PROPOSED GRID CONNECTION INFRASTRUCTURE FOR THE CAROLUS SOLAR PV1 FACILITY

Northern Cape Province

VISUAL IMPACT ASSESSMENT

Produced for:

Carolus Solar PV1 (Pty) Ltd

On behalf of:

Savannah Environmental (Pty) Ltd
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- July 2022 -

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1. STUDY APPROACH

1.1. Qualification and experience of the practitioner

Lourens du Plessis, a specialist in visual impact assessment and Geographical Information Systems (GIS), undertook the Visual Impact Assessment (VIA).

He 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 expertise are often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

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.

Savannah Environmental appointed Lourens du Plessis as an independent specialist consultant to undertake the visual impact assessment for the proposed grid connection infrastructure for the Carolus Solar PV1 Facility. He will not benefit from the outcome of the project decision-making.

1.2. Assumptions and limitations

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This assessment was undertaken during the planning stage of the project and is based on information available at that time.

This Visual Impact Assessment and all associated mapping has been undertaken according to the worst-case scenario.

1.3. Level of confidence

Level of confidence[1] is determined as a function of:

- The information available, and understanding of the study area by the practitioner:
    - 3: A high level of information is available of the study area and a thorough knowledge base could be established during site visits, surveys etc. The study area was readily accessible.
    - 2: A moderate level of information is available of the study area and a moderate knowledge base could be established during site visits, surveys etc. Accessibility to the study area was acceptable for the level of assessment.
    - 1: Limited information is available of the study area and a poor knowledge base could be established during site visits and/or surveys, or no site visit and/or surveys were carried out.

- The information available, understanding of the study area and experience of this type of project by the practitioner:
    - 3: A high level of information and knowledge is available of the project and the visual impact assessor is well experienced in this type of project and level of assessment.
    - 2: A moderate level of information and knowledge is available of the project and/or the visual impact assessor is moderately experienced in this type of project and level of assessment.
    - 1: Limited information and knowledge is available of the project and/or the visual impact assessor has a low experience level in this type of project and level of assessment.

These values are applied as follows:

		Information on the project & experience of the practitioner		
Information on the study area		**3**	**2**	**1**
	3	9	6	3
	2	6	4	2
	1	3	2	1

Table 1: Level of confidence

The level of confidence for this assessment is determined to be ***9*** *and indicates that the author's confidence in the accuracy of the findings is high:*

[1] Adapted from Oberholzer (2005).

- The information available, and understanding of the study area by the practitioner is rated as **3** and
- The information available, understanding and experience of this type of project by the practitioner is rated as **3**.

1.4. 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 infrastructure. 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.

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 proposed grid connection infrastructure for the Carolus Solar PV1 Facility.

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 were 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 the proposed grid infrastructure was not visible, no impact would occur.

  Viewshed analyses from the proposed infrastructure indicate the potential visibility.

- **Determine visual distance/observer proximity to the grid connection infrastructure**

  In order to refine the visual exposure of the grid connection infrastructure 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 structures.

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

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

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

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

  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 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 landscape**

  This is the capacity of the receiving environment to absorb the potential visual impact of the proposed structures. The visual absorption capacity (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.

  The digital terrain model utilised in the calculation of the visual exposure of the grid connection infrastructure does not incorporate the potential 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.

- **Calculate 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 determine the magnitude of each impact.

- **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**

  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.

2. BACKGROUND

Carolus Solar PV1 (Pty) Ltd is planning the construction and operation of grid connection infrastructure consisting of up to a 132kV Double circuit power line on Portion 3 of the Farm Carolus Poort No.3, the infrastructure will be located approximately 10km east of De Aar within the Emthanjeni Local Municipality in the Northern Cape Province.

The Grid connection infrastructure will include a 132 kV IPP Substation and a powerline with a capacity up to 132 kV which is being assessed within a 300m wide and between 3.3km and 9.3km long corridor connecting to either the new proposed Vetlaagte MTS or the new proposed Wag-'n-Bietjie MTS, which will respectively be located on the farm Vetlaagte (RE/4) or Wagt en Bittje (RE/5).

The Vetlaagte MTS will Loop into the Hydra-Perseus 2 or Hydra-Perseus 3 line (400 kV). Substations on either end of the line: Hydra and Perseus. The Wag-'n-Bietjie MTS will loop into the Hydra-Beta 1 line (400 kV). Substations on either end of the line: Hydra and Beta. These sites are currently under a separate BAR process.

The grid connection corridor will consist of:

- Onsite 132kV IPP Substation including the HV Stepup transformer, MV Interconnection building (footprint up to 100m x 100m located within the 300m wide corridor).
- Onsite 132kV Eskom switching station - 100m x 100m and 30m height, metering, relay & control buildings, laydown area, ablutions with conservancy tanks and water storage tanks, and access roads which is handed back to Eskom (Separate EA).
- 132kV Overhead Power Line (OHPL) – 30m height from the switching station to the Main Transmission Substation (MTS) located on either Vetlaagte (RE/4) or Wag en Bittje (RE/5) farms which will be handed back to Eskom (within 300m wide corridor and a 31m wide servitude).
- Access roads to substation sites (up to 8 m wide) and service tracks (up to 6 m wide) where no existing roads are available.

Figure 1: Regional locality of the study area.

The proposed grid connection infrastructure is indicated on the maps displayed within this report. Sample images of typical 132kV power line towers are displayed below.

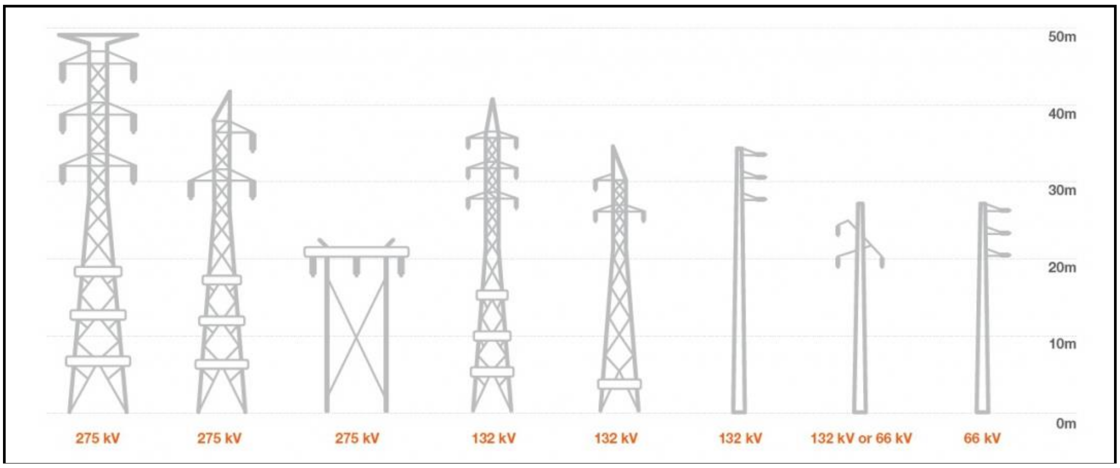


Figure 2: Schematic representation of power line towers

Figure 3: Typical 132 kV power line structures

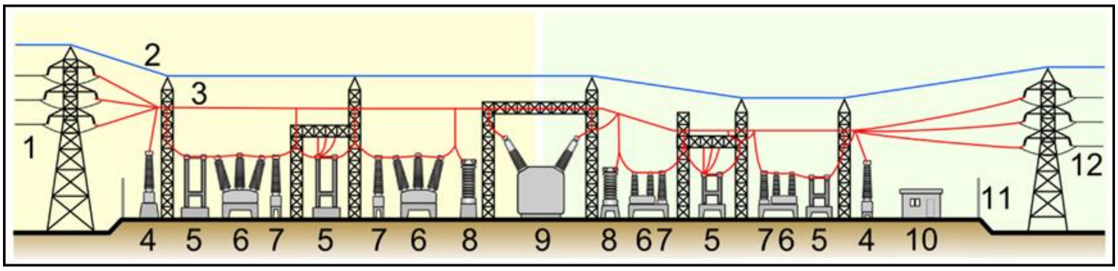


Figure 4: Schematic representation of the components of a substation. See below. (Source: Shigeru23 - Own work, CC BY-SA 3.0)

1. Primary power lines
2. Ground wire
3. Overhead lines
4. Transformer for measurement of electric voltage
5. Disconnect switch
6. Circuit breaker
7. Current transformer
8. Lightning arrester
9. Main transformer
10. Control building
11. Security fence
12. Secondary power lines

Figure 5: Typical substation.

3. SCOPE OF WORK

This report is the undertaking of a Visual Impact Assessment (VIA) of the proposed grid connection infrastructure as per the above mentioned.

The determination of the potential visual impacts is undertaken in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure.

The study area includes a minimum 3km buffer zone (area of potential visual influence) from the power line alignment and substation sites.

