

**PROPOSED LIMESTONE PHOTOVOLTIC 1 SOLAR ENERGY FACILITY,
NORTHERN CAPE PROVINCE**

VISUAL ASSESSMENT – INPUT FOR SCOPING REPORT

Produced for:

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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

AGV Projects (Pty) Ltd is proposing the development of a commercial Solar Energy Facility and associated infrastructure on a site located ~16km south-east of the town of Danielskuil in the Northern Cape Province. The site is located within the Kgatelopele Local Municipality and the ZF Mgcawu District Municipality. The project site comprises the following farm portion:

- Portion 4 of the Farm Engeland 300

The Limestone PV1 will have a contracted capacity of up to 75-150MW. A Project Site of 1842 ha and a Development area with an extent of 300-400ha has been identified by AGV Projects (Pty) Ltd as a technically suitable area for the development of the Limestone PV1. The project is planned as part of a larger cluster of renewable energy projects, which includes another 75-150MW PV Solar Energy Facility (Limestone PV2) located adjacent to Limestone PV1 and a 360MW Wind Energy Facility (Oryx Wind Energy Facility) also located near Danielskuil. The Limestone PV1 project site is proposed to accommodate the following infrastructure:

- PV modules mounted on either a single axis tracking & fixed structure, dependent on optimisation, technology available and cost.
- Inverters and transformers.
- Low voltage cabling between the PV modules to the inverters.
- Fence around the project development area with security and access control.
- Camera surveillance.
- Internet connection.
- 33kV cabling between the project components and the facility substation.
- 33/132kV onsite facility substation.
- Battery Energy Storage System (BESS) with a footprint of 3-5ha.
- Site offices and maintenance buildings, including workshop areas for maintenance and storage as well as parking for staff and visitors.
- Laydown/staging area on-site in front of mounting structures during installation. Temporary store area close to site entrance (Less than 2ha).
- Access roads (up to 6m wide) and internal distribution roads (up to 5m wide).
- Temporary concrete batching facility.
- Stormwater management infrastructure as required

A summary of the details and dimensions of the planned infrastructure associated with the project is provided in **Table 1**.

Table 1: Details or dimensions of typical infrastructure required for the 75-150MW Limestone PV1 Solar Energy Facility

Infrastructure	Footprint and dimensions
Number of Panels	To be determined
Panel Height	+/- 2.2m
Technology	Use of fixed-tilt and single-axis tracking.
Contracted Capacity	Between 75MWp and 150MWp
Area occupied by the solar array	To be determined in the EIA phase
Area occupied by the on-site facility substation	0.5 – 0.75ha
Capacity of on-site facility	33kV/132kV

substation	
Cabling between the PV array and the onsite substation	The cabling will be in underground trenches and operate at a voltage of up to 33kV.
Extent of areas required for laydown of materials, equipment etc.	Less than 2ha
Access and internal roads	Existing roads will be used as far as possible. Existing gravel roads can be utilized for site access (width of up to 6m). Upgrading of existing roads or new roads will be required. New internal access roads required (width of up to 5m), same for construction and operation. Internal access roads will be gravel/hard surfaced.
Temporary infrastructure	Temporary store area close to site entrance (Less than 2ha).

The power generated from the project will be sold to Eskom and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa, as contemplated in the Integrated Resource Plan.

The PV facility will take approximately 6-12 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 1: Photovoltaic (PV) solar panels. (Photo: SunPower Solar Power Plant – Prieska).



Figure 2: Aerial view of PV arrays. (Photo: Scatec Solar South Africa).



Figure 3: Aerial view of a BESS facility (Photo: Power Engineering International).



Figure 4: 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 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 existing high voltage powerlines and substations, secondary roads 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 Limestone PV1 facility and associated infrastructure from a desktop level.

