PROPOSED SAN SOLAR PHOTOVOLTAIC ENERGY FACILITY, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT – INPUT FOR SCOPING REPORT

Produced for:

San Solar Energy Facility (Pty) Ltd

On behalf of:

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Lourens du Plessis (t/a LOGIS) is a *Professional Geographical Information Sciences (GISc) Practitioner* registered with The South African Geomatics Council (SAGC), and specialises in Environmental GIS and Visual Impact Assessments (VIA).

Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His GIS expertise are often utilised in Environmental Impact Assessments, Environmental Management Frameworks, State of the Environment Reports, Environmental Management Plans, tourism development and environmental awareness projects.

He holds a BA degree in Geography and Anthropology from the University of Pretoria and worked at the GisLAB (Department of Landscape Architecture) from 1990 to 1997. He later became a member of the GisLAB and in 1997, when Q-Data Consulting acquired the GisLAB, worked for GIS Business Solutions for two years as project manager and senior consultant. In 1999 he joined MetroGIS (Pty) Ltd as director and equal partner until December 2015. From January 2016 he worked for SMEC South Africa (Pty) Ltd as a technical specialist until he went independent and began trading as LOGIS in April 2017.

Lourens has received various awards for his work over the past two decades, including EPPIC Awards for ENPAT, a Q-Data Consulting Performance Award and two ESRI (Environmental Systems Research Institute) awards for *Most Analytical* and *Best Cartographic Maps*, at Annual International ESRI User Conferences. He is a co-author of the ENPAT atlas and has had several of his maps published in various tourism, educational and environmental publications.

He 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.

1. INTRODUCTION

San Solar Energy Facility (Pty) Ltd is proposing the establishment of the **San Solar PV Energy Facility** on the remaining extent of the farm Wincanton 472, which lies approximately 16 km north west of Kathu in the Northern Cape Province.

The proposed site for the San Solar PV Energy Facility is located east of a railway line that dissects the farm Wincanton 472. The portions 6 and 4 of this farm, located west of the railway line, host the operational Sishen Solar Energy Facility and the Kathu Solar Energy Facility respectively. Please refer to the maps displayed in this report for the location of the aforementioned solar energy facilities in relation to each other and in terms of their regional locality.

The proposed development site lies within the Gamagara Local Municipality within the John Taolo Gaetsewe District Municipality in the Northern Cape Province. It is located approximately 16km (at the closest) north-west of Kathu and roughly 6km north east of Dibeng.

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.

The facility is proposed to have a maximum generating capacity of up to 100MW and will be comprised of photovoltaic (PV) panels strategically placed on a portion of the proposed site.

The San Solar PV facility project site is proposed to accommodate the following infrastructure, which will enable the facility to supply a contracted capacity of up to 100W:

- Solar PV array comprising PV modules and mounting structures.
- Inverters and transformers.
- Cabling between the panels, to be laid underground where practical.
- 33/132kV onsite facility substation.
- Cabling from the onsite substation to the collector substation (either underground or overhead).
- Electrical and auxiliary equipment required at the collector substation that serves that solar energy facility, including switchyard/bay, control building, fences, etc.
- Battery Energy Storage System (BESS).
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.
- Laydown areas.
- Access roads and internal distribution roads (up to 8m wide).
- Grid connection solution including a 132kV facility substation, 132kV switching station to be connected via a Loop-in-Loop-out (LILO) connection to the Fox - Umtu 132kV overhead power line located east of the site.

Figure 1: Regional locality of the study area.

The solar PV facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the San Solar PV Facility under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the San Solar PV facility set to inject up to 100MW into the national grid. In addition to bidding into the REIPPP, the developer is also considering options such as Private Power Purchase Agreements and Wheeling agreements to deliver the generated power to private Off-takers.

The PV facility will take approximately four months to construct and the operational lifespan of the facility is estimated at up to 30 years.

The proposed properties identified for the PV facility and associated infrastructure are indicated on the maps within this report. Sample images of similar PV technology and Battery Energy Storage System (BESS) facilities are provided below.

Figure 2: Photovoltaic (PV) solar panels. (*Photo: SunPower Solar Power Plant – Prieska)*.

Figure 3: Aerial view of PV arrays. (*Photo: Scatec Solar South Africa*).

Figure 4: Aerial view of a BESS facility (*Photo: Power Engineering International)*.

