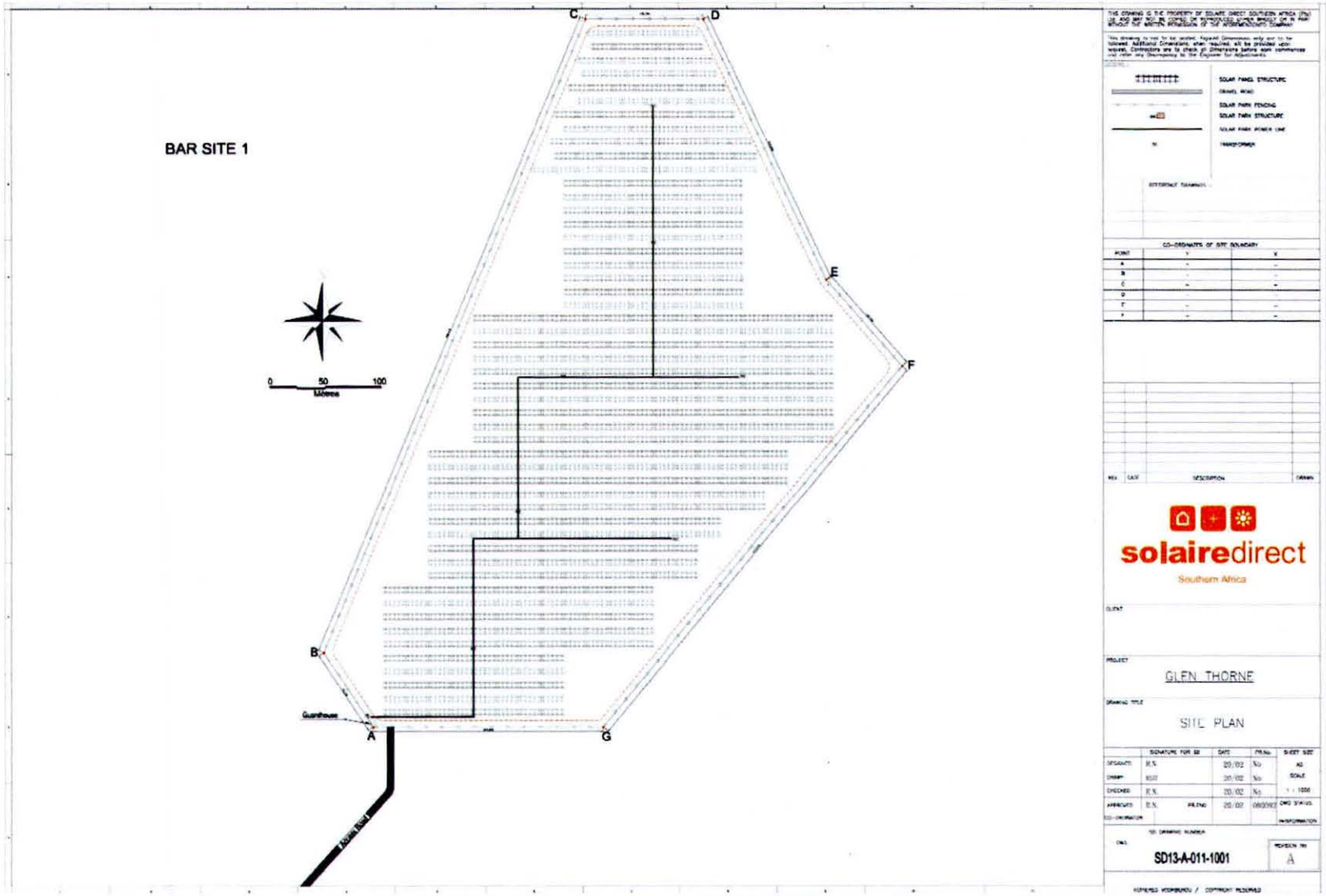
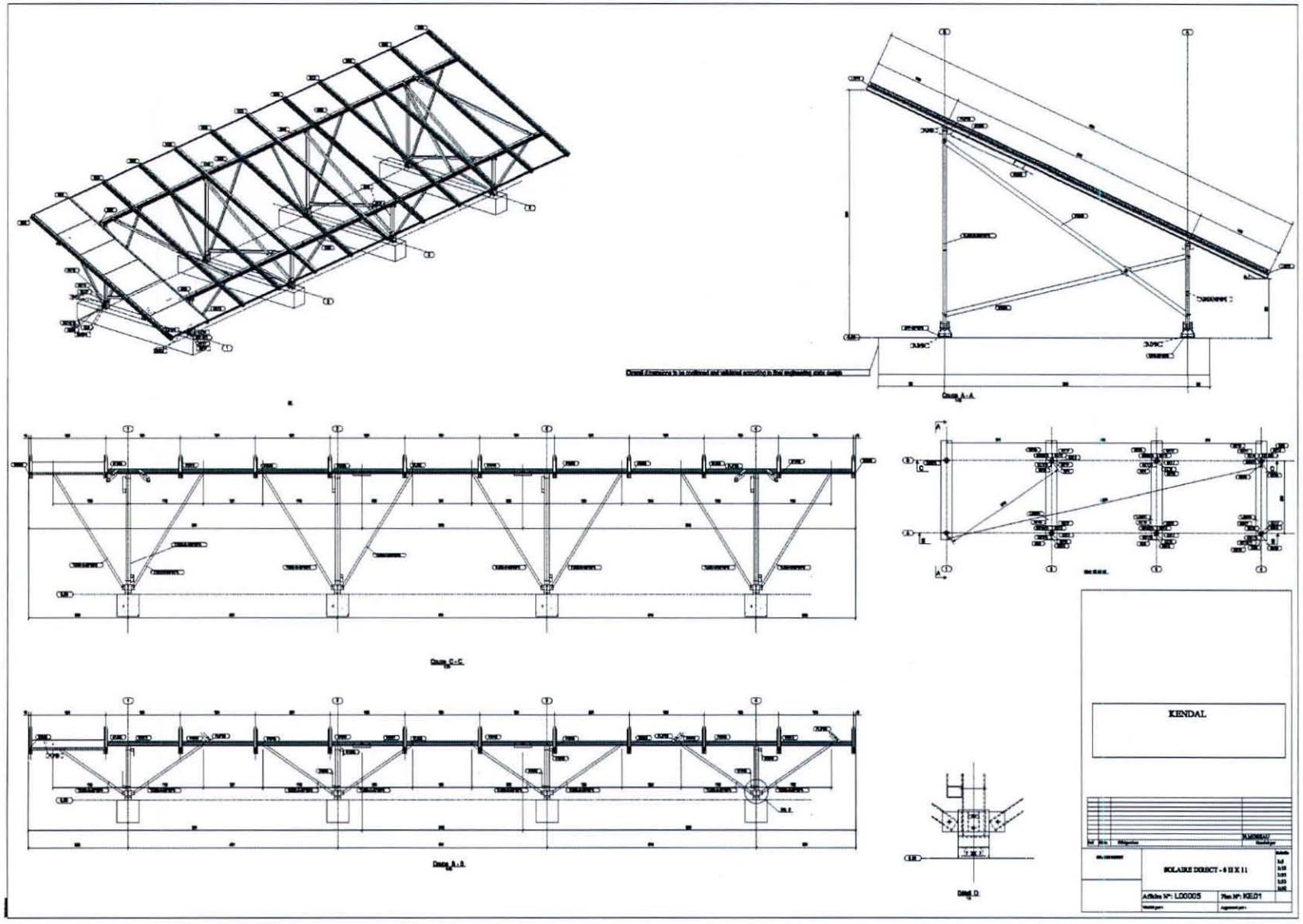
APPENDIX C: Facility illustrations



Appendix C.1: Generic Layout Plan for the proposed 10MW Solar PV Facility.



Appendix C.2: General Layout of Solar PV Frames and Panels.

SOLAIRE DIRECT TECHNOLOGIES : SD610

Mechanical Characteristics

Length (mm)	1660
Width (mm)	990
Height (mm)	45
Weight (Kg)	19
Junction Box	1 x Tyco junction Box with 3 Bypass diodes
Cables	Solar Cable, Length 1000mm, 4 mm² thick Assembled
Front Substrate	HiT SM, ARC White Glass glass 3.2mm thickness
Cells	60 polycrystalline cells (156 x 156 mm)
Encapsulation Material	EVA - Ethylene Vinyl Acetate
Back Substrate	Composite Sheet Tedlar or APA
Frame	45 mm Aluminum profile - Natural or Black Anodized
Unframed Dimensions	1652 x 982 x 5 mm (LxWxH) (Tol. +/- 2mm)

Electrical Characteristics

Power Class	235	230	225	220	215	210
Power Tolerance	+/- 3%	+/- 3%	+/- 3%	+/- 3%	+/- 3%	+/- 3%
Min Power (W)	227.95	223.1	218.25	213.4	208.55	203.7
Voltage at Max Power (Vmp)	29.4	29.3	28.9	28.8	28.6	28.3
Current at Max Power (Imp)	8.04	7.95	7.82	7.75	7.6	7.49
Open circuit Voltage (Voc)	36.9	36.7	36.6	36.4	36.3	36.1
Short Circuit Voltage (Isc)	8.65	8.55	8.4	8.3	8.2	8.1
Maximum System Voltage	1000	1000	1000	1000	1000	1000

Voltage temperature correction factor (Open Circuit)	-0.35%/K
Current Temperature correction factor (Short Circuit)	0.05%/K
Power Temperature correction Factor	-0.44 %/K
NOCT	45°C
(STC) Standard testing conditions :	1000 W/m², AM 1.5, 25°C

Use Conditions

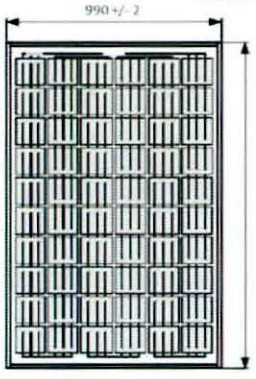
Temperature Range	-40 °C to + 85°C
Hail Test	Limited to a diameter of 28mm at an impact speed of 86 km/h
Test Load	Certified up to 5400 Pa according to IEC 61215 Ed. 2

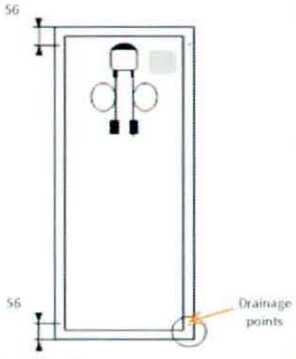
Certification

IEC 61215:2005 Ed. 2	Certified
EN6170 Class 1 & Class 2	Certified

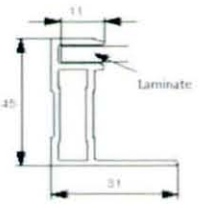
Warranty

Product	3 years
Power	Terrestrial: 25 years 80% yield
	Marine: 10 years / 90% yield





Solaire Direct frame Profile



solairedirect

Version 05/2009. Can be modified without notice. Average Electrical characteristics for Power class.
Power tolerance related to power class before <<LID>> /Pictures and Drawings Are not contractual

Appendix C.3: Solar PV Technology Specifications.

APPENDIX D: Specialist Reports

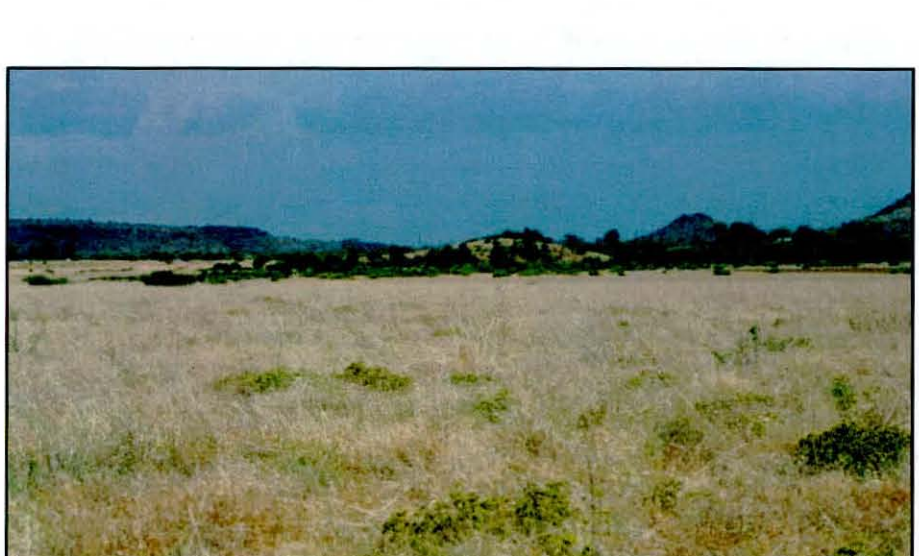
Appendix D.1 Biodiversity and Ecology Impact Assessment Report

PDF file attached.

D1_Biodiversity and Ecology Impact Assessment Report.pdf

DRAFT SCOPING REPORT

BIODIVERSITY AND ECOLOGY; GLEN THORNE PV SITE, FREE STATE.



EcoSol GIS
21 Neapolis
Pier Street
South End
Port Elizabeth

Simon Todd
simon.todd@uct.ac.za
0823326502 &
Andrew Skowno
drew@sa.wild.org
0827744613

Declaration of Consultants Independence

The authors of this report, do hereby declare that they are an independent consultant appointed by CSIR 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 the specialist performing such work. All opinions expressed in this report are their own.

Simon Todd Pr.Sci.Nat

Andrew Skowno

January 2012

Specialist Information

Simon Todd (sensitivity analysis and field assessment) and Andrew Skowno (desk top biodiversity analysis) of ECOSOL GIS conducted the study. Andrew and Simon both hold MSc. degrees in Botany from UCT and have combined 18 years of experience in conservation planning, biodiversity assessment and ecological research. Refer to www.ecosolgis.com for more details.

Contents

1 INTRODUCTION

In November 2011 EcoSol GIS was appointed by CSIR to conduct an ecological assessment of the proposed Glen Thorne solar PV installation as part of EIA process. The site is located near Bloemfontein and would have a peak generation capacity of 75 MW. The purpose of this report is to identify the likely ecological impacts of the development and identify development opportunities and constraints within the site as part of the Scoping Phase of the EIA process. The approach and terms of reference for the study are detailed below.

1.1 Terms of Reference

With regards to the flora of the site, the following terms of reference form the basis for this report:

- Describe the biodiversity and ecology at the site, develop a draft sensitivity map based on rapid field assessment and desktop study, and assess the potential impacts of the proposed development.
- Conduct vegetation and plant species surveys noting conservation significance and status.
- Identify and map vegetation habitats in the study area, paying careful attention to conservation constraints, threatened species that exist or may exist in the project area.
- Indicate presence of any seasonal wetlands, rivers, streams, dams etc.
- Provide photos illustrating any conservation action or plant species that may need special attention.
- Produce a vegetation sensitivity map of the project area which will be used to inform the layout of project infrastructure.

In terms of the terrestrial fauna of the site, the following terms of reference apply:

- A description of the occurrence and distribution of fauna (i.e. amphibians, reptiles and small-, medium- and large mammals) in the study area, which may be influenced by the proposed facility.
- The identification of Red Data species potentially affected by the proposed development.
- The identification of species-specific habitats in the study area, which may be influenced by the proposed development.
- An assessment of the potential impacts (positive, negative or cumulative if relevant) on fauna during the construction and operation of the proposed development.
- The identification of specific mitigating measures, for enhancing benefits and avoiding or mitigating negative impacts and risks, which should be implemented during design, construction and operation of the proposed development.

2 LEGISLATIVE OVERVIEW & PERMIT REQUIREMENTS

A summary of the relevant portions of the Acts which govern the activities and potential impacts to the environment associated with the development are listed below. Provided that standard mitigation and impact avoidance measures are implemented, not all the activities listed in the Acts below would actually be triggered.

National Environmental Management Act (NEMA) (Act No 107, 1998):

NEMA requires that measures are taken 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." In addition:

- That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied:
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- 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.

Environmental Conservation Act (ECA) (No 73 of 1989 Amendment Notice No. R1183 of 1997)

This Act provides for the effective protection and controlled utilisation of the environment. This Act has been largely repealed by NEMA, but certain provisions remain, in particular provisions relating to environmental impact assessments. The ECA requires that developers must undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations.

National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004):

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. In terms of the EIA regulations, a basic assessment report is required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur. However, all of the vegetation types within and surrounding the study site are classified as Least Threatened.

NEMBA also deals with endangered, threatened and otherwise controlled species. The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. Those relevant to the current study are listed below.

Under the **Environmental Impact Assessment Regulations Listing Notice 1 of 2010** (No. R.544) the following activities are likely to be triggered:

Activity 1: The construction of facilities or infrastructure for the generation of electricity where:

ii. the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare.

Activity 11 (Xi): The construction of infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

And, under **Environmental Impact Assessment Regulations Listing Notice 3** of 2010 *(R.546):*

Activity 14. The clearing of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation.

It is important to note that the above thresholds and activities also apply to phased developments "*where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.*"

National Forests Act (No. 84 of 1998):

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: "*no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner*

acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated".

