PROPOSED BOULDERS WIND FARM, WESTERN CAPE PROVINCE

VISUAL IMPACT ASSESSMENT

Produced for:

Vredenburg Windfarm (Pty) Ltd

On behalf of:

EOH Coastal & Environmental Services
25 Tecoma Street, Berea
East London
www.eoh.co.za/www.cesnet.co.za

Produced by:

Lourens du Plessis (PrGISc) t/a LOGIS
PO Box 384, La Montagne, 0184
M: 082 922 9019 E: lourens@logis.co.za
www.logis.co.za

- November 2018 -

CONTENTS

1. STUDY APPROACH
1.1. Qualification and Experience of the Practitioner
1.2. Assumptions and Limitations
1.3. Level of Confidence
1.4. Methodology

2. BACKGROUND AND PROPOSED INFRASTRUCTURE

3. SCOPE OF WORK

4. RELEVANT LEGISLATION AND GUIDELINES

5. THE AFFECTED ENVIRONMENT

6. RESULTS
6.1. Potential visual exposure
6.2. Cumulative visual assessment
6.3. Visual distance / observer proximity to the WEF
6.4. Viewer incidence / viewer perception
6.5. Visual absorption capacity
6.6. Visual impact index
6.7. Visual impact assessment: impact rating methodology
6.8. Visual impact assessment
6.8.1. Potential visual impact on sensitive visual receptors (residents and visitors) located within a 5km radius of the wind turbine structures
6.8.2. Potential visual impact on sensitive visual receptors (observers travelling along roads) located within a 5km radius of the wind turbine structures
6.8.3. Potential visual impact on Kasteelberg hill, including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road
6.8.4. Potential visual impact on sensitive visual receptors within the region (5 – 10km radius)
6.8.5. Construction impacts
6.8.6. Shadow flicker
6.8.7. Lighting impacts
6.8.8. Ancillary infrastructure
6.9. Visual impact assessment: secondary impacts
6.9.1. The potential impact on the sense of place of the region.
6.9.2. The potential cumulative visual impact of the wind farms on the visual quality of the landscape.
6.10. The potential to mitigate visual impacts

7. PHOTO SIMULATIONS
7.1. Viewpoint 1: before
7.2. Viewpoint 1: after
7.3. Viewpoint 2: before
7.4. Viewpoint 2: after
7.5. Viewpoint 3: before
7.6. Viewpoint 3: after
7.7. Viewpoint 4: before
7.8. Viewpoint 4: after
7.9. Viewpoint 5: before
7.10. Viewpoint 5: after
7.11. Viewpoint 6: before
7.12. Viewpoint 6: after

7.13. Viewpoint 7: before
7.14. Viewpoint 7: after

8. RELOCATION OF SELECTED WIND TURBINE POSITIONS AS PROPOSED MITIGATION

9. CONCLUSION AND RECOMMENDATIONS

10. IMPACT STATEMENT

11. MANAGEMENT PROGRAMME

12. REFERENCES/DATA SOURCES

FIGURES

Figure 1: The view from Britannica Heights to Paternoster and the Atlantic seaboard (in the distance).
Figure 2: West Coast 1 wind turbines as seen from the Vredenburg to Stompneus Bay secondary road.
Figure 3: Patrysberg as seen from the R399 arterial road.
Figure 4: Photograph depicting the rural land-use character of the area surrounding the proposed WEF.
Figure 5: Visual representation of the existing (right) and proposed (left) wind turbine structures.
Figure 6: Receptor 1 photo simulation (before: top, after: bottom).
Figure 7: Receptor 2 photo simulation (before: top, after: bottom).
Figure 8: Receptor 3 photo simulation (before: top, after: bottom).
Figure 9: Receptor 4 photo simulation (before: top, after: bottom).
Figure 10: Receptor 5 photo simulation (before: top, after: bottom).
Figure 11: Receptor 6 photo simulation (before: top, after: bottom).
Figure 12: Receptor 7 photo simulation (before: top, after: bottom).
Figure 13: Schematic representation of a wind turbine from 1, 2, 5 and 10km under perfect viewing conditions.
Figure 14: Photograph indicating the low VAC of the study area.
Figure 15: Aircraft warning lights fitted to the wind turbine hubs.
Figure 16: Photo simulation 1 (before construction).
Figure 17: Photo simulation 1 (after construction). *The closest Boulders Wind Farm turbine is 1.3km from this point*.
Figure 18: Photo simulation 2 (before construction).
Figure 19: Photo simulation 2 (after construction). *The closest Boulders Wind Farm turbine is 3.3km from this point*.
Figure 20: Photo simulation 3 (before construction).
Figure 21: Photo simulation 3 (after construction). *The closest Boulders Wind Farm turbine is 6.4km from this point*.
Figure 22: Photo simulation 4 (before construction).
Figure 23: Photo simulation 4 (after construction). *The closest Boulders Wind Farm turbine is 5.4km from this point*.
Figure 24: Photo simulation 5 (before construction).
Figure 25: Photo simulation 5 (after construction). *The closest Boulders Wind Farm turbine is 3.7km from this point*.
Figure 26: Photo simulation 6 (before construction).
Figure 27: Photo simulation 6 (after construction). *The closest Boulders Wind Farm turbine is 4.1km from this point.*
Figure 28: Photo simulation 7 (before construction).
Figure 29: Photo simulation 7 (after construction). *The closest Boulders Wind Farm turbine is 6.3km from this point (behind the West Coast 1 WEF turbines).*

Figure 30: Receptor 4 - wind turbine relocation (top: original layout, bottom: relocated layout).
Figure 31: Receptor 3 - wind turbine relocation (top: original layout, bottom: relocated layout).
Figure 32: Receptor 6 - wind turbine relocation (top: original layout, bottom: relocated layout).

MAPS

Map 1: Exclusions and restricted areas that informed the wind farm layout.
Map 2: Shaded relief map of the study area.
Map 3: Land cover and broad land use patterns.
Map 4: The Paternoster *plateau* (indicated by the dotted line).
Map 5: Viewshed analysis: Boulders Wind Farm.
Map 6: Viewshed analysis: West Coast 1 Wind Energy Facility.
Map 7: Cumulative viewshed analysis: Boulders Wind Farm and West Coast 1 WEF turbines.
Map 8: Receptor 1 position and potentially visible wind turbines.
Map 9: Receptor 2 position and potentially visible wind turbines.
Map 10: Receptor 3 position and potentially visible wind turbines.
Map 11: Receptor 4 position and potentially visible wind turbines.
Map 12: Receptor 5 position and potentially visible wind turbines.
Map 13: Receptor 6 position and potentially visible wind turbines.
Map 14: Receptor 7 position and potentially visible wind turbines.
Map 15: Proximity analysis and potential sensitive visual receptors.
Map 16: Potential visual exposure of the Boulders Wind Farm wind turbines to Paternoster and surrounds.
Map 17: Visual impact index.
Map 18: Potentially affected sensitive visual receptors.
Map 19: Photograph positions.
Map 20: Comparative viewshed analysis.

TABLES

Table 1: Level of confidence.
Table 2: Increase in frequency of visual exposure and increase/decrease in proximity to the closest visible wind turbine.
Table 3: Visual impact on observers (residents and visitors) in close proximity to the proposed wind turbine structures.
Table 4: Visual impact on observers travelling along roads in close proximity to the proposed wind turbine structures.
Table 5: Potential visual impact on Kasteelberg hill, including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road.
Table 6: Visual impact of the proposed wind turbine structures within the region.
Table 7: Visual impact of construction on sensitive visual receptors in close proximity to the proposed WF.
Table 8: Visual impact of shadow flicker on sensitive visual receptors in close proximity to the proposed WF.
Table 9: Impact table summarising the significance of visual impact of lighting at night on visual receptors in close to medium proximity to the proposed WF.
Table 10: Visual impact of the ancillary infrastructure.
Table 11: The potential impact on the sense of place of the region.
Table 12: The potential cumulative visual impact of the wind farms on the visual quality of the landscape.
Table 13: Management programme – Planning.

Table 14: Management programme – Construction.
Table 15: Management programme – Operation.
Table 16: Management programme – Decommissioning.

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 (previously PLATO), and specialises in Environmental GIS and Visual Impact Assessments (VIA).

Lourens, then director of MetroGIS (Pty) Ltd, also undertook the Visual Assessment Scoping Report for the original Saldanha Wind Energy Facility (as it was then referred to) on behalf of Aurecon SA (Pty) Ltd (submission date March 2011).

He has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His 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 2017 he worked for SMEC South Africa (Pty) Ltd as a technical specialist until he went independent and began trading as LOGIS in March 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 book 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.

EOH Coastal & Environmental Services appointed Lourens du Plessis as an independent specialist consultant to undertake the visual impact assessment for the proposed Boulders Wind Farm. 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 Vredenburg Windfarm (Pty) Ltd is correct and relevant to the proposed project.

1.3. Level of Confidence

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

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

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

These values are applied as follows:

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 GIS technology as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed project alternatives. A detailed Digital Terrain Model (DTM) for the study area was

---

[1] Adapted from Oberholzer (2005).

created from 5m interval contours supplied by the Chief Directorate National Geo-Spatial Information.

The Plan of Study for the Visual Impact Assessment 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.

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 5m contour interval 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 data set, 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 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 discernable 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 the VIA report.

- **Site visit and photo simulations**

Undertake a site visit 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. *Note: The site visit was undertaken from 30 September to 1 October 2017.*

Photographs from strategic viewpoints will be used to simulate a realistic post construction view of the WF. This will aid in visualising the perceived visual impact of the proposed WF and place it in spatial context.

2. BACKGROUND AND PROPOSED INFRASTRUCTURE

Vredenburg Windfarm (Pty) Ltd is proposing the establishment of a Wind Farm (WF) to generate approximately 140 Megawatts (MW) (contracted capacity) of renewable energy on ten properties near Vredenburg in the Saldanha Bay Local Municipal Area in the Western Cape. The project is collectively referred to as the **Boulders Wind Farm (WF)** and is situated adjacent to (predominantly north of) the existing, operational West Coast 1 Wind Energy Facility (WEF).

See **Map 1** for the locality of the proposed site.

A WF 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.

In order to optimise the use of the wind resource and the amount of power generated by the facility, the number of wind turbines erected in the area as well as the careful placement of the turbines in relation to the topography must be considered.

Vredenburg Windfarm (Pty) Ltd intends to construct up to 45 wind turbine generators (WTG) on the properties listed below:

- Boebezaks Kraal 2/40
- Boebezaks Kraal 3/40
- Boebezaks Kraal 5/40
- Frans Vlei 3/22
- Schuitjies Klip 1/22
- Schuitjies Klip 3/22
- Davids Fontyn 7/18
- Davids Fontyn 9/18
- Het Schuyte 1/21
- Uitkomst Re/6/23

Each wind turbine is expected to consist of a concrete foundation, a steel tower, a hub (placed at up to 120m above ground level) and three turbine blades attached to the hub. The overall height of the wind turbines are proposed to be up to 165m in extent. Variations of the above dimensions may occur, depending on the preferred supplier or commercial availability of wind turbines at the time of construction.

The positions (or layout) of the WTGs within the identified properties were informed by a number of criteria identified during the Scoping Phase public participation process. The restrictions, or exclusions, specific to the visual impact that was considered during the design of the layout include:

- The turbine layout adheres to a 4km coastal protection exclusion zone, as prescribed by the Western Cape Province's Department of Environmental Affairs and Development Planning (DEA&DP) Wind SEA (Strategic Environmental Assessment). The project proponent recognises the inherent value of the Atlantic seaboard and West Coast coastline as a scenic resource and tourist attraction, and subsequently agreed to not position any wind turbines within this zone.

- No wind turbines to be placed on or in close proximity (a minimum of 500m from the undisturbed (from agriculture) extent) of the Kasteelberg cultural historical site (as prescribed in the Visual Assessment Scoping Report). It must however be noted that Kasteelberg has not been formally proclaimed as a national or provincial heritage site.

- The delineation of a visual protection corridor aimed at preserving the visual corridor (scenic pastoral landscape) between Britannica Heights and Paternoster (see **Figure 1** below). No wind turbine structures will be placed within this corridor.

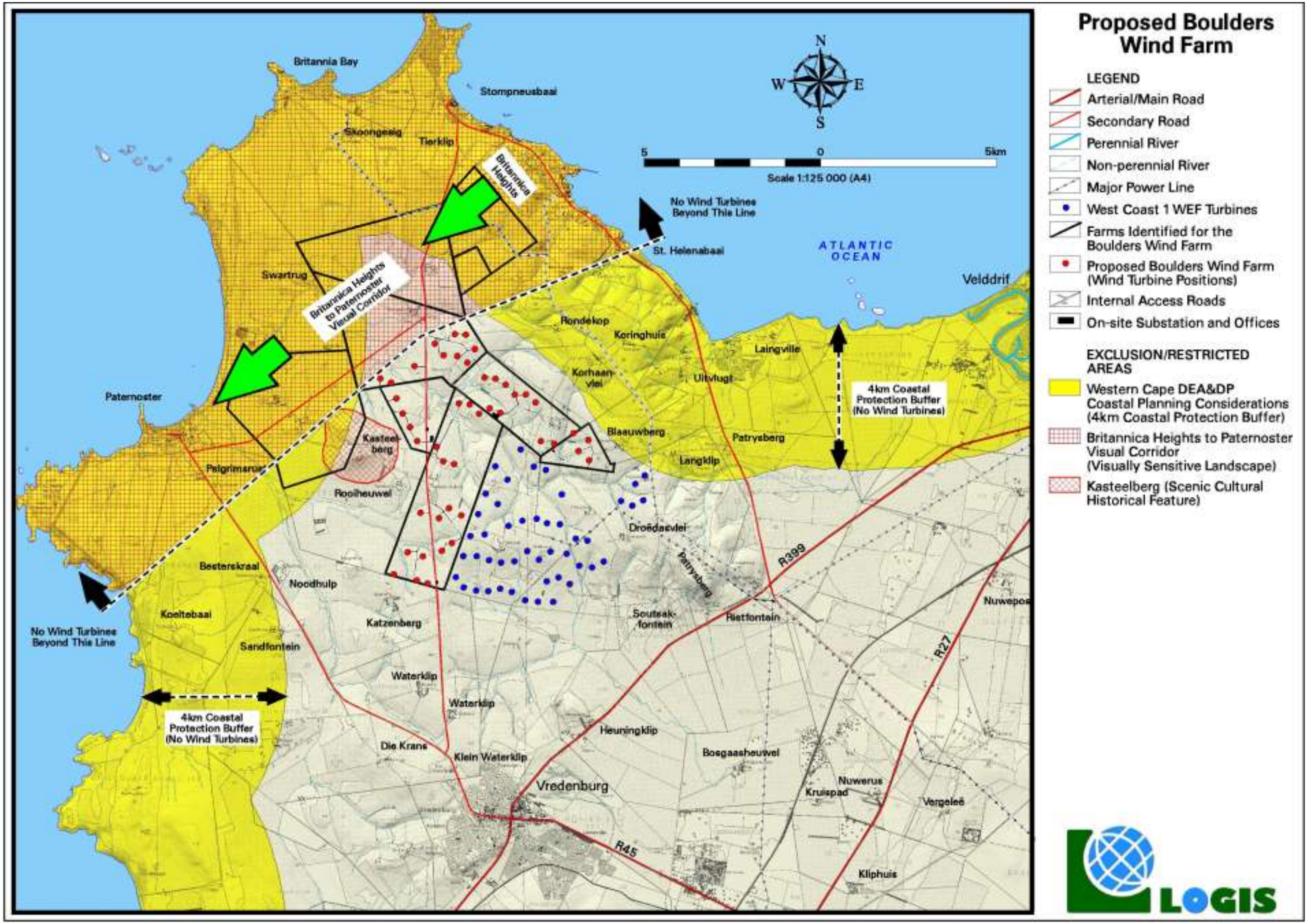
Refer to **Map 1** for the wind turbine layout and exclusion criteria.

