Africa and is therefore currently not operational. The Lichtenburg Vakansie Oord is situated directly adjacent to the Lichtenburg Game Breeding Centre and provides an ideal destination for tourists and people on vacation.

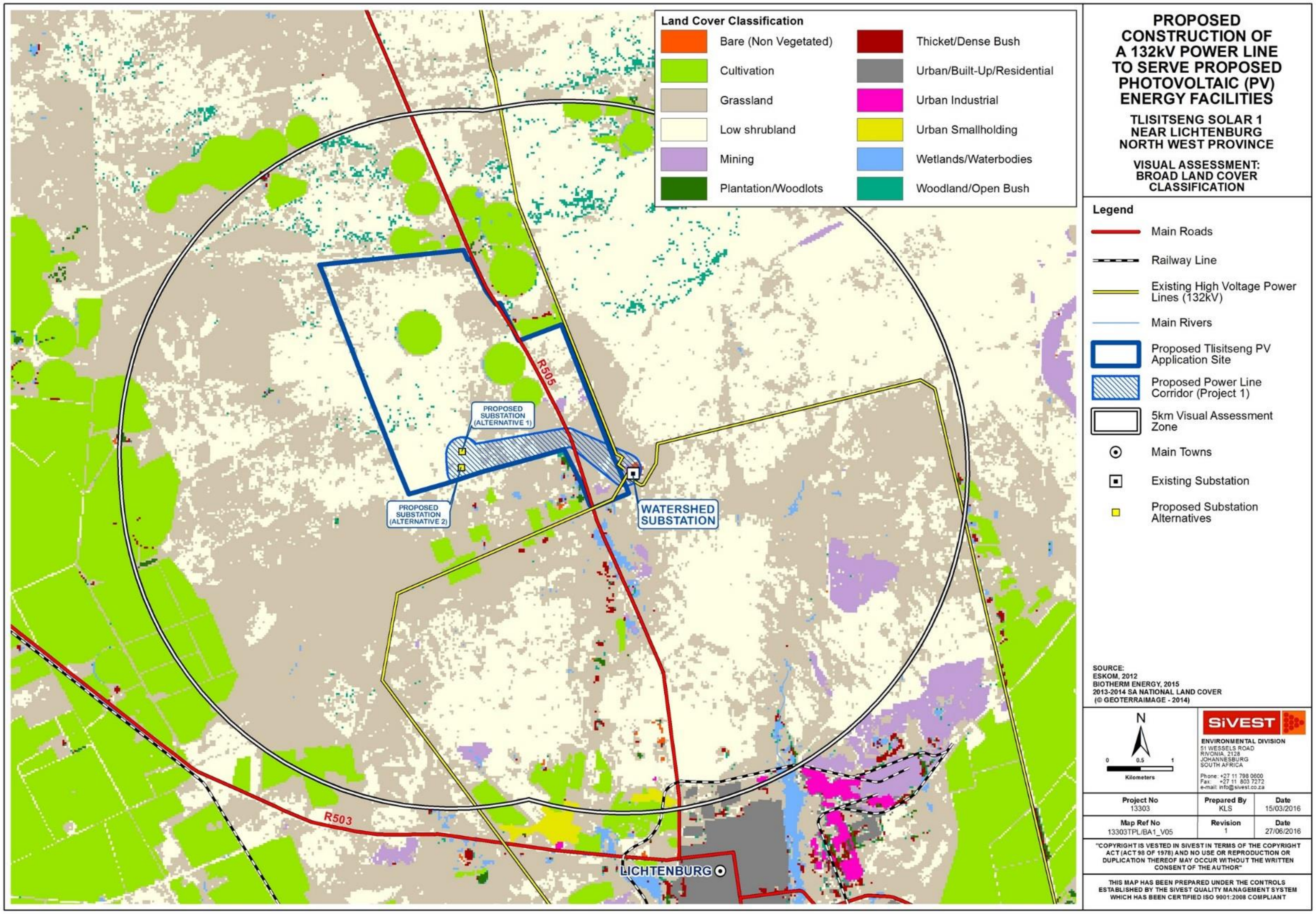


Figure 13: Land cover within the study area

2.2.1 Visual Implications

The predominant very low shrub layer and open areas of cultivated fields / grasslands results in wide-open vistas across most of the study area. Only in areas where tall trees (sometimes exotic) have been established around farmhouses, would the vegetation provide visual screening (**Figure 14**). The relatively low density of human habitation and the presence of natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (**Figure 15**). There are however significant patches of cultivation in the study area which have transformed the natural characteristics of the area. High levels of human transformation and visual degradation only become evident in the southern sector of the study area where urban/peri-urban development has taken place on the outskirts of Lichtenburg. The presence of the Watershed MTS and other linear elements are also expected to influence the visual character of the surrounding area, reducing the visual implications of the proposed development within these areas.

The influence of the level of human transformation on the visual character of the area is described in more detail below.

Figure 14: Example of tall trees that have been established around farmhouses and which provide visual screening

Figure 15: Typical natural rural visual character found within larger portions of the study area

2.3 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.

As previously mentioned, much of the study area is characterised by rural areas with low densities of human settlement. Agriculture in the form of maize cultivation is the dominant land use, which has transformed the natural vegetation in some areas. However, a large portion of the study area has retained a natural appearance due to the presence of the low shrubs and grasslands. The most prominent anthropogenic elements in these areas include the R505 main road, 132kV power lines, a substation (Watershed MTS) and other linear elements, such as telephone poles, communication poles and farm boundary fences. The presence of this infrastructure is an important factor in this context, as the introduction of the proposed 132kV on-site Tlisitseng 1 Substation and associated 132kV power line would result in less visual contrast where other anthropogenic elements (such as the Watershed MTS) are already present. Other human infrastructure in this setting occurs at a low density, and includes several gravel access roads and a west-east aligned railway line on the northern perimeter of Lichtenburg. Overall, the study area has a natural visual character, with certain areas displaying a rural or pastoral component where maize cultivation and farmsteads occur.

The relatively low density of human transformation throughout the surrounding 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 a substation and 132kV power line as introducing this type of development could be considered to be a degrading factor in this context.

It should however be noted that other solar energy facilities are proposed in relatively close proximity to the proposed development. These facilities and their associated infrastructure, typically consist of very large structures which are highly visible. As such, these facilities will significantly alter the visual character and baseline in the study area if constructed and make it appear to have a more industrial-type visual character.

2.4 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 an important component when assessing visual character and scenic value. The surrounding area can be considered to be typical of a rural farming landscape that consists of relatively flat areas of natural low shrubland and grassland interspersed with farmsteads, windmills, livestock holding pens and agricultural land Livestock farming and other forms of agriculture, such as maize production, are also evident within the surrounding area. This can be attributed to the fact that the nearby town of Lichtenburg is situated in the heart of the maize triangle, which is the main maize growing area in South Africa. Today the town is the centre of a huge farming district where maize, groundnuts and sunflower seeds are the main crops (http://www.places.co.za/html/lichtenburg.html).

The town of Lichtenburg was established in 1873 and is situated in the very western corner of South Africa's maize triangle. Lichtenburg is a farming and industrial town known for the manufacture of cement. (http://showme.co.za/south-africa/north-west/central-district/lichtenburg/). Apart from the agricultural, mining and quarrying activities taking place in the LM, there exists an opportunity for conservation and tourism. It should also be noted that the area surrounding Lichtenburg has a rich diamond mining history. In 1926 a diamond was found on the farm Elandsputte, resulting in a diamond rush where more than 100 000 diggers streamed to Lichtenburg. In 1927, 25 000 runners took part to peg their claims in one of the biggest diamond rushes in history, which resulted in the biggest pure red diamond ("pigeon blood red") in the world being found there (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm). Popular activities in the area include game viewing, fishing and motor car racing. Lichtenburg is also perfectly positioned to be an ideal stopover for travelers from Johannesburg to Mafikeng and Mmabatho. Tourist attractions situated within the greater area include the Lichtenburg Diggings Museum, Bakerville, Wondergat and the Lichtenburg Game Breeding Centre.

There are several attractions in Lichtenburg that pay homage to the town's rich Boer and prospector history as well as its prosperous farming and manufacturing present. Lichtenburg is the resting place of Anglo-Boer War General Koos de la Rey, and a statue of the General on his horse has been erected in the town square. The town and surrounds feature many heritage homes and a couple of National Monuments. The Lichtenburg Diggings Museum has exhibits of the alluvial diamond diggings which lasted from 1925-1935, then the richest public diggings in the world (http://www.southafrica.com/museums/lichtenburg/). The Ampie Bosman Cultural History Museum can also be found within the town of Lichtenburg and gives an introduction to the history of the town. In addition, a number of historical buildings can also be found within the town of Lichtenburg and include:

- The Dutch Reformed Church in Gerrit Maritz Street erected in 1890 (Declared a National Monument);
- The old magistrate's building which dates from 1895/96;

- The home where General De la Rey lived. This was demolished during the Anglo-Boer War but was rebuilt on the original foundations in 1902;
- The home of the founder of Lichtenburg, H.A. Greeff, built in 1875, which is still standing; and
- An old plantation house, home of the pioneer in dry-land farming, Col. H du Toit, erected in 1910.

The nearest known tourist attraction within the study area is the Lichtenburg Game Breeding Centre which is situated 2km north-east of Lichtenburg. The Lichtenburg Game Breeding Centre was operated by the National Zoological Gardens of South Africa and was mainly aimed at furthering the breeding programmes of endangered species already in place by the National Zoo, as well as supplementing the populations of local and international zoos. The reserve has maintained a largely natural character and was used to breed animals such as the addax, scimitar horned and Arabian oryx, and the mohrr gazelle. The centre is also characterised by the presence of a wetland area which used to be home to unique animals such as the pygmy hippo and Pere David's deer. White rhino, blue wildebeest, zebra, impala, gemsbok and many other species could also be found within the breeding centre. In addition, part of this wetland area has been honed into a series of dams and pans that function as a haven for water birds. The centre also features one of the largest bird hides in the country and special night drives can be arranged as the reserve has a network of game drive routes (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm).

Approximately 20km north of Lichtenburg lies the world-renowned diamond diggings known as "Bakerville". It was the richest public diggings ever mined and is only one of several "Diggers Towns" developed in Wild West style. Approximately 40km on the Mafikeng road lies “Wondergat”, which is one of the deepest sinkholes in South Africa where deep-freshwater diving can be practiced.

Based on the above, the study area can be regarded as a type ‘ii’ organically evolving cultural landscape. It can be considered both a relict landscape, due to rich history dating back to 1873 and a continuing landscape as the typical rural farming landscape represent how the environment 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 towns, such as Lichtenburg, engulfed by an otherwise rural environment, form an integral part of the wider landscape. In addition, the rich history could attract tourists into the area. This is important in the context of potential visual impacts associated with the proposed development of an on-site substation and power line as introducing this type of development could be considered to be a degrading factor in the context of the natural or rural / pastoral character of the study area, as discussed further below.

2.5 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 BA 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 low visual sensitivity. This is mainly owing to the relatively uninhabited character of the area and the presence of road, rail and electricity transmission infrastructure which would likely reduce the scenic quality 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, a number of potentially sensitive receptors are present in the study area.

It should be noted that several solar energy facilities are proposed within relatively close proximity to the proposed project.

2.6 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 on-site substation 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 of visual sensitivity;
- 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 a 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 substation 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. In order to account for this distance bands were used to assign zones of visual impact from the proposed development site. As such, the proposed development would be more visible to receptors located within a short distance and these 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.

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); and
- 2km < 5km (low impact zone)

A number of potentially sensitive visual receptors were identified. These are indicated in **Figure 23** below and each receptor is identified by a specific number (e.g. VR 1 = Visual Receptor 1). Of the potentially sensitive visual receptors identified, only three (3) receptor locations were identified as being sensitive within the study area due to their current and potential tourism significance, namely the Lichtenburg Vakansie Oord, the Lichtenburg Game Breeding Centre and the Rafters Pub (VR 62, VR 64 and VR 14 respectively). The Lichtenburg Vakansie Oord is situated approximately 3.6km south-east of the proposed 132kV power line corridor, adjacent to the Lichtenburg Game Breeding Centre, and is an ideal place for relaxation, adventure and scenic beauty. This holiday resort is an attractive destination for tourists and people on vacation and offers accommodation in the form of equipped chalets (**Figure 16**) and camping facilities. Other facilities that can be found within the holiday resort include lapa facilities with a boma, an in-house warm pool, an outside pool with slides (**Figure 17**), a day resort with 90m “Supertube” and 45m “Lane-Racer”, and an Olympic swimming pool with shaded island (http://lichtenburgvakansieoord.co.za/index2.htm).

Figure 16: The tiled roof chalets that are found within the Lichtenburg Vakansie Oord

Figure 17: The outside swimming pool area with slides which is found within the Lichtenburg Vakansie Oord

In addition, a tower which looks out over the adjacent Lichtenburg Game Breeding Centre can also be found within the resort (**Figure 18**). Due to the relatively tall nature of this structure, it is likely that individuals standing on the lookout tower might have views of the proposed development. The area surrounding the holiday resort has maintained a relatively natural or scenic character, with transformation limited mainly to the holiday resort area itself. This is most likely due to the fact that the Lichtenburg Vakansie Oord is situated adjacent to the largely natural area of the Lichtenburg Game Breeding Centre. It should however be noted that certain anthropogenic elements, such as telephone poles and a large cement factory (**Figure 19**), can be seen from within the holiday resort and are expected to lessen the visual sensitivity of the surrounding area. Although the above-mentioned cement factory is situated outside of the visual assessment zone, it is still expected to alter the visual character of the views from the Lichtenburg Vakansie Oord and will ultimately lessen the visual impact associated with the proposed development.

Figure 18: Lookout Tower found in the Lichtenburg Vakansie Oord which looks out over the adjacent Lichtenburg Game Breeding Centre


Figure 19: Large cement factory which can be seen from inside the Lichtenburg Vakansie Oord

The Lichtenburg Game Breeding Centre (VR 64) has maintained a largely natural character (**Figure 20)**. It should however be noted that a series of telephone poles can be found throughout the game breeding centre. In addition, other existing linear elements, such as a large cement factory and the tall steel structures that make up the Watersed MTS, are also visible from certain areas of the game breeding centre (**Figure 21**). The game breeding centre is also characterised by the presence of a wetland area which used to be home to unique animals such as the pygmy hippo and Pere David's deer.

Figure 20: View from one of the game drive routes in the Lichtenburg Game Breeding Centre showing the largely natural character of the area.

Figure 21: The tall steel structures of the Watershed MTS which can be seen from certain parts of the Lichtenburg Game Breeding Centre.

Part of the wetland area has been honed into a series of dams and pans that function as a haven for water birds. The centre also features one of the largest bird hides in the country and a network of game drive routes (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm). The Lichtenburg Game Breeding Centre was therefore considered to be an attractive tourist destination and would be adversely affected by the visual intrusion of the proposed development should it be visible from this location. It is however important to note that at this stage, the game breeding centre is no longer operated by the National Zoological Gardens of South Africa and is currently not operational. During the site visit it was also noted that all wetland areas, dams and pans were completely dry and burning had taken place within these areas (**Figure 22**). It is estimated that the restoration and construction process of the game breeding centre will last another year, however there is currently no definite decision on whether or not the centre will be opened for tourists (Steynberg, 2016). Despite this, the Lichtenburg Game Breeding Centre has still been regarded as a sensitive visual receptor for the purpose of this study as the game breeding centre will be re-opened and could be operated as a tourism facility in the future.

Figure 22: View of one of the dried up wetland/dam/pan areas within the Lichtenburg Game Breeding Centre where burning has taken place.

The Rafters Pub (referred to as plots locally) has been operating on Portion 1 of the Farm Talene 25 for approximately eight years. It is estimated that the pub receives between 300 and 340 visitors per month and when special events (i.e. pool tournaments etc.) are hosted, the visitor numbers are higher. The owner of the farm has expressed his intention to start a bird breeding programme focused on African Greys on the farm. It is also the intention of the owner to offer overnight accommodation and build four chalets on the property (Steynberg, 2016). The owner of the farm has expressed his concern about the possible negative visual impact and the effect that the project could have on the potential for tourism development as well as the sense of place on his farm (Steynberg, 2016). In addition at the Landowner Focus Group Meeting held in March 2016, the owner expressed his concern regarding the possible impact that the proposed development would have on their existing business. Patrons visit their establishment to escape the town in order to experience the calm atmosphere and nature on the farm. As such, the farm is regarded as a sensitive visual receptor due to its current economic activities which in part rely on the scenic nature of the surrounding area and due to the future potential of the farm as a tourism facility.

During the site visit, several scattered farmsteads / homesteads were identified within the study area. These dwellings are located within a mostly rural or pastoral setting and the proposed development will likely alter the natural vistas experienced from these dwellings. It is important to note that these visual receptor locations are regarded as potentially sensitive to the proposed development as the degree of visual impact experienced from these locations will vary from one inhabitant to another, as it is largely based on the viewer's perception and sentiments toward the development. Factors influencing the degree of visual impact experienced by viewers at these locations include the following:

- Value placed by the viewer on the rural characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical pastoral character of the surrounding area.

Only three (3) sensitive visual receptor locations were identified within the rural parts of the study area, these being the Lichtenburg Game Breeding Centre (VR 64) which occupies a large tract of land directly east of the proposed 132kV power line corridor, the Lichtenburg Vakansie Oord (VR 62) which can be found to the south-east of the proposed 132kV power line corridor, adjacent to the game breeding centre and the Rafters Pub which is located adjacent to the application site for the PV energy facility directly south-west of the power line corridor. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area. In addition, the only significant concentration of human habitation in the study area is the agricultural town of Lichtenburg, most of which lies outside the 5km assessment area. The northern sector of Lichtenburg which lies just inside the assessment area largely comprises of a mix of land uses with some receptors present. Although there is a relatively high concentration of receptors in this area, they are not all regarded as sensitive to the visual impact of the proposed development due to the existing visual degradation within these areas.

A list of the visually sensitive and potentially sensitive receptor locations (including coordinates) that were identified during the investigation are provided in **Appendix B**.

In many cases, roads, along which people travel, are considered to be sensitive receptor locations. The R505 main road which traverses the study area is considered to be a visually sensitive road as it is the main access road between Lichtenburg and the N18 national route to the north. This road can be used to access tourism attractions to the north of the study area such as the diamond diggings at Bakerville and the Wondergat sinkhole (http://www.tourismnorthwest.co.za). The relatively high volumes of motorists travelling along this road would therefore be visually exposed to the proposed power line and substation as the road traverses the power line corridor.

Table 2 below provides details of the sensitive visual receptor locations and roads that were identified within the study area.

Table 2: Visual receptor locations sensitive to the proposed on-site Tlisitseng 1 Substation and 132kV power line

Name	Distance from the proposed Tlisitseng 1 Substation site or 132kV power line corridor route	Visual Impact Zone
VR 62 – Lichtenburg Vakansie Oord	Approximately 3.7km	Low
VR 64 – Lichtenburg Game Breeding Centre	Approximately 1.5km	Moderate
VR 14 – Rafters Pub	Approximately 445m	High
R505 Secondary Road	Varies (directly traverses the power line corridor at the closest point)	Varies (High, Moderate and Low)

Other thoroughfares in the study area are primarily used by local farmers travelling to and from Lichtenburg. They are therefore not regarded as visually sensitive as they do not form part of any scenic tourist routes, and are not specifically valued or utilised for their scenic or tourism potential.

The sensitive / potentially sensitive visual receptor locations in relation to the zones of visual impact are indicted in **Figure 23** below.

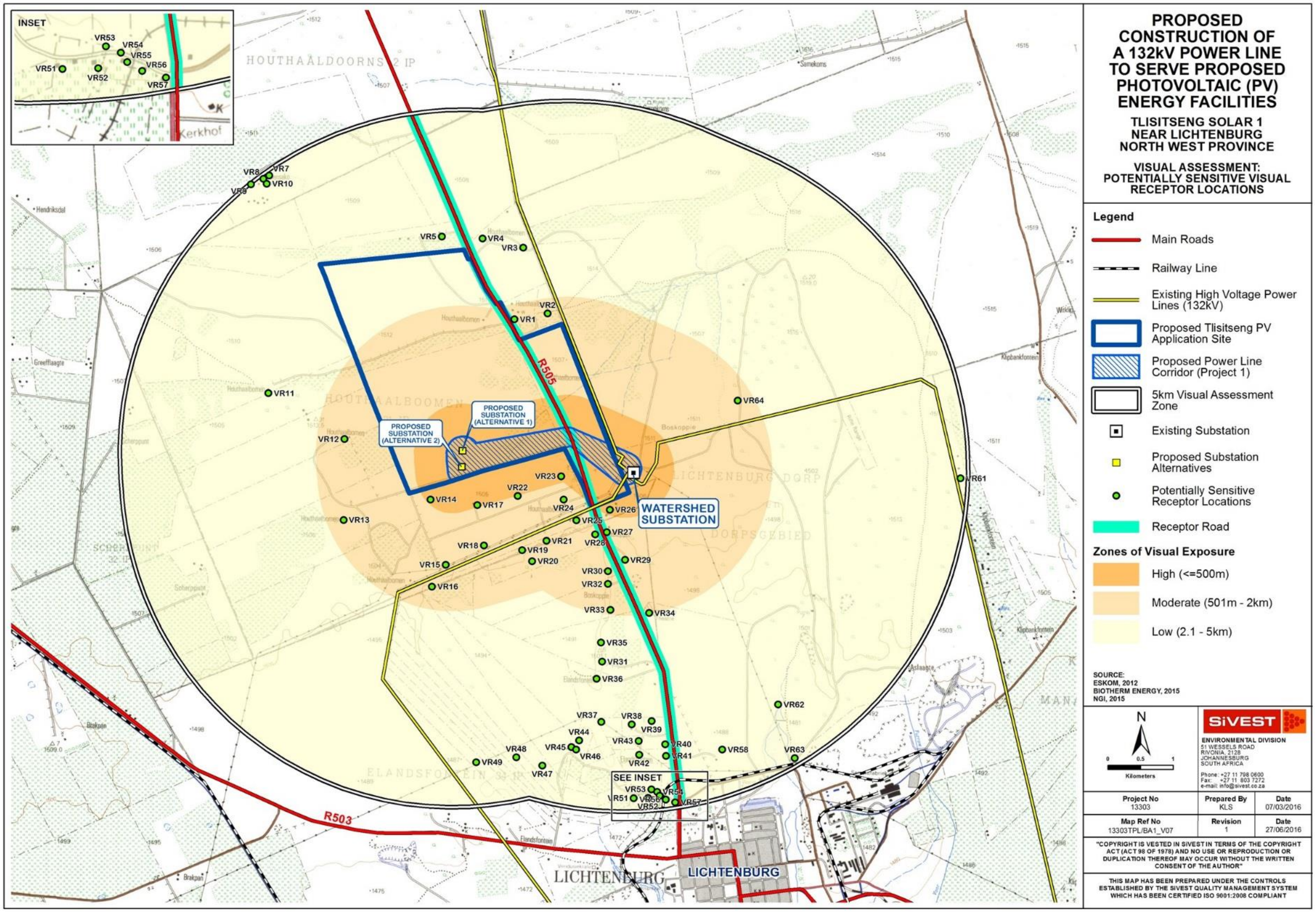


Figure 23: Visually sensitive receptors within the study area

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 an on-site substation and 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 28m (equivalent in height to a 9 storey building). Although pylon structure would be less visible than a building, the height of a tower / pylon thus means that the pylon would still typically be visible for a relatively large radius around it. A 132kV power line consists of a series of towers spaced approximately 250m to 400m 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 the taller vegetation under the power line servitude in certain vegetation types can worsen the visibility and incongruity of the power line in a largely natural bushier setting, by causing fragmentation of natural vegetation, thus making the power line more visible. The cleared strip of land is often highly visible and draws the viewer's attention to the power line servitude, especially when it occurs within a context of natural thicket / bushveld vegetation where bushes or trees commonly occur.

