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Hantam Photo Voltaic Solar Electricity Facility Visual Impact Assessment

Report

Version - Final

10 January 2012

Savannah Environmental (Pty) Ltd

GCS Project Number: 11-588

Client Reference: 11-588

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EXECUTIVE SUMMARY

GCS (Pty) Ltd (GCS) was appointed by Savannah Environmental (Pty) Ltd to complete a Visual Impact Assessment (VIA). This VIA is a specialist study that forms part of the Environmental Impact Assessment (EIA) report and addresses the visual affects of the proposed surface infrastructure consisting of several solar array areas and a series of 132kV powerlines leading into a switching station.

Solar Capital (Pty) Ltd plans to establish a photovoltaic solar energy facility on the farm Narosies 228 approximately 47km north of Loeriesfontein, Northern Cape. The proposed facility will consist of 7 solar catchment arrays, 132kV powerlines and a switching station. These arrays will be constructed in 7 separate phases. The electricity produced from this proposed facility will feed into an existing adjacent 400kV substation named Helios (Eskom owned).

The visual impact assessment completed a viewshed analysis of all proposed infrastructure along with the Helios substation. The Helios substation was included in the analysis as it already affects the regions 'sense of place'. Key visual receptors were also identified and examined during the site visit.

The analysis shows that approximately 70% of the proposed facility's viewshed will overlap with the existing viewshed of the Helios substation. With the above mentioned result in mind, coupled with the absence of tourism and a disturbed sense of place, it is conclude that the Hantam Photo Voltaic Solar facility will have a low visual impact on the region.

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1 INTRODUCTION

GCS (Pty) Ltd (GCS) was appointed by Savannah Environmental (Pty) Ltd to complete a Visual Impact Assessment (VIA). This VIA is a specialist study that forms part of the Environmental Impact Assessment (EIA) report and addresses the visual affects of the proposed surface infrastructure consisting of several solar array areas and a series of 132kV powerlines leading into a switching station.

1.1 Background

Solar Capital (Pty) Ltd plans to establish a photovoltaic solar energy facility on the farm Narosies 228 approximately 47km north of Loeriesfontein, Northern Cape. The study area falls within the Hantam (NC065) Local Municipality and the Namakwa (DC6) District Municipality (see **Figure 1**) (Municipal Demarcation Board South Africa, 2006). The proposed facility will consist of 7 solar catchment arrays along with associated infrastructure. These arrays will be constructed in 7 separate phases. The project includes the construction of photovoltaic solar panels (bulk of the infrastructure) along with a switching station and 132kV powerlines connecting the above mentioned. Each of the 7 phases will feed a 132kV powerline into the switching station. The switching station will be linked with the adjacent existing 400kV substation named Helios (Eskom owned).

This VIA assesses the potential visual impacts of the proposed infrastructure, as mentioned above, and includes the extent of the view solar catchment area, or what is known as the 'zone of visual influence' of the project (approximate 10 km buffer area around the operations). The purpose of this VIA is to determine the potential impact of the proposed project on the visual and aesthetic character of the study area. The rationale for this VIA is that the proposed activity may fundamentally alter the landscape character and sense of place of the local environment. The primary objective of this VIA is therefore to describe the potential impact of this activity on the visual character and sense of place of the area.

A site visit was completed on the 7th of December 2011 in order to accurately determine the site characteristics and assess the potential visual impact to identified visual receptors.

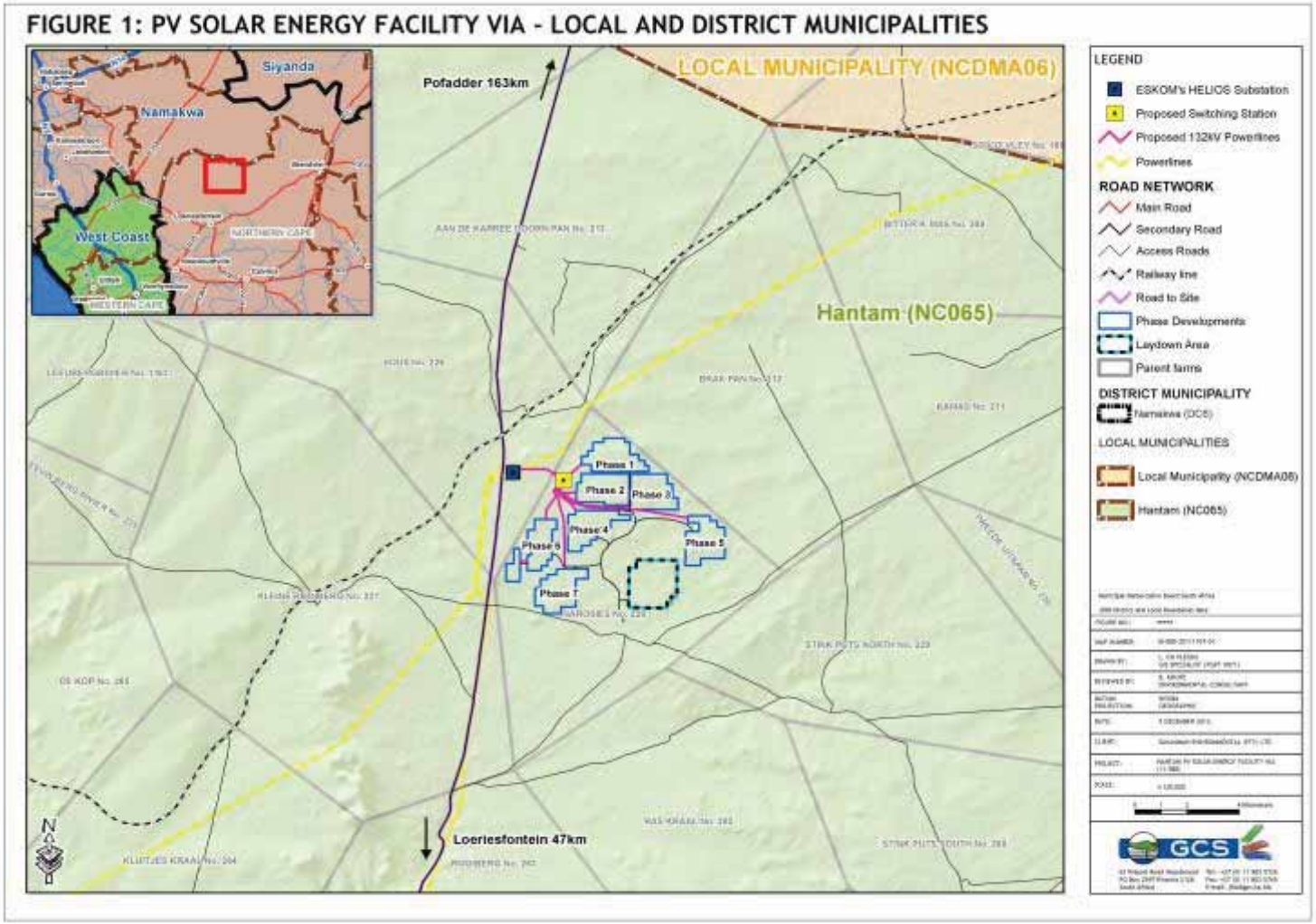

Figure 1 **Local and District Municipalities**

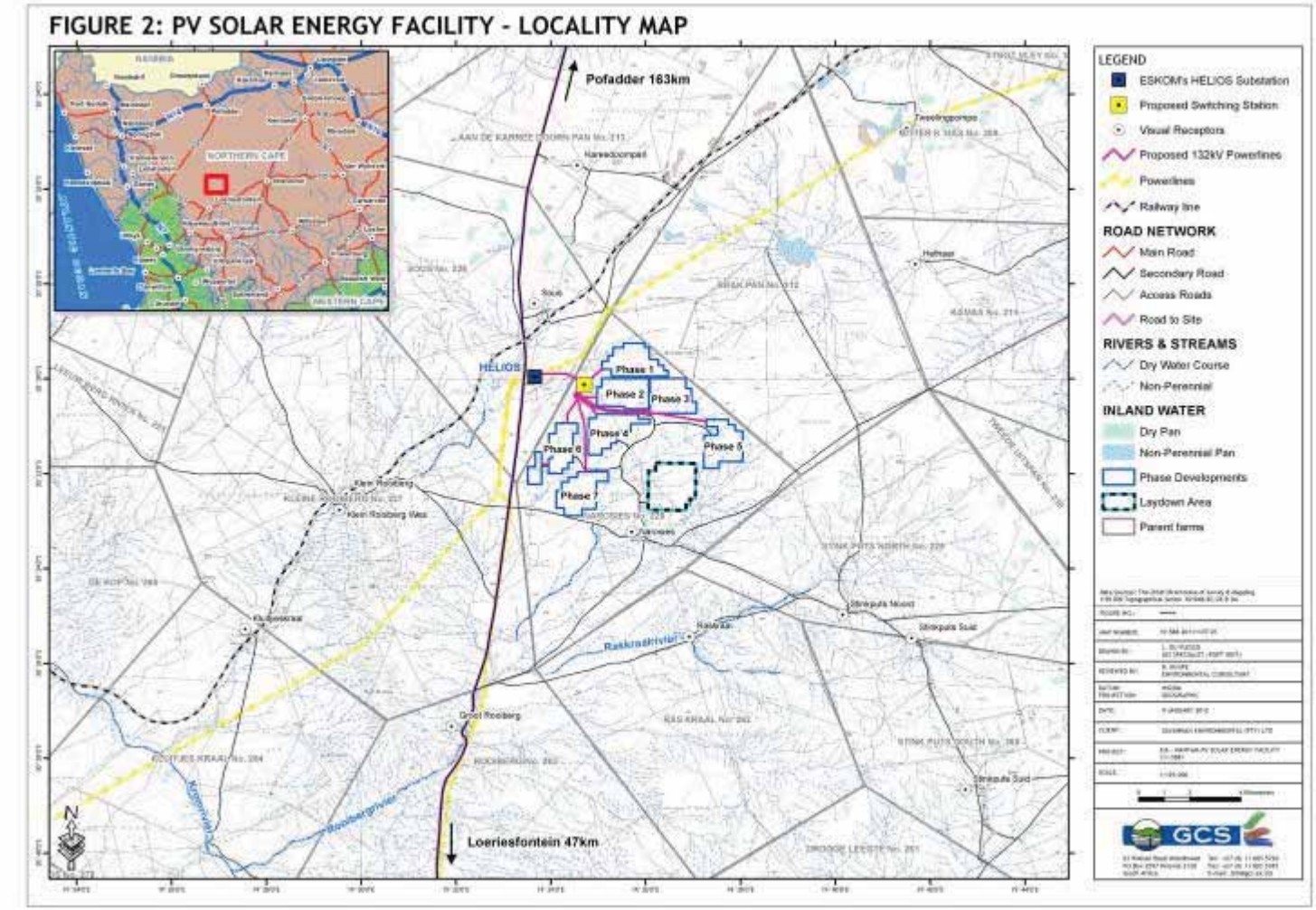

Figure 2 **Locality**

1.2 Scope of Work

The scope of work included in this specialist report includes:

- A description of the existing visual characteristics of the surrounding environment where development is to take place;
- A determination of the extent to which the proposed development will be visible;
- A determination of any potential visual impacts; and
- A recommendation of possible mitigation measures.