No protected tree species were observed at the site and as the site is quite small it is safe to conclude that no protected tree species occur within the study area.

Conservation of Agricultural Resources Act (Act 43 of 1983):

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodline of water courses and wetlands.

Several listed invasive species were observed at the site including *Opuntia ficus-indica, Salsola kali, Argemone ochroleuca subsp. ochroleuca* and *Nicotiana glauca.*

3 METHODOLOGY & APPROACH

This draft biodiversity and ecology scoping study is based on a field visit and desk-top assessment of available biodiversity and ecological information. A wide range of spatial data sets were interrogated and relevant information was extracted for the study site. A basic ecological sensitivity analysis was performed to identify areas of special interest or concern. The various approaches used and aspects taken into account are detailed below.

3.1 Site Visit

The site visit took place on 29 November 2011. During the site visit, the different biodiversity features, habitat and landscape units present at the site were identified and mapped in the field using a GPS and also onto satellite imagery of the site. Walk-through-surveys were conducted across the site and all plant and animal species observed were recorded. Searches for listed and protected plant species known to occur in the area were conducted and the location of any listed plant species observed was recorded using a GPS. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. The presence of sensitive habitats such as wetlands and unique edaphic environments such as gravel or quartz patches were noted in the field where present and their location recorded using a GPS. Photographs of any sensitive habitats and environments present were taken for documentation and illustration purposes.

The data collected during the site visit can be summarized as follows:

- A list of all plant species observed at the site
- Description and composition of the different habitats and plant communities observed on site.
- A list of all mammals, reptiles and amphibians directly or indirectly (spoor, scat, etc) observed at the site
- Maps of sensitive areas identified in the field and delineated on satellite imagery of the site
- GPS coordinates of significant point-location biodiversity features
- Photographs of the different habitats, environments and biodiversity features present.

3.2 Sensitivity Map

Following the site visit, an ecological sensitivity map of the site was generated by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases as described above. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

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

3.3 Data Sourcing and Review

- Information on animal and plant species recorded for the Quarter Degree Square (QDS) 2826CD was extracted from the SABIF/SIBIS database hosted by SANBI. This database includes the various botanical databases housed within SANBI as well as those from various herbaria and museums. The faunal data sources includes inter alia the SA Bird Atlas Project 1 and the SA Reptile Conservation Assessment (SARCA).
- Threatened Plant data was extracted from the Draft TSP and CREW data set (SANBI 2008, Raimondo 2009).

- Threatened Ecosystem data was extracted from the NEMBA listed ecosystems layer (SANBI 2008).
- Vegetation type conservation status was extracted from the South African National Vegetation Map (Mucina and Rutherford 2006).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystems Protection Assessment, CSIR 2010 (NFEPA).
- Important catchments and protected areas expansion areas were extracted from National Protected Areas Expansion Strategy 2008 (NPAES).
- River and streams from the NGI 1:50 000 series were buffered by 100m using ARCGIS.
- Land Cover was mapped for the study area using 1:30 000 scale digital aerial photographs obtained from NGI. All roads, pans, dams, urban areas, buildings, river areas, severely degraded areas and areas with no natural vegetation cover (transformed areas) were mapped for the site.

3.4 Key Limitations & Assumptions

The key assumption for this study is that the existing datasets which were used to assess site sensitivity are correct and reliable. In most cases the data sets used were not intended for fine scale planning work at scales larger than 1:250 000.

A single, one-day site visit was conducted and no long-term studies have taken place, which imposes some limitations on the interpretation of the data collected in the field particularly with regards to the extent to which the species lists generated from the site visit can be considered comprehensive. However, these lists were augmented with species likely to occur at the site based on distribution records from the literature and various spatial databases (SANBI's SIBIS and BGIS databases). Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friendmann and Daly (2004) and Skinner and Chimimba (2005) for mammals. The lists provided are based on species which are known to occur in the broad geographical area as well as an assessment of the availability and quality of suitable habitat at the site. This represents a sufficiently conservative and cautious approach which takes account of the study limitations.

3.5 Relevant Aspects of the Development

A single site is being considered and alternative sites are not being assessed or compared to one another. Important aspects of the construction and infrastructure of the development which are potentially relevant to assessing the likely impacts of the activities associated with the development include the following:

- Rows of PV panels supported by steel supports would occupy approximately 130 ha of the site when the full 75 MW is installed. This includes gaps of approximately 10 m between the rows, part of which will be roads for operation and maintenance activities.
- One or more permanent meteorological stations
- A small site office and storage facility, including security and ablution facilities

- Site fencing
- Car park
- Temporary construction camp
- Permanent accommodation
- A lay-down area for the temporary storage of materials during the construction activities.

Extracted from another solar development, check against BID documents

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 Vegetation

4.1.1 Broad-Scale Vegetation Patterns

In terms of the national vegetation map, (Mucina & Rutherford 2006) the site falls entirely within a single vegetation type, Highveld Alluvial Vegetation (Figure 1). Highveld Alluvial Vegetation is an azonal vegetation type, meaning that its distribution is controlled largely by edaphic conditions rather than climate. It has a total extent of 4656 km^2 and is associated with drainage lines and alluvial floodplains embedded within the western and central Grassland Biome such as the upper Riet, Harts, upper Modder, upper Caledon, Vet, Sand, Vals, Wilge, Mooi and middle and upper Vaal systems. Highveld Alluvial Vegetation is not a threatened vegetation type and the conservation status of this vegetation type is classified as Least Threatened. Approximately 25% has been transformed by intensive agriculture and the construction of dams (Mucina & Rutherford 2006). The vegetation type is however poorly protected as less than 10% falls within formal protected areas compared to the target of 31%. Within the wider area, Winburg Grassy Shrubland occurs on the higher ground to the southwest and northeast of the site, while Bloemfontein Karroid Shrubland occurs on dry stony slopes in the area. Both of these vegetation types are also listed as Least Threatened. Bloemfontein Dry Grassland occurs approximately 2 km to the east of the site and is listed as Endangered. The presence of an endangered vegetation type within relative close proximity to the site, indicates that if parts of the site share species and attributes in common with this vegetation type, a cautious approach to the transformation of such areas should be adopted. This is further highlighted by the fact that only the northern extent of the site corresponds well with Highveld Alluvial Vegetation and the southern section has elements of Winburg Grassy Shrubland.

4.1.2 Fine-Scale Vegetation Patterns

The vegetation of the site is quite variable and several different plant communities can be identified. At a coarse scale, the well-wooded riparian corridor along the floodplain of the Modder River can be separated from the open grasslands of the adjacent slopes and a limited extent of rocky outcrop which occurs embedded within the open grasslands. The dominant plant species within each of these units was fairly distinct. Within the riparian habitat, several plant communities could also be recognised which were related to silt deposition history and soil texture. Within the open grasslands, at least two communities could also be recognised which

appeared to be related to slope and moisture availability. The mesic habitats associated with the lowlands of the site and the floodplain of the Modder River, can be considered to be ecologically sensitive habitats. Such mesic grasslands are under threat from transformation and alien plant invasion. The rocky outcrop or koppie also represents a sensitive habitat as it constitutes a locally rare habitat type and contained a large amount of fauna and flora which are not found elsewhere on site such as aloes and several tree species. The vegetation on the koppie corresponds to the Windburg Grassy Shrubland of Mucina & Rutherford (2006). No nationally protected tree species were observed on site, but a large specimen of wild olive *Olea europaea* subsp. *africana* was observed on the small koppies which occurs towards the southwestern boundary of the site.

Photo 1. The rocky outcrop which occurs towards the southwestern boundary of the site. The koppie is the only rocky area within the site and contains a number of tree species which do not occur elsewhere at the site including *Olea europea* subsp. *africana*, *Eretia rigida*, *Rhus burchellii* and *R.pyroides*.

Photo 2. The floodplain of the Modder River consists of well-wooded areas interspersed with more open areas. The larger vegetation is dominated by *Acacia karoo*, with occasional other tree species such as *Rhus lancea* and *Ziziphus mucronata*.

Photo 3. The open grasslands on the floodplain of the Modder River. The lack of trees in these areas is probably related to soil properties such as seasonal waterlogging. These areas are very flat and dominated by species such as *Themeda triandra*, *Salsola glabrescens*, and *Ranunculus multifidus*.

Photo 4. The open grasslands of the higher-lying parts of the site, with scattered *Acacia karoo*, *Rhus pyroides* and *Asparagus laricinus* shrubs. Common and dominant grass species include *Themeda triandra*, *Setaria sphacelata* and *Cymbopogon pospischilii*.

4.2 Fauna

4.2.1 Mammals

The mammalian community at the site is likely to be of moderate to high diversity. As many as 55 terrestrial mammals and 5 bats potentially occur at the site. The limited extent and range of habitats available however implies that the actual number likely to be present is significantly less. Four species of conservation concern potentially occur at the site, these are the White-tailed Mouse *Mystromys albicaudatus* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Leopard *Panthera pardus* (Near Threatened), Black-footed cat *Felis nigripes* (Vulnerable) and Schreibers' long-fingered bat *Miniopterus schreibersii* (Near Threatened). Of these, the Leopard and Brown Hyaena are not likely to occur in the area as a result of the proximity of the site to urban areas and the high levels of human presence which characterize the area. There is a high probability the White-tailed Mouse occurs at the site as the habitat is suitable and the author (ST) has observed this species to be common in places with dolerite vertisols. The presence of vertisols appears to be significant for this species as it shelters and possibly also forages down the large cracks which develop in the soil during the dry season. The Black-footed Cat is a secretive species which may well occur at the site as the mix of open and densely vegetated areas represents attractive habitat for this species.

4.2.2 Reptiles

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3). This is a comparatively low total suggesting that the site has a relatively depauperate reptile assemblage. Based on distribution maps and habitat requirements, the composition of the reptile fauna is likely to comprise 1 terrapin, 22 snakes, 16 lizards and skinks and 1 gecko. This indicates an assemblage which is high in snakes relative to other reptiles. A single species of conservation concern may occur at the site, the Striped Harlequin Snake *Homoroselaps dorsalis* (Near Threatened). The site is however outside of recent distribution records and it is unlikely that it occurs at the site as it has not been recorded in the Bloemfontein area.

4.2.3 Amphibians

The site lies within or near the range of 13 amphibian species. Those that require permanent water are likely to be restricted to the vicinity of the Modder River as there did not appear to be any permanent water sources on site. There were however some ephemeral streams and occasionally flooded areas on site which would form habitat for those species which utilise such temporary water sources. The only species of conservation concern likely to occur on site is the Giant Bullfrog *Pyxicephalus adspersus*. As this species is known from the area and there appears to be suitable breeding habitat present for this species there is a high probability that it occurs at the site. Suitable habitat for the Giant Bullfrog includes the small drainage which traverses the central portion of the site as well as the low-lying areas between the drainage line and Modder River. The likely presence of this species in the area is a contributing factor to the higher sensitivity of the northern sections of the site.

4.3 Site Sensitivity Assessment

The extent of the different ecological sensitivity categories within the site is summarized below in Table 1. Due to the location of the site on the alluvial plain of the Modder River, a large proportion of the site is considered to be ecologically sensitive. Development within this area would disrupt the connectivity of the riparian corridor as well as result in a significant loss of habitat and local biodiversity. The area to the south of the small drainage line which runs east-west across the site is considered the most suitable area for development. This area includes a large fallow field as well as a similar extent of natural grassland. Development within this area could proceed with little ecological impact to the receiving environment provided that standard mitigation measures are applied. This area, which amounts to about 90 ha, is not sufficient to accommodate the 75 MW which has been proposed for the site. An additional 40 ha or more would be required to accommodate the full 75 MW and given the sensitivity of the rest of the site, it is difficult to see how this could be accommodated without resulting in significant negative impacts on the local environment.

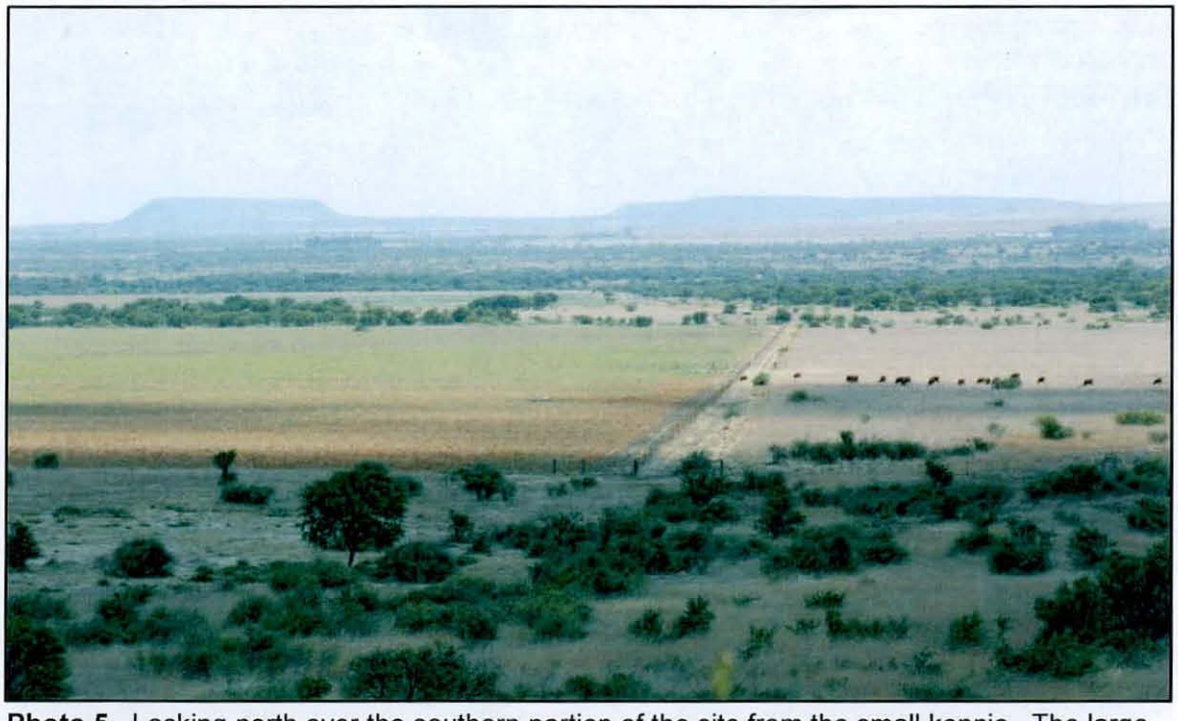


Photo 5. Looking north over the southern portion of the site from the small koppie. The large fallow field which can be seen on the left and the open grasslands to the right, represent the best development opportunities at the site as they have moderate to low biodiversity value. The wooded areas in the distance indicate the extent of the floodplain of the Modder River and represent an ecologically sensitive habitat that should be avoided as far as possible.

Table 1. Ecological sensitivity summary of the Glen Thorne site. The implications of the different sensitivity categories for the development potential of the site are listed along with the level of mitigation actions that would be required to effectively mitigate negative impacts within the different sensitivity classes. The residual impact reflects the post-mitigation impact that cannot be effectively mitigated and indicates the likely impact rating that would result from developing within that sensitivity class. .

Sensitivity	Area (Ha)	Development Potential	Mitigation Required	Residual Impact
Low	76.4	High	Low	Low
Medium	44.4	High	Low/Moderate	Low
Medium - High	48.0	Low	Moderate/High	Moderate
High	65.1	Very Low	Very High	High
Very High	145.3	Very Low	Very High	Very High

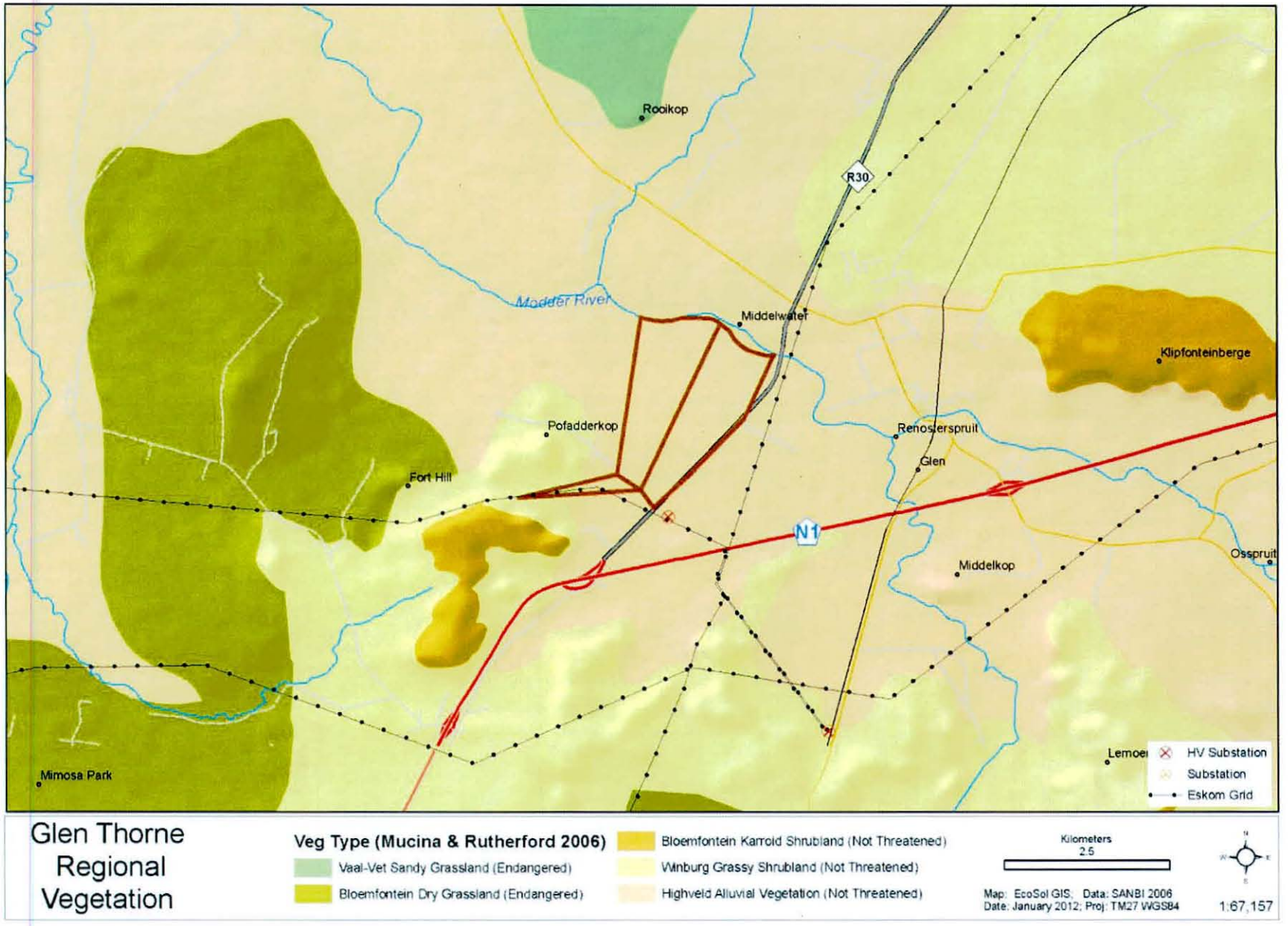


Figure 1. Regional vegetation map for proposed Glen Thorne PV site.