As mentioned above, how the viewer / receptor perceives the impact is also very important, as certain receptors may not consider the development of a substation and/or power line to be a visual impact. The scenic / aesthetic value of an area, and the types of land use practices also tend to affect people's perception of whether a substation and/or power line is an unwelcome intrusion, and thus the sensitivity of receptors to the erection of a substation and/or power line in an area. Power lines and substations are often perceived as visual impacts where value is placed on the scenic or aesthetic character of an 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 buildings and other linear structures such as roads, railways and especially other power lines and substations exist the visual environment could be considered to be “degraded” and thus the introduction of a new power line and substation in this setting may be considered to be less of a visual impact 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, 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 conform with the land use, settlement density, structural scale, form and pattern of elements that define the structure of the surrounding landscape. The 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, which could have a significant visual impact from 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 to 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 Tlisitseng 1 Substation), a 132kV power line and associated infrastructure which are aimed at feeding the electricity generated by the proposed Tlisitseng 1 solar PV energy facility (part of separate on-going EIA process) back into Eskom's national grid. In general, the development would not be consistent with the prevailing residential and pastoral land use within the surrounding area. However, the anthropogenic elements and built-up areas present within 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 linear and vertical structures such as roads, railways and especially other power lines and substations would influence the perception of whether a 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 within the study area, includes three (3) high voltage power lines and Watershed MTS. These elements have already degraded the natural environment to some extent and will significantly reduce the visual impact as the proposed development would conform with these elements. It is also important to note that the on-site substation and power line are being proposed to serve the Tlisitseng 1 solar PV energy facility. Thus, the substation and power line would only be constructed if the PV energy facility was developed as well. The visual contrast would therefore be dwarfed by the large number of visible PV panels. As such, the substation and power line are not expected to result in a significant visual contrast.

4.2 Receptor Impact Rating

In order to assess the potential visual impact of the proposed development on the sensitive / potentially sensitive receptor locations identified during the field investigation, a matrix that takes into account a number of factors 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 away from the proposed development (distance banding)
- Presence of potential screening factors (topography, vegetation etc.)
- Location of the receptor in terms of zones of visual contrast

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive / potentially sensitive visual receptor within this context. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location. This rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. 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**	**MEDIUM**	**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 high impact rating has thus been assigned to receptor locations that are located within 0<500m of the proposed development. Beyond 5km, the visual impact would be virtually nil, as the development would appear to merge with the elements on the horizon. Any receptor location beyond this distance has therefore been assigned an overriding nil impact rating. As such, despite the impact rating assigned to the other visual factors, the overall impact rating would remain nil, as the proposed development would not visually influence any receptors located more than 5km from the development. Where a receptor is located within more than one distance band, such as a receptor road, it is assigned the score according to the closest distance it will get from the proposed development i.e. the highest visual impact experienced.

As previously mentioned, 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 the zones of visual impact are as follows:

- 0 < 500m (high impact zone);
- 500m < 2km (moderate impact zone); and
- 2km < 5km (low impact zone).

4.2.2 Screening factors

The presence of screening factors is equally important in this context as the distance away from the development. Screening factors can be vegetation, buildings, as well as 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. The 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 contrasts 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.

Based on the land use and visual character in the surrounding landscape, the area was assessed to determine the level of transformation and 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 is an important factor 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** – Intensive agricultural lands / cultivated fields or areas within 500m of existing power line, road or rail infrastructure in undeveloped / natural / rural area; and
- **Low** – within 1km from visually transformed urban / built-up areas.

The outcome of the visual contrast classification in relation to the sensitive / potentially sensitive visual receptor locations is provided in **Figure 24** below.

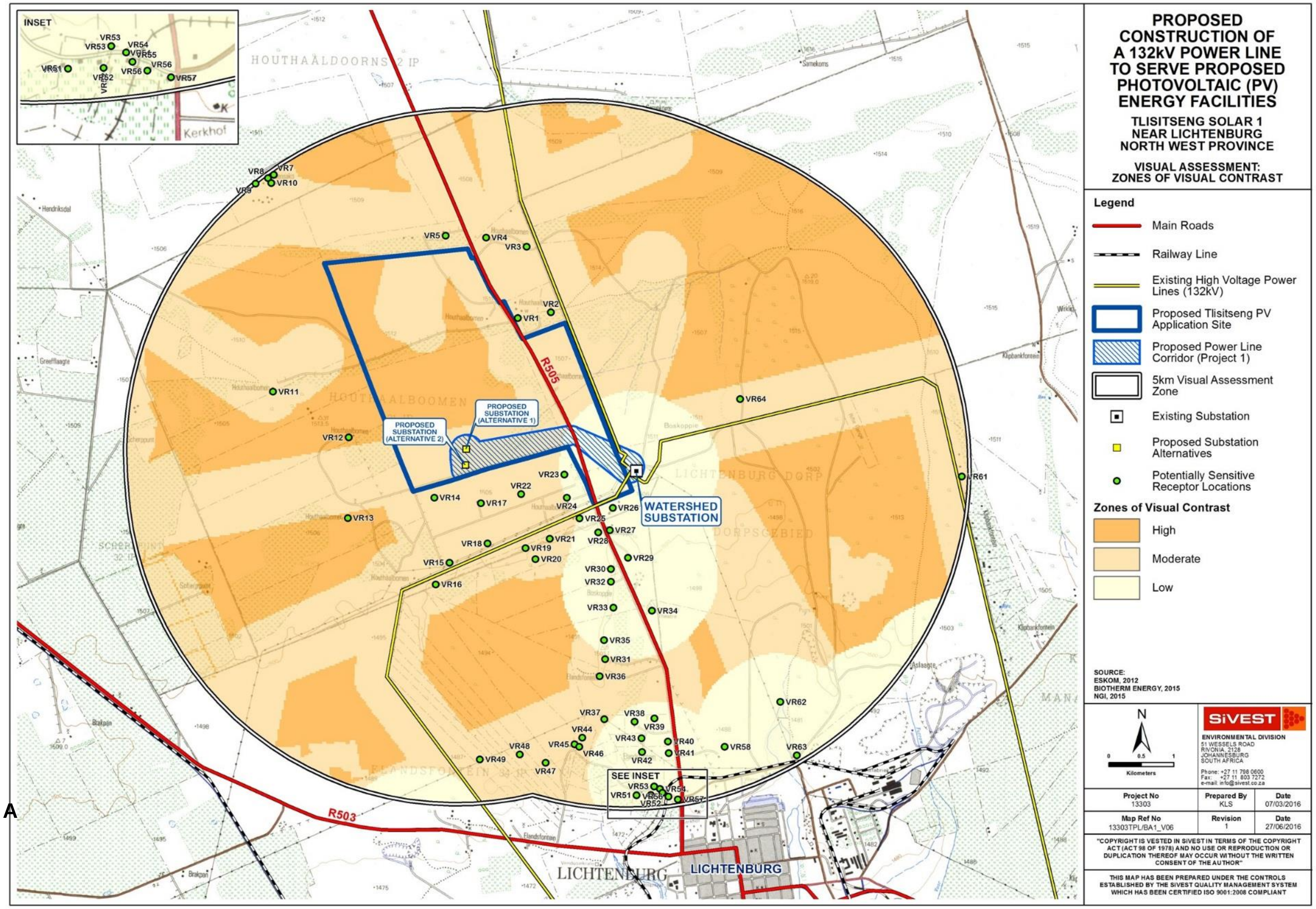


Figure 24: Zones of visual contrast

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
VR 1	Moderate (2)	High (3)	Moderate (2)	**MODERATE**
VR 2	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 3	Low (1)	High (3)	Moderate (2)	**MODERATE**
VR 4	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 5	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 7	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 8	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 9	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 10	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 11	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 12	Moderate (2)	Moderate (2)	High (3)	**MODERATE**
VR 13	Moderate (2)	Moderate (2)	High (3)	**MODERATE**
VR 14 – Rafters Pub	High (3)	Moderate (2)	Moderate (2)	**MODERATE**
VR 15	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 16	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 17	High (3)	Low (1)	Moderate (2)	**MODERATE**
VR 18	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 19	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 20	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 21	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 22	High (3)	Low (1)	Moderate (2)	**MODERATE**
VR 23	High (3)	Low (1)	Low (1)	**MODERATE**
VR 24	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 25	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 26	High (3)	Moderate (2)	Low (1)	**MODERATE**
VR 27	Moderate (2)	Low (1)	Low (1)	**LOW**

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 28	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 29	Moderate (2)	Negligible	Low (1)	**LOW**
VR 30	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 31	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 32	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 33	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 34 – Lichtenburg Drive-in Theatre	Moderate (2)	High (3)	Low (1)	**MODERATE**
VR 35	Low (1)	Low (1)	Low (1)	**LOW**
VR 36	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 37	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 38	Low (1)	High (3)	Low (1)	**MODERATE**
VR 39	Low (1)	High (3)	Low (1)	**MODERATE**
VR 40	Low (1)	Low (1)	Low (1)	**LOW**
VR 41	Low (1)	High (3)	Low (1)	**MODERATE**
VR 42	Low (1)	Low (1)	Low (1)	**LOW**
VR 43	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 44	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 45	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 46	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 47	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 48	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 49	Low (1)	High (3)	Moderate (2)	**MODERATE**
VR 51	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 52	Low (1)	Low (1)	Low (1)	**LOW**
VR 53	Low (1)	Low (1)	Low (1)	**LOW**
VR 54	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 55	Low (1)	Low (1)	Low (1)	**LOW**
VR 56	Low (1)	Low (1)	Low (1)	**LOW**
VR 57	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 58	Low (1)	High (3)	Low (1)	**MODERATE**
VR 62 – Lichtenburg Vakansie Oord	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 63	Low (1)	Low (1)	Low (1)	**LOW**

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 64 – Lichtenburg Game Breeding Centre	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**

As indicated above, the proposed development would result in a low visual impact on majority of the potentially sensitive visual receptor locations with the study area (32 in total). It is important to note that the proposed development would result in a moderate visual impact on the Lichtenburg Game Breeding Centre (VR 64) and Rafters Pub (VR 14) and have a low visual impact on the Lichtenburg Vakansie Oord (VR 62). Although the development would be visible (to a degree) from all of the potentially sensitive / sensitive visual receptor locations, it would not result in a high impact on any of the potentially sensitive receptor locations. In addition, the proposed development is likely to exert a moderate impact on twenty five (25) of the potentially sensitive visual receptor locations.

4.3 Night-time Impacts

The visual impact of lighting on the nightscape is largely dependent on the existing lighting 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 on-site Tlisitseng 1 Substation at night.

The area surrounding the proposed development site is mostly uninhabited and as a result, relatively few light sources are present. The town of Lichtenburg is the main source of light within the surrounding area, however it is located more than 6km away and are therefore expected to have a limited impact on the night scene. It must be noted that the Lichtenburg Game Breeding Centre, Lichtenburg Vakansie Oord and Lichtenburg Drive-in Theatre can be found within relatively close proximity to the application site and will most likely require some form of lighting for security reasons. At this stage, it is uncertain whether the Lichtenburg Drive-in Theatre is still operational and the impact of it on the night scene. It should also be noted that majority of the Lichtenburg Game Breeding Centre has maintained a largely natural / undisturbed character as it was used to breed animals for local and international zoos. The natural / undisturbed areas within the breeding centre are therefore not expected to be characterised by a large amount of lighting. The Lichtenburg Vakansie Oord is however expected to be illuminated at night and require lighting for security reasons as it is used as a holiday resort and offers accommodation and recreational facilities. In addition, another prominent light source within the study area at night is the security lighting at the Eskom Watershed MTS which the power lines are proposed to connect to. According to local farmers, the Watershed MTS can be seen at night from relatively far away. Other sources of light are limited to, isolated lighting from the surrounding farmsteads and residential dwellings. In general the study area is characterised by a picturesque dark starry sky and the visual character of the night environment is considered to be generally 'unpolluted' and pristine.

Due to the fact that the larger area is generally renowned as a tourist destination, the relatively natural dark character of the nightscape will be sensitive to the impact of additional lighting at night, particularly from nearby farmhouses. The security lighting required for the proposed project is likely to intrude on the nightscape and create glare, which will contrast with the dark backdrop of the surrounding area. Existing night time views from potentially sensitive receptors are characteristic of a relatively dark night scene with some light sources visible in the distance as well as those from the nearby Watershed MTS and Lichtenburg Vakansie Oord, as a result lighting impacts from the proposed substation will increase the existing light pollution in the surrounding area.

4.4 Visual Impact Summary

4.4.1 Access Roads

A network of gravel access roads will also be constructed to provide access to the power line. 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.

4.4.2 Power Line

As previously mentioned, one (1) power line corridor is being assessed in order to provide grid access from the proposed 132kV on-site Tlisitseng 1 Substation to Eskom's Watershed MTS (**Figure 25**). The proposed power line corridor has been aligned to traverse the R505 in a south-eastern direction towards the Watershed MTS. Here it will join up with three (3) existing 132kV power lines. It must however be noted that the proposed power line corridor is aligned within a part of the study area which is not characterised by existing electrical infrastructure and has remained largely natural (**Figure 26**). The tall steel structures that make up the Watershed MTS are however visible from parts of the proposed power line corridor.

Figure 25: View of the Watershed MTS

Figure 26: View from the proposed power line corridor showing the largely natural character of the area. The tall steel structures that make up the Watershed MTS are however visible from parts of the power line corridor

Power lines are anthropogenic elements that are typically found in the landscape, both in urban or industrial and in more 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 distribution and 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.

A summary of the visual impact of the proposed power line corridor 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, are discussed in **Table 5** 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 5: Visual impact summary of the proposed power line corridor 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 would typically be highly visible due to the very flat terrain and wide-ranging vistas in the study area. Localised topographical undulations would offer minimal visual screening. **Vegetation:** The predominant very low shrub layer and open areas of cultivated fields / grasslands results in wide-open vistas across most of the study area. Only in areas where artificial wooded vegetation has been established around farmhouses, would the vegetation provide visual screening. **Land use:** Much of the assessment area is characterised by natural unimproved vegetation.	The area has a largely natural rural or pastoral visual character. The most prominent anthropogenic elements and built infrastructure in the study area include the R505 main road, gravel access roads, existing 132kV power lines, the Watershed MTS, the Lichtenburg Vakansie Oord, the Lichtenburg Game Breeding Centre, isolated farmhouses and other linear elements, such as telephone poles, communication poles, windmills and farm boundary fences.	Although the area is largely natural or rural / pastoral and the prevailing agricultural activities have left the vegetation mostly intact, the presence of the existing 132kV power lines have introduced a distinct linear element into the landscape. As such, the addition of a power line which would be aligned in close proximity to the existing power lines would contrast moderately with the existing linear elements. However, the presence of the proposed Tlisitseng solar 1 PV energy facilities (part of separate on-going EIA process) would lessen the visual contrast.	Potentially sensitive visual receptors within viewing distance (5km) from the power line corridor are limited to approximately fifty six (56) scattered farmsteads and one (1) Drive-in Theatre. In addition, three (3) receptor locations, namely VR 62 – The Lichtenburg Vakansie Oord, VR 64 – The Lichtenburg Game Breeding Centre and VR 14 – Rafters Pub, were deemed to be sensitive receptors due to their significance as tourism facilities. It must be noted that a significant number of the farmsteads identified are located within 2km from the power line corridors. From these distances the visual impact associated	Due to the large number of visual receptors present within viewing distance from the proposed power line corridors, and the fact that the alignment runs in close proximity to existing 132kV power lines, the power line would result in a medium visual impact. Refer to **Section 4.5** for the overall visual impact rating.

Cultivated land is largely concentrated on the western boundary of the study area, with smaller, scattered patches of cultivation evident throughout the study area. The power line would contrast within this setting.			with the power line is expected to be significant.	

4.4.3 On-site Substation

A new 132kV on-site substation (namely the Tlisitseng 1 Substation) is being proposed in order to supply the electricity generated by the proposed Tlisitseng 1 solar PV energy facility (part of separate on-going EIA process) to Eskom's national grid. In isolation, the proposed Tlisitseng 1 Substation may be considered to be visually intrusive; however, it must be assumed that the on-site substation would be built to serve the needs of the power generated from the proposed Tlisitseng 1 solar PV energy facility. Thus the substation would only be constructed if the proposed PV energy facility was developed as well. The substation would likely form part of the PV complex, as viewed from the surrounding farmsteads. Views of the substation would therefore be dwarfed by the large number of PV panels that would be visible. As such, the substation is not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

4.5 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 132kV on-site Tlisitseng 1 Substation, 132kV power line and the associated infrastructure.

Please refer to **Appendix A** below for an explanation of the impact rating methodology.

4.5.1 Planning

No visual impacts are expected during planning.

4.5.2 Construction

Table 6: Rating of visual impacts of the proposed on-site Tlisitseng 1 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. 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, maintenance vehicles travelling along the gravel access roads could increase dust emissions and expose surrounding farmstead to dust plumes. In addition, vehicles and trucks travelling to and from the proposed Substation site on gravel access roads would increase dust emissions. 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. The visual intrusion of the construction activities associated with the proposed substation and power line could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the R505 and visitors at the Lichtenburg Game Breeding Centre, Lichtenburg Vakansie Oord and Rafters Pub. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape. Wind blowing over these disturbed areas could therefore result in dust which would have a visual impact. The clearing of vegetation will also be required for the installation of the proposed Tlisitseng 1 Substation. This is expected to result in the generation of dust, alter the natural character of the surrounding area and therefore create 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	▪ Plan carefully to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist. ▪ Vegetation clearing should take place in a phased manner. ▪ Make use of nurseries to speed up recovery of vegetation. ▪ 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. ▪ Ensure that dust suppression techniques are implemented on gravel access roads, where possible. ▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles.	

	▪ Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid. ▪ Select the substation alternative that will have the least impact on visual receptors (i.e. Substation Alternative 1). ▪ 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. ▪ Where possible, laydown areas and temporary construction equipment and camps should be placed in already in disturbed areas in order to minimise vegetation clearing. ▪ Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting. ▪ Where possible, protect existing local trees and maintain natural vegetation outside the development footprint.

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.5.3 Operation

Table 7: Rating of visual impacts of the proposed on-site Tlisitseng 1 Substation and 132kV power line (including associated infrastructure) during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The proposed Tlisitseng 1 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. 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, maintenance vehicles travelling along the gravel access roads could increase dust emissions and expose surrounding farmstead to dust plumes. In addition, maintenance vehicles may also need to access the proposed on-site Tlisitseng 1 Substation via gravel access roads and are also expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the proposed Tlisitseng 1 Substation could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the proposed Tlisitseng 1 Substation and 132kV power line could also adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the R505 and visitors at the Lichtenburg Game Breeding Centre, Lichtenburg Vakansie Oord and Rafters Pub.	
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 (medium negative)	-34 (medium negative)
Mitigation measures	▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible, limit the amount of security and operational lighting present at the on-site substation. ▪ If possible, the O&M buildings should not be illuminated at night. Alternatively, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself). ▪ If possible, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself); ▪ Make use of minimum lumen or wattage in fixtures; ▪ Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights; ▪ If possible, make use of motion detectors on security lighting. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the substation site and power line access roads. ▪ Ensure that dust suppression techniques are implemented on gravel access roads, where possible. ▪ Only clear vegetation which is required to be cleared for the correct operation of the development. ▪ Ensure that the associated infrastructure are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact of the development on these dwellings. ▪ Align the power line within the authorised corridor as far away from Rafters Pub as possible i.e. in the northern and eastern parts of the corridor.	

	▪ Non-reflective surfaces should be utilised where possible. ▪ If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. ▪ Bury cables under the ground where possible. ▪ The O&M buildings should be painted with natural tones that fit with the surrounding environment. ▪ Select the alternatives that will have the least impact on visual receptors (i.e. Substation Alternative 1).