Additional infrastructure may include the following:

- Cabling between the components;
- Internal access roads to each turbine;
- A workshop area for control, maintenance and storage;
- A Substation to facilitate the connection between the facility and the grid; and
- A 132kV power line.

The construction phase of the WF is dependent on the number of turbines ultimately erected and is estimated at one week per turbine. The construction phase is expected to be 2 years. The lifespan of the facility is approximated at 20 to 25 years.

Figure 1: The view from Britannica Heights to Paternoster and the Atlantic seaboard (in the distance).



Map 1: Exclusions and restricted areas that informed the Boulders Wind Farm layout.

Notes related to the above map (Map 1)

The Britannica Heights to Paternoster Visual Corridor, indicated as a dashed line beyond which no turbines are to be located, is a spatial representation of the landscape view featured in **Figure 1** above. The intention is to ensure that no direct visual intrusion of wind turbines affect observers located at Britannica Heights, when they look south-west towards Paternoster and the Atlantic seaboard, thereby protecting the pastoral character of the view corridor. This line is slightly bent in order to include observers/residents further south-east of Britannica Heights (up to Sterbakenkop hill). It should further be noted that the line represents a view corridor and not a viewshed from any specific observer or vantage point.

3. SCOPE OF WORK

This report is the undertaking of a Visual Impact Assessment (VIA) of the proposed/preferred WTG layout as determined by the project proponent after consideration of the Scoping Phase environmental and social sensitivities.

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 737km² (the extent of the maps displayed in this report) and includes a minimum 10km buffer zone from the proposed wind turbine structures.

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

- The visibility of the facility from, and potential visual impact on observers travelling along the arterial (R27, R45 and R399) and secondary (local) roads within the study area.

- The visibility of the facility from, and potential visual impact on built-up centres and populated places (i.e. the towns of Vredenburg, Paternoster, Britannia Bay, Stompneus Bay, St Helena Bay, Britannica Heights, Laingville and Velddrif) within the study area.

- The visibility of the facility from, and potential visual impact on farmsteads 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 pastoral landscape and small coastal towns (tourist attractions).

- The potential visual impact of ancillary infrastructure (i.e. the substation, associated power lines, internal access roads etc.) on observers in close proximity of the facility.

- The potential visual impact of lighting of the facility in terms of light glare, light trespass and sky glow.

- The potential visual impact of shadow flicker.

- The potential cumulative visual impact of the proposed WF and associated infrastructure in context of the operational West Coast 1 WEF.

- Potential visual impacts associated with the construction phase.

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 portions of a number of different farms with a combined surface area of approximately 5084ha. The final surface area (development footprint) to be utilised for the facility will be smaller (~42ha), depending on the type of turbine selected, the final site layout and the placement of wind turbines and ancillary infrastructure. The site is located approximately 6km north of Vredenburg (at the closest boundary) and immediately adjacent to the operational West Coast 1 WEF. Access to the site is provided by the Vredenburg to Stompneus Bay secondary gravel road that traverses the proposed development site.

Topography, vegetation and hydrology

The study area is located on land that ranges in elevation from sea level at the coast to approximately 270m above sea level at the top of the hills. The dominant topographical unit or terrain type of the study area is *moderately undulating plains* to the west and *plains* to the east. A number of rolling hills occur within the area, with the *Patrysberg*, adjacent to the R399 being the largest of these. Other smaller hills include the *Klipheuwel* and *Kasteelberg*.

The farms comprising the proposed WEF lie within four vegetation types namely; *Saldanha Granite Strandveld, Cape Inland Salt Pans, Saldanha Flats Strandveld* and *Saldanha Limestone Strandveld.* It should be noted, however, that the affected farms have all been heavily transformed by agricultural activities.

Land cover within the study area is dominated by *low shrubland and fynbos* and *cultivated land / agricultural fields.*

The most prominent terrestrial hydrological feature is the Berg River mouth (at Port Owen/Veldrif) that is situated in the north-eastern corner of the study area (outside of the development site). A number of smaller drainage systems, wetlands and man-made dams are evident within the central study area and development site. Refer to **Maps 2** and **3** for the topography and land cover maps of the study area.

Land use and settlement patterns

The study area has a rural character with very few built structures outside of the previously mentioned town boundaries (refer to **Section 3. Scope of Work**). Exceptions occur where homesteads (rural residence or dwellings) are found and at the West Coast 1 WEF, where 47 wind turbines are operational and clearly noticeable.

Wheat and maize farming dominate the general land-use character of this relatively arid region with rainfall of less than 500mm per annum.

The region has a population density of approximately 65 people per km^2 with the highest concentrations occurring in the towns of Vredenburg and Port Owen. A number of smaller towns occur along the Atlantic seaboard. These towns (Paternoster, Britannia Bay, Stompneus Bay, St. Helena Bay, etc.) are popular tourist destinations due to their close proximity to the ocean and their distinct West Coast character.

There are a number of farm residences (farmsteads) scattered throughout the study area. Some of these in closer proximity to the proposed WEF include:

- Klein Waterklip
- Heuningklip
- Waterklip
- Die Krans
- Nieuwe Rust
- Sandfontein
- Koeltebaai
- Trekoskraal
- Besterskraal
- Noodhulp
- Pelgrimsrust
- Uitkomst
- Rooiheuwel
- Langklip
- Skuitjiesklip
- Swartrug
- Morkelsdam
- Rondekop
- Korhaanvlei
- Koringhuis
- Uitvlugt
- Blaauwberg
- Langklip
- Droëdasvlei
- Soutsakfontein
- Katzenberg
- Droëvlei
- Klipheuwel
- Boebezakskraal
- Kaalberg/Britannica Heights
- Fransvlei
- Klippiesvlei
- Skuitjies

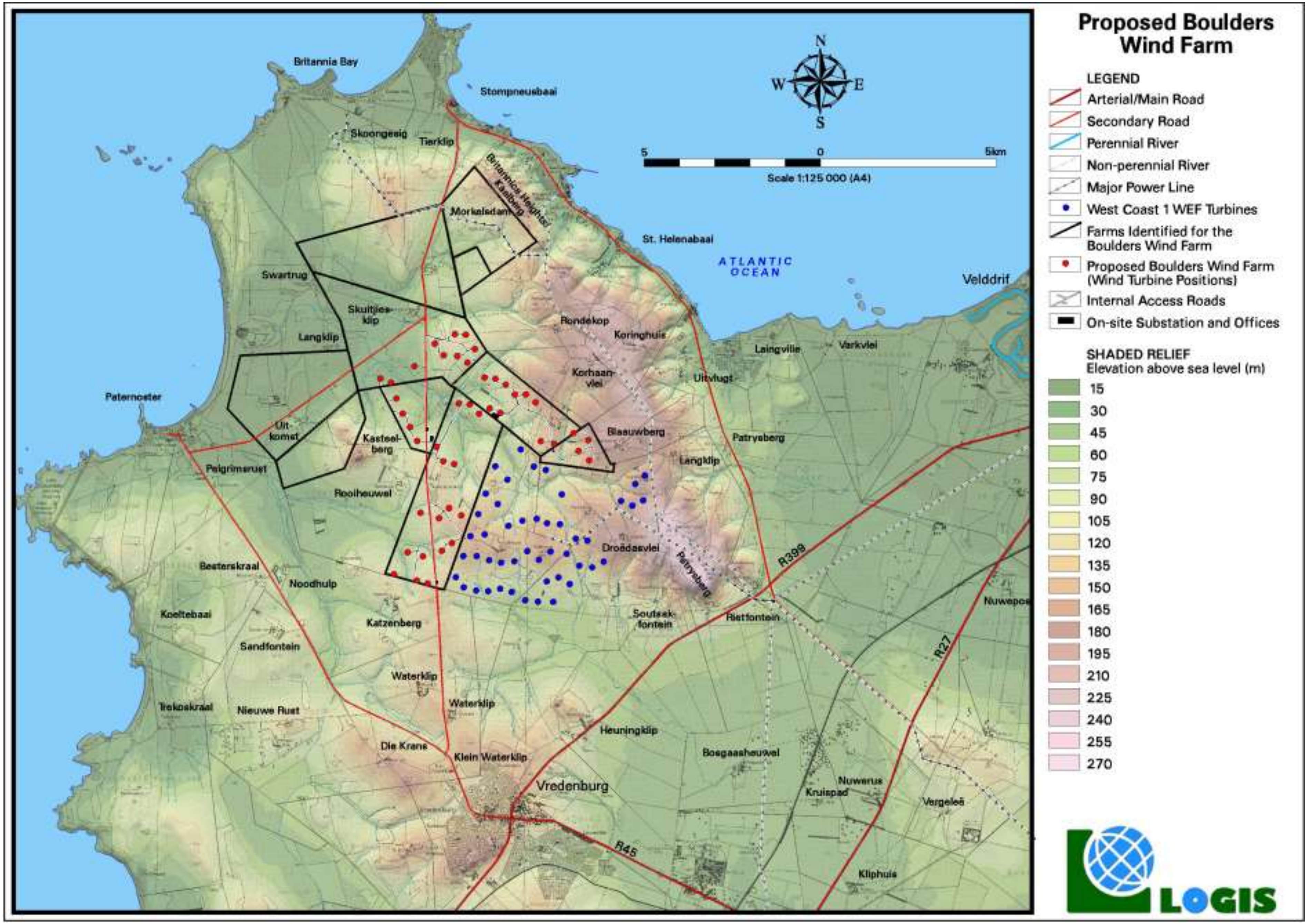
Formal conservation areas in the region include the Cape Columbine Nature Reserve to the west of Paternoster, and the Paternoster Rock Island Reserve and *Groot* Paternoster Private Nature Reserve to the north. These reserves are located at distances exceeding 10km from the proposed turbine structures.

Sources: DEA (ENPAT Western Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland) and NLC2013-14 (DEA).

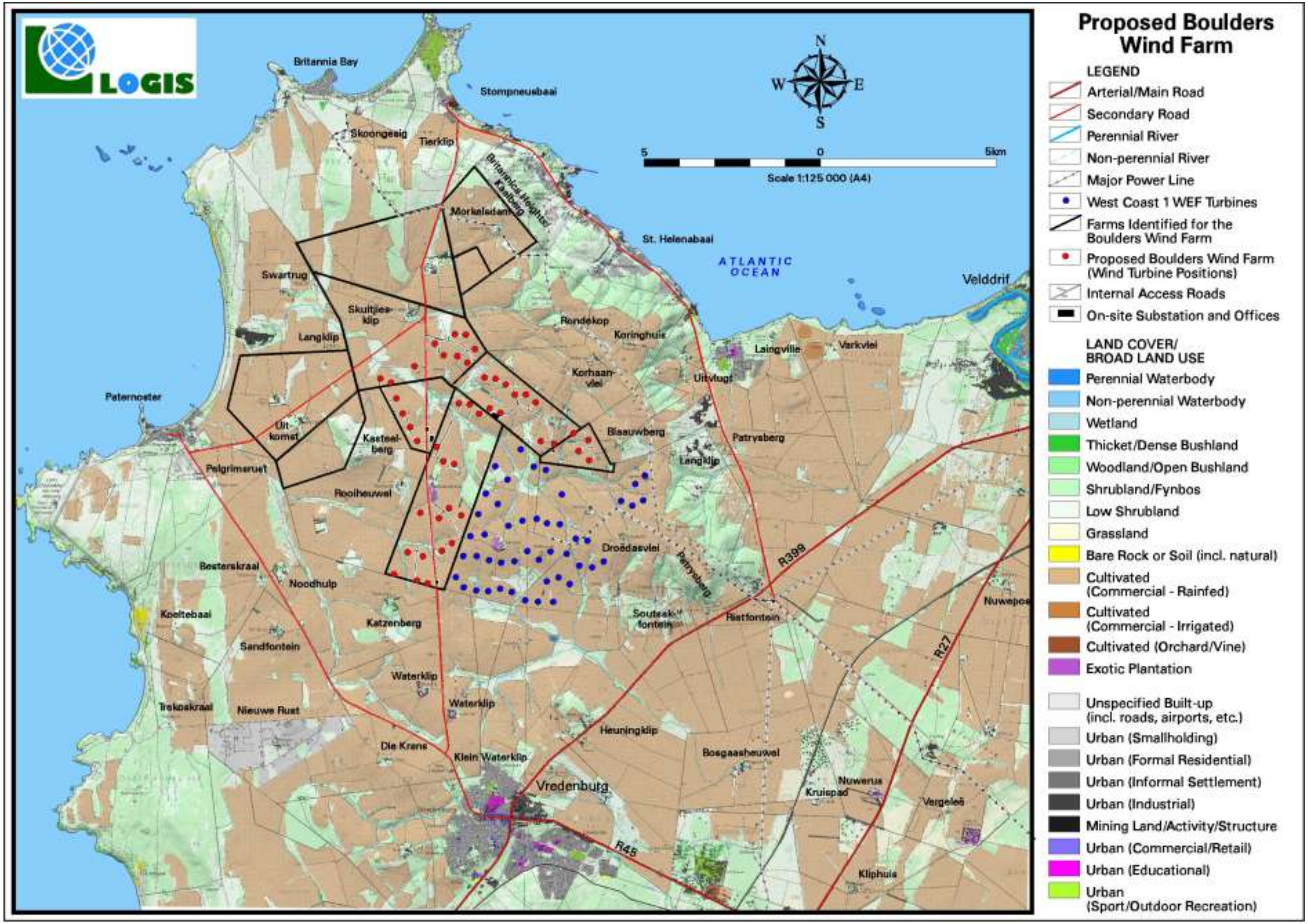
Figure 2: West Coast 1 WEF wind turbines as seen from the Vredenburg to Stompneus Bay secondary road.

Figure 3: Patrysberg as seen from the R399 arterial road.

Figure 4: Photograph depicting the rural land-use character of the area surrounding the proposed WF.



Map 2: Shaded relief map of the study area.



Map 3: Land cover and broad land use patterns.

6. RESULTS

6.1. Potential visual exposure

A visibility analysis was undertaken from each of the wind turbine positions (45 in total) at an offset of 120m (approximate hub-height) above ground level. The result of the visibility analysis is displayed on **Map 5**.

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

The result of the viewshed analysis displays 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 Boulders Wind Farm, whilst lower lying areas such as valleys are shielded, or not as exposed.

It is expected that the wind turbines will be exposed to observers travelling along the arterial (R399) and secondary roads within the study area, as well as from Paternoster, Kalkoond and farm residences (homesteads) within the region.