Anticipated issues related to the potential visual impact of the proposed grid connection infrastructure include the following:

- The visibility of the infrastructure to, and potential visual impact on, observers travelling along the arterial and secondary roads within the study area.
- The visibility of the infrastructure to, and potential visual impact on, residents of rural homesteads or settlements within the study area.
- The potential visual impact of associated infrastructure (i.e. access roads and cleared servitudes) on sensitive visual receptors.
- The potential visual impact of the infrastructure on the visual character or sense of place of the region.

- The potential visual impact of the infrastructure on tourist routes or tourist destinations/attractions (if present).

- The potential cumulative visual impact of the proposed power lines in relation to other infrastructure and built forms.

- 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 constitute a visual impact at a local and/or potentially at a regional scale.

4. RELEVANT LEGISLATION AND GUIDELINES

The following legislation and guidelines have been considered in the preparation of this report:

- National Environmental Management Act 107 of 1998 (NEMA);
- The Environmental Impact Assessment Regulations, 2014 (as amended);
- Guideline on Generic Terms of Reference for EAPS and Project Schedules (DEADP, Provincial Government of the Western Cape, 2011); and
- Guideline for involving visual and aesthetic specialists in EIA processes: Edition 1.

5. THE AFFECTED ENVIRONMENT

The properties for the proposed Pixley Park Cluster of Renewable Energy Facilities and associated Grid Connection Infrastructure are located about 10km east of the town of De Aar within the Emthanjeni Local Municipality. Regionally, the study area is located about 44km east of Britstown, 37km north-west of Hanover and about 67km north of Richmond within the Northern Cape Province.

The study area occurs on land that ranges in elevation from approximately 1,230m above sea level (along the Brak River to the north-west) to 1,560m at the top of the hill north-west of the properties. The terrain surrounding the proposed properties is generally flat, sloping gently to the north and south-west towards the Brak River. A few farm dams are present in the broader area.

The Brak River bisects the north-eastern part of the properties, and two water bodies are located within or near the property boundaries. The terrain type of the region is relatively homogenous and is described as predominantly lowlands with hills. Some prominent hills and ridges occur in the study area - a small range of hills lies along the north-western border of the properties, refer to **Map 1.**

De Aar is a primary commercial distribution centre for a large area of the central Great Karoo. Major economic activities of the area include wool production and livestock farming. The area is also popular for hunting.

The study area is sparsely populated outside of the De Aar urban area (i.e. less than two people per km2 within the district municipality). De Aar is the third largest town in the Northern Cape with a population density of 30-100 people per km². In addition to De Aar, a number of isolated homesteads occur throughout the study area. Some of these in the study area include:

- Hartebeeshoek
- Rietfontein
- Riet

- Bloemhof
- Rusoord
- Merino
- Caroluspoort
- Vetlaagte
- Ebenezer
- Wag-'n-Bietjie

Figure 6: Topography and vegetation of the region.
Note the hills in the background and flat landscape in the middle and foreground.

The N10 national road traverses the study area from the N1 national road (near Hanover) to De Aar. Rail infrastructure is prominent in the area, with De Aar representing the second most important railway junction in South Africa. Lines run from the north, west, south and the south-east, converging in the town. These lines include both freight and passenger lines.

Other industrial infrastructure within the study area includes the Hydra (to the west of the proposed Pixley Park properties) and Bletterman Substations. The Hydra Substation road provides access to the Pixley Park properties from the N10 national road. There is a significant network of power lines extending in all directions from these substations. Some of these include:

- Hydra/Perseus 2 and 3 400kV
- Beta/Hydra 1 400kV
- Hydra/Ndhlovu 1 132kV
- Hydra/Roodekuil 1 132kV
- Hydra/Roodekuil 2 220kV
- Hydra/Ruigtevallei 1 and 2 220kV
- Bletterman/Taaibos 1 132kV
- Hydra/Poseidon 1 and 2 400kV

Figure 7: The Hydra Substation in the west of the study area.

Figure 8: Power line infrastructure along the N10 national road.

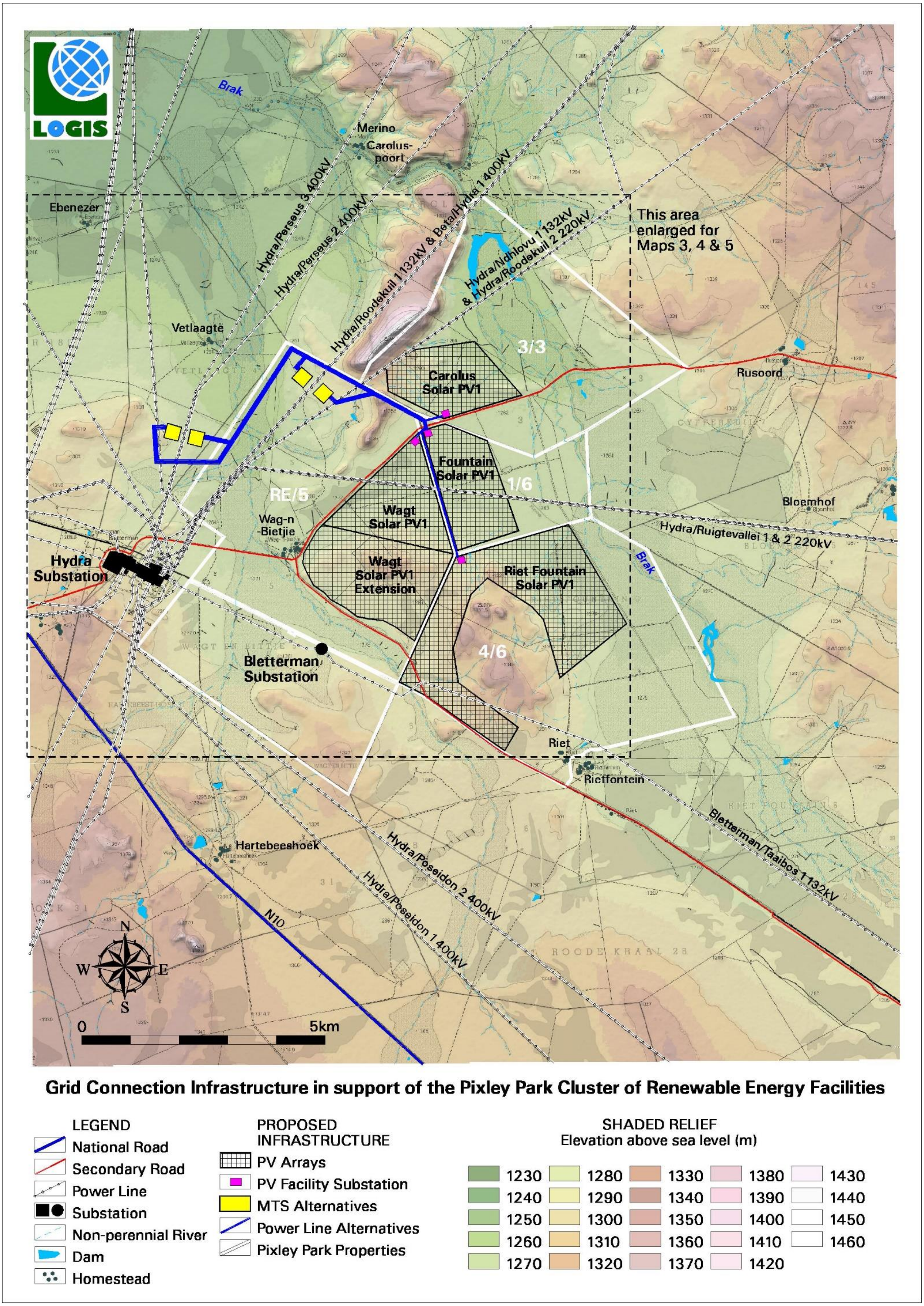
The climate within the region is semi-arid, with the study area receiving between 320mm and 433mm of rainfall per annum. Land cover is primarily *shrubland* with patches of *grassland* and *bare rock and soil* in places. Some *wetland* and *degraded land* is evident along the water courses. Vegetation types include *Northern Upper Karoo* on the flat terrain within the study area, and *Besemkaree Koppies Shrubland* on the more elevated terrain and hills. Refer to **Map 2.**

Despite the significant industrial type infrastructure in and around the town of De Aar and at the Hydra Substation, the greater landscape of the study area is characterised by wide-open spaces and otherwise very limited development. It should however be noted that there are a number of authorised (and current) 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]