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.5.4 Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase. It is however recommended that the following mitigation be implemented during decommissioning:

- All infrastructure that is not required for the post-decommissioning use should be removed;
- Rehabilitate all cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist; and
- Monitor rehabilitated areas post-decommissioning and implement remedial actions, as required.

5 COMPARATIVE ASSESSMENT OF ALTERNATIVES

As previously mentioned, only two (2) on-site substation site alternatives are being investigated at this stage.

The preference rating for each alternative is provided in **Table 8** below. The alternatives are rated as being either preferred (the alternative will result in a low visual impact / reduce the visual impact), not-preferred (the alternative will result in relatively high visual impact / increase the visual impact), favourable (the visual impact will be relatively insignificant) and no-preference (each alternative would result in an equal visual impact).

The degree of visual impact and rating has been determined based on the following factors:

- The location of the on-site substation site in relation to areas of high elevation, especially ridges, koppies or hills;
- The location of the on-site switching substation site in relation to sensitive receptor locations; and
- The location of the 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 8: Comparative Assessment of Alternatives

Alternative	Preference	Reasons
SUBSTATION		
Alternative 1	Preferred	The proposed substation site alternative is situated in a largely natural area and no other existing electrical infrastructure and significant anthropogenic features are located within close proximity. The Watershed MTS can be found approximately 2.4km to the south-east of the proposed substation site alternative. No sensitive or potentially sensitive visual receptors can be found within 500m of this alternative. Twelve (12) potentially sensitive receptor locations can be found within 2km of the proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can be found within 2km of this alternative. It must be noted that one (1) sensitive visual receptor, namely VR 64 – Lichtenburg Game Breeding Centre, can be found further than 2km

Alternative	Preference	Reasons
		from the substation site alternative, within the low impact zone, while one (1) sensitive visual receptor, namely VR 62 – Lichtenburg Vakansie Oord, can be found further than 5km from the alternative and is considered to be negligible from a visual perspective. As such, Substation Site Alternative 1 is considered to be the preferred option as it would impact on slightly fewer potentially sensitive receptor locations. In addition, the substation would only be constructed if the proposed Tlisitseng solar 1 PV energy facility was developed as well. The impact of the substation would therefore be dwarfed by the large number of PV panels that would be visible.
Alternative 2	Favourable	The proposed substation site alternative is situated in a largely natural area and no other existing electrical infrastructure and significant anthropogenic features are located within close proximity. The Watershed MTS can be found approximately 2.4km to the south-east of Substation Site Alternative 2. No sensitive or potentially sensitive visual receptors can be found within 500m of this alternative. Thirteen (13) potentially sensitive receptor locations can be found within 2km of the proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafterrs Pub, can be found within 2km of Substation Site Alternative 2. It must be noted that one (1) sensitive visual receptor, namely

Alternative	Preference	Reasons
		VR 64 – Lichtenburg Game Breeding Centre, can be found further than 2km from the substation site alternative, within the low impact zone, while one (1) sensitive visual receptor, namely VR 62 – Lichtenburg Vakansie Oord, can be found further than 5km from the alternative and is considered to be negligible from a visual perspective. Although Substation Site Alternative 2 is located slightly closer to only one (1) of the potentially sensitive visual receptors it is still considered to be a favourable option as it would impact on fewer potentially sensitive receptor locations. In addition, the substation would only be constructed if the proposed Tlisitseng solar 1 PV energy facility was developed as well. The impact of the substation would therefore be dwarfed by the large number of PV panels that would be visible.

6 CONCLUSIONS

The Visual Impact Assessment (VIA) conducted for the proposed on-site Tlisitseng 1 Substation, 132kV power line and associated infrastructure has demonstrated that much of the study area has a natural visual character, with certain areas displaying a distinctly rural or pastoral component where maize cultivation and farmsteads occur. In addition, the study area is generally not valued for its tourism significance and is rated as having a low visual sensitivity. It should however be noted that the larger area might be valued for its tourism significance as the rich history of the area and the presence of several tourist attractions could attract tourists into the area. It was ascertained that due to the dominant farming practices and the relatively limited human habitation in the surrounding area, only three (3) sensitive receptors are present in the study area, namely the Lichtenburg Vakansie Oord (VR 62), the Lichtenburg Game Breeding Centre (VR 64) and Rafters Pub (VR 14). These three (3) visually sensitive receptors are regarded as facilities with current and future tourism potential and are therefore expected to experience the most significant visual impacts as a result of the proposed development. It should however be noted that at this stage, the game breeding centre is not operational. However, it is estimated that the restoration and construction process of the game breeding centre will last another year and it may be operated as a tourism facility in the future. Despite the tourism significance of the three (3) sensitive visual receptor locations, the proposed development is expected to have a low visual impact on the Lichtenburg Vakansie Oord while it will have a moderate visual impact on the Lichtenburg Game Breeding Centre and Rafters Pub. It must also be noted that the R505 main road, which traverses the power line corridor as well as the study area, is considered to be a visually sensitive road and the relatively high volumes of motorists travelling along this road would be visually exposed to the proposed development. Several scattered farmsteads / homesteads which are used to house the local farmers as well as their farm workers were also identified within the study area and are regarded as potentially sensitive visual receptors. Upon further investigation, it was established that the proposed development would have a low visual impact on majority of the potentially visual receptors. The proposed development was not deemed to have a high visual impact on any of the receptor locations identified within the study area.

The overall significance of the visual impacts as a result of the proposed development during construction and operation was assessed according to SiVEST's impact rating matrix. The assessment revealed that overall the proposed on-site Tlisitseng 1 Substation and 132kV power line would have a low visual impact during construction and a medium visual impact during operation, with a number of mitigation measures available.

As part of the VIA, the proposed on-site substation site alternatives were also comparatively assessed. The comparative assessment of alternatives revealed that the proposed On-site Substation Site Alternative 1 would be the preferred option, while On-site Substation Site Alternative 2 was deemed to be a favourable option from a visual perspective.

Overall it can be concluded that the visual impact of the proposed on-site Tlisitseng 1 Substation and 132kV power line would be reduced due to the presence of existing electrical infrastructure and linear elements in the study area, as well as the lack of sensitive visual receptors present. In addition, the on-site substation and power line are being proposed in order to supply the electricity generated by the two (2) proposed Tlisitseng PV energy facilities to Eskom's national grid. Thus the substation and power line would only be constructed if the proposed Tlisitseng PV energy facilities are developed as well. The substation and power line would likely form part of the PV complex, as viewed from the surrounding farmsteads and the impact would therefore be dwarfed by the large number of PV panels that would be visible.

6.1 Environmental Impact Statement

It is SiVEST's opinion that the visual impacts are not significant enough to prevent the project from proceeding and that an Environmental Authorisation (EA) should be granted. From a visual impact perspective only three (3) sensitive visual receptors have been identified within the study area. In addition, the existing electrical infrastructure and other linear elements already present within the study area have already altered the natural character of the surrounding environment to a degree and are expected to lower the visual sensitivity of the area. The visual impacts associated with the proposed development is expected to have a low visual impact on most of the sensitive and potentially sensitive visual receptors identified within the study area. It must also be noted that SiVEST believe that the impacts 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

LIST OF VISUALLY SENSITIVE AND POTENTIALLY SENSITIVE RECEPTOR LOCATIONS

Table i: Visually sensitive / potentially sensitive receptor locations within the study area

Name	Type	Coordinates	Zone of visual exposure
VR 1	Houthaalboomen Farmhouse	26° 4'12.82"S 26° 7'30.12"E	Moderate
VR 2	Houthaalboomen Farmhouse	26° 4'9.67"S 26° 7'48.32"E	Moderate
VR 3	Houthaalboomen Farmhouse	26° 3'37.12"S 26° 7'34.57"E	Low
VR 4	Houthaalboomen Farmhouse	26° 3'32.67"S 26° 7'12.12"E	Low
VR 5	Houthaalboomen Farmhouse	26° 3'31.90"S 26° 6'49.78"E	Low
VR 7	Houthaaldoorns Farmhouse (Sensako)	26° 3'2.28"S 26° 5'14.55"E	Low
VR 8	Houthaaldoorns Farmhouse (Sensako)	26° 3'3.96"S 26° 5'11.37"E	Low
VR 9	Houthaaldoorns Farmhouse (Sensako)	26° 3'6.79"S 26° 5'4.42"E	Low
VR 10	Houthaaldoorns Farmhouse (Sensako)	26° 3'6.37"S 26° 5'13.13"E	Low
VR 11	Houthaalboomen Farmhouse	26° 4'50.57"S 26° 5'15.03"E	Low
VR 12	Houthaalboomen Farmhouse	26° 5'13.10"S 26° 5'57.13"E	Moderate
VR 13	Houthaalboomen Farmhouse	26° 5'53.32"S 26° 5'56.97"E	Moderate
VR 14	Talene Farmhouse and Rafters Pub	26° 5'42.74"S 26° 6'44.71"E	High
VR 15	Houthaalboomen Farmhouse	26° 6'15.12"S 26° 6'53.49"E	Moderate
VR 16	Elandsfontein Farmhouse	26° 6'26.07"S 26° 6'45.92"E	Moderate
VR 17	Talene Farmhouse	26° 5'45.27"S 26° 7'10.49"E	High
VR 18	Houthaalboomen Farmhouse	26° 6'5.41"S 26° 7'14.36"E	Moderate
VR 19	Houthaalboomen Farmhouse	26° 6'7.51"S 26° 7'35.37"E	Moderate
VR 20	Elandsfontein Farmhouse	26° 6'13.00"S 26° 7'41.02"E	Moderate

Name	Type	Coordinates	Zone of visual exposure
VR 21	Houthaalboomen Farmhouse	26° 6'2.84"S 26° 7'48.74"E	Moderate
VR 22	Talene Farmhouse	26° 5'40.57"S 26° 7'32.71"E	High
VR 23	Talene Farmhouse	26° 5'30.63"S 26° 7'56.63"E	High
VR 24	Priem Farmhouse	26° 5'42.17"S 26° 7'58.07"E	Moderate
VR 25	Priem Farmhouse	26° 5'52.54"S 26° 8'5.17"E	Moderate
VR 26	Priem Farmhouse	26° 5'47.07"S 26° 8'23.48"E	High
VR 27	Elandsfontein Farmhouse	26° 5'58.23"S 26° 8'21.92"E	Moderate
VR 28	Elandsfontein Farmhouse	26° 5'59.46"S 26° 8'15.53"E	Moderate
VR 29	Elandsfontein Farmhouse	26° 6'12.00"S 26° 8'32.09"E	Moderate
VR 30	Elandsfontein Farmhouse	26° 6'17.60"S 26° 8'22.83"E	Moderate
VR 31	Elandsfontein Farmhouse	26° 7'2.71"S 26° 8'19.94"E	Low
VR 32	Elandsfontein Farmhouse (Boskoppie)	26° 6'24.04"S 26° 8'22.83"E	Moderate
VR 33	Elandsfontein Farmhouse	26° 6'36.89"S 26° 8'24.30"E	Moderate
VR 34	Lichtenburg Drive-in Theatre	26° 6'38.28"S 26° 8'45.61"E	Moderate
VR 35	Elandsfontein Farmhouse	26° 6'53.21"S 26° 8'19.33"E	Low
VR 36	Elandsfontein Farmhouse	26° 7'11.22"S 26° 8'17.02"E	Low
VR 37	Elandsfontein Farmhouse	26° 7'32.70"S 26° 8'19.87"E	Low
VR 38	Elandsfontein Farmhouse	26° 7'33.72"S 26° 8'36.66"E	Low
VR 39	Elandsfontein Farmhouse	26° 7'31.97"S 26° 8'47.57"E	Low
VR 40	Elandsfontein Farmhouse	26° 7'43.44"S	Low

Name	Type	Coordinates	Zone of visual exposure
		26° 8'55.14"E	
VR 41	Elandsfontein Farmhouse	26° 7'49.21"S 26° 8'55.71"E	Low
VR 42	Elandsfontein Farmhouse (Elandsfontein)	26° 7'48.81"S 26° 8'40.81"E	Low
VR 43	Elandsfontein Farmhouse	26° 7'41.96"S 26° 8'40.52"E	Low
VR 44	Elandsfontein Farmhouse	26° 7'42.01"S 26° 8'7.67"E	Low
VR 45	Elandsfontein Farmhouse	26° 7'45.34"S 26° 8'3.46"E	Low
VR 46	Elandsfontein Farmhouse	26° 7'46.47"S 26° 8'6.12"E	Low
VR 47	Elandsfontein Farmhouse	26° 7'54.67"S 26° 7'47.65"E	Low
VR 48	Elandsfontein Farmhouse	26° 7'50.58"S 26° 7'33.20"E	Low
VR 49	Elandsfontein Farmhouse	26° 7'53.23"S 26° 7'11.21"E	Low
VR 51	Elandsfontein Farmhouse	26° 8'10.44"S 26° 8'38.10"E	Low
VR 52	Elandsfontein Farmhouse	26° 8'10.29"S 26° 8'45.99"E	Low
VR 53	Elandsfontein Farmhouse	26° 8'5.95"S 26° 8'47.70"E	Low
VR 54	Elandsfontein Farmhouse	26° 8'7.24"S 26° 8'50.98"E	Low
VR 55	Elandsfontein Farmhouse	26° 8'9.14"S 26° 8'52.41"E	Low
VR 56	Elandsfontein Farmhouse	26° 8'10.95"S 26° 8'55.66"E	Low
VR 57	Elandsfontein Farmhouse	26° 8’12.30”S 26° 9’0.90”E	Low
VR 58	Lichtenburg Town and Townlands Farmhouse	26° 7'45.88"S 26° 9'26.55"E	Low
VR 62	Lichtenburg Vakansie Oord (Vacation Resort)	26° 7'23.23"S 26° 9'57.12"E	Low
VR 63	Pub near the entrances of the Lichtenburg Game Breeding Centre and Lichtenburg Vakansie Oord	26° 7'49.84"S 26°10'6.46"E	Low

Name	Type	Coordinates	Zone of visual exposure
VR 64	Lichtenburg Game Breeding Centre (Tourism Facility)	26° 4'52.19"S 26° 9'33.45"E	Moderate

SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Stephan Jacobs
Tel No.: +27 11 798 0677
Email: stephanj@sivest.co.za

srk consulting

Section A, 2nd Floor,
Norfolk House
54 Norfolk Terrace,
Westville, 3630
P O Box 1969
Westville, 3630
South Africa
T: +27 (0) 31 279 1200
F: +27 (0) 31 279 1204
E: durban@srk.co.za
www.srk.co.za

29 July 2016
489025/ALLK/1607083

Ms. A. Gibb
SiVEST
PO Box 2921
Rivonia
2128

Attention: Ms. A. Gibb

Dear Ms. Gibb

Peer Review of the Tslsitseng 1 and 2 PV and Grid Connection Visual Impact Assessment Reports

SiVEST Reports: 13303

SiVEST (Pty) Ltd. (SiVEST) is undertaking Environmental Impact Assessments (EIA's) for:

1) The construction of the Tslisitseng Solar 1 Photovoltaic (PV) Energy Facility (**EIA Ref: 14/12/16/3/3/2/889**); and
2) The construction of the Tslisitseng Solar 2 Photovoltaic (PV) Energy Facility (**EIA Ref: 14/12/16/3/3/2/890**)

As well as Basic Assessments for:

1) The construction of the Tlisitseng 1 Substation and associated 132 kV Power Line; and
2) The construction of the Tlisitseng 2 Substation and associated 132 kV Power Line.

As part of the Environmental Authorisation process, a Visual Impact Assessment (VIA) for each of these projects was needed. As SiVEST is the primary environmental assessment practitioner (EAP) for the environmental assessments and VIA, an external peer review is required.

This letter constitutes the independent peer review conducted by SRK Consulting (South Africa) (Pty) Ltd. (SRK). As the Tlisitseng 1 and Tlisitseng 2 projects shares the same property, and hence the same sensitive receptors, this letter presents the review findings of all three reports.

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. For ease of reference, the reports for the PV Facilities are labelled: **PV** and the substation and 132 kV power lines are labelled: **Grid**

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.	**Section 1 of Report**
(d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	**Present** **(Grid Section 1.3)** **(PV Section 1.4)**
(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process.	**Present** **(Grid Section 1.4)** **(PV Section 1.5)**
(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 4 and Section 5**
(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 1.4)**
(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)**

	Legal Requirement	Relevant Section in Specialist study
(n)	A reasoned opinion[1] (Environmental Impact Statement)-	**Present (Section 6.1)**
	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 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**

Some additional recommendations for improving the report were identified during the review process. These are listed below:

1. Recommendation was made that vegetation rehabilitation could involve the establishment of nurseries, to aid in reducing the time for the vegetation cleared to re-establish.
2. Some text in the report may not be relevant or too emotive; these recommendations are made in the report.
3. Recommendations for additional mitigation measures have been included in the text.

Additional comments for the reports have been compiled in separate Word Document submitted to SiVEST on 29 July 2016:

- **SRK Report: 489025_SivestReview_Tlisitseng_1_GridReview_20160729**
- **SRK Report: 489025_SivestReview_Tlisitseng_1_PV_20160729**
- **SRK Report: 489025_SivestReview_Tlisitseng_2_GridReview_20160729**
- **SRK Report: 489025_SivestReview_Tlisitseng_2_PV_20160729**

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

SRK Consulting - Certified Electronic Signature
srk consulting
489025/42578/Letter Report
6637-6579-3009-ALLK
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Mr. K. Allan (Pr. Sci. Nat.)
Senior GIS Specialist

SRK Consulting - Certified Electronic Signature
srk consulting
489025/42578/Report
949-2091-740-JORD
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Mr. W. Jordaan (Pr. Sci. Nat.)
Associate Partner

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK). SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

[1] Also include a summary of the impacts.

Appendix D8

SOCIO-ECONOMIC

BASIC ASSESSMENT FOR THE TLISITSENG 1 132KV SUBSTATION AND 132KV POWERLINE NEAR LICHTENBURG, NORTH WEST PROVINCE

SOCIO-ECONOMIC ASSESSMENT

FINAL REPORT

JULY 2016

URBAN-ECON
Development Economists

Celebrate Development Diversity

P.O. Box 13554, HATFIELD 0028
Tel: (012) 342-8686
Fax: (012) 342 8688
E-mail: pta@urban-econ.com

Celebrate Development Diversity.

Version:

Final version 2

21 July 2016

Project leader:

Elena Broughton

Cell: 082 463 2325

Email: elena@urban-econ.com

Report writer:

Mariette Steynberg

Cell: 079 029 5586

Email: mariette@urban-econ.com

SPECIALISTS DETAILS

Elena Broughton

Cell: 082 463 2325

E-mail: elena@urban-econ.com

Position: Manager/Senior Economist

Qualifications: MSc Technology Management, BSC (Hon) Technology Management, BCom (Hon) Economics

Experience: 11 years

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 11 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.

Mariette Steynberg

Cell: 079 029 5586

E-mail: mariette@urban-econ.com

Position: Development Economist

Qualifications: BComHons (International Trade and Development)

Experience: 3 years

Brief profile: Mariette Steynberg completed her BCom degree in 2008 at the University of Johannesburg with a double major in Economics and Econometrics. She went on to complete a BCom Honours degree in 2009 majoring in International Trade and Development Economics. To further her capabilities in the field she successfully completed a Post Graduate Diploma in Financial Planning in 2013 while working as a trainee planner before relocating to Pretoria to pursue a career in Economics.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

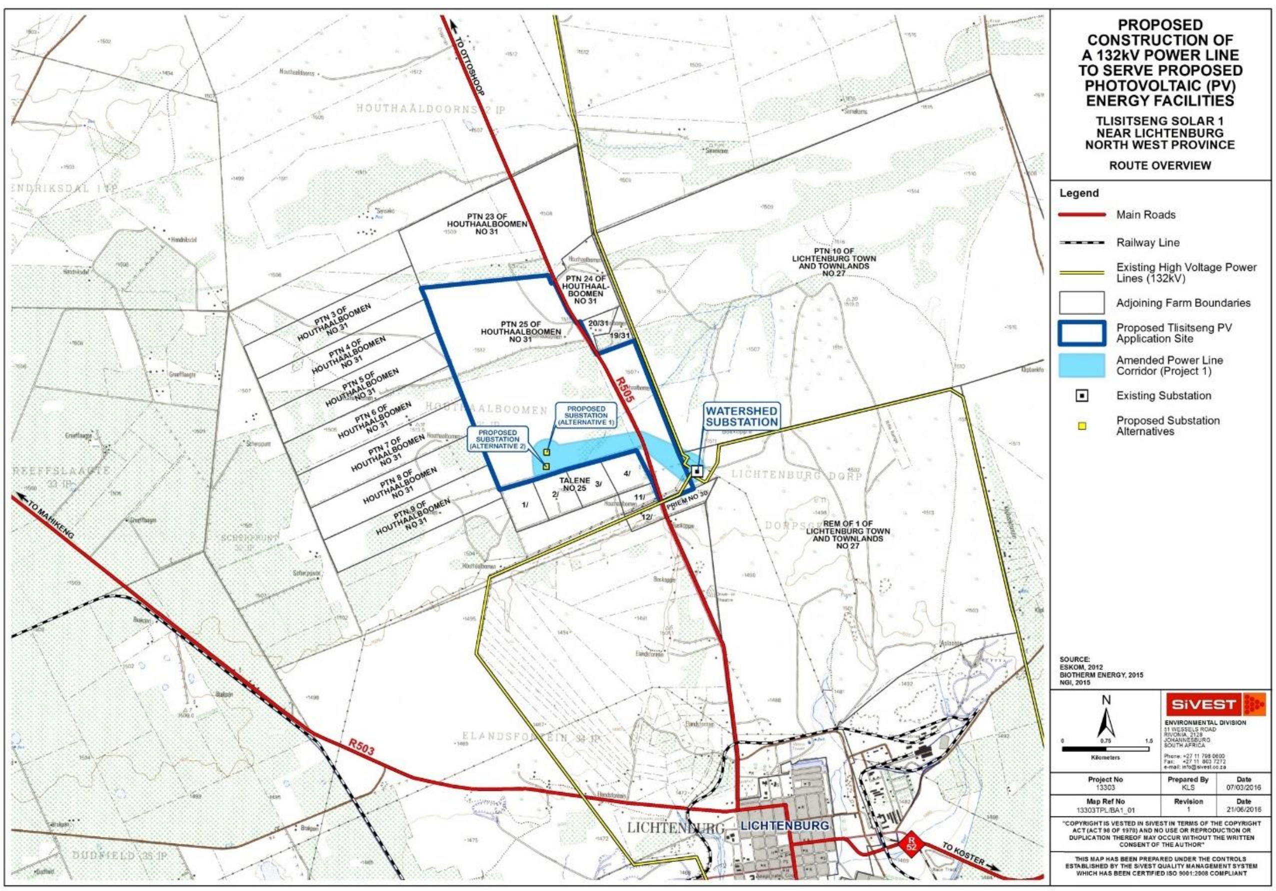
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
CBD	Central Business District
CSP	Concentrated Solar Power
DC	Direct Current
DoE	Department of Energy
DM	District Municipality
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ha	Hectare
GDP	Gross Domestic Product
IDP	Integrated Development Plan
IEA	International Energy Agency
IRP	Integrated Resource Plan
kV	kilovolts
LM	Local Municipality
m	Metre
m^2	Square metre
mm	Millimetre
MTS	Main Transmission Substation
MW	Megawhatt
NDP	National Development Plan
NGPF	New Growth Path Framework
NSDP	National Spatial Development Perspective
OHL	Over Head Lines
OPEX	Operational Expenditure
PDP	Provincial Development Plan
PSDF	Provincial Spatial Development Framework
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
REIPPP	Renewable Energy Independent Power Producer Procurement
SDF	Spatial Development Framework
SETRM	Solar Energy Technology Roadmap
SMMEs	Small, Medium, and Micro Entreprises
Stats SA	Statistics South Africa
UCT	University of Cape Town

1 INTRODUCTION

This document is prepared by **Urban-Econ Development Economists** in request by **SiVEST Environmental Division** on behalf of **BioTherm Energy (Pty) Ltd** to undertake a Socio-Economic Basic Assessment for the development of the **Tlisitseng 1 132 kV Substation and 132 kV powerline** near Lichtenburg in the North West Province. The socio-economic impact study is done in accordance with the Basic Assessment Report Guidelines, prepared by the Department of Environmental Affairs.

