PROPOSED WATERBERG PHOTOVOLTAIC PLANT, VISUAL IMPACT ASSESSMENT

Produced for:

Thupela Energy

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment in collaboration with V&L Landscape Architects CC.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, the core elements are more widely applicable.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Waterberg Photovoltaic plant. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Thupela Energy is proposing the establishment of a photovoltaic (PV) facility and associated infrastructure for electricity production on Portion 2 of the Farm Goedgevonden KR 104, within the Modimolle Local Municipality within the Waterberg District Municipality in the Limpopo Province.

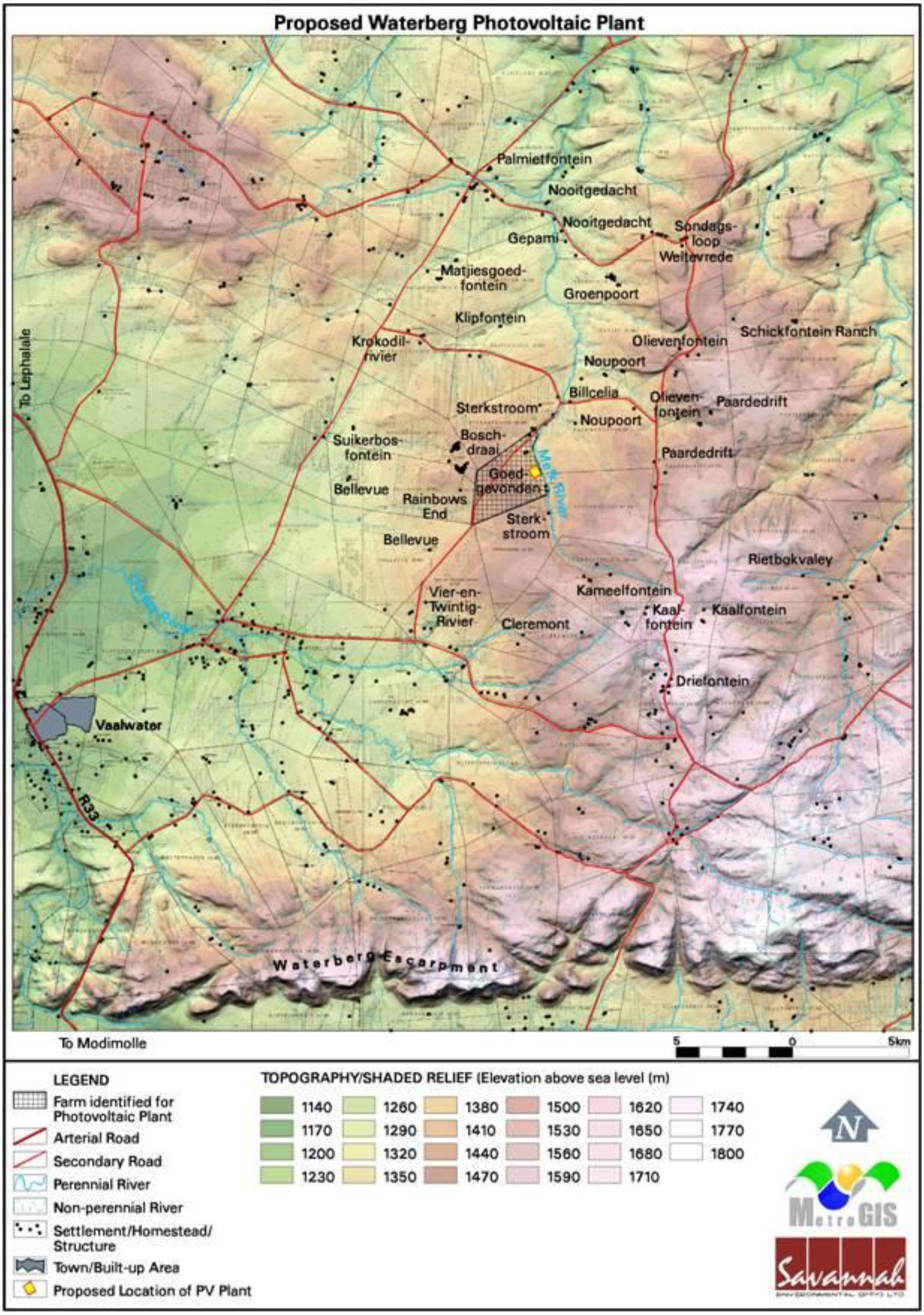
The proposed site is located approximately 20km (at the closest) north-east of Vaalwater. The locality of the proposed PV plant is shown on **Map 1**.

Photovoltaic technology is used to generate electricity by converting solar radiation into direct current electricity using semiconductors (i.e. silicon) through the photovoltaic effect. PV technology refers to the use of multiple PV cells which are linked together to form PV panels. The proposed PV panels will have a tracking functionality which will allow them to follow the movement of the sun during the day.

Thupela Energy intends to utilise the PV panels to generate up to 5MW of electricity by strategically placing the PV panels within the identified site in order to maximise electricity generation via exposure to the solar resource.

Additional infrastructure is expected to include a switching station adjacent to the Mink overhead power line (to allow for the evacuation of the electricity into the Eskom grid), internal access roads, and a low volume water supply pipeline from an on-site borehole, workshop/storage area, and a visitor's centre.

The construction phase of the proposed facility is expected to be 6-8 months whilst the lifespan of the facility is anticipated to be 20 to 30 years.



Map 1: Locality map of the proposed Waterberg PV plant showing shaded relief (topography and elevation above sea level)

2. SCOPE OF WORK

The study area for the visual assessment encompasses a geographical area of 1,657km^2 and includes a minimum 16km buffer zone from the proposed development area. It includes the town of Vaalwater as well as sections of the R33 arterial road and a number of secondary (local) roads.

The scope of work includes the assessment of potential visual impacts in terms of their nature, extent, duration, magnitude, probability, and significance during the construction and operation of the proposed facility.

In this regard, specific issues related to the potential visual impact were identified during a site visit to the affected environment. Issues related to the proposed Photovoltaic plant include:

- The visibility of the facility to, and potential visual impact on, observers travelling along the secondary roads in close proximity of the proposed facility.
- The visibility of the facility to, and potential visual impact on, individual/isolated landowners/homesteads located within areas of potential visual exposure. Some of these may include *Kameelfontein, Kaalfontein, Sterkstroom, Goedgevonden, Paardedrift, Kasjet*, etc.
- The potential visual exposure of the facility to protected areas in close proximity to the proposed PV plant (i.e. specifically the farms Kasjet 59 KR and Olievenfontein 111 KR that form part of the Waterberg Biosphere Reserve's buffer areas).
- The visibility of the facility to, and potential visual impact on tourist routes and destinations within the region, with specific reference to the scenic Waterberg Meander.
- The potential visual impact of the construction of ancillary infrastructure (i.e. the switching station, internal access roads and low volume water supply pipeline) on observers in close proximity to the facility.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity to the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts.

3. METHODOLOGY FOR THE ASSESSMENT OF THE VISUAL IMPACT

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography, and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The procedure utilised to identify issues related to the visual impact includes the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment.

- The sourcing of relevant spatial data. This includes cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed facility could have a potential impact.
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed Waterberg Photovoltaic plant and its related infrastructure, as well as to offer potential mitigation measures, where required.

The following methodology has been followed for the assessment of visual impact:

- **Determine potential visual exposure**

  The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed PV plant and associated infrastructure were not visible, no impact would occur.