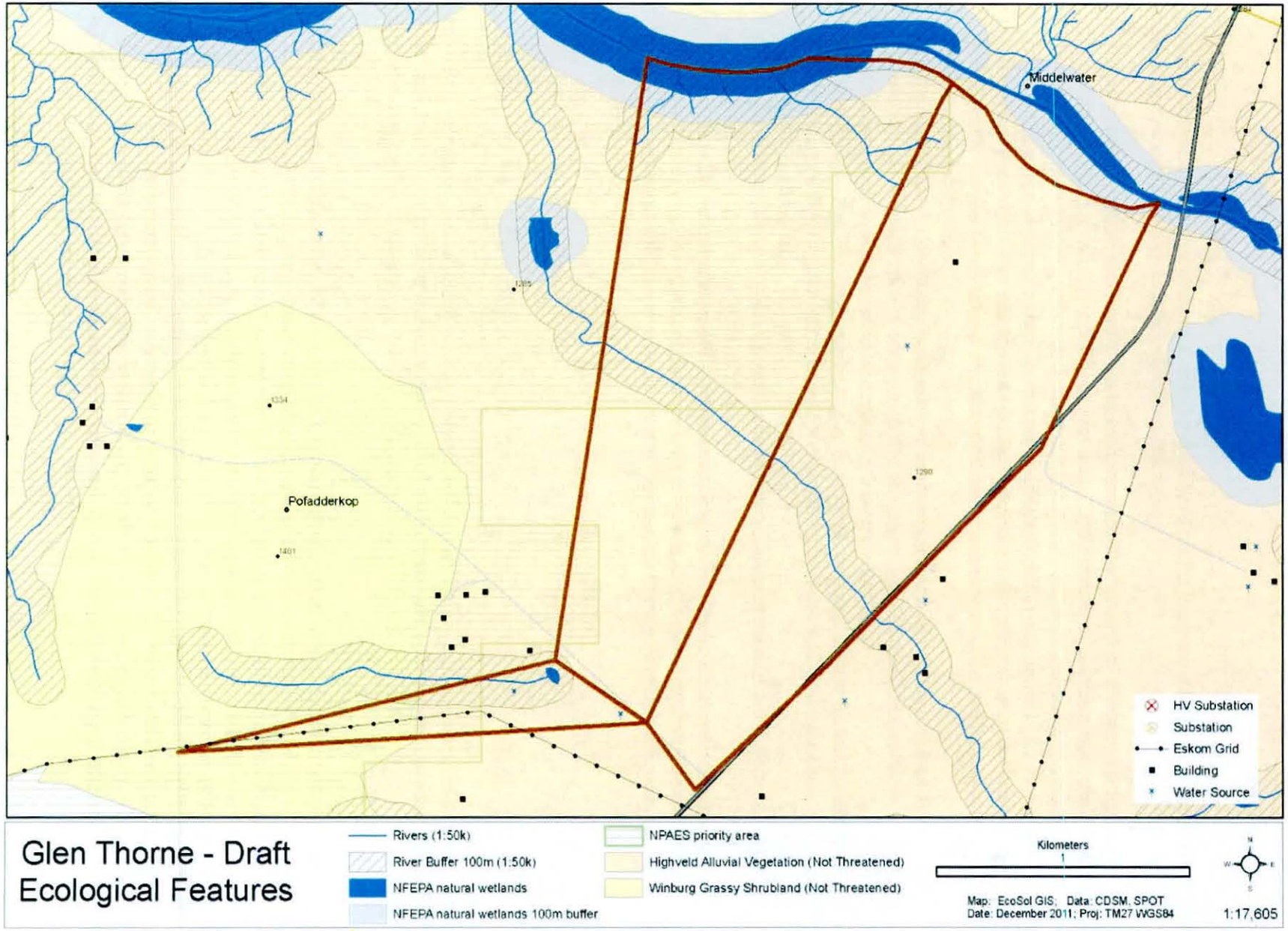


Figure 2. Biodiversity and ecological features of Glen Thorne proposed PV site.

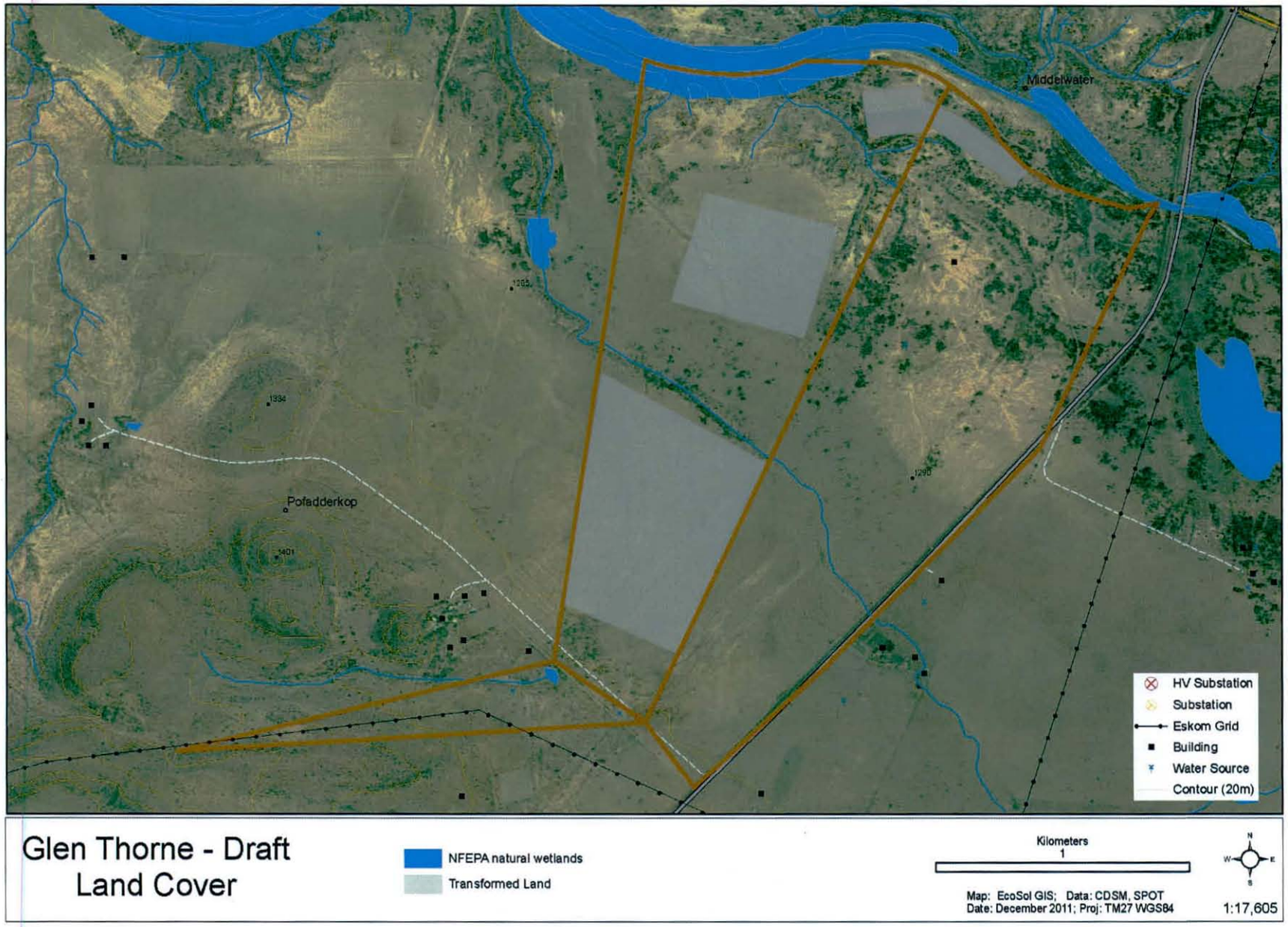


Figure 3. Land cover for proposed Glen Thorne PV site, mapped at scale of 1:10 000 using NGI aerial photos circa 2008.

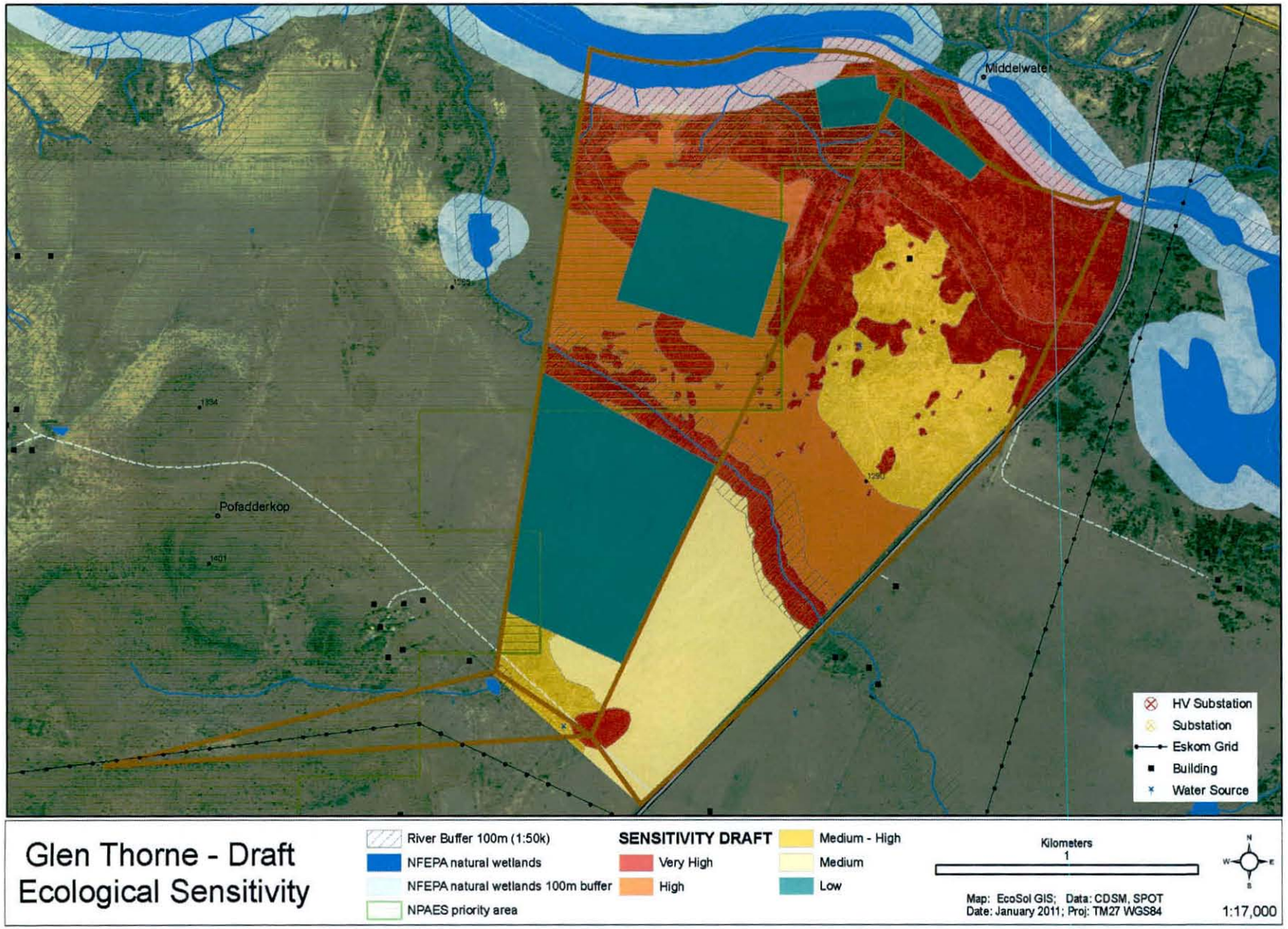


Figure 4. Draft sensitivity map developed for Glen Thorne proposed PV site; refer to Table 1 and Table 2.

5 IMPACT IDENTIFICATION & NATURE

Potential impacts on the terrestrial ecology of the site resulting from the development of the site as a renewable energy facility include the following

- **Biodiversity** – where biodiversity is taken to mean 1) the number of different species and individuals in a habitat or geographical area; 2) the variety of different habitats within an area; 3) the variety of interactions that occur between different species in a habitat; and 4) the range of genetic variation among individuals within a species.
- **Sensitive Habitats** – impacts to ecologically sensitive habitats such as riparian areas or edaphically unique areas such as quartz patches, or areas which are the habitat of rare or endangered species.
- **Ecosystem Function** - Impacts on ecosystem function such as the regulation of water flow and quality resulting from changes to the abiotic environment. Changes to disturbance regimes such as fire frequency may also result.
- **Connectivity** – Habitat fragmentation or a reduction in the ability of fauna to move about the landscape, this may impact ecosystem function as well as gene flow and other aspects of biodiversity.
- **Ecosystem Resilience** - Intact ecosystems are better able to recover from perturbations and resist invasion by alien plants.
- **Secondary/Cumulative Impacts** – When considered in isolation, the development of a single site may not be significant, however, when considered in light of similar actual or potential developments in the area, a greater concern for broader ecological processes may arise.

6 ASSESMENT OF RISKS AND POTENTIAL IMPACTS

Potential ecological impacts resulting from the development would stem from a variety of different activities and risk factors associated with the construction and operational phases of the project including the following:

Construction Phase

- **Vegetation Clearing** for PV arrays, roads, buildings etc will lead to habitat loss for fauna and potentially the loss of sensitive species, habitats and ecosystems.
- **High Erosion Risk** will result due to the loss of plant cover and disturbance created during the construction phase. Although the effects would probably only become apparent during the operational phase, the impact stems from the construction phase and suitable mitigation measures will also need to be applied at this stage.
- **Presence and operation of construction vehicles** on site. These create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
- **Increased human presence** can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

Operational Phase

- Disturbance created during the construction phase will leave the site vulnerable to **alien plant invasion** for at least the first few years of the operational phase.
- The presence of the PV panels will **shade the soil** which will create a number of potential secondary impacts such as changes in plant and faunal community composition.
- **Maintenance activities** such as vegetation clearing will impact the biodiversity of the site if not conducted in a sensitive manner.
- **Loss of connectivity & habitat fragmentation** will result if the facility is **fenced-off** in a manner which limits the movement of fauna.

Impacts to be Assessed in the EIA Phase

Given the above activities and risk factors, impacts likely to result from the development that will be assessed during the EIA phase include the following:

- Loss of natural vegetation
- Alien plant invasion
- Loss of faunal habitat and disturbance
- Erosion Risk
- Loss of connectivity
- Cumulative Impacts

7 DISCUSSION AND CONCLUSIONS

Given the sensitivity of parts of the site, the potential for significant negative ecological impacts as a result of the development is high. The lower-lying parts of the site which are associated with the floodplain of the Modder River are viewed as being largely unsuitable for development from an ecological perspective. This results from their high biodiversity value and the ecosystem services that such areas provide. Given the nature and sensitivity of this environment it would be difficult to effectively mitigate the likely impacts of the development within this area. The higher-lying southern portion of the site is less ecologically sensitive and apart from a small rocky outcrop represents a relatively ecologically homogenous area that could be developed with little residual impact on the local environment. This area is however not sufficient to accommodate the full 75 MW that has been planned for the site and an additional 40 to 60 ha would be required. Restricting the development to the low and medium sensitivity areas would therefore necessarily result in a reduction in the potential output of the development, but would ensure that the development proceeds with a relatively low impact rating. Should the development proceed with the full 75 MW, it is likely that the ecological impacts associated with the development would be significantly increased. The location of a large proportion of the site within the floodplain of the Modder River imposes a significant constraint on the development potential of the site that cannot be easily circumvented.