Towns, homesteads and roads expected to be visually influenced include:

- Kalkoond
- Paternoster
- Pelgrimsrust
- Kaalberg/Britannica Heights
- Morkelsdam
- Swartrug
- Uitkomst
- Besterskraal
- Noodhulp
- Sandfontein
- Nieuwe Rust
- Waterklip
- Droëvlei
- Skuitjiesklip
- Klipheuwel
- Fransvlei
- Droëdasvlei
- Klippiesvlei
- Langklip
- Korhaanvlei
- Rondekop
- Rooiheuwel
- Boebezakskraal
- Katzenberg
- Skuitjies
- Blauwberg
- R399 Arterial Road
- Paternoster-Stompneus Bay Road
- Vredenburg-Paternoster Road
- Vredenburg-Stompneus Bay Road

It is envisaged that the structures, where visible from shorter distances (e.g. less than 5km), may 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:

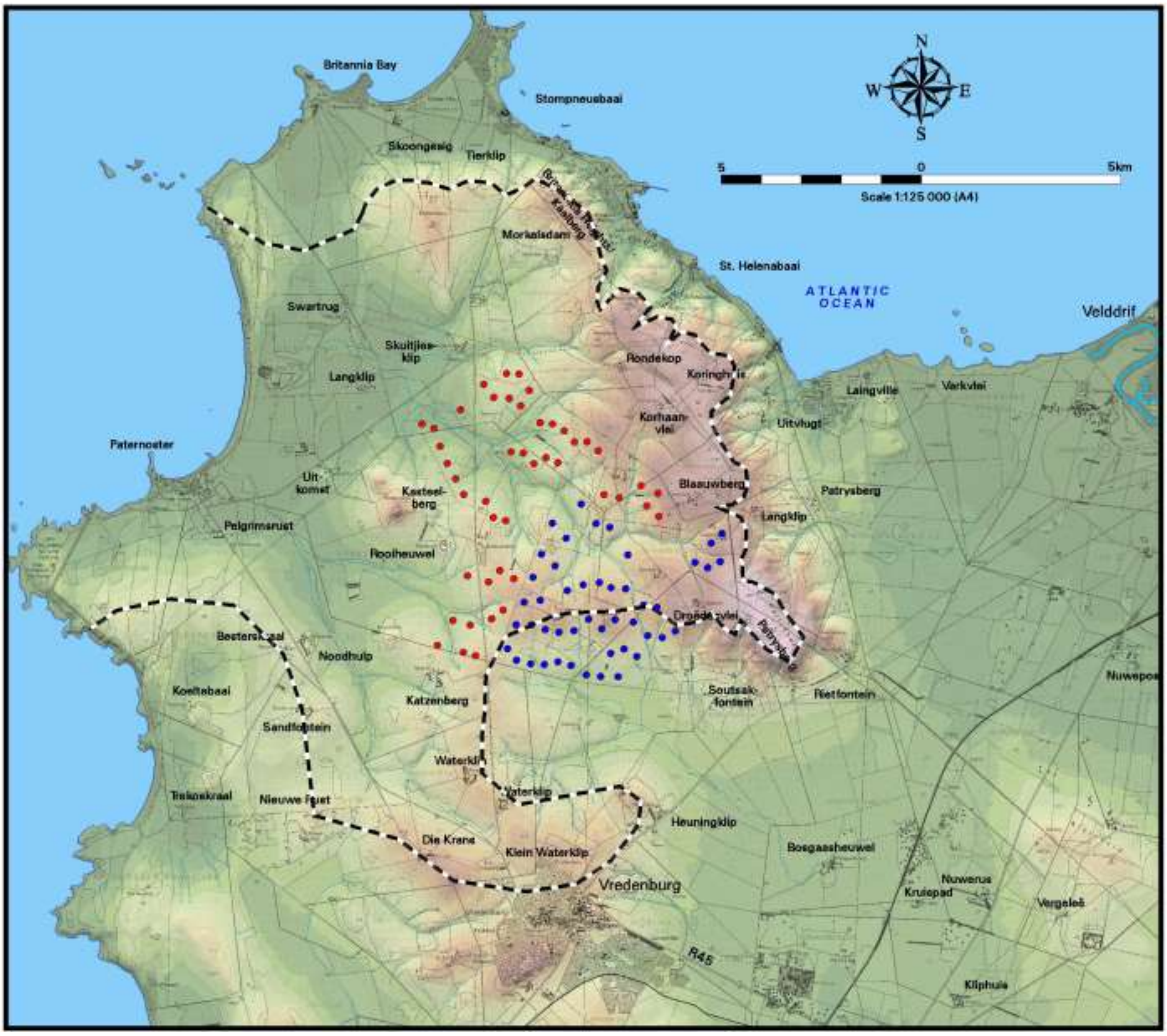
- Combined, where several WEF's wind turbines are within the observer's arc of vision at the same time;
- Successive, where the observer has to turn his or her head to see the various WEF's wind turbines; and
- Sequential, when the observer has to move to another viewpoint to see different developments, 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.

This section of the VIA report sets out to identify potential cumulative visual impacts for the West Coast 1 WEF and Boulders WF, to determine the extent of potential impact, and to quantify the significance of the impact. It further aims to determine whether the potential cumulative visual impact can be mitigated and to ultimately conclude whether the potential cumulative visual impact is within acceptable limits, or whether it would irrevocably change the landscape of the Paternoster *plateau*.

The geographical entity referred to as the Paternoster *plateau* is indicated on the **Map 4** below. The Paternoster *plateau* (and plains) is delineated along the visual skyline or watershed boundary of the area located between Paternoster and Vredenburg. It is bounded to the north-east by the ridgeline/escarpment that visually excludes the coastal areas of Stompneus Bay and St. Helena Bay. From this escarpment the landscape has an even slope (undulating plains) down towards Paternoster. All of the proposed Boulders WF wind turbines and 24 of the West Coast 1 WEF wind turbines are located within this area.



Map 4: The Paternoster *plateau* (indicated by the dotted line).

The cumulative impact of wind farm development on landscape and visual amenity is a product of:

- The distance between individual windfarms (or turbines);
- The distance over which wind farms (or turbines) are visible;
- The overall character of the landscape and its sensitivity to windfarms;
- The siting and design of the windfarms themselves; and
- The way in which the landscape is experienced.

For specific receptors, the following criteria are considered in coming to a judgement on cumulative effect:

- The number of wind turbines visible;
- The distance from the receptor to the wind turbines; and
- The relative turbine size and extent of each proposal.

The cumulative impact of wind farm development on landscape and visual amenity is largely a subjective assessment or value judgement, which is difficult to quantify. This study will consider this value judgement to some degree, but will primarily focus on the potential cumulative visual impact on specific receptors which is more quantifiable. The sum of these cumulative visual impacts will inform the overall acceptability of the Boulders WF within the receiving environment.

“Cumulative Impact”, in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[2].

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

» Unacceptable risk
» Unacceptable loss
» Complete or whole-scale changes to the environment or sense of place
» Unacceptable increase in impact

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

The following analyses/activities are undertaken in order to identify and quantify the potential cumulative visual impact:

- Viewshed analyses to determine the area of potential combined visual exposure (i.e. where combined cumulative visual impacts may occur);
- The identification of a representative set of sensitive visual receptors;
- The determination of the increase/decrease in frequency of turbine sightings;
- The determination of the increase/decrease in proximity to the turbine structures;
- The identification of individual turbines that may contribute to the potential cumulative visual impact;
- Determine the significance of the potential cumulative visual impact; and
- Photo simulations that graphically illustrate the potential cumulative visual impact.

Cumulative visual exposure

The proposed Boulders Wind Farm wind turbine layout is located adjacent to the existing West Coast 1 WEF. The physical wind turbine footprints of the two facilities are contained within a 4.3km radius, effectively creating an 8.6km diameter wind energy generation hub (shown on **Map 7** below).

The visual exposure of the Boulders Wind Farm layout and the West Coast 1 WEF turbines is analysed in order to determine whether there is a significant correlation between the visual exposure of the two layouts, or whether the construction of the Boulders Wind Farm turbines would contribute to the potential cumulative visual exposure of wind turbine structures within the region.

A visibility analysis of the West Coast 1 WEF turbines was undertaken individually from each of the existing wind turbine positions (47 in total) at an offset of 80m (approximate hub-height) above ground level. The result of the West Coast 1 WEF visibility analysis is displayed on **Map 6** below. The Boulders Wind Farm visibility analysis is displayed on **Map 5** and discussed in the previous section of the report. Of relevance is the fact that the proposed Boulders WF wind turbines (120m hub-height) will be 50% larger than the West Coast 1 wind turbines, potentially aggravating the cumulative visual impact. **Figure 5** below places this in visual context, where the larger wind turbine to the left represents the Boulders WF turbine and the right the West Coast 1 wind turbine. Viewed from the same distance the larger turbine is more imposing and intrusive, and generally more visible from longer distances. A reduction in the size of the wind turbine dimensions may mitigate the potential cumulative visual impact to some degree.

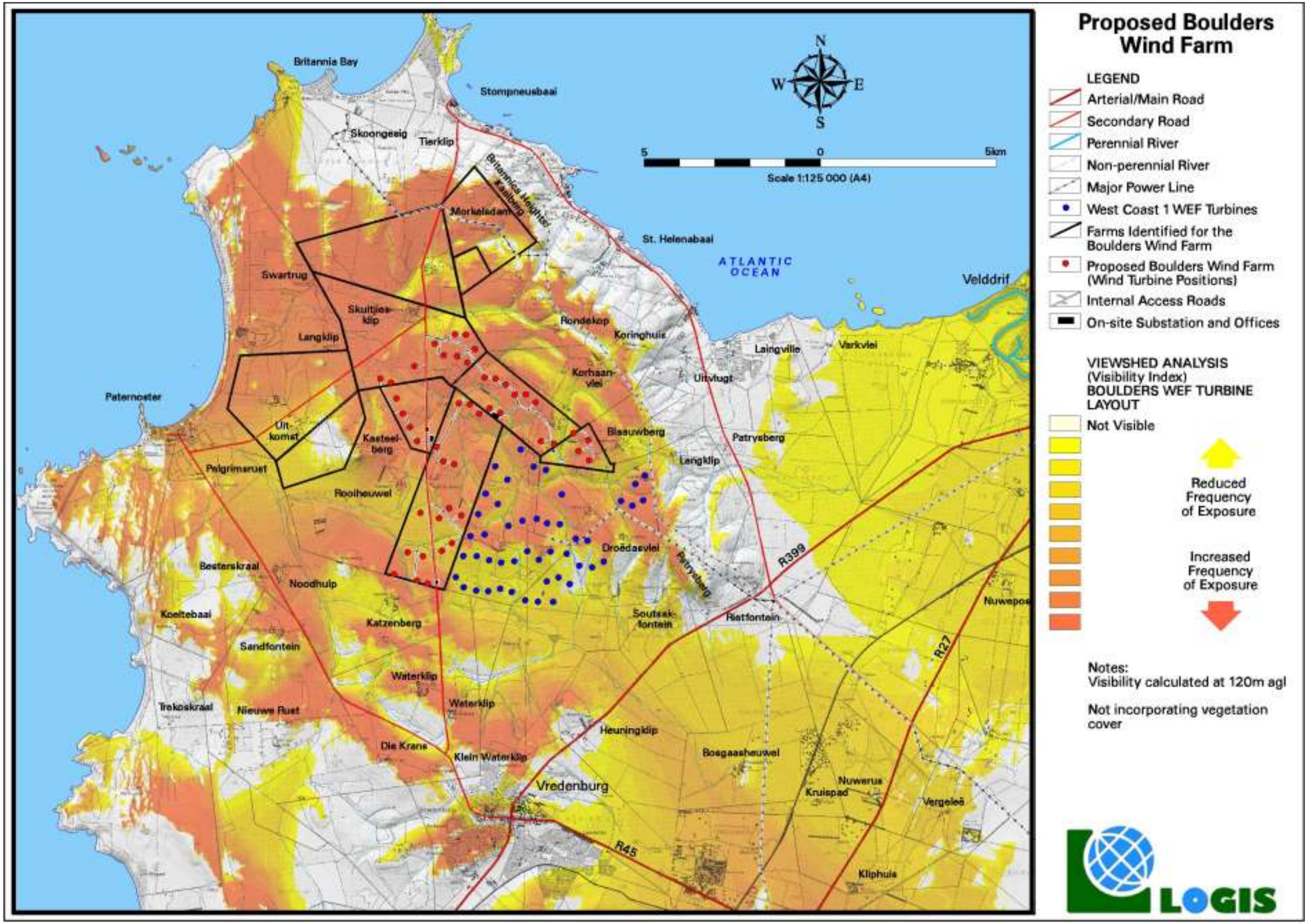
[2] Unless otherwise stated, all definitions are from the 2014 EIA Regulations (GNR 326).

Figure 5: Visual representation of the existing (right) and proposed (left) wind turbine structures.

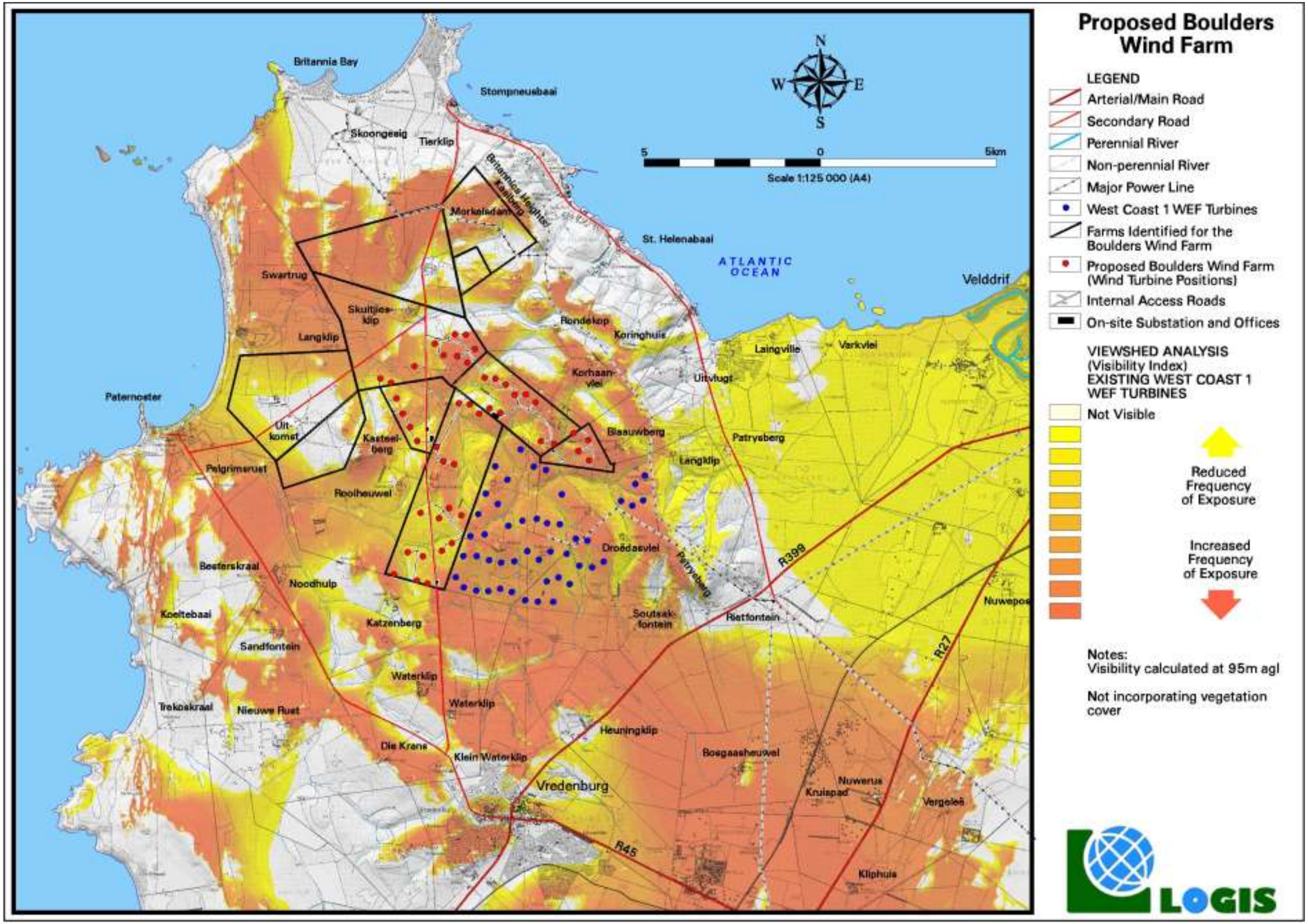
At first glance the visual exposure of both WEF turbines appears to be very similar, but at closer inspection it is revealed that the West Coast 1 turbines (the five most easterly turbines) spread the visual exposure to Laingville, Uitvlugt, Varkvlei, Patrysberg and Langklip. The frequency of visual exposure to the south-east, towards the R399 arterial road, is also higher than for the Boulders Wind Farm wind turbines. The Boulders WF's wind turbine layout north of the West Coast 1 WEF dictates the increased frequency of visual exposure to the north and west (towards Schuitjies, Langklip, Uitkomst, Paternoster, Kasteelberg, etc.).