1.3 Legislation and Guidelines

There are no specific legal requirements in the National Environmental Management Act (Act No. 107 of 1998) (NEMA) that specifically regulate activities that may infringe on the visual attributes of a region.

The National Heritage Resources Act (Act No. 25 of 1999) provides legislative protection for listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes and requires that these areas are protected against physical and aesthetic change.

Visual pollution is controlled, to a limited extent, by the Advertising on Roads and Ribbons Act (Act No. 21 of 1940), which deals mainly with signage on public roads. The 'Guideline for involving visual & aesthetic specialists in EIA processes,' by Oberholzer (2005) has been developed to provide guidelines and general good practices for the specialist visual input into the EIA process in South Africa. These guidelines were extensively used as a guide for this assessment (Please refer to Appendix A).

1.4 Report Structure

The report structure for the contents of the VIA is detailed below and will guide the reader to the relevant sections.

Chapter 1 - *Introduction*

This chapter provides some background information on the proposed project and the objectives of this report. This section also lists the legislation and guidelines followed by the assessment.

Chapter 2 – *Study Approach*

This chapter provides a brief description of the project features, a list of data sources, a short description of the methodology of the assessment and a discussion of assumptions made and limitations to the study.

Chapter 3 – *Description of the Project*

This chapter provides a brief description of the project during construction and operational phase.

Chapter 4 – *Description of the Environment*

This chapter provides a brief description of the surrounding and potentially affected environment.

Chapter 5 – *Impact Description and Assessment*

This chapter discusses criteria used to determine the potential visual impacts and summarises them in table format.

Chapter 6 – *Mitigation Measures*

This chapter highlights some of the mitigation measures that may be applied to reduce the overall visual impact.

Chapter 7 – *Conclusion*

The conclusion provides a brief discussion on the findings of the report.

Chapter 8 – *References*

This chapter provides a list of references.

Appendices

2 STUDY APPROACH

2.1 Information and Data Sources

- The Chief Directorate of Survey & Mapping 1:50 000 Topographical Series: 3019AB, BC, CB and DA
- Ladislav Mucina & Michael C. Rutherford (eds). 2006. The Vegetation of South Africa, Lesotho and Swaziland. SANBI. "Vegmap"
- Google Earth™ Mapping service: 2011.

2.2 Method

To evaluate the potential impacts of the proposed activity, the inherent scenic value of the landscape first needs to be determined. Data collected during a site visit allowed for a comprehensive description and evaluation of the receiving environment. The following method was used for the project:

- Site visit (7 December 2011)- one field survey was undertaken and the study area scrutinized to the extent that the receiving environment could be documented and adequately described;
- Project components - the physical characteristics of the project components were determined, described and illustrated;
- Determine the setting, visual character and land use of the area surrounding the proposed solar facility, and the sense of place;
- Define the extent of the affected visual environmental, the viewing distance and the critical views/visual receptors that may be affected by the proposed project;
- Determine the Visual Absorption Potential (ability of the landscape to accommodate the proposed project from a visual perspective);
- Complete an assessment of the potential impacts in order to determine the significance thereof.

2.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this study:

- The major limitation of this study is the unavoidable subjectivity relating to the assessment of the visual impact. Findings will also be restricted to information on hand, as well as the quality of spatial data.

- The Chief Directorate of Survey & Mapping possesses 5m contours for the majority of South Africa, however due to the remoteness of this particular study area only 20m contours were available. The use of 20m contours mean that topographical features such as the railway line embankments (that may have a height of 10m) will not be taken into consideration.

2.4 Project Features

Physical dimensions of the proposed solar infrastructure of particular relevance to the VIA:

- Seven 2m high photovoltaic solar arrays with a total footprint area of 13377 ha.
- 30m high 132kV Power lines from the solar panels feeding into the switching station with a total length of 18 478m.
- A 5m high switching station with a 1.59 ha surface area that connects to the existing Eskom Helios Substation (Refer to **Photo 2.1** below).

Photo 2.1 Eskom Helios Substation

3 DESCRIPTION OF PROPOSED DEVELOPMENT

3.1 Overview of the Activity

3.1.1 Construction Phase

The construction of the Hantam Solar Power facility will occur in 7 phases. Two meter (2m) high PV solar panel arrays will be constructed during each phase. Each of these arrays will have a 132kV powerline that will feed the generated electricity to the switching station, southeast of the Helios substation.

A laydown area of (274.3 ha) within the site proposed for development will be used throughout the construction phase to facilitate the storage of building materials etc (Refer to **Figure 3**).

3.1.2 Operational Phase

During the operational phase all 7 of the proposed solar facilities (13377 ha) will be operational. Where possible, cables will be buried underground to minimize exposure to environmental elements.

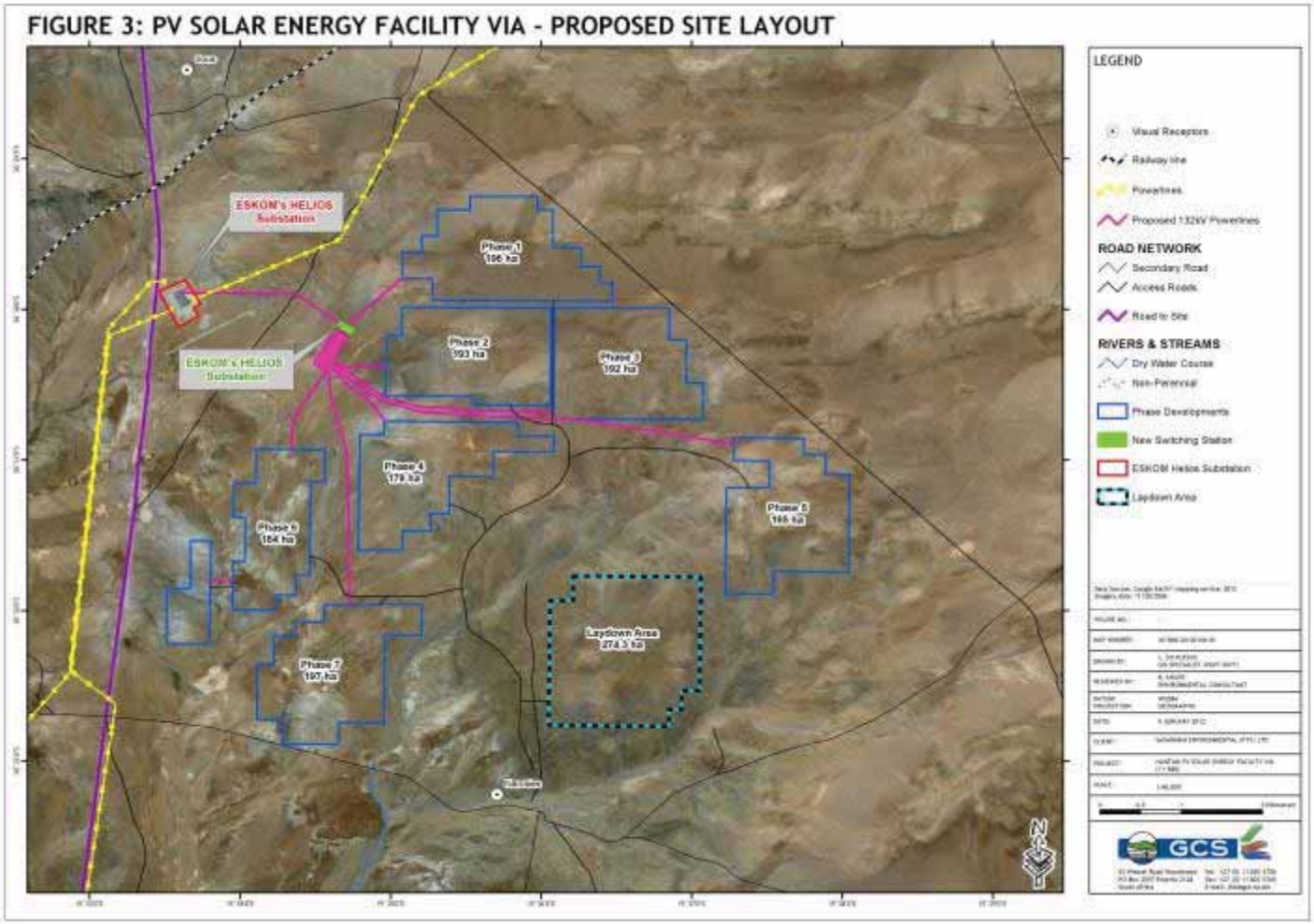

Figure 3 Proposed Site Layout

4 DESCRIPTION OF THE ENVIRONMENT

The following sections discuss the environmental parameters which have a direct impact on aesthetic value of the area.

4.1 Topography

The project area has an elevation ranging from 712 – 1000 metres above mean sea level (mamsl). The study area is characterised by gentle slopes in a south western direction. To the west are two hills that act as a natural visual buffer. A number of dry pans and non-perennial pans also lie north and east study area (please refer to **Figure 4**).

The embankment of the railway line approximately 2.5km to the west of the site is elevated from the surrounding environment. The embankment varies in an estimated height of between 2m and 10m (at a road crossing as seen in **Photo 4.1** below). These embankments thus provide relatively good visual screening for observers west of the rail road.