8 REFERENCES

CSIR, 2010. National Freshwater Ecosystems Priority Areas (NFEPA). Funded by XYZ. CSIR

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg

Henning, G.A., Terblanche, R.F. & Ball, J.B. 2009. South African Red Data Book: butterflies. SANBI Biodiversity Series 13. Pp. 158. South African National Biodiversity Institute, Pretoria

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C

Mucina L. & Rutherford, M.C. (eds) (2006). The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Nel JL; Smith-Adao LB; Amis M; Bhengu S; Hardwick D; Mack S; Maherry AC; Mbona N; Petersen CL; Swartz E; Van Deventer H; Van Niekerk L; Wistebaar N. 2009. Identifying & enabling protection of national freshwater ecosystem priority areas (NFEPA) for South Africa. CSIR Report: CSIR/NRE/ECO/ER/2009/0030/A

Nel, J.L., Reyers, B., Van Deventer, H., Smith-Adao, L. 2007. Protected Area Expansion Strategy: Spatial assessment of river priorities. Final Report. *CSIR Report number CSIR/NRE/ECO/2007/0134/C.*

PRECIS (National Herbarium Pretoria (PRE) Computerised Information System), National Herbarium in Pretoria, Data extracted May 2010

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama, P.A. (eds) 2009. Red List of South African plants 2009. Strelitzia 25. South African National Biodiversity Institute, Pretoria

SANBI (2008). Threatened Ecosystems in South Africa: General Information. South African Biodiversity Institute, Pretoria.

9 Annex 1. Documented Sensitive Areas Checklist

- **NEMBA listed threatened ecosystems**; Habitats on site are listed as not threatened (Highveld Alluvial Vegetation).
- **Critical Biodiversity Areas or Ecological Support Areas (CBAs or ESAs):** No CBA areas defined for the Province.
- **Important Bird Areas (IBAs)**, None (nearest IBA = Soetdoring Nature Reserve which is 21 km north west of site).
- **NPAES priority areas outside protected areas**; Yes, western 1/3rd of study site falls within a priority area outside national parks identified in the National Protected Areas Expansion strategy 2008.
- **Proximity to National Parks or Provincial Reserves**: Not within 10km of NP or 5km or PR. Nearest Provincial Reserve = Soetdoring Nature Reserve which is 21 km north west of site. .
- **Proximity to water courses and wetlands:** Yes, portions of the site are within the 32m (NEMA List 1 Act 11) of water course and 100m (DWA guidelines) of water course or wetland.
- **NFEPA Priority Wetlands:** Riverine Wetland associated with the Modder Rivier, NFEPA rank of 6 (other wetlands) not a selected priority wetland.
- **NFEPA Priority River:** Modder River classified as D = Largely Modified; and does not contribute significantly to freshwater ecosystem targets. Not classified as flagship river reach,

Appendix D.2 Freshwater Ecosystem Impact Assessment Report

PDF files attached.

D2.A_Freshwater Ecosystem Impact Assessment Report

D2.B_Draft Plan for EMP

INPUTS INTO SCOPING REPORT FOR THE PROPOSED CONSTRUCTION OF A 75 MWP FACILITY AT GLEN THORNE SITE, FREE STATE.

FRESHWATER ECOSYSTEMS

Comments provided by Liz Day, Freshwater Consulting cc (t/a FCG), Cape Town

Comments based on desk top assessment and site visit of 8th February 2012

Introduction

An initial assessment of the Glen Thorne Site, focusing on the proposed development footprint indicated in Figure 1, indicated that the site is a complex one from a freshwater ecosystems perspective, and that there are several challenges that would need to be overcome in design and layout of the proposed Solar Plant, if it is to avoid significant impacts to freshwater ecosystems. This document serves to provide a brief outline of FCG's preliminary findings at this site, for input into the study Scoping Report.

Overview of freshwater ecosystems on the site

The Glen Thorne site lies within the catchment of the **Modder River**, which forms the northern boundary of the site (Figure 1). The river has been highly modified from its natural condition in the study area reaches, with mining of sand along the river banks along the north western site boundary contributing to extensive loss of riverine habitat and precipitating erosion nick-points within the channel and remnant banks. The Modder River on the site, and particularly along its upstream (eastern) reaches within the site, is associated with an extensive, wooded riparian corridor, which gives way to open floodplain grasslands.

The site itself has been relatively disturbed by past agricultural activities, some of which have resulted in the partial disruption of natural drainage lines across the site. A large proportion of the site south of the Modder River floodplain is overlain with clayey soils, identified by the soils specialist as Arcadia soils forms, comprising 45 – 55% clay (Le Roux 2012). Following saturation, these result in perching of runoff on the surface, and the creation of multiple ephemeral channels across the landscape. The channels convey surface runoff and seepage from highlying areas down towards major drainage lines, and comply with the National Water Act (Act 36 of 1998) definition of a water course, which states that the term "water course" refers to:

- A 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.

The following drainage lines, shown in Figure 1, were discerned on the southern portion of the site, in the vicinity of the proposed development footprint:

- A major, south easterly to north westerly running ephemeral stream – this system, mapped by Ecosol GIS (2012), is fed both by drainage from its catchment to the south east of the site, and from seepage and surface runoff from the current site and the elevated areas to the south west. The stream itself has been classified as a valley bottom wetland on the basis of its position in the landscape, its major characteristics and the outcomes of shallow augering of local soils in terms of the DWAF (2005) wetland delineation methodology. This said, it is recognised that the stream conveys ephemeral flows only, and wetland conditions within the stream course are limited to isolated areas, interconnected by the stream channel. The system is highly vulnerable to erosion, which would be triggered by increases in the velocity / magnitude of flows through it, or by the creation of nick-points at access / crossing points. It is connected to wetlands upstream of the R30 by a culvert, and as such facilitates longitudinal connectivity between these areas and both the Modder River and its associated floodplain;
- A minor drainage line ("ephemeral drainage line 1" in Figure 1) that rises in the low hills around Pofadderkop to the south west of the site and flows into the site in a roughly north easterly direction. Immediately upstream of the site, the drainage line is impounded by an earth dam, and overflows / seepage from this dam are passed beneath the Glen Thorne southern boundary road, from where they daylight onto the site. Seepage wetlands have developed upstream of the fence, where water probably backs up at times upstream of the culvert. From the road culvert, flows pass along a shallow but nevertheless defined channel, which broadens out in places to form periodically wetted flats. The channel runs thus for some 180m, but effectively ceases at the first ploughed field. From here, runoff dissipates across the field as dispersed surface flow, which finds its way during high flow periods, to the major ephemeral stream / valley bottom wetland described above. GOOGLE imagery for the site illustrates this effect, and the multiple drainage lines visible in aerial photographs have been roughly arrowed in Figure 1. Dissipation of flows in this manner is of value to the downstream system, since it reduces the likelihood of receipt of concentrated flows, that would otherwise promote erosion;

Figure 1 **Preliminary map of the Glen Thorne site, indicating the location of significant watercourses on the site. Proposed development footprint indicated by purple polygon.**

- A minor drainage line / hillslope seep ("ephemeral drainage line 2" in Figure 1) that originates on the footslopes of the rocky outcrop on the southern portion of the site: Surface clays in this area promote shallow surface and subsurface seepage of water downstream, particularly once initial saturation has occurred and the clay soils no longer facilitate infiltration through dry exposed cracks. The zone of shallow clays that give rise to ephemeral wettedness has been roughly mapped in Figure 1 around the base of the rocky outcrop. Auguring of the drainage line revealed wetland conditions (shown by the presence of defined nodules) patchily along the length of the drainage line, which, like drainage line 1, also disperses eventually across the lower, flattened slopes, where surface soils are lower in clays. The drainage line provides a hydrological link with the downstream catchment, while dissipation of flows prevents the effects of erosion from a concentrated runoff source;
- A third drainage line ("ephemeral drainage line 3" in Figure 1) was also mapped as draining off the north eastern slopes of the rocky outcrop. It is a much drier drainage line, and although, like drainage line 2, it includes patches of defined wetland along its route, much of its route is terrestrial and is probably in part the result of preferential flow paths across vehicle access tracks. Nonetheless, it allows dispersed, hydrological connectivity with the major ephemeral tributary connecting these systems with the Modder River.

Implications of Scoping Phase findings for development proposals

The broad descriptions of drainage lines and wetland conditions outlined above, with a focus on the southern portion of the site highlighted for potential development, suggest that any further consideration of the Glen Thorne site for Solar Farm development needs to take cognisance of the following issues:

- Development within 100m of any of the mapped drainage lines would require a Water Use Licence from the Department of Water Affairs;
- The clay soils of much of the development area are problematic, in that they promote rapid surface runoff, and if flows are concentrated through development hardening, these will be more prone to erosion and further concentration of flows;

Any development that takes place in the proposed development envelope would need to ensure that:

  - it did not result in concentrated flows off the site and into the major ephemeral drainage line;
  - it did not result in changes in flow velocities downstream;
  - it maintained both south west to north east (rocky outcrop and Pofadderkop areas to the major ephemeral drainage line / valley bottom wetland) and south-east to north west connectivity, linking these and systems upstream of the R30 with the Modder River and its floodplains;
  - it did not discharge polluted water into downstream areas, or water with a different salinity to natural systems – SOME sources of potential pollution would include any grey water discharges, car park or road runoff, and wash water when solar panels are periodically cleaned;
  - it did not affect areas of recharge that would support wetlands / streams on the site.

Clearly, the above requirements pose considerable challenges to the development team, and need to be considered carefully in future aspects of development planning.

Mitigation measures would need to be developed with a detailed understanding of the proposed structures and their management on site (e.g. washing regimes, spacing), but would be likely to require at least that:

- Water courses and wetland areas are protected by adequately sized buffer areas, sized and designed according to the actual functional requirements of the buffers, including maintenance of ecological connectivity through what would become an increasingly (ecologically) sterile site – the specific habitat requirements of key fauna would need to be considered in this regard;
- Water flows off the site are managed so as to allow dissipation and filtration upstream of natural water courses, and the major ephemeral drainage line and Modder River itself in particular;
- The alignment and design of all infrastructure, including roads, pylons and pipes, should take cognisance of natural drainage lines, and be designed such that they do not result in erosion as a result of concentration of flows, bypassing of natural, dependent downstream water courses and /or shrinkage of downstream watercourses or wetlands as a result of narrowing of channels and flow corridors;
- Water quality impacts are effectively mitigated.

Plan of Study (Methods) for EIA

The following plan of study / terms of reference will inform additional input into the freshwater ecosystems EIA for this site:

- Carry out fieldwork to locate and describe the freshwater features in the study area, with a key focus on the impact footprint for the site;
- Generate a map showing the sites in relation to any Critical Biodiversity Areas and links to ecological corridors and support areas;
- Provide a description of the current state of the wetland on site, supported by relevant photographs;
- Identify and describe the conservation value and conservation planning frameworks relevant to this site;
- Describe the areas where ecosystem conditions have been transformed;
- Determine recommended management actions to address potential impacts;
- Consider the risks of increased run-off from the solar panels and washing regimes;
- Assist in the applications for a Water Use Licence if required;
- Provide a detailed sensitivity map of the site, including mapping of disturbance and transformation on site with respect to wetland ecosystems;
- Provide monitoring requirements as input into the construction and operational phase Environmental Management Plan (EMP), as well as generic rehabilitation guidelines.

In addition to the triggering an Environmental Impact Assessment Process, the proposed development would also be likely to trigger other legislation, from a freshwater ecosystems perspective. In particular, General and/or Special Authorisations may be required from the National Department of Water Affairs (DWA) if any activity of the proposed project entails:

- Abstraction of water from a water resource;
- Interruptions to the natural passage of water along a water course; and

- Development within 500 m of a wetland.

Initial feedback from the Department of Water Affairs: Free State has however indicated that a setback or buffer of 100 m horizontal distance from watercourses will be sufficient not to trigger the requirement for a Water Use Licence.

The freshwater specialist would, during the course of the EIA for this project, also be tasked with liaison with DWA to determine whether a WULA is applicable, and with the submission of such an application if necessary.

DRAFT PLAN FOR EMP: GLEN THORNE BA REPORT

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
Pre-construction activities	Potential disturbance and damage to freshwater features/ecosystems	High (Negative)	• Water courses and wetland areas should be protected by adequately sized buffer areas, sized and designed according to the actual functional requirements of the buffers, including maintenance of ecological connectivity through what would become an increasingly (ecologically) sterile site – the specific habitat requirements of key fauna would need to be considered in this regard. • It is recommended that hardened surfaces should be setback by at least 50m from all drainage lines / flow dissipation pathways • The alignment and design of all infrastructure, including roads, pylons and pipes, should take cognisance of natural drainage lines, and be designed such that they do not result in erosion as a	Low (Negative)	Restricted to the Planning and Design phase of the activity

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
			result of concentration of flows, bypassing of natural, dependent downstream water courses and /or shrinkage of downstream watercourses or wetlands as a result of narrowing of channels and flow corridors. It is recommended that a system of shallow depressions should be created within the developed portion of the site – that is, in the area across which the solar panels extend – and that these be used as part of the stormwater attenuation system. • The site design should allow for the retention or re-establishment of appropriate indigenous vegetation beneath the panels, as this will further reduce runoff rates • A detailed stormwater management system must be developed, that clearly indicates		

DRAFT PLAN FOR EMP: GLEN THORNE BA REPORT

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
			how attenuation of stormwater volumes and velocities is to be achieved upstream of existing water courses – these include the braided ephemeral streams mapped in the freshwater ecosystems report, which currently dissipate across disturbed agricultural areas		
Construction phase	• Disturbance of sensitive drainage lines, resulting in increased vulnerability to erosion • Contamination of downstream water bodies as a result of receipt of contaminated water from construction activities (e.g. runoff containing oils, sediments, cement)	Medium	• All ephemeral drainage lines (including the braided flow paths marked in the freshwater report) should be demarcated as no-go areas during construction; they should be marked with temporary fencing, located 50m from the edge of the drainage line • Construction design should seek to minimise disturbance of natural ground levels and to maintain, as far as possible, existing ground cover by	Low	Inspect weekly during construction

DRAFT PLAN FOR EMP: GLEN THORNE BA REPORT

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
			vegetation • Temporary sediment collection ponds should be created between the construction zone and the demarcated ephemeral drainage lines, in which runoff from the disturbed site can collect before passing into the downstream catchment after • measures to dissipate the velocities of runoff from the site into adjacent water courses should be outlined in detailed Method Statements and implemented on site prior to the start of any activities that will disturb existing surface conditions • No wash water or water that is in any way contaminated by construction or other materials should be passed into natural watercourses – arrangements should be made for the containment and separate disposal		

DRAFT PLAN FOR EMP: GLEN THORNE BA REPORT

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
			of water used for ablutions or cooking during construction I • A construction phase Environmental Management Programme should be compiled and implemented, such that it clearly addresses *inter alia* the above activities, as well as appropriate locations for construction camps, vehicle storage and parking areas, ablution facilities and waste management , such that these do not impact on sensitive or otherwise important terrestrial or wetland areas		
Operation Phase	• discharge of polluted water into downstream areas, or water with a different salinity to natural systems – sources of potential pollution would include any grey water	Medium to high (Negative)	• A stormwater management system must be designed, implemented and maintained so as to ensure that runoff from the site does not result in the passage of concentrated flows into drainage	Medium (Negative)	Annual inspection

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
	discharges, car park or road runoff, and wash water when solar panels are periodically cleaned; • affects on areas of recharge that would support wetlands / streams on the site.		lines, does not result in any bank or bed erosion in these systems, does not necessitate their being lined or otherwise artificially stabilised and does not result in droughting of natural systems through diversion of flows into adjacent water courses • the stormwater management plan should specifically address runoff from areas likely to generate high volumes of water during rainfall events, including car parks, roofs and the solar panels themselves • the use of measures that will contribute to the filtration of potentially contaminated water from car parks or other sources of contamination should be included in the stormwater management system; examples of appropriate measures include gravel filtration beds, vegetated swales (assuming		

DRAFT PLAN FOR EMP: GLEN THORNE BA REPORT

ACTIVITY	POTENTIAL IMPACT	STATUS & SIGNIFICANCE WITHOUT MITIGATION	MITIGATION	STATUS & SIGNIFICANCE WITH MITIGATION	MONITORING FREQUENCY
			that vegetation will be sustained, given the dry climate of the area) • wash water from the panels should be directed through settlement / filtration areas upstream of its passage into any watercourse, or ideally filtered, stored and recycled for subsequent washing activities • septic tanks should not be used for the management of sewage on site, given the close proximity of drainage lines and shallow subsurface systems directly into water courses		

