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Enviro INSIGHT environmental impact assessments

Appendix D7:

Visual Impact Assessment

PROPOSED BOTTERBLOM WIND ENERGY FACILITY, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT – INPUT FOR SCOPING REPORT

Produced for:

FE Botterblom (Pty) Ltd

On behalf of:

Enviro-Insight CC
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Produced by:

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- February 2022 -

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1. STUDY APPROACH

1.1. Qualification and Experience of the Practitioner

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

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 modelling 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.

Enviro-Insight CC appointed Lourens du Plessis as an independent specialist consultant to undertake the visual impact assessment for the proposed Botterblom Wind Energy Facility (WEF). He will not benefit from the outcome of the project decision-making.

1.2. Assumptions and Limitations

This assessment was undertaken during the planning stage of the project and is based on information available at that time. It is assumed that all information regarding the project details provided by the client is correct and relevant to the proposed project.

1.3. Level of Confidence

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

[1] Adapted from Oberholzer (2005).

- 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:

Table 1: Level of confidence.

	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

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:*

- 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 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 Plan of Study for the Visual Impact Assessment (VIA) is stated below.

The VIA will be 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 wind turbine generator (WTG) layout.

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

The VIA will consider potential cumulative visual impacts, or alternatively the potential to concentrate visual exposure/impact within the region (if applicable).

The following VIA-specific tasks have been 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 AW3D30 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 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 would be exposed to the project infrastructure.

This is done in order to focus the 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 dataset, is a land use character map, that further aids in identifying sensitive areas and possible critical features (i.e. tourist facilities, national parks, etc. – if applicable), that should be addressed.

- **Determine the visual absorption capacity (VAC) 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 will be 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 is 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 this VIA report.

- **Site visit**

A site visit was undertaken (December 2020) in order 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.

2. BACKGROUND AND PROPOSED INFRASTRUCTURE

FE Botterblom (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site near Loeriesfontein, in the Northern Cape Province (Hantam Local Municipality of the Namakwa District Municipality). Up to 35 wind turbines are proposed to be constructed over a broader area of approximately ~5,600ha in extent. The proposed facility would be known as the **Botterblom Wind Energy Facility (WEF).**

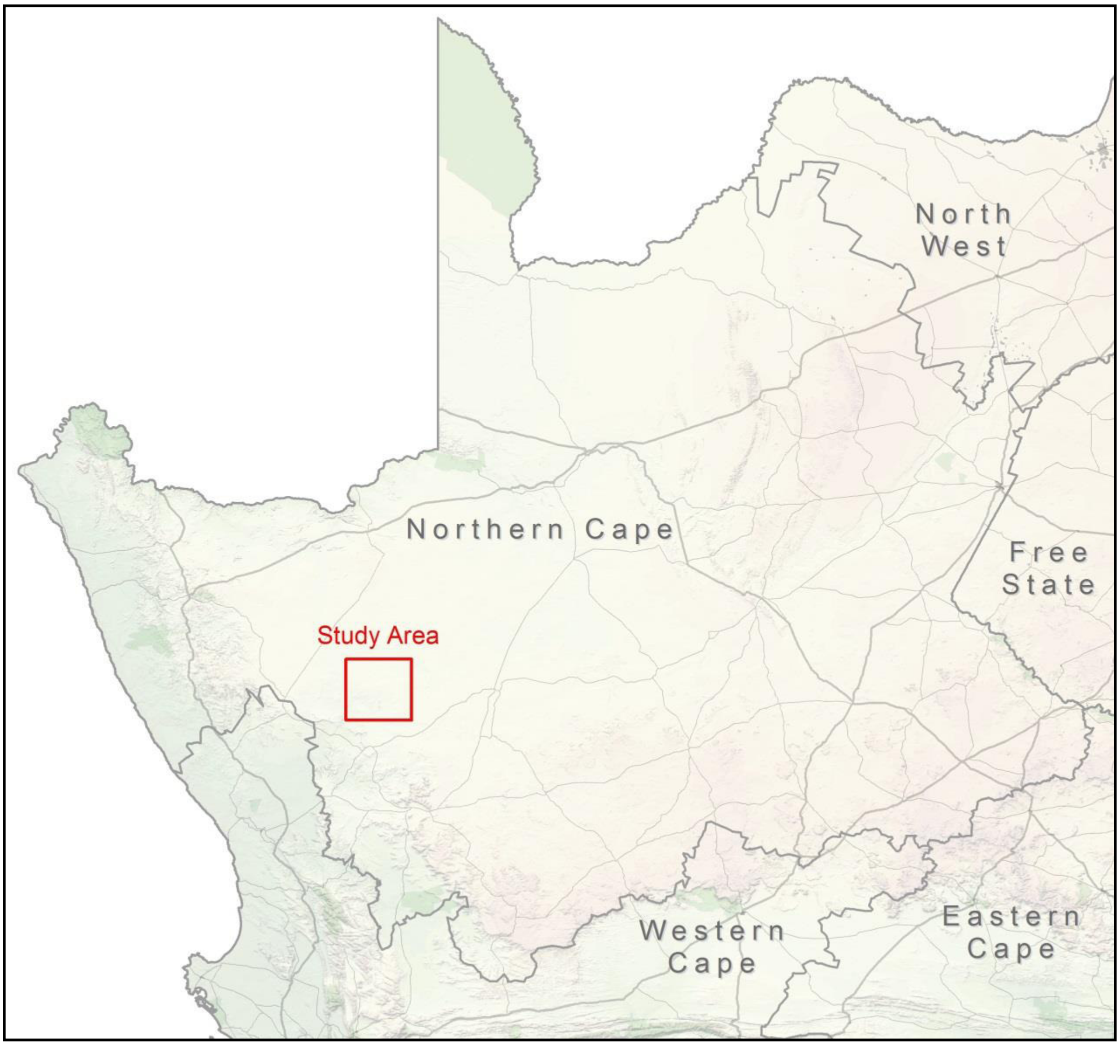

Figure 1: Regional locality of the study area.

The proposed Botterblom Wind Energy Facility is proposed on the following farm portion:

- Remaining Extent of Farm Sous 226.

The proposed Botterblom WEF will consist of up to 35 wind turbines, with a generation capacity of between 4.5 and 7.5 MW per turbine, depending on the available technology at the time. Each turbine will have a hub height of up to 150m and a rotor diameter of up to 175m. The final turbine model to be utilised will only be determined closer to the time of construction, depending on the technology available at the time.

The components of the WEF and associated infrastructure are as follows:

- Up to 35 wind turbines, with a generation capacity of between 4.5 and 7.5 MW per turbine (depending on the available technology at the time),
- turbines will have a hub height of up to 150m and a rotor diameter of up to 175m. The final turbine model to be utilised will only be determined closer to the time of construction (depending on the technology available at the time),
- onsite substation/s of 100mX100m (33/132kV) to facilitate the connection between the WEF and Helios substation,
- a Battery Energy Storage System (BESS),
- concrete foundations to support turbine towers,
- cabling between turbines, to be laid underground where practical,
- internal/ access roads (up to 10 m in width) linking the wind turbines and other infrastructure on the site,
- permanent workshop area and office for control, maintenance and storage, and
- temporary laydown areas during the construction phase (which will be rehabilitated).

A WEF generates electricity by means of wind turbines that harness the wind of the area as a renewable source of energy. Wind energy generation, or wind farming as it is commonly referred to, is generally considered to be an environmentally friendly electricity generation option.

The WEF will take approximately 18 months to construct and the operational lifespan of the facility is estimated at 20 years.

Three wind turbine layouts are considered and are indicated on **Figure 2** below:

- Alternative 1 (32 turbines indicated in white)
- Alternative 2 (30 turbines indicated in green)
- Alternative 3 (50 turbines indicated in blue)

Please take note: *Alternative 3 was considered for the maximum number of turbines for the property, but was disregarded from an early stage due to sensitivities and setbacks identified early in the process.*

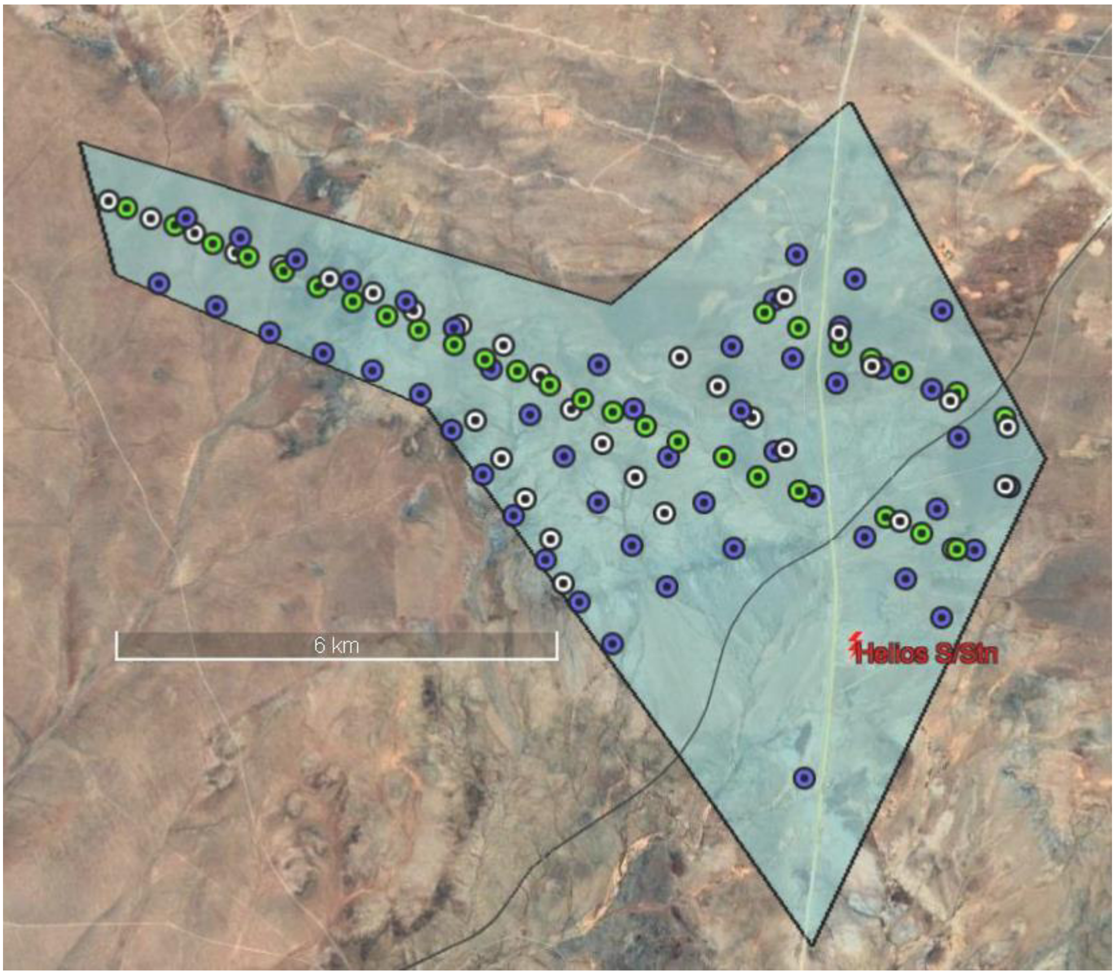

Figure 2: Aerial view of the proposed wind turbine layouts and Helios Main Transmission Substations (MTS).