  Viewshed analyses of the proposed PV plant facility and the related infrastructure, based on a 20 m interval digital terrain model of the study area, indicate the potential visibility.

- **Determine visual distance / observer proximity to the facility**

  In order to refine the visual exposure of the facility on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence for the facility.

  Proximity radii for the proposed development site are created in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structures in relation to their environment.

  The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed facility.

- **Determine viewer incidence / viewer perception**

  The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed PV plant and its related infrastructure.

  It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, and purpose of sighting which would create a myriad of options.

- **Determine the visual absorption capacity of the natural vegetation**

  This is the capacity of the receiving environment to absorb or screen the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

  The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate the potential visual absorption capacity (VAC) of the natural vegetation of the region. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, supplemented with field observations.

- **Determine the visual impact index**

  The results of the above analyses are merged in order to determine where the areas of likely visual impact would occur. These areas are further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

4. THE AFFECTED ENVIRONMENT

The proposed location for the PV plant is situated approximately 24km by secondary road north-east of Vaalwater on portion 2 of the farm Goedgevonden 104 KR.

The site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha (but no more than 30 ha). This development site of 20 ha will be situated within the greater 50 ha footprint.

This farm (surface area 7.5km^2) is located on the Waterberg plateau (table land) at elevations ranging between 1360m and 1420m above mean sea level.

The farm has an even slope gradient and the site-specific terrain morphological description is *lowlands with hills*.

The Melk River (which drains into the Lephalale River sub-catchment) forms the eastern boundary of the farm, which straddles the watershed boundary between this river and the Dwars River sub-catchment. The latter converges with the Mokolo River near Vaalwater. See **Map 1.**

The predominant economic activity within the study area is cattle and game farming with some irrigated and dryland agriculture occurring at a less intensive degree.

The study area has a low population density (less than 10 people per km^2) with the highest concentration occurring at the small town of Vaalwater. The proposed site location can be described as remote.

The only arterial road is the R33 in the east of the study area. This road also forms part of the *Waterberg Meander* tourist route. The remainder of roads are secondary (local) roads.

The area is rural in character with very few structures impinging on the general sense of place. Farming homesteads dot the countryside at irregular intervals.

Vegetation cover is defined as natural *woodland* and *thicket and bushland*, while large tracts of land, including parts of the proposed farm, have been transformed (fallow land, old agricultural fields or overgrazed land) through agricultural or cattle farming practises. See **Map 2** for the broad land cover types map of the study area.

Figure 1: General environment surrounding the proposed Waterberg PV Plant.

Figure 2: Natural vegetation cover surrounding the proposed Waterberg PV Plant.

The Waterberg Biosphere Reserve (buffer and transition area) is located in the north west of the study area.

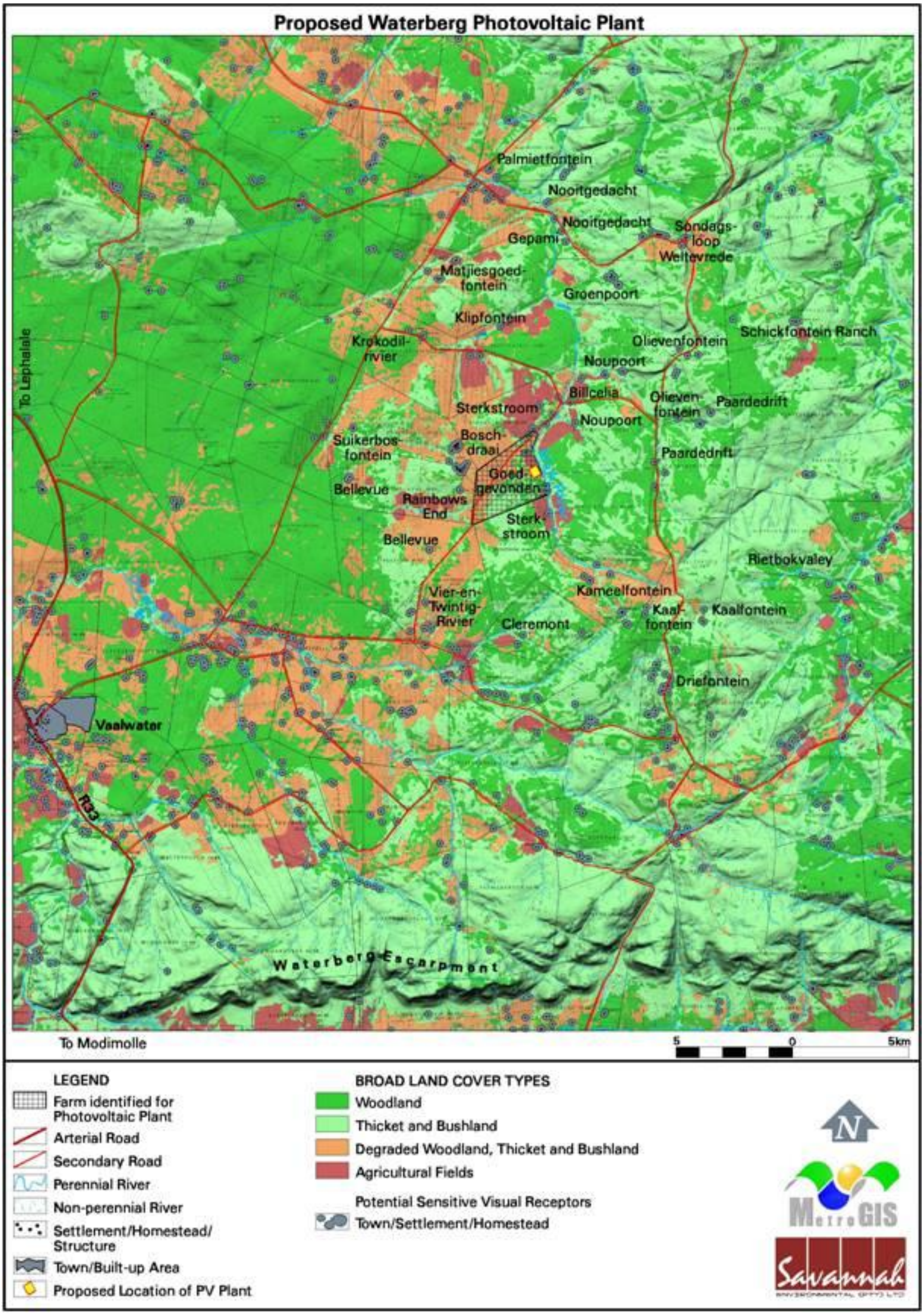
Biosphere Reserve ***core areas*** represent *"securely protected sites for conserving biological diversity, monitoring minimally disturbed ecosystems, and undertaking non-destructive research and other low-impact uses".* Biosphere Reserves further include ***buffer zones*** that *"surrounds or adjoins the core areas, and is used for co-operative activities compatible with sound ecological practices, including environmental education, recreation, and eco-tourism and applied and basic research*" and ***transition zones*** that *"contain a variety of agricultural activities, settlements and other uses".*[1]

A small section of the site (north west of the secondary road) is located within the transition zone of the Biosphere Reserve. However, the facility footprint (i.e. the location of the PV plant infrastructure on the site) falls outside of this zone. See **Map 3.**