Appendix D.3 Built Heritage and Archaeology Impact Assessment Report

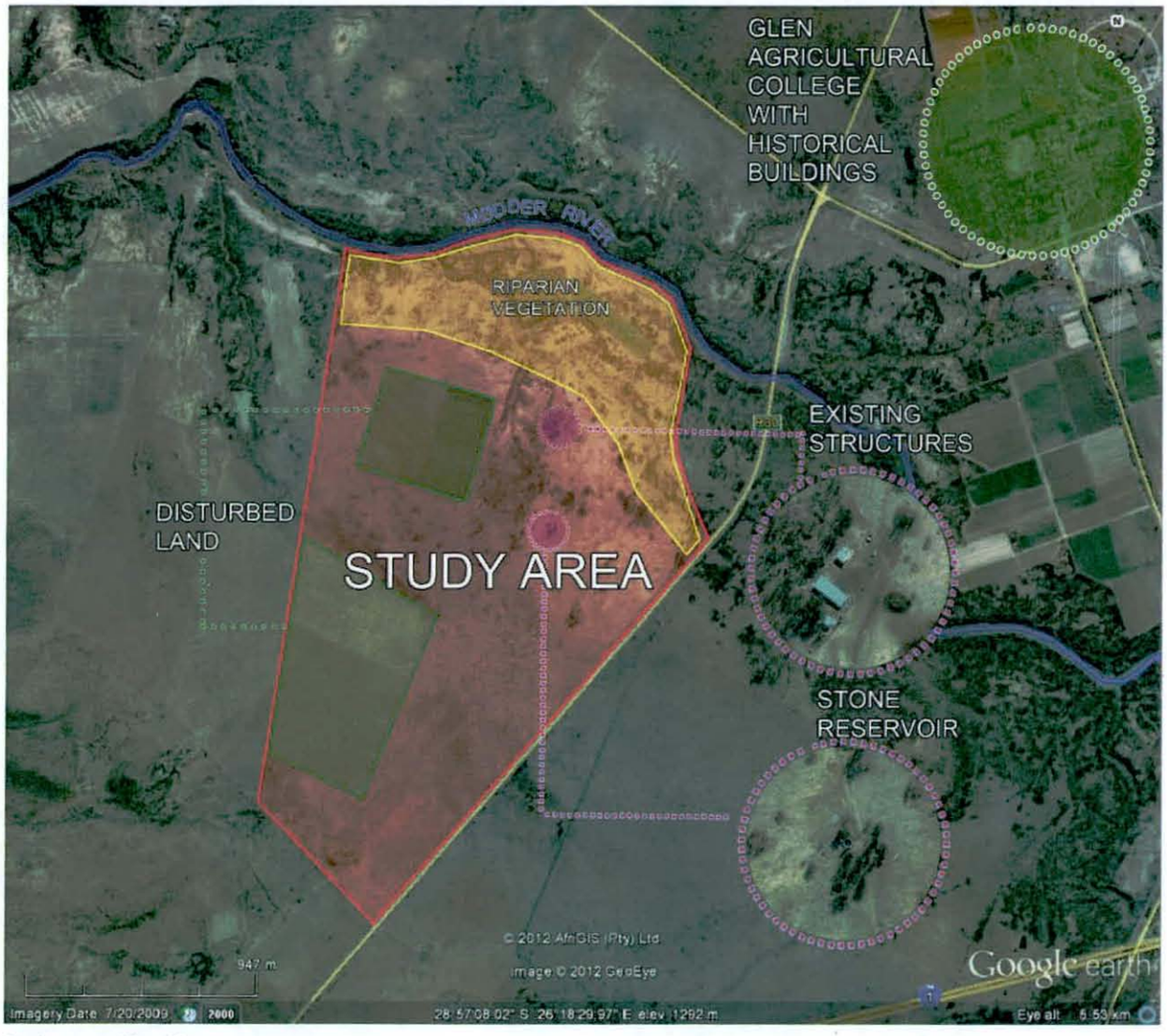
PDF file attached.

D3_Built Heritage and Archaeology Impact Assessment Report

BUILT HERITAGE IMPACT ASSESSMENT FOR THE CONSTRUCTION OF A PHOTOVOLTAIC POWER PLANT ON THE FARM GLEN THORNE, NEAR BLOEMFONTEIN

Draft scoping report 13 february 2012 ROODT

AERIAL VIEW OF SITE



Study area - Glen Thorne

INTRODUCTION

Glen Thorne, the proposed site for a photovoltaic power plant is situated on the R30, approximately 5km to the north of Bloemfontein. This is a very scenic part of the Free State and the area is known for its agricultural activities. The site is also very close to the Glen Agricultural College that has a history in the training of young farmers that dates to 1919 when the agricultural college was opened.

What makes the area attractive is the Modder River that meanders through the landscape, and which also forms the northern border of the Glen Thorne study area. The riparian vegetation is very lush and attractive. The farmer has also indicated that he does not wish to encroach on the trees in this area.

Riparian vegetation close to the Modder River.

View across the site to the south.

HERITAGE CONTEXT

Historically, the area north of Bloemfontein is known for military activities that took place here during the South African War (1900 – 1902). Evidence of fortifications can be found on the hills around Bloemfontein and it is known that military activities occurred in the Glen area (but not actual engagement between the parties).

No evidence of war activities were, however, found at the study area.

There are a number of labourer's houses and a small round water reservoir constructed with stone at the study area. These are, however, not of any particular heritage value, and are also located within the riparian trees, and would therefore not be under any threat.

The most probable area to be utilized for the power plant would be the disturbed land that can clearly be seen on aerial photographs as well as per site visit.

It is remotely possible that further studies might reveal evidence of historically important activities, but these are not evident at present.

Stone reservoir.

HERITAGE CONTEXT continued...

The most important impact that this development will have will probably be visually, as the development will clearly be visible from the R30. Screening the development from the road will mitigate the impact. This will be important as the landscape has historically been associated with the splendid views of the landscape around the river, and the agricultural activities that are intensely pursued in this area for a 100 years or more.

Should further studies be required, these could readily be undertaken.

The developer is also further obliged to inform the Provincial Heritage Resources Authority of the Free State in writing of the intended development as is required according to Section 38 of the National Heritage Resources Act, No 25 of 1999 (National Heritage Resources Act 1999: 62 – 63). Should the Provincial Heritage Resources Authority deem it necessary, they could require an impact assessment report that has to contain specific information as set out in the relevant clause of the Act. In our opinion, however, this will not be necessary in this instance.

Should such an impact assessment, however, be required, the authors would be willing to assist in preparing and submitting the necessary information and/or applications.

The site is visually exposed to the R30 on left.

Agricultural activity close to the river.

ANTON ROODT
ARCHITECT AND URBAN PLANNER

REFERENCES

- Republic of South Africa. 1999. National Heritage Resources Authority of 25 of 1999. Vol 406, 28 April, No 19974. Government Gazette, Cape Town.
- Roodt, A.J. 2008. Glen Agricultural College – A Short History of the Main Building. Unpublished report, Bloemfontein.
- Schoeman, K. 1980. Bloemfontein: Die Onstaan van `n Stad 1846 – 1946. Human & Rousseau, Cape Town

COBUS DREYER
Pr. Archaeologist/Heritage Specialist

P.O. Box 12910
BRANDHOF 9324
Bloemfontein
dreyerj@telkomsa.net

Tel: 051-444 1187
Fax: 051-444 4395
Cell: 083 357 7982

10 FEBRUARY 2012

FIRST PHASE ARCHAEOLOGICAL & HERITAGE INVESTIGATION OF THE PROPOSED PV SOLAR INSTALLATION ON GLEN THORNE 2163, BLOEMFONTEIN

EXECUTIVE SUMMARY

A PV Solar insstallation is planned on the farm Glen Thorne 2163, Bloemfontein. The farm is located along the R30 main road to Brandfort.

The land is located on a flood plain along the Modder River which consists of black clay soil. Part of the proposed area contains cultivated grazing fields.

No objects of cultural, historical or archaeolical significance was found during the present survey.

I recommend that further planning and development of the PV solar plant may continue.

INTRODUCTION & DESCRIPTION

Scope and Limitations

The Archaeological and Heritage Impact Assessment forms part of the Environmental Impact Assessment (EIA) undertaken by the CSIR on behalf of the applicant, who is planning to construct a 75MW Solar Energy Plant on about 130ha of the property.

The investigation provided an opportunity to examine the site proposed for the PV Solar installations. Part of the area consists of cultivated land while the rest

contains a short grass cover with scatters of Acacia trees and thorny shrubs. No limitations were experienced during site visit.

Methodology

Standard archaeological survey and recording methods were applied.

1. The proposed land was inspected on foot.
2. GPS points were taken and the surroundings and features were recorded on camera.

INVESTIGATION

The site proposed for the PV Solar installation on the farm Glen Thorne 2163, north of Bloemfontein, was inspected on 6 February 2012. Anton Roodt from the Roodt Partnership, Bloemfontein, took me to the site. At the farm we were directed by the farm manager.

The CSIR has instigated the establishment of a number of solar farms to supplement the supply of electricity to the national power network. Solar power is considered a desirable energy producer without any adverse bi-products. The harnessing solar energy is relatively innocuous, compared to fossil fuel power production. It is also considred that most existing land use practices may continue with little interruption.

Photo voltaic (PV) cells will be mounted on frames placed above ground level. Rows of panels will be placed about 10m apart to allow for access during operation and maintenance. It is anticipated that minor surface related earthworks may have to be undertaken to accommodate the structures. The planning of the plant will provide for offices, store rooms and ablution and security facilities. The installation will further include fencing of the site, provision of a vehicle parking area, temporary construction camp and permanent accommodation.

The Iron Age archaeology of the Free State had been described by Maggs (1976) and was summarised by Dreyer (1996). Iron Age stone-walled sites are normally restricted to higher ground or hilly parts and are not found in the low-lying open areas around Bloemfontein.

Stone Age lithic material is not likely to occur on the clay soils on the floodplain along the Modder River.

From a series of Environmental Impact Assessments (EIA) previously done in this region, we have learnt that the northern and north-eastern outskirts of

Bloemfontein, from the Tempe Military Base and the environs of the old Karee Railway Station and the Glen Agricultural College is characterised by remnants of Anglo-Boer War activities. Fired cartridge shells and metal food containers displaying heavily soldered seams, are some of the most common finds.

The area was examined for possible archaeological and historical material and to establish the potential impact on any cultural material that might be found. The Heritage Impact Assessment (HIA) is done in terms of the National Heritage Resources Act (NHRA), (25 of 1999) and under the Environmental Conservation Act, (73 of 1989).

The study aims to locate and evaluate the significance of cultural heritage sites, archaeological material, manmade structures older than 60 years, and sites associated with oral histories and graves that might be affected by the proposed developments. The study likewise aims to assess the potential impact on archaeological and historical material and to recommend specific mitigation measures to avoid the risk of any damage or destruction of the finds during the construction and operation of the proposed developments.

LOCALITY

The proposed site is located on the Remainder of, and Portion 3 of the farm Glen Thorne 2163, Bloemfontein. The farm is situated about 25km north of Bloemfontein along the R30 to Brandfort and borders on the Modder River (Maps 1&3) (Surveyor-General 1973).

The locality of the proposed development area is indicated on Map 2.

The land on a flood plain along the Modder River contains two areas of cultivated fields, while the remainder has a short grass cover with scatters of Acacia trees and thorny shrubs. (Figs.4&8).

The area consists of a deep deposit of sterile black clay soil.

The following GPS coordinates (Cape scale) were taken (2826CD).

A	28°57'56"S 026°17'52"E Altitude 1305m (Figs.1&2).
B	28°57'20"S 026°18'08"E Altitude 1274m (Figs.3&4).
C	28°56'32"S 026°18'28"E Altitude 1287m (Figs.5).
D	28°57'14"S 026°18'45"E Altitude 1235m (Figs.6&7).

RESULTS

FINDS

The possibility of Anglo-Boer War relics are ruled out on the flood plain along the Modder River.

No other cultural and historical material or graves were found during the investigation, nor were there any stone tool material visible.

ASSESSMENT OF IMPACT

Part of the site has already been disturbed by farming activities (Figs.).

Nothing of cultural, historical or archaeolical significance was found during the present survey.

RECOMMENDATIONS

It is clear that there will be no impact on the archaeological or historical heritage of the area.

I recommend that the planning of the proposed the PV Solar installation on the farm Glen Thorne 2163, outside Bloemfontein, may proceed.

MITIGATION

No mitigation measures will be needed in this area of development.

ACKNOWLEDGEMENTS

I thank Anton Roodt from the Roodt Partnership, Bloemfontein, for taking me to the site.

SELECT BIBLIOGRAPHY:

- DEACON, J. 1992. Archaeology for Planners, Developers and Local Authorities. Cape Town: National Monuments Council.

- DREYER, J. 1996. Introduction to Free State Iron Age Archaeology. In: Guide to archaeological sites in the Free State and Lesotho. Southern African Association of Archaeologists (SA3), 14th Biennial Conference, Bloemfontein, Post-conference tour 5-8 July 1996. Bloemfontein: National Museum.

- DREYER, C. 2007. First phase archaeological and cultural heritage investigation of the proposed residential developments on the Annex of Wildealskloof 2607, Bloemfontein. AIA Report for MDA Environmental Consultants, Bloemfontein.

- DREYER, J. 2009. First phase archaeological and historical investigation of the proposed poultry facilities on Portions 2 & 3 Wildealskloof 1205, Bloemfontein. EIA Report for MDA Environmental Consultants, Bloemfontein.

- HUMPHREYS, A.J.B. 1986. Searching for the past. Cape Town: David Philip.

- JANSEN VAN VUUREN, D. 20 January 2012. Visual Impact Assessment for the Construction of a Photovoltaic Power Plant near Bloemfontein, Free State. MetroGIS submitted to CSIR.

- LE ROUX, P. A. L. 2012. Report on a soil survey as part of an Environmental Impact Assessment of the development of a Solar Farm on the soils of Glen Thorne Solar Farm Bloemfontein. Done for the CSIR. Department of Soil Sciences, University of the Free State, Bloemfontein.

- MAGGS, T.M. 1976. Iron Age Communities of the Southern Highveld. Pietermaritzburg: Natal Museum.

- PAKENHAM, T. 1997. The Boer War. Johannesburg: Jonathan Ball.

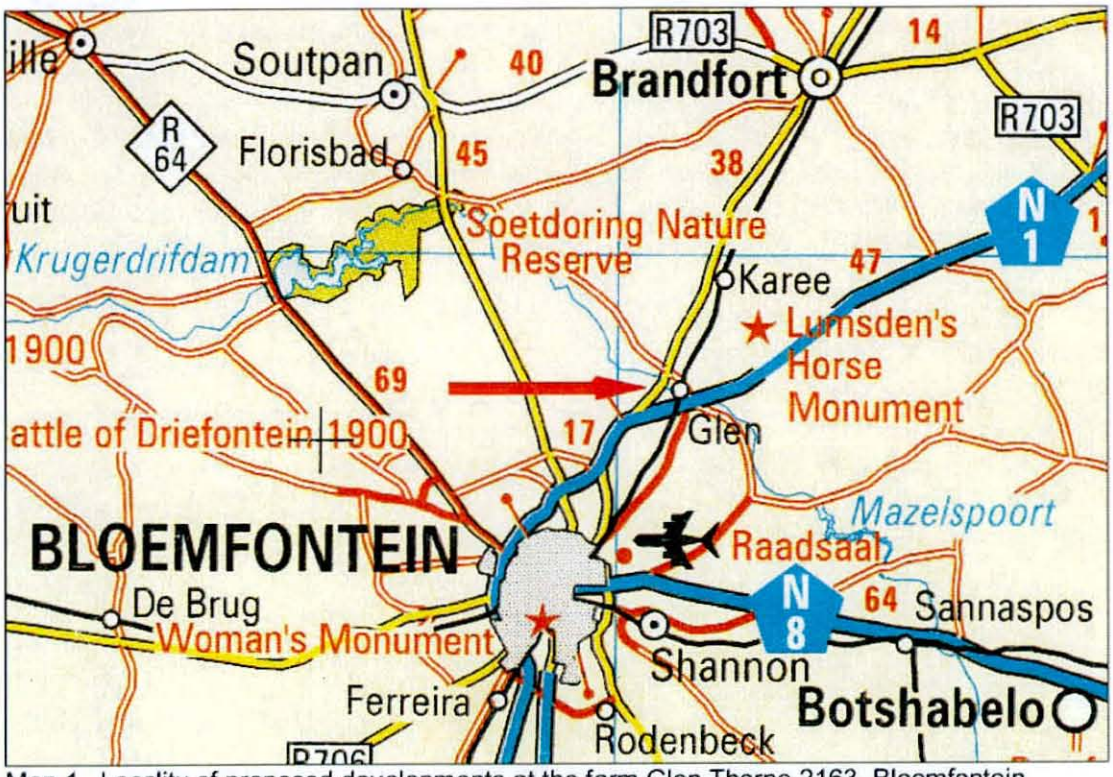
- PISTORIUS, J.C.C. 1994. Eskom Archaeological Site Identification Guide. Johannesburg: Eskom.

- SCHOEMAN, K. 1980. Bloemfontein – die ontstaan van 'n stad. Kaapstad: Human & Rousseau.

- SURVEYOR-GENERAL O.F.S. 1973. Index of Orange Free State Farms. Bloemfontein.