Photo 4.1 Railway Bridge Crossing

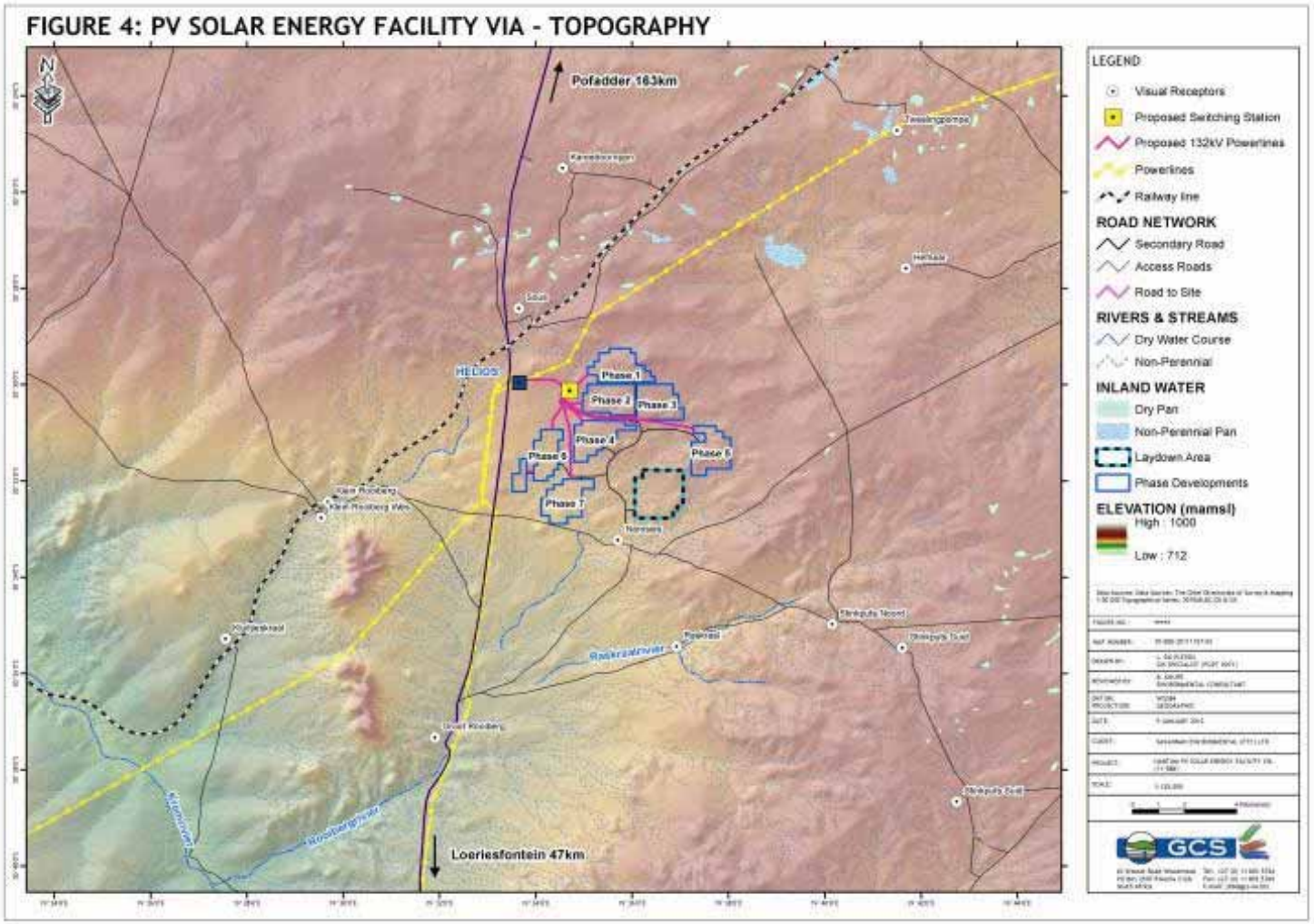

Figure 4 Topography

4.2 Vegetation

The proposed development falls entirely on the Bushmanland Basin Shrubland which consist mainly of small Karoo bushes which provides little to no visual screening at all. To the south west and far west of the proposed development the areas are classified as Hantam Karoo and Western Bushmanland Klipveld, both these regions share a similar visual characteristic to the Bushmanland Basin Shrubland in that it provides very little natural vegetative cover that can shield from visual impacts (Refer to **Figure 5**).

Photo 4.2 Typical vegetation found in the Bushmanland Basin Shrubland

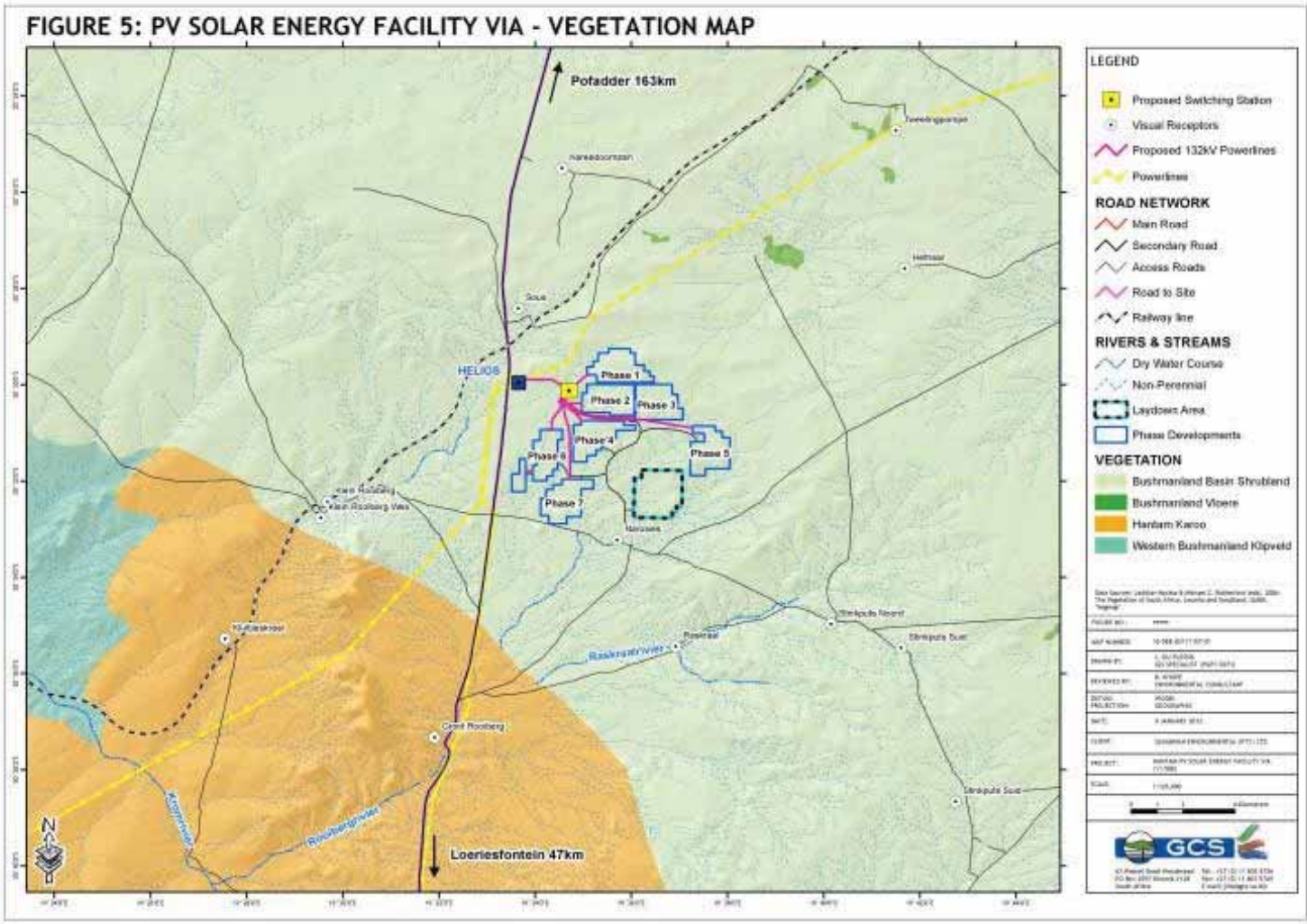

Figure 5 Vegetation

4.3 Land Use

According to ENPAT (2001) the land use for the entire study area is classified as vacant or unspecified. The land use for the region is dominated by a single form of agriculture namely sheep farming, as the climate and natural vegetation lends itself to this practice. There are several small homesteads within a 10km radius where sheep farming is the main source of income.

4.4 Transportation Routes

All the roads in the area are gravel roads of different quality. The surrounding farms are connected by a network of gravel roads which are classified as "access roads" that ultimately connect to the main road that runs from south to north. This main road is a "secondary" road and is used as the main source of transportation for construction vehicles, trucks and farmers. The road extends 47km south to the town of Loeriesfontein and 163km north towards Pofadder.

To the west of the study a railway line runs through the region from south west to north east. This railway line is mostly used to transport iron ore to Saldanha. The TRANSNET freight rail company is actively working on this rail line however the particulars of the project are unknown.

4.5 Sense of Place

Central to the concept of sense of place is that the landscape requires uniqueness and distinctiveness. The primary informant of these qualities is the spatial form and character of the natural landscape taken together with the cultural transformations and traditions associated with the historic use and habitation of the area.

In terms of this study area, and speaking to local farming residents, the existing Eskom Helios substation is a key landmark. Directions and distance is often explained using this feature as spatial reference.

Other than the previously mentioned railway line the only other activity that takes place in this area is localised sheep farming around remote homesteads. On the main gravel road passing through this area one mostly encounters farm vehicles and trucks transporting goods. Even though the remoteness of the area and the vast open spaces do add to the sense of place, central to all of this remains the Helios Substation.

It has thus been established that the study area presents a relatively weak sense of place primarily because of the presence of powerlines visible from the majority of the study area.

4.6 Visual Quality and Character

4.6.1 Tourism Value

The greater Namakwa District Municipality is an area that does provide many opportunities for tourists wanting to visit the Northern Cape or those traveling through the Karoo towards the west coast of South Africa. The town of Loeriesfontein (47km South) is the closest tourist attraction as it is home to the "Windpomp Museum". An estimated 33km south of Loeriesfontein is one of the world's largest Quiver Tree forests (Namakwa District Municipality, 2012).

The road passing the proposed development is however not a tourist route as potential tourists travelling to the above mentioned locations and further towards the coast will most likely use the R358 to the west or the R357 to the east of the site as these are tarred roads.

4.6.2 Scenic Value

With high rise powerlines feeding in and out of the adjacent Helios substation from the south-west and north-east and the presence of the railroad the study area can no longer be viewed as pristine from a visual standpoint.

Photo 4.3 Photograph showing a typical electrical power line found throughout the area

5 IMPACT DESCRIPTION AND ASSESSMENT

5.1 The Visual Analysis

5.1.1 The Viewing Distance

The visual impact of an object in the landscape diminishes at an exponential rate as the distance between the observer and the object increases (Hull and Bishop, 1988). Thus, the visual impact at 1000m would be approximately a quarter of the impact as viewed from 500m. Consequently, at 2000m, it would be one sixteenth of the impact at 500m. The 'zone of potential influence' (the area defined as the radius about the centre point of the project beyond which the visual impact of the most visible features will be insignificant) was established at 10km. Over 10km the impact of the proposed infrastructure on visibility would have diminished considerably due to the diminishing effect of distance and atmospheric conditions (haze). On the other hand the visual impact of the project components within a distance of 2000m or less would be at its maximum (Refer to **Figure 6**).