4. THE AFFECTED ENVIRONMENT

The proposed Limestone PV1 Facility and associated infrastructure is located approximately 16km south-east of the town of Danielskuil and 9 Km east of Lime Acres within the Kgatelopele Local Municipality and the ZF Mgcawu District Municipality. Regionally, the study area is located about 52km south east of Postmasburg, 96 km south of Kuruman and about 65km north west of Delspoorthoop within the Northern Cape Province.



Figure 5: Limestone PV1 Solar Facility property.

The study area occurs on land that ranges in elevation from approximately 1424m above sea level in the Great Pan and Rooipan in the west to 1454m a.s.l on the site itself and areas to the north and south west. The terrain surrounding the proposed property is generally flat. Two (2) pans, the Great Pan and Rooipan are located to the west of the proposed site, and there are numerous non-perennial pans present in the broader area. See **Map 1** for the shaded relief/topography map of the study area.

The study area is sparsely populated with 7.5 people per km² within the local municipality. In addition to Lime Acres, a number of isolated homesteads occur throughout the study area. Some of these in the study area include:

- England¹
- Langverwag
- Olienspruit
- Dikkbos
- Murray
- Aandrus
- Tevrede

Access to the site is from a secondary road via the R385. Rail infrastructure is prominent in the area, with the Transnet Cape Corridor Freight railway line running from north east to south bisects the proposed site. This railway line is along heavy-haul railway line that connects mines between Warrenton in the North-East to Cape Town in the South. It is used primarily to transport commodities such as iron ore, manganese and lime and does not carry passengers.

Other industrial infrastructure within the study area includes numerous existing high voltage lines that traverse the site:

- Olien/Ferrum 1 and 2 275 kV
- Olien/Ouplaas 1 132 kV
- Plateau/Trewill 1 132 kV
- Karats/Olien 1 and 2 132 kV
- Noko/Olien 1 132 kV
- Olien/Ulco 1 132 kV
- Silverstreams/Ulco 1 132 kV
- Boundary/Olien 1 and 2 275 kV

All of these lines above congregate at the Olien substation which is located within the proposed Limestone PV1 development footprint. The Trewill substation is located just east of the Olien substation.