1.1 Brief Description of the Project

BioTherm proposes the development of the Tlisitseng 1 Solar PV energy facility near Lichtenburg in the North West Province. It is intended that the PV facility, with a 75 MW export capacity and its associated infrastructure will be established on Portion 25 of Farm Houthaalboomen 31. The PV facility will have an on-site 132 kV substation and powerline. Connection to the grid will be via the existing Eskom Watershed Main Transmission Substation (MTS). Map 1-1 indicates the proposed location of the substation alternatives and the powerline.



Map 1-1: Proposed location of Tsilitseng 1 132 kV substation and powerline on Portion 25 of Farm Houthaalboomen 31

1.2 Scope and Purpose of the Study

The purpose of the socio-economic basic assessment is to determine the potential socio-economic implications of the proposed project activities at each of the proposed three possible locations, and to compare their effects with the “no-go” alternative. The “no go” alternative assumes that the proposed Tlisitseng 1 substation and associated powerline are not established at any of the sites, which means that it represents the status of the environment, including the socio-economic situation.

The basic assessment report addresses the impacts as set out in the guidelines in terms of the Environmental Impact Assessment Regulations of 2014. The purpose of the socio-economic basic assessment report is as follows:

- 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.
- Create a socio-economic profile for the study area using secondary data. The guidelines for 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.
- Identify and analyse the potential socio-economic value of the proposed project and recommend the preferred site alternative considering the socio-economic characteristics of the proposed locations and their surrounding environments.
- 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.

1.3 Methodology

The methodology employed in conducting the study comprised of three steps as illustrated in **Figure 1-1**.

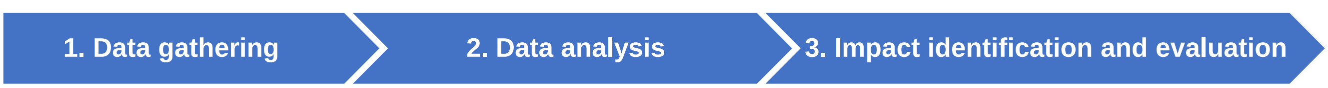


Figure 1-1: Methodology

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. The following information sources were used in gathering the data:

- Stats SA Census 2011
- Quantec Research database
- National, provincial, and local policy documents and plans
- Interviews with the land owners of the directly and indirectly affected farms in the areas that took place during 1 and 2 December 2015

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 substation and powerlines. Where applicable, the anticipated impacts were analysed in the context in of site alternative.

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 (IDP)
  - Ngaka Modiri Molema District Municipality (DM) Integrated Development Plan (IDP) (2012 – 2016)
  - Ditsobotla Local Municipality Integrated Development Plan (IDP) (2011/12 – 2015/16)
- Spatial Development Frameworks
  - National Spatial Development Perspective (2006)
  - North West Provincial Spatial Development Framework (PSDF) (2008)
- Provincial strategic documents
  - Renewable Energy Strategy for the North West Province (2012)
  - North West Provincial Development Plan (PDP) (2030)
  - North West Province Growth and Development Strategy (2004 – 2014)

- National strategic documents
  - National Energy Act (2008)
  - National White Paper on Renewable Energy (2003)
  - National Integrated Resource Plan for Electricity (2010 - 2030)
  - Overview of Renewable Energy Roadmap – the workshop on the Draft Integrated Energy Planning Report
  - Comment on the national Solar Energy Roadmap (in the process of being developed)
  - The National Development Plan (NDP) (2030)
  - New Growth Path Framework (NGPF) (2011)

Primary data gathering

The primary data gathering was done by in-person interviews with the identified interested and affected individuals. Where in-person interviews were not possible, all efforts were made to communicate with the specific individuals either telephonically or via electronic correspondence.

The in-person interviews were undertaken during a site visit that took place between 1 December 2015 and 2 December 2015. During this time, a total of nine interviews were completed. Seven of these interviews related to the directly and indirectly affected parcels, one was with the library assistant in the Lichtenburg public library and the final with the chairperson of the Community Policing Forum. The last two interviews were done to triangulate the information gathered from secondary data sources on the socio-economic status quo of the wider community that may be affected by the proposed development.

Below is a list of all of the stakeholders that were consulted by means of in-person interviews during site visit, which took place in the beginning of December 2015.

- Directly or indirectly affected land owners/residents:
  - Mr Ferdi Hertzenberg – Directly affected land owner Portion 25 of Farm Houthaalboomen 31
  - Mr Henry Nel – Portions 23 and 24 of Farm Houthaalboomen 31
  - Mr Gert Pieterse – Portion 19 of Houthaalboomen 31
  - Mr Gysbert Goedhals – Portion 3 of Farm Talene 25
  - Mark & Jackie Hechter – Portion 1 of Farm Talene 25
  - Mr Wessel Wessels Portions 3, 4, 5, 6, and 7 of Farm Houthaalboomen 31
  - Mr Jan Steinman – Portion 10 of Lichtenburg town and townlands 27

- Members of the wider community:
  - Library assistant at Lichtenburg Public Library
  - Mr. Godfrey Samore Ditsobotla – LM Chairperson of the Community Policing Forum

Consultation with the owners of the following indirectly affected farm portions did not take place due to various reasons as indicated:

- Portion 20 of Farm Houthaalboomen 31: The land owner has shown negligible interest in being consulted on the project.

- Portion 2 of Farm Talene 25: The land owner has shown negligible interest in being consulted on the project at the time of the site visit (December 2015). However, due cognisance was given to the comments submitted by the owner in the letter dated 24 June 2016.
- Portion 4 of Talene 25: During a telephonic conversation with the owner, which took place during the site visit, it was indicated that he had no interest in consultation until a community meeting with all of the interested and affected parties have taken place. Comments received in a letter dated 22 June 2016 were considered in the assessment.
- Portions 8 and 9 of Farm Houthaalboomen 31: At the first consultation meeting that took place in December 2015, it was revealed that the land owner of this property did not have any concerns or objections to the project. No further consultation was required.

Further to the above, comments from the following parties submitted by form of a letter were considered:

- Mark Hechter, the owner of Portion 1 of Farm Talene 25: Letter dated 25 July 2011 and e-mail sent on 30 June 2016
- Mr Gysbert Goedhals, the owner of Portion 3 of Farm Talene 25: Letter dated 25 June 2016
- Mr Andries van Rooyen, the owner of Portion 2 of Farm Talene 25: Letter dated 24 June 2016
- Mr Fazel VarVariawa, the owner of Portion 4 of Talene 25: Letter dated 22 June 2016

1.5 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 budget specified.
- Possible impacts and 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.
- It is assumed that the motivation, and ensuing planning and feasibility studies for the project were done with integrity and that all information provided to the specialist by the project proponent and its consultants to date is accurate.
- It is assumed that the project description and infrastructure components as discussed above are reasonably accurate. These details were used to assess the potential impacts.
- With regard to the in-person interviews undertaken the following assumptions are made:
    - Questions asked during the interviews were answered accurately and truthfully.

  - That the attitudes of the respondents towards the project will remain reasonably stable over the short- to medium-term.

- The assumption is that no significant concern exists for those land owners who have not provided comments on the project either through personal interviews or through e-mail/letter, or it can be reasonably assumed that consultation would have been sought. Where applicable, Google Earth imagery was used to attempt to determine the current level of economic activity taking place on the relevant farm portions to aid in assessment of any potential impact and its extent on the specific land owner.

- At the same time, it is assumed that the general concerns and opinions raised by all other land owners interviewed, such as security concerns, would also apply to the land owners who did not provide their feedback for whatever reasons.

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 local level. Furthermore, the analysis signposts any red-flag or developmental concerns that could jeopardise the development of the project and assist in amending it preventing costly and unnecessary delays.

The following government strategic documents applicable to the delineated study areas were examined:

- National (South Africa) and provincial (North West) level Renewable Energy (RE) policy:
    - National Energy Act (2008),
    - National White Paper on Renewable Energy (2003),
    - National Integrated Resource Plan for Electricity (2010 – 2030),
    - Renewable Energy Strategy for the North West Province (2012)
    - Overview of RE Roadmap – the workshop on the Draft Integrated Energy Planning Report,
    - Comment on the National Solar Energy Roadmap, due for release in October 2016
- National, provincial, and local level spatial policy:
    - National Spatial Development Perspective (2006)
    - North West Provincial Spatial Development Framework (PSDF) (2008)
- National, provincial, and local level socio-economic development policy
    - National Development Plan (NDP) (2030)
    - New Growth Path Framework (NGPF) (2011)
    - North West Provincial Development Plan (PDP) (2030)
    - North West Province Growth and Development Strategy (2004 – 2014)
    - Ngaka Modiri Molema DM Integrated Development Plan (IDP) (2012 – 2016), and
    - Ditsobotla LM Integrated Development Plan (IDP) (2011/12 – 2015/16).

Renewable Energy (RE) policy

The **National Energy Act** (Act no, 34 of 2008), promulgated in 2008, has, as one of its key objectives, the promotion of diversity of supply of energy and its sources. From this standpoint, the Act directly references the importance of the RE sector, with a mention of the solar energy sector included. The aim is to ensure that the South African economy is able to grow and develop, fast tracking poverty alleviation, through the availability of a sustainable, diverse energy mix. Moreover, the goal is to provide for the increased generation and consumption of RE (Republic of South Africa, 2008).

The 2003 **White Paper on Renewable Energy** elaborates on the South African Government's policy principles, and strategic goals and objectives for promotion and implementation of the RE sector in the country. The White Paper, which acts as a supplement to the White Paper on Energy Policy, identifies the long- and medium-term potential of RE in South Africa.

As a signatory to the Kyoto Protocol, the country has made commitments to achieve greenhouse gas emissions reduction targets. Considering the high reliance of South Africa on coal-fired power stations for electricity generation, the government's commitment to the development of a framework for the establishment and operation of a national RE framework is vital to the achievement of the emission reduction targets. Moreover, the development of a national RE framework will aid in increasing energy security in South Africa over time, through the diversification of supply. In this regard, the government's long-term goal is the establishment of a renewable energy industry, with RE energy carriers that are capable of offering a sustainable, non-subsidised alternative to fossil fuels (Department of Minerals and Energy, 2003).

The **Integrated Resource Plan (IRP), for Electricity** (2010 – 2030) final report provides for the disaggregation of RE technologies to differentiate and display solar photovoltaic (PV), concentrated solar power (CSP), and wind options clearly. The following policy considerations assisted in arriving at this version of the IRP:

- The installation of RE technologies brought forward in order to accelerate a local industry.
- To provide for the uncertainties associated with the cost of renewables and fuels, a nuclear fleet was included.
- The emissions constraint of 275 million tons of carbon dioxide per year after 2024 was maintained.
- Energy efficiency demand side management measures were maintained.

The key conclusions from a review of the IRP, relevant to the RE sector, is that the accelerated roll out of RE technologies must be allowed and promoted in order to derive the benefits of localisation in these RE technologies. Moreover, it places emphasis on the establishment of a Solar PV programme (Republic of South Africa, 2011).

An overview of the **Renewable Energy Roadmap** states that the mandate of the Department of Energy (DoE) is the provision of secure and sustainable sources of electricity to stimulate economic development. The aim is to improve South Africa's energy mix by 2025, by having 30% clean energy generation. The Renewable Energy Roadmap elaborates by saying that four focus areas are key to achieving the Government's RE objectives; financial instruments, legal instruments, technology development, and awareness building, capacity building, and education (Modise, 2013).

The South African **Solar Energy Technology Roadmap** (SETRM) is being developed following collaboration between the DoE and the International Energy Agency (IEA), the GIZ, and the Department of Science and Technology (Modise, 2013). The objective of the SETRM is stated as "To develop a clear, comprehensive, and prioritised implementation plan (i.e. roadmap) for the development and diffusion of concentrated solar power; solar photovoltaic technology; solar heating and cooling technologies; and related R&D in South Africa toward reduced energy use, carbon emissions reduction; distributed electricity generation, expanded independent power production and electricity supply to the national grid, as well as the reduction of reliance on carbon fuels" on the DoE's website. The SETRM is set for release at the end of 2015.

According to the **Renewable Energy Policy for the North West Province**, the region is the fourth largest electricity consumer in the country (12%), with the bulk of this electricity requirement being supplied by coal-fired power stations in Mpumalanga. It furthermore states that roughly 63% of the electricity usage takes place in the mining sector, with the rural communities suffering from energy poverty in many cases. In communities, where electricity is not accessible, the households make use of wood for cooking and lighting; this is impacting negatively on the environment and the health of these communities. The RE Policy simultaneously recognises the potential for economic development and job creation that could ensue from the RE sector in the Province. Based on these aspects, the key objectives of the policy are set out as:

- Reduction of the Province's contribution to climate change.
- Alleviation of energy poverty.
- The promotion of economic development and job creation by developing a green economy.

With regard to solar energy generation, the Province's RE Policy notes that the North West Province has very good potential as a location for these projects – with average daily solar radiation rates of greater than 8 000 MJ/m^2; only the Northern Cape Province receives more solar radiation than the North West Province. The Dr. Ruth Segomotsi Mompati DM receives on average only 5% less solar radiation than Upington (an area that is considered a prime location for solar PV projects); the study area, therefore, shows high potential for solar energy application. The RE Policy subsequently proposes the following actions for the development of the Solar PV industry in the North West Province, and moreover, the areas identified as having a high potential:

- Identification of a suitable entity linked to the North West Province Government to drive the opportunities associated with Solar PV project under the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme.
- The Province should initiate a project as part of the implementation plan to identify suitable areas with the following requirements:
  - Suitable and proven measured level of solar radiation.
  - Possibility of long-term lease or option on property.
  - Good grid infrastructure in close proximity.
  - Suitable connection point into the grid.
  - Low impact on agriculture and the environment.
  - Suitable access to and around the site to aid effective execution.
  - Close proximity to communities that could benefit from local economic development and job creation.
- The Province should also explore the likelihood of attracting PV project developers by packaging the most suitable and viable land areas for PV projects.
- The Province should focus on the development of local content for the manufacturing of components for the PV industry. As risk and uncertainty is associated with PV projects, long-term procurement programmes are needed to stimulate investment in local manufacturing, ensuring the future of the Solar PV industry (Department of Economic Development, Environment, Conservation, and Tourism, 2012).

Spatial planning policy

In the **National Spatial Development Perspective** (NSDP) (2006), the Mafikeng-Lichtenburg area is highlighted as one of South Africa's key economic centres, and classed as an undiversified economy, comprising of the public services and administration, retail, and private services sectors predominantly. The National Spatial Development Perspective furthermore states that, the relatively large population consists of a large percentage living in poverty. It recommends a proactive approach, to address the issue of migration towards areas with high economic potential and subsequent undesirable settlement patterns and marginalisation of the poor. The previous NSDP describes the country's spatial vision as follows (The Presidency of the Republic of South Africa, 2006):

- Focussing of economic growth stimulants and employment creation in areas where it is most effective and sustainable.
- The support of restricting where feasible to ensure greater economic competitiveness.
- Fostering development based on local potential.
- Ensuring that development institutions are able to provide basic needs throughout the country.

This vision is advanced by the 2006 NSDP by ensuring that a systematic overview and framework for the understanding of the national spatial economy is provided, and aims to be used as a means for dialogue between the various spheres of government for deciding where to focus infrastructure investment and development spending for example. The 2006 NSDP furthermore states that, certain opportunities and challenges exist for the local and district municipalities to ensure that coordinated government action is implemented. Actions with reference to the current project include (The Presidency of the Republic of South Africa, 2006):

- Decisively dealing with poverty, social and economic exclusion, and spatial fragmentation.
- Exploring and addressing the implication of natural resource potential and use for growing the economy and addressing poverty.
- Seeking out new areas of comparative advantage to identify and develop clusters of specialisation in collaboration with, especially, the provincial and national departments of trade and industry, labour, and economic affairs.

The **North West Provincial Spatial Development Framework and Environmental Management Plan** (PSDF – EMP) of 2008, is closely aligned to the NSDP, and as such places key importance on economic growth and poverty eradication. The spatial rationale is centred on the need to address issues related to; spatial planning, socio-economic development, infrastructure, and the sustainable and conservative use of natural resources. The PSDF – EMP highlights the fact that the legacy of the Apartheid-era policy is the key issue, with parts of the Province being significantly underdeveloped.

Although the PSDF – EMP does not include any land use or bioregional mapping, it does provide information on the required natural resources and socio-economic issues that must be addressed. The most prominent natural resource problems include; inadequate water resources (impacting future development), bush encroachment and alien invasive species, land and soil degradation, and overgrazing. The most significant socio-economic issues highlighted in the PSDF – EMP are as follows (Department of Economic Development, Environment, Conservation, and Tourism, 2008):

- The creation of employment opportunities - including increased economic opportunities for the youth and women.
- The eradication of poverty.
- Attraction investment into the Province.
- Achieving sustainable economic growth.
- The fight against, and prevention of HIV/Aids and other diseases.
- Achieving food security.
- Improved physical infrastructure, including the availability of industrial land.

- Decreasing the Province’s illiteracy levels.
- Development of the Province’s tourism potential.
- Managing population growth, urbanisation, and migration.

Socio-economic development policy

The **National Development Plan 2010 – 2030** (NDP 2030) aims to eliminate poverty and reduce inequality by 2030. At the same time it is geared towards achieving economic growth by expanding opportunities, building capabilities, reducing poverty, and involving communities in their own development, all leading to an increase in living standards of these communities. The NDP 2030 recognises nine key challenges that need to be addressed. Although all challenges are seen to be important, the priority areas can be identified as job creation and improvement of the quality of national education. Managing the transition towards a low carbon economy is also one of the nine key national challenges; in line with this, the expansion and acceleration of a commercial RE sector is seen as a key intervention strategy. The NDP 2030 seeks to ensure that half of all electricity generation capacity is provided by renewable resources (National Planning Commission, 2011).

The **New Growth Path Framework** (NGPF) of 2011 states that the achievement of decent work creation, reducing inequality, and poverty eradication, can only take place if the South African economy is restructured. It is required that the economy improves its rate of labour absorption, as well ascomposition and rate of growth. To aid in this goal, five key job drivers were identified, and according to the NGPF, one of these job drivers is “Seizing the potential of new economies” (Department of Economic Development, 2010)

The NGPF states that technology innovation is capable of significant employment creation, with the potential to achieve a target of 300 000 jobs by 2020, and 400 000 jobs by 2030 that could be directly attributed to the Green Economy. One of the main strategies to achieve this job creation target is the comprehensive support required by the energy efficiency and RE sectors. Programmes aimed at encouraging the local production of inputs, (with solar water heaters as a starting point), and appropriate pricing policies will form a part of the strategy (Department of Economic Development, 2010).

The **North West Provincial Development Plan** (2030) is shaped from the NDP and attempts to align with the NDP’s vision, objectives and priorities for a united South Africa in 2030. The key focus areas of the PDP are based on the main challenges hampering growth in the North West Province, and are similar to that of the NDP, with a focus on the rural economy, and the upgrading, provision, and maintenance of economic infrastructure in the Province. Furthermore, the Province is focused on the transformation of human settlements and the eradication of corruption. The PDP states that RE, especially solar, and waste/biomass initiatives, is seen as being increasingly important in the Province, as its contribution to provincial energy consumption is envisaged to increase over the next two decades (North West Planning Commission, 2013).