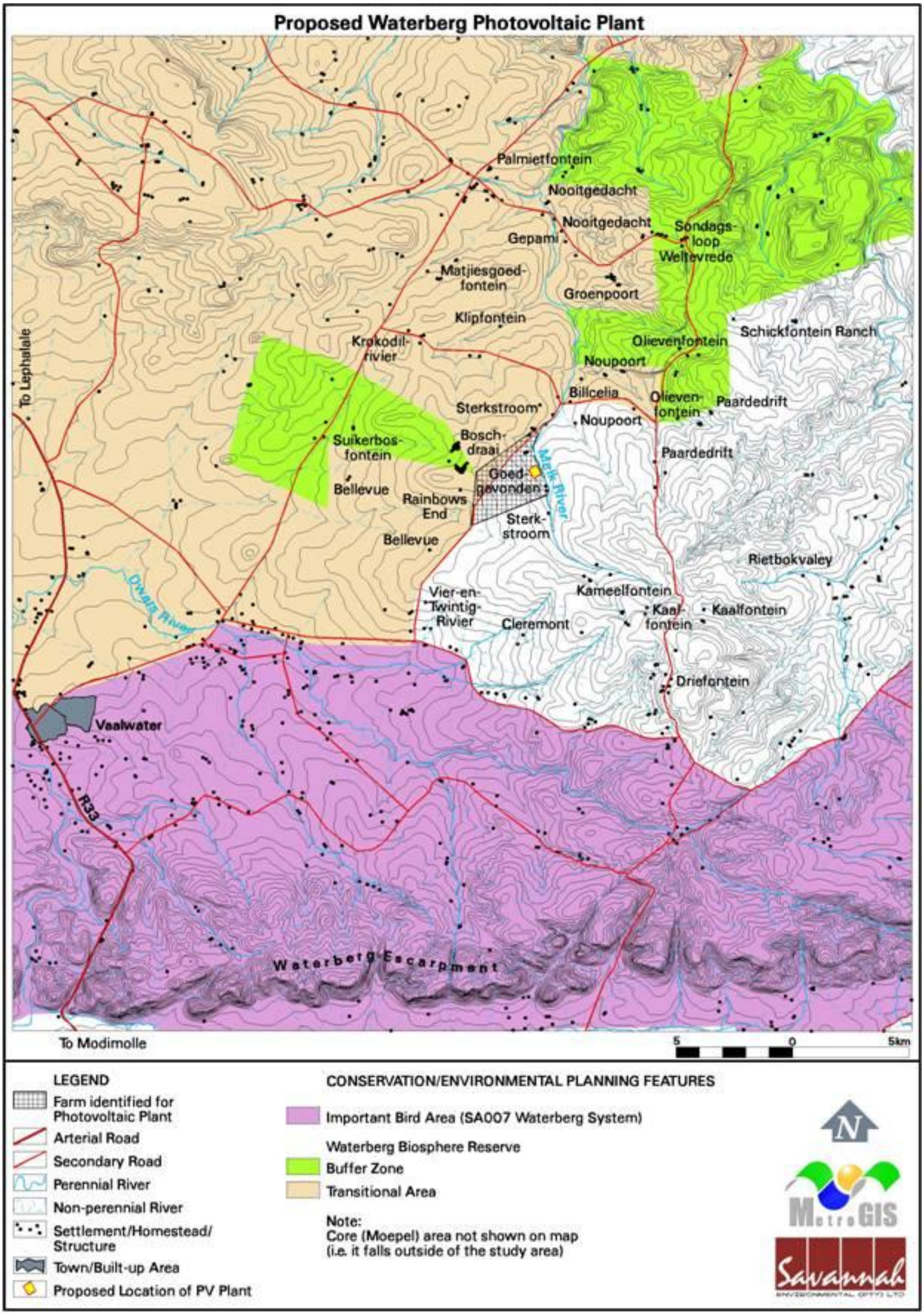
In the south of the study area is an area identified as an *Important Bird Area* although it does not enjoy any statutory protection.

Source: Department of Environmental Affairs and Tourism (2001), CSIR/ARC NLC (2000) and site observations.

[1] *Cape Nature, 2008. (Joint statement by biosphere reserve managers/coordinators regarding developments within the core, buffer and transition areas).*



Map 2: Broad land cover and land use including potential sensitive visual receptors within the study area



Map 3: Conservation and environmental planning features within the study area.

5. RESULTS

5.1. Potential visual exposure

The visibility analysis was undertaken from actual ground level at an offset of 6m (the approximate maximum height of the structures) above average ground level. As no formal layout of the PV plant is available yet, the entire area of the proposed development footprint was used in order to simulate a worst-case scenario.

The potential visual exposure of the facility is indicated on **Map 4**. The shading indicates areas from which the facility would potentially be visible.

It is clear from the viewshed analysis that the facility would be exposed to a relatively small and localised geographical area within this region due to the small dimensions of the facility's components.

A scattered area of visual exposure will be limited to higher lying areas (e.g. hilltops and ridges) located to the north-east and south-east of the proposed PV plant. This is due to the plant's proposed location on agricultural land adjacent to the Melk River (i.e. at a relatively low elevation in relation to other areas within the farm) as well as the structure dimensions (i.e. a maximum height of 6m).

The PV plant is not expected to be visible from any major roads (i.e. the R33 arterial road) but may be visible from limited sections of the secondary roads near the site (i.e. from the secondary road traversing the farm Goedgevonden 104 KR). Visibility may be possible from the following homesteads/settlements where the natural vegetation cover permits (i.e. where the natural vegetation had been removed):

- Kameelfontein
- Kaalfontein
- Goedgevonden
- Billcelia
- Paardedrift
- Noupoort
- Olievenfontein

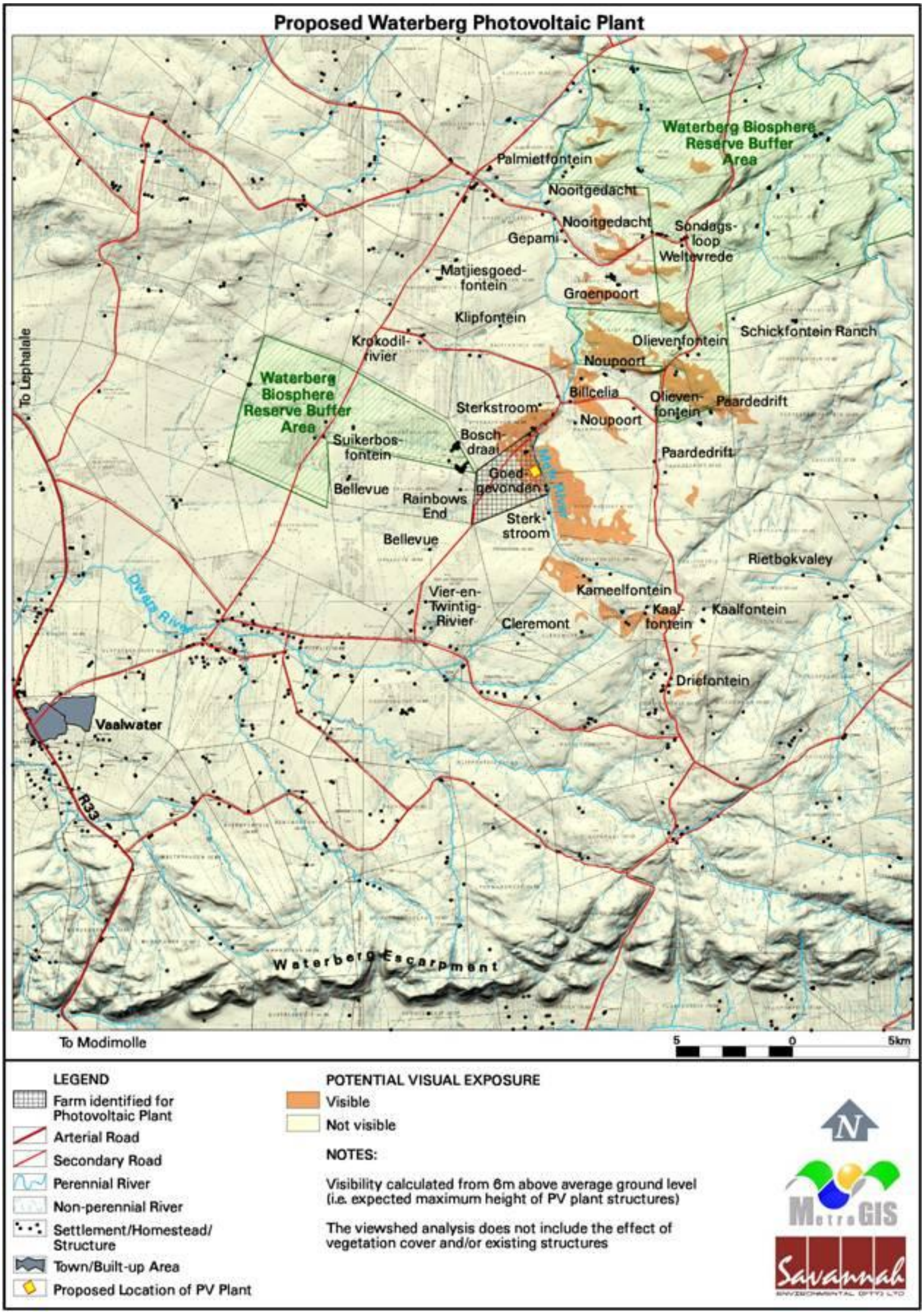
The proposed PV plant will not be visible from Vaalwater.