3. SCOPE OF WORK

This report is the Visual Impact Assessment (VIA) of the proposed Botterblom WEF as described above.

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 for the visual assessment encompasses a geographical area of approximately 3,056km² (the extent of the full page maps displayed in this report) and includes a minimum 20km buffer zone (area of potential visual influence) from the boundaries of the proposed farm identified for the WEF development.

The study area does not include any towns or built up areas, or any national, arterial or main roads, but it does contain a number of farm settlements and homesteads. The Eskom Helios Main Transmission Substation is located on the farm identified for the WEF.

Anticipated issues related to the potential visual impact of the proposed Botterblom WEF include the following:

- The visibility of the facility from, and potential visual impact on observers travelling along the secondary (local) roads within the study area.

- The visibility of the facility from, and potential visual impact on farm settlements and homesteads (rural residences) within the study area.

- The potential visual impact of the facility on the visual character and sense of place of the region, with specific reference to the vast landscape, open plains and the scenic mountains (Klein and Groot Rooiberge).

- The potential visual impact of the facility on tourist routes or tourist destinations (e.g. tourist facilities within the study area) if applicable.

- The potential visual impact of the construction of ancillary infrastructure (i.e. internal access roads, buildings, Battery Energy Storage System (BESS) (if applicable), 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 construction of the WEF adjacent to the operational Khobab and Loeriesfontein WEFs and other authorised renewable energy applications in the study area

- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility.

- The potential visual impact of shadow flicker.

- 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 regional scale.

4. RELEVANT LEGISLATION AND GUIDELINES

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

- 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).

5. THE AFFECTED ENVIRONMENT

The project is proposed on a site on the following farm portion:

- Remaining Extent of Farm Sous 226.

This farm is located immediately south and south-west of the operational Khobab and Loeriesfontein WEFs. These WEFs respectively have 58 and 61 operational wind turbines, each connected (from their collector substations) to the Eskom Helios Main Transmission Substation, located on the farm.

The farm encompasses a surface area of approximately 5,600ha, but the final surface area to be utilised for the WEF may be smaller, depending on the number of turbines erected, the final site layout and the placement of the wind turbines.

Regionally, this farm is located some 50km north of the little town of Loeriesfontein (at the closest) within the Northern Cape Province, within a region commonly referred to as the *Bushmanland*. The Bushmanland falls within the arid Nama-Karoo Biome; a biome characterised by its dry semi-dessert climate and associated dessert-like vegetation. The vegetation cover of the majority of the study area, to the north and east, is identified as *Bushmanland Basin Shrubland*, interspersed with non-perennial pans (*Bushmanland Vloere*). The section to the south-west is described as *Hantam Karoo*.

The topography of the study area is relatively flat and homogenous, described predominantly as *slightly irregular plains and pans* to the north and east, and *plains* to the south-west. The elevation ranges from 560m above sea level (a.s.l.) in the south-west (along the Krom River floodplain) to 1,009m a.s.l. at the top of the Klein Rooiberg. This mesa or flat-topped mountain and the Groot Rooiberg south of it are the most prominent topographical features within a vast expansive landscape. Refer to **Map 1** for a topographical map of the study area.

The WEF site itself is located at an average elevation of 932m a.s.l. and has an even slope to the south towards the Klein-Rooiberg and the Rooiberg Rivers. These two non-perennial rivers and the dry Sandkraal River all flow into the Krom River. These rivers are only occasionally flooded during infrequent rainfall periods and are therefore dry riverbeds for most of the year. Other hydrological features in the study area are non-perennial pans to the north. Some of the larger pans include:

- Konnes se Pan
- Dwaggas Salt Pan
- Boegoefontein Pan
- Bitterputs Pan
- Kareedoring Pan
- Brakpan

Some of these pans are home to the limited industrial activities within the region, namely salt mining, e.g. at Dwaggas Pan and Boegoefontein Pan. Other than these relatively small salt mining operations, the only industrial infrastructure includes the Sishen to Saldanha iron ore railway line, the Helios Substation, the Loeriesfontein and Khobab WEFs, and the Aries to Helios 400kV and Helios to June 400kV power lines. The railway line, power lines and the Loeriesfontein secondary (gravel) road all traverse the proposed Botterblom development site.

In spite of the limited industrial activity, it should be noted that the region has attracted a large number of renewable energy applications (both wind and solar), most of which have been authorised. See **Figure 3**.

Other than the infrastructure and activities mentioned previously, the dominant land use (at present) within the region is sheep farming. There is very limited agricultural activity (dryland cultivation) due to the limited rainfall (less than 300mm per annum) and arid climate. The predominant land cover types include seasonal grassland, bare sand surfaces and Low Shrubland, mainly to the south. Some Woodland occurs along the dry riverbeds and drainage lines to the south-west. Refer to **Map 2** for the land cover and broad land use patterns within the study area.

Overall, the region has a predominantly undeveloped, rural and natural character, with scattered isolated homesteads or farm settlements occurring within the study area. These are generally located at great distances from each other. The region has a population density of less the 1 person per km^2.

There are no conservation or protected areas within the study area, and no tourist destinations or tourist facilities were identified within the region.[2]

Figure 3: View of the expansive Bushmanland landscape (*Photo credit: Google Earth – Rehan Opperman*).

Figure 4: The Klein and Groot Rooiberge (*Photo credit: Google Earth – Rehan Opperman*).

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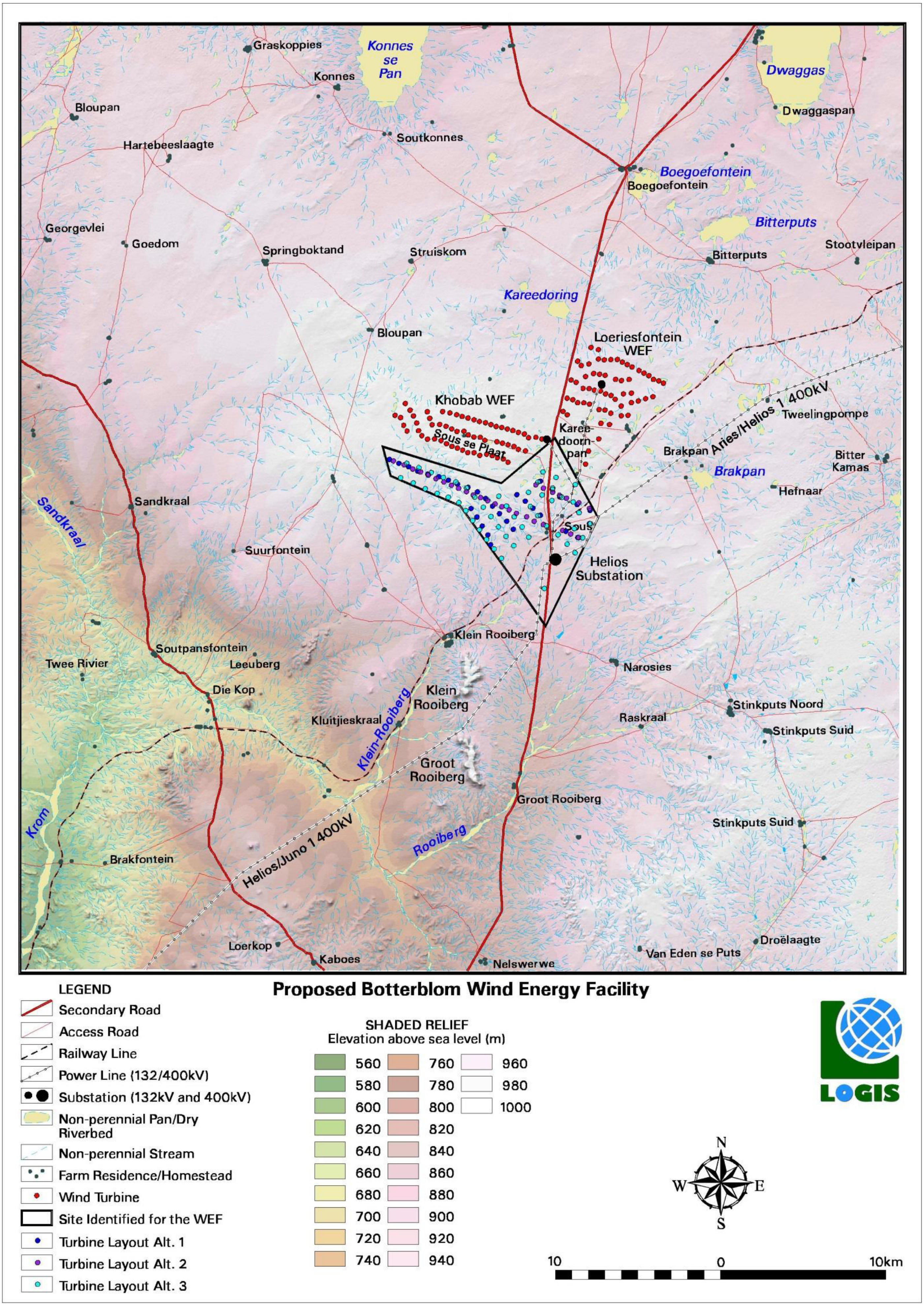
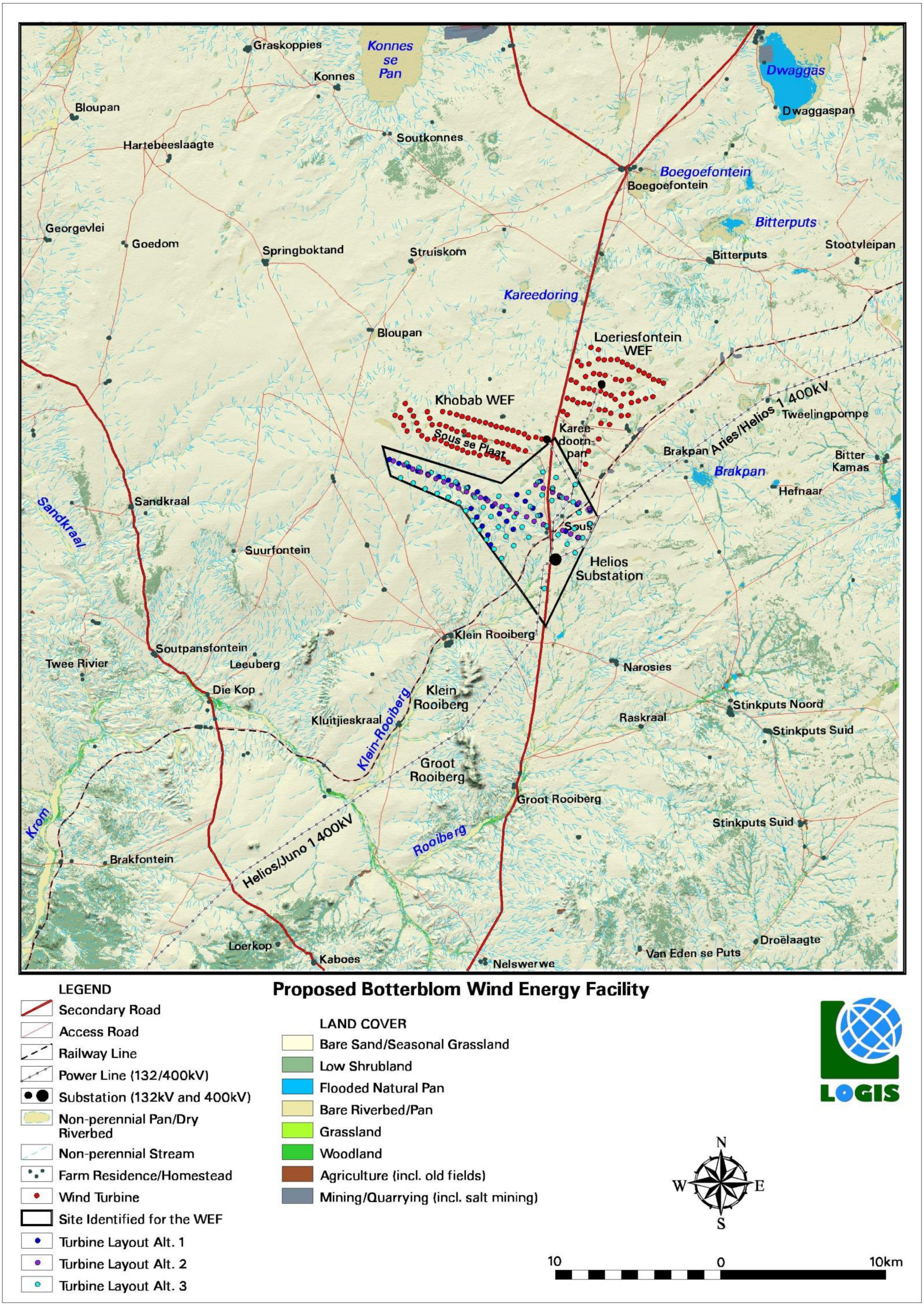
[2] Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q2 and SAPAD2019-20 (DEA).