The North West **Provincial Growth and Development Strategy** (PGDS) (2004 – 2014) identifies a small private sector as one of the key developmental challenges in the Province. Other challenges include low population densities, inadequate infrastructure and service delivery backlogs, a predominantly poor population with low literacy levels, substantial inequalities between rich and poor, as well as disparities between urban and rural communities, and the HIV/Aids pandemic. Considering this, the objectives of the PGDS are addressing poverty and unemployment, and simultaneously improving the low level of skills and expertise in the Province (North West Province: Office of the Premier, 2004).

The PGDS identifies the following pillars of economic development:

- Growth and Investment,
- Agricultural and Rural Development,
- Mining and Energy,
- Manufacturing,
- Tourism,
- Construction and Infrastructure,
- Small Medium and Micro Enterprises (SMMEs), and
- Training and Skills Development.

Importantly, RE and Solar technologies are not addressed within the Mining and Energy pillar, or in the PGDS. Focus is, however, on provision for a more diversified future economy.

The **Ngaka Modiri Molema DM's Integrated Development Plan** (IDP) 2012 – 2016, states its mission as providing a developmental municipal governance system for a better life for all in the Ngaka Modiri Molema DM, with the following listed as priorities for the IDP (Ngaka Modiri Molema District Municipality):

- Provision of water and sanitation.
- Improvement of local road infrastructure.
- Local economic development and job creation.
- Environmental health management.
- Promote integration of services.
- Promote intergovernmental coordination and relations.
- Support local municipalities.

The IDP finds that the following are the DM's most prominent development challenges:

- In general, the DM is significantly under-serviced in terms of social as well economic infrastructure.
- The area is large, with respect to, any settlements across various municipalities.
- Such dispersed settlement patterns impact on the cost of erecting, operating, and maintaining infrastructure.
- The affordability of infrastructure is further impacted by the level of poverty and human development issues.
- The most economically active and productive individuals are drawn away from the DM.
- The structure of the economy requires an overhaul through targeted and accelerated interventions.
- Diversification of the economy, while maintaining the triple bottom-line principle, is critical.

In the 2015 adaption of the IDP, the Environmental Management Framework and State of the Environment Report is discussed briefly. The adapted 2015 – 2016 IDP states that the plan is currently under review but will include a comprehensive analysis of key emerging issues, such as the opportunity for alternative energy in the DM, as these issues will impact on the future state of the environment. Also related to the proposed project is the discussion around the DM's Rural Development Strategy, with the objective of facilitating integrated development and social cohesion through participatory approaches in partnership with all sectors of society. The strategy aims to stimulate rural development and food security by creating vibrant, equitable, and sustainable rural communities. Some of the measures that could be used to achieve this may include (Ngaka Modiri Molema District Municipality):

- Contributing to the redistribution of agricultural land – improving food security of the rural poor.
- Creating business opportunities.
- Decongestion and rehabilitation of overcrowded rural areas.
- Expanding opportunities for youth, women, people with disabilities, and older people from rural areas.
- Addressing issues such as; access to health care, decent housing, creation of decent jobs, as well as the development of road infrastructure. All key factors in achieving economic growth and development.

According to the **Ditsobotla LM Integrated Development Plan** (IDP) (2011/12 – 2015/16), the municipality's electricity provision is a joint function of the Ditobotla LM and Eskom, with the DM being licensed to provide electricity to Lichtenburg, Blydeville, and Coligny. It furthermore states that areas without access to electricity is mostly located in the rural regions, such as Grasfontein and Bakerville, and that universal electrification will be addressed by a joint planning programme between the LM and Eskom. The IDP also states that there is a need for renovation and/or replacement of the electrical infrastructure in the Lichtenburg CBD as this infrastructure is old. There is also a requirement for the provision of the expansion of the current load supply to the CBD in order to aid the expansion of the property and business markets. Aligned with this is the identification of "low energy resources" as a critical economic factor impacting on the municipality's ability to achieve its growth and development objectives (Ditsobotla LM, 2011).

The LM's **Spatial Development Framework (SDF)** is not available from its website. The IDP though, includes a summary of this SDF, of 2006. If required, attempts will be made during the EIA-phase of the project to obtain the full SDF document. Regardless, the IDP does provide some insight into the LM's spatial goals and objectives.

The SDF takes the approach of developmental clusters, referring to a grouping of more than one settlement within the LM. One such cluster is the Lichtenburg cluster, which includes the settlements of Lichtenburg, Boikhutso, and Blydeville. The relatively high percentage of the population residing in rural areas, as well as various land claims is likely to cause a unique service delivery scenario for the LM and all of its developmental clusters, not least the Lichtenburg cluster (Ditsobotla LM, 2011).

Directly north of Lichtenburg, (the proposed project location is located north-west of Lichtenburg), lies the Lichtenburg Game Breeding Centre. The SDF has identified this area as an ideal location for the potential development of the Open Space System in the LM; however, the extensive diamond mining located north of the Lichtenburg Game Breeding Centre in Bakerville, Grasfontein, and Carlsonia, go against this proposal. Similarly the area south west of Lichtenburg, where the upper catchment area of the Hartriver is located, has also been earmarked as important for protection as it is the origin of the Hartsriver, traversing a number of other municipalities in the western parts of the North West Province. Moreover, the Hartsriver feeds into Barperspan – an international RAMSAR site (wetlands of international importance). It is therefore, important that this catchment area, the river, and adjacent areas are protected from undesirable developments. The north western parts of the LM is characterised by abandoned, un-rehabilitated diamond mining activities, or extensive farming activities focused predominantly on cattle and grazing activities. (Ditsobotla LM, 2011).

The IDP also provides some feedback on the spatial development strategies set out in the 2006 SDF. Urban integration is an important strategy, aimed at moving away from the fragmented urban structure currently prevalent within the Ditsobotla LM. The vision is that a more compact system will lead to more cost-effective municipal services and public transportation infrastructure. It goes on to state that an important factor in achieving a more desirable urban settlement pattern is the provision of bulk infrastructure development in a rationalised manner. Just as important as the extension of the network, is ensuring that the existing infrastructure has sufficient capacity to deal with expected future development pressures. Upgrading of the existing electricity network in Lichtenburg, as the economic core of the municipality, is required to ensure that the expected residential and economic growth can be accommodated.

Although no mention is made of the potential for RE projects in the Ditsobotla LM, the inference is that the implementation and operation of the proposed Tlisitseng Solar PV project will assist in the extension and strengthening of the electrical network in the region and beyond, thereby aiding in ensuring that the LM is able to accommodate the envisioned growth and development.

3 BASELINE INFORMATION

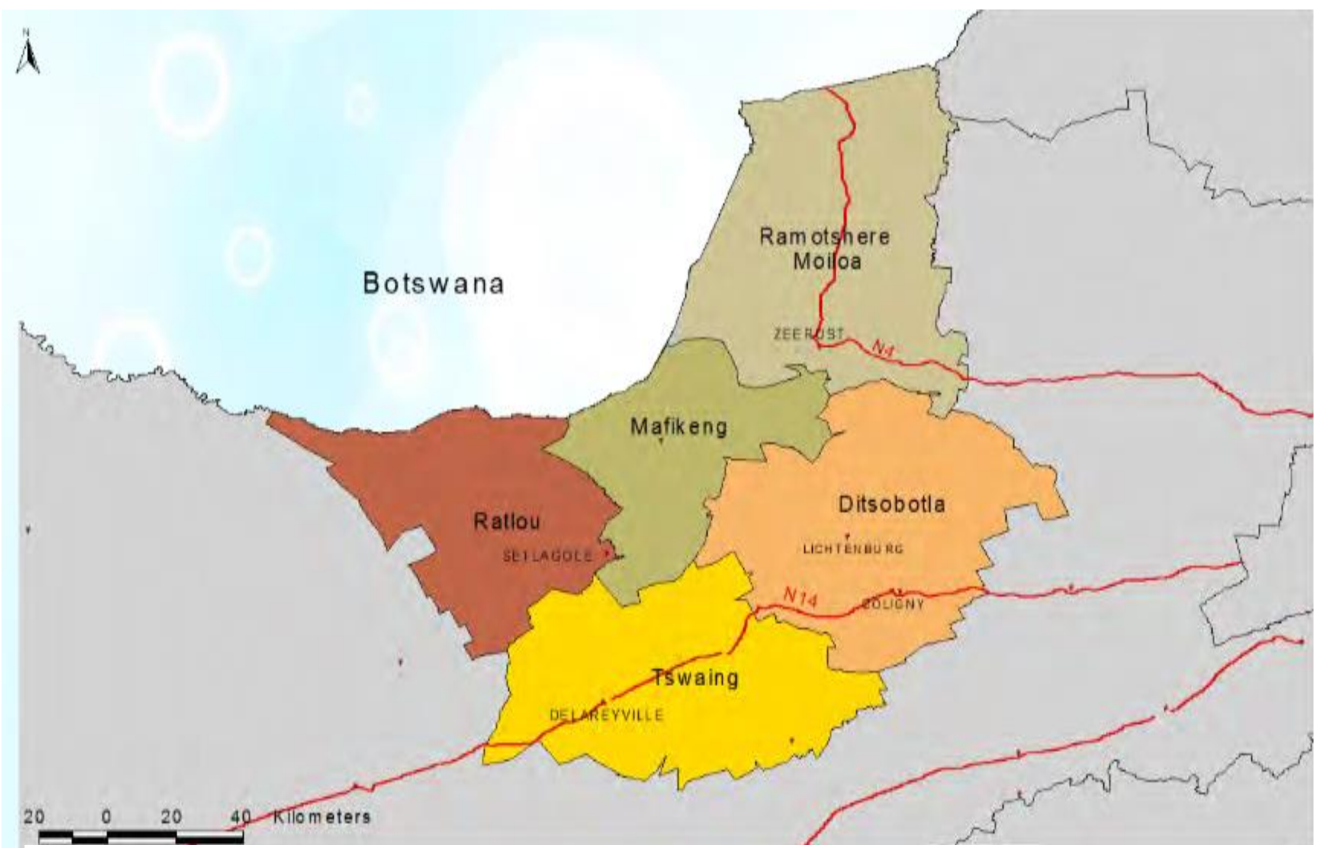
This chapter examines key socio-economic characteristics of the study area, as per delineation provided in the previous chapter. This is essential as it provides both qualitative and quantitative data related to the communities and economies under observation, creating a baseline against, which the impacts can be assessed.

3.1 Study area's composition and locational factors

Spatial context and regional linkages

The proposed Tlisitseng Solar PV plant project is located close to Lichtenburg, which is the administrative centre and economic hub of the Ditsobotla LM. The Ditsobotla LM is one of five local municipalities comprising the Ngaka Modiri Molema DM, one of the four districts of the North West Province. Map 3-1 indicates the locality of the LM in relation to the other four LMs as well as key regional linkages.

The North West Province is mostly rural in nature, comprising 9.7% of the total surface area of South Africa. Four of Botswana's districts border the Province. Domestically, the Provinces of Limpopo, Gauteng, Free State, and the Northern Cape border the North West Province. Also located within the Ngaka Modiri Molema DM, is the Mafikeng LM, capital of the district and Province.



Map 3-1: Locality of the Ditsobotla LM (Ngaka Modiri Molema District Municipality)

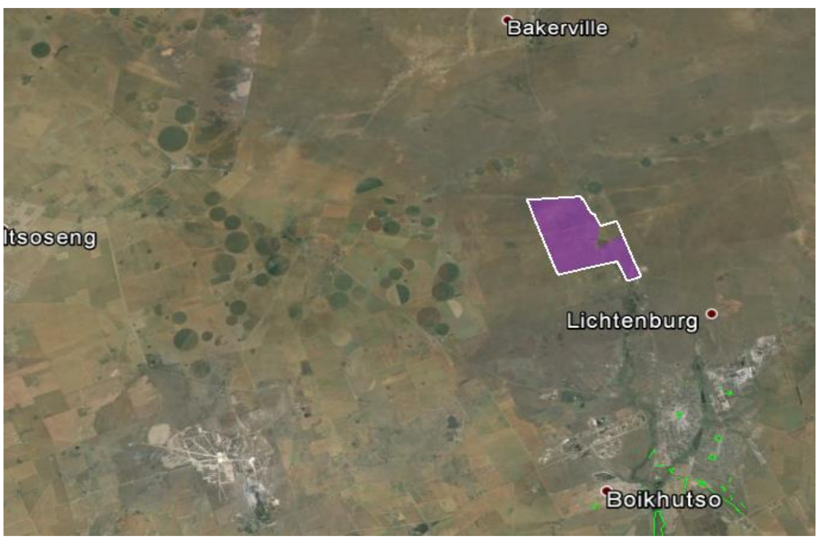
As can be seen from Map 3-1, one national road, the N14, traverses the primary study area. A section of the N14, which connects the western parts of Gauteng with the central parts of the North West

Province, passes through the south eastern parts of the Ditsobotla LM, through the towns of Coligny and Biesiesvlei. Other important main roads linking the Ditsobotla LM with surrounding LMs include (Ditsobotla LM, 2011):

- Road 52 from Koster to Lichtenburg, and further westwards from Lichtenburg to Mafikeng (R503). This road carries high traffic volumes, and traverses the municipality in an east-west direction.
- The R503 connects Lichtenburg in a south eastern direction with Coligny and ultimately Klerksdorp.
- The R505, traversing the LM in a north-south direction, connects Lichtenburg to Ottoshoop when travelling north and Gerdau and Ottosdal when travelling south.
- The R52 connects Lichtenburg with Itekeng and Biesiesvlei.
- Parts of Route R53, the road that connects Ventersdorp and Swartruggens, transverses the eastern parts of the Ditsobotla LM.

Towns and settlements

The closest major town to the proposed project site is Lichtenburg, the administrative hub of the Ditsobotla LM. Other settlements in close proximity include Bakerville, Boikhutso, and Itsoseng.



Map 3-2: Towns and settlements close to the proposed project site.

Lichtenburg is situated approximately 230 kms from Johannesburg and is located in the middle of the maize triangle, South Africa's main maize growing area. The production of cement is also another main economic activity taking place in close proximity, with three major cement producers operating within an 80 km radius of the town.

As seen on Map 3-2, Bakerville is located approximately 20 kms north of Lichtenburg. The settlement is a world-renowned diamond site, covering an area of roughly 35 km from east to west. The town originated due to the significant diamond deposit that was found there, and grew at a rate that eventually meant Bakerville was larger than Cape Town at the time. As previously mentioned, today the diamond mining activities are mostly abandoned, leaving the land on which it took place largely un-rehabilitated.

The Ditsobotla LM's SDF groups towns within the LM according to certain specific geographical locations. These clusters of towns and settlements are (Ditsobotla LM, 2011):

- The Lichtenburg cluster: including Lichtenburg, Boikhutso, and Blydeville.
- The Coligny cluster: includes Coligny and Tlhabologang.

- The Itsoseng cluster: Comprising of Sheila, Verdwaal 1 and 2, and Itsoseng.
- The Bodibe cluster: Includes Bodipe, Springbokpan, Welverdiend, and Matile / Meetmekaar.

The Lichtenburg cluster is not only considered the core area of the municipality, but is also spatially located in the centre of the Ditsobotla LM. It is within the area between the Lichtenburg and Itsoseng clusters that approximately 60% of the population is located. However, the fact that 28% of the population reside on farms within the LM, comparatively more than other LMs in the district, means that service delivery is required to take consideration of the rural areas.

Resources and land capability

According to the Ditsobotla LM's 2006 SDF, the area of the project site is dominated by agriculture activities. More specifically, cattle and grazing. The entire southern part of the Ditsobotla LM is focused on commercial dry land and irrigated agricultural activities.

The LM has a number of mining and quarrying activities taking place in proximity to Lichtenburg:

- The limestone quarries and operations of Afrisam around Dudfield.
- The limestone quarry of Lafarge between Bodipe and Springbokpan.
- The quarrying areas of Lafarge immediately west of Lichtenburg and in the area north east of the main Lafarge plant situated at the Lichtenburg industrial area.
- The extensive diamond mining activities occurring in the north western parts of the LM, specifically Bakersville, Grasfontein, and Welverdiend.
- The state quarries found in the northern parts of the LM.

Apart from the agricultural, and mining and quarrying activities taking place in the LM, there exists an opportunity for conservation and tourism, with Lichtenburg considered arguably the prettiest town in the North West based on the rich diamond mining history of the area. Aligned with this aim of conservation is the LM's SDF goal of creating an Open Space System by linking all natural elements of value and the "High Environmental Control Zones" in the LM. Elements that may be included into this system in close proximity to the proposed project site include: Molope Eye conservancy and nature reserve, the Malmanies Eye Natural Reserve, the Lichtenburg Game Breeding Centre, and the upper catchment areas of the Hartsriver. The SDF states that the linking of these natural resources in an Open Space System, will create an environment where conservation and environmental protection is considered as a primary factor, making sure no undesirable developments take place there (Ditsobotla LM, 2011).

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.

The Ngaka Modiri Molema DM is home to 842 702 people residing in 227 003 households, with 20% of the DM's total population residing in the Ditsobotla LM. At the same time Lichtenburg's population is estimated as 26 337 (7 540 households), 15.6% and 3.1% of the populations of the LM and DM respectively (Stats SA, 2012).

According to the National Census of 2011, 99.99% of Lichtenburg's population is settled in urban areas, with the remaining 0.01% (3 persons) living on farms. This is markedly different from the scenario in the study area's DM and LM where 61.5% and 24.1% of the respective populations reside on tribal or traditional land; this signifies the relative rural nature of the municipalities being studied. The Ditsobotla LM's IDP, as well as the Ngaka Modiri Molema DM's IDP, takes cognisance of the fact that the high number of its population residing in rural or tribal areas increases the complexity of adequate service delivery, and that service delivery backlogs in the economic as well as social services sphere are present for these rural communities. The fact that nearly all of Lichtenburg's population is staying in the urban area can thus be seen as an indication that this population group enjoys relatively better service delivery; although, the LM's IDP does state that the infrastructure in Lichtenburg, especially the electrical infrastructure, is in need of maintenance or replacement (Ditsobotla LM, 2011).

The majority of the DM's population is African, (94%), with Whites being the next biggest population group at 3.6%; 89% of the LM's population is African, with the African population in Lichtenburg being the smallest of the respective study areas at 60%. Within the LM, 8% of the population is White with a further 1.9% being Coloured. In Lichtenburg the White population is slightly bigger at 30%, with a Coloured population of 7.7% (Stats SA, 2012). According the 2011 Census, the most prominent home language spoken across all of the study areas is Setswana, with Afrikaans and English the preferred home language of the next biggest groups of the population.

Within Lichtenburg the male to female ratio is virtually 1:1, with 49.97% of the town's population being male and 50.03% female. The situation is slightly different in the LM and DM, where the respective populations have slightly more females than males (Stats SA, 2012). In all of the areas being studied, the majority of the population is of working age (15 – 64); however, in some cases the dependency ratio is relatively high when compared to that of the country (Stats SA, 2012):

- In the Ngaka Modiri Molema DM, 60.8% of the population is of working age, with 39.2% being aged 0 – 14 or older than 65. This means that the dependency ratio for the DM is higher than the average for the country (34.5%).
- The Ditsobotla LM's population consists of a slightly higher percentage of working aged individuals – 61.9%, regardless the number of individuals who would be dependent on those of working age is still higher than the country average at 38.1%.
- Lichtenburg is the only study area where the dependency ratio is smaller than that of the country. With a dependency ratio of 33.8%, and 66.2% of the population aged 15 – 64, Lichtenburg has a slightly higher proportion of individuals being economically active than the rest of the study areas. This could be seen as a driver for growth if employment creation is able to provide sufficient opportunities and the work force is suitably skilled.

3.3 Economy

The structure of the economy and the composition of its employment provide 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.

Based on current prices, the economy of the North West Province is valued at R199 551 million. This is the equivalent of a 6.5% contribution to the national GDP. At the same time, the economy of the Ngaka Modiri Molema DM was valued at R31 007 million in current prices, while the economy of the Ditsobotla LM was estimated to have a GDP of R8 122 million in current prices. The LM comprises more than a quarter (26.2%) of the GDP of the DM, and 4.1% of the North West Province's GDP is attributable to Dibotla LM (Quantec, 2014).

Over a ten-year period ranging from 2003 to 2013, the Ditsobotla LM's economy grew by a Compounded Average Growth Rate (CAGR) of 5%. The growth recorded in the LM is higher than the rate at which the DM and Province's respective economies grew. It is estimated that these economies grew by 3.2% and 22% in the DM and Province respectively, over the same five-year period. In turn, the growth of 2.2% recorded in the Province is below that of the country, which was estimated at 3.3% for the same ten-year period (Quantec, 2014).

The comparatively high growth rate in the LM can be attributed to the growth recorded in the Wholesale, trade, and accommodation, and Finance, insurance, and real estate sectors. Based on current prices, the Wholesale, trade, and accommodation sector comprises 23.9% of the Ditsobotla economy, with the Finance, insurance, and real estate sector accounting for a further 23% of the LM's GDP in current prices (Quantec, 2014). Thus a CAGR of 6.5% in the Wholesale, trade, and accommodation sector, and 8.5% in the Finance, insurance, and real estate sector is likely to have driven the bulk of the LM's economic growth based on the importance and contribution of these sectors to its economy.

In terms of the structure of the economies being studied, and the most significant economic activities taking place within these, the economy of the Ditsobotla LM is not unlike that of the country. Based on current prices, the economy of South Africa is a service economy with the tertiary sector contributing 70.5% of the national GDP. The importance of tertiary activities increases slightly in the LM – here the tertiary sector comprises 77% of the economy's GDP. It can furthermore be stated that wholesale, trade, and accommodation industries are contributing more to the LM's economy when comparing the proportionate contribution to that in the country's economy (16.6%). Other significant structural differences between the Ditsobotla and the South African economy relate to manufacturing industries being a slightly more important contributor to the national GDP. This sector contributes 11.3% to South Africa's economy and 9.4% to the economy of the LM. The importance of the primary economy is also lower in the LM (8%), versus the 11.5% that the primary sector contributes to the country's GDP. In addition, the primary sector is structured differently in the LM, here agriculture is more important (6.8% of the LM's GDP), compared to the 1.2% contribution of the mining sector. In the country, the mining sector contributes 9.2% to the national GDP.