These observations were once again tested by means of overlaying the two visibility analyses. The cumulative viewshed analysis is displayed on **Map 6**. The area of combined visual exposure is indicated in red, West Coast 1 wind turbine exposure in yellow and the additional area of exposure for the Boulders Wind Farm in green. The compass superimposed over the existing and proposed wind turbine positions further illustrates the directions of increased visual exposure of the two wind farms, as mentioned in the previous paragraph.

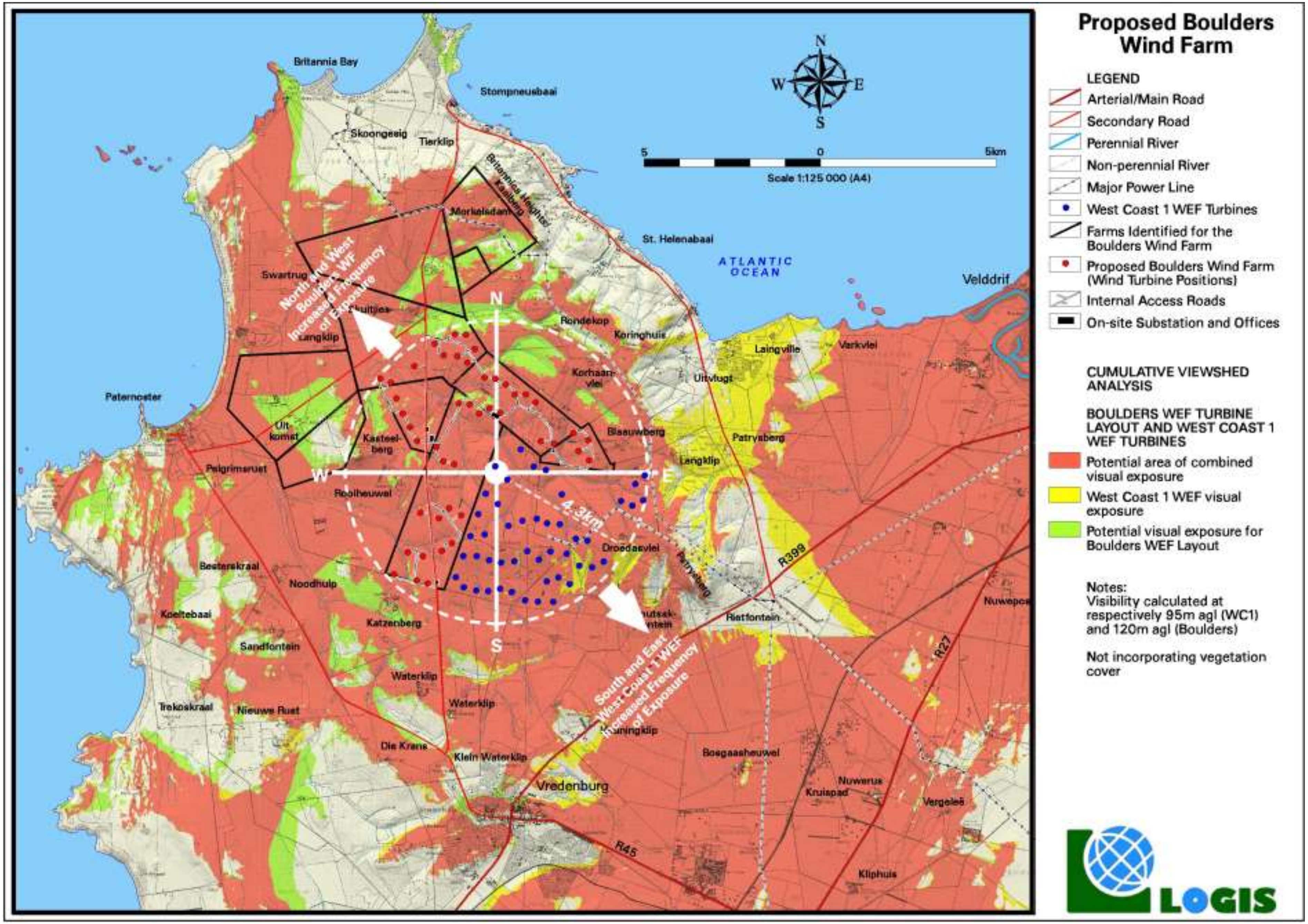
There is a very good correlation between the visual exposure of the two tested wind turbine layouts with very limited additional visual exposure. The frequency of visual exposure is however expected to increase within the potential area of combined visual exposure, thereby potentially increasing the cumulative visual impact on sensitive visual receptors.



Map 5: Viewshed analysis: Boulders Wind Farm.



Map 6: Viewshed analysis: West Coast 1 Wind Energy Facility.



Map 7: Cumulative viewshed analysis: Boulders Wind Farm and West Coast 1 WEF turbines.

Sensitive visual receptors

For the purpose of this study seven potentially sensitive visual receptors where selected within the combined area of visual exposure. They are indicated and numbered on **Maps 8** to **14** and listed below:

- 1) Observers travelling along the Vredenburg to Stompneus Bay road south of the facilities;
- 2) Observers near *Noodhulp*;
- 3) The Paternoster viewpoint
- 4) The rocky outcrop at the Paternoster beach;
- 5) Observers travelling along the Vredenburg to Stompneus Bay road north of the facilities;
- 6) Residents at Britannica Heights; and
- 7) Observers travelling along the R399 arterial road.

The rationale for the selection of these receptors is discussed in more detail in **Section 6.4.** (Viewer incidence / viewer perception).

Frequency of visual exposure and visual distance

The frequency of visual exposure to wind turbines and the visual distance from the wind turbines for the abovementioned receptors are displayed in the table below. The table indicates the receptor, the number of turbines visible (respectively for the West Coast 1 WEF and Boulders WF), the total number of turbines potentially visible and the percentage increase in the number of visible turbines. It should be noted that the turbines indicated as 'visible' include turbines that may only be partially visible (i.e. it may only be the nacelle and blades that are visible).

Additional to this, the table also indicates the distances to the closest visible turbine (respectively for the West Coast 1 WEF and Boulders WF), the increase (or decrease) in distance to the closest turbine and the percentage increase/decrease in proximity to the closest visible wind turbine.

The follow ratings were applied to the data provided in the table:

Increase in frequency of visual exposure

0 – 50%	low increase
50.1 – 100%	moderate increase
100.1 – 150%	high increase
150.1% >	very high increase

Note: A 100% increase implies that double the amount of wind turbines would be visible from the specific receptor after the construction of the Boulders WF. This is seen as a cut-off point where the frequency of visual exposure is considered to become high and the potential cumulative visual impact may exceed acceptable levels. Greater than 100% is considered an unacceptable increase in impact.

Increase in proximity to the closest wind turbine

< 10%	negligible increase/significant decrease (positive)
10.1 – 25%	moderate increase
25.1 – 50%	high increase
50.1 – 100%	very high increase

Note: The increase in proximity to additional wind turbines placed in the landscape exponentially increases the potential for cumulative visual impacts to occur. In other words, the closer the additional wind turbines are placed to the receptor, the higher the potential cumulative visual impact. A 100% increase in proximity would for instance mean the turbine is placed at the receptor site. A negative value implies a decrease in proximity and is seen to a positive from a cumulative visual impact point of view.

Table 2: Increase in frequency of visual exposure and increase/decrease in proximity to the closest visible wind turbine.

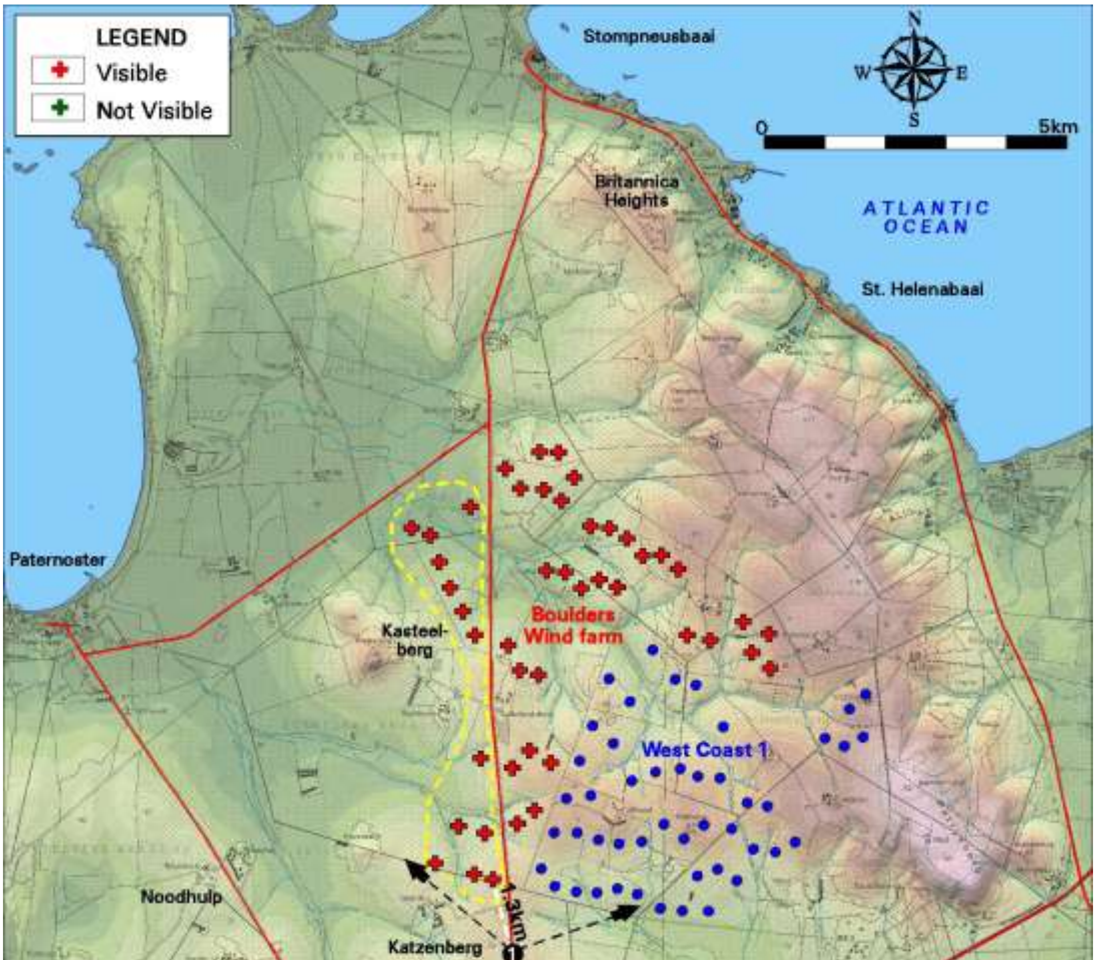
Potential Sensitive Visual Receptor	No. of turbines visible		Total	% Increase in no. of turbines	Distance to closest visible turbine (m)		Increase or decrease	% Increase in proximity
	WC1	Boulders			WC1	Boulders		
1 Stompneus Bay Road South	47	45	92	**96%**	1,301 Short distance	1,289 Short distance	12m closer	**1%**
2 Noodhulp (Vredenburg Road to Paternoster)	45	40	85	**89%**	5,043 Medium - longer distance	3,266 Medium distance	1,777m closer	**35%**
3 Paternoster viewpoint	27	36	63	**133%**	9,348 Medium - longer distance	6,467 Medium - longer distance	2,881m closer	**31%**
4 Paternoster beach	11	38	49	**345%**	8,632 Medium - longer distance	5,414 Medium - longer distance	3,218m closer	**37%**
5 Stompneus Bay Road North	39	45	84	**115%**	7,335 Medium - longer distance	3,749 Medium distance	3,586m closer	**49%**
6 Britannica Heights	46	45	91	**98%**	7,134 Medium - longer distance	4,104 Medium Distance	3,030m closer	**42%**
7 R399	42	14	56	**33%**	3,242 Medium distance	6,571 Medium - longer distance	3,016m farther	**-49%**
Average Increase				**130%**			1,641m closer	**21%**

Receptor 1: Stompneus Bay Road South

Receptor 1 (observers travelling along Stompneus Bay road south of the facilities) is expected to have a **moderate cumulative visual impact** (Note: not to be confused with the potential visual impact). Potentially all the wind turbines from both facilities may be visible (a total of 92 wind turbines). The proximity of the two wind farm's wind turbines to the east of the road makes it difficult to distinguish between which turbines belong to which WEF, mitigating the potential cumulative visual impact. The road however visually delineates the edge of this 'wind farm' and turbines to the west (identified in yellow dashed line) would need to be relocated or removed for this mitigation to be successful.

General note: Please refer to the table above for the amount of visible turbines. The visible turbines are indicated on the maps below. The large scale photo simulations are available at **Section 7.** (Photo Simulations).

Figure 6: Receptor 1 photo simulation (before: top, after: bottom).

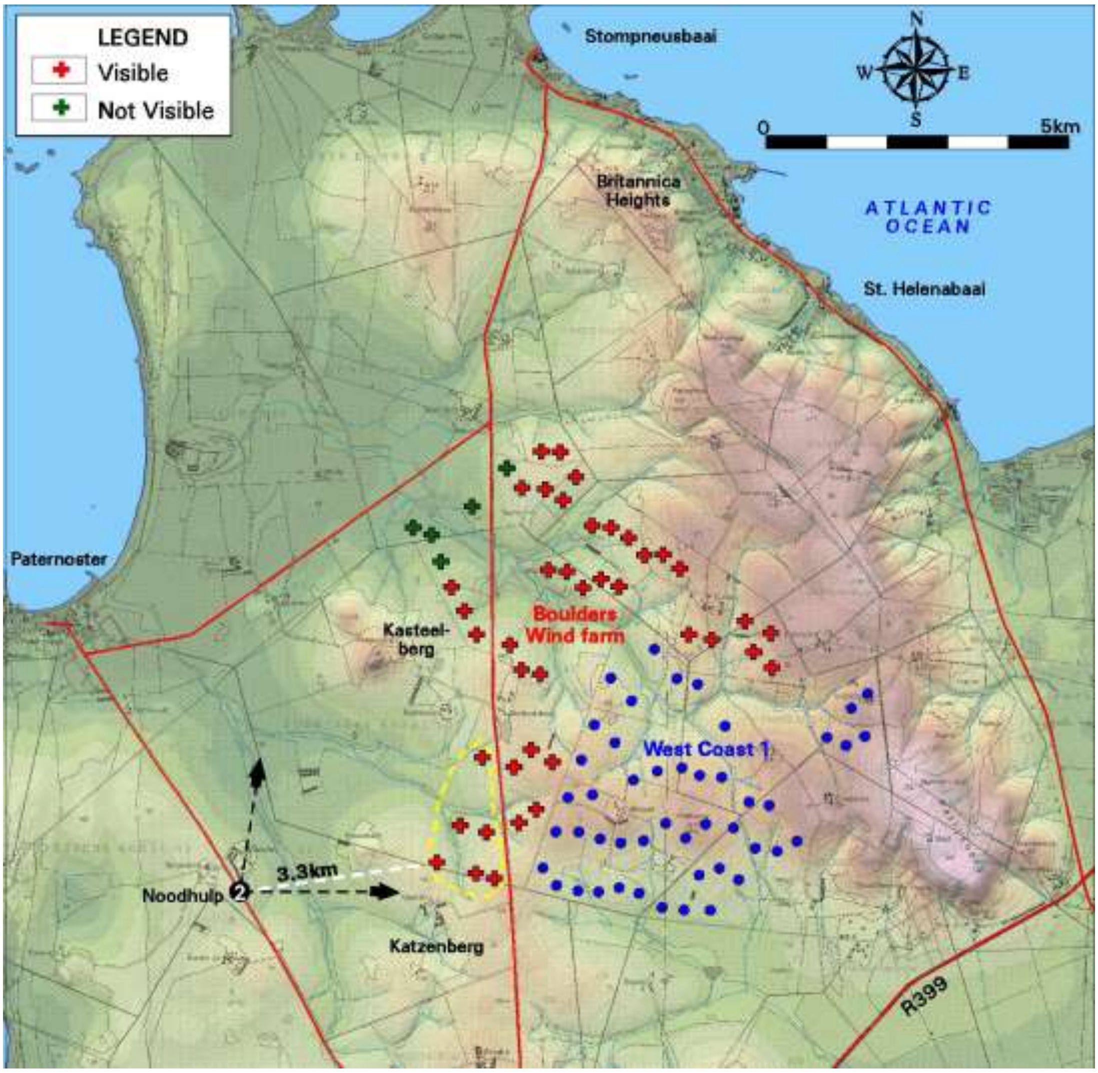


Map 8: Receptor 1 position and potentially visible wind turbines.