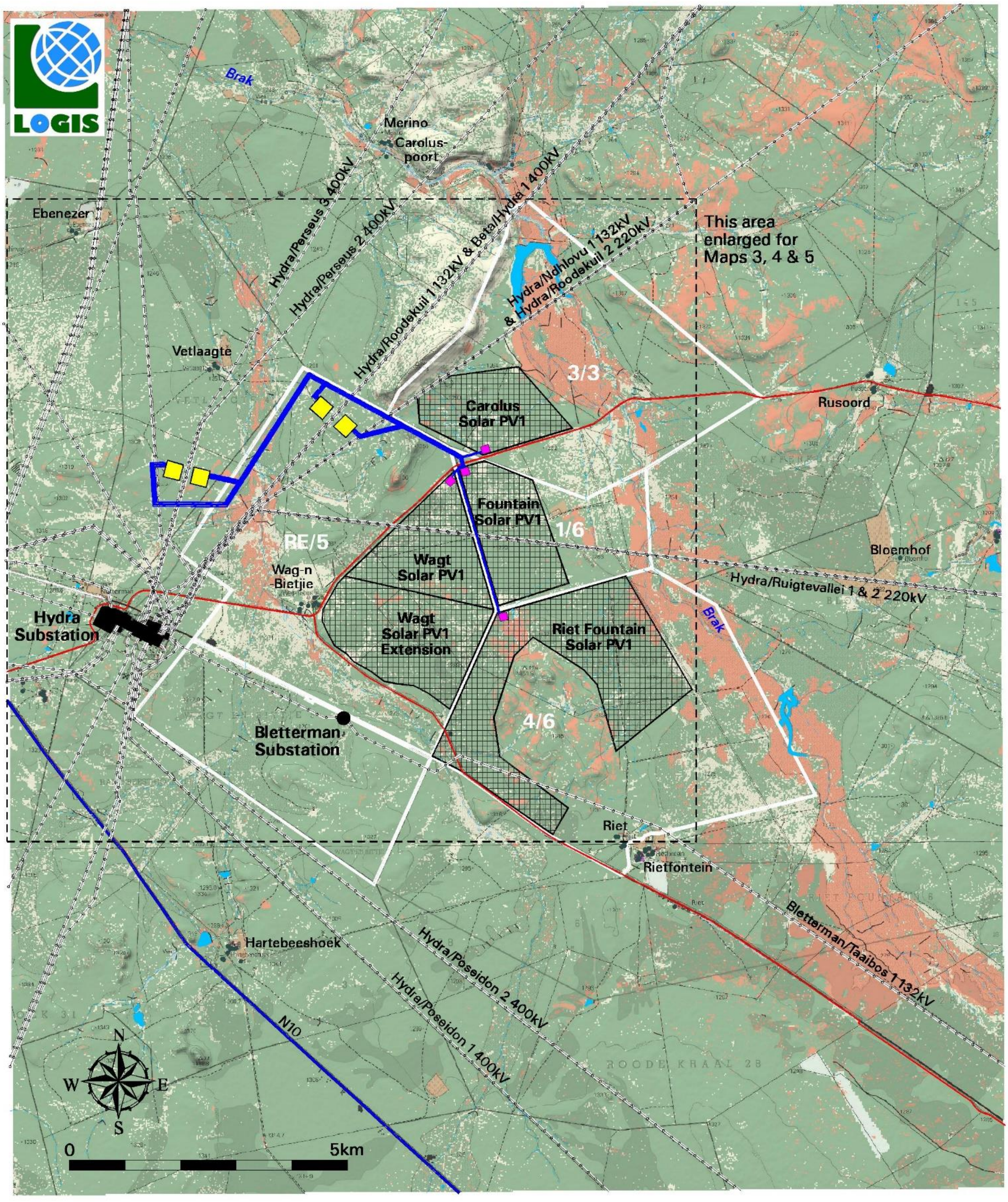
[2] Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q1 and SAPAD2021 (DFFE), Wikipedia.

Figure 9: Landscape character of the study area showing undeveloped wide open spaces interspersed with power lines.

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.



Map 1: Shaded relief map of the study area



Grid Connection Infrastructure in support of the Pixley Park Cluster of Renewable Energy Facilities

LEGEND	PROPOSED INFRASTRUCTURE	LAND COVER/BROAD LAND USES PATTERNS
National Road	PV Arrays	Low Shrubland
Secondary Road	PV Facility Substation	Natural Grassland
Power Line	MTS Alternatives	Bare Rock and Soil (both natural and erosion)
Substation	Power Line Alternatives	Fallow Land and Old Fields
Non-perennial River	Pixley Park Properties	Dryland Agriculture
Dam		
Homestead		

Map 2: Land cover and broad land use patterns

6. RESULTS

6.1. Potential visual exposure

The potential visual exposure (visibility) of the grid connection infrastructure is shown on **Map 3**. The visibility analyses were undertaken from the proposed power line alignments at 30m above ground level (i.e. the approximate maximum height of the power line towers). The viewshed analyses were restricted to a 3km radius due to the fact that visibility beyond this distance is expected to be negligible/highly unlikely for the relatively constrained vertical dimensions of this type of infrastructure (i.e. a 132kV power line).

Map 3 also indicates proximity radii from the proposed grid connection infrastructure in order to show the viewing distance (scale of observation) of the structures in relation to their surrounds.

Figure 10: Examples of 132 kV overhead power lines

General

It is expected that the grid connection infrastructure, both the Preferred and other three (3) alternatives may theoretically be visible within the 3km visual corridor and potentially highly visible within a 0.5km radius of the structures due to the generally flat terrain it traverses. Beyond 1,5km the visibility becomes more scattered due to the undulating nature of the topography. The grid connection structures are unlikely to be visible beyond a 3km radius of the structures.

It should also be noted that the potential visual exposure will not occur in isolation, but rather in conjunction with the existing power lines and Hydra substation within the study area.

Seeing that the Alternative Vetlaagte MTS and powerline, the Wag-'n-Bietjie MTS and power line alternative and the Alternative Wag-'n-Bietjie MTS and power line follow along the same route as the Preferred Vetlaagte MTS and power line, the following holds true for all alternatives:

0 – 0.5km (short distance)

It is expected that the power line structures and substations (both preferred and the alternatives) would be highly visible within a 0.5 Km radius. There are no residences within this zone. There is a section of the secondary road that traverses the site passing the Hydra substation and the Wag-'n-Bietjie homestead. Observers travelling along this road will be exposed to the project infrastructure.

0.5 – 1.5km (short to medium distance)

Potential visual exposure in the short to medium distance (i.e. between 0.5 and 1.5km), is still highly concentrated, with small pockets of visually screened areas to the north west of the Preferred Vetlaagte MTS and north of the start of the alignment.

The potential sensitive visual receptors within this zone include residents of Vetlaagte and users of the secondary road.

The rest of the visually exposed areas fall within vacant farmland and open space generally devoid of potential sensitive visual receptors.

1.5 – 3km (medium to long distance)

Within a 1.5 – 3km radius, the visual exposure becomes slightly scattered and interrupted due to the undulating nature of the topography. Visually screened areas lie to the west, north of the Alternative Wag-'n-Bietjie MTS and east.

Sensitive visual receptors are observers travelling along the secondary road and residents of Vetlaagte and Wag-n-Bietjie.

> 3km

At distances exceeding 3km the intensity of visual exposure is expected to be very low and highly unlikely due to the distance between the object (grid connection infrastructure) and the observer.

Conclusion

In general terms it is envisaged that the grid connection infrastructure, where visible from shorter distances (e.g. less than 0.5km and potentially up to 1.5km), and where sensitive visual receptors may find themselves within this zone, may constitute a high visual prominence, potentially resulting in a visual impact. The incidence rate of sensitive visual receptors is however expected to be low, due to the generally remote location of the proposed infrastructure and the low number of potential observers. It should once again be noted that the potential visual exposure will not occur in isolation, but rather in conjunction with the existing power lines and Hydra substation in the study area.

The potential visual exposure for the Preferred and three (3) other Alternatives is expected to be very similar in extent owing to the fact that all alternatives follow along the Preferred Alternatives route and impact on the same potential sensitive visual receptors.

6.2. Potential cumulative visual exposure

Cumulative visual impacts can be defined as the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments. In this case the 'development' would be a new 132kV power line and substation as seen in conjunction with the existing (or proposed/authorised) grid connection infrastructure in close proximity.

Cumulative visual impacts may be:

- Combined, where several power lines are within the observer's arc of vision at the same time;
- Successive, where the observer has to turn his or her head to see the various structures of a power line; and
- Sequential, when the observer has to move to another viewpoint to see different power line structures, or different views of the same power line (such as when travelling along a route).

The visual impact assessor is required (by the competent authority) to identify and quantify the cumulative visual impacts and to propose potential mitigating measures. This is often problematic as most regulatory bodies do not have specific rules, regulations or standards for completing a cumulative visual assessment, nor do they offer meaningful guidance regarding appropriate assessment methods. There are also not any authoritative thresholds or restrictions related to the capacity of certain landscapes to absorb the cumulative visual impacts of the power line infrastructure.

To complicate matters even further, cumulative visual impact is not just the sum of the impacts of two developments. The combined effect of both may be much greater than the sum of the two individual effects, or even less.