It is envisaged that the structures, **where visible from short distances**, would be easily and comfortably visible to observers travelling along secondary roads or from residences located nearby, especially within a 4km radius of the PV plant.

What would be visible is a relatively expansive surface area (approximately 20ha) utilised by the PV infrastructure, notwithstanding the constrained vertical dimensions of the PV plant.

A portion of the property on which the proposed development is located falls within the transition zone of the Waterberg Biosphere Reserve, although the proposed development footprint for the facility itself does not.

The development will, however, potentially be visible from a section of the Waterberg Biosphere Reserve's buffer zone.



Map 4: Potential visual exposure of the proposed Waterberg PV plant.

5.2 Visual distance/observer proximity to the facility

MetroGIS determined the proximity radii based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure). MetroGIS developed this methodology in the absence of any known and/or acceptable standards for South African solar facilities.

The proximity radii (calculated from the boundary of the proposed development footprint for the PV plant) are shown on **Map 5** and are as follows:

- 0 - 4km. Short distance view where the PV plant would dominate the frame of vision and constitute a very high visual prominence.
- 4 - 8km. Medium distance view where the structures would be easily and comfortable visible and constitute a high visual prominence.
- 8 - 16km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 16km. Long distance view of the facility where the facility could potentially still be visible though not as easily recognisable. This zone constitutes a medium to low visual prominence for the facility.

It is envisaged that the nature of the structure within the natural state of the regional environment would create a significant contrast that would make the facility visible and recognisable from within the determined viewshed.

5.3 Viewer incidence/viewer perception

Refer to **Map 5**. Viewer incidence is calculated to be the highest along corridor/roads within the study area. Although these corridors do not carry many observers per se, they do represent the highest *potential concentration* of observers within the study area.

Viewer incidence is relatively low within a 16 km radius of the proposed PV plant. However, the region has a high tourism value and inherent sense of place based on culture, game farming and history. A plethora of lodges, accommodation, community linked projects and scenic vantage points occur within the region.

In addition, the so-called 'Waterberg Meander' is routed along the R33, which bypasses the site some 20km to the west. This route falls outside of the potential viewshed zone (see **Map 4**), but some of the tourist destinations within the study area are listed attractions as part of the Meander.

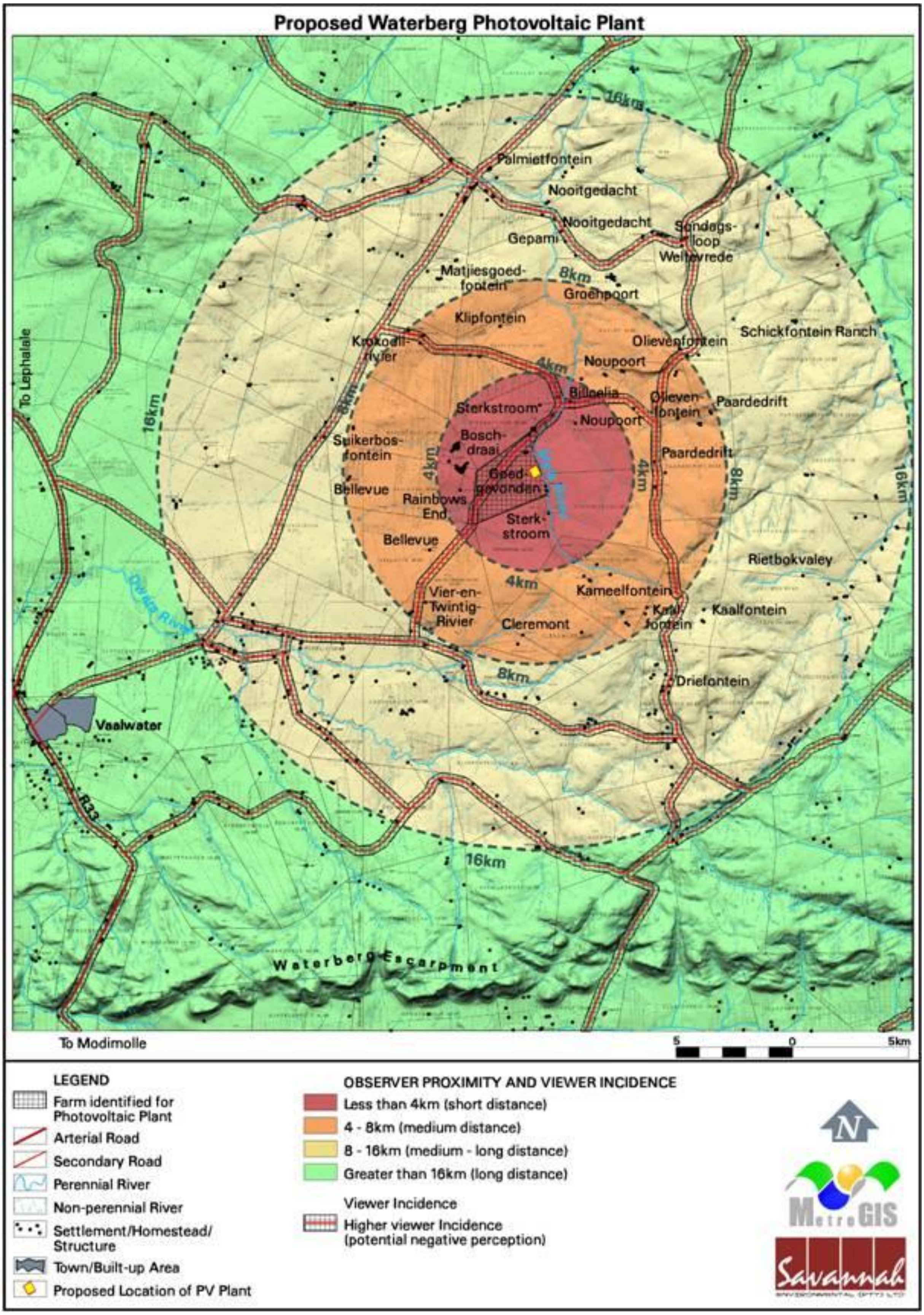
Residents and visitors to this area are considered to be potentially sensitive visual receptors upon which the proposed facility could have a negative visual impact. This is specific for observers in close proximity to the facility, who fall within the potential viewshed zone, as the severity of the visual impact decreases with increased distance from the proposed facility.