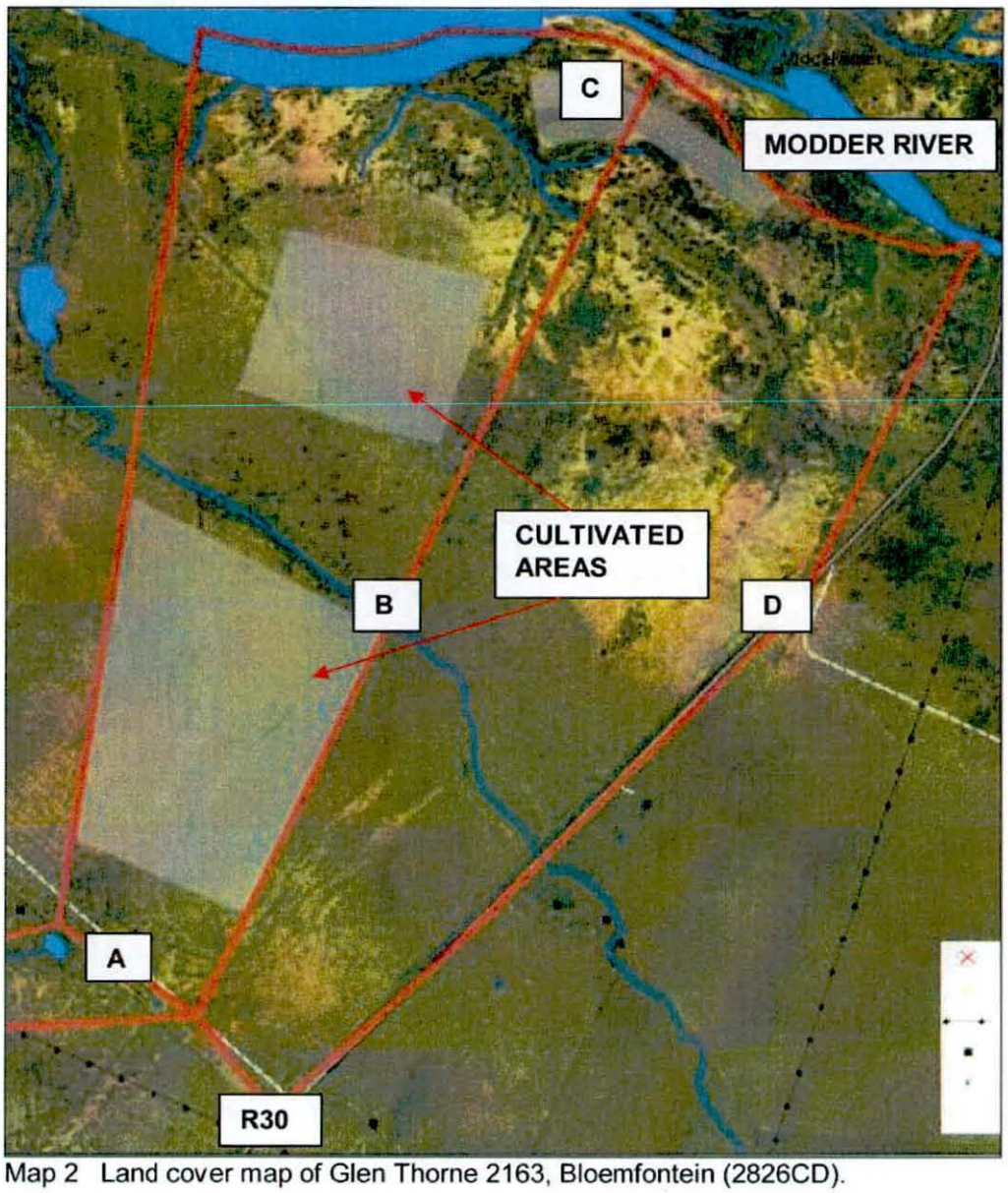
- TODD, S. & SKOWNO, A. 2012. Draft scoping report: Biodiversity& Ecology: Glen Thorpe PV site, Free State. EcoSol GIS.Port Elizabeth.

LIST OF ILLUSTRATIONS

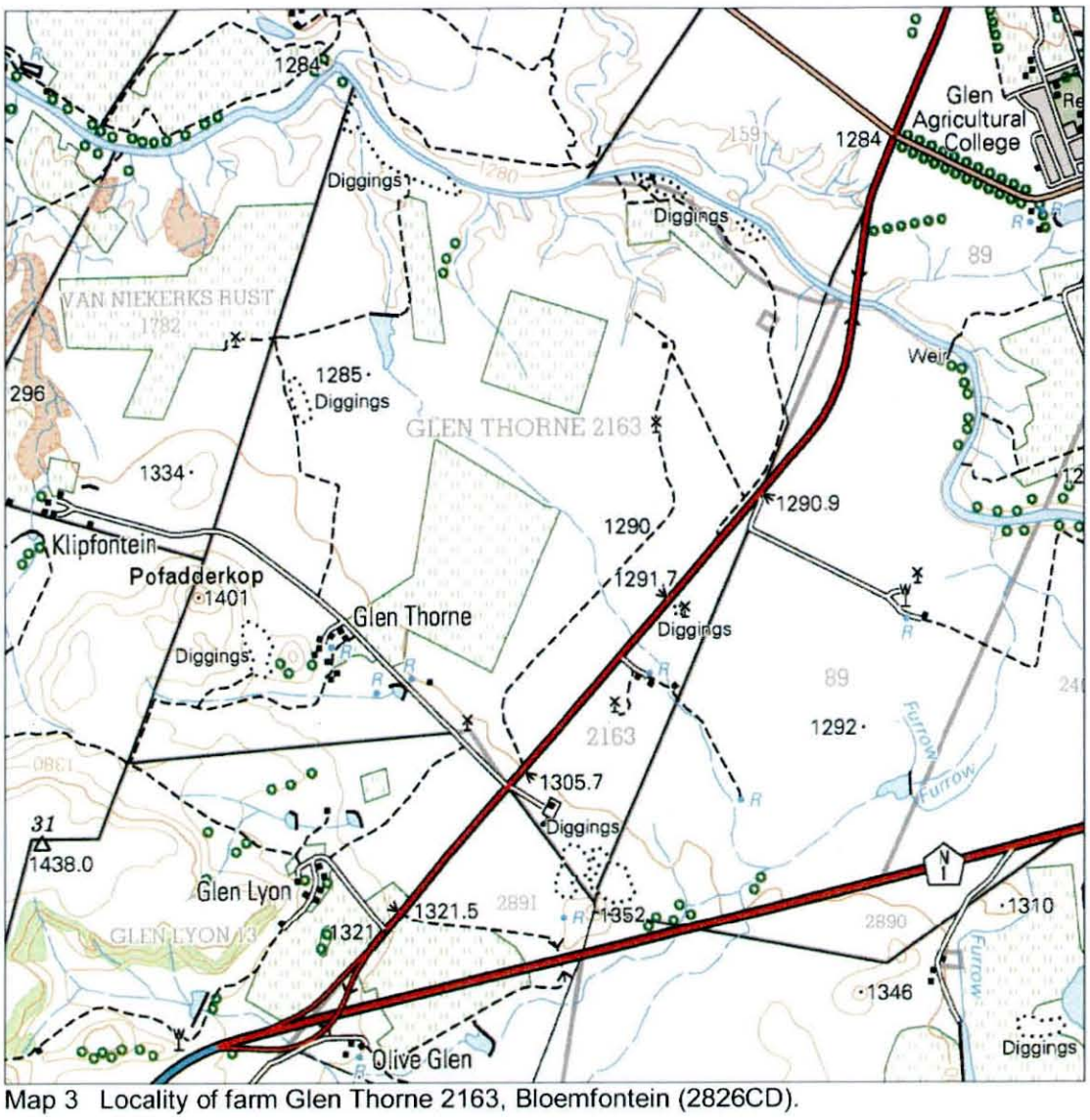


Map 1 Locality of proposed developments at the farm Glen Thorne 2163, Bloemfontein.

Fig.1 Point A at Glen Thorne 2163, Bloemfontein.



Map 2 Land cover map of Glen Thorne 2163, Bloemfontein (2826CD).



Map 3 Locality of farm Glen Thorne 2163, Bloemfontein (2826CD).

Fig.2 Point A at Glen Thorne 2163, Bloemfontein.

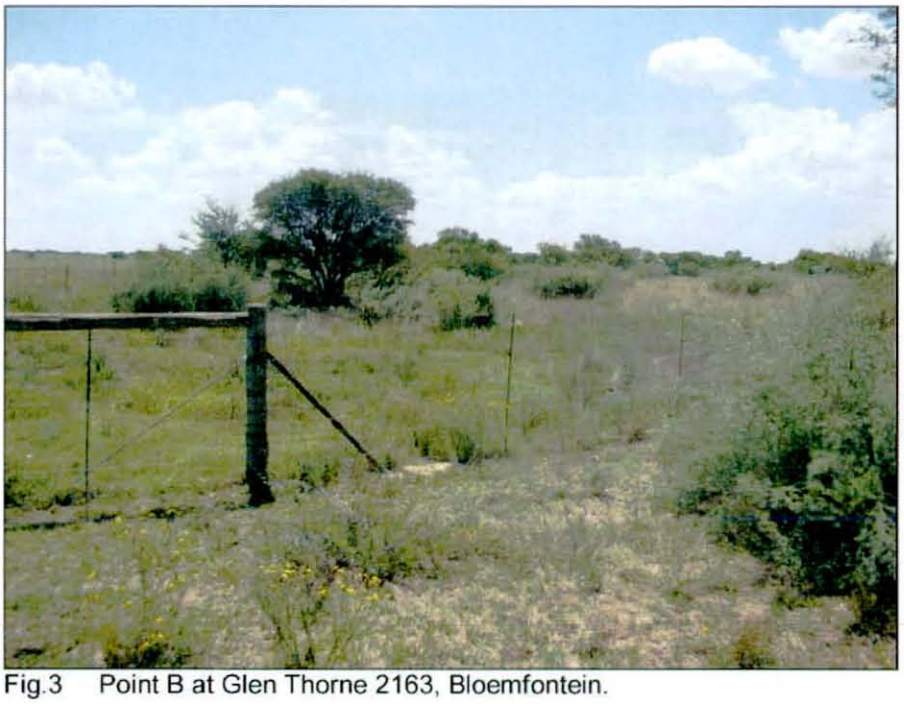


Fig.3 Point B at Glen Thorne 2163, Bloemfontein.

Fig.4 Point B at Glen Thorne 2163, Bloemfontein.

Fig.5 Sand mining from the Modder River at Point C, Glen Thorne 2163, Bloemfontein.

Fig.6 Point D at Glen Thorne 2163, Bloemfontein.

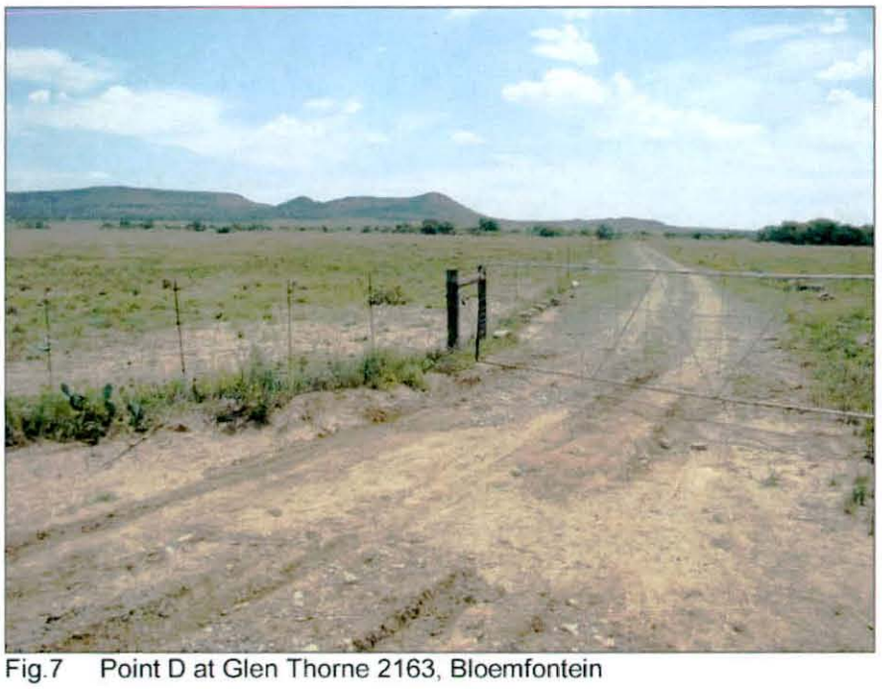


Fig.7 Point D at Glen Thorne 2163, Bloemfontein

Fig.8 Windmill and water reservoir dam near Point B at Glen Thorne 2163, Bloemfontein

Appendix D.4 Soil/Land and Agricultural Potential Impact Assessment Report

PDF file attached.

D4_Soil & Land and Agricultural Potential Impact Assessment Report

Soil Survey Report, part of an Environmental Impact Assessment of the development of a Solar Farm on Glen Thorne, Bloemfontein

Done for the CSIR

February 2012

By Pieter A.L. le Roux
(Pr. Sci. Nat. Soil Scientist)

Dept of Soil, Crop and Climate Sciences
University of the Free State
BLOEMFONTEIN

Executive Summary

The site is situated close to Glen Agricultural Research Station north of Bloemfontein. The soils are rated for agricultural (natural pasture, dryland cash cropping, irrigated pasture and irrigated cash crops) and ecological impact (potential pollution and hydropedology). Current environmental conditions are good. Soils were only slightly transformed by dryland cropping actions and no visible degradation was caused. The slope of the terrain is 1% and current land use is natural veldt used for grazing and dryland cropping.

The impact of solar panels on the land will be insignificant in terms of soil degradation and crazing capacity. Alternative land is Mispah soils at steep midslopes with a possible increased risk of erosion and land close the river with a risk of flooding. Impact is limited to:

a. During the construction phase vehicle movement will compact the soil in some degree depending on the number of passes. It will deteriorate vegetation even when driven over once or twice, demolish vegetation in tracks used frequently and remove vegetation where foundations are made for solar panels.
b. Digging of foundations may disturb the soil system as the subsoil may land on the surface.
c. Solar panels will shade vegetation from direct sunlight and rain.
d. Cleaning of panels with water will enhance localised water application.

The proposed site is deep Arcadia soils which are physically very active and Valsrivier soils which are sensitive for erosion. The Agricultural potential of the soils is limited to grazing and is low. The sustainability of cattle/sheep production at low stocking rates on natural veldt on these soils are high.

Table Rating of impacts

Direct Impacts: *Soil compaction and disturbance, vegetation degradation in construction phase*							
Mitigation	Spatial Extent	Intensity	Duration	Probability	Significance & Status		Confidence
					Without Mitigation	With Mitigation	
Prevention, and restricting the range	Localised on site	Low	Temporary	High	Very low	Very low	High
Indirect Impacts: *Redistribution of sunlight, temperature and rainwater by solar panels*							
Mitigation	Spatial Extent	Intensity	Duration	Probability	Significance & Status		Confidence
					Without Mitigation	With Mitigation	
IRWH	Site	Low	Permanent	High	Low	Positive	High

In spite of reduced growth under the panels due to limited rain, the grazing capacity may be increased by IRWH.

Groundwater recharge potential will be increased by limiting erosion and techniques like IRWH.

Performance of the IRWH structures and process must be evaluated by IRWH experts yearly.

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
NATURAL AND AGRICULTURAL SCIENCES
NATUUR- EN LANDBOUWETENSKAPPE

Glossary of terminology and abbreviations

IRWH Infield Rainwater Harvesting

Table of Contents

1. Introduction

1.1. Locality

The site is situated close to Glen Agricultural Research Station north of Bloemfontein (Figure 1).

1.2. Methodology

The land was surveyed to serve as data to analyse the agro-ecosystem and the natural ecosystem and possible impact of a solar farm on these systems. These data are used to evaluate the quality of the soil and terrain for common land-use, including different agricultural land-use types, as required in the EIA process.

The soils were surveyed using soil test pits distributed across the study area. The distribution of the pits were determined by the anticipated soil distribution pattern using Land Type Data (Land Type Survey Staff, 2004), land surface observations and tacit knowledge. The author is familiar with areas of the site and the soil distribution pattern of the land type. The soils were classified according to the South African soil classification system (Soil Classification Working Group, 1991). Hand auger observations and correlations with vegetation, soil surface features and terrain were used to complete the survey. Interpolation between observations was used to delineate soil bodies.

The soils are rated for agricultural (natural pasture, dryland cash cropping, irrigated pasture and irrigated cash crops) and ecological impact (potential pollution and hydropedology).

1.3. Condition

Current environmental conditions: The soils are currently in good condition with very limited erosion. Erosion is not associated with current land-use. Dryland crops are in a poor condition in spite of the good rains of the previous season. No future changes to the environment that will occur if the activity does not proceed.

1.4. Transformations

Soils were only slightly transformed by dryland cropping actions. No visible degradation was caused.