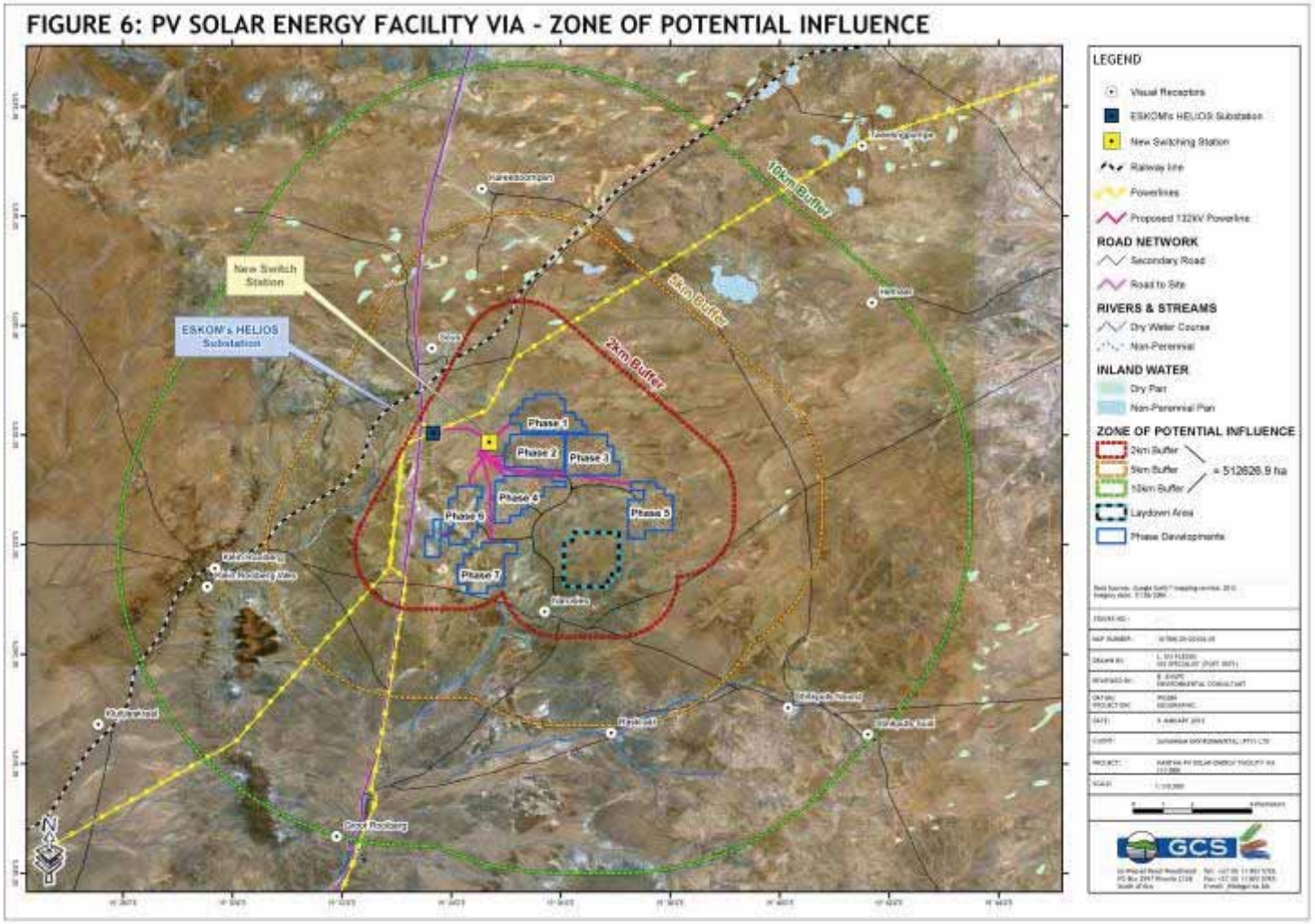

Figure 6 Zone of Potential Influence

5.1.2 Viewshed

A viewshed analysis is carried out to define areas, which contain all possible observation sites from which the proposed infrastructure would be visible.

Topographic data was captured for the site and its environs at 20m contour intervals to create the Digital Elevation Model (DEM). The DEM includes features such as vegetation, rivers, roads and nearby urban areas. These features were draped over the topographic data to complete the model used to generate the viewshed analysis. The visibility analysis considers the worst-case scenario, using line-of-sight i.e. ignoring trees and other structures and is based on topography alone. This assists the process of identifying possible affected viewers and the extent of the effected environment.

Eight separate viewsheds was calculated to assess the visual impact of the proposed development. These eight viewsheds are;

- The existing Helios substation (Refer to **Figure 7)**.
- Each of the 7 proposed phases separately, assessing the relevant solar arrays, powerlines and switching station **(Refer to Figures 8-14)**

A viewshed for the current Helios substation was included in the analysis to aid as a source of comparison in order to determine where the proposed new development's viewshed will overlap with current areas that are already visually exposed to this substation.

The viewshed areas were all calculated within the 10km zone of potential influence (512626.9 ha) boundary as the viewshed beyond this point becomes highly subjective (section 5.1.1).

Table 5.1 Summary of Viewshed Analysis

Phase	Infrastructure	Infrastructure Dimensions			Phase Viewshed (ha)	% Additional Viewshed in Zone of Potential Influence	% Phase viewshed that Overlaps with Helios Viewshed	Affected Receptors	Receptor Description
		Solar Array Area (ha)	132kV Power line length (m)	Height (m)					
1	Solar Array	196		2	34041	18.9	71.3	7	Kareedoornpan, Hefnaar, Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	2624.7	30					
	Switching Station	1.59	-	5					
2	Solar Array	192	-	2	29921	10.9	81.1	5	Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	2772.2	30					
	Switching Station	1.59	-	5					
3	Solar Array	193	-	2	33404	17.6	72.7	6	Hefnaar, Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	4760.8	30					
	Switching Station	1.59	-	5					
4	Solar Array	179	-	2	30047	11.1	80.9	5	Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	3249	30					
	Switching Station	192	-	5					
5	Solar Array	195	-	2	34686	20.1	70.1	6	Hefnaar, Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	6793	30					
	Switching Station	192	-	5					
6	Solar Array	184	-	2	30324	11.6	80.2	5	Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	3770.9	30					
	Switching Station	192	-	5					
7	Solar Array	197	-	2	30371	11.7	80.1	5	Sous, Klein Rooiberg/Wes, Narosies & Groot Rooiberg
	132kv Power line	-	5322.2	30					
	Switching Station	192	-	5					