Figure 5: Close up view of a BESS facility *(Photo: Greenbiz.com).*

2. SCOPE OF WORK

The scope of the work includes a scoping level visual assessment of the issues related to the visual impact. The scoping phase is the process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an impact assessment. The main purpose is to focus the impact assessment on a manageable number of important questions on which decision-making is expected to focus and to ensure that only key issues and reasonable alternatives are examined.

The study area for the visual assessment encompasses a geographical area of approximately 252km² (the extent of the full page maps displayed in this report) and includes a minimum 6km buffer zone (area of potential visual influence) from the proposed project site.

The study area includes the small town of Dibeng, a long section of the R380 arterial road, the Sishen airfield and a number of farm dwellings or homesteads.

3. METHODOLOGY

The study was undertaken using Geographical 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 topographical data provided by the Japan Aerospace Exploration Agency (JAXA), Earth Observation Research Centre, in the form of the ALOS Global Digital Surface Model "ALOS World 3D - 30m" (AW3D30) elevation model.

The methodology utilised to identify issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model of the potentially affected environment.
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments or receptors upon which the proposed facility could have a potential impact.
- The creation of viewshed analyses from the proposed project site 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 and activities.

This report (scoping report) sets out to identify the possible visual impacts related to the proposed San Solar PV Energy Facility from a desktop level.

4. THE AFFECTED ENVIRONMENT

The identified site for the proposed San Solar PV facility is located on the remaining extent of Wincanton 472, measuring approximately 9km².

The site is located east of Dibeng and approximately 18km by road (along the R380 main road) north-west of Kathu in the Southern Kalahari of the Northern Cape Province.

The topography of the study area is described as *plains* and elevations range from 1,105m in the north-west to 1,195m in the south-east of the study area near the Sishen airfield. The entire study area has a very even (flat) slope from the south-east to the north-west. The site itself is located at an average elevation of 1,143m above sea level.

The Ga-Mogara non-perennial river (a dry river bed for most of the year) is the most prominent hydrological feature within this arid region. See **Map 1** for the shaded relief/topography map of the study area.

The region is sparsely populated (less than 5 people per km^2), with the highest concentrations occurring in the towns of Kathu and Dibeng, and at the Sishen Mine. In addition to the towns and the mine settlements, a number of isolated homesteads occur throughout the study area. Some of these in the study area include:

- Bosaar[1]
- Flatlands
- Halliford
- Selsden
- Haakbosskerm homestead and restaurant
- Limebank
- Klein Landbank
- Curtis
- Dundrum

The Stokkiesdraai guesthouse is located adjacent (south-west) of the proposed San Solar PV facility site.

It is uncertain whether all of these farmsteads are inhabited or not. It stands to reason that farmsteads that are not currently inhabited will not be visually impacted upon at present. These farmsteads do, however retain the potential to be affected visually should they ever become inhabited again in the future. For this reason, the author of this document operates under the assumption that they are all inhabited.

Cattle and game farming is undertaken within the study area, with very little agricultural activity due to the scarcity of perennial water (for irrigated agriculture) and the low annual rainfall (for dryland agriculture).

Land cover is predominantly *grassland* and *low shrubland* with large areas of *open woodland* in the north-east of the study area, and also scattered throughout the south-west. The vegetation type is *Kathu Bushveld* of the *Eastern Kalahari Bushveld Bioregion*, within the *Savanna Biome*. Bare rock and soil also occur in places such as the dry Ga-Mogara floodplain.

Significant tracts of land south of the study area have been transformed by mining and prospecting activities. See **Map 2** for the broad land cover types map of the study area.

Infrastructure in the region is focussed around the Anglo America Kumba iron ore mine located south-west of Kathu. The expansion of the town of Kathu and most of the larger settlements within the study area are mainly attributed to the mine. Infrastructure closer to the proposed San Solar PV facility includes the Kathu Solar PV, Kathu Solar Energy Facility (SEF) and the Sishen Solar PV facilities.

In spite of the predominantly rural and natural character of the study area, there are a large number of overhead power lines in the study area, associated mainly with the Ferrum Substation located at the mine. These include:

- Ferrum-Wincanton 1 132kV
- Ferrum-Fox 1 132kV
- Adams-Ferrum 1 132kV

[1] The names listed below are of the homestead or farm dwelling as indicated on the SA 1: 50 000 topographical maps and do not refer to the registered farm name.