Receptor 2: Noodhulp (Vredenburg Road to Paternoster)

Receptor 2 (*Noodhulp* along the Paternoster road) is expected to experience a moderate increase in the visibility of wind turbine structures. However, the turbines will be placed in closer proximity (from *medium-longer* distance to *medium* distance) to the receptor, potentially aggravating the potential cumulative visual impact. Potential mitigation of this impact may entail the removal or relocation of the six turbines closest to the receptor (indicated on the map).

Figure 7: Receptor 2 photo simulation (before: top, after: bottom).

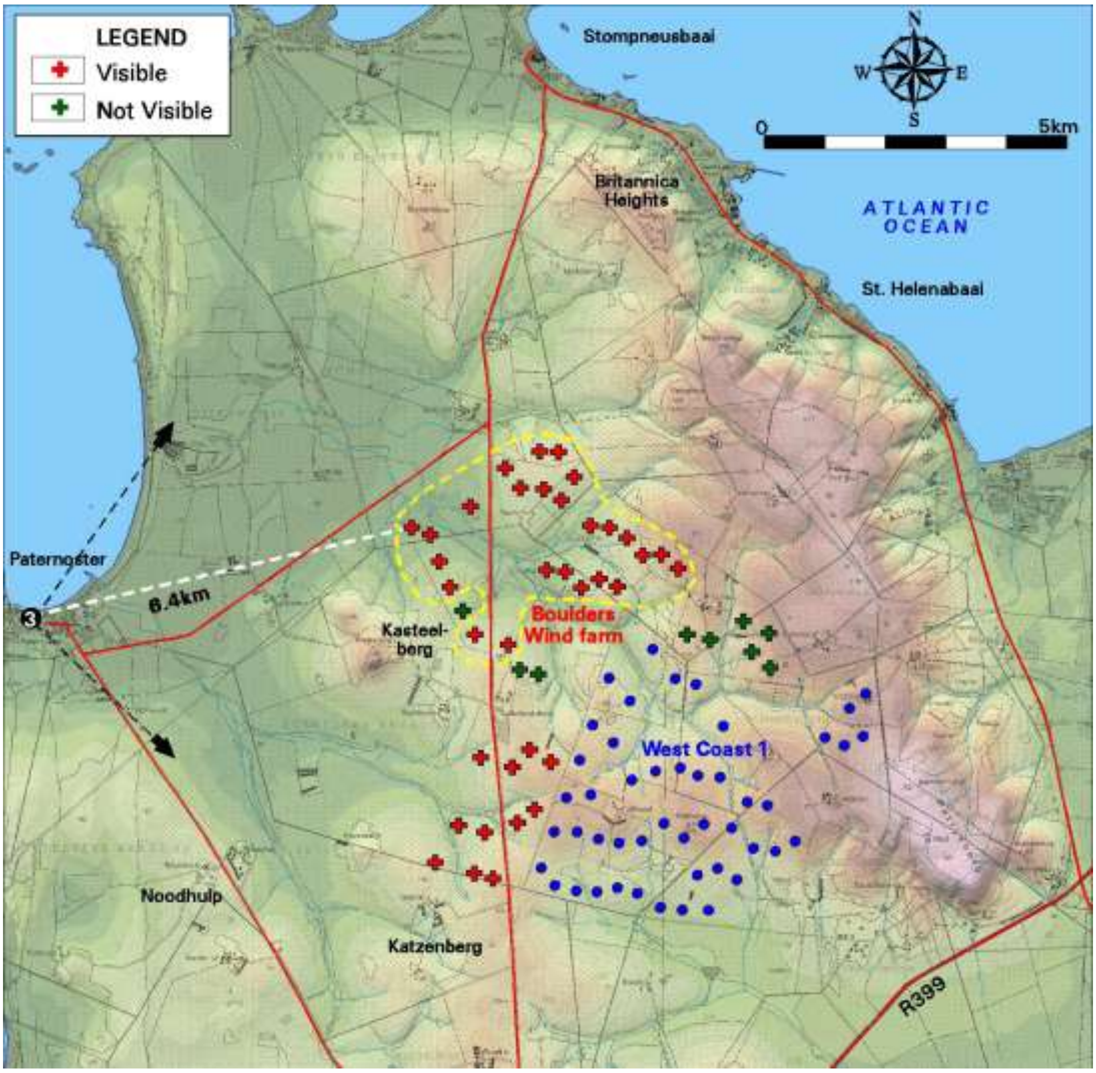


Map 9: Receptor 2 position and potentially visible wind turbines.

Receptor 3: Paternoster Viewpoint

This receptor located west of Paternoster is expected to have a very high increase in the frequency of exposed wind turbines. The cumulative visual impact is expected to be of high significance as the turbines would be spread out across the skyline, east and west of the Kasteelberg hill. The existing West Coast 1 wind turbines are located east (to the right) of the hill whilst the majority of the Boulders WF wind turbines would manifest to the west (left) of this hill, a distinct separation that will aggravate the cumulative visual impact. The only mitigation of this potential cumulative visual impact is the removal or relocation of up to 25 turbines (indicated on the map below) that are completely or partially visible.

Figure 8: Receptor 3 photo simulation (before: top, after: bottom).

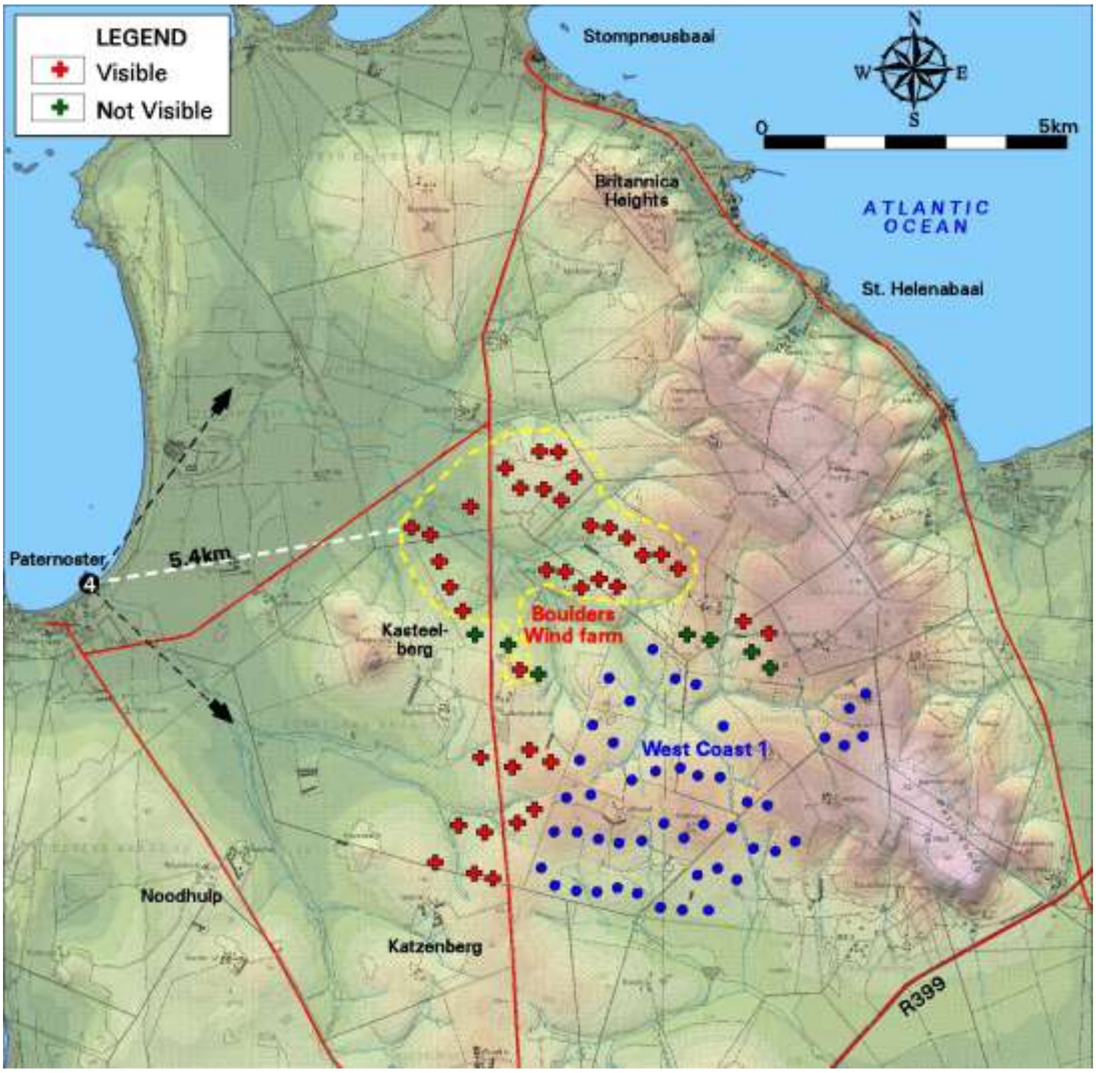


Map 10: Receptor 3 position and potentially visible wind turbines.

Receptor 4: Paternoster Beach

This receptor (Paternoster beach) shares the same characteristics as the previous receptor. It is expected to have a very high cumulative visual impact as 38 new turbines would be visible on the horizon. Up to 26 turbines would need to be removed or relocated in order to mitigate this impact. Refer to the map below.

Figure 9: Receptor 4 photo simulation (before: top, after: bottom).

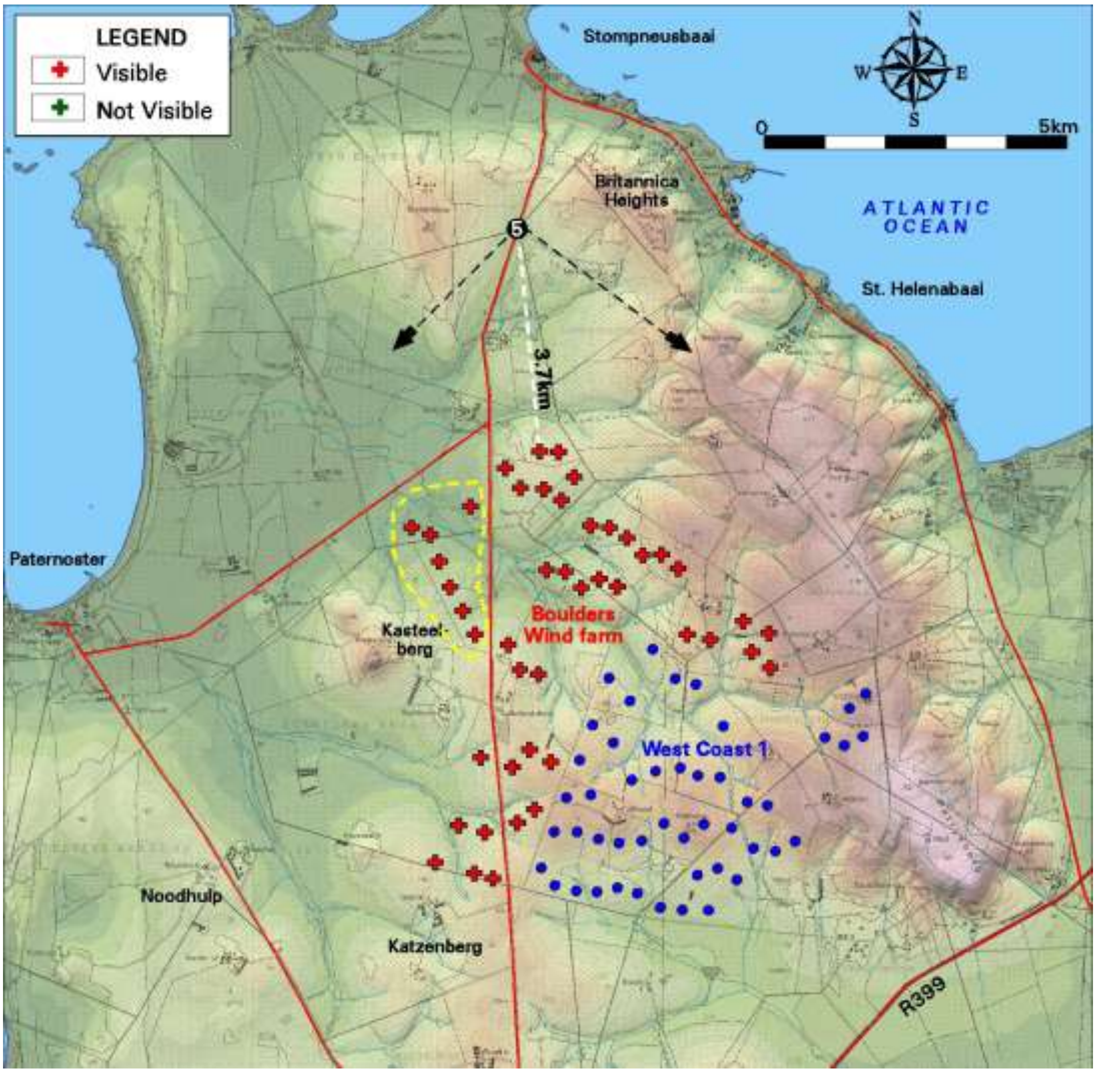


Map 11: Receptor 4 position and potentially visible wind turbines.

Receptor 5: Stompneus Bay Road North

This receptor (observers travelling south along the Stompneus Bay road) will have the third highest frequency of visual exposure to the Boulders WF and West Coast 1 WEF. A combined 84 turbines may be visible from both facilities. The Boulders wind turbines would also be located in closer proximity to this receptor, aggravating the cumulative visual impact. The road once again acts as a delineation of the 'combined' WEF's boundary, prompting the removal or relocation of the seven turbines located west of this road.

Figure 10: Receptor 5 photo simulation (before: top, after: bottom).