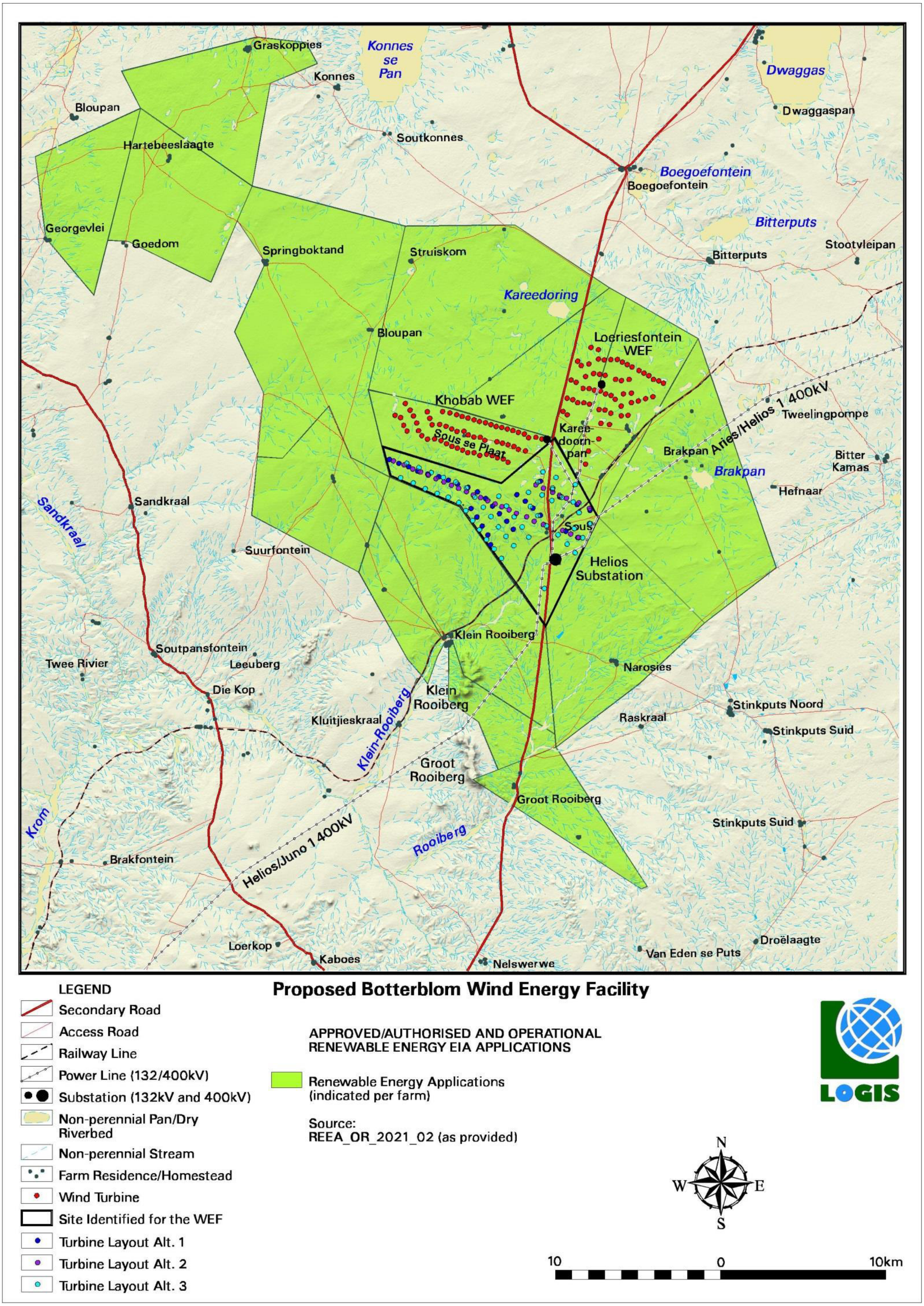
Figure 5: Long distance view of the Dwaggas Salt Pan from the north (*Photo credit: Google Earth – Rehan Opperman*).



Map 1: Shaded relief map of the study area.



Map 2: Land cover and broad land use patterns.



Map 3: Approved/authorised Renewable Energy EIA Applications within the study area.

*Note related to **Map 3**: The Renewable Energy EIA Application (REEA) database is not always updated regularly and therefore some projects shown on Map 3 may no longer be considered for development, or no longer have valid Environmental Authorisations (EAs). The data is displayed as provided and the author does not accept responsibility for the accuracy thereof.*

6. RESULTS

6.1. Potential visual exposure

A visibility analysis was undertaken from each of the wind turbine positions at an offset of 150m (approximate hub-height) above ground level. All three layout alternatives were calculated individually and compared. There was a negligible difference in the visual exposure of the alternatives due to the tall turbine dimensions, the close proximity of the layouts to each other and the generally flat topography within the study area (i.e. they will all be similarly exposed). The results of the visibility analyses are displayed on **Map 4**.

The viewshed analyses do not include the effect of vegetation cover or existing structures on the exposure of the proposed WEF, therefore signifying a worst-case scenario.

The results of the viewshed analyses display the potential areas of visual exposure, as well as the potential frequency of exposure. The frequency of exposure indicates the number of turbines that may be exposed i.e. more turbines may be visible in the darker orange areas than in the yellow areas. Land that is more elevated is typically more exposed to the proposed WEF, whilst lower lying areas such as valleys are shielded, or not as exposed.

The following is evident from the viewshed analyses:

0 – 5km

The proposed WEF would have a large core area of potential visual exposure within a 5km radius of the development site. This is due to the tall wind turbine structures and the flat topography. This core area includes the Khobab WEF, the largest part of the Loeriesfontein WEF and a 21.5km section of the Loeriesfontein secondary road.

There are a number of homesteads within a 5km radius of the proposed WEF that may be exposed to the wind turbine structures. These include:

- Kareedoornpan[3] (Loeriesfontein WEF)
- Sous se Plaat (Khobab WEF)
- Sous (proposed Botterblom WEF)
- Narosies

It is expected that the turbine structures would be clearly visible from these homesteads and the Loeriesfontein secondary road.

5 – 10km

Visual exposure will remain high in the medium distance (i.e. between 5 and 10km), due to the flat undulating nature of the topography. Of importance in this

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[3] 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.

zone are a number of homesteads that may be exposed to the wind turbine structures. These include:

- Bloupan
- Brakpan
- Klein Rooiberg
- Raskraal

It is expected that the turbine structures would be clearly visible from these homesteads and sections of the Loeriesfontein secondary road.