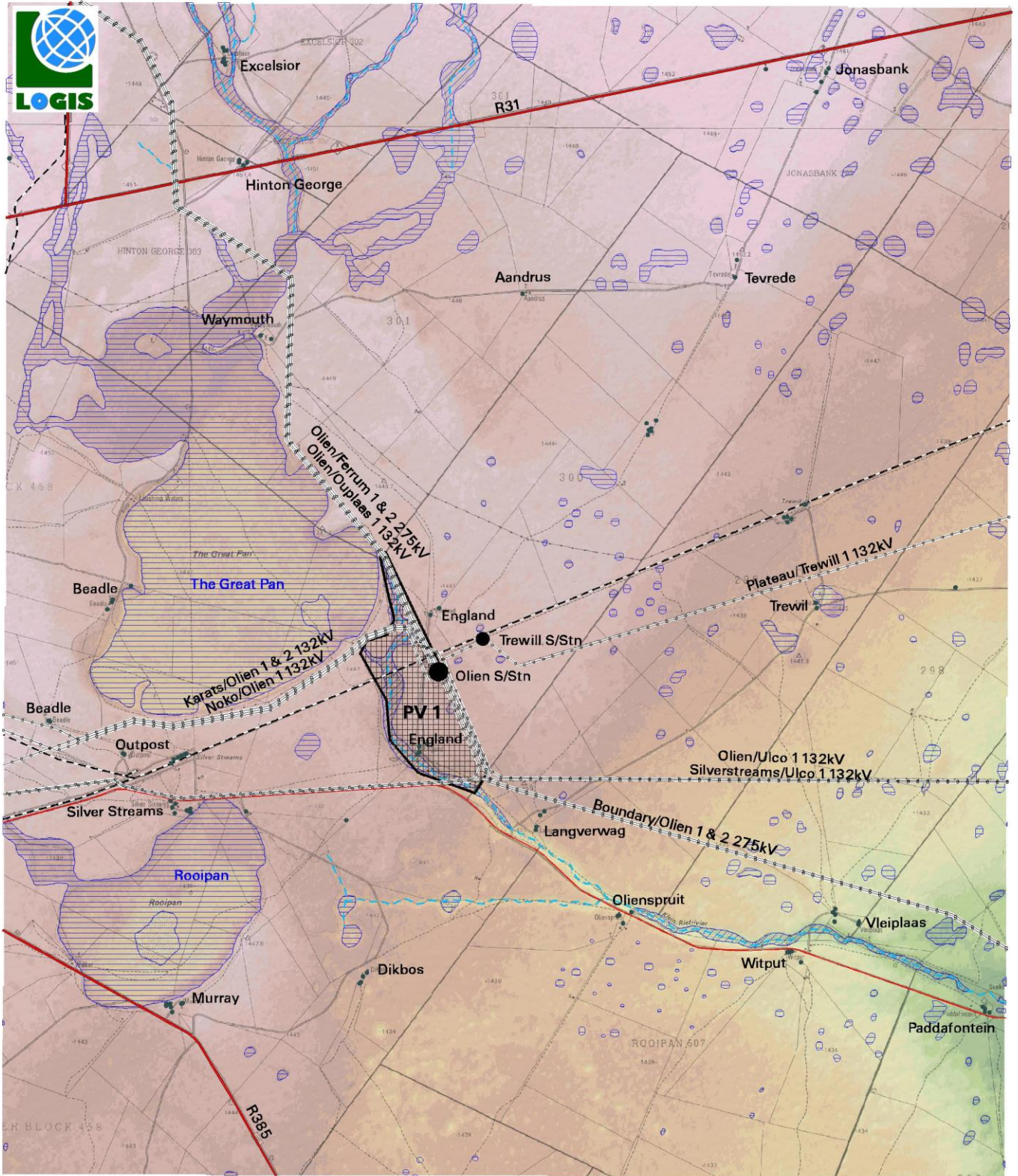
The climate within the region is semi-arid, with the study area receiving approximately 200 mm of rainfall per annum. Land cover is primarily low *shrubland* concentrated more to the west and south west, and grassland found to the east with scattered areas of open woodland. Refer to **Map 2**.

The greater landscape of the study area is characterised by wide-open spaces and very limited development. It should however be noted that there are a few of authorised (and current)/ proposed renewable energy applications within the study area and the greater region, that may change the landscape to some degree in the future. There are no formally protected or conservation areas within the study area. ²

There are no tourist routes or protected areas found within the study area.

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.

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.



- LEGEND**
- Arterial/Main Road
 - Secondary Road
 - Railway Line
 - Power Line
 - Substation
 - Homestead
 - Non-perennial River
 - Non-perennial Pan
 - Non-perennial Water Course
 - Proposed PV Facility