- Fox-Umtu 1 132kV
- Impala-Mamatwane 1 132

There are no designated protected areas within the region and no major tourist attractions or destinations (besides the Haakbosskerm restaurant and Stokkiesdraai guesthouse) were identified within the study area.[2]

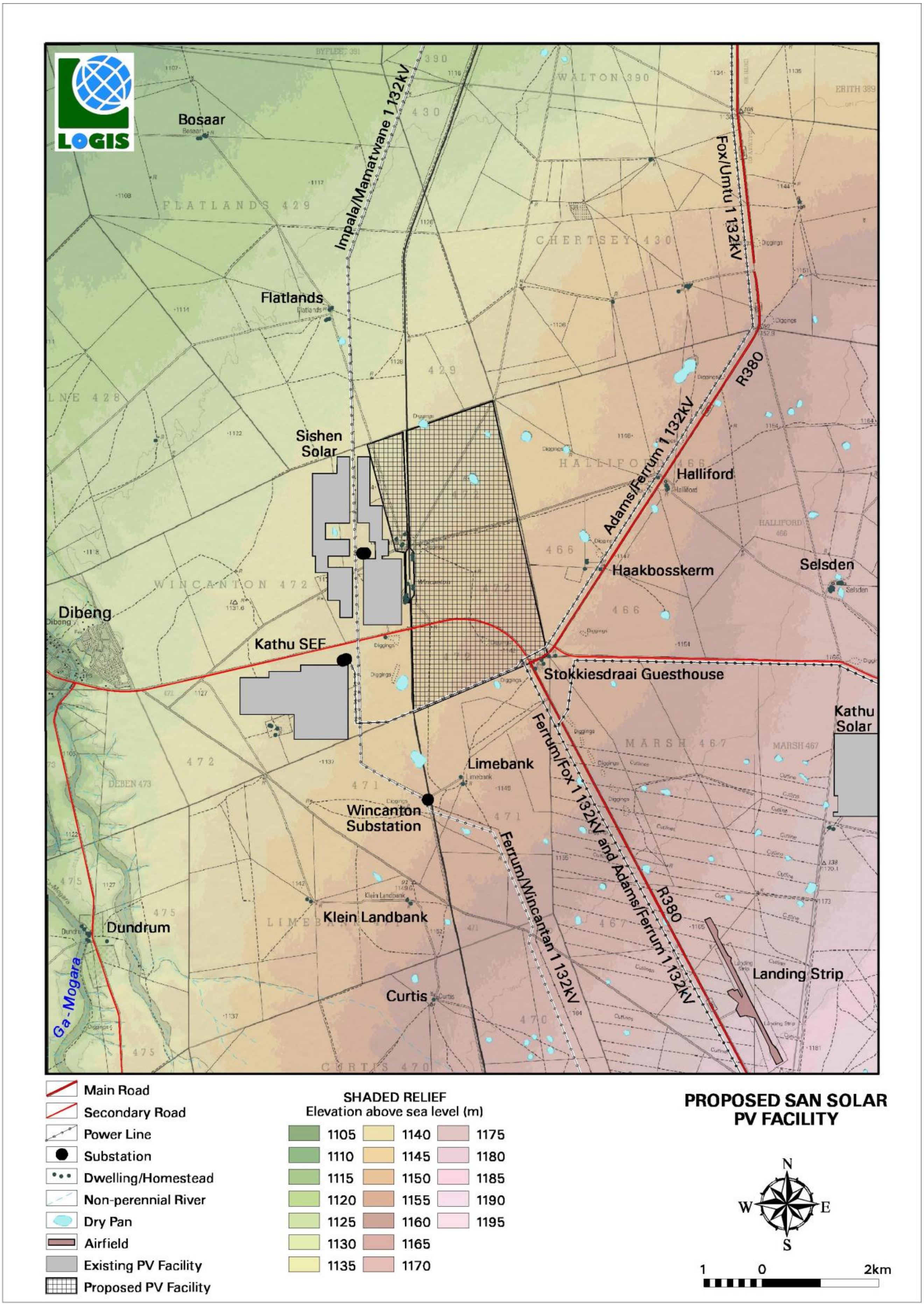
The photographs below aid in describing the general environment within the study area and surrounding the proposed project infrastructure.