10 – 20km

In the medium to longer distance (i.e. between 10 and 20km), visual exposure will be somewhat reduced, especially towards the west. This zone also includes a number of settlements and homesteads, as well as sections of secondary roads.

Exposed homesteads may include:

- Soutkonnes
- Bitterputs
- Goedom
- Struiskom
- Boegoefontein
- Bitterputs
- Springboktand
- Tweelingpompe
- Bitter Kamas
- Hefnaar
- Soutpansfontein
- Stinkputs Noord
- Kluitjieskraal
- Stinkputs Suid

It is expected that the turbine structures would be visible from these homesteads and sections of secondary roads.

> 20km

Visual exposure beyond a 20km radius is significantly reduced, especially in the south west, along the Krom River valley.

Exposed homesteads may include:

- Konnes
- Stootvleipan
- Loerkop
- Nelswerwe

It is expected that the turbine structures may be visible from these homesteads and sections of secondary roads.

Conclusion

It is envisaged that the WEF structures would be easily and comfortably visible to observers (i.e. people travelling along the Loeriesfontein secondary road, residing at homesteads or visiting the region), especially within a 5-10km radius of the

WEF and would constitute a high visual prominence, potentially resulting in a high visual impact.

6.2. Cumulative visual assessment

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 practice the terms 'effects' and 'impacts' are used interchangeably.

Cumulative visual impacts may be:

- Combined, where the wind turbines of several WEFs 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 WEF's wind turbines; and
- Sequential, when the observer has to move to another viewpoint to see different developments, or different views of the same development (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 wind turbines.

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 WEF development on the landscape and visual amenity is a product of:

- The distance between individual WEFs (or turbines);
- The distance over which the wind turbines are visible;
- The overall character of the landscape and its sensitivity to the structures;
- The siting and design of the WEFs themselves; 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 all the projects existing and proposed in the area.

For the purpose of this study, viewshed analyses were undertaken from all existing, proposed and authorised WEFs within a 30km radius of the proposed Botterblom WEF, of which the wind turbine layouts were available at the time of drafting this report.

These include:

- Botterblom WEF (50 turbines)
- Khobab WEF 1 (58 turbines)
- Loeriesfontein WEF (61 turbines)

The following authorised WEFs are mentioned, but wind turbine layouts weren't readily available for inclusion:

- Ithemba WEF
- !XHA Boom WEF
- Kokerboom WEF
- Dwarsrug WEF

Note: Some of these WEFs mentioned above may consist of more than one phase.

Visibility analyses of the Botterblom, Khobab and Loeriesfontein WEFs were undertaken individually from each of the WEF's wind turbine positions at an offset off 150m above ground level (the approximate/estimated hub-height). The results of these viewshed analyses were overlain in order to determine areas where all three WEFs may theoretically be visible, areas where two may be visible, and ultimately areas where turbines from only a single WEF may be visible.

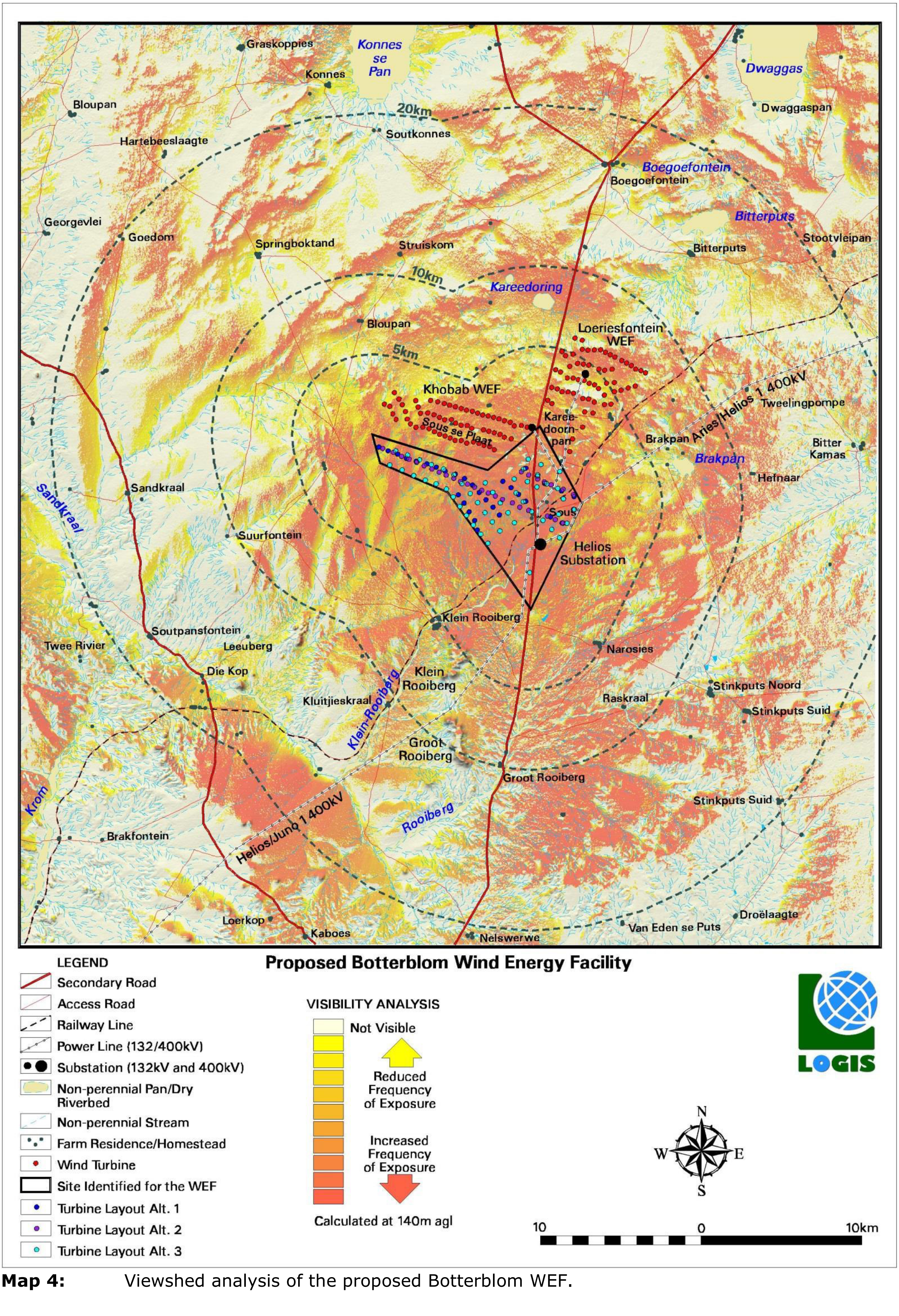
The cumulative viewshed analysis is displayed on **Map 5** and the number of WEFs visible is indicated in the legend, e.g. an area where wind turbines from just one WEF is visible are indicated in green, an area where wind turbines from two WEFs may be visible in yellow, and areas exposed to all three WEFs in red.

Results

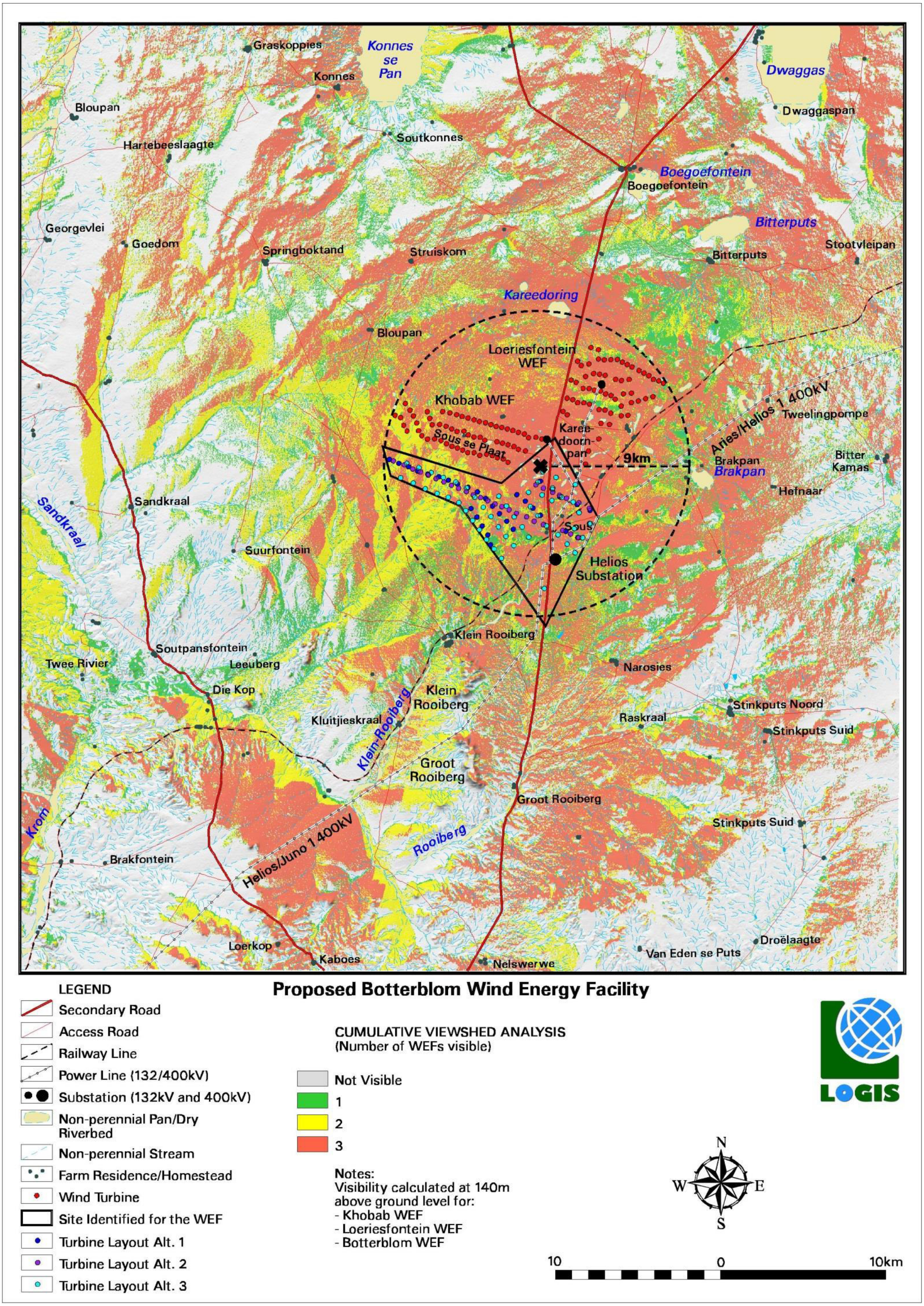
The physical development footprints of all of the above WEFs are contained within an approximately 9km radius of each other, effectively creating an 18km diameter wind energy generation hub (shown on **Map 5**). The general close proximity of the WEFs adjacent to each other has as an effect that the viewshed patterns are very similar. This is also attributed to the homogenous topography of the study area. Chances are that the three WEFs may be viewed as one large WEF, rather than three individual WEFs.