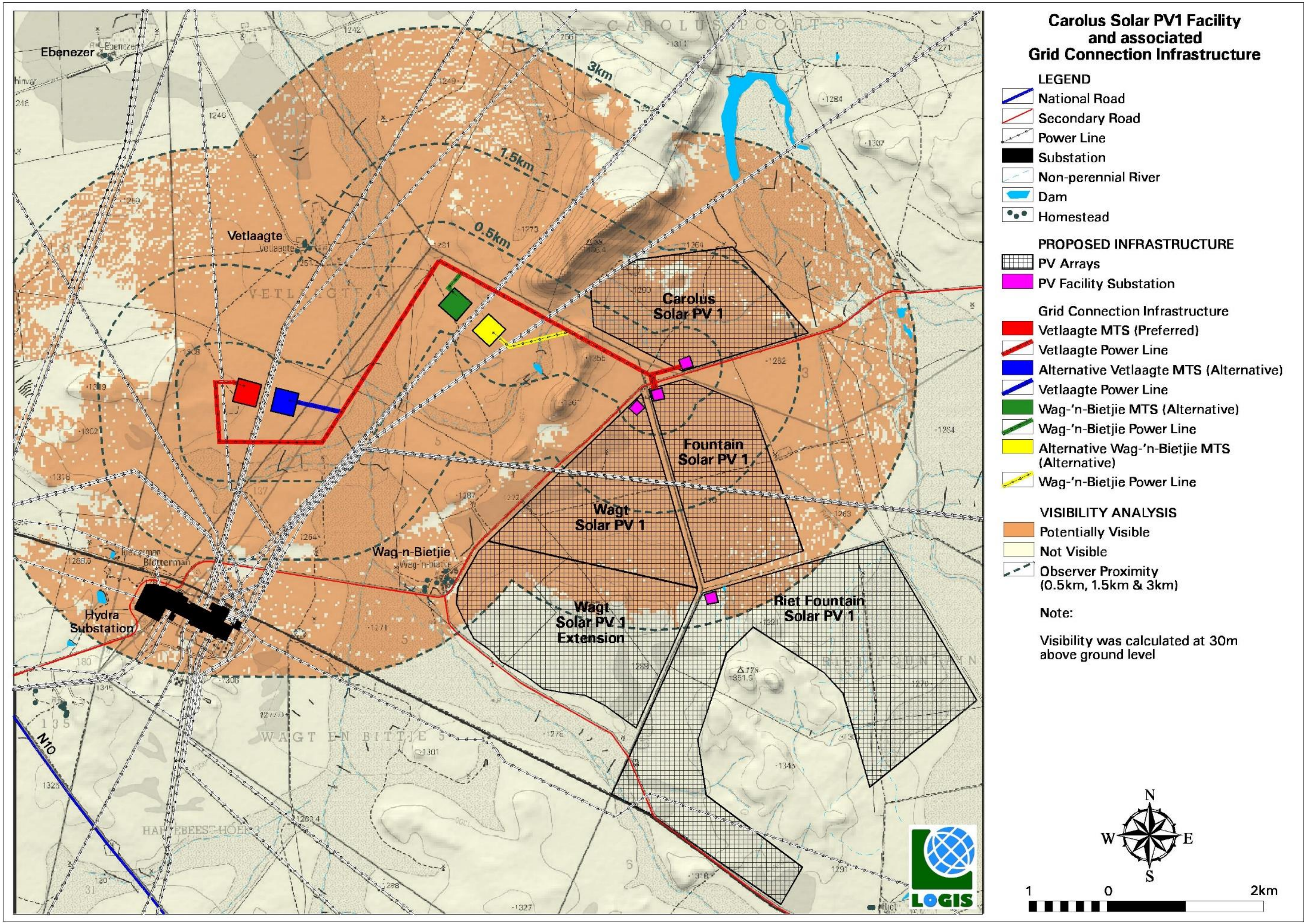
The cumulative impact of the proposed grid connection infrastructure on the landscape and visual amenity is a product of:

- The distance between the power lines;
- The distance over which the structures are visible;
- The overall character of the landscape and its sensitivity to the structures;
- The siting and design of the power line; and
- The way in which the landscape is experienced.

The specialist is required to conclude if the proposed 'development' will result in any unacceptable loss of visual resource considering the industrial infrastructure proposed in the area.

Conclusion

The proposed power line infrastructure and substation is located in an area where there are numerous existing power lines and the existing Hydra Substation located to the south west of the alignment. The visual amenity along this power line corridor has already been compromised to a large degree. Admittedly, the frequency of visual exposure to power line infrastructure is expected to increase, but it is still preferable to consolidate the linear infrastructure as much as possible. To this end, the cumulative visual impact associated with the proposed power line is considered to be within acceptable limits.



Map 1: Viewshed analysis of the proposed grid connection infrastructure

6.3. Visual distance / observer proximity to the grid connection infrastructure

The proximity radii are based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger grid connection infrastructure (e.g. 400kV power lines) and downwards for smaller structures (e.g. 132kV power line) due to variations in height. This methodology was developed in the absence of any known and/or accepted standards for South African power line infrastructure.

The proximity radii (calculated from the grid connection infrastructure) are indicated on **Map 4**, and include the following:

- 0 – 0.5km - Short distance view where the structures would dominate the frame of vision and constitute a very high visual prominence.
- 0.5 – 1.5km - Medium distance views where the structures would be easily and comfortably visible and constitute a high visual prominence.
- 1.5 - 3km - Medium to longer distance view where the structures would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 3km - Long distance view where the structures may still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the power lines.

The visual distance theory and the observer's proximity to the 132kV power line are closely related, and especially relevant, when considered from areas with a higher viewer incidence and a potentially negative visual perception of the proposed infrastructure.

6.4. 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.

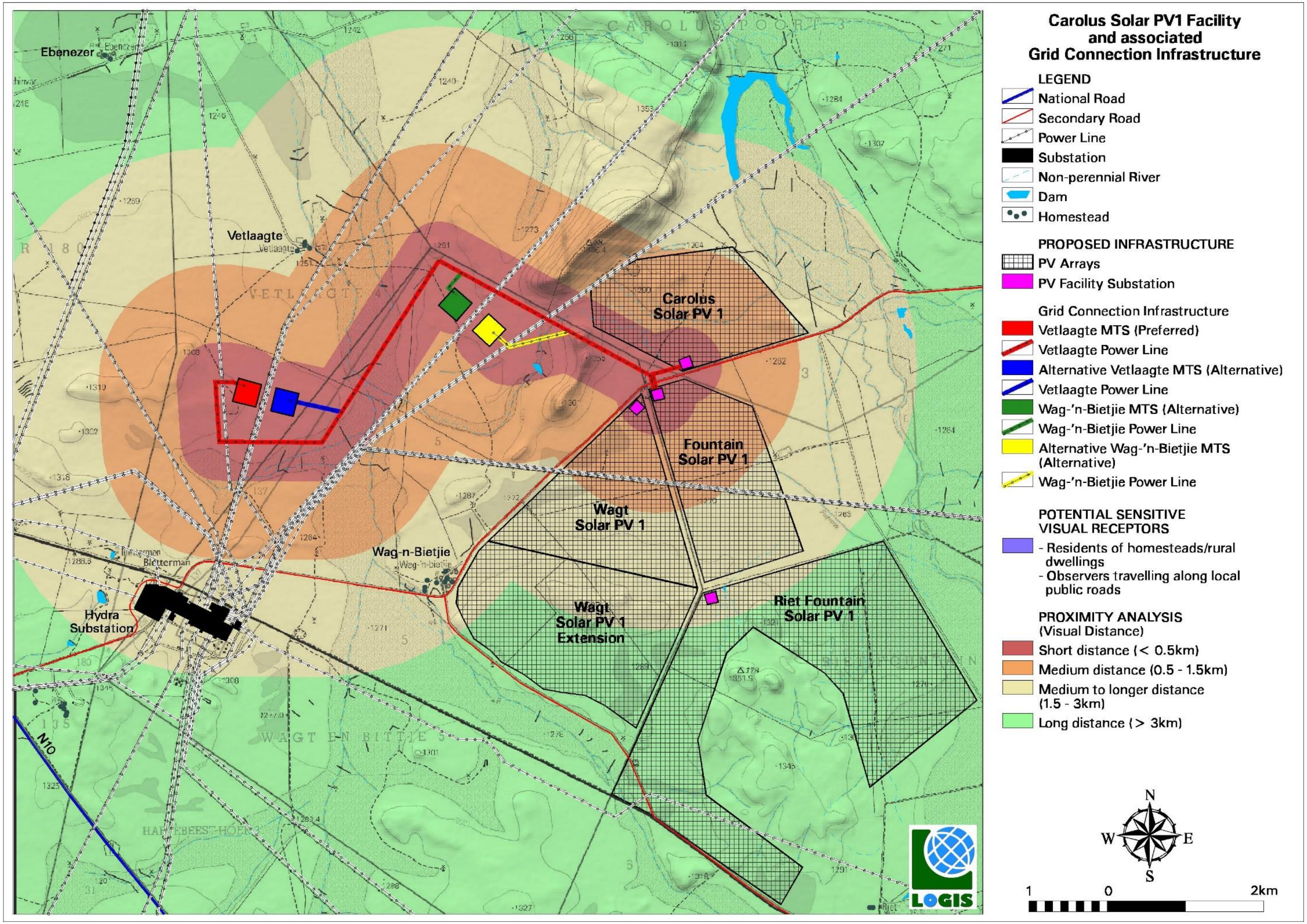
It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed grid connection infrastructure. It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer: regularity of sighting, cultural background, state of mind, purpose of sighting, etc. which would create a myriad of options.