Figure 6: Typical vegetation occurring in the vicinity of the proposed solar energy facility.

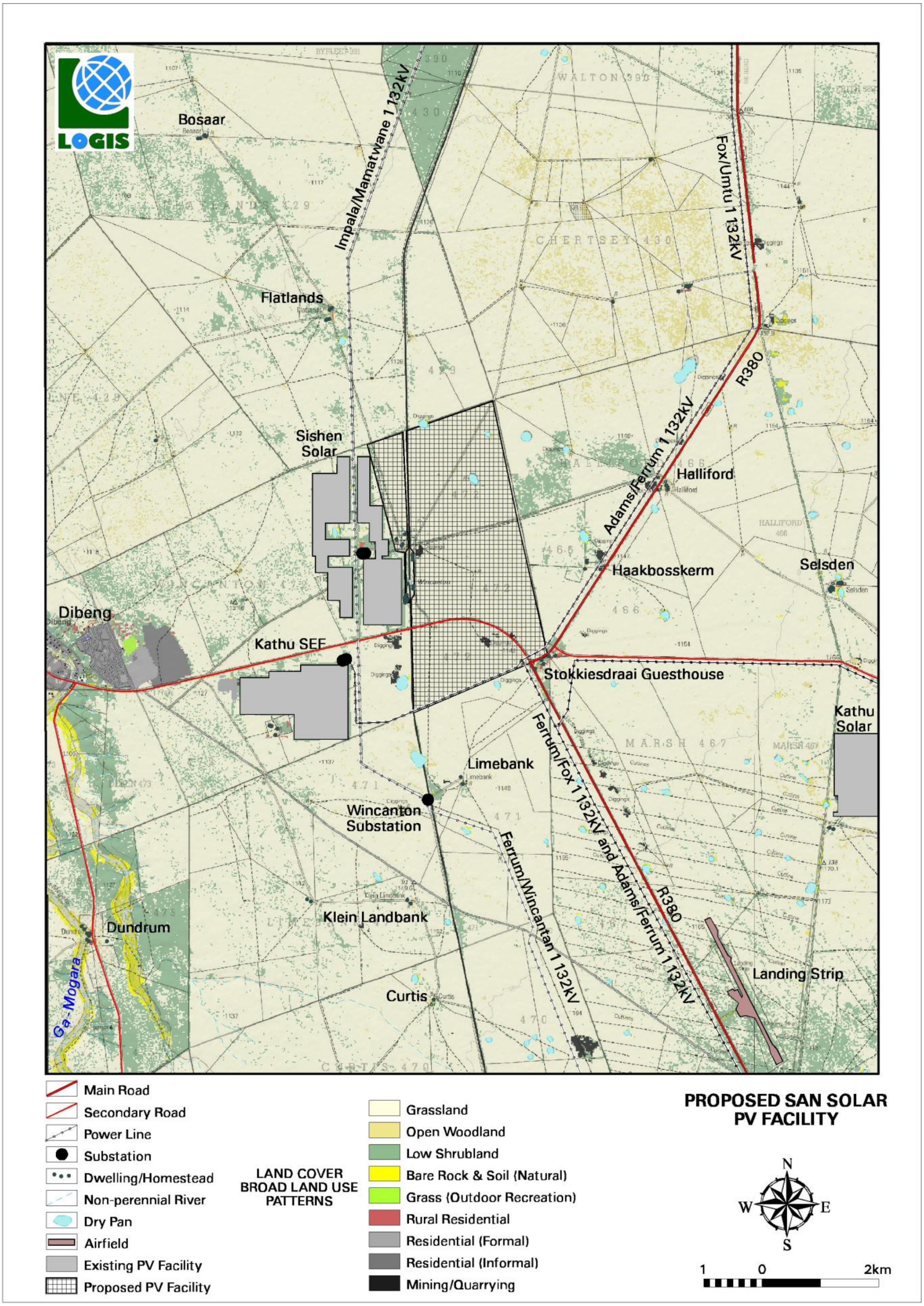
[2] Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q1 and SAPAD2021 (DFFE), Wikipedia.

Figure 7: Visual quality on the outskirts of the town of Dibeng, west of the proposed solar energy facility.