This statement should however not distract from the fact that there will be a large amount of wind energy generation structures and ancillary infrastructure (e.g. overhead power lines and substations) within this area that currently have very little built structures besides the existing WEFs, Helios Substation and associated power lines.

Alternately, it is preferable to concentrate future wind energy infrastructure within this wind hub, considering the fact that there are already two operational WEFs (and a number of authorised renewable energy applications in the region) and they are both in relative close proximity to an existing grid connection point (i.e. the Helios Substation). This will largely help to prevent the scattered proliferation of WEF structures throughout the greater region. The remote location of the proposed WEF, and the generally limited number of affected sensitive visual receptors, further mitigates the potential cumulative visual exposure of the WEFs. The potential cumulative visual impact is therefore considered to be within acceptable limits.



Map 4: Viewshed analysis of the proposed Botterblom WEF.



Map 5: Cumulative viewshed analysis of the proposed and existing wind turbines within the study area.

6.3. Visual distance / observer proximity to the WEF

The proximity radii are based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger WEFs (e.g. more than 50 wind turbines) and downwards for smaller WEFs (e.g. less than 50 turbines). This methodology was developed in the absence of any known and/or accepted standards for South African WEFs.

The principle of reduced impact over distance is applied in order to determine the core area of visual influence for these types of structures. It is envisaged that the nature of the structures and the rural character of the study area would create a significant contrast that would make the facility visible and recognisable from greater distances.

The proximity radii for the wind turbines were 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. It should be noted that even though the proximity radii are indicated as (near) concentric circles from the wind turbines, the visual prominence of the structures will only apply where they are visible, as determined in the previous section (**Section 6.1**) of this report.

The proximity radii, based on the dimensions of the proposed development footprint are indicated on **Map 6**, and include the following:

- 0 - 5km. Short distance view where the WEF would dominate the frame of vision and constitute a very high visual prominence.
- 5 – 10km. Short to medium distance view where the structures would be easily and comfortably visible and constitute a high visual prominence.
- 10 - 20km. Medium to long distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a moderate visual prominence.
- > 20km. Long distance view of the facility where the structures are not expected to be immediately visible and not easily recognisable. This zone constitutes a lower visual prominence for the facility.

Figure 6: Schematic representation of a wind turbine from 1, 2, 5 and 10km under perfect viewing conditions.

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 potentially negative visual perception of the proposed facility.

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

Viewer incidence is calculated to be the highest along the public roads (e.g. the Loeriesfontein secondary road) within the study area. Travellers using these roads may be negatively impacted upon by visual exposure to the WEF.

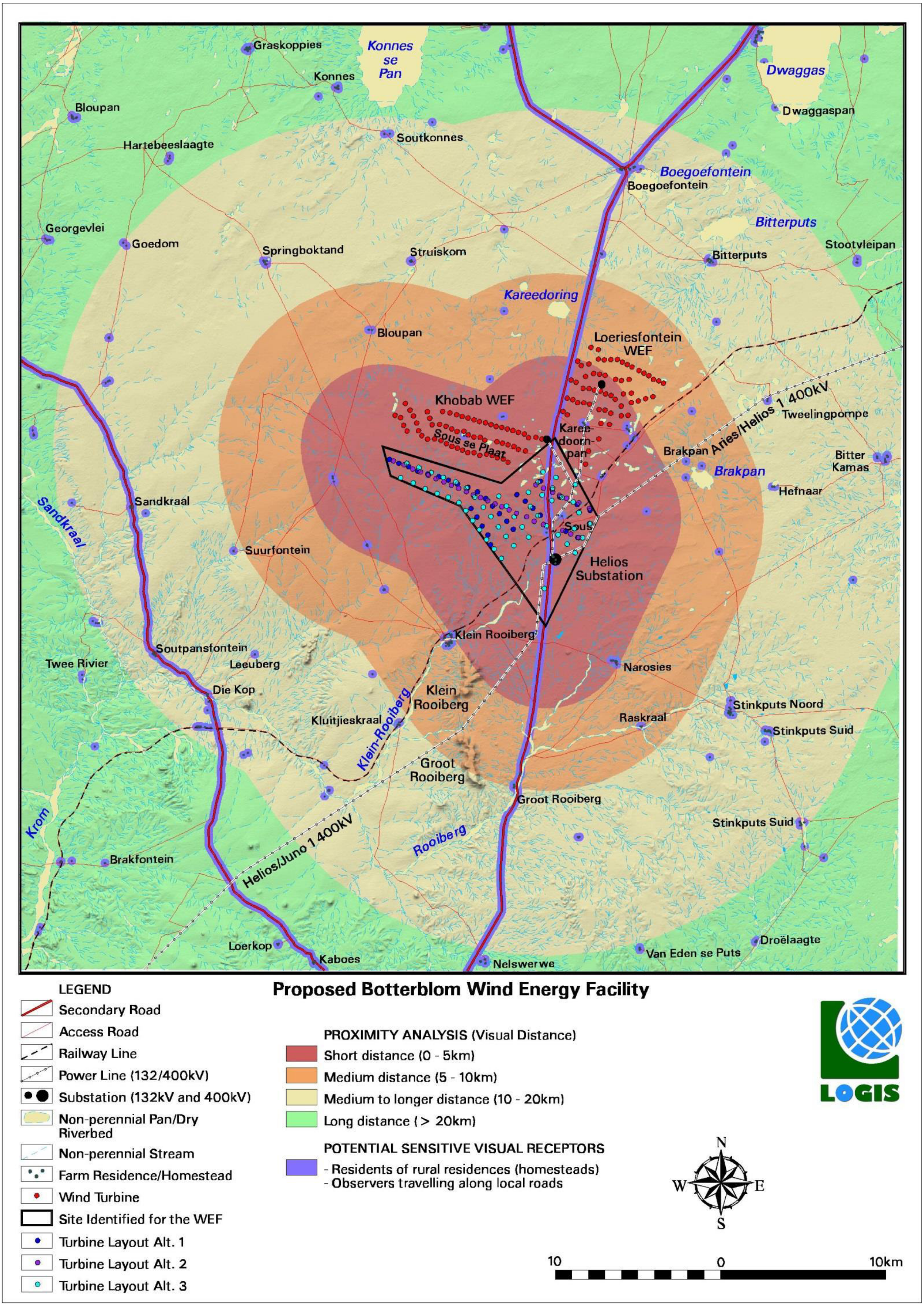
Additional sensitive visual receptors are located at the farm residences (homesteads) throughout the study area. It is expected that the viewer's perception, unless the observer is associated with (or supportive of) the WEF, would generally be negative.

Due to the remote location of the proposed Botterblom WEF, there are a relatively limited number of potential sensitive visual receptors located within a 20km radius of the proposed facility. These potentially affected sensitive visual receptors are listed in **Section 6.1**. It is expected that these landowners may experience visual impacts ranging from moderate to high significance, depending on their proximity to the wind turbine structures, and their potential sensitivity (aversion) to wind turbine infrastructure.

Alternately, residents of homesteads that are located on properties earmarked for future renewable energy facilities (refer to **Map 3**) may be supportive of the WEF, or at the very least, indifferent to the construction of additional WEFs in the region.

Refer to **Map 6** for the location of the potential sensitive visual receptors discussed above.

The author is not aware of any specific objections raised against the construction and operation of the proposed Botterblom WEF.



Map 6: Proximity analysis and potential sensitive visual receptors.

6.5. Visual absorption capacity

The broader study area is located within the Nama-Karoo biome characterised by large open plains, *low shrubland*, grassland and bare soil in places.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is deemed low by virtue of the nature (or absence) of the vegetation and the low occurrence of urban development. 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.

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 facility). 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 Botterblom WEF are displayed on **Map 7**. 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 infrastructure, a high viewer incidence and a potentially negative perception (i.e. a sensitive visual receptor) 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 **potentially sensitive visual receptors** within a 5km radius of the WEF may experience a **very high** visual impact. The magnitude of visual impact on sensitive visual receptors subsequently subsides with distance to; **high** within a 5 – 10km radius (where sensitive receptors are present) and **moderate** within a 10 – 20km radius (where sensitive receptors are present). Receptors beyond 20km are expected to have a **low** potential visual impact.

Likely areas of potential visual impact and potential sensitive visual receptors located within a 20km radius of the proposed WEF are displayed on **Map 7**.

Magnitude of the potential visual impact

The WEF may have a visual impact of **very high** magnitude on the following observers (within a 5km radius):

Residents of/visitors to[4]:

- Kareedoornpan (Loeriesfontein WEF)
- Sous se Plaat (Khobab WEF)
- Sous (proposed Botterblom WEF)
- Narosies

Note:

The location of these homesteads on either existing WEFs, or on proposed/authorised WEFs, reduces the probability of this impact occurring i.e. it is assumed that the landowners are supportive of the WEF developments on the affected properties.

Observers travelling along the:

- Loeriesfontein secondary road traversing the proposed WEF

The WEF may have a visual impact of **high** magnitude on the following observers (5 – 10km radius):

Residents of/visitors to:

- Bloupan
- Brakpan
- Klein Rooiberg
- Raskraal

Note:

The location of the former three homesteads on farms earmarked for renewable energy facilities reduces the probability of this impact occurring i.e. it is assumed that the landowners are supportive of WEF and solar energy developments within the region.

The WEF may have a visual impact of **moderate** magnitude impact on the following observers located between a 10 – 20km radius of the wind turbine structures:

Residents of/visitors to:

- Soutkonnes
- Bitterputs
- Goedom
- Struiskom
- Boegoefontein
- Bitterputs
- Springboktand
- Tweelingpompe
- Bitter Kamas
- Hefnaar
- Soutpansfontein
- Stinkputs Noord
- Kluitjieskraal

[4] 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.