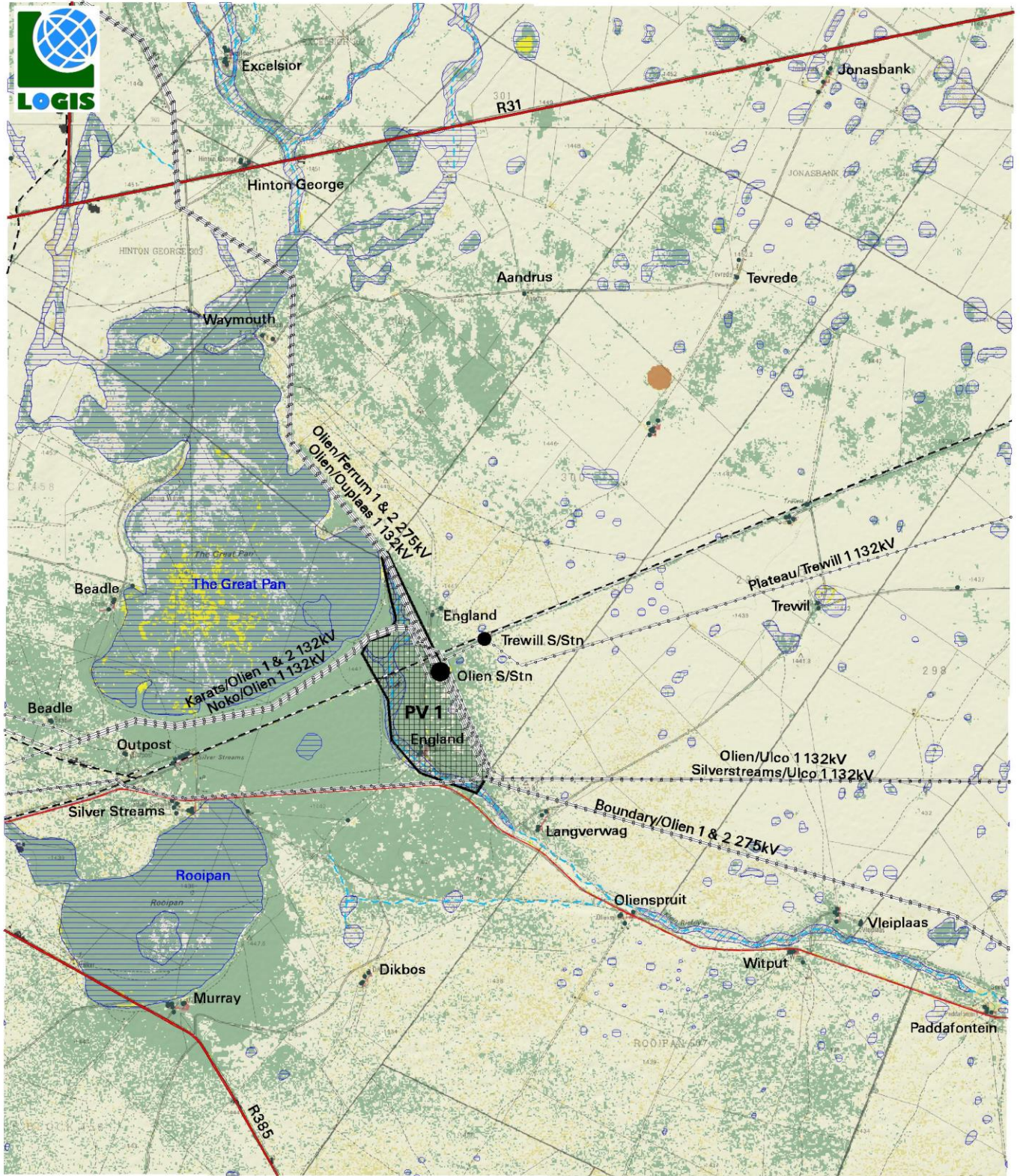
SHADED RELIEF
Elevation above sea level (m)

1420	1434	1448
1422	1436	1450
1424	1438	1452
1426	1440	1454
1428	1442	1456
1430	1444	1458
1432	1446	1461

**Proposed Limestone PV 1
Solar Energy Facility**



Map 1: Shaded relief map of the study area.



- LEGEND**
- Arterial/Main Road
 - Secondary Road
 - Railway Line
 - Power Line
 - Substation
 - Homestead
 - Non-perennial River
 - Non-perennial Pan
 - Non-perennial Water Course
 - Proposed PV Facility

- LAND COVER/BROAD LAND USE PATTERNS**
- Grassland
 - Low Shrubland
 - Bare Sand
 - Open Woodland
 - Cultivated Agriculture

Proposed Limestone PV 1 Solar Energy Facility



Map 2: Land cover and broad land use patterns.