The structure of the Province's economy as seen in **Table 3-1**, is remarkably different to that of the country and LM, whereas the DM's economy is structured similarly to that of the LM. In the Province the importance of the primary sector increases significantly due to the mining activities that have been so prevalent in this Province, with 30.8% of the Province's GDP being generated by mining activities. The reliance of the North West Province's economy on tertiary industries is also significantly below that of the other economies being studied. It is estimated that the tertiary sector contributes 58.1% to the Province's GDP. In contrast to this is the importance of the tertiary sector in the DM, here service activities are the most important contributor, generating 81.9% of the Ngaka Modiri Molema DM's GDP. This comparatively high reliance is mostly due to the higher than average importance of the general government services sector – 22.7% of the DM's GDP is generated by government services.

Table 3-1: Economic structure of the various delineated study areas

Economic Sector	Ngaka Modiri Molema DM		Ditsobotla LM	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R1 361	4.4%	R553	6.8%
Mining and quarrying	R683	2.2%	R97	1.2%
Manufacturing	R1 871	6.0%	R761	9.4%
Electricity, gas and water	R689	2.2%	R158	1.9%
Construction	R1 005	3.2%	R287	3.5%
Trade	R6 388	20.6%	R1 938	23.9%
Transport and communication	R2 403	7.7%	R649	8.0%
Finance and business services	R6 373	20.6%	R1 867	23.0%
Personal services	R3 187	10.3%	R767	9.4%
General government	R7 045	22.7%	R1 045	12.9%
TOTAL	**R31 007**	**100%**	**R8 122**	**100%**
Economic Sector	**South Africa**		**North West Province**	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R72 202	2.3%	R4 815	2.4%
Mining and quarrying	R282 366	9.2%	R61 478	30.8%
Manufacturing	R349 066	11.3%	R9 580	4.8%
Electricity, gas and water	R91 201	3.0%	R2 642	1.3%
Construction	R114 754	3.7%	R5 065	2.5%
Trade	R510 666	16.6%	R24 937	12.5%
Transport and communication	R272 303	8.8%	R15 383	7.7%
Finance and business services	R680 443	22.1%	R30 209	15.1%
Personal services	R182 795	5.9%	R16 588	8.3%
General government	R524 716	17.0%	R28 855	14.5%
TOTAL	**R3 080 513**	**100%**	**R199 551**	**100%**

(Quantec, 2014)

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.

Table 3-2: labour force of the delineated study areas

Indicator	South Africa	North West Province	Ngaka Modiri Molema DM	Ditsobotla LM	Lichtenburg
Working age population	33 928 806	2 273 362	512 630	104 628	17 407
Non-economically active population	13 238 633	907 948	243 945	44 487	6 169
Labour force	18 841 453	1 236 786	226 903	53 005	10 683
Employed	13 254 829	848 107	150 683	37 933	8 495
Unemployed	5 586 624	388 679	76 220	15 072	2 188
Unemployment rate	29.7%	31.4%	33.6%	28.4%	20.5%
Labour force participation rate	55.5%	54.4%	44.3%	50.7%	61.4%
Discouraged work seekers	5.4%	5.7%	8.2%	6.8%	3.2%

(Stats SA, 2012)

The Ngaka Modiri Molema DM has a working age population (15 – 64 years of age) of 512 630 individuals – 60.8% of its total population. According to South Africa's official unemployment definition, it is estimated that 33.6% of the DM's labour force is unemployed, while 8.2% can be classified as discouraged work seekers (Stats SA, 2012). Within the Ditsobotla LM the situation improves slightly since here, according to the Census 2011, there is a working age population of 104 623. Furthermore, the LM has an approximate unemployment rate of 28.4%, while 6.8% of the population are discouraged work seekers.

As expected in the previous section, where it was revealed that the household income levels in Lichtenburg are comparatively, significantly higher than that of the municipalities being studied, and the employment situation in the town is noticeably more positive than that of the DM or LM. In Lichtenburg, where 66% of the population is of working age, unemployment is estimated at 20.5% and discouraged work seekers comprise 3.2% of the town's 17 407 working age population. It follows that Lichtenburg's labour force participation rate is also significantly higher at 61.4%, compared to the 44.3% and 50.7% in the DM and LM.

In the Ditsobotla LM 11.3% of all employment is created by the agriculture sector - more than the 7.7% in the DM created by the same sector. Nationally the agriculture sector creates an even smaller proportion of total employment opportunities – 5.8%. The economy is predominantly, still a service economy, though, with practically three quarters of all jobs, in all of the respective study areas, generated by the tertiary sector (Quantec, 2014). More specifically, the tertiary sector created 74.6% of all employment opportunities in the LM. The biggest contributors to this job creation is the wholesale and retail trade sector (38.6%), and the community, social and personal services sector (25.6%) (Quantec, 2014).

3.5 Income

According to the 2011 Census, literacy levels in Lichtenburg are relatively on par with the level of literacy recorded in South Africa. The literacy levels in the municipalities being studied are below that of the country though, indicating a community that is relatively less employable than the Lichtenburg community or the broader South Africa. Approximately 17% and 15% of the DM and LM's respective populations, aged 20 years and older, have had no access to formal education, while 8.7% of the population of Lichtenburg has had no schooling. In the DM, only 20.3% of the population aged 20 years and older successfully completed matric, with 8.1% achieving a higher education. The situation is even worse in the LM, where only 19.7% of the population, aged 20 and older, has obtained a matric certificate. In Lichtenburg, 27.7% of the population has completed matric, while 12% successfully completed tertiary studies.

In Lichtenburg the average monthly household income is R12 194, which is significantly more than the average national household income of R9 235 per month. The broader population of the study area is earning considerably less, with the average monthly income for the DM and LM at R5 772 and R6 004, respectively, per household (Stats SA). The lower than average national income levels could be indicative of a limited number of job opportunities available, which in turn is associated with a smaller than average economic base.

Easier access to employment opportunities can be viewed as the reason why Lichtenburg has a smaller proportion of households living with no income (10.2%), compared to the 15.3% and 12.5% of households in the DM and LM not receiving any monthly income. Furthermore, the fact that fewer (39%) of Lichtenburg's households, versus 58.6% and 59.3% of the households in the DM and LM, earn an income of R3 200 or less per month can be seen as an indication of the relative quality of the employment opportunities offered in Lichtenburg compared to that of the DM and LM

3.6 Access to services and state of local built environment

Access to shelter, water, electricity, sanitation, and other services are indicators that assist to determine 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 Access to Housing and Basic Services

- **Housing:** It is estimated that 86.7% of households in Lichtenburg reside in formal brick structures, be it stand-alone houses, complexes, in a block of flats, or as a second building in a yard. A further 12.6% of Lichtenburg's households reside in informal dwellings, with only 0.1% of the town's households living on tribal or traditional land. Within the Ditsobotla LM the proportions vary significantly, with only 74% of the households of this municipality living in formal brick structures. Proportionally more of the DM's population is living on tribal land, in traditional structures such as huts (8%), with 16.8% living in some kind of informal structure. The situation in the Ngaka Modiri Molema DM mirrors that of Lichtenburg more closely, here 82.7% of households reside in brick structures of some sort, with 12.7% living in informal structures. The number of traditional dwellings is proportionally more however, at 3.5%.
  It must be noted that the LM is in the process of implementing a housing programme, specifically in the towns of Tlhabologang and Boikhutso (Ditsobotla LM, 2011). The objective of the housing programme is to address the sanitation backlog; regardless, the result will be that fewer households will reside in informal settlements in the LM.

- **Access to water**: It is estimated that 91% of all households in Lichtenburg have access to piped water either inside the dwelling or in the yard. The situation is markedly worse in the LM and DM where only 65.9% and 51% of the respective households have access to piped water in the dwelling or yard. This statistic for access to piped water is worse than the national average, where 73% of households have access to piped water in their dwelling or yard. The dire situation in these municipalities is further reflected in the fact that 14% of households in the DM, and 10.9% of households in the LM, have no access to water. According to the Ngaka Modiri Molema DM's IDP, the proportion of households with no access to water have declined from 2000 to 2010. This backlog remains a service delivery issue in the DM however (Ngaka Modiri Molema District Municipality).

  The 205/2016 revision of the DM's IDP states that the DM was declared a Water Services Authority (WSA) in 2003, giving the district authority to perform water and sanitation services in its jurisdiction. The Department of Water Affairs bulk infrastructure systems operational within the DM, are concentrated in the Mafikeng, Ditsobotla, and Ramotshere Moiloa LMs. Other infrastructure systems in the DM include (Ngaka Modiri Molema District Municipality):

- 30 reservoirs,
- Five pump stations and eight water purification works, and
- 12 waste water treatment works.

The revised IDP also states that the surface water in the area is generally insufficient, leading to rural water supply often relying on ground water sources, and that the WSA is in the process of developing a Water Services Development Plan (WSDP) and Water Services Master Plan. The WSDP will provide a backlog study and identify projects than need to be implemented, while the master plan will reconcile the available water sources with the demand for water supply (Ngaka Modiri Molema District Municipality).

The Ditsobeng LM's IDP (2011/12 – 2015/16), states that a services backlog study commissioned in 2007 by the Department of Developmental Local Government, revealed that 18 023 households receive water connection services below RDP standards, while a further 20 559 of the municipality's households receive services within the RDP standards. It was estimated that upgrades for these households, to either be within the RDP standards or for yard connection, would require a total budget of R214 million. The IDP furthermore makes mention of the fact that two major bulk water infrastructure projects, aimed at addressing water shortages in Tlhabologang and Itsoseng were being implemented (Ditsobotla LM, 2011).

As far as water infrastructure is concerned, the IDP states that; the Lichtenburg water treatment plant is more than fifty years old, but well maintained, and the pump station in Itsoseng requires overhaul maintenance. Of the 30 reservoirs within the DM, 16 are located within the LM's boundaries. According to the IDP, the municipal infrastructure audit revealed that 9 of these reservoirs are in good condition, while one is in average condition, and three more in poor condition. The reservoirs in poor condition provide bulk water to Itsoseng and Verdwaal (Ditsobotla LM, 2011).

- **Access to sanitation**: If not managed and provided adequately, the basic need of sewerage and sanitation can pose serious health and safety risks to the communities not receiving these basic services. In Lichtenburg, 90% of the households had access to a flushing toilet, while almost 2% of the households had no access to toilet facilities. At the same time, 4% of the town's households were using pit latrines while 0.12% were still reliant on the bucket system.

  The situation is markedly worse in the municipalities being studied. In the Ngaka Modiri Molema DM only 38.5% of households had access to a flushing toilet, while 7.5% of the households had no access. The bulk of the households (57%) in the DM were using pit latrine systems, with 1.2% of households using the bucket system. More households had access to a flushing toilet in the LM (47%); however, 4.9% of the Ditsobotla LM's households were still using the bucket system. A situation that is in stark contrast to the government's determination to eradicate all bucket toilet systems by 2007. 35% Of households in the LM were using pit latrines while 0.3% had no access to toilet facilities.

As mentioned in the previous section, the Ngaka Modiri Molema DM has been awarded WSA status. The WSA is in the process of developing the WSDP and master plan, which will provide guidance on addressing these services backlogs with the limited water resources in the DM.

The findings discussed here can be somewhat verified by the fact that the Ditsobotla LM's IDP states that the largest sanitation backlogs are prevalent in rural areas and urban based informal settlements, explaining the comparatively high level of sanitation in Lichtenburg when compared to the rest of the LM. The IDP estimated that it would cost R80.9 million to upgrade the 10 274 households in the municipality (with sanitation systems below RDP standard), to pit latrine systems. To address the large number of households still making use of the bucket toilet system, the LM has implemented a housing programme involving the construction of low cost houses in Tlhabologang and Boikhutso (Ditsobotla LM, 2011).

- **Access to electricity**: The indicator "electricity for lighting", was used as a proxy for measuring households' access to electricity. In Lichtenburg 86% of households had access to electricity; this is only slightly more than the national average proportion with access of 84.8%. The situation is somewhat worse in the municipalities studied, with 80.5% and 74% of households in the DM and LM respectively having access to the grid.

  The main alternative source for lighting in the study areas was candles; 12% of households in Lichtenberg utilised this lighting method, while 17.7% of households in the DM did the same. In the Ditsobotla LM, nearly a quarter of all households were reliant on candles for lighting. Of interest to this project is the fact that 18 households in Lichtenburg (0.2% of all households), were using solar power for lighting.

  According to the Ditsobotla LM's IDP, the LM is licensed to provide electricity to Lichtenburg, Blydeville and Coligny, with the remainder of the LM serviced by Eskom. The IDP furthermore reveals that areas without electricity are mainly located in rural areas such as Grasfontein and Bakerville for example. Based on the IDP, the electrical infrastructure in Lichtenburg is old, requires maintenance, and is in need of upgrades. Moreover, load supply to Lichtenburg needs to be increased to provide for the demand associated with the growing property and business markets in the town. The IDP states that, based on preliminary business plans and estimates, the cost of the new infrastructure is approximately R29 million.

- **Refuse removal service:** It is estimated that 62% of households nationally have their refuse removed by a local authority on a weekly basis. This national estimate is substantially below the number of households in Lichtenburg (87.8%), with regular weekly refuse removal services. At the same time, only slightly more than a third of households in both the LM and DM have regular refuse removal services. It is more common for households in these municipalities to have their own refuse dump, with 54% of homes in the DM, and 48.9% in the LM using this method of waste disposal. Also noteworthy is the fact that the LM has the highest proportion of households within the study areas with no means of refuse disposal (6.6%), compared to the DM (6.1%), and Lichtenburg where 2.7% of households have no access to refuse removal services.

  Based on the findings of the Ditsobotla LM's IDP, the municipality recognises the serious health issues posed by the non-collection and improper disposal of refuse. However, in order for the LM to address these service backlogs it is required that the organisational structure of the LM be reviewed in order to align with the challenges highlighted in the Strategic Environmental Assessment Report (Ditsobotla LM, 2011).

- **Internet access:** Internet access has become increasingly important for accessing economic opportunities. Although not a definitive measure, it could be argued that a lack of access to the knowledge readily available on the internet could negatively affect an individual's ability to access quality educational and economic opportunities.

  In Lichtenburg 58.6% of households have no internet access. These are fewer households than the national average of 64.5%; regardless, it still excludes more than half of the town's population from the potential that could be associated with internet access. The situation is significantly worse in the studied municipalities, where almost three quarters of all households have no access. For those with access, a cell phone is the most common method of access, followed by home internet access or access at work.

3.6.2 Social and Recreational Infrastructure

The Ditsobotla LM's IDP (2011/12 – 2015/16) contains information on the following social and recreational infrastructure within the LM:

- **Health services –** There are two hospitals and nine clinics within the Ditsobotla jurisdiction.
  - General de la Rey Hospital: located on the Thabo Mbeki Drive. The hospital provides in-patient care and maternity services. The outpatient unit provides emergency care until a patient can be transferred to the Thusong Hospital.
  - Thusong Hospital: situated roughly 25 km from Lichtenburg, on the Mafikeng road at the turn off to Itsoseng. The hospital has the following facilities available: theatres, male and female medical wards, a gynaecology ward, a paediatric ward, a maternity ward, a tuberculosis ward, out-patients, and casualties.
  - Nine community clinics in the following towns: Lichtenburg, Boikhutso, Blydeville, Coligny, Tlhabologang, Itekeng, Bodibe, and Itsoseng.
  - The IDP estimates that about 31 health facilities are required to provide adequately. However, considering the current population (168 904) and the planning norm of one clinic per 5 000 community members, the requirement is more likely to be approximately 20 clinics in the LM.
  - There is one formal old age home located in the LM, the Lichthuis Old Age Home, situated in Lichtenburg.

- **Community facilities and services (sport fields etc.)**
  - Most of the existing community facilities, including sports grounds, are located in urban areas, excluding most of the LM's rural population.
  - Facilities located in rural areas are of poor standards compared to the facilities available in Lichtenburg.
  - The challenge facing the LM in this regard is therefore, considered to be not only access to existing facilities, but also ensuring that available facilities are tailored to the social circumstances and conditions of the communities they target.

  - According to the IDP, the sport fields in Ga-Motlatla, Verdwaal, and Bodibe are in various stages of completion. Projects were initiated to finalise them for handover to the respective communities for utilisation.

- **Cemeteries**
  - Additional land for cemeteries is required in the communities of Itekeng, Coligny, and Itsoseng.
  - Maintenance of cemetery yards in all areas of the LM remains a challenge. There is also a need for all cemeteries to be fenced, and ablution facilities to be constructed at all cemeteries in the LM.
  - The IDP believes that the challenges with regards to the provision of adequate cemeteries will rely on a focus on the following aspects:
    - Providing cemeteries that meet sustainable, technical, and environmental criteria.
    - Accommodating diverse cultural requirements and the function of cemeteries as public spaces in each to ensure a dignified municipality.
    - Fostering civil and private sector partnerships in cemetery development and management.
    - Special attention must be given to those in need, respecting the bereaved at burial. It is also important to protect and properly maintain cemeteries as public property and create a safe working space for cemetery employees.

- **Community halls**
  - All community halls within the LM require renovation. The towns in which these renovations will take place are: Lichtenburg, Boikhutso, Itekeng, Itsoseng, Sonop, and Tlhabologang.
  - Bakerville, Grasfontein, Bodibe, and Verdwaal are all areas that require new community hall facilities.

- **Traffic and licensing services**
  - Generally, traffic law enforcement is concentrated in urban areas such as Lichtenburg and Coligny.
  - This is mainly due to a lack of human resources as well as below par traffic infrastructure in rural or former township areas.

- **Disaster management**
  - An Emergency Services Unit exist within the Ditsobotla LM for fire and rescue services as well as disaster management.
  - The unit is functional; however, it is not up to standard and under-resourced, with only temporary employees and insufficient equipment.
  - The Ngaka Modiri Molema DM commissioned the drafting of a Disaster Management Framework and Disaster Risk Management Plan. The Draft Gap Analysis Report found that the LM does not conform to legislative requirements. The DM will address these gaps through a comprehensive disaster management plan incorporating the needs of category-B municipalities.

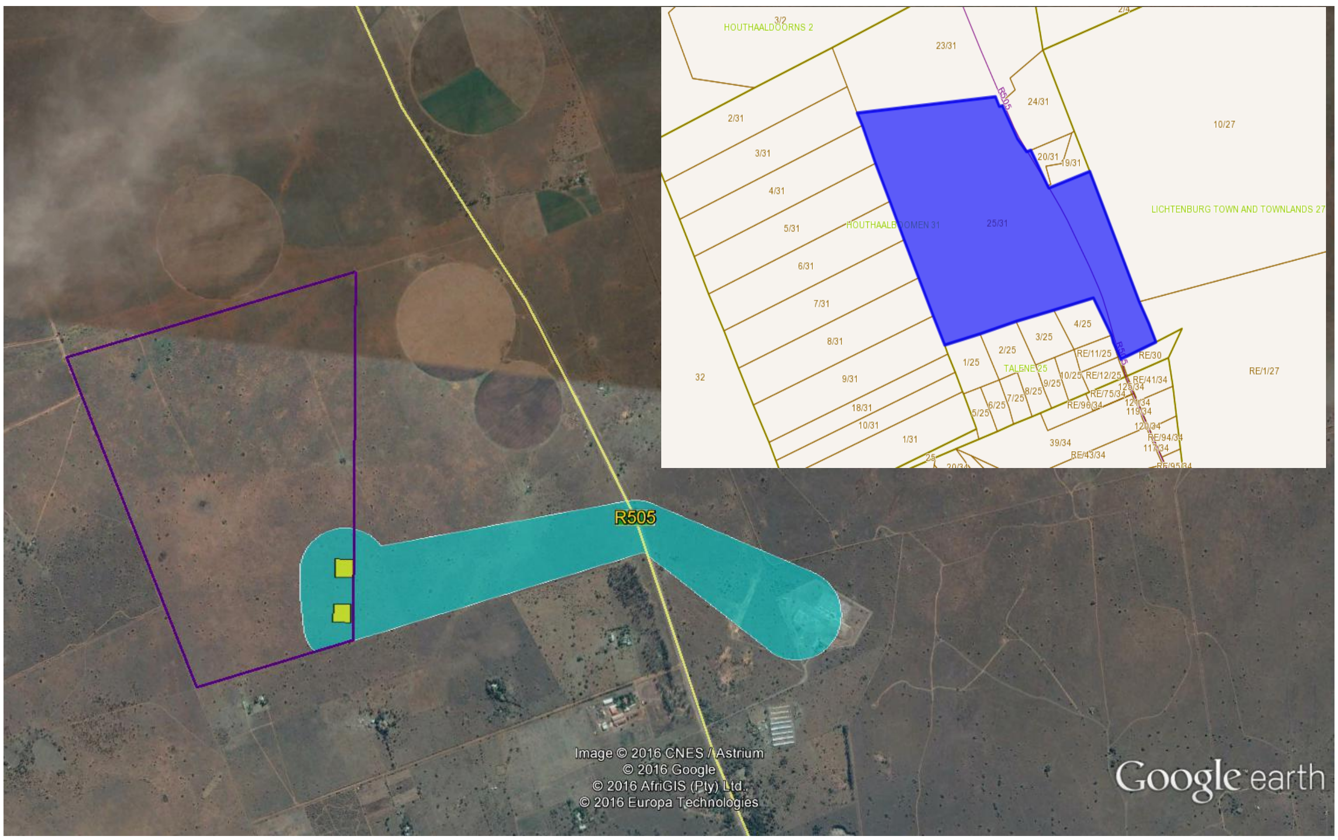
- Moreover, the provision of services in the LM is hampered by problems surrounding powers and functions. According to the IDP, the LM has not yet entered into a service level agreement with the DM for provision of these services.

3.7 Site-related information

The following paragraphs provide the socio-economic profiles of the farm portions where the proposed project is planned to be constructed.