Viewer incidence within the study area is anticipated to be the highest along the secondary road adjacent to the proposed project infrastructure. Travellers using this road may be negatively impacted upon by visual exposure to the grid connection infrastructure.

Additional sensitive visual receptors are located at the farm residences (homesteads) of Vetlaagte, Wag-'n-Bietjie and others throughout the study area. It is expected that the viewer's perception, unless the observer is associated with (or supportive of) the grid connection infrastructure, would generally be negative.

Due to the generally remote location of the proposed power line and substation, and the sparsely populated nature of the receiving environment, there are only a limited number of potential sensitive visual receptors in closer proximity to the proposed infrastructure. These receptor sites are listed in **Section 6.1** and are indicated on **Map 4.**

The author is not aware of any objections raised against the proposed grid connection infrastructure.



Map 4: Proximity analysis and potential sensitive visual receptors

6.5. Visual absorption capacity

Visual Absorption Capacity (VAC) is the capacity of the receiving environment to absorb the potential visual impact of the proposed development. 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 also generally increases with distance, where discernible detail in visual characteristics of both environment and development decreases.

Land cover is primarily *shrubland* with patches of *grassland* and *bare rock and soil* in places. Some wetland and degraded land is evident along the water courses. Vegetation types include Northern Upper Karoo on the flat terrain within the study area, and Besemkaree Koppies Shrubland on the more elevated terrain and hills.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is low by virtue of the limited height (or absence) of the vegetation and the overall low occurrence of buildings, structures and infrastructure. The height of the power line towers (pylons) add to the potential visual intrusion of the power line against the background of the horizon. In addition, the scale and form of the proposed structures mean that it is unlikely that the environment will visually absorb them in terms of texture, colour, form and light/shade characteristics. Within this area the VAC of vegetation will not be taken into account, thus assuming a worst case scenario in the impact assessment.

Where homesteads and settlements occur, some more significant vegetation and trees may have been planted, which would contribute to the visual absorption capacity (i.e. shielding the observers from the infrastructure). As this is not a consistent occurrence, however, VAC will not be taken into account for any of the homesteads or settlements, thus assuming a worst case scenario in the impact assessment.

6.6. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed grid connection infrastructure culminate in a visual impact index. Here the weighted impact and the likely areas of impact have been indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

The criteria (previously discussed in this report) which inform the visual impact index are:

- Visibility or Visual exposure of the structures
- Observer proximity or Visual distance from the structures
- The presence of sensitive visual receptors
- The perceived negative perception or objections to the structures (if applicable)
- The visual absorption capacity of the vegetation cover or built structures (if applicable)

An area with short distance visual exposure to the proposed grid connection infrastructure, a high viewer incidence and a potentially negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact and determining the potential **magnitude** of the visual impact.

The index indicates that **potential sensitive visual receptors** within a 500m radius of the project infrastructure may experience visual impacts of a **very high magnitude**. The magnitude of visual impact on sensitive visual receptors subsequently subsides with distance to; **high** within a 0.5 – 1.5km radius (where/if sensitive receptors are present) and **moderate** within a 1.5 – 3km radius (where/if sensitive receptors are present). Receptors beyond 3km are expected to have visual impacts of **low** or **negligible** magnitude.

The visual impact index and potentially affected sensitive visual receptors are indicated on **Map 5**. In general, there are only a limited number of receptor sites within closer proximity (3km) to the proposed project infrastructure. The magnitude of the potential visual impact on these receptor sites are discussed below.

Seeing that the Alternative Vetlaagte MTS and powerline, the Wag-'n-Bietjie MTS and power line alternative and the Alternative Wag-'n-Bietjie MTS and power line follow along the same route as the Preferred Vetlaagte MTS and power line, the following holds true for all alternatives:

Magnitude of the potential visual impact

0 – 0.5km

The grid connection infrastructure (power line and substation) may have a visual impact of **very high** magnitude on the following observers:

Site 1: Observers travelling along the secondary road where it traverses adjacent to the power line alignment

The presence of existing powerlines reduces the probability of this impact occurring i.e. there is already a visual intrusion and existing visual impact.

0.5 – 1.5km

The grid connection infrastructure (power line and substation) may have a visual impact of **high** magnitude on the following observers:

Residents of/or visitors to:

- Site 2: Vetlaagte

The presence of existing powerlines reduces the probability of this impact occurring i.e. there is already a visual intrusion and existing visual impact.

1.5 – 3km

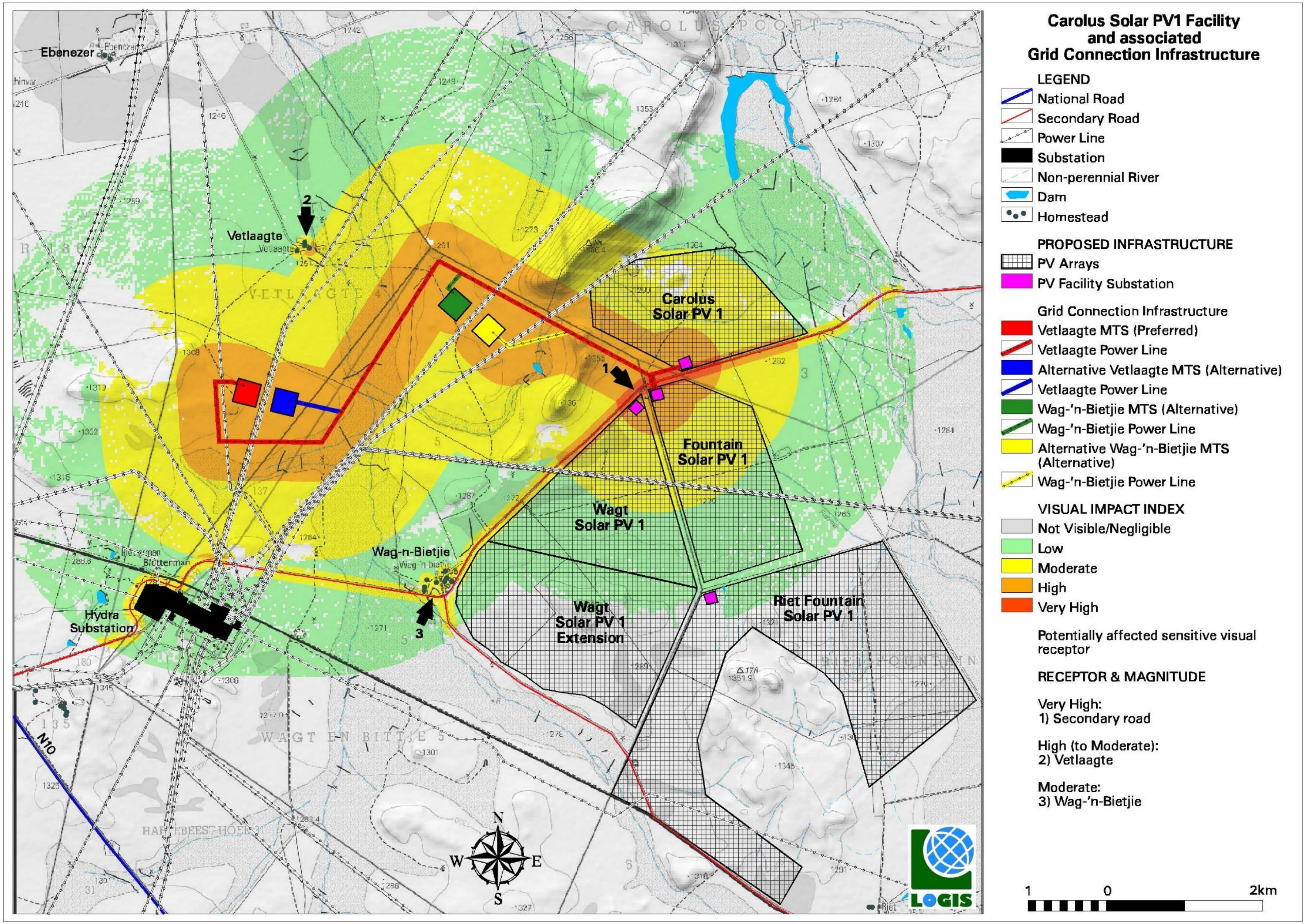
The grid connection infrastructure (power line and substation) may have a visual impact of **moderate** magnitude on the following observers:

Residents of/or visitors to:

- Site 3: Wag-n-Bietjie

Observers travelling along the secondary road where it traverses adjacent to the power line alignment.

The presence of existing powerlines and the Hydra substation reduces the probability of this impact occurring i.e. there is already a visual intrusion and existing visual impact.