These observers may have potentially negative perceptions of the PV plant, especially if they are hospitality operators or their guests staying at, or travelling to and from tourist destinations in the region.

Receptors residing in this area are accustomed to the wide natural and agricultural expanses. Developments, especially industrial style structures, visible from their homesteads/settlements may constitute a negative visual impact. The property of Mr Willie Van Rooyen (i.e. Sterkstroom Farm) represents such a receptor. Land use on this farm includes both cattle ranching and tourism facilities. The latter will be visually affected by the proposed PV plant.

The Waterberg Biosphere Reserve transition and buffer zones also represent potentially sensitive visual receptor sites due to the nature oriented tourism activities taking place within. This having been said, the following is of relevance:

- The proposed development footprint lies outside of the Waterberg Biosphere Reserve's buffer and transitional areas. A portion of the broader property falls within the transition area, but no infrastructure is proposed for this portion (i.e. the developmental footprint falls outside the Waterberg Biosphere area).
- The extent of the potential visual exposure is very limited within the Waterberg Biosphere Reserve buffer zone.



Map 5: Observer proximity to the proposed Waterberg PV plant and areas of potentially high viewer incidence.

5.4. Visual absorption capacity of the natural vegetation

The visual absorption capacity (VAC) of the natural vegetation cover (*woodland* and *thicket and bushland*) is considered high for this study area.

Refer to **Figure 3**, which shows a view from a point opposite Kataba Ranch (on the southern side of the D2416 road, just west of *Billcelia*) an area that is shown to be visually exposed in the viewshed analysis (Map 2). The proposed development site lies directly within line of sight from where the photo was taken, but the dense bush (even after a burn) will not allow for a view of the facility.

Similarly, it may be assumed that all receptor sites within the potential viewshed may be similarly screened from the visual impact of the proposed facility, provided the natural vegetation *in close proximity to the receptor* is intact, and the receptor is not positioned on an elevated vantage point looking down onto the PV plant.

Figure 3: Photograph depicting the potentially high Visual Absorption Capacity of the vegetation in the study area.

5.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed PV plant are displayed on **Map 6.** Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index. The vegetation absorption capacity of the surrounding vegetation is not included in the calculation of these indices.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception by affected receptors (i.e. they have complained or raised concerns) would therefore have a higher value (greater impact) on the index. This helps in focusing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

The index immediately gives a strong indication that observers in close proximity to the facility (within 4 km) would have the highest visual experience of the facility and would be exposed to a **high** visual impact.

Observers travelling along the limited stretch of the access road to the facility and on the D2747 secondary road could experience **very high** visual impact. Although these roads do not carry a large number of motorists, they provide thoroughfare and access to a number of tourism destinations and stopping points off the Waterberg Meander.

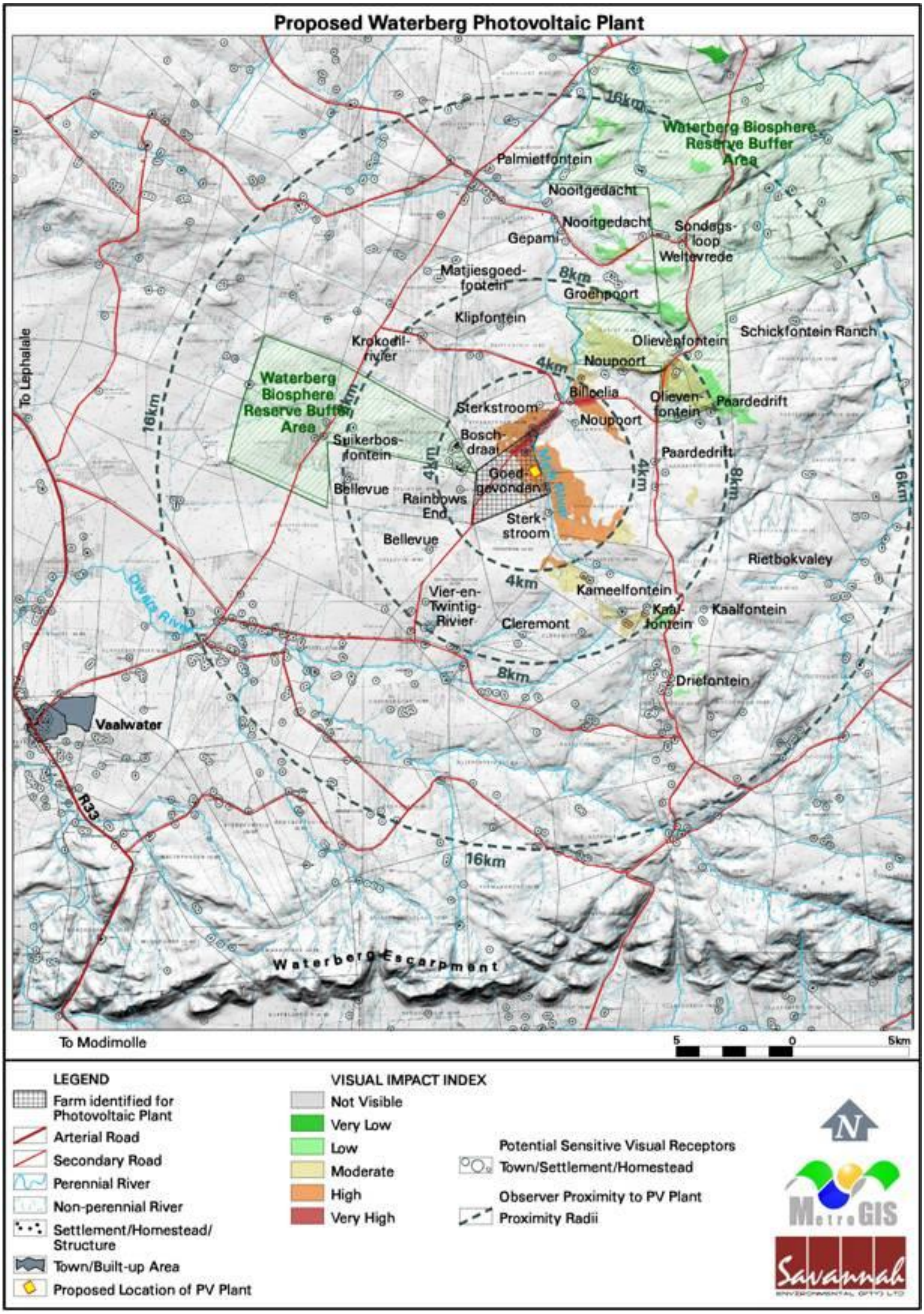
It is, however, envisaged that many people travelling along this road would more than likely be visiting the facility (which would be an attraction of sorts) or be local farmers/workers travelling to town.

Other areas highlighted by the visual impact index are the settlements and farmsteads surrounding the facility (mostly concentrated to the north-east). These areas would be impacted on at distances of between 4 and 8 km and may experience **moderate** visual impact.

It is interesting to note that the other smaller settlements and farmsteads (some as close as 2 to 3 km from the facility) as well as settlements and sites along the D579, D2416 and D1959 secondary roads would either not be able to see the PV plant or would at best catch glimpses of the facility. This is due the plant's low-lying location in the landscape (i.e. close to the Melk River).