1.5. Land-use

The slope of the terrain is 1.5% and current land use is natural veldt used for grazing and dryland cropping. Housing for labourers is now built on the southern border of the site. The current status of the land is good with very little erosion, a good cover of natural veldt and remainders of dryland crops. No anthropogenic degradation is visible. Possible land use options for the site are grazing by sheep, cattle and/or goats.

1.6. Impact on current use

The impact of solar panels on the land will be insignificant in terms of soil degradation and crazing capacity.

1.7. Alternative sites

The alternative land is Mispah/Glenrosa soils at steep midslopes with a possible increased risk of erosion and Oakleaf soils on land close the river with a risk of flooding.

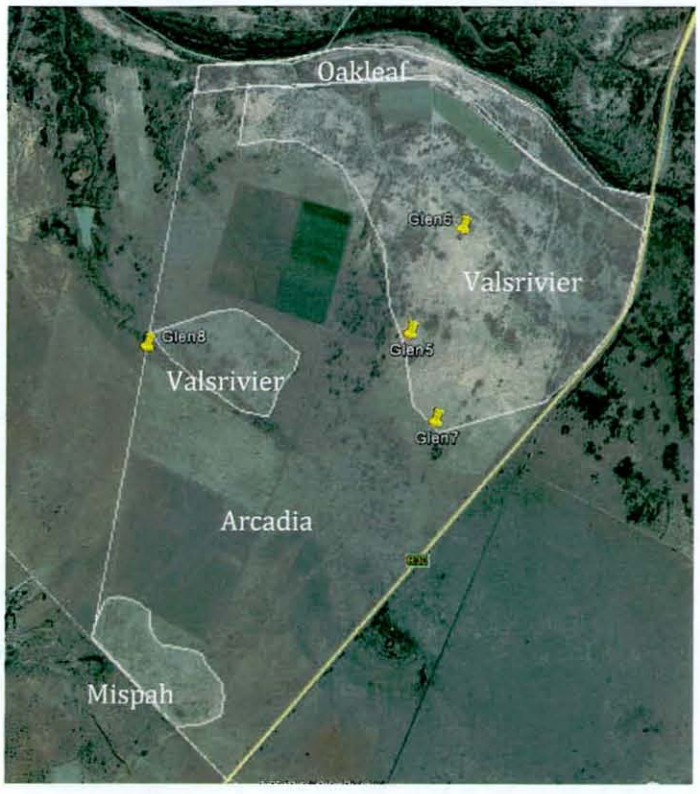


Figure 1 Soil map of Glen-Thorne. Profile pits are indicated as Glen1 to Glen7.

2. Impact on the soil and vegetation cover

2.1. Compaction

During the construction phase vehicle movement will compact the soil in some degree depending on the number of passes. It will deteriorate vegetation even when driven over once or twice, demolish vegetation in tracks used frequently and remove vegetation where foundations are made for solar panels.

2.2. Disturbing soils

Digging of profile pits generates soil material. The Valsrivier soil has erosion sensitive subsoil which when left on the surface may influence erosion sensitivity.

2.3. Shade

Solar panels will shade vegetation from direct sunlight and rain.

2.4. Extra water

Cleaning of panels with water will enhance localised water application.

3. Description

The surveyed area is relative homogeneous with Arcadia and Valsrivier soils dominating the site (Figure 1). Oakleaf soils occur closer to the river and outside the current allocation of the site. Mispah and Glenrosa soils occupy the terrain higher up outside the current site allocation.

3.1 Arcadia soil form

The Arcadia soils are deep (>1,2m) vertic A horizons on saprolite, black in colour (the colour changes down slope to brown) and of clay texture (45 - 55% clay).

3.2 Valsrivier soil form

The Valsrivier soils are very deep (>2m) orthic A/pedocutanic B/unspecified material without signs of wetness horizons; brown A horizon and red-brown B horizon; clayey texture (20 - 30% and 45 - 60% clay in the A and B horizons respectively).

The areas with Oakleaf, Mispah and Glenrosa soil forms are not suitable. Oakleaf soil form is under the 100 year flood line and the Mispah and Glenrosa soil forms in steep midslopes of the hills.

4. Identified issues

Impact of the Solar Farm on the soil and the agricultural ecosystem (potential and sustainability) and natural ecosystem (pollution and hydrology).

3.3 Arcadia soil form

3.1.1 *Behaviour*

They are extremely physically active and shrink when dry and swell when wet. Heave can exceed 100 mm and the movement can lift buried pipes and poles to the surface. With the start of the rainy season the soils are dry and cracked and water infiltration is high bypassing the soil body and potentially recharging the groundwater or downslope soils. After some rain the soil swell and the cracks close. Infiltration rate is slow in the wet state. Arcadias are typically inverting itself and horizonisation is not present and therefore the soils are not sensitive to disturbance. The inherent physical activity of Arcadias automatically revert compaction by heavy vehicle wheels occurring during construction.

3.1.2 *Suitability*

Dryland cropping: The main requirement for dryland cropping is plant available water. Arcadia soils hold large amounts of water not available for cash crops. The dry climate of Bloemfontein does not support dryland cropping on clay soils. The soils are to dry.

Natural veldt: Arcadia soils accommodate a selected composition of vegetation but due to the dry nature the production is lower than on soils with sandy texture that occur in this region.

Irrigation of cash crops: Arcadia soils have a strong structure and high clay content and are not suitable for irrigation according to the guidelines of the Free State Department of Agriculture.

Irrigation of pasture: The high clay content of Arcadia soils impacts on a low infiltration rate and poor distribution of irrigation water. Although it does produce forage supporting cattle farming the production system is extremely management sensitive and other soils are preferred.

Ecosystem: Soils of the Arcadia form are recharge soils. They crack intensely and rain water drain to the saprolite by preference flow potentially recharging the groundwater and alternatively feeding the lower lying interflow soils and the river stream. The soils store large amounts of organic carbon.

3.1.3 *Evaluation*

The Agricultural potential of the soils are low and restricted to grazing. The sustainability of cattle/sheep production on natural veldt on these soils is high.

3.2 Valsrivier soil form

3.2.1 *Behaviour*

They are moderately physically active. The soils are sensitive to erosion. The subsoils are more sensitive to erosion and should preferably not be exposed.

3.2.2 *Suitability*

Dryland cropping: The main limitation for dryland cropping is plant available water. The relative sandy A horizon take water in well. However, Valsrivier soils hold large amounts of water not available for cash crops in the subsoil. The dry climate of Bloemfontein does not support dryland cropping on these soils. The soils are to dry.

Natural veldt: Valsrivier soils accommodate a wide variety of vegetation but due to the dry nature the production is lower than on soils with sandy texture that occur in this region.

Irrigation of cash crops: Arcadia soils have a strong structure and high clay content subsoil and are not suitable for irrigation and is disqualified by the guidelines of the Free State Department of Agriculture.

Irrigation of pasture: The slightly high clay content of Valsrivier soils impacts on a low infiltration rate and poor distribution of irrigation water. Although it does produce forage supporting cattle farming. The production system is extremely management sensitive and is disqualified by the guidelines of the Free State Department of Agriculture.

Ecosystem: Soils of the Valsrivier form have limited recharge ability due to its dry nature. They crack slightly and part of the rain water may drain to the saprolite by preference flow potentially recharging the groundwater and alternatively feeding the lower lying interflow soils and the river stream.

3.2.3 *Evaluation*

The Agricultural potential of the soils are low (restricted to grazing) and the sustainability of cattle/sheep production on natural veldt on these soils are high.

5. Permit requirements

None

6. Assessment of impacts and identification of management actions

Potentially impacts are soil compaction, soil disturbance and vegetation growth reduction in the construction phase and vegetative growth affected by reduced direct sunlight, lower temperature and localised water accumulation in the operational phase.

Table 1: Rating of impacts

Direct Impacts: *Soil compaction and disturbance, vegetation degradation in construction phase*							
Mitigation	Spatial Extent	Intensity	Duration	Probability	Significance & Status		Confidence
					Without Mitigation	With Mitigation	
Prevention, and restricting range	Localised on site	Low	Temporary	High	Very low	Very low	High
Indirect Impacts: *Redistribution of sunlight, temperature and rainwater by solar panels*							
Mitigation	Spatial Extent	Intensity	Duration	Probability	Significance & Status		Confidence
					Without Mitigation	With Mitigation	
IRWH	Site	Low	Permanent	High	Low	Positive	High

6.1. Soil compaction, disturbance of soil and harm to the vegetation:

Local, direct impacts of low intensity, temporary duration and very low significance are predicted with a high level of confidence.

6.1.1. Management actions:

During construction vehicles will probably be used to transport equipment on site. The traffic will degrade vegetation. If the soil is wet during construction the wheels of loaded vehicles will compact the soil enhancing erosion and veldt degradation.

Soils excavated for foundations should be used to construct IRWH structures. Valsrivier soils should be placed in the same sequence namely subsoils first and topsoils on the surface.

6.1.2. Mitigation measures

Traffic should be prevented on wet soil, a condition expected more during rainy season.

6.1.3. Positive impacts

None

6.1.4. Monitoring mitigation program

Prevention is important as vehicles will get stuck in the Arcadia soils when wet. Damage will be localised.

6.2. Redistribution of sunlight, temperature and rainwater:

Local, indirect impacts of low intensity, permanent duration, and definite but low significance, slightly negative and potentially positive status are predicted with high confidence.

The solar panels reduce the direct sunlight and rain on vegetation. Direct sunlight can reach shaded areas during early morning and late afternoon. Indirect sunlight will play a role radiating on vegetation. The reduction in direct sunlight has two effects. Firstly it potentially reduces photosynthesis and vegetative growth. Secondly it reduces the temperature of the shaded area. Dry semi-arid regions of South Africa have excessive sunlight and reduction of midday heat may contribute more to vegetative production than what is lost by shading.

Rain water will be redistributed by the solar panels. The water falling on the panels will be accumulated in a line at the bottom of the panels. Arcadia soils are not sensitive for erosion as they crack and take water in at a high rate.

6.2.1. Management actions

Erosion must be limited. To limit erosion the runoff must be stopped. Water falling from the panels must be retained and infiltration in the retention area must be increased. Runoff can be limited by small horizontal ridges with basins and infiltration can be enhanced significantly by mulching.

6.2.2. Mitigation measures

The accumulation of rain water of a runoff area on a small area is the basic principle of Infield Rain-Water Harvesting (IRWH) developed at Glen Agricultural Research Station. Soil removed from the foundation pits of the panels can be used to build a small horizontal ridge and basins can be made next to the ridge by hand. The water accumulating in the ridges will boost vegetative growth in and around the basins.

6.2.3. Positive impacts

In spite of reduced growth under the panels due to limited rain, the grazing capacity may be increased by IRWH.

Groundwater recharge potential will be increased by limiting erosion and techniques like IRWH.

6.2.4. Monitoring mitigation program

Performance of the IRWH structures and process must be evaluated by IRWH experts yearly.

7. References

Land Type Survey Staff, 1976-2006. Land type Survey Database. ARC-ISCW, Pretoria.

Soil Classification Working Group, 1991. Soil classification, a taxonomic system for South Africa. Memoirs for the Natural Agricultural Resources of South Africa no. 15. Dept. of Agricultural Development, Pretoria.

8. Appendix: Inventory of Land Type Dc13

LAND TYPE / *LANDTIP* ..... : **Dc13**
CLIMATE ZONE *KLIMAATSONE* ..... : 445
Area / *Oppervlakte* ..... : 90270 ha
Estimated area unavailable for agriculture
Beraamde oppervlakte onbeskikbaar vir landbou : 1590 ha

Occurrence (maps) and areas *Voorkoms (kaarte) en oppervlakte* :
2824 Kimberley (12030 ha) 2826 Winburg (30780 ha)
2924 Koffiefontein (27980 ha) 2926 Bloemfontein (19460 ha)

Inventory by *Inventaris deur* :
J F Eloff & A T P Bennie
Model Profiles *Modale profiele* :
P251 P464 P467 P468 P469

Terrain unit *Terreineenheid*	1	3	4	5
% of land type% *van landtipe*	1	5	59	35
Area *Oppervlakte (ha)*	903	4514	53259	31594
Slope / *Helling (%)*	1 - 2	8 - 25	0 - 1	0 - 1
Slope length *Hellingslengte (m)*	50 - 200	100 - 300	600 - 1200	200 - 600
Slope shape *Hellingsvorm*	Y	Z-X	Z	Z-X
MB0, MB1 (ha)	0	2257	53259	26835
MB2 - MB4 (ha)	903	2257	0	4739

Soil series or land classes *Grondseries of landklasse*	**Depth** *Diepte* (mm)	MB	ha	%	ha	%	ha	%	ha	%	**Total** *Totaal* ha	%	**Clay content %** *Klei-inhoud %* A	E	B21	Hor	**Texture** *Tekstuur* Class / *Klas*	**Depth limiting material** *Diepte-beperkende material*
Soil-rock complex																		
Grond-rotskompleks:																		
Rock/Rots		4	722	80	1354	30					2076	2.3						
Millwood Mw11, Glengarr Bo31.																		
Glendale Sd21	100-250	3	90	10	451	10					542	0.6	25-45		35-55	A	fSaCILm-SaCl	R
Mispah Ms10, Sherrocks Hu36.																		
Williamson Gs16	100-250	3	90	10	451	10					542	0.6	8-20		15-30	A	LmfSa-SaLm	R
Lindley Ve41, Shepperdrale Va42	>1200	0					30358	37			30358	33.6	20-30		45-60	B	fSaCl-Cl	
Limpopo Os46, Mutale Os47	400-1200	0							12638	40	12638	14.0	15-30		30-50	B	fSaCILm-SaCl	R
Benheim Bo41, Glengarr Bo31	300-450	0					7989	15			7989	8.9	35-45		40-55	A	fSaCl	vp
Gelykvlakte Ar20	300-900	0					5326	10	632	2	5958	6.6	45-55			A	fSaCl-Cl	R
Dundee Du10	>1200	0							5687	18	5687	6.3	30-45			A	fSaCILm-SaCl	
Dundee Du10	>1200	0							4739	15	4739	5.3	25-25			A	fSaLm-SaCILm	
Lakfontein Gs26.																		
Williamson Gs16, Swartland Sw31.																		
Shilolokwa Sw21	100-300	0			1806	40	2663	5			4468	5.0	18-28		35-45	A	fSaLm-SaCILm	R,vp
Milkwood Mw11, Greythorns Mw21	300-600	0					4261	8			4261	4.7	45-55			A	fSaCl-Cl	R
Dundee Du10	>1200	0							3159	10	3159	3.5	10-15			A	LmfSa	
Glendale Sd21, Sherrocks Hu36	300-600	0			226	5	1598	3			1823	2.0	15-25		25-40	B	fSaCILm-SaCl	R

Appendix D.5 Visual Impact Assessment Report

PDF file attached.

D5_Visual Impact Assessment Report

Visual Impact Assessment for the Construction of a Photovoltaic Power Plant near Bloemfontein, Free State.

Draft Scoping Report

Submitted to CSIR

20January 2012

CSIR
our future through science

MetroGIS

Visual Impact Assessment for the Construction of a Photovoltaic Power Plant near Bloemfontein, Free State.

Draft Scoping Report

Table of Contents:

Maps:

VISUAL IMPACT ASSESSMENT:
Scoping Report.

1. INTRODUCTION

MetroGIS was appointed by CSIR, to undertake a visual impact assessment (VIA) with regard to the construction of a photovoltaic (PV) power plant approximately 25 km north-east of Bloemfontein in the Mangaung Local Municipality, Free State province. The proposed development area consists of the following farm portions, as indicated on the location map provided by CSIR:

- Portion 3 of the farm Glen Thorne-2163, and
- Remainder of the farm Glen Thorne-2163.

The location and extent of these farm portions are displayed on the map in Figure 1.

The VIA forms part of an Environmental Impact Assessment study (EIA) that is being undertaken by CSIR on behalf of Solairedirect, the applicant, who is proposing to construct a 75MW Solar Energy Facility (SEF) on the above mentioned properties.

The VIA is being undertaken by Dawie Jansen van Vuuren in his capacity as professional GIS science practitioner and VIA specialist. He has been involved in VIA studies since 2006 and has subsequently undertaken numerous VIA studies involving a wide range of developments, including power generation facilities (Solar, Wind, OCGT, CCGT, UCG), transmission lines and substations, all of which relate to energy infrastructure. Mr Jansen van Vuuren has been appointed as an independent consultant to undertake the visual impact assessment for the proposed Solar Energy Facility. Neither he, or MetroGIS will benefit from the outcome of the project decision-making.