5. VISUAL EXPOSURE/VISIBILITY

The result of the viewshed analysis for the proposed Limestone PV1 Facility and associated infrastructure is shown on the map below (**Map 3**). The viewshed analysis was undertaken from a representative number of vantage points within the development footprint at an offset of 5m 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 3 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

The visual exposure for the Limestone PV1 facility would largely be concentrated on the site itself and extend to the west, south and south east.

The following is evident from the viewshed analyses:

0 – 1km

The PV facility may be highly visible within a core area of a 1km radius of the proposed development. Small pockets of visually screened areas lie to the south west. There are two residences/farmsteads known as England located within this zone. However, the one England farmstead is located within the proposed development footprint, therefore it is assumed that the landowner has bought into the proposed development.

Additionally, a small section of a secondary road is located within this zone in the south, south west. It is anticipated that the proposed PV facility will be highly visible from this portion of road.

1 – 3km

Visual exposure within this zone, while still highly concentrated, does become fragmented. Potential sensitive visual receptors include residents of Langverwag and users of the secondary road. Other than these receptors, the rest of the visually exposed areas fall within vacant land and open space.

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 but does include the residents of Aandrus, Olienspruit, Witput, Dikbos, Murray, Silverstreams, Outpost and Beadle homesteads. The PV facility may be visible from the aforementioned homesteads, but is not expected to be visible from the Waymouth residence.

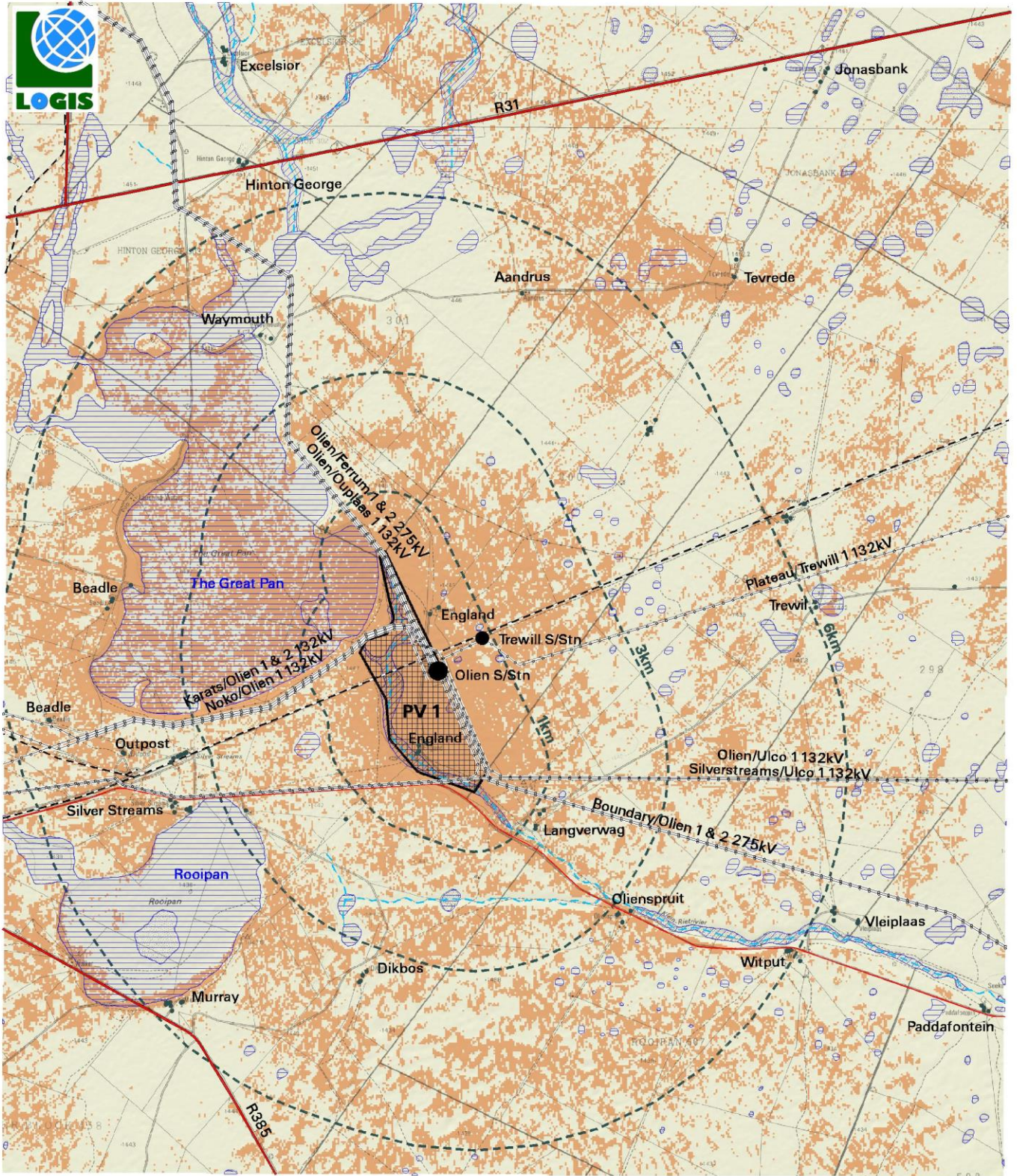
A secondary road is also located within this zone, however only small portions may be visually exposed and the intrusion will be fleeting.