Very limited parts of the Waterberg Biosphere Reserve transition zone could be subject to **high** visual impact.

At this point, it is important to consider the high VAC of the vegetation in the study area. Where present, this high VAC will reduce the probability of the above visual impacts occurring. The effect of the VAC is thus taken into account during the impact assessment which follows.



Map 6: Visual impact index of the proposed Waterberg PV plant.

5.6. Visual impact assessment

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 2: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads near the proposed PV plant) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude**- None (= 0), minor (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5)
- **Probability** - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5)
- **Nature** (positive, negative or neutral)
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5)
- **Significance** - low, medium, or high.

The **significance** of the potential visual impact is equal to the **consequence** multiplied by the **probability** of the impact occurring, where the consequence is determined by the sum of the individual scores for magnitude, reversibility, duration and extent (i.e. **significance = consequence (magnitude + reversibility + duration + extent) x probability**).

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

*Please note that due to the declining visual impact over distance, the **extent** (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.*

5.6.1 The PV plant

Potential visual impact on users of secondary roads and settlements in close proximity to the PV plant

It has been established that the PV plant would be visible from various secondary roads and potential tourist routes within the region, although not from the R33.

The observers' purpose for visiting the region (nature oriented tourism) and the industrial nature of the facility's structure will be in conflict. This applies to the D2747, D2416, and D579 that will have a short distance view (i.e. within 4km) of the proposed development site, constituting a **high** visual impact. If VAC and mitigation are taken into account, this impact is expected to be **medium.**

The settlement of *Billcelia* in close proximity of the proposed PV plant may experience a **high** visual impact. Similarly, this impact will be **medium** if VAC and mitigation are taken into account.

The table below illustrates this impact assessment.

Table 1 Impact table summarising the significance of visual impacts on users of secondary roads in close proximity of the PV plant.

Nature of Impact: Potential visual impact on users of secondary roads in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very High **(5)**	Very High **(5)**	Very High **(5)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	High **(64)**	Medium **(48)**	Medium **(32)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on residents of settlements within the region

The proposed PV plant not will be visible from any built up areas within close proximity of the development site. The closest town (Vaalwater) to the facility is situated approximately 30km away as the crow flies. Settlements located beyond the 8km radius have not been reflected in the table below.

Other settlements in the region (i.e. between 4km and 8km from the proposed PV plant) may experience a **medium** visual impact, even with VAC being taken into account. These include *Kameelfontein* and *Kaalfontein.* This impact may be mitigated to **low**.

Many of the settlements that are not envisaged to be visually affected are situated behind hillocks/undulations and are effectively shielded by the topography.

The table below illustrates this impact assessment.

Table 2 Impact table summarising the significance of visual impacts on residents of settlements within the region.

Nature of Impact: Potential visual impact on residents of settlements within the region			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(3)**	Moderate **(3)**	Moderate **(3)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	Medium **(52)**	Medium **(39)**	Low **(26)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on protected areas in close proximity of the PV plant

The PV plant will potentially affect very limited parts of the transition zone of the Waterberg Biosphere Reserve. Within these very limited areas, visual impact is anticipated to be **low.**

The table below illustrates this impact assessment.

Table 3 Impact table summarising the significance of visual impacts on protected areas in close proximity of the PV plant.

Nature of Impact: Potential visual impact on protected areas in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	Low **(2)**	Improbable **(1)**	Improbable **(1)**
Significance	Low **(30)**	Low **(15)**	Low **(15)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on tourist routes and destinations within the region

Some of the farms adjacent to the proposed facility have been set aside for game farming/cattle farming and tourism destinations. These and other 'points of interest' off the Waterberg Meander could result in a **medium** visual impact. Certain stretches along the D579, D2416, D2747, and D1959 may be similarly impact on. This impact remains of **medium** significance when considering VAC, and may be mitigated to **low.**

The table below illustrates this impact assessment.

Table 4 Impact table summarising the significance of visual impacts on tourist routes and destinations within the region.

Nature of Impact: Potential visual impact on tourist routes and destinations within the region			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	Medium **(56)**	Medium **(42)**	Low **(28)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.2.2 Ancillary infrastructure

Potential visual impact of on-site ancillary infrastructure on visual receptors in close proximity of the PV plant.

The ancillary infrastructure associated with the PV plant includes a switching station, internal access roads, and a low volume water supply pipeline from an on-site borehole, workshop/storage area, and a visitor's centre.

These structures will not significantly add to the visual impact of the PV plant, as they will all be modestly sized, and will thus not exceed the visual exposure of the primary PV infrastructure.

The anticipated impacted of this ancillary infrastructure is expected to be **medium**. This impact has a **low** significance when taking VAC into account.

The table below illustrates this impact assessment.

Table 5 Impact table summarising the significance of visual impacts of ancillary infrastructure on visual receptors in close proximity of the PV plant.

Nature of Impact: Potential visual impact of ancillary infrastructure on visual receptors in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	Medium **(3)**	Low **(2)**	Low **(2)**
Significance	Medium **(45)**	Low **(30)**	Low **(30)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.3. Secondary visual impacts

5.3.1. Lighting impacts

Potential visual impact of lighting on visual receptors in close proximity of the PV plant.

The area earmarked for the placement of the PV Plant has a relatively small number of populated places (towns, settlements and farmsteads).

Although these are not densely populated areas, the light trespass and glare from the security and after-hours operational lighting will have some significance. Furthermore, the sense of place and cultural ambiance of the local area increases its sensitivity to such lighting intrusions

However, it is reported that in terms of security lighting, no high mast lights will be installed on site as these would interfere with the operations of the plant due to shading. It is planned that infrared security cameras will be used, and that maintenance activities would likely be undertaken with the use of torches.

The anticipated impacts of lighting are expected to be **moderate**, and becomes of **low** significance when considering VAC.

The table below illustrates this impact assessment.

Table 6 Impact table summarising the significance of visual impacts of lighting on visual receptors in close proximity of the PV plant.

Nature of Impact: Potential visual impact of lighting on visual receptors in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Low **(2)**	Low **(2)**	Low **(2)**
Probability	Medium **(3)**	Low **(2)**	Low **(2)**
Significance	Medium **(39)**	Low **(26)**	Low **(26)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.3.2. Potential visual impacts associated with the construction phase

The construction phase of a project is potentially the phase that causes the most disturbances. During this time there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and landowners in the area.

Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:

- Reduce the construction period through careful planning and productive implementation of resources.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
- Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
- Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

5.4 The potential to mitigate visual impacts

- The primary visual impact, namely the appearance of the PV plant (mainly the solar panel field) is not possible to mitigate. Although the functional design of the structures cannot be changed in order to reduce visual impacts, it is proposed that the standard height of the units be set at 3-4m and that a 6m height should only be used on exception where absolutely necessary. This will reduce the facility’s visual intrusion and increase the vegetations’ ability to mask the facility.

The proposed placement of the proposed facility on the site is the best spot in terms of minimising potential visual impact (i.e. low down in the landscape, visually shielded by topography).

The high VAC of the natural vegetation also goes far in reducing the significance of potential visual impacts. Similarly, it may be assumed that receptor sites exposed to visual impact may mitigate this impact by planting a vegetation screen similar in form and density to the natural vegetation of the receiving environment. It should be noted, however, that this measure will only be effective if the screen is planted *in close proximity to the receptor*. This means that the visual impact must be screened at the property which is experiencing the impact, rather than at the development site itself.