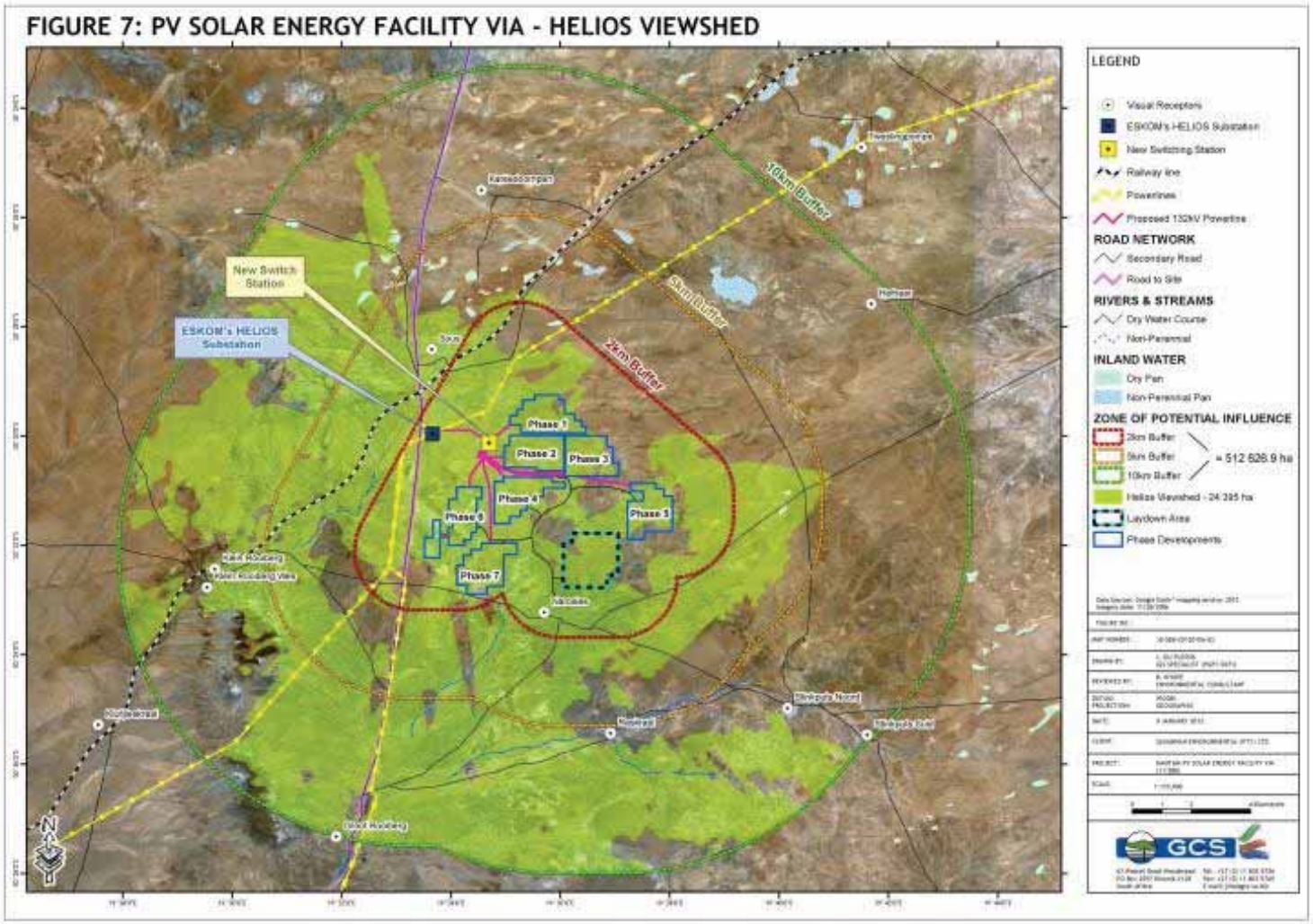

Figure 7 **Helios Substation Viewshed**

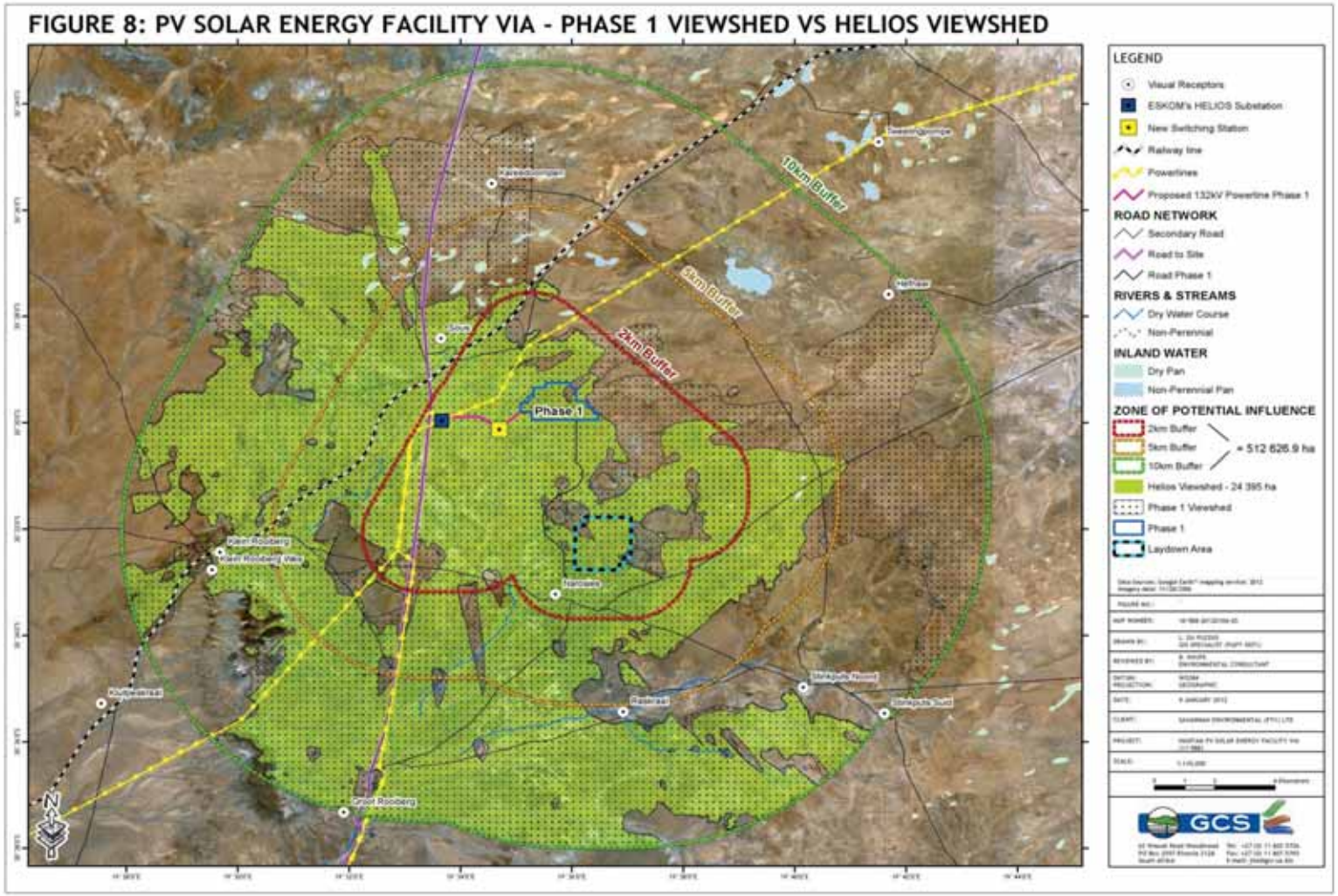

Figure 8 Phase 1 Viewshed

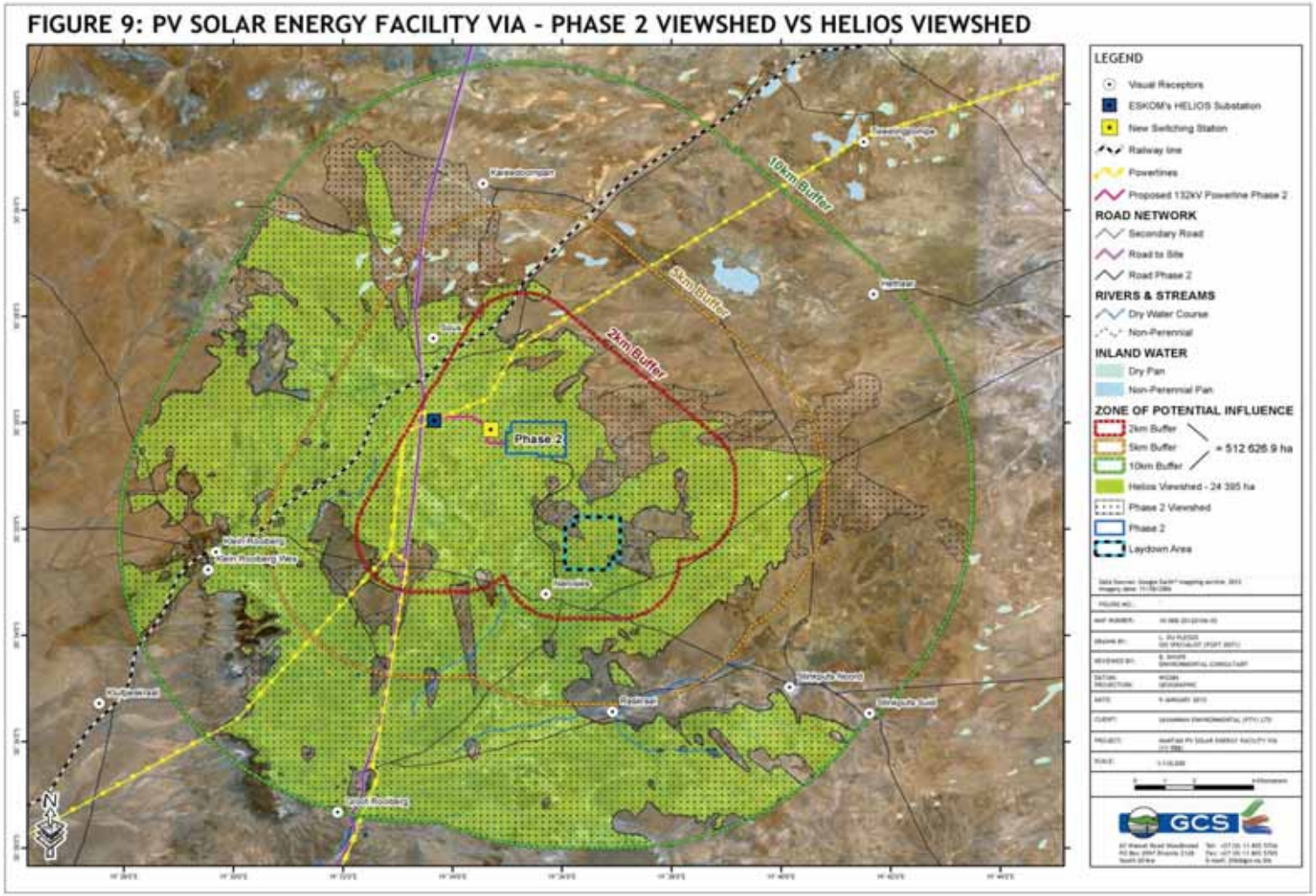

Figure 9 Phase 2 Viewshed

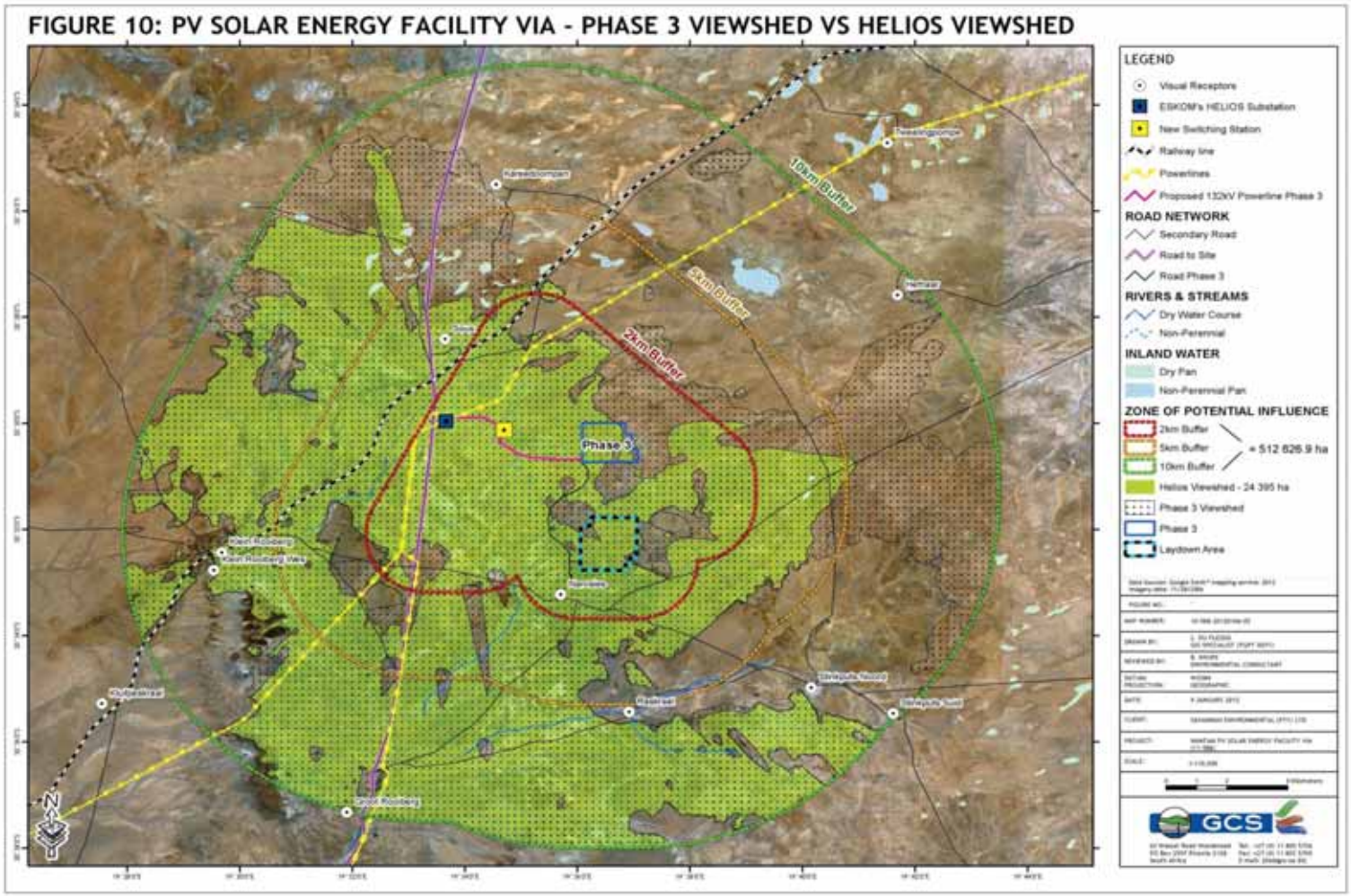

Figure 10 Phase 3 Viewshed

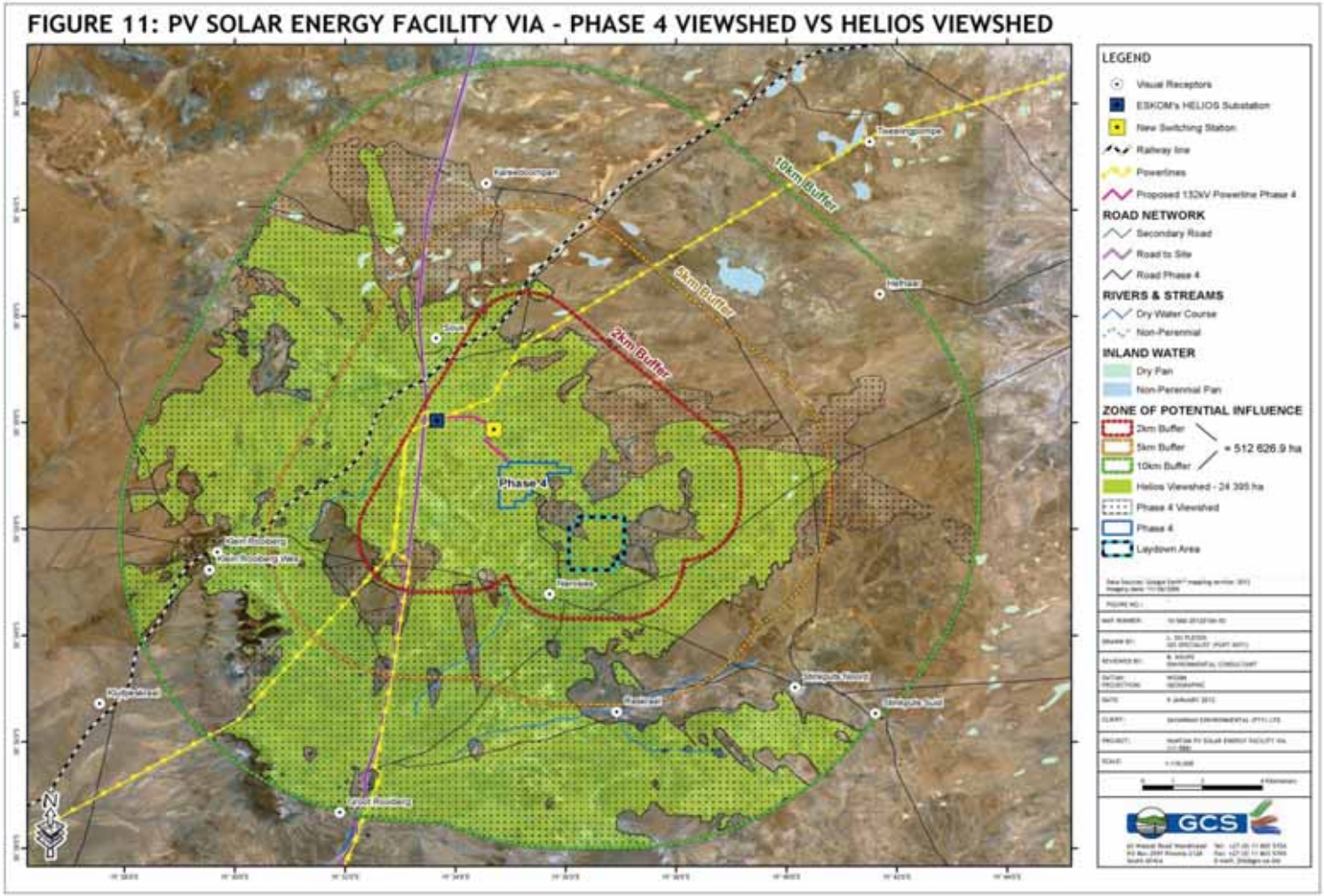

Figure 11 Phase 4 Viewshed

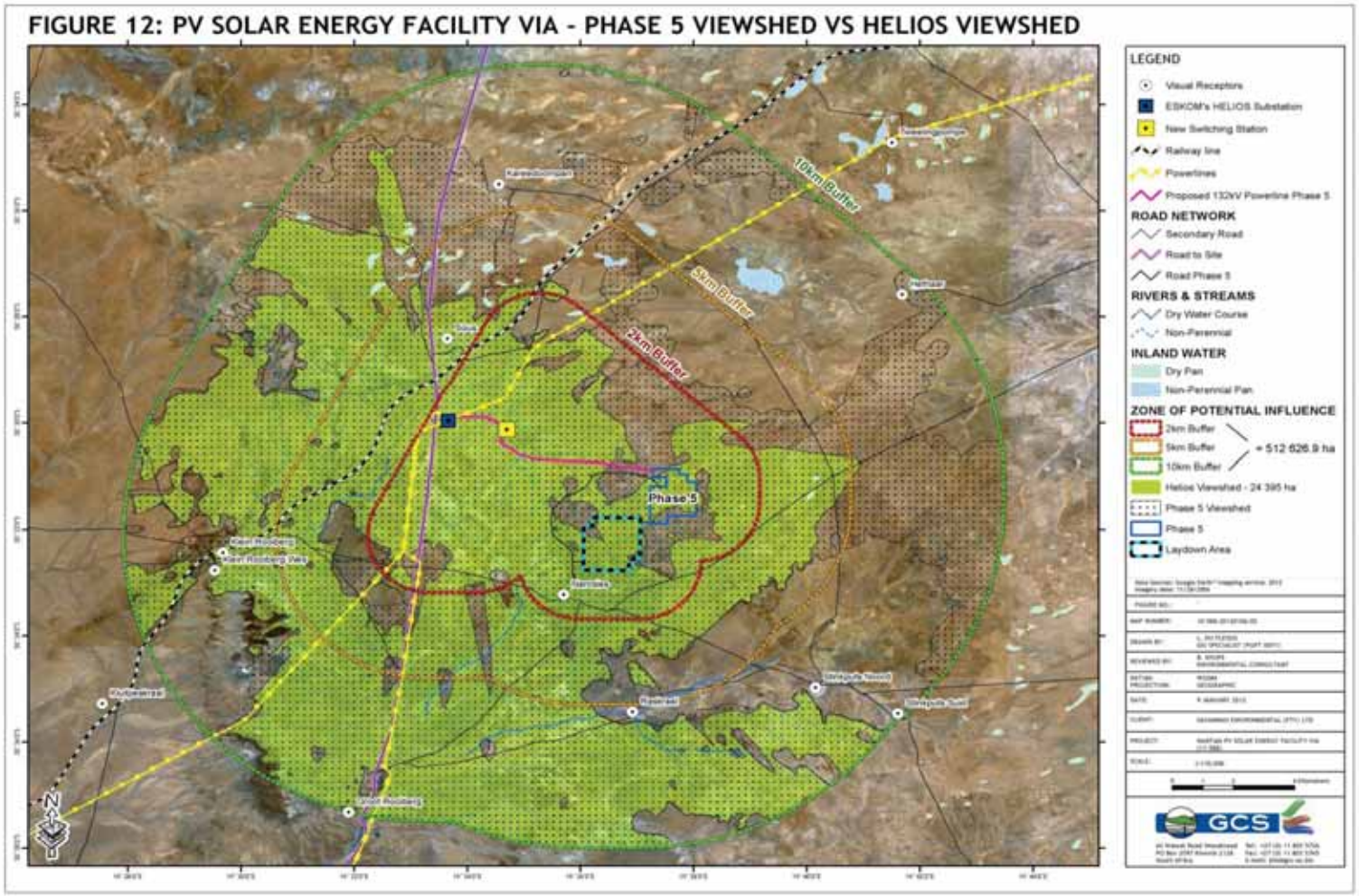

Figure 12 Phase 5 Viewshed

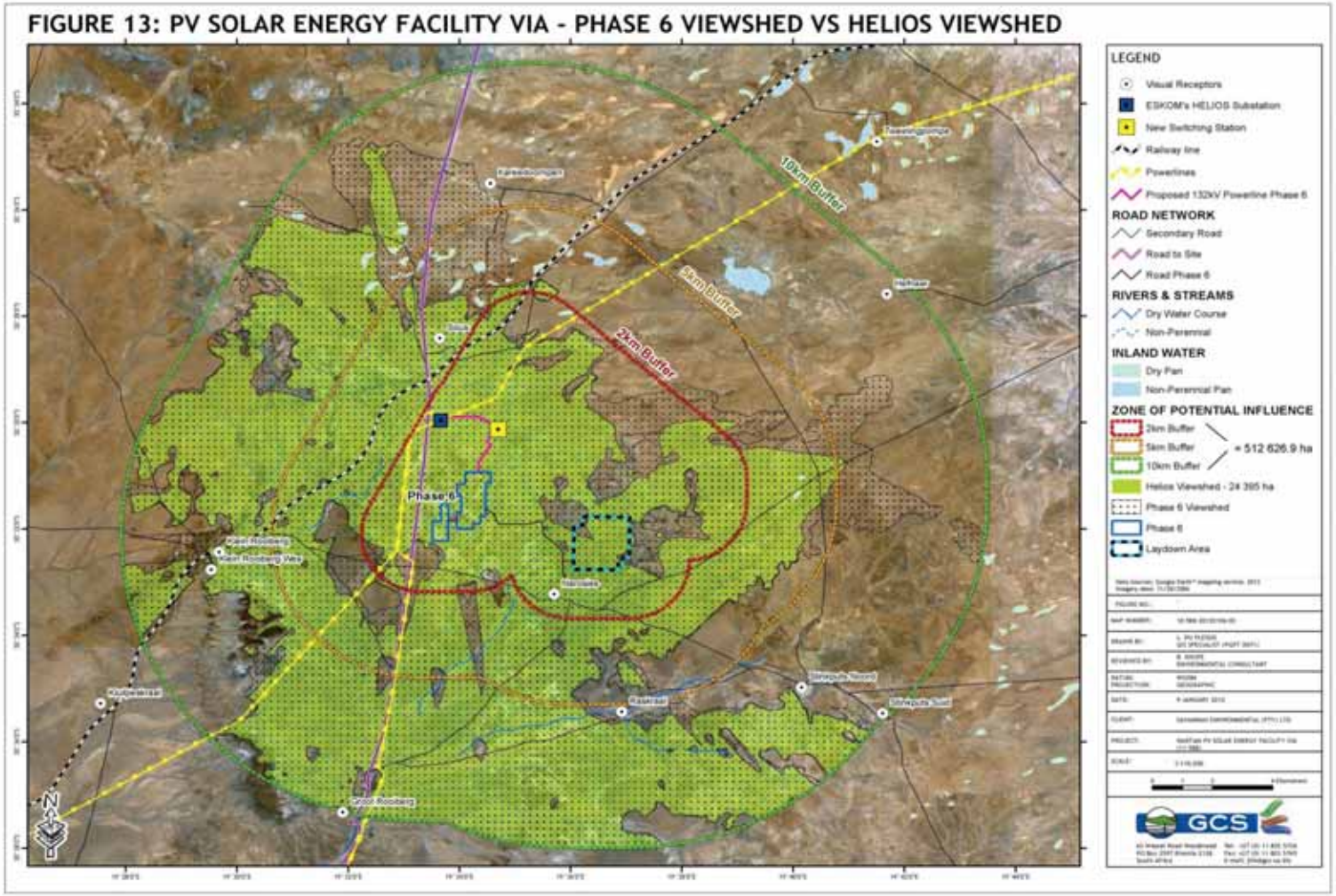

Figure 13 Phase 6 Viewshed

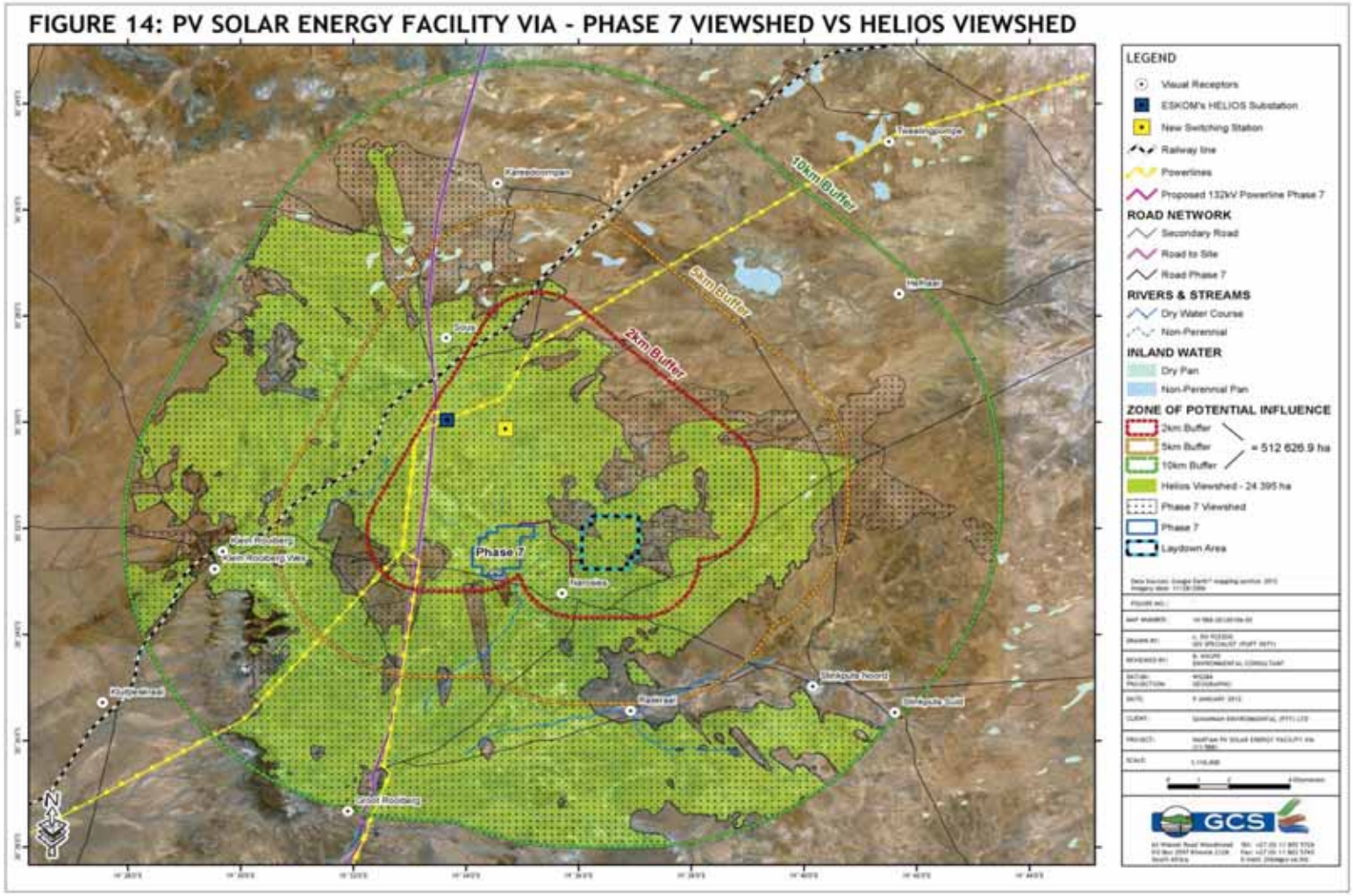

Figure 14 Phase 7 Viewshed

5.1.3 The Visual Absorption Capacity

Visual Absorption Capacity (VAC) signifies the ability of the landscape to accept additional human intervention without serious loss of character and visual quality or value. VAC is founded on the characteristics of the physical environment such as:

Degree of Visual Screening - A degree of visual screening is provided by landforms, vegetation cover and/or structures such as buildings. For example, a high degree of visual screening is present in an area that is mountainous and is covered with a forest compared to an undulating a mundane landscape covered in grass.

Terrain variability - Terrain variability reflects the magnitude of topographic elevation and diversity in slope variation. A highly variable terrain will be recognised as one with great elevation differences and a diversity of slope variation creating talus slopes, cliffs and valleys. An undulating landscape with a monotonous and repetitive landform will be an example of low terrain variability.

Land Cover - Land cover refers to the perceivable surface of the landscape and the diversity of patterns, colours and textures that are presented by the particular land cover (i.e. urbanised, cultivated, forested, etc). Areas which have a high visual absorption capacity are able to easily accept objects so that their visual impact is less noticeable. Conversely areas with low visual absorption capacity will suffer a higher visual impact from structures imposed on them.

It is concluded that the study area possesses a medium visual absorption capacity based on the following:

- The sparseness of vegetation and the lack of structures or notable landforms provide a low degree of visual screening.