Map 5: Visual impact index and potentially affected sensitive visual receptors

6.7. Visual impact assessment: impact rating methodology

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 **Section 3:** 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 in the vicinity of the proposed power line alignment) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - long distance (very low = 1), medium to longer distance (low = 2), short distance (medium = 3) and very short distance (high = 4)[3].
- **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 (= 2), low (= 4), medium/moderate (= 6), high (= 8) and very high (= 10)[4].
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5).
- **Status** (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, duration and extent (i.e. **significance = consequence (magnitude + 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)

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[3] Long distance = > 3km. Medium to longer distance = 1.5 – 3km. Short distance = 0.5 – 1.5km. Very short distance = < 0.5km (refer to Section 6.3. Visual distance/observer proximity to the grid connection infrastructure).

[4] This value is read from the visual impact index. Where more than one value is applicable, the higher of these will be used as a worst case scenario.

6.8. Visual impact assessment

The primary visual impacts of the proposed Carolus grid connection infrastructure are assessed below.

6.8.1. Construction impacts

6.8.1.1. Potential visual impact of construction activities on sensitive visual receptors in close proximity to the proposed grid connection infrastructure.

During construction, there may be an increase in heavy vehicles utilising the roads to the power line servitude and MTS site that may cause, at the very least, a visual nuisance to other road users and landowners in the area.

Construction activities may potentially result in a **moderate** (significance rating = 48), temporary visual impact, that may be mitigated to **low** (significance rating = 20).

A mitigating factor within this scenario is the very low occurrence of receptors within the receiving environment and within close proximity to the proposed infrastructure. Additionally, observers traveling along the secondary road will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring. It should also be noted that Wag-'n-Bietjie MTS Alternative/powerline and Alternative Wag-'n-Bietjie MTS alternative/powerline will have a marginally lower impact due to its shorter length than compared to Vetlaagte MTS preferred/powerline and Alternative Vetlaagte MTS alternative/powerline.

Table 2: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed grid connection infrastructure.

Nature of Impact: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed grid connection infrastructure.								
	VETLAAGTE MTS AND POWER LINE (PREFERRED)		**ALTERNATIVE VETLAAGTE MTS AND POWERLINE (ALT)**		**WAG-'N-BIETJIE MTS AND POWERLINE (ALT)**		**ALTERNATIVE WG-'N-BIETJIE MTS AND POWERLINE (ALT)**	
	No mitigation	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**
Extent	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**
Duration	Short term	Short term	Short term	Short term	Short term	Short term	Short term	Short term

	(2)	**(2)**	**(2)**	**(2)**	**(2)**	**(2)**	**(2)**	**(2)**
Magnitude	Very High **(10)**	Low **(4)**	Very High **(10)**	Low **(4)**	Very High **(10)**	Low **(4)**	Very High **(10)**	Low **(4)**
Probability	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**
Significance	Moderate **(48)**	Low **(20)**	Moderate **(48)**	Low **(20)**	Moderate **(48)**	Low **(20)**	Moderate **(48)**	Low **(20)**
Status (positive/negative)	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources	No	No	No	No	No	No	No	No
Can impacts be mitigated?	Yes							
Mitigation: Planning: ➢ Retain and maintain natural vegetation immediately adjacent to the development footprint/servitude. Construction: ➢ Ensure that vegetation is not unnecessarily removed during the construction phase. ➢ Plan the placement of lay-down areas (if required) and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible. ➢ Restrict the activities and movement of construction workers and vehicles to the immediate construction area and existing access roads. ➢ Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed of regularly at licensed waste facilities. ➢ Reduce and control construction dust using appropriate and effective dust suppression techniques as and when required (i.e. whenever dust becomes apparent). ➢ Restrict construction activities to daylight hours whenever possible in order to reduce lighting impacts. Rehabilitate all disturbed areas immediately after the completion of construction works.								
Cumulative: The construction of the infrastructure will increase the cumulative visual impact of electrical type infrastructure within the region. This is specifically relevant in light of the numerous existing power lines and Hydra substation in the area.								
Residual: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.								

6.8.2. Operational impacts

6.8.2.1. Potential visual impact on sensitive visual receptors located within a 0.5km radius of the grid connection infrastructure during the operational phase

The grid connection infrastructure is expected to have a **moderate** visual impact (significance rating = 57) on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure. The visual impact of the power line will largely be absorbed by the presence of the existing power lines.

No mitigation of this impact is possible (i.e. the structures will be visible regardless), but general mitigation and management measures are recommended as best practice. The table below illustrates this impact assessment.

A mitigating factor within this scenario is the very low occurrence of receptors within the receiving environment. No homesteads are located within 0.5 Km and observers traveling along the secondary road will only be exposed to the visual intrusion for a short period of time. Additionally, the proximity of existing powerlines and the Hydra Substation reduces the probability of this impact occurring as there is already an existing visual intrusion.

Table 3: Visual impact on observers in close proximity to the proposed grid connection infrastructure.

Nature of Impact: Visual impact on observers travelling along the secondary roads in close proximity to the power line and MTS structures.								
	VETLAAGTE MTS AND POWER LINE (PREFERRED)		**ALTERNATIVE VETLAAGTE MTS AND POWERLINE (ALT)**		**WAG-‘N-BIETJIE MTS AND POWERLINE (ALT)**		**ALTERNATIVE WG-‘N-BIETJIE MTS AND POWERLINE (ALT)**	
	No mitigation	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**
Extent	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**
Duration	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**
Magnitude	Very High **(10)**	Very High **(10)**	Very High **(10)**	Very High **(10)**	Very High **(10)**	Very High **(10)**	Very High **(10)**	Very High **(10)**
Probability	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**
Significance	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**	Moderate **(57)**
Status (positive/negative)	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative

Reversibility	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources	No	No	No	No	No	No	No	No
Can impacts be mitigated?	No							
Mitigation: Planning: ➢ Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint/servitude. Operations: ➢ Maintain the general appearance of the infrastructure. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all affected areas. Consult an ecologist regarding rehabilitation specifications.								
Cumulative: The construction of the infrastructure will increase the cumulative visual impact of electrical type infrastructure within the region. This is specifically relevant in light of the numerous existing power lines and Hydra substation in the area.								
Residual: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.								

6.8.2.2. Potential visual impact on sensitive visual receptors within the region (1.5 – 3km radius) during the operation of the grid connection infrastructure

The grid connection infrastructure will have a **low** visual impact (significance rating = 28) on observers traveling along the roads and residents of homesteads within a 1.5 - 3km radius of the infrastructure.

A mitigating factor within this scenario is the very low occurrence of receptors within the receiving environment. Observers traveling along the secondary road will only be exposed to the visual intrusion for a short period of time. Additionally, the proximity of existing powerlines and the Hydra Substation reduces the probability of this impact occurring as there is already an existing visual intrusion.

It should also be noted that Wag-'n-Bietjie MTS Alternative/powerline and Alternative Wag-'n-Bietjie MTS alternative/powerline will have a marginally lower impact due to its shorter length than compared to Vetlaagte MTS preferred/powerline and Alternative Vetlaagte MTS alternative/powerline.

No mitigation of this impact is possible (i.e. the structures will be visible regardless), but general mitigation and management measures are recommended as best practice. The table below illustrates this impact assessment.

Table 4: Visual impact of the proposed grid connection infrastructure within the region.

Nature of Impact: Visual impact on observers travelling along the roads and residents at homesteads within a 1.5 – 3km radius of the grid connection infrastructure.								
	VETLAAGTE MTS AND POWER LINE (PREFERRED)		**ALTERNATIVE VETLAAGTE MTS AND POWERLINE (ALT)**		**WAG-'N-BIETJIE MTS AND POWERLINE (ALT)**		**ALTERNATIVE WG-'N-BIETJIE MTS AND POWERLINE (ALT)**	
	No mitigation	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**
Extent	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**	Short distance **(3)**
Duration	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**
Magnitude	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**
Probability	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**
Significance	Low **(28)**	Low **(28)**	Low **(28)**	Low **(28)**	Low **(28)**	Low **(28)**	Low **(28)**	Low **(28)**
Status (positive/negative)	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources	No	No	No	No	No	No	No	No
Can impacts be mitigated?	No							

Mitigation:

Planning:

- Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint/servitude.

Operations:

- Maintain the general appearance of the servitude as a whole.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use.

➢ Rehabilitate all affected areas. Consult an ecologist regarding rehabilitation specifications.
Cumulative: The construction of the infrastructure will increase the cumulative visual impact of electrical type infrastructure within the region. This is specifically relevant in light of the numerous existing power lines and Hydra substation in the area.
Residual: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.

6.8.2.3. Potential visual impact of associated infrastructure on sensitive visual receptors in close proximity

The height of the proposed new Vetlaagte or Wag-'n-Bietjie main transmission substation will not exceed 30m in height, therefore the visual exposure of this component will fall within the view sheds generated for the power line infrastructure (which is not expected to exceed 30m). Other associated infrastructure would include access roads and cleared servitudes along the alignments.

Servitudes will need to be maintained along the length of the proposed power line for their entire operational life and access roads will be required both to construct the power line, and to maintain the servitudes (operational phase). These servitudes and access roads have the potential of manifesting as landscape scarring, and thus represent a potential visual impact within the viewshed areas. This is especially relevant for steep slopes where erosion could occur over time. Such erosion and landscape scarring could represent a visual impact.