It is recommended that the visual screen be planned and specified by a planning professional in order to maximise the screening benefit. In addition, it is imperative that the species of plants utilised be ecologically appropriate for the natural environment.

- Mitigation of secondary visual impacts associated with the construction of roads include proper planning and construction of roads with adequate drainage structures in place to forego potential erosion problems.

  The pipeline should be placed underground to avoid additional visual clutter. Proper re-instatement and re-vegetation is recommended for the pipeline.

  Also, the construction areas, including road servitudes, must be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained in order to minimise the visual impact of the access roads.

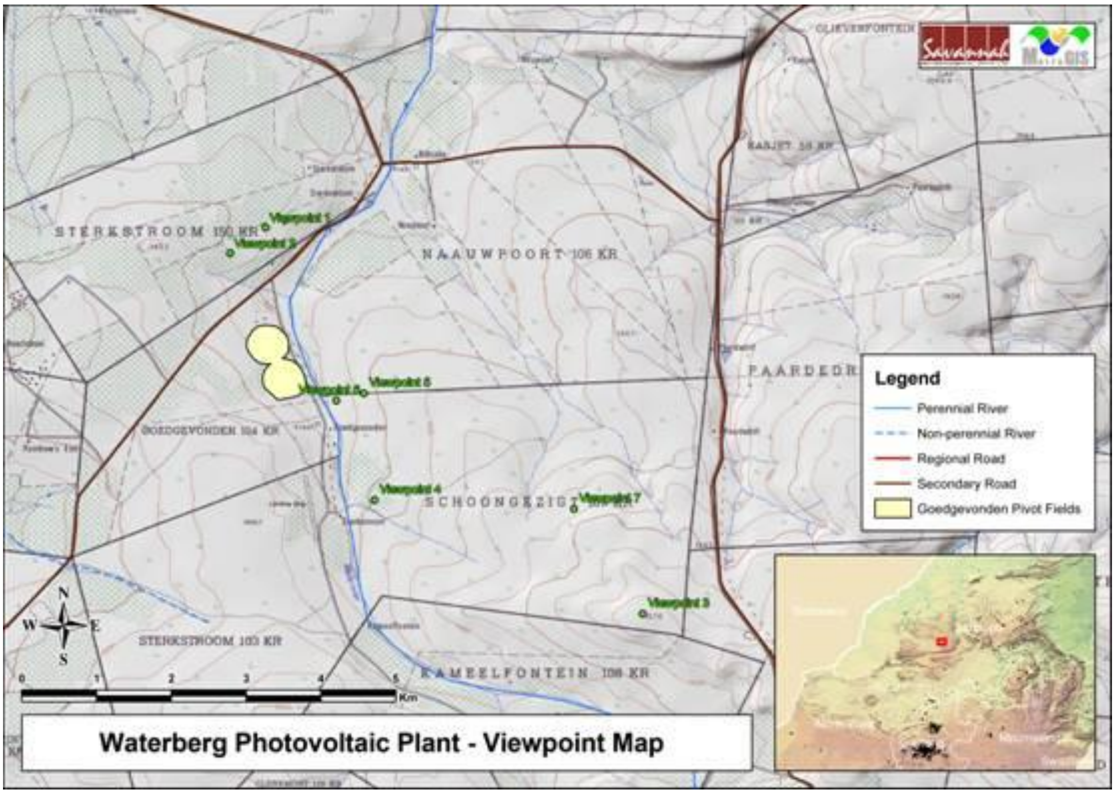
- Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:
  - Reduce the construction period through careful planning and productive implementation of resources.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
  - Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
  - Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an ongoing basis.

6. PHOTOGRAPHIC VIEWS

Photographs were taken (in addition to the above spatial analyses) in order to aid the visualisation of the potential visual impact that the facility would have on the receiving environment. Various points as highlighted in the scoping phase (through input from I&APs) as well as sites indicated by specialists' comments were visited and photographs were taken of the potential view of the development site.

The photograph positions are indicated on **Map 8** below and should be referenced with the photograph being viewed in order to place the observer in spatial context. The approximate viewing distances indicated were measured from the closest aspect of the facility to the vantage point.



Map 8: Photograph positions

Figure 4: **Viewpoint 1:** Panoramic view of the development site looking from the western boundary of the Farm Sterkstroom 105/4.

Figure 5: **Viewpoint 2:** Panoramic view looking south-east from the lodge situated on the Sterkstroom Farm 105/4

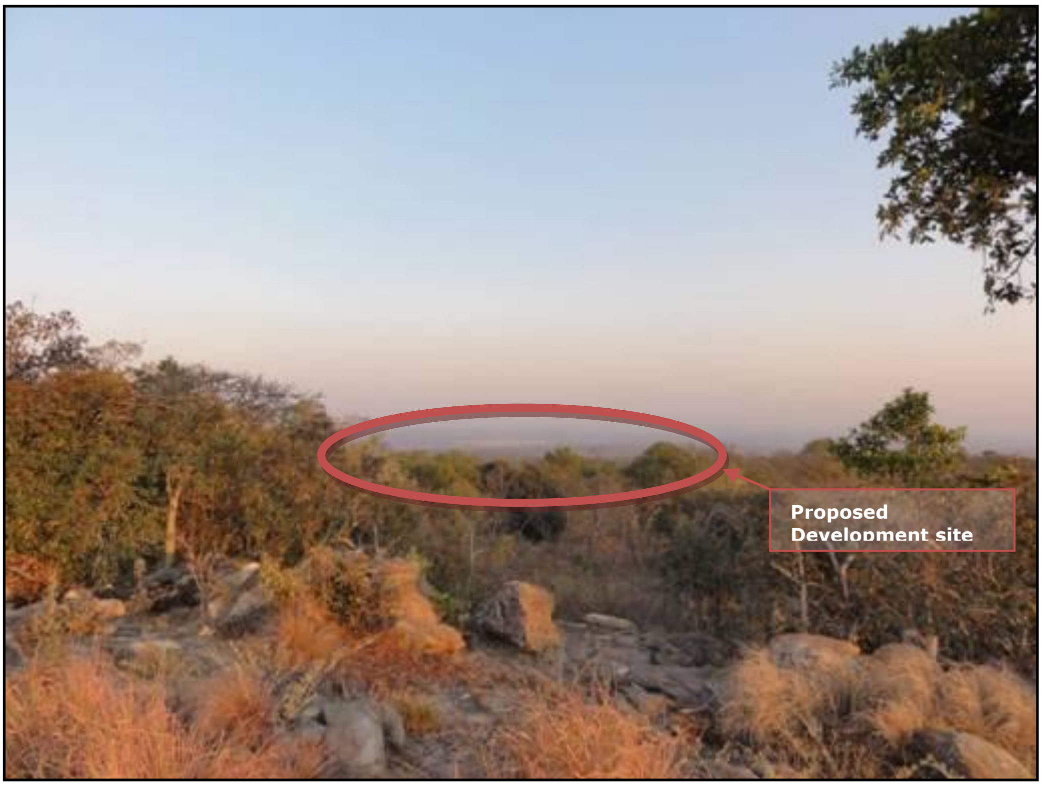


Figure 6: **Viewpoint 3:** Photographic view of the proposed site from a koppie within the Farm Schoongezigt 107 (proposed site for future lodge).

Figure 7: **Viewpoint 4:** Photographic views of the proposed site from the road next to an existing lodge undergoing renovation. Farm Schoongezigt 107.

Figure 8: **Viewpoint 5:** Photographic view of the proposed site from a road running along the farm boundary between the farms Schoongezigt 107 and Naauwpoort 106

Figure 9: **Viewpoint 6:** Photographic views of the proposed site from a road close to the south-easterly corner of the development site.