- Stinkputs Suid

Note:

The location of the Struiskom and Springboktand homesteads on farms earmarked for renewable energy facilities reduces the probability of this impact occurring i.e. it is assumed that the landowners are supportive of WEF and solar energy developments within the region.

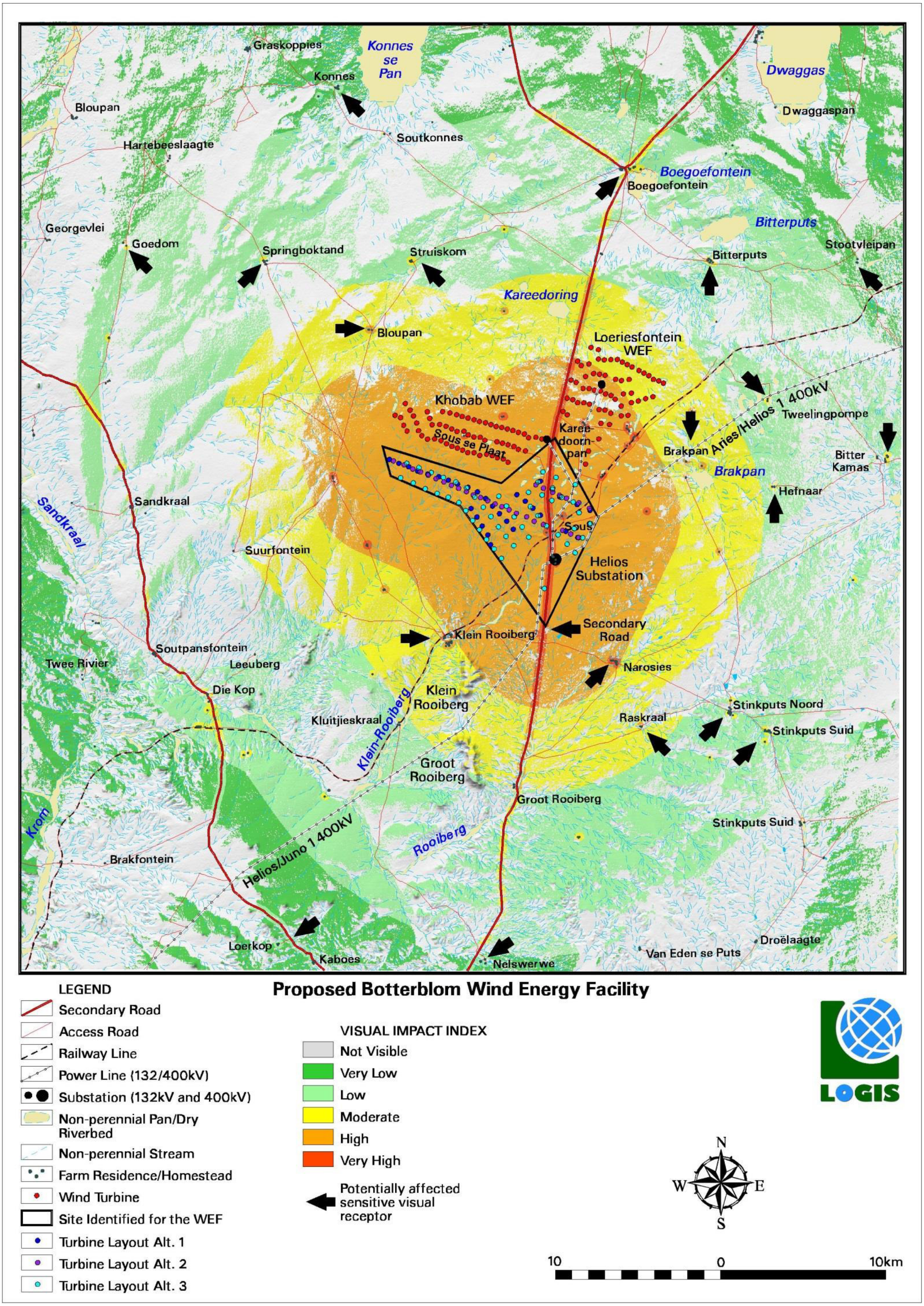
The WEF may have a visual impact of **low** magnitude on the following observers (beyond a 20km radius):

Residents of/visitors to:

- Konnes
- Stootvleipan
- Loerkop
- Nelswerwe

Note:

Where any of the above-mentioned homesteads are derelict or deserted, the visual impact will be non-existent, until such time as it is inhabited again.



Map 7: Visual impact index and potentially affected sensitive visual receptors.

7. VISUAL IMPACT ASSESSMENT

7.1. 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 infrastructure) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very low = 1), local (low = 2), regional (medium = 3), national (high = 4) or international (very high = 5)[5].
- **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)[6].
- **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)
- 30-60 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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[5] Local = within 5km of the development site. Regional = between 5-10km (and potentially up to 20km) from the development site.

[6] 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.

7.2. Visual impact assessment

The primary visual impacts of the proposed WEF are assessed as follows:

7.2.1. Construction impacts

Potential visual impact of construction activities on sensitive visual receptors in close proximity to the proposed WEF.

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

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

Table 2: Visual impact of construction on sensitive visual receptors in close proximity to the proposed WEF.

Nature of Impact: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed WEF.		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Short term **(2)**	Short term **(2)**
Magnitude	High **(8)**	Moderate **(6)**
Probability	Highly Probable **(4)**	Improbable **(2)**
Significance	Moderate **(48)**	Low **(20)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Planning: ➢ Retain and maintain natural vegetation in all areas outside of the development footprint, but within the project site. Construction: ➢ Ensure that vegetation is not unnecessarily removed during the construction period. ➢ Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) where possible. ➢ Restrict the activities and movement of construction workers and vehicles to the immediate construction site 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 approved 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.		

Residual impacts: None, provided that rehabilitation works are carried out as required.

7.2.2. Potential visual impact on sensitive visual receptors (residents and visitors) located within a 5km radius of the wind turbine structures

The operation of the Botterblom WEF is expected to have a **high** visual impact (significance rating = 64) on observers/visitors residing at homesteads within a 5km radius of the wind turbine structures. This includes:

- Kareedoornpan (Loeriesfontein WEF)
- Sous se Plaat (Khobab WEF)
- Sous (proposed Botterblom WEF)
- Narosies

These homesteads are all located on existing or proposed WEF properties, assuming their support for WEF developments.

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 3: Visual impact on observers (residents and visitors) in close proximity to the proposed wind turbine structures.

Nature of Impact: Visual impact on observers (residents at homesteads and visitors/tourists) in close proximity (i.e. within 5km) to the wind turbine structures		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(10)**	Very high **(10)**
Probability	Highly probable **(4)**	Highly probable **(4)**
Significance	High **(64)**	High **(64)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practice management measures can be implemented.	
Generic best practise mitigation/management measures: <u>Planning:</u> ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. <u>Operations:</u> ➢ Maintain the general appearance of the facility as a whole. <u>Decommissioning:</u> ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

7.2.3. Potential visual impact on sensitive visual receptors (observers travelling along roads) located within a 5km radius of the wind turbine structures

The operation of the Botterblom WEF is expected to have a **high** visual impact (significance rating = 64) on observers traveling along the roads within a 5km radius of the wind turbine structures. This includes observers travelling along the:

- Loeriesfontein secondary road traversing the proposed WEF

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 on observers travelling along roads in close proximity to the proposed wind turbine structures.

Nature of Impact: Visual impact on observers travelling along the roads in close proximity (i.e. within 5km) to the wind turbine structures		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(10)**	Very high **(10)**
Probability	Highly probable **(4)**	Highly probable **(4)**
Significance	High **(64)**	High **(64)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practice management measures can be implemented.	
Generic best practise mitigation/management measures: Planning: ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. Operations: ➢ Maintain the general appearance of the facility as a whole. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

7.2.4. Potential visual impact on sensitive visual receptors within the region (5 – 10km radius)

The Botterblom WEF could have a **high** visual impact (significance rating = 60) on residents of (or visitors to) homesteads within a 5 - 10km radius of the wind turbine structures.

Residents of/visitors to:

- Raskraal

The following properties are provisionally included, due to their assumed support for renewable energy facility developments within the region.

- Bloupan
- Brakpan
- Klein Rooiberg

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 5: Visual impact of the proposed wind turbine structures within the region (5 – 10km).

Nature of Impact: Visual impact on observers travelling along the roads and residents at homesteads within a 5 – 10km radius of the wind turbine structures		
	Without mitigation	***With mitigation***
Extent	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	High **(8)**
Probability	Highly probable **(4)**	Highly probable **(4)**
Significance	High **(60)**	High **(60)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	
Generic best practise mitigation/management measures: Planning: ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. Operations: ➢ Maintain the general appearance of the facility as a whole. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

7.2.5. Potential visual impact on sensitive visual receptors within the region (10 – 20km radius)

The Botterblom WEF could have a **moderate** visual impact (significance rating = 39) on residents of (or visitors to) homesteads within a 10 - 20km radius of the wind turbine structures.

Residents of/visitors to:

- Soutkonnes
- Bitterputs

- Goedom
- Boegoefontein
- Bitterputs
- Tweelingpompe
- Bitter Kamas
- Hefnaar
- Soutpansfontein
- Stinkputs Noord
- Kluitjieskraal
- Stinkputs Suid

The following properties are provisionally included, due to their assumed support for renewable energy facility developments within the region.

- Struiskom
- Springboktand

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 6: Visual impact of the proposed wind turbine structures within the region (10 – 20km).

Nature of Impact: Visual impact on observers travelling along the roads and residents at homesteads within a 10 – 20km radius of the wind turbine structures		
	Without mitigation	***With mitigation***
Extent	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Moderate **(6)**
Probability	Probable **(3)**	Probable **(3)**
Significance	Moderate **(39)**	Moderate **(39)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	
Generic best practise mitigation/management measures: Planning: ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. Operations: ➢ Maintain the general appearance of the facility as a whole. Decommissioning: ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

7.2.6. Shadow flicker

Shadow flicker only occurs when the sky is clear, and when the turbine rotor blades are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that "*most shadow impact is associated with 3-4 times the height of the object*". Based on this research, an 800m buffer along the edge of the outer most turbines is identified as the zone within which there is a risk of shadow flicker occurring.