As access roads and servitudes have no elevation or height, so the visual impact of this associated infrastructure will be absorbed by the visual impact the primary infrastructure.

The grid connection infrastructure is expected to have a moderate visual impact (significance rating = 57) on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure pre mitigation and a low visual impact (significance rating= 30) post mitigation.

A mitigating factor within this scenario is the very low occurrence of receptors within the receiving environment. Observers traveling along the secondary road will only be exposed to the visual intrusion for a short period of time. Additionally, the secondary road is located 2 km from the proposed Wag-'n-Bietjie main transmission substation and alternative and 2 km from the proposed Vetlaagte main transmission substation thereby reducing the likelihood of this impact occurring.

Table 5: Visual impact of associated infrastructure on sensitive visual receptors in close proximity

Nature of Impact: Potential visual impact of associated infrastructure on sensitive visual receptors in close proximity								
	VETLAAGTE MTS AND POWER LINE (PREFERRED)		**ALTERNATIVE VETLAAGTE MTS AND POWERLINE (ALT)**		**WAG-'N-BIETJIE MTS AND POWERLINE (ALT)**		**ALTERNATIVE WAG-'N-BIETJIE MTS AND POWERLINE (ALT)**	
	No mitigation	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**
Extent	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**	Very short distance **(4)**
Duration	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**	Permanent **(5)**
Magnitude	Very High **(10)**	Moderate **(6)**	Very High **(10)**	Moderate **(6)**	Very High **(10)**	Moderate **(6)**	Very High **(10)**	Moderate **(6)**
Probability	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**	Probable **(3)**	Improbable **(2)**
Significance	Moderate **(57)**	Low **(30)**	Moderate **(57)**	Low **(30)**	Moderate **(57)**	Low **(30)**	Moderate **(57)**	Low **(30)**
Status (positive/negative)	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources	No	No	No	No	No	No	No	No
Can impacts be mitigated?	Yes							

Mitigation:

Planning:

- Retain and maintain natural vegetation immediately adjacent to the development footprint/servitude.

Construction:

- Ensure that vegetation is not unnecessarily removed during the construction phase.
- Plan the placement of lay-down areas (if required) and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction area and existing access roads.
- Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed of regularly at licensed waste facilities.
- Reduce and control construction dust using appropriate and effective dust suppression techniques as and when required (i.e. whenever dust becomes apparent).

➢ Restrict construction activities to daylight hours whenever possible in order to reduce lighting impacts. Rehabilitate all disturbed areas immediately after the completion of construction works.
Cumulative: The construction of the infrastructure will increase the cumulative visual impact of electrical type infrastructure within the region. This is specifically relevant in light of the numerous existing power lines and Hydra substation in the area.
Residual: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.

6.8.2.4. Potential visual impact of lighting on sensitive visual receptors in the region

It can be expected that the light trespass and glare from the security and after-hours operational lighting (flood lights) for the proposed new Vetlaagte or Wag-'n-Bietjie MTS will have some significance on the receiving environment.

Another potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The substation lighting may contribute to the effect of sky glow.

The grid connection infrastructure is expected to have a moderate visual impact (significance rating = 39) on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure mitigated to low (significance rating= 22).

Table 6: Visual impact of lighting on sensitive visual receptors in close proximity

Nature of Impact: Potential visual impact of lighting at night on visual receptors in close proximity to the proposed infrastructure		
	Proposed Main transmission substation	
	No Mitigation	**Mitigation considered**
Extent	Short (3)	Short (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	***Moderate (39)***	***Low (22)***
Status (positive/negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: ➢ Planning & operation: ➢ The possibility of limiting aircraft warning lights to the turbines on the perimeter according to CAA requirements, thereby reducing the overall impact, must be investigated. ➢ Shield the sources of light by physical barriers (walls, vegetation, or the structure itself). ➢ Limit mounting heights of lighting fixtures, or alternatively use foot-lights or bollard level lights. ➢ Make use of minimum lumen or wattage in fixtures. ➢ Make use of down-lighters, or shielded fixtures. ➢ Make use of Low-Pressure Sodium lighting or other types of low impact lighting. ➢ Make use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.		
Cumulative impacts: None.		
Residual impacts: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.		

6.9. Visual impact assessment: secondary impacts

The potential visual impact of the proposed grid connection infrastructure on the visual landscape and sense of place of the region.

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.), plays a significant role.

An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

The greater environment has a rural and undeveloped character. Settlements, where these occur, are limited in extent and domestic in scale. These vast, generally undeveloped landscapes are considered to have a high visual quality, except where structures (such as power lines and the Hydra substation) represent existing visual disturbances.

The anticipated visual impact of the proposed grid connection infrastructure on the regional visual quality (i.e. beyond 3km of the proposed infrastructure), and by implication, on the sense of place, is difficult to quantify, but is generally expected to be of **low** significance. This is due to the fact that there are numerous powerlines within the study area as well as the existing Hydra substation. However, the potential future development of neighbouring renewable energy projects may drastically change the overall visual impact on the sense of place within the region.

Within the study area there are numerous existing power lines that all congregate at the Hydra Substation. The addition of the proposed powerline will contribute to the overall occurrence of industrial type infrastructure within the region. However, the low incidence of visual receptors within this environment and the relatively remote location of the proposed powerline reduces the probability of this impact occurring.

Table 7: The potential impact on the sense of place of the region.

Nature of Impact: The potential impact of the development of the proposed grid connection infrastructure on the sense of place of the region.								
	VETLAAGTE MTS AND POWER LINE (PREFERRED)		**ALTERNATIVE VETLAAGTE MTS AND POWERLINE (ALT)**		**WAG-'N-BIETJIE MTS AND POWERLINE (ALT)**		**ALTERNATIVE WG-'N-BIETJIE MTS AND POWERLINE (ALT)**	
	No mitigation	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**	**No mitigation**	**Mitigation considered**
Extent	Medium **(2)**	Medium **(2)**	Medium **(2)**	Medium **(2)**	Medium **(2)**	Medium **(2)**	Medium **(2)**	Medium **(2)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**
Probability	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**
Significance	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**
Status (positive/negative)	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss	No	No	No	No	No	No	No	No

of resources								
Can impacts be mitigated?	No							
Mitigation: Planning: ➢ Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint/servitude. Operations: ➢ Maintain the general appearance of the servitude as a whole. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all affected areas. Consult an ecologist regarding rehabilitation specifications.								
Cumulative: The construction of the infrastructure will increase the cumulative visual impact of electrical type infrastructure within the region. This is specifically relevant in light of the numerous existing power lines and Hydra substation in the area.								
Residual: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.								

The potential cumulative visual impact of the proposed grid connection infrastructure on the visual quality of the landscape.

The construction of the Carolus grid connection infrastructure may increase the cumulative visual impact of industrial type infrastructure within the region.

The anticipated cumulative visual impact of the proposed grid connection infrastructure is expected to be of **moderate** significance (significance rating = 42). This is considered to be acceptable from a visual impact perspective.

Within the study area there are numerous existing power lines that all congregate at the Hydra Substation. The addition of the proposed powerline will contribute to the overall occurrence of industrial type infrastructure within the region. However, the low incidence of visual receptors within this environment and the relatively remote location of the proposed powerline reduces the probability of this impact occurring.

Table 8: The potential cumulative visual impact on the visual quality of the landscape.

Nature of Impact: The potential cumulative visual impact of the grid connection infrastructure on the visual quality of the landscape.		
	Proposed substation and associated powerlines	
	Overall impact of the project considered in isolation (with mitigation)	**Cumulative impact of the project and other projects within the area (with mitigation)**
Extent	Very short distance **(4)**	Medium to longer distance **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	High **(8)**
Probability	Improbable **(2)**	Probable **(3)**
Significance	***Moderate (32)***	Moderate (42)
Status (positive/negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	No	No
Mitigation: ***Generic best practise mitigation/management measures:*** Planning: ➢ Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint/servitude. Operations: ➢ Maintain the general appearance of the servitude as a whole. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all affected areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: None. The visual impact of the power line and substation will be removed after decommissioning. If the substation and lines are not decommissioned and removed, then the impact will persist.		

6.10. The potential to mitigate visual impacts

The primary visual impact, namely the appearance of the proposed grid connection infrastructure is not possible to mitigate. The functional design of the structures cannot be changed in order to reduce visual impacts.

Secondary impacts anticipated as a result of the proposed grid connection infrastructure (i.e. visual character and sense of place) are also not possible to mitigate.

The following mitigation is, however possible:

- Retain/re-establish and maintain natural vegetation in all areas immediately adjacent to the development footprint/servitude. This measure will help to soften the appearance of the grid connection infrastructure within its context.

- Mitigation of visual impacts associated with the construction phase, albeit temporary, would entail proper planning, management and rehabilitation of the construction site. Recommended mitigation measures include the following:

    - Ensure that vegetation is not unnecessarily cleared or removed during the construction period.
    - Plan the placement of laydown areas (if required) and any potential temporary construction camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
    - Restrict the activities and movement of construction workers and vehicles to the immediate construction area and existing access roads.
    - Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
    - Reduce and control construction dust through the use of appropriate and effective dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
    - Restrict construction activities to daylight hours as far as possible, in order to negate or reduce the visual impacts associated with lighting.
    - Rehabilitate all disturbed areas, construction areas, roads, slopes etc. immediately after the completion of construction works. If necessary, an ecologist must be consulted to assist or give input into rehabilitation specifications.