- Terrain variability is low as the topography is characterised by gentle slopes with very little change in elevation.
- Land cover is rated as high as there are multiple high rise electrical lines and the Helios substation directly associated with the land cover.

5.1.4 Critical Viewpoints

Farms Narosies and Sous are regarded as critical viewpoints as they will have clear visibility of the site. The other affected receptors are beyond the 5km viewing distance barrier and as mentioned in section 5.1.1 atmospheric haze starts to distort the view. The high temperatures associated with the region often produce mirages. A mirage is a naturally occurring optical phenomenon in which light rays are bent to produce a displaced image of distant objects or the sky.

A list of photos of each observer site (refer to **Table** 5.2) in the direction of the proposed development can be found in **Appendix B**.

Table 5.2 Observer Site Locations

Oberserver Name	Latitude	Longitude
Kareedoornpan	-30.42495	19.57597
Raskraal	-30.59054	19.61537
Groot Rooiberg	-30.62208	19.53175
Stinkputs Noord	-30.58289	19.66923
Narosies	-30.55370	19.59513
Klein Rooiberg	-30.54049	19.49476
Sous	-30.47350	19.56079
Hefnaar	-30.45969	19.69477
Stinkputs Suid	-30.59107	19.69357

5.2 The Visual Impact

Visual impact is defined as the significance and/or magnitude of changes to visual quality of the area resulting from a development or change in land use that may occur in the landscape.

Significance or magnitude is a measure of the response of viewers to the changes that occur. It represents the interaction between humans and the landscape changes that they observe. The response to visible changes in the landscape may vary significantly between individuals.

The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity.

An assessment of the significance of direct, indirect and cumulative impacts of all 3 the project features (section 2.1) will be rated in terms of the following criteria:

- ***Extent*** of Visual Impact – The extent of the visual impact is determined by the calculated viewshed. The viewshed will have a regional impact on the environment. A value between 1 and 5 will be assigned (with 1 being low and 5 being high). The extent rating for each phase will be based on its surface percentage within the zone of potential influence not already affected by the Existing Helios viewshed (refer to **Table 5.1**). This is calculated with the following equation:
  Extent = ((Phase viewshed – Overlap with Helios viewshed)/Zone of Influence) X 100.
- ***Duration*** of Visual Impact – The duration of visual impact, indicates the duration that the impact will take place, in this case it is permanent as the facilities' structures are the source of impact. A score of 5 is assigned to all 3 features.
- ***Magnitude*** of Visual Impact – The magnitude of the visual impact is classified on a scale of 0-10 based on the affect that the impact will have on ongoing processes in the environment. Ratings were based on the percentage of the phase viewshed that overlaps with the existing Helios substation viewshed and the number of affected receptors (refer to **Table 5.1**). A higher overlap percentage will be seen as a lower impact as it corresponds with existing impacted areas.
- ***Probability*** of Visual Impact occurrence – Describes the likelihood of the impact actually occurring. Probability is assess on a scale of 1-5 where 1 is very improbable and 5 is definite (impact will occur regardless of any prevention measures). All the proposed structures' visual impact may be mitigated to a certain extent but there will still be a definite visual presence.
- ***Significance*** of the Visual Impact – The significance is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high.
  Significance (S) = (Extent (E) + Duration (D) + Magnitude (M) x Probability (P)
  The significance weightings for each potential impact are as follows:
  - < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
  - 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
  - 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

- ***Status*** of visual impact – The status is described as either positive, negative or neutral. With the presence of the existing Helios substation and the powerlines throughout the region the proposed development is seen to have a neutral status as the environment is already disturbed.