> 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.

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 road in closer proximity to the facility.



- LEGEND**
- Arterial/Main Road
 - Secondary Road
 - Railway Line
 - Power Line
 - Substation
 - Homestead
 - Non-perennial River
 - Non-perennial Pan
 - Non-perennial Water Course
 - Proposed PV Facility

- VISIBILITY ANALYSIS**
- Potentially Visible
 - Not Visible
 - Observer Proximity (1km, 3km & 6km)

Note:
 Visibility was calculated at 5m above ground level

Proposed Limestone PV 1 Solar Energy Facility



Map 3: 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 secondary road in closer proximity to the proposed infrastructure.
- 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 an area where various solar energy generation applications have been authorised, or are still being assessed.
- 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/rail travel hazard.
- Potential visual impact of solar glint and glare on static ground-based receptors (residents of homesteads) in close proximity to the PV facility.
- 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 2: Impact table summarising the potential primary visual impacts associated with the proposed PV facility.

<p>Impact</p> <p>Visual impact of the facility on observers in close proximity to the proposed PV facility infrastructure and activities. Potential sensitive visual receptors include:</p> <ul style="list-style-type: none">• Residents of homesteads and farm dwellings (in closer proximity to the

<ul style="list-style-type: none"> facility) Observers travelling along the secondary roads traversing near the proposed developments 			
Issue	Nature of Impact	Extent of Impact	No-Go Areas
The viewing of the PV facility infrastructure and activities	The potential negative experience of viewing the infrastructure and activities within a predominantly undeveloped setting	Primarily observers situated within a 3km radius of the facility	N.A.
<p>Description of expected significance of impact</p> <p>Extent: Local Duration: Long term Magnitude: Moderate to High (depending on observer proximity) Probability: Probable Significance: Moderate to High Status (positive, neutral or negative): Negative Reversibility: Recoverable Irreplaceable loss of resources: No Can impacts be mitigated: Yes</p>			
<p>Gaps in knowledge & recommendations for further study</p> <p>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.</p> <p>Additional spatial analyses are required in order to create a visual impact index that will include the following criteria:</p> <ul style="list-style-type: none"> 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 <p>Additional activities:</p> <ul style="list-style-type: none"> Identify potential cumulative visual impacts Undertake a site visit Recommend mitigation measures and/or infrastructure placement alternatives <p>Refer to the Plan of Study for the EIA phase of the project below.</p>			

7. CONCLUSION AND RECOMMENDATIONS

The fact that some components of the proposed Limestone PV1 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.

Additionally, due to the location of the proposed PV site whereby the railway line bisects the proposed site, the need for a glint and glare assessment should be investigated.

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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