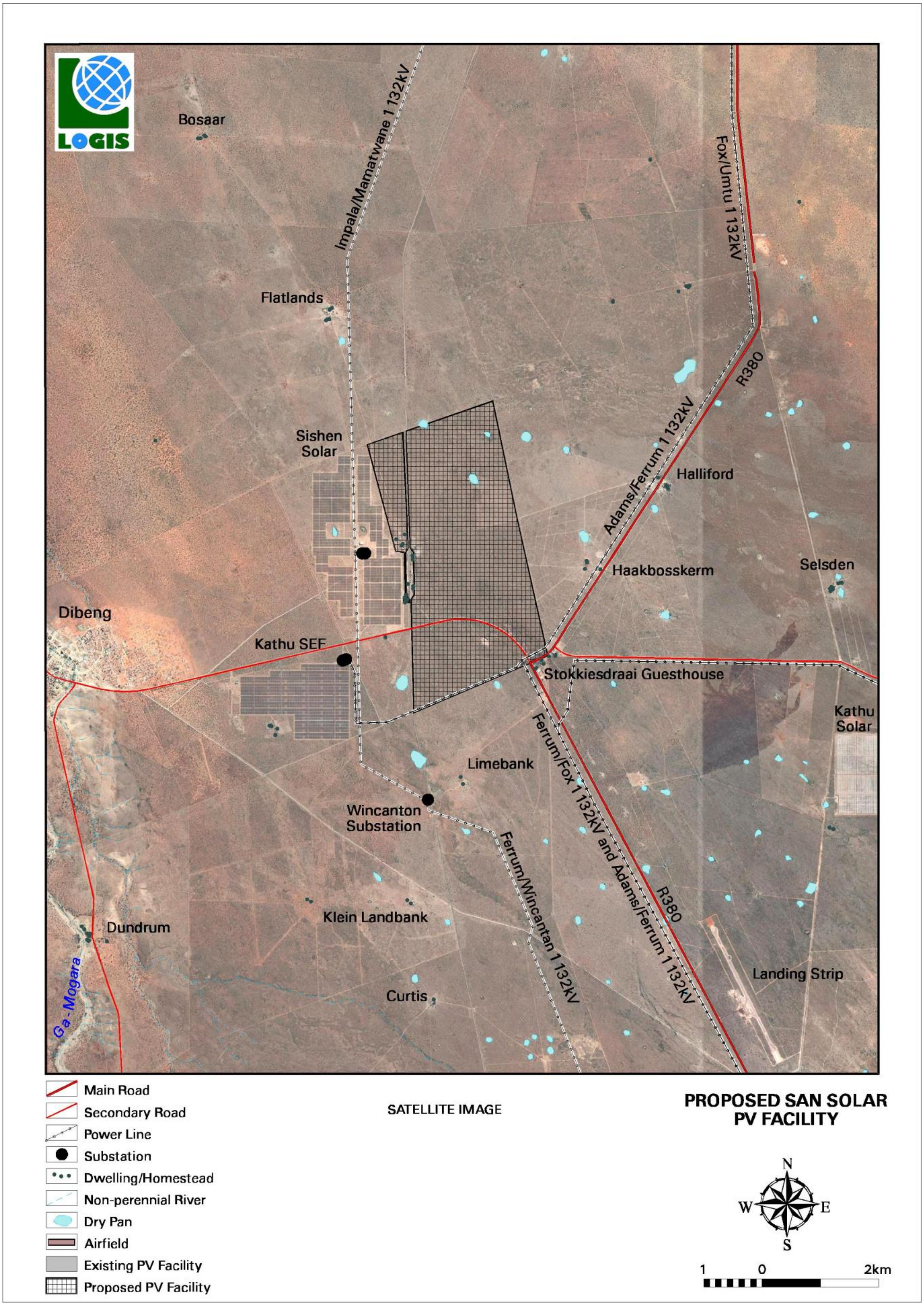
Figure 8: Visual quality of the receiving environment with railway line infrastructure evident in the foreground.



Map 1: Shaded relief map of the study area.



Map 2: Land cover and broad land use patterns.



Map 3: Satellite image.

5. VISUAL EXPOSURE/VISIBILITY

The result of the viewshed analysis for the proposed facility is shown on the map below (**Map 4**). The viewshed analysis was undertaken from a representative number of vantage points within the development footprint at an offset of 4m above ground level. This was done in order to determine the general visual exposure (visibility) of the area under investigation, simulating the maximum height of the proposed structures (PV panels, inverters and BESS) associated with the facility.