5.3 Visual Impact Summary

5.3.1 Proposed Phase 1

Table 5.3 Proposed Phase 1 Impact Rating

Nature: Visual impact of the proposed Hantam 1 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (45)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation. » The close proximity of the switching station to the Helios Substation will ensure that		

this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.2 Proposed Phase 2

Table 5.4 Proposed Phase 2 Impact Rating

Nature: Visual impact of the proposed Hantam 2 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (45)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation. » The close proximity of the switching station to the Helios Substation will ensure that		

this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.3 Proposed Phase 3

Table 5.5 Proposed Phase 3 Impact Rating

Nature: Visual impact of the proposed Hantam 3 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (45)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation. » The close proximity of the switching station to the Helios Substation will ensure that		

this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.4 Proposed Phase 4

Table 5.6 Proposed Phase 4 Impact Rating

Nature: Visual impact of the proposed Hantam 4 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (45)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation.		

» The close proximity of the switching station to the Helios Substation will ensure that this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.5 Proposed Phase 5

Table 5.7 Proposed Phase 5 Impact Rating

Nature: Visual impact of the proposed Hantam 5 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (2)	Low (2)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (50)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation. » The close proximity of the switching station to the Helios Substation will ensure that		

this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.6 Proposed Phase 6

Table 5.8 Proposed Phase 6 Impact Rating

Nature: Visual impact of the proposed Hantam 6 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (2)	Low (2)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (50)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation.		

» The close proximity of the switching station to the Helios Substation will ensure that this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

5.3.7 Proposed Phase 7

Table 5.9 Proposed Phase 7 Impact Rating

Nature: Visual impact of the proposed Hantam 7 PV solar energy facility and associated infrastructure adjacent homesteads and users of adjacent roads. The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity. The potential visual impact of the facility is negative due to the existing Helios Substation and associated infrastructure as well as the number of potential visual receptors.		
	Without mitigation	**With mitigation**
Extent	Low (2)	Low (2)
Duration	High (5)	High (5)
Magnitude	Low (3)	Low (2)
Probability	High (5)	High (5)
Significance	**Medium (50)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » 100m Buffer around Solar Arrays. » Cables can be buried underground. » Buildings can be blended with natural paint colours. » Mitigation on power lines is difficult as building specifications are stringent.		
Cumulative impacts: » The 132kV powerlines are surrounded by existing power lines feeding into the Helios Substation. They will therefore have a high cumulative impact as they add to this existing disturbance. » The solar array will have a high cumulative impact as it is adjacent to the main road and the Helios Substation. » The close proximity of the switching station to the Helios Substation will ensure that		

this structure is absorbed by the existing Helios Substation infrastructure. It will therefore have a low cumulative impact.
Residual Impacts: Residual visual impacts will remain as long as the facility is operational.

6 MITIGATION MEASURES

The aim of mitigation is to avoid, reduce and where possible remedy or offset, any significant negative (adverse) effects on the environment arising from the proposed activity (GLVIA; 2008).

In considering measures to effect mitigation, there are three rules to consider. Mitigation measures should be:

- Economically feasible;
- Effective (time allowed for implementation and provision for management/maintenance); and
- Visually acceptable (within the context of the existing landscape).

To address these measures the following principles should be considered:

- Mitigation should be planned to fit into the existing landscape character. They should respect and build upon landscape distinctiveness;
- Mitigation should primarily aim to blend the proposed development into its surroundings and generally reduce its visibility; and
- It should be recognised that many mitigation measures, especially planting/rehabilitation, are not immediately effective.

6.1 General Recommendations

6.1.1 Buildings and Structures

Structures that are required to be built from steel or concrete can be painted in a natural tone fitting with the surrounding environment. Light faded green and tans can be used at the base of buildings, fading to lighter colours, with the top section of the buildings painted a light grey to merge with the skyline. Tall structures' roofs should be painted a 'dirty' grey or light blue. A principle to note is that lighter tones advance toward the viewer while darker tones recede from the viewer. Pure whites, blacks and bright colours should be avoided.

To reduce the potential of glare external surfaces of buildings and structures should be articulated or textured to create interplay of light and shade. Avoid shiny or bare metal where possible.

6.1.2 Access Roads

During construction of the project development, access roads will require an effective dust suppression management programme, such as regular wetting and/or the use of non-polluting chemicals that will retain moisture in the road surface. Where a paved surface is required use dark paving materials that complement the natural brown colours and textures of the soil and rock in the area rather than light coloured materials i.e. concrete colours should be avoided.

6.1.3 Light Pollution

Light pollution should be seriously and carefully considered and kept to a minimum wherever possible as light at night travels great distances. Security flood lighting and operational lighting should only be used where absolutely necessary and carefully directed, preferably away from sensitive viewing areas, i.e. the main road adjacent to the site and nearby homesteads. Wherever possible, lights should be directed downwards so as to avoid illuminating the sky and minimizing light spills.

6.2 Essential Mitigation Measures

The following are recommended as essential mitigation measures to reduce the visual impacts (Oberholzer, 2010);

- A 100m buffer for the solar arrays from public roads and neighbouring farms.
- Cables should be placed underground where possible.
- Buildings should be designed to be compatible in scale and form with rural buildings of the surrounding area. Yards and storage areas should be by masonry walls.
- The colour of the solar array structures should be selected to blend with the surrounding environment and to be in the medium browns and light greys to minimize visibility and avoid reflectivity.
- External lighting should be confined and limited to the switching station and maintenance buildings. Lights should be low-level and fitted with reflectors to avoid light spillage.

6.3 Environmental Management Plan

Due to the subjective nature visual impacts and accurate mitigation and monitoring methods are difficult to establish. The Environmental Management Plan (EMP) in terms of visual impact for the 7 proposed phases are listed below.

6.3.1 Proposed Phase 1

Table 6.1 EMP Phase 1

OBJECTIVE: Mitigate the overall visual exposure of **Phase 1** during construction and operational phase.		
Project Components	196ha Solar Array, 2624.7m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.2 Proposed Phase 2

Table 6.2 EMP Phase 2

OBJECTIVE: Mitigate the overall visual exposure of **Phase 2** during construction and operational phase.		
Project Components	192ha Solar Array, 2772.2m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.3 Proposed Phase 3

Table 6.3 EMP Phase 3

OBJECTIVE: Mitigate the overall visual exposure of **Phase 3** during construction and operational phase.		
Project Components	193ha Solar Array, 4760.8m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.4 Proposed Phase 4

Table 6.4 EMP Phase 4

OBJECTIVE: Mitigate the overall visual exposure of **Phase 4** during construction and operational phase.		
Project Components	179ha Solar Array, 3249m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.5 Proposed Phase 5

Table 6.5 EMP Phase 5

OBJECTIVE: Mitigate the overall visual exposure of **Phase 5** during construction and operational phase.		
Project Components	195ha Solar Array, 6793m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.6 Proposed Phase 6

Table 6.6 EMP Phase 6

OBJECTIVE: Mitigate the overall visual exposure of **Phase 6** during construction and operational phase.		
Project Components	184ha Solar Array, 3770.9m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

6.3.7 Proposed Phase 7

Table 6.7 EMP Phase 7

OBJECTIVE: Mitigate the overall visual exposure of **Phase 7** during construction and operational phase.		
Project Components	197ha Solar Array, 5322.2m 132kV Power line & 1.59ha Switching	
Potential Impact	Negatively effect the scenic value and add cumulative visual impacts to the region.	
Activity/Risk Source	None	
Mitigation: Target/Objective	Due to the subjective nature of the visual impact, accurate mitigation target can not be set.	
Mitigation: Action/Control	**Responsibility**	**Timeframe**
100m Buffer around solar arrays around public roads and neighbouring farms.	Project Planning Managers	Construction Phase
Cables should be placed underground where possible.	Project Planning Managers	Construction Phase
Colour blending of solar arrays to match surrounding environment.	Project Planning Managers	Construction Phase/Operational Phase
External lighting confined to switching station and maintenance buildings.	Plant operator	Operational Phase
Performance Indicatior	Good Performance will be noted when no additional visual receptors beyond the highlighted in the VIA are impacted.	
Monitoring	Site visits of affected and unaffected visual receptors to determine if their visual impact status has changed.	

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APPENDIX A: GUIDELINE FOR INVOLVING VISUAL & AESTETHIC SPECIALIST IN EIA PROCESS

Table X depicts the general expected level of visual impacts for various types of developments and environments. According to the categorisation of visual impacts (Oberholzer: 2005) the activity is expected to have a very high visual impact.

Categorisation of Visual Impacts (Oberholzer, 2005)

Type of environment	Type of development (Low to high intensity)				
	Category 1 development	Category 2 development	Category 3 development	Category 4 development	Category 5 development
Protected/wild areas of international, national, or regional significance	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected	Very high visual impact expected
Areas or routes of high scenic, cultural or historical significance	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected
Areas or routes of medium scenic, cultural or historical significance	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected
Areas or routes of low scenic, cultural or historical significance / disturbed	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	***High visual impact expected***
Disturbed or degraded sites / run-down urban areas / wasteland	Little or no visual impact expected. Possible benefits	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected

Key to categories of development (Oberholzer, 2005)

Category 1 development:
e.g. nature reserves, nature-related recreation, camping, picnicking, trails and minimal visitor facilities.
Category 2 development:
e.g. low-key recreation / resort / residential type development, small-scale agriculture / nurseries, narrow roads and small-scale infrastructure.
Category 3 development:
e.g. low density resort / residential type development, golf or polo estates, low to medium-scale infrastructure.

Category 4 development:
e.g. medium density residential development, sports facilities, small-scale commercial facilities / office parks, one-stop petrol stations, light industry, medium-scale infrastructure.
Category 5 development:
e.g. high density township / residential development, retail and office complexes, industrial facilities, refineries, treatment plants, power stations, wind energy farms, power lines, freeways, toll roads, large-scale infrastructure. Large-scale development of agricultural land and commercial tree plantations. Quarrying and mining activities with related processing plants.

This VIA will therefore conform to the requirements of a level four assessment as identified by Oberholzer (2005) which requires the realisation of the following:

- Identification of issues raised in scoping phase, and site visit;
- Description of the receiving environment and the proposed project;
- Establishment of view catchment area, view corridors, viewpoints and receptors;
- Indication of potential visual impacts using established criteria;
- Description mitigation measures

APPENDIX B: PHOTOS OF VIEWS FROM RECEPTOR LOCATIONS

View from Farm Groot Rooiberg

View from Farm Klein Rooiberg

View from Farm Stinkpits Suid

View from Farm Stinkpits Noord

View from Farm Hefnaar (deserted)

View from Farm Narosies (site proposed for development)

View from Farm Sous (Helios substation Infrastructure can be see on the horizon)

View from Farm Raskraal

View from Farm Kareedoornpan