3.7.1 Land-use profile

Map 3-3 indicates the substation site alternatives on Portion 25 of Farm Houthaalboomen 31 together with the proposed powerline corridor.



Map 3-3: Farms directly and indirectly impacted by the proposed Tlisitseng 1 132kV substation and powerline (Chief Surveyor-General, 2016)

The following farm portions will be directly affected by the proposed location of the substation and/or powerlines:

- 132 kV Substation alternative 1 and 2: Portion 25 of Farm Houthaalboomen 31
- 132 kV powerline corridor: Portion 25 of Farm Houthaalboomen 31

It should be emphasized that **the proposed power line corridor is NO LONGER overlaps with the Portion 2 of Talene 25, Portion 3 of Talene 25, and Portion 4 of Talene 25**, which owners objected to the power line traversing their properties. However, the owners of Portion 1 and Portion 3 of Farm

Talene 25 have expressed their concerns over the visual impact on the sense of place and the operations of the pub located on it.

The primary data gathered with respect to the above-mentioned farm portions during the site visit are discussed below. As mentioned previously, the owner of Portion 2 of Talene 25 does not have any objections or concerns with respect to the project; while the owner of Portion 4 of Talene 25 expressed his willingness to share any information and provide feedback only after the initial public meeting. The respective land owners of Portion 20 and Portion 19 of Farm Houthaaboomen have also not expressed any concern or objection to the project and its possible effects on their sense of place.

Portion 25 of Farm Houthaalboomen 31

Mr Hertzenberg is the owner of the directly impacted farm, i.e Portion 25 of Farm Houthaalboomen 31. He views the commercial agriculture activities taking place on the farm as “up and coming”, indicating that the operations are not yet well established. He has indicated that the rental income that he would derive from leasing the land for the proposed PV facility will be used to acquire land to continue the operations elsewhere in the area.

- **Economic activities:**
    - Roughly 86 ha is currently under irrigation, producing maize. This will not be affected by the Tlisitseng PV facilities.
    - Grazing: 150 cows and 120 calves. These will have to be relocated to a different farm to make way for the project.
    - Estimated profit for the total operations on Portion 25 of Farm Houthaalboomen is R5 000 per ha.
    - The rental received from the PV project will be used to lease land, where commercial farming can be continued.
    - Four permanent workers are employed on the farm, who receive minimum wage.
- **Services:** The farm uses borehole water and has a grid connection.
- **Residency:** The land owner resides in town. Four workers have lodging on the farm but go home over weekends. The workers therefore, are not perceived to have a cultural connection with the boarding as they do not consider this their homes.
- **Concerns raised:** The land owner mentioned that he would require an advancement from the developer to ensure that he is able to acquire alternative farming land, from which to continue his livestock farming operations.
- **Community observations:** The land owner could make the following observations about the broader community:
    - High unemployment and related to that high crime rate are the biggest socio-economic ills facing the broader community.

Portion 4 of Farm Talene 25

The owner of the property, Mr Fazel VarVariawa, stated in the letter submitted on 22 June 2016 that he objects to the development of power lines that would traverse his property. No other issues were raised.

It should be emphasised, that the option of power lines traversing this property is no longer considered; therefore, the raised concern is no longer valid.

Portion 3 of Farm Talene 25

The farm portion (locally referred to as plots) is owned by Mr. Goedhals. The land owner and his wife have been living on the farm for 32 years. The farm is not used for any commercial activity; it is used as a residence by the land owner. The land owner expressed his objections for the establishment of the power line through the property and raised concerns that it would impact on the sense of place, personal security and privacy, property loss, and possible impact on property values.

Since that the option of power lines traversing this property is no longer considered; the raised concerns are no longer valid.

Portion 1 of Farm Talene 25

The portion of land is owned by Mr. and Mrs. Hechter. They have been owners of the land for roughly eight years. The Rafters Pub have been operating on the farm portion (referred to as plots locally) for the same number of years.

- **Economic activities:**
  - Rafters pub is the main economic activity on the farm. It is estimated that the pub receives between 300 and 340 visitors per month. When special events (i.e. pool tournaments etc.) are hosted, the visitor numbers are higher.
  - The owner is actively involved in the management of the pub; two more full time workers are employed at the pub.
  - The land also has some sheep for subsistence farming. The land owner did however, explain that they want to create a petting zoo for the children of the pub patrons.
  - As a side venture, paintball is offered on the farm. This however, makes a very small contribution to the overall business revenue.
  - Future tourism/economic potential:
    - The land owner indicated that they plan to start a bird breeding programme focussed on African Greys. Further information provided suggested that as of July 2016, four cages for the birds were built and were planned to be expanded to eight cages. Two African Gey have already been ordered.
    - They plan to start offering overnight accommodation and want to start off by building four chalets on the property.
    - No sign of the commencement of these activities were present during the site visit in December 2015, even though the land owner stated that they want to begin with the breeding programme early in the same month.
- **Services:** The farm uses borehole water; electricity is supplied by Eskom.
- **Residency:** The land owners live on the property and plan to use it for retirement. Consultation revealed that peaceful retirement planning was the reason for purchasing the property in the first place. No workers reside on the farm.
- **Concerns raised:**
  - The land owners are most concerned about the possible negative visual impact of the solar PV plant but has not raised specific issues related to the power lines.
  - The land owner raised some concern about the influx of workers and the impact this may have on crime in the area, including potential loss of livestock due to theft and security risk for visitors of the pub. Unwanted visitors to the pub may also become a problem.

- A concern was raised over the effect of construction impacts such as dust, noise, etc., on the proposed African Grey breeding programme.

3.7.2 Access to infrastructure

Consultation with the land owner revealed that Portion 25 of Farm Houthaalboomen 31 is connected to the national Eskom grid and makes use of borehole water for its irrigation. A concern has been raised by most of the indirectly affected land owners of the possibility of disruption to their own borehole water supply as a result of the needs of the proposed development. These concerns though are not related to the power line but rather refer to the development of the solar PV plant, which is discussed in another report.

4 IMPACT ANALYSIS

The following sections discuss the socio-economic impacts that the proposed substation and associated power lines are envisaged to create considering the knowledge of the potentially affected socio-economic environment.

4.1 Impact on employment creation

The project proponent estimates that the construction period of the proposed Tlisitseng 1 132 kV substation and the powerline will create six employment opportunities, with 70% of these opportunities being made available to previously disadvantaged individuals. The project proponent furthermore, estimates that the total labour cost for the construction period of the proposed Tlisitseng 1 132 kV substation and powerline will be R1 044 000 (2015 prices).

The demand for materials and services needed during the construction phase will contribute to the creation of additional Full-Time Equivalent (FTE) employment positions among supplying businesses. Both direct and indirect employment opportunities created during construction will increase household consumption expenditure; thus, further stimulating demand for household goods and services, and creating FTE employment in the respective sectors (i.e. mainly tertiary industries).

In addition to the construction phase labour requirement, it is estimated that the proposed 132 kV substation and powerline will support about 1.5 FTE opportunities for maintenance associated with this aspect of the Tlisitseng 1 development. The cost of this, over the first ten years of operation of the power facility is estimated at R3 960 000 in 2015 prices. It is estimated that R2 613 600 (66%) of this labour cost will accrue to previously disadvantaged individuals.

The impact on employment creation will be the same for all site alternatives considered as outlined below. Therefore, both of the substations represent the preferred choices from this perspective.

Alternative	Preference	Reasons
Tlisitseng 1 Substation Option 1	No preference	Employment creation will be the same regardless of site alternative chosen.
Tlisitseng 1 Substation Option 2	No preference	

4.2 Impact on economic production

The construction of the Tlisitseng 1 132 kV substation and powerline will involve capital expenditure on construction activities and input materials such as steel structures, cables, concrete, etc. This will directly and indirectly contribute to the revenue generation of those industries related to this sector by increasing the demand for goods and services for respective businesses.

Consultation with the project proponent revealed that the 132 kV substation and powerlines will require an initial investment of R79.6 million in capital expenditure. It is unlikely that this economic stimulation will be confined to the primary study area, or even the Province, only. The fact that the direct investment will also create indirect and induced multiplier effects, ensures that the positive impact, albeit small, will likely be a positive impact of national extent. On average, for very R1 million spent on civil engineering activities, the economy will benefit by an additional R2.01 million. Therefore, it can be estimated that provided that the total capital expenditure mentioned above is spent in South Africa, the economy of the country will experience a total increase in production of R239.6 million.

The impact on production will be the same for all site alternatives considered as outlined below. Therefore, both of the substations represent the preferred choices from this perspective.

Alternative	Preference	Reasons
Tlisitseng 1 Substation Option 1	No preference	The impact on production will be the same regardless of site alternative chosen.
Tlisitseng 1 Substation Option 2	No preference	

4.3 Impact on service infrastructure

The proposed Tlisitseng 1 132 kV substation and powerline will assist in increasing the national grid capacity since it will be utilised for connection of the Tlisitseng 1 PV facility to the Watershed MTS. Connection of the Tlisitseng 1 PV facility to the national grid will contribute towards the strengthening of the national electricity supply and greening of the economy.

The impact will be the same for all site alternatives considered as outlined below. Therefore, both of the substations represent the preferred choices from this perspective.

Alternative	Preference	Reasons
Tlisitseng 1 Substation Option 1	No preference	The impact will be the same regardless of site alternative chosen.
Tlisitseng 1 Substation Option 2	No preference	

4.4 Impact on existing land uses and change in sense of place

Regardless of the substation site alternative chosen, the substation is proposed to be located on Portion 25 of Farm Houthaalboomen 31. The farm is used for maize farming, using irrigation and commercial livestock farming. Consultation with the directly impacted land owner revealed that the maize production will not be impacted by any of the components of the Tlisitseng development. The land owner plans to acquire alternative land to continue the current level of commercial livestock farming activities.

Construction activities can be expected to be accompanied by noise and visual disturbance created by the construction activities themselves, as well as the presence and movement of construction workers on the impacted farms. This could potentially cause a change in the sense of place for workers and residents located in the immediate zone of influence (i.e. affected farm and directly adjacent farms). Once operational, the visible substation and powerline will further negatively impact the sense of place for residents, farm employees, as well as any potential visitors to the area.

The specific route that the powerlines will follow is not yet determined; however, the corridor for the envisaged power lines whether starting at Substation site alternative 1 or 2 will be confined to the Portion 25 of Farm Houthaalboomen 31. None of the other properties will be impacted by the footprint of the power line, which means that no workers should infringe on the privacy or property of the owners of Portion 2, Portion 3, and Portion 4 of Farm Talene 25. However, since the proposed corridor is located along the boundary of the above-mentioned property with Portion 4, Portion 2, and Portion 3 of Farm Talene 25, some visual impact may still be exerted on these properties and some other nearby properties. Furthermore, the presence of construction workers on the nearby farm may still negatively impact on the way the residents of Portion 2, Portion 3, and Portion 4 of Farm Talene 25 and other farm portions adjacent to the project site perceive their safety and security.

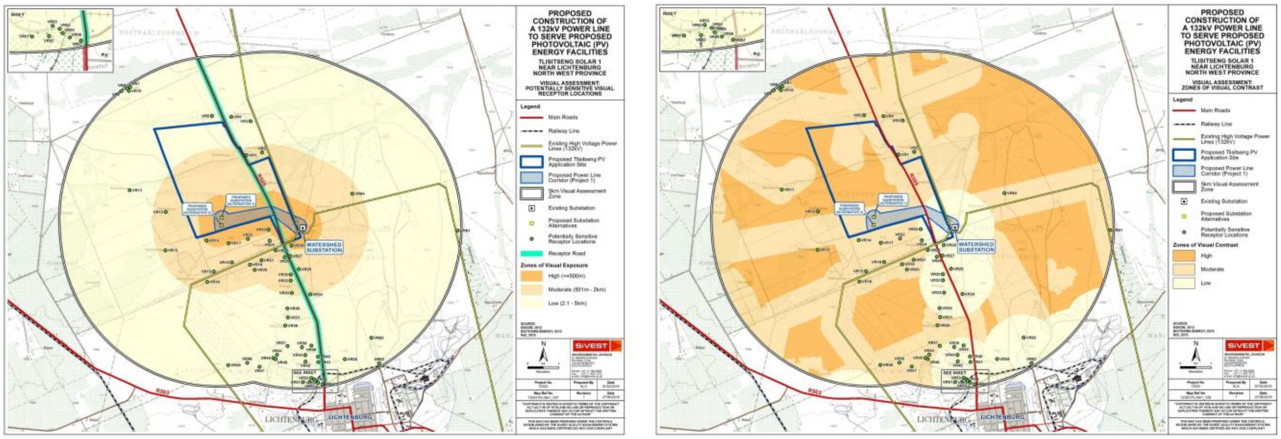


Figure 4-1: Visual exposure zone (left) and visual impact (right) of the 132kV power line for Tlisitseng 1 Solar PV facility (SiVEST, 2016)

The preferred substation site alternative is dependent on the following factors:

- **Land use:** The impact on the current land use will be the same for both site alternatives being considered. Regardless of the site alternative chosen, the commercial livestock activities on Portion 25 of Farm Houthaalboomen will be negatively impacted. The land owner will however, acquire alternative land where the activities can be continued; thus, no permanent decrease in agricultural production can be expected directly as a result of the construction of the substation and powerline.
- **Change in sense of place:** As discussed, the land owner of Portion 1 of Farm Talene 25 has expressed unhappiness over the potential visual impact that could ensue from the proposed infrastructure developments. Currently, the farm hosts a local entertainment spot (Rafter Pub) with plans to start offering accommodation facilities in the future. The land owner also resides on the farm and plans to retire on the same farm. Furthermore, the land owner of Portion 3 of Farm Talene 25 objects to the project in general and also raised concerns over the change in the sense of place.

Considering the above, it is recommended that when selecting the specific route for the power line, it should be chosen in such a way as to locate further away from the boundary of Portion 25 of Farm Houthaalboomen with Portion 2, Portion 3, and Portion 4 of Farm Talene 25. Then, considering the fact that the consultation revealed that the potentially visually sensitive land owners are located south of the proposed Tlisisteng PV array, the substation site alternative 2 may be associated with a smaller visual effect due to its being located further away from these sensitive receptors, compared to substation site alternative 1.

Alternative	Preference	Reasons
Tlisitseng 1 Substation Option 1	Preferred	The alternative is associated with a smaller visual impact on the sensitive receptor due to being located further away from them.
Tlisitseng 1 Substation Option 2	Not preferred	The alternative will have the largest impact on sensitive receptors due to the proximity to them.

5 IMPACT EVALUATION AND PROPOSED MITIGATION MEASURES

Based on the impact analysis discussed in the previous section, the impact evaluation is done for the preferred substation site alternative 2.

Table 5-1: Impact Table for substation site alternative 2 and the powerlines

Impact on employment creation		
Environmental Parameter	Construction, and to some degree maintenance, of the proposed substation and powerline will create or support employment in the relevant sectors as a result of direct, indirect, and induced effects.	
Issue/Impact/Environmental Effect/Nature	It is estimated that the project will create six temporary employment positions during the construction phase and 1.5 FTE sustainable annual positions for servitude maintenance and maintenance of the substation thereafter.	
Extent	Impact will affect the entire country.	
Probability	The impact will certainly occur (greater than 75% chance).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	The impact and its effects is predominantly short term	
Cumulative effect	No cumulative effect	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system component in a way that is barely perceptible.	
Significance rating	**Prior to mitigation measures:** Positive low: The anticipated impact will have minor positive effects. **After mitigation measures:** The proposed mitigation measures will increase the benefit but will not increase the magnitude of the impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1

Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	12	12
Mitigation measures	Where possible and feasible, local labour procurement should be practised. In addition, if feasible, goods and services should be procured from local small businesses. This will increase the benefit to the local community.	
Impact on economic production		
Environmental Parameter	The proposed substation and powerline will require capital expenditure for goods and services during its construction. This will directly and indirectly contribute to revenue generation of those industries related to this sector by increasing the demand for goods and services for respective businesses	
Issue/Impact/Environmental Effect/Nature	The project requires a direct CAPEX investment of R79.6 million, provided that the total CAPEX is spent in South Africa, the economy of the country will experience a total increase in production of R239.6 million.	
Extent	The impact will affect the national economy	
Probability	The impact will certainly occur (greater than 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 and its effects will disappear once the construction period is over.	
Cumulative effect	The impact does not have any cumulative effects.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system/component but the system/component still continues to function in a moderately modified way.	
Significance rating	**Prior to mitigation measures:** Positive medium impact: the anticipated impact will have moderate positive effects. **After mitigation measures:**	

	Proposed mitigation measures will increase the benefit to the local community member, but the national impact will remain positive medium.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	24	24
Mitigation measures	If possible, goods and services should be procured from local small businesses and local contractors should be utilised to maximise the benefit to the local community.	
Impact on service infrastructure		
Environmental Parameter	The proposed development requires access to the Watershed MTS.	
Issue/Impact/Environmental Effect/Nature	The proposed 132 kV substation and powerline will provide the required access for the proposed Tlisitseng 1 PV facility to the national grid.	
Extent	The impact will affect the country	
Probability	The impact will certainly occur (greater than 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	Permanent	
Cumulative effect	The impact will not have any cumulative effects.	

Intensity/magnitude	Impact alters the quality, use, and integrity of the system/component but the system/component still continues to function in a moderately modified way.	
Significance rating	**Prior to mitigation measures:** Positive medium impact: the anticipated impact will have moderate positive effects. **After mitigation measures:** Positive medium impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	2	2
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	32	32
Mitigation measures	No mitigation measures exist.	
Impact on current land uses and change in sense of place		
Environmental Parameter	The directly impacted land is used for commercial maize and livestock farming, while the adjacent or indirectly affected farm portions are predominantly used for a mix of commercial farming activities, catering, and residential purposes.	
Issue/Impact/Environmental Effect/Nature	The construction of the proposed substation will neutralise the land for agricultural purposes. At the same time, the construction activities and corresponding influx of construction workers to the sight will result in a change of sense of place for the local community; once completed, the physical presence of the electrical infrastructure constructed will contribute towards this change.	
Extent	The impact will affect the local community	
Probability	The impact will certainly occur (greater than 75% chance of occurrence)	

Reversibility	The impact is unlikely to be reversed, even with intense mitigation measures.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	Permanent	
Cumulative effect	The impact would result in a significant cumulative effect since it will coincide with the development of the PV facility, the result being that the entire area affected by the footprint of Tlisitseng 1 PV array will be neutralised for agriculture production while the change in sense of place will be magnified for the community as a result of additional structures being developed.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system/component but the system/component still continues to function in a moderately modified way.	
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measures will achieve the desired significance rating of Negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	3	3
Irreplaceable loss	2	2
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	36	18
Mitigation measures	• The conditions set and requested by the directly affected land owner should be adhered to in order to limit the interruption to agricultural production.	

	• Implement the mitigation measures recommended by the other relevant specialist (visual), where feasible to limit negative impacts and their effect on the community's sense of place. • Implement public consultation and information sessions to limit the influx of migrant job seekers. • Strict rules of conduct and access control procedures should be enforced at all times to ensure that the personal property of the land owners on and surrounding the site is respected by all workers/contractors of the project proponent.

6 CONCLUSION

BioTherm proposes the development of the Tlisitseng 1 Solar PV energy facility on Portion 25 of Farm Houthaalboomen 31 near Lichtenburg in the North West Province. It is intended that the PV facility will be connected to the national grid via the nearby Watershed MTS. To achieve this connection, the proposed 132 kV on-site substation and 132 kV powerline must be constructed.

The review of applicable key policy documents revealed that all spheres of government support the establishment of the proposed project at the envisaged location. No red flags could be identified that could impact the project from a policy perspective, although care will have to be taken to ensure that the establishment and growth of activities identified as drivers of economic development in the study area is not unduly negatively impacted by the establishment of the project in the proposed region.

The proposed construction of bulk infrastructure will not only assist by providing the infrastructure for the Tlisitseng 1 development to gain access to the national grid by improving electricity supply in the region. It also has the potential to stimulate the national economy through an increase in production to the value of R239.6 million. The construction will furthermore, create or support approximately six temporary jobs, while the maintenance will create 1.5 permanent FTE opportunities. The benefit to the local community is uncertain; however, certain mitigation measures can be implemented by the project proponent, which would maximise the benefit to the local community.

The directly impacted land owner of Portion 25 of Farm Houthaalboomen 31 has indicated that alternative land can be acquired, which would allow him to continue the current levels of agriculture production. This is however, dependent on the condition that he receives some rental income in advance. No loss in agricultural production is, therefore, expected as a direct result of the development.

At the same time, the adjacent land owners of Portion 1 of Farm Talene 25 and Portion 3 of Farm Talene 25 have objected to the project due to the possible visual impact and effects thereof on their sense of place.

Considering the location of the sensitive receptors identified from the consultation process suggest that substation site alternative 1 may be associated with a slightly lower negative effect on the sensitive receptors than that of site alternative 2. This is mainly due to site alternative 1 being located further away from the sensitive receptors observed on Portion 1, Portion 2, Portion 3, and Portion 4 of Farm Talene 25. Considering the fact that all other impacts evaluated will be the same regardless of the site alternative chosen, site alternative 1 is indeed the preferred alternative from a socio-economic perspective.