The viewshed analysis will be further refined once a preliminary and/or final layout is completed and will be regenerated for the actual position of the infrastructure on the site and actual proposed infrastructure during the EIA phase of the project.

Map 4 also indicates proximity radii from the development footprint in order to show the viewing distance (scale of observation) of the facility in relation to its surrounds.

Results

It is clear that the relatively constrained dimensions of the PV facility would amount to a fairly limited area of potential visual exposure. The visual exposure would largely be contained within a 6km radius of the proposed development site, with the predominant exposure to the north-west.

The following is evident from the viewshed analyses:

0 – 1km

The PV facility may be highly visible within a 1km radius of the development. The Stokkiesdraai guesthouse is located within this zone, as well as sections of the R380 main road.

1 – 3km

This zone contains the Haakbosskerm homestead and restaurant, the Limebank, Flatlands and Halliford homesteads, and sections of the R380 main road. Other than these potential receptor sites, the rest of the visually exposed areas fall within vacant farmland or natural open space. It is expected that the PV facility would be clearly visible from these homesteads.

3 - 6km

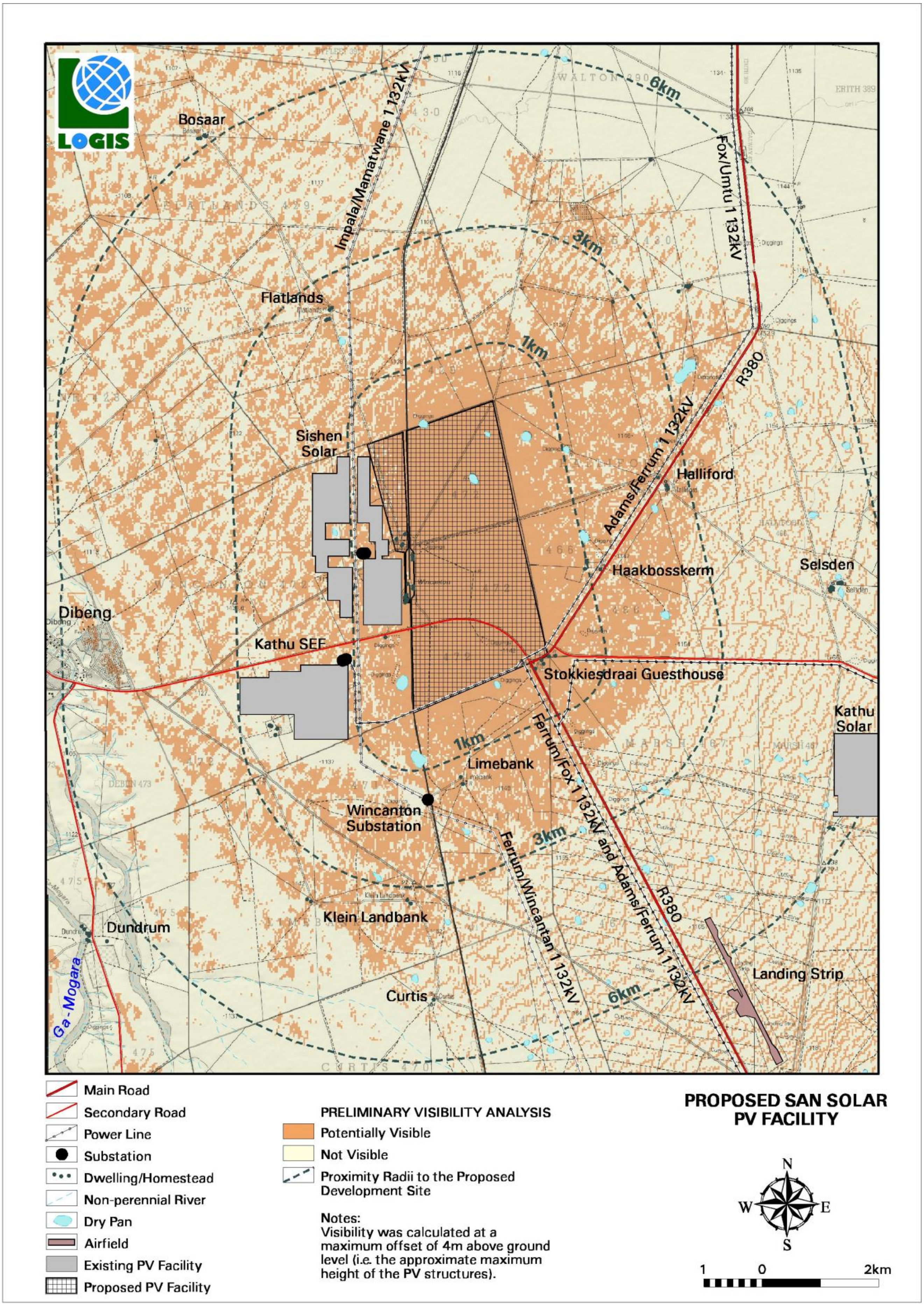
Within a 3 – 6km radius, the visual exposure is more scattered and interrupted due to the undulating nature of the topography. Most of this zone falls within vacant open space and agricultural land, but does include some farm dwellings and residences. Some of these include Curtis, Klein Landbank, Selsden and the eastern outlying parts of Dibeng. It is expected that the PV facility may be visible from these homesteads.