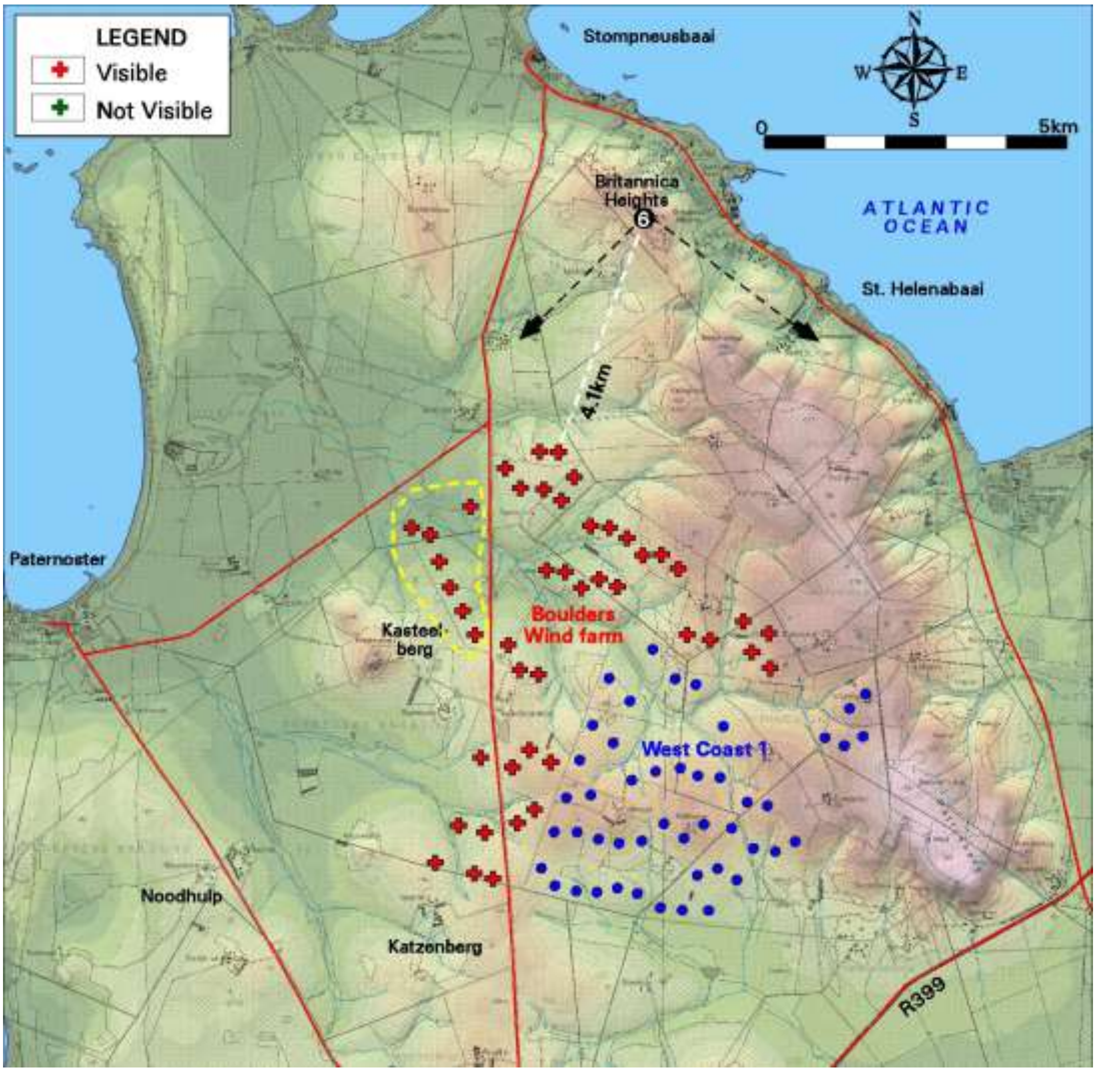


Map 12: Receptor 5 position and potentially visible wind turbines.

Receptor 6: Britannica Heights

Observers at Britannica Heights will have a similar visual experience of the wind turbines as the previous receptor (receptor 5). It is expected to have a moderate increase in the frequency of visual exposure (up to 91 turbine may be visible), but the turbines will be located in closer proximity to Britannica Heights (within medium distance (5km) of this receptor). The same turbines, as at receptor 5, will need to be removed or relocated in order to successfully mitigate this potential cumulative visual impact.

Figure 11: Receptor 6 photo simulation (before: top, after: bottom).

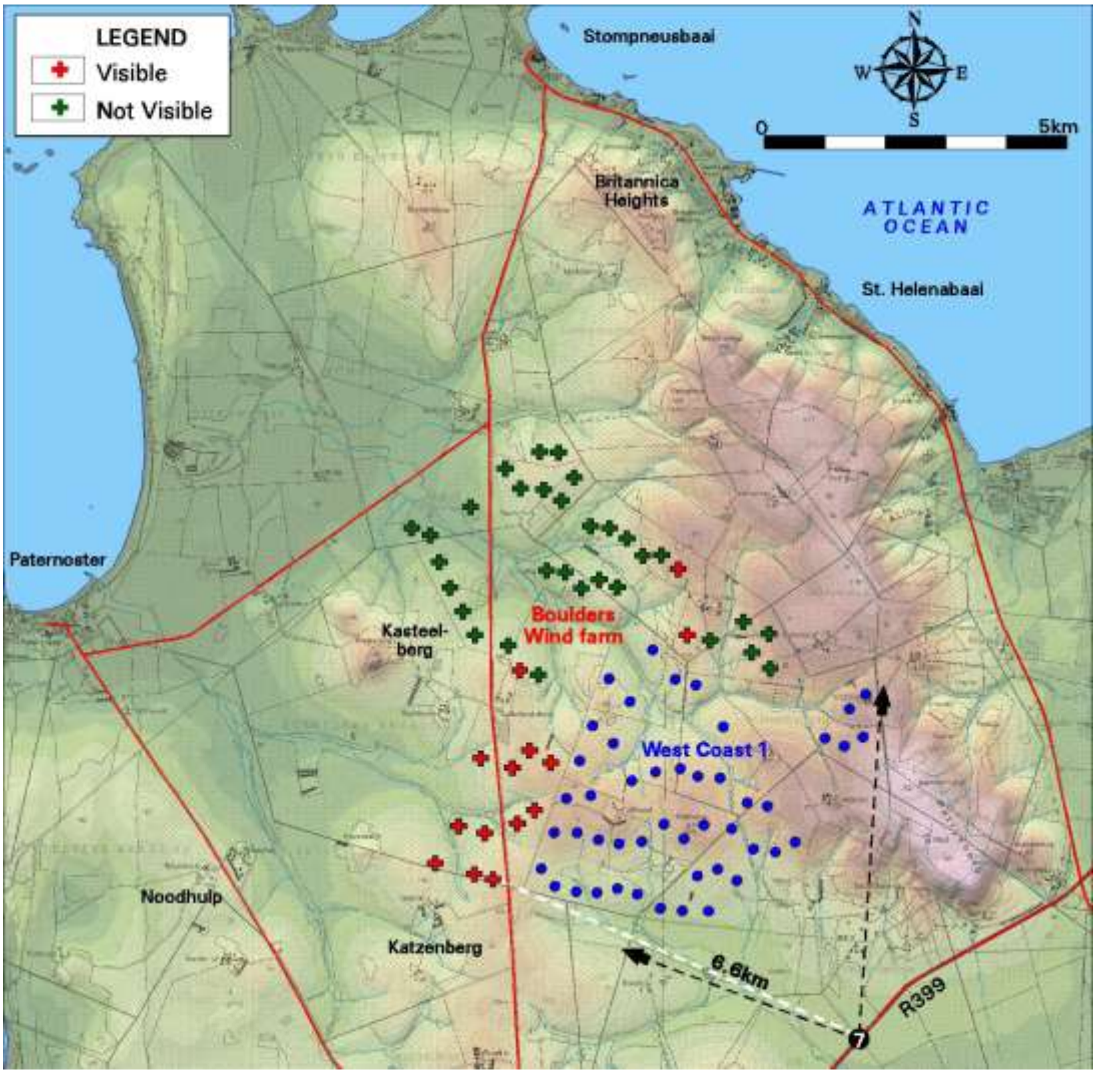


Map 13: Receptor 6 position and potentially visible wind turbines.

Receptor 7: R399 Arterial Road

This receptor (observers travelling along the R399) is the only receptor to have a low increase in the frequency of visual exposure. It is also the only one to have an increase in distance to the turbine structures (a positive), where the turbine structures of the Boulders WF will be located an additional 3km farther than the West Coast 1 turbines. The cumulative visual impact is therefore expected to be of low significance.

Figure 12: Receptor 7 photo simulation (before: top, after: bottom).



Map 14: Receptor 7 position and potentially visible wind turbines.

Conclusion

The overall potential increase in the frequency of visual exposure of wind turbine structures, should the Boulders WF be constructed, is expected to be high (130%). The wind turbine structures will, on average, be in a 1.6km closer proximity to the potential visual receptors. It is expected that the overall cumulative visual impact will be of high significance due to the:

- The open landscape context of the Paternoster *plateau* (wide panoramic views valued by residents and visitors alike);
- The activities of the residents and visitors (outdoor recreation related to the tourism industry of the region);
- Sensitivity of the visual receptors to wind farm developments (based on comments, responses and objections); and
- The magnitude of the cumulative change to the landscape (in terms of the scale, nature and frequency of combined or sequential views of the turbine structures).

In spite of the physical similarities between the visual exposure and the close proximity of the two wind farms, this consolidation into one large wind farm is only applicable in theory in this instance. In visual terms, and more specifically in terms of the cumulative visual impact on the landscape, the Paternoster *plateau* is an area where the receptor sensitivity is a limiting factor to any further wind energy developments.

An area where receptor sensitivity may be a limiting factor to further development is described as:

"*An area where receptor sensitivity tends to be highest, and where cumulative landscape and visual effects are therefore more likely to be considered unacceptable. Receptor sensitivity may relate to landscape character (including landscapes designated for their scenic quality or wildness), and/or to the presence of high numbers of sensitive visual receptors.*

Areas may or may not be subject to existing cumulative effects, and in these areas cumulative effect may not be the primary 'limiting factor' on development. Rather the sensitivity of landscape and visual receptors indicates that relatively low levels of cumulative effect may be considered unacceptable". (LUC, July 2014).

The author is of the opinion that besides the physical scale and extent of the cumulative visual exposure of the two WEFs being a limiting factor (as illustrated earlier), the Paternoster *plateau* may have reached its capacity to accommodate wind energy infrastructure, based largely on (but not restricted to) the concept of 'receptor sensitivity'. The sensitivity of the landscape, including the Paternoster *plateau* and adjacent elevated terrain such as Kasteelberg and the Britannica Heights ridgeline with open vistas and visual receptors which are drawn to the area as a result of the natural features and beauty indicates that relatively low levels of cumulative effect may be considered unacceptable.

The result of the assessment of the cumulative visual impact of the proposed Boulders WF and the West Coast 1 WEF is that the construction of all the proposed wind turbines in their proposed locations may pose a critical risk to the visual quality and landscape of the Paternoster *plateau*.

If no mitigation is undertaken (i.e. if the identified wind turbines cannot be relocated or removed) the cumulative visual impact may have as an effect the potential loss of the Paternoster *plateau* as a scenic resource.

If mitigation is considered the potential cumulative impact may be within acceptable limits. This would include, as a minimum requirement, the removal or relocation of the wind turbines west of the Vredenburg to Stompneus Bay road and an investigation into the potential overall reduction in the wind turbine size, in order to match the dimensions of the West Coast 1 wind turbines.

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 100 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.

The proximity radii, based on the dimensions of the proposed development footprint are indicated on **Map 15**, and include the following:

- 0 - 1km. Very short distance view where the WEF would dominate the frame of vision and constitute an extremely high visual prominence.
- 1 – 2.5km. Short distance view where the structures would be easily and comfortably visible and constitute a very high visual prominence.
- 2.5 - 5km. Medium distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a high visual prominence.
- 5 - 10km. Medium to longer distance view of the facility where the facility could potentially still be visible though not as easily recognisable. This zone constitutes a moderate visual prominence for the facility.
- > 10km. 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 13: 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 WF 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 arterial and secondary roads within the study area. Commuters and tourists using these roads may be negatively impacted upon by visual exposure to the WF.

Viewer incidence is generally low within a 5km radius of the proposed WF; however, the region has a high tourism value and inherent sense of place based on its location along the Atlantic seaboard and cultural/historical character.

Residents and visitors to this area are therefore seen as sensitive visual receptors upon which the construction of the WF could have a potential negative visual impact. Potential sensitive visual receptors include mainly residents of homesteads and visitors travelling along the secondary access roads.

Specific mention should be made of landowners/points of interest along the coastline that have formally objected, raised concerns or were identified during the Public Participation Process undertaken in the Scoping Phase. Some of these include:

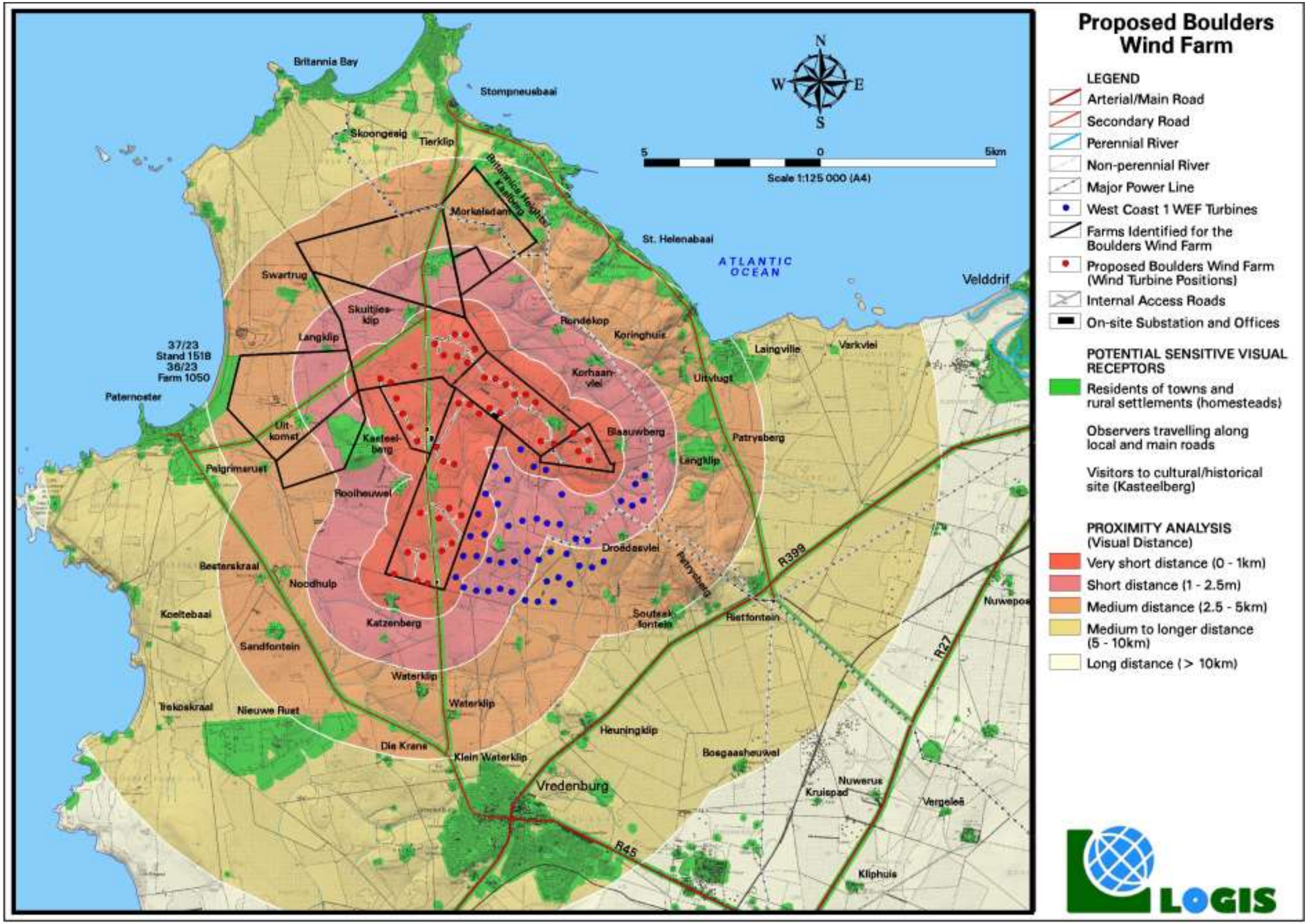
- Residents of Britannica Heights
- Remainder Portion 37 of Farm 23 and Stand 1518 (adjacent landowner)
- Portion 36 of Farm 23 (adjacent landowner)
- Remainder of Farm 1050 (Strandloper Investment Trust)
- A specific viewpoint at the west of Paternoster (Refer to **Map 19** - Viewpoint 3). This site is a favourite location for tourists to take photographs of the bay, the town and *Kasteelberg* (see below).