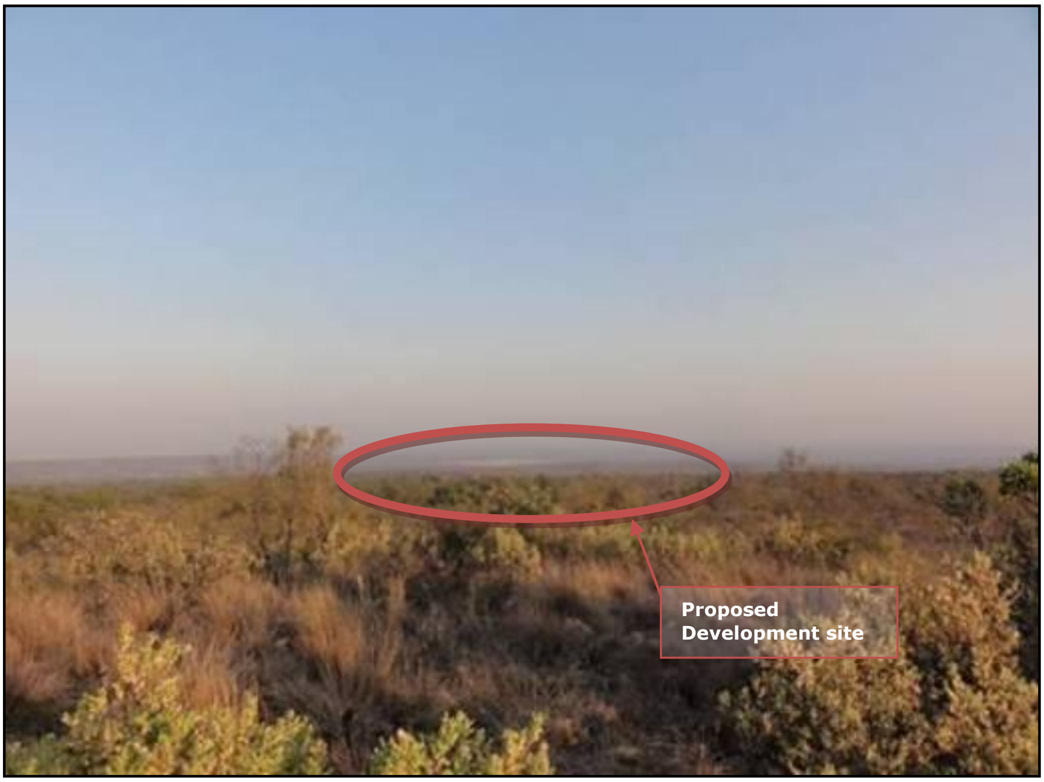


Figure 10: **Viewpoint 7** Photographic view of the proposed site from high ground within the Farm Schoongezigt 107.

7. CONCLUSIONS AND RECOMMENDATIONS

The placement of the proposed Waterberg Photovoltaic Plant and its associated structures will have a visual impact on the natural scenic resources of this region. The natural and relatively unspoiled views surrounding the PV plant will be transformed for the entire operational lifespan (approximately 30 years) of the plant.

The author is, however, of the opinion that the PV plant has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy to generate power and is therefore generally perceived in a more favourable light. It does not omit any harmful byproducts or pollutants and is therefore not negatively associated with possible health risks to observers.

The PV plant further has a novel and futuristic design that invokes a curiosity factor not present with other conventional power generating plants. The advantage being that the PV plant can become an attraction or a landmark within the region that people would actually want to come and see.

However, this opinion should not distract from the fact that the PV plant would be visible within an area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial style structures.

The area potentially affected by the proposed development is generally seen as having a high scenic value and the proposed PV plant is expected to form a noticeable contrast within this predominantly natural and agricultural region.

There are also not many options as to the mitigation of the visual impact of the facility.

Although the functional design of the structures cannot be changed in order to reduce visual impacts, it is proposed that the standard height of the units be set at 3-4m and that a 6m height should only be used on exception where absolutely necessary. This will reduce the facility's visual intrusion and increase the vegetations' ability to mask the facility.

Receptor sites exposed to visual impact may mitigate this impact by planting a vegetation screen similar in form and density to the natural vegetation of the receiving environment. It should be noted, however, that this measure will only be effective if the screen is planted *in close proximity to the receptor*. This means that the visual impact must be screened at the property which is experiencing the impact, rather than at the development site itself.

It is recommended that the visual screen be planned and specified by a planning professional in order to maximise the screening benefit. In addition, it is imperative that the species of plants utilised be ecologically appropriate for the natural environment.

Ancillary infrastructure (i.e. the switching station, the internal access roads, the pipeline, the workshop/storage area, and the visitor's centre) must be properly planned with due cognisance of the topography, that all disturbed areas be properly rehabilitated, and that all infrastructure and the general surrounds be maintained in a neat and appealing way.

The construction phase of the facility should be sensitive to potential observers in the vicinity of the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.

Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

The pipeline should be placed underground to avoid additional visual clutter. Proper re-instatement and re-vegetation is recommended for the pipeline.

The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.

8. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Waterberg PV plant, it is acknowledged that existing high quality natural and rural views from receptors surrounding the site will be transformed for the entire operational lifespan (approximately 30 years) of the facility.

The potential visual impact on users of secondary roads in close proximity to the proposed PV plant will be of medium significance after VAC and mitigation have been taken into account.

Within the region, the potential visual impact on residents and on tourist routes and destinations will be of low significance after VAC and mitigation have been taken into account. The significance of the potential visual impact on protected areas in close proximity to the facility will also be low.

This anticipated visual impact is not, however, considered to be a fatal flaw from a visual perspective, considering the relatively low incidence of visual receptors in the region, and the contained area of potential visual exposure.

Furthermore, it is the opinion of the author that this impact is not likely to detract from the regional tourism appeal, numbers of tourists or tourism potential of the existing centers and destinations. The facility may, in fact add to the plethora of attractions within the region. Within natural areas, the nature of recreational activities (game viewing, quad biking, arts and crafts viewing etc) undertaken in the region is not likely to be influenced[2].

It is therefore recommended that the development of the facility as proposed be supported, subject to the recommended mitigation measures (chapter 7) and management actions (chapter 9).

[2] *The Waterberg Meander Brochure – volume 1: http://www.waterbergbiosphere.org/News_1_Waterberg+Meander+brochure.htm*

9. MANAGEMENT PLAN

The management plan table aims to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts. The management plan primarily focuses on the mitigation and management of potential secondary visual impacts, due to the fact that the primary visual impact has very low or limited mitigation potential.

Table 7: Management plan – Waterberg Photovoltaic plant

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction and operation of the Waterberg Photovoltaic plant.		
Project component/s	Construction site, access roads, substations and internal power lines.	
Potential Impact	Potential scarring and erosion due to the unnecessary removal of vegetation	
Activity/risk source	The viewing of the abovementioned by observers on or near the site	
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity to the proposed PV plant and its related infrastructure	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	Thupela Energy/contractors	During construction
Limit access to the construction sites to existing access roads.	Thupela Energy /contractors	During construction
Rehabilitate all disturbed areas to acceptable visual standards.	Thupela Energy /contractors	During construction
Maintain the general appearance of the facility in an aesthetically pleasing way.	Thupela Energy	During Operation
Performance Indicator	Vegetation cover that remains intact with no erosion.	
Monitoring	Monitoring of vegetation clearing during the construction phase.	

9. REFERENCES/DATA SOURCES

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