> 6km

At distances exceeding 6km the intensity of visual exposure is expected to be very low and highly unlikely due to the distance between the object (development) and the observer. This zone contains a single potentially exposed receptor site, namely the Bosaar homestead.

Conclusion

In general terms it is envisaged that the structures, where visible from shorter distances (e.g. less than 1km and potentially up to 3km), and where sensitive visual receptors may find themselves within this zone, may constitute a high visual prominence, potentially resulting in a visual impact. This may include residents of the farm dwellings mentioned above, as well as observers travelling along the roads in closer proximity to the facility.



Map 4: Map indicating the potential (preliminary) visual exposure of the proposed PV facility.

6. ANTICIPATED ISSUES RELATED TO THE VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed PV facility include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along the R380 main road.
- The visibility of the facility to, and potential visual impact on residents of dwellings within the study area, with specific reference to the farm residences in closer proximity to the proposed development.
- The potential visual impact of the facility on the visual character or sense of place of the region.
- The potential visual impact of the facility on tourist routes or tourist destinations/facilities (if present).
- The potential visual impact of the construction of ancillary infrastructure (i.e. internal access roads, buildings, etc.) on observers in close proximity to the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential cumulative visual impacts (or consolidation of visual impacts), with specific reference to the placement of the PV facility within close proximity of two operational PV facilities.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility.
- Potential visual impact of solar glint and glare as a visual distraction and possible air/road travel hazard.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may potentially constitute a visual impact at a local and/or regional scale. These need to be assessed in greater detail during the EIA phase of the project.

Table 1: Impact table summarising the potential primary visual impacts associated with the proposed PV facility.

<table>
<tr><td colspan="4">Impact

Visual impact of the facility on observers in close proximity to the proposed PV facility infrastructure and activities. Potential sensitive visual receptors include:

• Residents of homesteads and farm dwellings (in close proximity to the facility)
• Observers travelling along the R380 main road</td></tr>
<tr><td>Issue</td><td>Nature of Impact</td><td>Extent of Impact</td><td>No-Go Areas</td></tr>
<tr><td>The viewing of the PV</td><td>The potential negative experience of viewing</td><td>Primarily observers situated within a</td><td>N.A.</td></tr>
</table>

<table>
<tr><td>facility infrastructure and activities</td><td>the infrastructure and activities within a predominantly undeveloped setting</td><td>3km radius of the facility</td><td></td></tr>
<tr><td colspan="4">Description of expected significance of impact

Extent: Local
Duration: Long term
Magnitude: Moderate to High
Probability: Probable
Significance: Moderate to High
Status (positive, neutral or negative): Negative
Reversibility: Recoverable
Irreplaceable loss of resources: No
Can impacts be mitigated: Yes</td></tr>
<tr><td colspan="4">Gaps in knowledge & recommendations for further study

A finalised layout of the PV facility and ancillary infrastructure are required for further analysis. This includes the provision of the dimensions of the proposed structures and ancillary equipment.