The concerns of these receptors have largely been addressed through the placement of the wind turbine structures and design of the general layout of the wind farm infrastructure. Refer to **Section 2 (Background and Proposed Infrastructure).** The receptors must still be included in the visual impact assessment, in order to determine the visual impacts remaining, notwithstanding the rectifying/mitigating measures implemented during the wind farm design and turbine placement.

Additional reference is made to the *Kasteelberg* hill and rocky outcrop that is indicated as a visually sensitive topographical and cultural/historical feature. Access to this site is currently restricted due to its location on private land, but visitors (mainly academics studying the site and surrounds) may nevertheless be negatively impacted on by the wind turbine structures. The Heritage Impact Assessment (HIA) and Social Impact Assessment (SIA) reports refer to the *Kasteelberg* and its surrounds as a "*significant cultural landscape of the Vredenburg Peninsula*" and as such is included as a sensitive visual receptor in the VIA report.

Within a 10km radius, viewer incidence increases with the presence of larger towns such as Vredenburg, Laingville, Paternoster, St Helena Bay, Stompneus Bay and Britannia Bay, most of which are holiday destinations. A specific concern was raised about the visibility of the wind turbine structures from the beach at Paternoster. The section dealing with the visual impact index **(Section 6.6.)** will address this potential sensitive visual receptor individually and will determine the location and potential magnitude of potential visual impact.

Refer to **Map 15** for the location of the potential sensitive visual receptors discussed above.



Map 15: Proximity analysis and potential sensitive visual receptors.

6.5. Visual absorption capacity

The land cover within the study area is dominated by *low shrubland and fynbos* and *cultivated land / agricultural fields.*

Low shrubland and Fynbos is described as:

Natural / semi-natural low shrub dominated areas, typically with < ± 2m canopy height, specifically associated with the Fynbos Biome. It includes a range of canopy densities encompassing sparse to dense canopy covers. Very sparse covers may be associated with the bare ground class. Note that taller tree / bush / shrub communities within this vegetation type are typically classified separately as one of the other tree or bush dominated cover classes.

Cultivated land / agricultural fields (rain-fed) are described as:

Cultivated lands used primarily for the production of rain-fed, annual crops for commercial markets. It is typically represented by large field units, often in dense local or regional clusters. In most cases the defined cultivated extent represents the actual cultivated or potential extent.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment and especially the area in close proximity to the proposed WF is deemed low by virtue of the nature of the vegetation and the low occurrence of urban development.

The significant height of wind turbine structures adds to the potential visual intrusion of the WF against the background of the horizon. In addition, the scale and form of the 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 visual absorption. As this is not a consistent occurrence, however, VAC will not be taken into account for any of the homesteads or settlements, therefore assuming a worst case scenario in the impact assessment.

Within the built-up areas of Vredenburg, Laingville, Paternoster, St Helena Bay, Stompneus Bay and Britannia Bay VAC will be of relevance, due to the presence of buildings and structures, referred to as visual clutter. In this respect, the presence of the built-up environment will 'absorb' the visual impact.

Figure 14: Photograph indicating the low VAC of the study area.

6.6. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed Boulders Wind Farm project are displayed on **Map 17**. 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.

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

General

The index indicates that potentially sensitive visual receptors within a 1km radius of the WF may experience an **extremely high** visual impact. The magnitude of visual impact on sensitive visual receptors subsequently subsides with distance to; **very high** within a 1 – 2.5km radius, **high** within a 2.5 – 5km radius and **moderate** between a 5 – 10km radius. Receptors beyond 10km are expected to have a **low** potential visual impact. Potentially affected visual receptors are shown on **Map 18**.

The WF may have an **extremely high** visual impact on the following observers:

Residents of:

- Rooiheuwel
- Boebezakskraal
- Katzenberg
- Skuitjies
- Blauwberg

Observers travelling along the:
- Vredenburg-Stompneus Bay road
- Paternoster-Stompneus Bay road

The WF may have a **very high** visual impact on the following observers:

Residents of/visitors to:
- Unknown/unnamed settlement north of Skuitjiesklip
- Skuitjiesklip
- Langklip
- Kasteelberg (cultural/historical site)
- Klipheuwel
- Fransvlei
- Droëdasvlei
- Klippiesvlei
- Korhaanvlei
- Rondekop

The WF may have a **high** visual impact on the following observers:

Residents of:
- Kaalberg/Britannica Heights
- Morkelsdam
- Swartrug
- Portion 37/23 (adjacent land owner)
- Portion 36/23 (adjacent land owner)
- Farm 1050 (Strandloper Investment Trust)
- Uitkomst
- Besterskraal
- Noodhulp
- Sandfontein
- Nieuwe Rust
- Waterklip
- Droëvlei

Observers travelling along the:
- Vredenburg-Paternoster (R399) arterial road

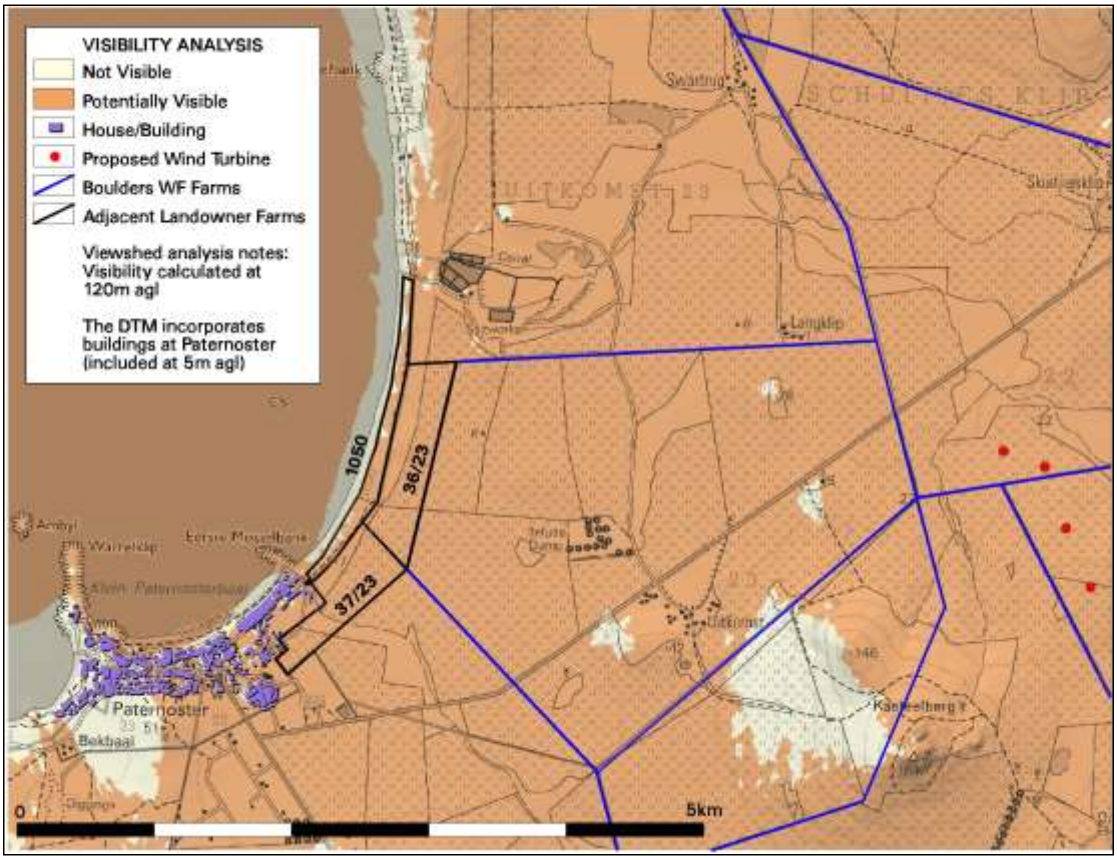
The WF may have a **moderate** (to potentially **high**) visual impact on the following observers:

Residents of/visitors to:
- Kalkoond
- Paternoster (incl. scenic viewpoints, Stand 1518 and all receptors located in and in close proximity to the town)
- Pelgrimsrust
- Die Krans

The areas of potential visual exposure of the wind turbine structures to observers at the Paternoster beach are indicated below (**Map 16**).

Note:
The location of Boebezakskraal, Uitkomst, Skuitjiesklip, Morkelsdam, Skuitjies, Klippiesvlei, Fransvlei and Klipheuwel on properties earmarked for the Boulders Wind Farm or located on the existing West Coast 1 WEF property reduces the probability of this impact occurring.

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



Map 16: Potential visual exposure of the Boulders Wind Farm wind turbines to Paternoster and surrounds.

The map above provides a closer view of the visual exposure of the proposed Boulders WF wind turbines on Paternoster, the Paternoster beach and adjacent landowners. The four most north-westerly wind turbine positions are indicated on the map, and account for the wind turbines in closest proximity to Paternoster.

The areas indicated as 'potentially visible' mark sections of the beach and surrounds where observers may be able to view the Boulders Wind Farm turbines. A large part of the beach to the west, between Warrelklip and Eerste Mosselbank, will be exposed to the wind turbines. A section south-west of Eerste Mosselbank will not be exposed and the beach further northwards will be shielded from the turbines by the coastal dune east of the beach.

The adjacent landowners (indicated as Farms 1050, 37/23 and 36/23) will also be exposed to the wind turbine structures. These properties are undeveloped at present, but objections have been lodged against the Boulders WF, due to the wind farm's proximity to the farms and its perceived visual impact on the future development potential of these properties.

The potential visual exposure will be at distances ranging between 4km (Farm 26/23) to 6.6km (western viewpoint in Paternoster) to the closest turbine. The presence of built structures within Paternoster and the relatively long distance between the observer and the wind turbines is expected to mitigate the potential visual impact within the town to some degree.

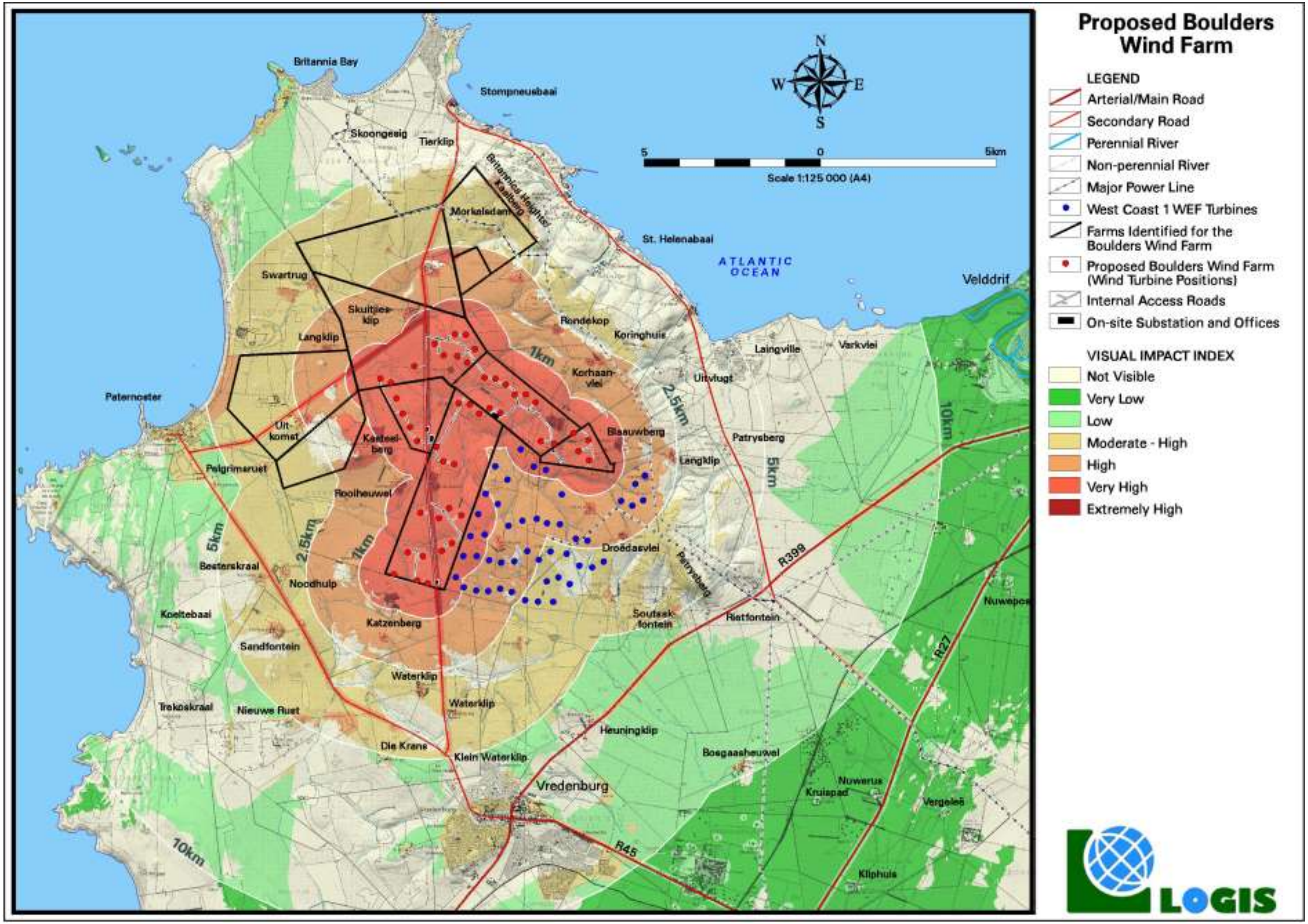
Refer to **Figures 21** and **23** for simulated views of the proposed Boulders Wind Farm and existing West Coast 1 WEF wind turbines from the western elevated viewpoint (overlooking the bay, beach and Paternoster) and the eastern exposed section (the rocky outcrops on the beach). The wind turbines are likely to be visible and easily recognisable, albeit at distances exceeding 6km (Viewpoint 3) and 5km (Viewpoint 4) respectively. Refer to **Map 19** for the photograph positions.