There are no places of residence within the 800m buffer. The significance of shadow flicker is therefore anticipated to be **low** to **negligible**.

Table 7: Visual impact of shadow flicker on sensitive visual receptors in close proximity to the proposed WEF.

Nature of Impact: Visual impact of shadow flicker on sensitive visual receptors in close proximity to the proposed WEF.		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Low **(20)**	Low **(20)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	N.A. due to the low probability of occurrence	
Generic best practise mitigation/management measures: N.A.		
Residual impacts: N.A.		

7.2.7. Lighting impacts

Potential visual impact of operational, safety and security lighting of the facility at night.

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. This is especially true due to the strobing effect of the lights, a function specifically designed to attract the observer's attention. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts have traditionally been very low other than to restrict the number of lights to turbines that delineate the outer perimeter of the facility.

Figure 7: Aircraft warning lights fitted to the wind turbine hubs (Source: http://www.pinchercreekecho.com/2015/04/29/md-of-pincher-creek-takes-on-wind-turbine-lights.)

Some ground-breaking new technology in the development of strobing lights that only activate when an aircraft is detected nearby may aid in restricting light pollution at night and should be investigated and implemented by the project proponent, if available and permissible by the CAA. This new technology is referred to as *needs-based night lights,* which deactivates the wind turbine's night lights when there is no flying object within the airspace of the WEF. The system relies on the active detection of aircraft by radar sensors, which relays a switch-on signal to the central wind farm control to activate the obstacle lights. See the diagram in **Figure 8** below.[7]

[7] Source: Nordex Energy GmbH, 2019

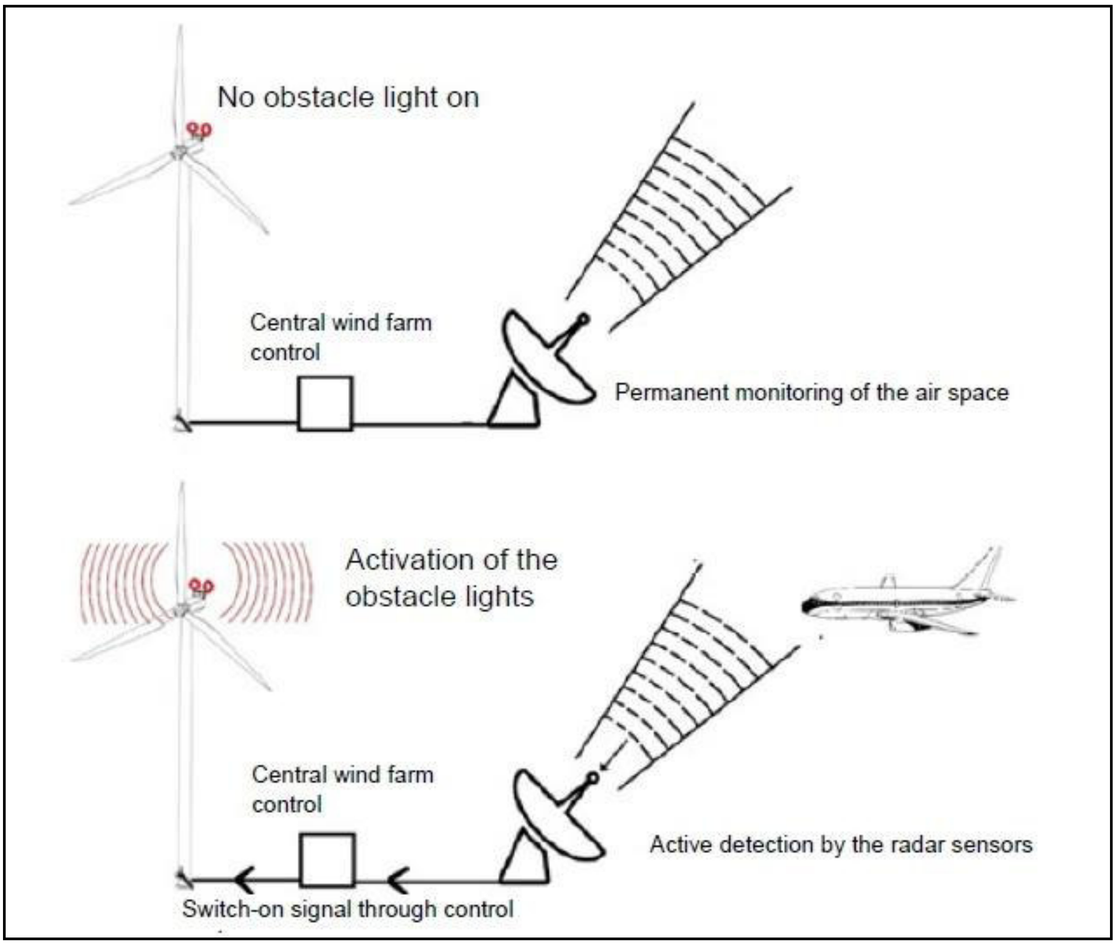

Figure 8: Diagram of the functional principle of the needs-based night lights.

Last is the 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.

This anticipated lighting impact is likely to be of **high** significance (rating = 60), and may be mitigated to **moderate** (rating = 45) especially within a 5 to 10km radius of the wind turbine structures.

Table 8: Impact table summarising the significance of visual impact of lighting at night on visual receptors in close to medium proximity (5-10km) to the proposed WEF.

Nature of Impact: Visual impact of lighting at night on sensitive visual receptors.		
	No mitigation	***Mitigation considered***
Extent	Local/Regional **(3)**	Local/Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	High **(8)**
Probability	Highly probable **(4)**	Probable **(3)**
Significance	High **(60)**	Moderate **(45)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation: Planning & operation: ➢ Implement needs-based night lighting if considered acceptable by the CAA. ➢ Limit aircraft warning lights to the turbines on the perimeter according to CAA requirements, thereby reducing the overall impact. ➢ 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.
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

7.2.8. Ancillary infrastructure

On-site ancillary infrastructure associated with the WEF includes a 33/132kV substation and collector substation, underground 33kV cabling between the wind turbines, internal access roads, workshop and office and staff accommodation. No dedicated viewshed analyses have been generated for the ancillary infrastructure, as the range of visual exposure will fall within (and be overshadowed by) that of the turbines.

The anticipated visual impact resulting from this infrastructure is likely to be of **low** significance both before and after mitigation.

Table 9: Visual impact of the ancillary infrastructure.

Nature of Impact: Visual impact of the ancillary infrastructure on observers in close proximity to the structures.		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Low **(20)**	Low **(20)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	

Generic best practise mitigation/management measures: <u>Planning:</u> ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. <u>Operations:</u> ➢ Maintain the general appearance of the infrastructure. <u>Decommissioning:</u> ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
Residual impacts: The visual impact will be removed after decommissioning, provided the ancillary infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

7.3. Visual impact assessment: secondary impacts

7.3.1. The potential impact on the 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.), play 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, undeveloped character and a natural appearance. These generally undeveloped landscapes are considered to have a high visual quality.

The significance of the visual impacts on the sense of place within the **region** (i.e. beyond a 20km radius of the development and within the greater region) is expected to be of **low** significance.

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 10: The potential impact on the sense of place of the region.

Nature of Impact: The potential impact on the sense of place of the region.		
	Without mitigation	***With mitigation***
Extent	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Low **(22)**	Low **(22)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	

Generic best practise mitigation/management measures: <u>Planning:</u> ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site. <u>Operations:</u> ➢ Maintain the general appearance of the facility as a whole. <u>Decommissioning:</u> ➢ Remove infrastructure not required for the post-decommissioning use. ➢ Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

7.3.2. The potential cumulative visual impact of wind farms on the visual quality of the landscape

The cumulative visual impact of the proposed Botterblom WEF and the existing Khobab and Loeriesfontein WEFs are discussed in **Section 6.2.**

The cumulative visual impact (should all the authorised wind and solar projects be constructed) is expected to be **high**, depending on the observer's sensitivity to renewable energy generation infrastructure. In spite of this, the cumulative visual impact is still considered to be within acceptable limits, due to the generally remote location of the infrastructure and the limited number of affected sensitive visual receptors.

Table 11: The potential cumulative visual impact of wind farms on the visual quality of the landscape.

Nature of Impact: The potential cumulative visual impact of wind farms on the visual quality of the landscape.		
	Overall impact of the proposed project considered in isolation	***Cumulative impact of the project and other projects in the area***
Extent	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	Very high **(10)**
Probability	Highly probable **(4)**	Highly probable **(4)**
Significance	High **(60)**	High **(68)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation measures: N.A.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

7.4. The potential to mitigate visual impacts

The primary visual impact, namely the appearance of the WEF (the wind turbines) is not possible to mitigate. The functional design of the turbines cannot be changed in order to reduce visual impacts.

Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*".

Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact.

The overall potential for mitigation is therefore generally low or non-existent. The following mitigation is, however possible:

- It is recommended that vegetation cover (i.e. either natural or cultivated) be maintained in all areas outside of the actual development footprint (but still within the project site), both during construction and operation of the proposed WEF. This will minimise visual impact as a result of cleared areas and areas denuded of vegetation.

- Existing roads should be utilised wherever possible. New roads should be planned taking due cognisance of the topography to limit cut and fill requirements. Construction/upgrade of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.

- In terms of onsite ancillary buildings and structures, it is recommended that it be planned so that the clearing of vegetation is minimised. This implies consolidating this infrastructure as much as possible and making use of already disturbed areas rather than undisturbed sites wherever possible.

- Install aircraft warning lights that only activate when the presence of an aircraft is detected, if permitted by the CAA, and where deemed feasible.

- The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact.

- Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility. The correct specification and placement of lighting and light fixtures for the proposed WEF and ancillary infrastructure will go far to contain rather than spread the light. Mitigation measures include the following:

    - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
    - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
    - Making use of minimum lumen or wattage in fixtures;
    - Making use of down-lighters, or shielded fixtures;
    - Making use of Low Pressure Sodium lighting or other types of low impact lighting.

- Making 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.

- 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.
    - Reduce the construction period through careful logistical planning and productive implementation of resources.
    - Plan the placement of laydown areas 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 site 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 approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
    - Restrict construction activities to daylight hours 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 should be consulted to assist or give input into rehabilitation specifications.