Additional spatial analyses are required in order to create a visual impact index that will include the following criteria:
Visual exposure
Visual distance/observer proximity to the structures/activities
Viewer incidence/viewer perception (sensitive visual receptors)
Visual absorption capacity of the environment surrounding the infrastructure and activities
Additional activities:
Identify potential cumulative visual impacts
Undertake a site visit
Recommend mitigation measures and/or infrastructure placement alternatives
Refer to the Plan of Study for the EIA phase of the project below.</td></tr>
</table>

7. CONCLUSION AND RECOMMENDATIONS

The fact that some components of the proposed San Solar PV Energy Facility and associated infrastructure may be visible does not necessarily imply a high visual impact. Sensitive visual receptors within (but not restricted to) a 3km buffer zone from the facility need to be identified and the severity of the visual impact assessed within the EIA phase of the project.

It is recommended that additional spatial analyses be undertaken in order to create a visual impact index that will further aid in determining potential areas of visual impact. This exercise should be undertaken for the core PV facility as well as for the ancillary infrastructure, as these structures (e.g. the BESS structures) are envisaged to have varying levels of visual impact at a more localised scale. The site-specific issues (as mentioned earlier in the report) and potential sensitive visual receptors should be measured against this visual impact index and be addressed individually in terms of nature, extent, duration, probability, severity and significance of visual impact.

This recommended work must be undertaken during the Environmental Impact Assessment (EIA) Phase of reporting for this proposed project. In this respect, the Plan of Study for the EIA is as follows:

Visual Impact Assessment (VIA)

The VIA is determined according to the nature, extent, duration, intensity or magnitude, probability and significance of the potential visual impacts, and will propose management actions and/or monitoring programs, and may include recommendations related to the solar energy facility layout.

The visual impact is determined for the highest impact-operating scenario (worst-case scenario) and varying climatic conditions (i.e. different seasons, weather conditions, etc.) are not considered.

The VIA considers potential cumulative visual impacts, or alternatively the potential to concentrate visual exposure/impact within the region.

The following VIA-specific tasks must be undertaken:

- **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 (or where) the proposed facility and associated infrastructure were not visible, no impact would occur.

The viewshed analyses of the proposed facility and the related infrastructure are based on a detailed digital terrain model of the study area.

The first step in determining the visual impact of the proposed facility is to identify the areas from which the structures would be visible. The type of structures, the dimensions, the extent of operations and their support infrastructure are taken into account.

- **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 this type of structure.

Proximity radii for the proposed infrastructure 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 (anticipated) negative visual perception of the proposed facility.

- **Determine viewer incidence/viewer perception (sensitive visual receptors)**

The next layer of information is the identification of areas of high viewer incidence (i.e. main roads, residential areas, settlements, etc.) that may be exposed to the project infrastructure.

This is done in order to focus attention on areas where the perceived visual impact of the facility will be the highest and where the perception of affected observers will be negative.

Related to this data set, is a land use character map, that further aids in identifying sensitive areas and possible critical features (i.e. tourist facilities, protected areas, etc.), that should be addressed.

- **Determine the visual absorption capacity of the landscape**

This is the capacity of the receiving environment to absorb 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 VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

The VAC also generally increases with distance, where discernible detail in visual characteristics of both environment and structure decreases.

- **Calculate the visual impact index**

The results of the above analyses are merged in order to determine the areas of likely visual impact and where the viewer perception would be negative. An area with short distance visual exposure to the proposed infrastructure, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This focusses the attention to the critical areas of potential impact and determines the potential **magnitude** of the visual impact.

Geographical Information Systems (GIS) software is used to perform all the analyses and to overlay relevant geographical data sets in order to generate a visual impact index.

- **Determine impact significance**

The potential visual impacts are quantified in their respective geographical locations in order to determine the significance of the anticipated impact on identified receptors. Significance is determined as a function of extent, duration, magnitude (derived from the visual impact index) and probability. Potential cumulative and residual visual impacts are also addressed. The results of this section are displayed in impact tables and summarised in an impact statement.

- **Propose mitigation measures**

The preferred alternative (or a possible permutation of the alternatives) will be based on its potential to reduce the visual impact. Additional general mitigation measures will be proposed in terms of the planning, construction, operation and decommissioning phases of the project.

- **Reporting and map display**

All the data categories, used to calculate the visual impact index, and the results of the analyses will be displayed as maps in the accompanying report. The methodology of the analyses, the results of the visual impact assessment and the conclusion of the assessment will be addressed in the VIA report.

- **Site visit**

Undertake a site visit in order to collect a photographic record of the affected environment, to verify the results of the spatial analyses and to identify any additional site specific issues that may need to be addressed in the VIA report.

8. REFERENCES/DATA SOURCES

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