- During operation, the maintenance of the grid connection infrastructure will ensure that the infrastructure does not degrade, therefore aggravating visual impact.

- Roads must be maintained to forego erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as a when required.

- Once the grid connection infrastructure has exhausted its life span, all associated infrastructure not required for the post rehabilitation use of the site/servitude should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications.

- All rehabilitated areas should be monitored for at least a year following decommissioning, and remedial actions implemented as and when required.

Good practice requires that the mitigation of both primary and secondary visual impacts, as listed above, be implemented and maintained on an ongoing basis.

7. CONCLUSION AND RECOMMENDATIONS

The construction and operation of the proposed Carolus grid connection infrastructure for the Carolus Solar PV1 Facility may have a visual impact on the study area, especially within a 0.5km radius (and potentially up to a radius of 3km) of the power line structure and substation. The visual impact will differ amongst places, depending on the distance from the infrastructure.

Within the study area there are numerous existing power lines that all congregate at the Hydra Substation. The visual amenity along this infrastructure corridor has already been compromised to a large degree. Admittedly, the frequency of visual exposure to power lines is expected to increase, but it is still preferable to consolidate the linear infrastructure as much as possible. To this end, the cumulative visual impact associated with the proposed grid connection infrastructure is considered to be within acceptable limits.

Overall, the significance of the visual impacts is expected to range from **moderate** to **low** as a result of the generally undeveloped character of the landscape. No visual impacts of a high significance are expected to occur.

A number of mitigation measures have been proposed (**Section 6.10.**). Regardless of whether or not mitigation measures will reduce the significance of the anticipated visual impacts, they are considered to be good practice and should all be implemented and maintained throughout the construction, operation and decommissioning phases of the proposed grid connection infrastructure.

Four (4) alternatives have been proposed for the Carolus grid connection. Based on the above analyses, taking into consideration sensitive visual receptors within close proximity and existing infrastructure, Wag-‘n-Bietjie MTS (Alternative)/powerline would be the most preferable owing to the shorter length of the powerline. However, none of the Project Alternatives are considered fatally flawed from a visual perspective.

If mitigation is implemented as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Carolus grid connection infrastructure is considered to be acceptable from a visual impact perspective.

8. IMPACT STATEMENT

The findings of the Visual Impact Assessment undertaken for the proposed Carolus grid connection infrastructure indicates that the visual environment surrounding the power line, especially within a 0.5km radius (and potentially up to a 1.5km radius), may be visually impacted upon for the anticipated operational lifespan of the grid connection infrastructure.

This impact is applicable to the proposed grid connection infrastructure and to the potential cumulative visual impact of the infrastructure in association with existing power line infrastructure (and future power generation infrastructure) within the region.

The following is a summary of impacts remaining, assuming mitigation as recommended is implemented:

- During the construction phase, there may be an increase in heavy vehicles utilising the roads to the power line that may cause, at the very least, a visual nuisance to other road users and landowners in the area. Construction activities may potentially result in a **moderate** temporary visual impact that may be mitigated to **low**.

- The grid connection infrastructure is expected to have a **moderate** visual impact on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure. The visual impact of the power line will largely be absorbed by the presence of the existing power line infrastructure.

- The grid connection infrastructure is expected to have a **low** negative visual impact on observers traveling along the roads and residents of homesteads within a 1.5 - 3km radius of the structures.

- The potential visual impact of associated infrastructure is expected to have a **moderate** visual impact on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure pre mitigation and a **low** visual impact post mitigation.

- Potential visual impact of lighting is expected to have a moderate visual impact on observers within a 0.5km radius (and potentially up to a 1.5km radius) of the grid connection infrastructure mitigated to low.

- The anticipated visual impact of the proposed grid connection infrastructure on the regional visual quality, and by implication, on the sense of place, is difficult to quantify, but is generally expected to be of **low** negative significance. This is due to the relatively low viewer incidence within close proximity to the proposed grid connection infrastructure and the presence of existing powerlines.

- The anticipated cumulative visual impact of the proposed grid connection infrastructure is expected to be of **moderate** negative significance, which is considered to be acceptable from a visual perspective. This is once again due to the relatively low viewer incidence within close proximity to the power line infrastructure.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from **moderate** to **low** significance. No visual impacts of a high significance are expected to occur. Anticipated visual impacts on sensitive visual receptors in close proximity to the power line are not considered to be fatal flaws for the proposed project.

Considering all factors, it is recommended that the development of the grid connection infrastructure as proposed be supported; subject to the implementation of the recommended mitigation measures (**Section 6.10.**) and management programme (**Section 9**).

9. MANAGEMENT PROGRAMME

The following management plan tables aim to summarise the key findings of the visual impact report and suggest possible management actions in order to mitigate the potential visual impacts. Refer to the tables below.

Table 10: Management Programme: Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the proposed grid connection infrastructure.		
Project component/s	Carolus Grid connection infrastructure.	
Potential Impact	Primary visual impact due to the presence of the grid connection infrastructure in the landscape.	
Activity/risk source	The viewing of the grid connection infrastructure by observers near the infrastructure as well as within the region.	
Mitigation: Target/Objective	Optimal planning of infrastructure so as to minimise visual impact.	
Mitigation: Action/control	Responsibility	Timeframe
Implement an environmentally responsive planning approach for the development of roads and infrastructure to limit cut and fill requirements. Plan with due cognisance of the topography.	Project proponent / design consultant	Planning phase.
Consolidate infrastructure and make use of already disturbed sites rather than natural areas, as far as practically feasible.	Project proponent / design consultant	Planning phase.
Performance Indicator	No visible degradation of access roads and other associated infrastructure from surrounding areas.	
Monitoring	Not applicable.	

Table 11: Management Programme: Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the proposed grid connection infrastructure.		
Project component/s	Construction activities associated with the development of the 132kV power line.	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing.	
Activity/risk source	The viewing of general construction activities by observers near the development areas.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.	
Mitigation: Action/control	Responsibility	Timeframe
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	Project proponent / contractor	Early in the construction phase.
Plan the placement of laydown areas (if required) and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	Project proponent / contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction area and existing access roads.	Project proponent / contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately	Project proponent / contractor	Throughout the construction phase.

stored (if not removed daily) and then disposed regularly at licensed waste facilities.		
Reduce and control construction dust through the use of appropriate and effective dust suppression techniques as and when required (i.e. whenever dust becomes apparent).	Project proponent / contractor	Throughout the construction phase.
Restrict construction activities to daylight hours, as far as possible, in order to negate or reduce the visual impacts associated with lighting.	Project proponent / contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. If necessary, consult an ecologist to give input into rehabilitation specifications.	Project proponent / contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover within the servitudes and in the vicinity of the grid connection infrastructure has been maintained as far as possible and disturbed areas have been rehabilitated with no evidence of erosion.	
Monitoring	Monitoring of vegetation clearing during construction. Monitoring of rehabilitated areas post construction.	

Table 12: Management Programme: Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the proposed grid connection infrastructure.		
Project component/s	Carolus Grid connection infrastructure.	
Potential Impact	Visual impact of vegetation rehabilitation failure.	
Activity/risk source	The viewing of the above mentioned by observers near the infrastructure.	
Mitigation: Target/Objective	Well-rehabilitated and maintained servitudes.	
Mitigation: Action/control	Responsibility	Timeframe
Maintain roads to forego erosion and to suppress dust.	Project proponent / operator	Throughout the operation phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	Project proponent / operator	Throughout the operation phase.
Performance Indicator	Intact vegetation within servitudes and in the vicinity of the infrastructure.	
Monitoring	Monitoring of rehabilitated areas.	

Table 13: Management Programme: Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the proposed grid connection infrastructure.	
Project component/s	Carolus Grid connection infrastructure.
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.
Activity/risk source	The viewing of the residual scarring and vegetation rehabilitation failure by observers along or near the areas where the grid connection infrastructure was constructed.
Mitigation: Target/Objective	Rehabilitated vegetation in all disturbed areas.

Mitigation: Action/control	Responsibility	Timeframe
Remove infrastructure not required for the post-decommissioning use of the site/servitude.	Project proponent / operator	During the decommissioning phase.
Rehabilitate access roads and servitudes not required for the post-decommissioning use of the sites. If necessary, consult an ecologist to give input into rehabilitation specifications.	Project proponent / operator	During the decommissioning phase.
Monitor rehabilitated areas quarterly for at least a year following decommissioning, and implement remedial action as and when required.	Project proponent / operator	Post decommissioning.

Performance Indicator	Intact vegetation along and in the vicinity of the servitude.
Monitoring	If rehabilitation is successful then no further monitoring is required.

10. REFERENCES/DATA SOURCES

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