- During operation, the maintenance of the turbines and ancillary structures and infrastructure must be undertaken to ensure that the facility does not degrade, therefore aggravating the 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 facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site must be removed and all disturbed areas appropriately rehabilitated. An ecologist must 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.

- Secondary impacts anticipated as a result of the proposed WEF (i.e. visual character and sense of place) are not possible to mitigate. There is also no mitigation to ameliorate the negative visual impacts on roads frequented by tourists and which provides access to tourist destinations within the region.

  Where sensitive visual receptors (as identified in **Section 6.6.**) are likely to be affected and where valid objections (as determined by the visual specialist) are raised by these receptors during the application process, it is recommended that the developer investigate the receptor's willingness (and the viability) of screening of visual impacts at the receptor site prior to construction commencing. This may entail the planting of natural vegetation, natural trees or the construction of screens in the pre-dominant direction of impact likely to be experienced by the principal receptor at the site. Ultimately, visual screening is most effective when placed at the receptor itself and should be considered in this context only.

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

8. CONCLUSION AND RECOMMENDATIONS

The visual impact assessment (VIA) practitioner takes great care to ensure that all the spatial analyses and mapping is as accurate as possible. The intention is to quantify, using visibility analyses, proximity analyses and the identification of sensitive receptors, the potential visual impacts associated with the proposed Botterblom WEF. These processes are deemed to be transparent and scientifically defensible when interrogated.

However, visual impact is ultimately a subjective concept. The *subjects* in this case are the residents of, and visitors to the region. The author has attempted to accurately capture the location of these *subjects* (i.e. sensitive visual receptors and areas of likely visual impact) to the best of his ability, drawing on years of experience as a VIA practitioner. The VIA further adopts a risk averse approach in so far as to assume that the perception of most (if not all) of the sensitive visual receptors (bar the landowners of the properties earmarked for the development), would be predominantly negative towards the development of a WEF in the region.

There are likely to be supporters of the Botterblom WEF (as renewable energy generation is a global priority) amongst the population of the larger region, but they are normally expected to be indifferent to the construction of the WEF and not as vocal in their support for the wind farm as potential detractors thereof (should any be identified). To the knowledge of the author, no objections were raised.

However, it is expected that the construction and operation of the proposed Botterblom WEF and its associated infrastructure, will have a high visual impact on the study area, especially within (but potentially not restricted to) a 5-10km radius of the proposed facility. The visual impact will differ amongst places, depending on the distance from the facility, but will generally be restricted to a 20km radius of the WEF. Tourists travelling through the region and residents of homesteads will likely experience visual impacts where the wind turbine structures are visible.

The combined visual impact or cumulative impact of wind energy facilities (i.e. the existing Khobab and Loeriesfontein WEFs, and the numerous authorised WEFs in the region) is expected to increase the area of potential visual impact within the region. The intensity of visual impact (number of turbines visible) to exposed receptors, especially those located within a 5-10km radius of the proposed Botterblom WEF, is expected to increase when considered in conjunction with the other existing, proposed or authorised WEFs. The fact that these WEFs are located within a very remote area offsets the significance of this impact to some degree. This is due mainly to the fact that the population density of the region is very low and mostly (in terms of surface area) devoid of sensitive visual receptors.

Overall, the significance of the visual impacts associated with the proposed Botterblom WEF is expected to be high as a result of the generally undeveloped character of the landscape. The facility would be visible within an area that contains certain sensitive visual receptors who could consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along the secondary roads, residents of rural homesteads and tourists passing through or holidaying in the region.

Conventional mitigation (e.g. such as screening of the structures) of the potential visual impacts is highly unlikely to succeed due to the nature of the development and the receiving environment. A number of mitigation measures have been proposed (**Section 7.4**). The proposed mitigation measures will primarily be effective in terms of mitigating lighting and construction phase visual impacts.

Note: 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 facility, should it be authorised.

9. IMPACT STATEMENT

The findings of the Visual Impact Assessment undertaken for the proposed Botterblom WEF is that the visual environment surrounding the site, especially within a 5-10km radius (and potentially up to 20km), will be visually impacted upon for the anticipated operational lifespan of the facility (i.e. 20 - 25 years). This statement is applicable to any of the three proposed wind turbine layouts.

The following is a summary of impacts remaining:

- Construction phase activities may potentially result in a **moderate** temporary visual impact that may be mitigated to **low**.
- The operation of the Botterblom WEF is expected to have a **high** visual impact on observers/visitors residing at homesteads within a 5km radius of the wind turbine structures. No mitigation of this impact is possible.
- The operation of the Botterblom WEF is expected to have a **high** visual impact on observers traveling along the public roads within a 5km radius of the wind turbine structures. No mitigation of this impact is possible.
- The operation of the Botterblom WEF could have a **high** visual impact on sensitive visual receptors within the region (5 - 10km radius of the wind turbine structures). No mitigation of this impact is possible.
- The Botterblom WEF could have a **moderate** visual impact on residents of (or visitors to) homesteads within a 10 - 20km radius of the wind turbine structures.
- There are no places of residence within an 800m buffer from the wind turbine structures. The significance of shadow flicker is therefore anticipated to be **low** to **negligible**.
- The anticipated night-time lighting impact is likely to be of **high** significance and may be mitigated to **moderate**, provided that *needs-based aircraft warning lights* (if permitted by the CAA and deemed feasible), is installed.

- The anticipated visual impact resulting from ancillary infrastructure is likely to be of **low** significance both before and after mitigation.

- The significance of the visual impacts on the sense of place within the region (i.e. beyond a 20km radius of the development and within the greater region) is expected to be of **low** significance.

- The cumulative visual impact of the existing Khobab and Loeriesfontein WEFs, the proposed Botterblom WEF, and other authorised WEFs is expected to be of **high** significance. In spite of this, the cumulative visual impact is still considered to be within acceptable limits, due to the generally remote location of the WEFs and the limited number of affected sensitive visual receptors.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from **high** to **low** significance. Anticipated visual impacts on sensitive visual receptors in close proximity to the proposed facility remain high and are not possible to mitigate. Even though it is possible that the potential visual impacts may exceed acceptable levels within the context of the receiving environment, the proposed WEF development is not considered to be fatally flawed.

A fatal flaw occurs when:

- There is non-compliance with Acts, Ordinances, By-laws and adopted policies relating to visual pollution, scenic routes, special areas or proclaimed heritage sites.

- Non-compliance with conditions of existing Records of Decision.

- Impacts that may be evaluated to be of high significance and that are considered by the **majority** of stakeholders and decision-makers to be unacceptable.[8]

In terms of the proposed wind turbine layout, the project proponent needs to adhere to all relevant National, Provincial and Local Government regulations and ordinances, including all prescribed health and safety guidelines. If these are not adhered to, the layout may be deemed non-compliant, and may need to be revised in order to ensure compliance. The author is not aware of any non-compliance and the layout is deemed acceptable within this (legal) context.

10. MANAGEMENT PROGRAMME

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

Refer to the tables overleaf.

[8] Source: Oberholzer, B. 2005

Table 12: Management programme – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Botterblom WEF.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substations and workshop).	
Potential Impact	Primary visual impact of the facility due to the presence of the turbines and associated infrastructure as well as the visual impact of lighting at night.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 5-10km of the site) as well as within the region.	
Mitigation: Target/Objective	Optimal planning of infrastructure to minimise visual impact.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Retain and maintain natural and / or cultivated vegetation in all areas outside of the development footprint, but within the project site.	Project proponent/ design consultant/ Engineering, Procurement and Construction (EPC) contractor	Early in the planning phase.
Make use of existing roads wherever possible and plan the layout and construction of roads and infrastructure with due cognisance of the topography to limit cut and fill requirements.	Project proponent/ design consultant/ EPC contractor	Early in the planning phase.
Plan all roads, ancillary buildings and ancillary infrastructure in such a way that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than undisturbed areas.	Project proponent/ design consultant/ EPC contractor	Early in the planning phase.
Consult a lighting engineer in the design and planning of lighting to ensure the correct specification and placement of lighting and light fixtures for the WEF and the ancillary infrastructure. The following is recommended: o Install aircraft warning lights that only activate when an aircraft is detected (CAA regulations/conditions permitting, and where deemed feasible). o Limit aircraft warning lights for the proposed WEF to the turbines on the perimeter, thereby reducing the overall requirement (CAA regulations/conditions permitting). o Shield the sources of light by physical barriers (walls, vegetation, or the structure itself); o Limit mounting heights of fixtures, or use foot-lights or bollard lights; o Make use of minimum lumen or wattage in fixtures; o Making use of down-lighters or shielded fixtures; o Make use of Low Pressure Sodium lighting or other low impact lighting. o Make use of motion detectors on security lighting, so allowing the site to remain in	Project proponent/ design consultant/ EPC contractor	Early in the planning phase.

darkness until lighting is required for security or maintenance purposes.		

Performance Indicator	Minimal exposure (limited or no complaints from I&APs) of ancillary infrastructure and lighting at night to observers on or near the site (i.e. within 5-10km) and within the region.
Monitoring	Not applicable.

Table 13: Management programme – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Botterblom WEF.		
Project Component/s	Construction site and activities	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate construction work areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	Project proponent/ EPC contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	Project proponent/ EPC contractor	Early in the construction phase.
Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	Project proponent/ EPC contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Project proponent/ EPC contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.	Project proponent/ EPC contractor	Throughout the construction phase.
Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).	Project proponent/ EPC contractor	Throughout the construction phase.
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Project proponent/ EPC contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.	Project proponent/ EPC contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of the construction contract).	

	Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).

Table 14: Management programme – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Botterblom WEF.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substations and workshop).	
Potential Impact	Visual impact of facility degradation (including operational wind turbines) and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Maintain the general appearance of the facility as a whole, including the turbines, servitudes and the ancillary buildings.	Project proponent/ operator	Throughout the operation phase.
Maintain roads and servitudes 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	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of the entire site on an ongoing basis (by operator).	

Table 15: Management programme – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Botterblom WEF.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substations and workshop).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Only the infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Remove infrastructure not required for the post-decommissioning use of the site. This may include the turbines, substations, ancillary buildings, masts etc.	Project proponent/ operator	During the decommissioning phase.
Rehabilitate access roads and servitudes not required for the post-decommissioning use of the site. If necessary, an ecologist should be consulted 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	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of rehabilitated areas quarterly for at least a year following	

	decommissioning.

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