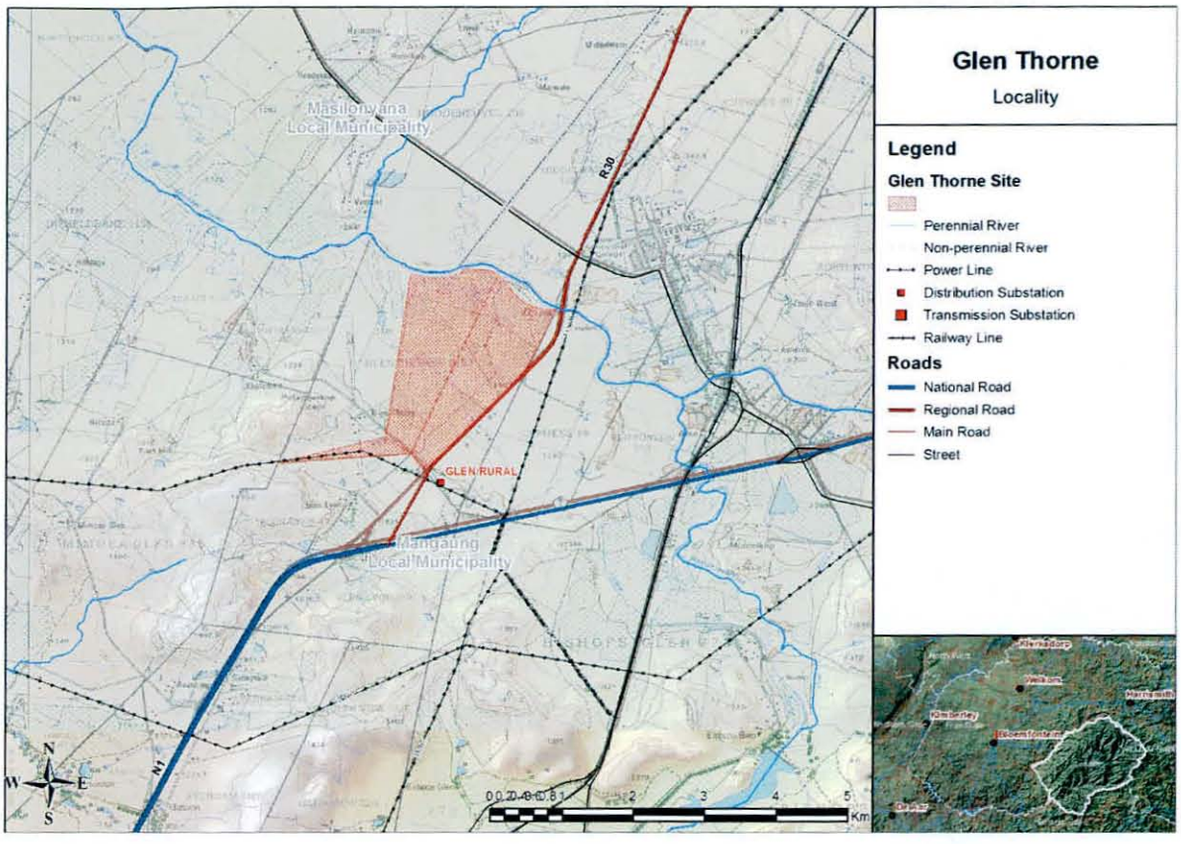


Figure 1: Location of the proposed PV plant development area.

The EIA project is currently in its scoping phase. This document describes issues relating to possible visual impact on a scoping level. In this phase, the type and extent of the proposed development and the character of the receiving environment is analysed, thereby determining the scope of visual impact issues that need to be addressed in the next phase, when a detailed visual impact assessment is undertaken.

2. SCOPE OF WORK

The scope of work for this study as a scoping level visual impact assessment. The purpose is to define the spatial context / sphere of influence of the proposed development in terms of visibility, and to identify possible sensitive viewer locations. The spatial context of the study is determined by a visibility analysis, and the proximity of viewer locations to the proposed solar

plant. This is based on existing information as it is collated in a geographic information system (GIS) and interpreted as a desktop study.

For the purpose of this scoping report, the study area has been demarcated as a buffer of approximately 30km from the boundaries of the proposed development area.

3. METHODOLOGY

All objects are visually perceived by virtue of spatial dimensions. Within the visual sense, we as humans obtain clues about reality through size, brightness, colour and texture information. The arrangement of objects on the surface of the earth, and locations given by their neighbourhood relations, are important features of spatial situations which are relevant in all spatial analysis tasks. Thus the spatial domain can be used particularly well to model reality and convey knowledge by means of symbolic representation (as in maps). Based on this theoretical concept, GIS technology is used as a primary tool for visual impact analysis.

The following GIS activities are undertaken:

- **Data Sourcing**. Information with regard to the proposed project and the type of solar technology (in particular the spatial extent of major components) is important to determine visibility and exposure. In this respect spatial data (location and layout) with regard to the PV plant must be provided by the client. In addition, data with regard to the physical environment is extracted for a 30km radius around the site and collated into a dedicated GIS project, providing input for spatial analysis and modelling.
- **Data processing**. In order to conduct spatial analysis, data need to be prepared in the required format. For the purpose of a viewshed analysis, a DTM is generated from existing 20m topographical contours.
- **Spatial Analysis.** A viewshed analysis is undertaken to determine visibility. This is based on the spatial distribution and heights of the SEF infrastructure, being

representative of an extensive development with specific vertical dimensions and footprint.

- **Mapping.** Having processed spatial data, maps have been created to visualise the following environmental attributes:
    - Topography;
    - Land use / Land cover;
    - Vegetation;
    - Visibility.
- **Interpretation.** By interpreting the information depicted by maps, it is possible to Identify sensitive environments or areas upon which the project could have a potential visual impact. Critical areas will be highlighted during this phase, which will be studied in more detail during the next phase.

4. PROJECT DESCRIPTION

A formal layout of the SEF has not yet been finalised, but infrastructure is likely to include the following:

- An array of PV panels that would cover a total surface area of 150ha;
- Underground cabling between the PV panels;
- Invertors;
- A power line that is likely to connect to the existing Glen Thorne substation 300m south of the site;
- An administrative building;
- Internal access roads;
- Security lighting;
- Security fence.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

The project is located in a rural area 25 km north-east of Bloemfontein, within the Mangaun Local Municipality. The proposed development site is located directly south of the Modder river and west of the R30 arterial road.

Development within a relative short radius of 5km from the site shows a mixture of rural settlement, with Glen Agricultural College and small holdings (1.5 km to 3 km east of the site) being prominent in the area. A number of guest houses and a private resort are located in this area.

Bloemfontein, 25 km south-west of the site, is a regional as well as national centre, with a high degree of road and air traffic converging onto the city.

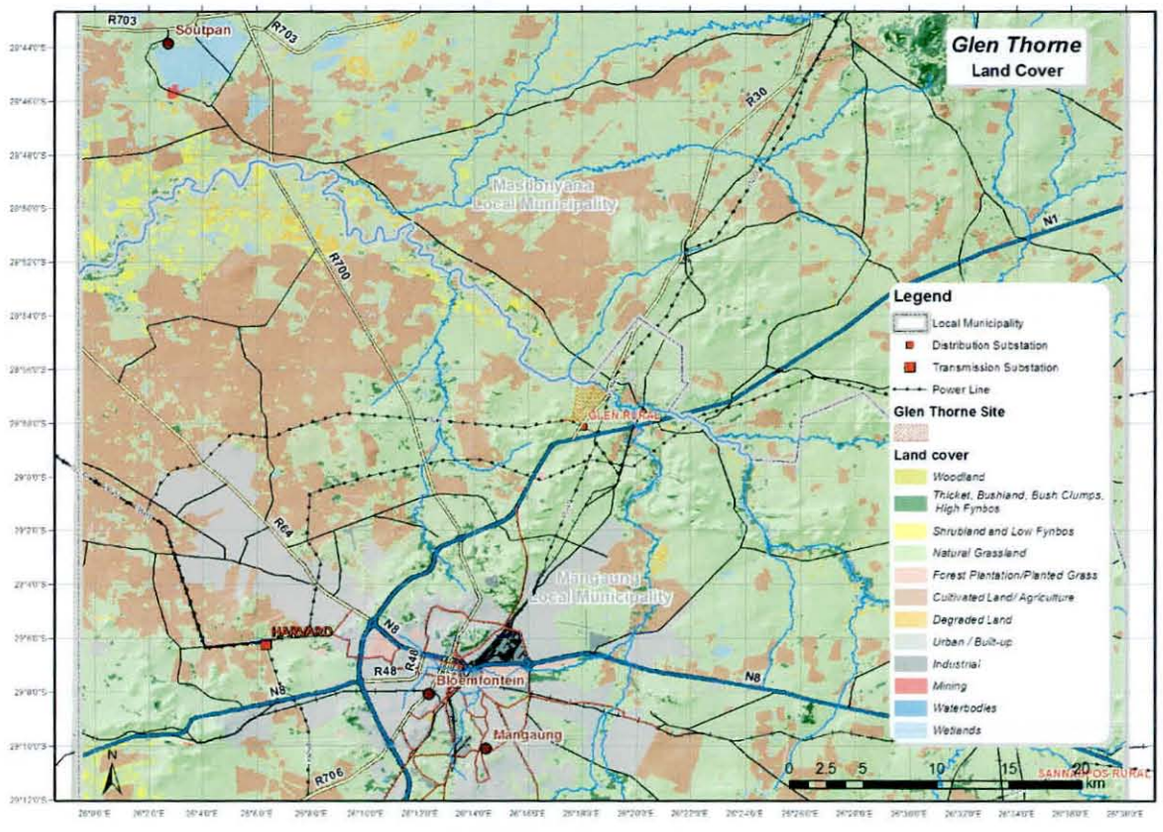


Figure 2: Land use / Land cover around the proposed site.

Infrastructure in the study area consist of a network of roads, powerlines, substations, a railway line, and communication towers on high koppies. The N1 national road between Bloemfontein and Winburg runs 1.5 south of the site. The R30 arterial road north towards Brandfort has recently been upgraded to a toll road, and carries large volumes of traffic. The Glen Substation is located about 300m south of the development site.

Visual resources originate from the natural environment, as it is shaped by topographical features and vegetation cover (refer to the photograph in Figure 3). The topography presents an undulating character, sloping gently towards the Modder river. Prominent koppies and ridges are located south of the development site. The banks of the Modder river are densely vegetated with bush and trees, shielding it from far distance views. The combination of woodland and high ridges forms a unique landscape with a coherent visual character, providing aesthetically pleasing views in places. These could be further enhanced with views of the river, where it forms part of the scene.

The location of trees and bush clumps, as well as existing infrastructure such as roads and transmission lines, may provide some visual absorption capacity to mitigate the visual impact of the SEF. This will be further analysed during the EIA phase of the project.

Figure 3: Topography and natural environment around the proposed development site.

6. VISIBILITY AND VISUAL EXPOSURE

Visibility is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words "how much" of it can be seen. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total. Visibility can be modelled by making use of a digital terrain model (DTM), and applying a viewshed analysis using GIS software. The map in Figure 4 shows the result of a preliminary viewshed analysis for the PV panels, at a height of 4.5m above ground level. For the purpose of the viewshed analysis, the array of panels have been provisionally placed in a more or less 150 ha footprint area.

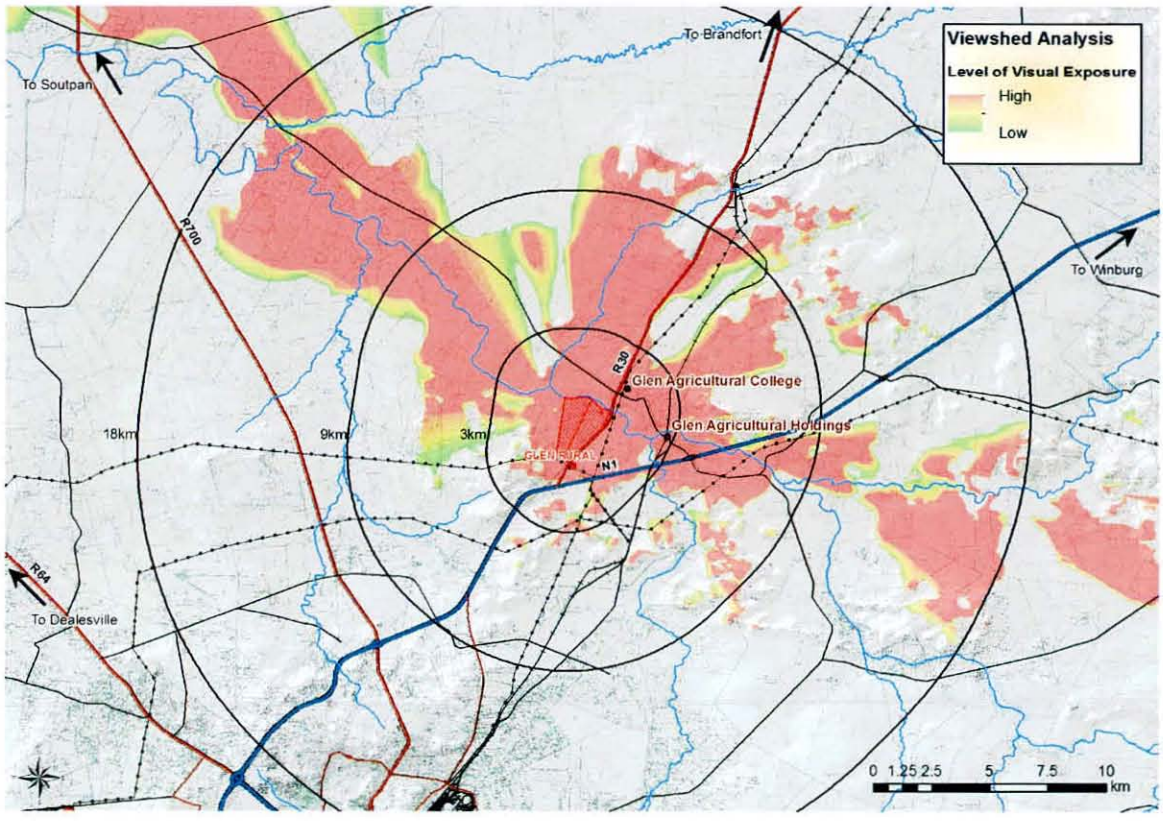


Figure 4: Viewshed analysis of PV panels depicting possible visibility.

The viewshed analysis reflects a distinct pattern of visibility to the north, north-west and the east. It is evident that high ridges and koppies south of the development site effectively screen the SEF from exposure to the south.

A core area of between 2 – 4 km, where exposure of the SEF is expected to be high, includes a number of farmsteads and the Glen area east of the site. Within this zone, high visual impacts are anticipated. However, the occurrence of bush and trees may screen the SEF from exposure in as far as it will dominate the foreground of scenes around the observer.

Between 3 – 9km visibility extends to the north, east, and nort-west. In this zone exposure of the SEF will be moderate to low.

Further west and east, along Modder river valley, visibility extends to distances further than 20km. It is however envisaged that, at this distance, the degree of exposure of the SEF will be very small, and that it would not be recognisable as a distinct feature in the landscape, with little to no visual impact.

The modelling of visibility is merely conceptual. Being based on DTM data, it does not take into account the effect of buildings, trees etc. that could shield the facility from being visible. The viewshed analysis therefore signifies a worst-case scenario. The immediate landscape surrounding the observer has a determining influence on long distance views. It is expected that the woodland character of the landscape will offer a large degree of visual absorption capacity and screening effects.

Once a final layout of the SEF is completed, the viewshed analysis will be regenerated and refined to reflect the visual exposure of the development according to its actual position in the landscape. If possible, the screening effect of vegetation will be modelled as well. This will be undertaken during the EIA phase of the project.

7. POTENTIAL VISUAL RECEPTORS

The viewshed analysis gives an indication of possible visual exposure to a number of receiving environments. It is envisaged that the proposed PV plant will be visible to residents on farmsteads, observers travelling on nearby roads, and visitors to the area. Exposure to the N1 national road, and the R30 road towards Brandfort is expected to be high within 2 km to 4 km from the site, becoming lower with increased distance. The Glen community to the east may have high exposure of the facility, but only in places where vegetation has been cleared and views into the far distance are possible.

8. ISSUES RELATING TO POSSIBLE VISUAL IMPACT

The following issues are anticipated regarding possible visual impact:

- The visual exposure of the SEF occupying an extent of 150ha in an agricultural area;
- The exposure of the SEF components and potential visual impact in respect of sensitive receiving environments, including the following:
    - Residents in the Glen area;
    - Farmsteads on surrounding farms;
    - Observers travelling along roads, especially the N1 and the R30; and
    - Guest houses in the area.
- Potential impact of the facility on the visual character of the landscape and sense of place of the region;
- The potential visual impact of operational, safety and security lighting at night time on observers living in close proximity to the site;

9. CONCLUSIONS AND RECOMMENDATIONS

The development of a PV plant on the proposed development site involves the construction of solar panels, invertors, buildings, and a security fence that will by highly visible to observers within 3 – 4km from the facility.

Visual receptors include residents in Glen and on farmsteads, visitors to guest houses and travellers on the N1, the R30 and other roads in the area.

It is recommended that the potential visual impact on these receptors be assessed in further detail. Additional analyses must be undertaken, such as a detailed proximity analysis and visual absorption analysis, taking into account the effect of existing development nearby. More detailed viewshed analyses will be undertaken of all major SEF components, based on the final layout of the facility.

This work must be undertaken during the next phase (EIA phase) for this project.

REFERENCES/DATA SOURCES

Chief Director of National Geo-spatial Information, varying dates. *1:50 000 Topo-cadastral maps and digital data.*

CSIR/ARC, 2000. *National Land-cover Database 2000 (NLC 2000)*

National Botanical Institute (NBI), 2004. *Vegetation Map of South Africa, Lesotho and Swaziland (Unpublished Beta Version 3.0)*