ANNEXURE A: IMPACT RATING CRITERIA AND METHODOOGY

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:

Table 1: Description of terms

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 have different scales and as such bracketing ranges are often required. This is often useful during detailed assessment of a project in terms of further defining the determined.		
1	International and National	Will affect the entire country.
2	Province/region	Will affect the entire Province or region.
3	Local/district	Will affect the local area or district.
4	Site	The impact will only affect the site.
Probability		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (less than 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 resource	The impact will result in significant loss of resources.
4	Complete loss of resource	The impact results 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 and last for the entire operational life of the development, but will be mitigated by direct human action or 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 severly 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 is often impossible. If possible rehabilitation and remediation is 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 - 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 - 28	Positive low impact	The anticipated impact will have minor positive effects.
29 - 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 - 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 - 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 - 73	Positive high impact	The anticipated impact will have significant positive effects.
74 - 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 - 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

Table 2: 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

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Appendix D9

GEOTECHNICAL

GEOTECHNICAL ENGINEERING
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P. O. Box 227
Maraisburg
1700
South Africa

Geopractica (Pty) Ltd
Reg Number:- 2004\010151\07
VAT Number:- 4300102060
B-BBEE Status:- Level 4 Contributor

Construction House
1164 Minnie Postma Street
Florida Extension 11
Johannesburg

Tel:- +27 11 674 1325 Fax:- +27 11 6744513 E-mail:-thando@geopractica.co.za

To: **SiVEST**	To: **e-mail**
Attention: **Andrea Gibb**	Time: **4 40 PM**
From: **Thanduxolo Msengana**	Date: **18 July 2016**
Ref: *Z:\Projects 2016\SiVest\Tlisitseng 1 and 2 PV Projects\Tlisitseng Solar 1, Alternative 1&2\Desktop Study\Tlisitseng Solar 1 alternative 1 and 2. (Rev 1).wpd*	
THIS DOCUMENT CONSISTS OF ..6.. SHEETS INCLUDING THIS PAGE	

PROJECT: Lichtenburg Solar PV Projects.
SUBJECT: Geotechnical Desktop Review - Tlisitseng Solar 1, Alternative 1 & 2

1 Introduction

Following the completion of the Geotechnical Desk Top Review, dated April 2016, Geopractica were notified that the original substation alternative sites have moved some 800m south west and therefore a revised Geotechnical Desk Top Review is required.

On the 6th July 2016, a letter of appointment, referenced 13303 was received from Ms. A. Gibb of Sivest, instructing Geopractica to proceed with the revised geotechnical desktop review.

The sites are adjacent to each other and it is assumed that each substation site will be in the order of 1Ha.

This geotechnical desk top review only focuses on Tlisitseng Solar 1, alternative substation sites 1 and 2.

2 Objectives

The objectives of the desktop study was to complete a geotechnical review of the 2 alternative substation sites using the following topics :-

2.1 Climate and weather
2.2 Local Geology
2.3 Site Description
2.4 Topography and Drainage
2.5 Seismicity
2.6 Expected Soil Profile
2.7 General

3 Database and Literary Review

This literary review was conducted on data obtained from the following sources:-

3.0.1 Previous investigations in the area undertaken by Geopractica (Pty) Ltd and Geostrategies c.c.
3.0.2 Previous published investigations in the area undertaken by other consultants.
3.0.3 The 1:250 000 geological map, “No 2626 West Rand” was consulted in order to determine the regional geology in the vicinity of the site.
3.0.4 The 1:50,000 topo-cadastral map “2626 AA Lichtenburg” was assessed for topography and drainage of the site.
3.0.5 Google Earth imagery both current and historical.
3.0.6 Seismic hazard map of South Africa.
3.0.7 Internet.

4 Climate and Weather Conditions

According to the Climatic N value map of South Africa compiled by Weinert, Lichtenburg falls into the transition zone between Sub Humid and Sub Arid having an N value marginally greater than 5.

This would indicate that the most likely method of weathering of the bedrock would be due to mechanical disintegration, as opposed to chemical weathering in the areas of the country having a higher annual rainfall.

The weathering profile in these more arid regions of the country, should therefore favour the generation of a thinner residual soil horizon, than would be the case in the more humid, wetter coastal regions.

The average annual rainfall in this area is between 566mm and 620mm, most of which occurs in heavy isolated falls between November and March.

The average maximum summer temperature of approximately 28,0°C occurs in January with an average maximum of 18°C in June. Frost in winter is relatively common.

5 Local Geology

From available literature, it is evident that the site is underlain by dolomite belonging to the Malmani Subgroup within the Transvaal Sequence.

This blue/grey, hard rock dolomite is typically interbedded with of very hard, grey chert, and the upper surface usually weathers insitu to form a dark brown, silty sand with abundant, close packed gravels, cobbles and boulders of both fresh and leached chert and dolomite (residuum).

The bedrock profile within the dolomites is highly variable with hard, steep, dolomite pinnacles with deeply weathered slots (grykes) in between. These hard rock dolomite pinnacle can occur close to surface or at a significant depth, and can be widely separated or closely spaced. These features are due to the fact that dolomites can be easily dissolved by slightly acid ground water, percolating downward from surface, into the underlying formation.

Typically these slots can be filled with wad (a very soft, silt and clay derived from the insitu decomposition of dolomite) and other alluvial debris (dolomite residuum). The collapse of these cavities can result in the formation of sinkholes or doline depressions at the surface.

On the West Rand, most sinkhole and doline formation was related to the drawdown of the local watertable, due to underground mining operations. Human development could also be the triggering mechanism for the formation of sinkholes and dolines, due to the ingress of surface water into the underlying formation due to leaking sewers, water storage ponds, water taps, stormwater drains as well as water services to residential and commercial buildings.

The Malmani Subgroup is subdivided into the Oaktree (lower), Monte Christo (lower middle), Lytleton (upper middle) and Eccles (upper) formations. The Oaktree and Lytleton are chert poor while the Monte Christo and Eccles are generally chert rich. According to the geological map, the site is located within the lower middle Monte Christo (chert rich) Formation.
Typically the chert rich formations tend to be less problematic as the insoluble chert lenses within the dolomite bedrock tend to provide stability to the surrounding soluble dolomite.

A further factor which reduces the risk profile of dolomite terrains, is the presence of a thick and non erodible blanketing soil layer, over the underlying dolomite formation.

The Malmani Subgroup is inturn overlain by quaternary sandy gravel and pedogenic soils in the form of calcrete.

A site geological map has been attached as appendix 3 of this report.

6 Site Description

The proposed Tlisitseng Solar 1 site is located on the southern extent of portion 25 of farm Houthaalboomen 31-IP, approximately 8km north west of Lichtenburg in the North West Province. The new substation alternative sites are close to each other (approximately 150m) and are bounded to the south by farm Talene 25-IP.

The individual substation sites are approximately 1Ha in extent and they corridor trend in an east west direction towards the R505 main road.

The site is covered predominantly by tufted veld grass, with scattered shrubs and small indigenous trees.

7 Topography and Drainage

7.1 Proposed Substation Alternative 1

This site generally slopes gently towards the north and east at a gradient of between 0.7% and 1%, which should be sufficient for stormwater runoff, in the form of sheet wash towards the north and east, after periods of heavy prolonged rainfall. With the site being overlain by a relatively thin horizon of permeable sandy hillwash it is likely that downward percolation of precipitation (under normal conditions) is likely. However Google Earth imagery suggests that this site may be underlain by well developed, shallow, undulating calcrete horizon, which is typically impermeable and thus stormwater ponding could be an issue in this area, particularly after heavy or prolong rainfall.

7.2 Proposed Substation Alternative 2

Substation site “alternative 2" generally slopes gently towards the north and west at a gradient of between 1% and 2%, which should be sufficient for stormwater runoff, in the form of sheet wash towards the north and west, after periods of heavy prolonged rainfall. With the site being overlain by a relatively thin horizon of permeable sandy hillwash it is likely that downward percolation of precipitation (under normal conditions) is likely. However Google Earth imagery suggests that this site may be underlain by well developed, shallow, undulating calcrete horizon, which is typically impermeable and thus stormwater ponding could be an issue in this area, particularly after heavy or prolong rainfall.

8 Seismicity

According to the seismic hazard map of South Africa, the site is situated in the area where peak ground acceleration with a 10% probability of being exceeded in a 50 year period falls between 0.12g and 0.16g as seen on the seismic hazard map of South Africa, located in appendix 4.

9 Anticipated Soil Profile

Each typical soil type will be discussed below, considering the potential problems which can be generally anticipated, as well as possible geotechnical solution.

9.1 Recently Transported Soil Types

It can be anticipated that the entire site will have a surface cover of recently transported soils. The thickness of this cover can be expected to vary, according to the recent geological depositional processes that were active at the time. Main critical factors will be the general topography of the areas at the time of the sedimentation cycle as well as the presence of large rivers and lakes. As these transported sediments were laid down in recent geological times, they will not have undergone any significant consolidation. They can therefore be considered to be of a loose consistency, and could experience settlement under applied foundation loading.

Most structures in this area are therefore typically founded at the base of these recently transported materials, on the more competent pedogenic or residual soil horizons.

Alternatively, these loose, potentially collapsible and consolidating soils are removed down to a specified depth, and replaced with well compacted, inert, granular fill materials, which provide a competent base for the proposed structures.

9.1.1 *Wind Blown Aeolian Sands*

These soils have been transported under the action of wind. They usually form relatively deep horizons, and at surface display characteristic undulating sand dune features.

Due to their method of deposition, these sandy soils are generally of low cohesion and consistency, and can be expected to settle under foundation loading.

Where this sandy surface horizons is thick, the most appropriate geotechnical solution would be to excavate to a specified depth, and re-compact the removed soils back up to foundation level. This solution is referred to as constructing an engineered soil mattress.

If the horizon is thin, structures could be founded on competent underlying pedogenic (calcrete) or residual soil horizons.

This material is also popular used as plaster sand in building constructions.

9.1.2 *Water Transported Hillwash*

These hillwash soils have been transported by water, generally over fairly short distances, from higher ground down to lower lying areas.

They usually form more cohesive soils than the aeolian sands, but are also of generally low consistency.

A further characteristic of these soils is that over time, downward percolating of rain water carrying dissolved cementing solutions, can create bridges between the individual soil particles. On saturation and loading of these soils, the soil bridges can break down, resulting in collapse settlement.

The geotechnical solution to founding in such soils is to place the foundation on an engineered soil mattress.

9.1.3 *Water Transported Alluvium*

Alluvium are sediments that have been deposited from rivers, either after overflowing their banks in periods of flooding, or as alluvial fans entering lakes and lagoons, as well as bottom sediments dropped as the velocity of the river was impeded and reduced.

These sediments can include boulders, gravels and sands, as well as fine silts and clays.

The coarse gravel and sandy soils are often suitable as a founding medium, provided they are not immediately underlain by very soft silt or clayey soils.

The alluvial clays can however be problematic, as they could exhibit settlement or expansive behaviour. Where materials of high plasticity are present at founding elevation, it is recommended that they be excavated out, and replaced with well compacted, inert, granular materials.

9.2 Pedogenic Formations

9.2.1 *Ferricrete and Calcrete*

Where a fluctuating perched water table occurs, the near surface permeable soils can become cemented by iron or lime (calcium) rich solutions, to form well cemented ferricrete or calcrete horizons.

Due to the increase consistency and competence of these soils, they provide a potentially good founding medium for light to medium loaded structures, depending upon the thickness and degree of cementation.

This material may be intersected in both alternative substation sites.

9.3 Monte Christo Formation (Residual Soils and Bedrock Geology)

9.3.1 *Dolomites*

These rocks are formed due to biological synthesis and inorganic precipitation, in an ancient inland sea.

As these rocks are highly soluble by slightly acidic ground waters, under these conditions the possibility exists for the formation of sinkholes and doline depressions.

These features generally only occur where static or flowing water is present, such as human settlements, dams, commercial farming using intensive irrigation and poor stormwater facilitation.

Large scale dewatering processes also escalates the formation of these features.

Where none of these are present, the risk of sinkholes are considerably reduced.

The sandy and gravelly composition of soils derived from the weathering of dolomite and chert, are typically suitable as a founding medium for light to medium loaded structures. Only if the area has been classified as a suitably stable dolomite environment.

10 Comments

The comments made below are general, and based on anticipated geological and geotechnical conditions.

In terms of SANS 1936:2012 parts 1 to 4 “Development on Dolomite Land” a two phase (feasibility and design level) geotechnical and dolomite stability investigation will be needed to be undertaken on the chosen site.

10.1 General Anticipated Founding Solutions

10.1.1 *Proposed Alternative 1 and Alternative 2 of Tlisitseng Solar 1*

Is possibly underlain by shallow dense pedogenic material or chert residuum. These material are likely to be suitable as founding medium for lightly to medium loaded structures.

10.2 General

Due to fact that this entire site is underlain at depth by dolomite, it is a legal requirement that a Dolomite Stability Investigation (DSI) be undertaken in accordance with the South African National Standards SANS 1936-Parts 1 to 4 Development of Dolomitic Land.

For the substation, build on a 1 hectare property, this DSI will comprise a gravity survey and the drilling of a minimum of 3 boreholes for a feasibility level (Phase 1) investigation.

It is also evident from the Topographical maps and Google Images that a water boreholes are present near the both Alternative 1 and 2 - sites. These borehole are probably used for irrigation purpose and as mentioned in section 9.3.1above, dewatering has a significant effect on the underlying dolomite stability.

10.3 Construction Problems

The removal of large hard rock chert boulders and or hardpan calcretre, could be problematic, on both sites, when undertaking the bulk excavation or deep trenches for the installation of services.

10.4 Construction Materials

It is likely that relatively competent construction materials will be available on both site (calcrete gravels), whilst a dolomite aggregate quarry is located some 5km south of the sites.

10.5 Geotechnical Site Classification

10.5.1 *Proposed Alternative 1 and Alternative 2 of Tlisitseng Solar 1*

The site is likely to be allocated a Geotechnical Site Classification Designation of P/R, in terms of the NHBRC requirements.

Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.

Yours faithfully
For:- **Geopractica (Pty) Ltd**

Colin Dalton (Principal)

Thanduxolo Msengana (BSc Geology)

APPENDIX 1
SITE PLAN

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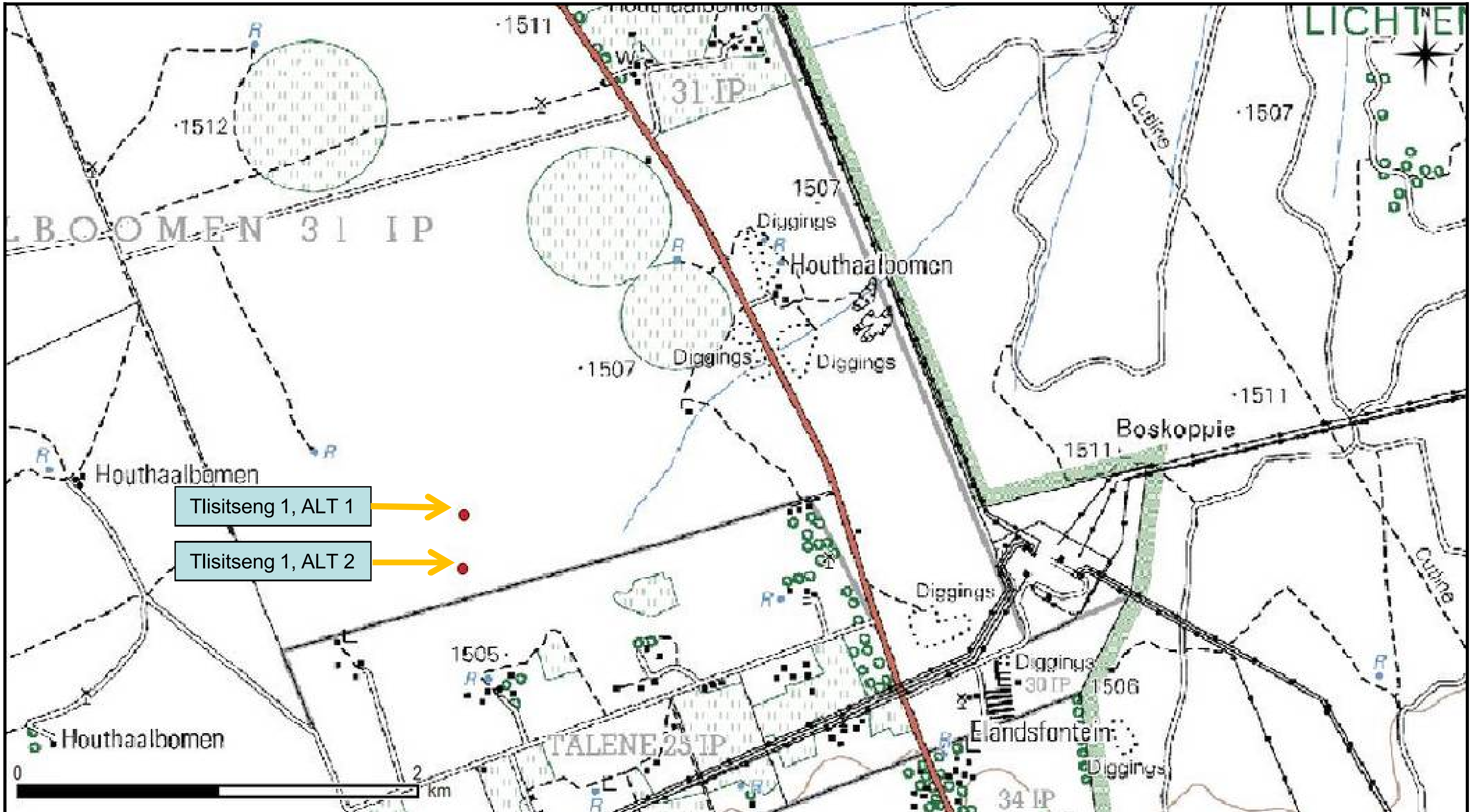
SITE PLAN	DATE: July 2016
SIVEST	Job No: 16082/1
TLISITSENG SOLAR 1, ALTENETIVE 1 & 2 – LICHTENBURG	Figure: 1

APPENDIX 2

TOPOGRAPHICAL MAP



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TOPOGRAPHICAL MAP

SIVEST

TLISITSENG SOLAR 1, ALTENETIVE 1 & 2 – LICHTENBURG

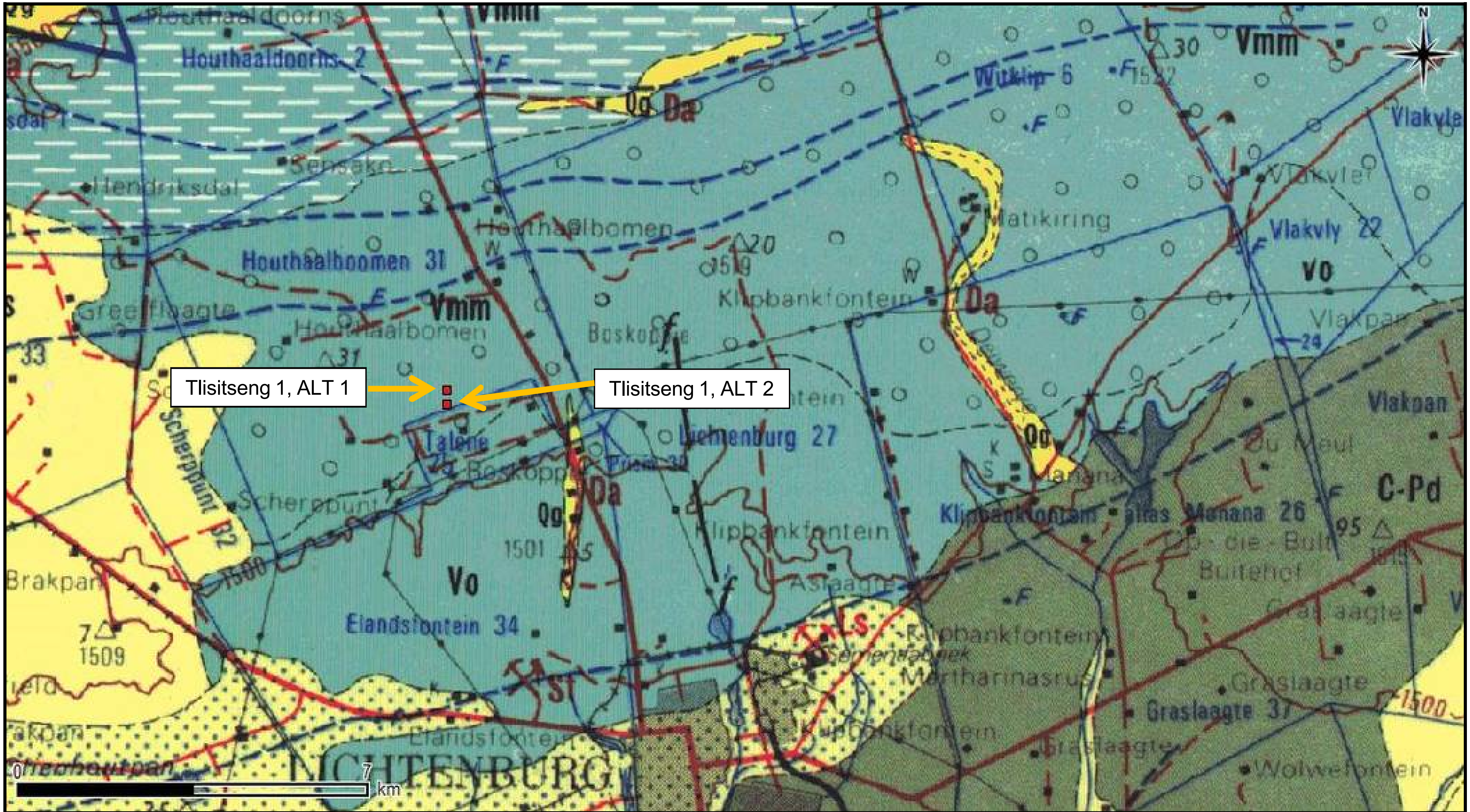
DATE : July 2016

Job No : 16082/1

Figure : 2

APPENDIX 3

REGIONAL GEOLOGICAL MAP



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REGIONAL GEOLOGY PLAN	DATE : July 2016
SIVEST	Job No : 16082/1
TLISITSENG SOLAR 1, ALTENETIVE 1 & 2 – LICHTENBURG	Figure : 3

APPENDIX 4

SEISMIC MAP

4.1 MAP 1: SEISMIC HAZARD MAP OF SOUTH AFRICA

Peak ground acceleration (g) with a 10 % probability of being exceeded in a 50 year period