Conclusion

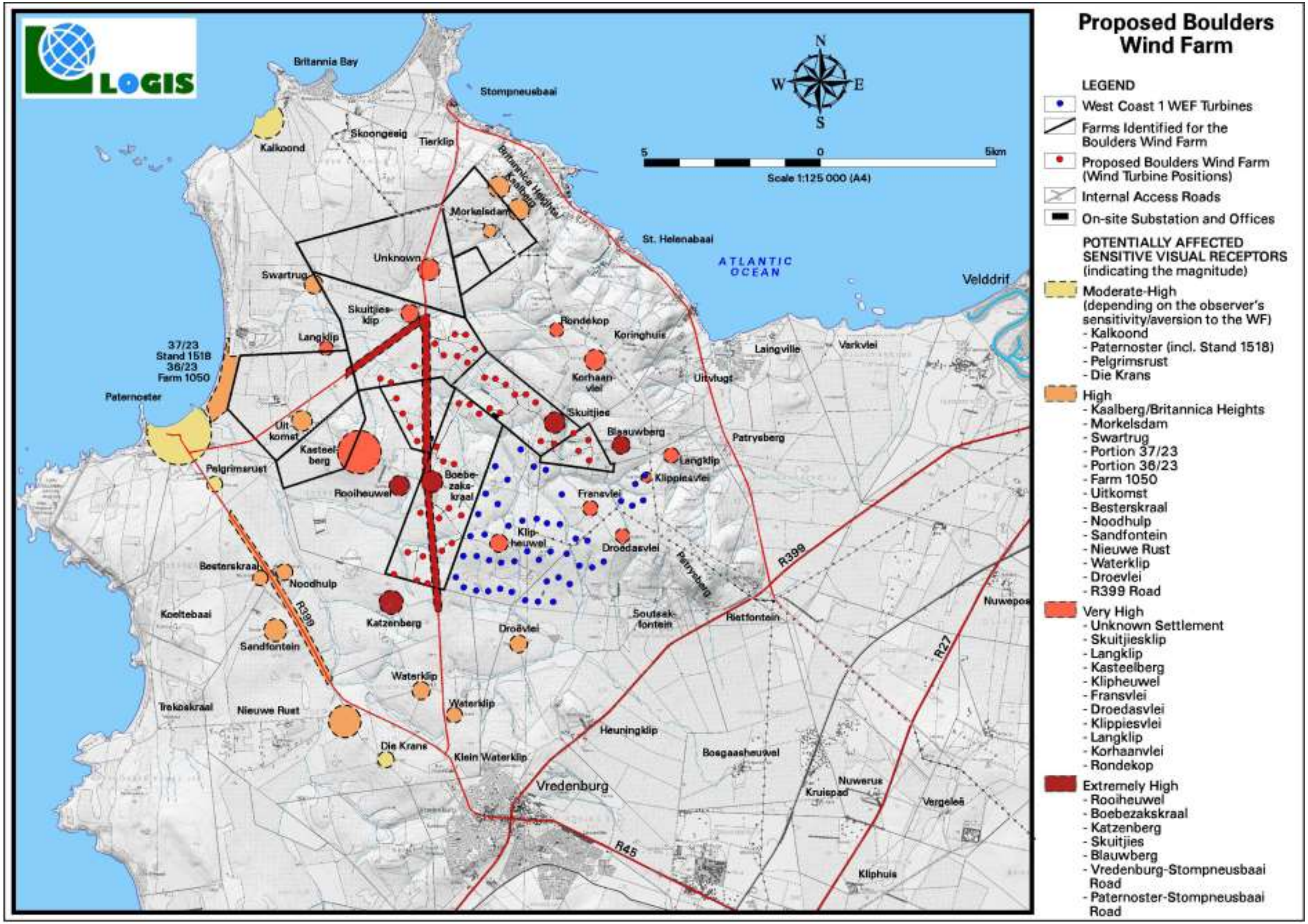
Observers that are indifferent to the wind farm development may not be overtly visually distressed thereby, due to the generally long distance between the observer and the wind turbines.

It is however expected that sensitised visual receptors and sensitised residents/landowners may experience visual impacts ranging between **moderate** to **high** significance and even **very high** significance, depending on their aversion or sensitivity to the WF.

Also refer to **Section 6.2. Cumulative visual assessment** (Receptors 3 and 4) for more information related to these visual receptors.



Map 17: Visual impact index.



Map 18: Potentially affected sensitive visual receptors.

6.7. Visual impact assessment: impact rating methodology

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 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 alignment) 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)[3].
- **Duration** - very short (0-1 yrs. = 1), short (2-5 yrs. = 2), medium (5-15 yrs. = 3), long (>15 yrs. = 4), and permanent (= 5).
- **Magnitude** - None (= 0), minor (= 2), low (= 4), medium/moderate (= 6), high (= 8) and very high (= 10)[4].
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5).
- **Status** (positive, negative or neutral).
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5).
- **Significance** - low, medium or high.

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

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

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 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)

[3] Local = within 5km of the development site. Regional = between 5-10km from the development site.

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

6.8. Visual impact assessment

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

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

The construction of the Boulders Wind Farm 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:

- Rooiheuwel
- Boebezakskraal
- Katzenberg
- Skuitjies
- Blauwberg
- Unknown/unnamed settlement north of Skuitjiesklip
- Skuitjiesklip
- Langklip
- Klipheuwel
- Fransvlei
- Droëdasvlei
- Klippiesvlei
- Korhaanvlei
- Rondekop
- Kaalberg/Britannica Heights
- Morkelsdam
- Swartrug
- Portion 37/23 (adjacent land owner)
- Portion 36/23 (adjacent land owner)
- Farm 1050 (Strandloper Investment Trust)
- Uitkomst
- Besterskraal
- Noodhulp
- Sandfontein
- Nieuwe Rust
- Waterklip
- Droëvlei

Note:
The location of Boebezakskraal, Uitkomst, Skuitjiesklip, Morkelsdam, Skuitjies, Klippiesvlei, Fransvlei and Klipheuwel on properties earmarked for the Boulders Wind Farm or located on the existing West Coast 1 WEF property reduces the probability of this impact occurring at these receptor sites.

The following receptors are provisionally included, due to their status in marginal proximity (5-6km) to the wind turbine structures, and due to the observer's potential aversion/sensitivity to the wind farm development.

Residents of/visitors to:

- Kalkoond
- Paternoster (incl. scenic viewpoints, Stand 1518 and all receptors located in and in close proximity to the town)
- Pelgrimsrust
- Die Krans

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: Planning: ➢ Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude. 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. Failing this, the visual impact will remain.		

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

The construction of the Boulders Wind Farm 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:

- Vredenburg-Stompneus Bay road
- Paternoster-Stompneus Bay road
- Vredenburg-Paternoster (R399) arterial road

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.

<table>
<tr><td colspan="3">Nature of Impact:
Visual impact on observers travelling along the roads in close proximity (i.e. within 5km) to the wind turbine structures</td></tr>
<tr><td></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Extent</td><td>Local (2)</td><td>Local (2)</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Long term (4)</td></tr>
<tr><td>Magnitude</td><td>Very high (10)</td><td>Very high (10)</td></tr>
<tr><td>Probability</td><td>Highly probable (4)</td><td>Highly probable (4)</td></tr>
<tr><td>Significance</td><td>High (64)</td><td>High (64)</td></tr>
<tr><td>Status (positive, neutral or negative)</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Reversibility</td><td>Reversible (1)</td><td>Reversible (1)</td></tr>
<tr><td>Irreplaceable loss of resources?</td><td>No</td><td>No</td></tr>
<tr><td>Can impacts be mitigated?</td><td colspan="2">No, only best practice management measures can be implemented.</td></tr>
<tr><td colspan="3">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.
<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.</td></tr>
<tr><td colspan="3">Residual impacts:
The visual impact will be removed after decommissioning, provided the WEF infrastructure is removed. Failing this, the visual impact will remain.</td></tr>
</table>

6.8.3. Potential visual impact on Kasteelberg hill, including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road

The construction of the Boulders Wind Farm could have a **high** visual impact (significance rating = 64) on the Kasteelberg hill, the cultural landscape and the perceived sense of place related to this cultural/historical feature. The impact is expected to occur along the Vredenburg to Stompneus Bay road where the observer's view of this hill and the Atlantic seaboard at Paternoster will be interrupted by wind turbines constructed west of this road.

Mitigation of this impact is possible and entails the relocation of the wind turbines (13 in total) to the east of the road (or outright removal of the wind turbines in the event that they cannot be accommodated to the east of the road). The post mitigation visual impact is expected to be of **low** significance.

Discussion

This proposed mitigation measure is derived from the HIA report for this project. It is endorsed by the VIA practitioner, but only as an effective mitigation of the visual impact on views from the road in question to the Kasteelberg hill and Atlantic seaboard at Paternoster (i.e. westerly vistas). The removal of the wind turbine positions to the west of this road is not expected to significantly alter the overall visual impact of the proposed Boulders WF. Ultimately the HIA report should be consulted in order to inform decision-making regarding the potential impact on this cultural-historical feature.

It must further be noted that there is existing visual degradation on or in close proximity to the Kasteelberg hill in the form of two telecommunication masts, overhead power lines, telephone cables and an off-road (informal) race track. The visual impact of these structures/activities on the Kasteelberg hill was not assessed as part of this VIA.

The Kasteelberg cultural/historical site is not a Protected Heritage Site (PHS) and the cultural scenic value and archaeological sensitivity/value of this site is largely informed by the HIA report (and the SIA report to some degree).

The site is located on private land and is not accessible to the public. It is primarily used for academic research purposes. This influences the viewer incidence at the receptor site (i.e. views of the wind turbines from Kasteelberg), but not the viewer incidence along the Vredenburg-Stompneus Bay (public) road.

This road is not classified as a *scenic tourist route*, but that does not detract from the fact that residents and tourists may frequent this road *en route* to their residences or tourist destinations located further north.

Table 5: Potential visual impact on Kasteelberg hill, including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road.

Nature of Impact: Visual impact of wind turbines (west of the Vredenburg-Stompneus Bay road) obstructing views of the Kasteelberg hill and Atlantic seaboard at Paternoster (from this road).		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(10)**	Low **(4)**

Probability	Highly probable **(4)**	Improbable **(2)**
Significance	High **(64)**	Low **(20)**
Status (positive, neutral or negative)	Negative	Neutral
Reversibility	Reversible (1)	Reversible **(1)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation / Management: Planning: ➢ All wind turbine positions west of this road (13 in total) must be relocated to the east (or removed).		
Residual impacts: No residual impacts are envisaged if mitigation is undertaken.		

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

The construction of the Boulders Wind Farm could have a **moderate-high** visual impact (significance rating = 60) on observers travelling along the roads and residents of homesteads within a 5 - 10km radius of the wind turbine structures.

The significance rating of the visual impact is dependent on the observer's potential indifference (**moderate**) or aversion/sensitivity (**high**) to the proposed wind farm development.

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.

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	Moderate-High **(8)**	Moderate-High **(8)**
Probability	Highly probable **(4)**	Highly probable **(4)**
Significance	Moderate-High **(60)**	Moderate-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. 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 WF infrastructure is removed. Failing this, the visual impact will remain.

6.8.5. Construction impacts

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

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 land owners in the area.

Construction activities may potentially result in a **moderate** (significance rating = 40), temporary visual impact, that may be mitigated to **low** (significance rating = 24).

Table 7: Visual impact of construction on sensitive visual receptors in close proximity to the proposed WF.

Nature of Impact: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed WF.		
	Without mitigation	***With mitigation***
Extent	Local **(2)**	Local **(2)**
Duration	Short term **(2)**	Short term **(2)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	Highly Probable **(4)**	Probable **(3)**
Significance	Moderate **(40)**	Low **(24)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation: <u>Planning:</u> ➢ Retain and maintain natural vegetation in all areas outside of the development footprint. <u>Construction:</u> ➢ Ensure that vegetation is not unnecessarily removed during the construction period. ➢ Plan the placement of lay-down 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.
Cumulative impacts: None.
Residual impacts: None, provided that rehabilitation works are carried out as specified.

6.8.6. 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, a 660m 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 major roads or places of residence within the 660m buffer. The significance of shadow flicker is therefore anticipated to be **low** to **negligible**.

Table 8: Visual impact of shadow flicker on sensitive visual receptors in close proximity to the proposed WF.

Nature of Impact: Visual impact of shadow flicker on sensitive visual receptors in close proximity to the proposed WF.		
	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.	

6.8.7. 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 is low other than to restrict the number of lights to turbines that delineate the outer perimeter of the facility.

Some promising new research in strobing lights that only activate when an aircraft is detected nearby may aid in restricting light pollution at night and should be investigated by the project proponent.

Figure 15: 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.)

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, contribute to the increase in sky glow.

This anticipated lighting impact is likely to be of **moderate-high** significance (rating = 60), and may be mitigated to **moderate** (rating = 42) especially within a 5 to 6km radius of the wind turbine structures.

The significance rating of the visual impact is dependent on the observer's potential indifference (**moderate**) or aversion/sensitivity (**high**) to the proposed wind farm development.

Table 9: Impact table summarising the significance of visual impact of lighting at night on visual receptors in close to medium proximity to the proposed WF.

Nature of Impact: Visual impact of lighting at night on sensitive visual receptors.		
	No mitigation	***Mitigation considered***
Extent	Local/Regional **(3)**	Local/Regional **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate-High **(8)**	High **(8)**
Probability	Highly probable **(4)**	Probable **(3)**
Significance	Moderate-High **(60)**	Moderate **(42)**
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:
- Limit aircraft warning lights to the turbines on the perimeter according to CAA requirements, thereby reducing the overall impact.
- Investigate aircraft warning lights that only activate when the presence of an aircraft is detected.
- Shield the sources of light by physical barriers (walls, vegetation, or the structure itself).
- Limit mounting heights of lighting fixtures, or alternatively use foot-lights or bollard level lights.
- Make use of minimum lumen or wattage in fixtures.
- Make use of down-lighters, or shielded fixtures.
- Make use of Low Pressure Sodium lighting or other types of low impact lighting.
- Make use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Cumulative impacts:
The construction of an additional WF may potentially increase the visual impacts associated with light pollution within an otherwise rural setting.

Residual impacts:
The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.

6.8.8. Ancillary infrastructure

On-site ancillary infrastructure associated with the WF includes a 33/132kV substation, underground 33kV cabling between the wind turbines, internal access roads, a workshop and office. No dedicated viewshed analyses have been generated for the ancillary infrastructure, as the range of visual exposure will fall within 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 10: Visual impact of the ancillary infrastructure.

<table>
<tr><td colspan="3">Nature of Impact:
Visual impact of the ancillary infrastructure on observers in close proximity to the structures.</td></tr>
<tr><td></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Extent</td><td>Local (2)</td><td>Local (2)</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Long term (4)</td></tr>
<tr><td>Magnitude</td><td>Low (4)</td><td>Low (4)</td></tr>
<tr><td>Probability</td><td>Improbable (2)</td><td>Improbable (2)</td></tr>
<tr><td>Significance</td><td>Low (20)</td><td>Low (20)</td></tr>
<tr><td>Status (positive, neutral or negative)</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Reversibility</td><td>Reversible (1)</td><td>Reversible (1)</td></tr>
<tr><td>Irreplaceable loss of resources?</td><td>No</td><td>No</td></tr>
<tr><td>Can impacts be mitigated?</td><td colspan="2">No, only best practise measures can be implemented</td></tr>
<tr><td colspan="3">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.
<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.</td></tr>
<tr><td colspan="3">Residual impacts:
The visual impact will be removed after decommissioning, provided the ancillary infrastructure is removed. Failing this, the visual impact will remain.</td></tr>
</table>

6.9. Visual impact assessment: secondary impacts

6.9.1. 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, notwithstanding the presence of the existing West Coast 1 WEF. The coastal areas have an even greater visual attraction due to their ocean views and West Coast character. The immediate threat of visual impacts on the character (or sense of place) of these coastal areas is largely mitigated by the implementation of the 4km Coastal Protection Buffer and the protection of the Britannica Heights to Paternoster Scenic Landscape (refer **Section 2**).

In addition to this, the existing WEF appears to not have affected the popularity of the Paternoster peninsula and coastal holiday towns detrimentally, implying that the sense of place (especially along the coastline) has not changed dramatically, even with the development of the West Coast 1 WEF.

The significance of the visual impacts on the sense of place within the **region** (i.e. beyond a 5-6km radius of the development and within the greater Vredenburg area) is expected to be of **moderate** 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 11: 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	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. 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 WF infrastructure is removed. Failing this, the visual impact will remain.		

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

In spite of the physical similarities between the visual exposure and the close proximity of the two wind farms, the consolidation into one large wind farm is only applicable in theory in this instance.

In visual terms, and more specifically in terms of the cumulative visual impact on the landscape, the Paternoster *plateau* is an area where the receptor sensitivity is a limiting factor to any further wind energy developments.

The cumulative visual impact of the West Coast 1 WEF and the Boulders WF is expected to be of **high** significance due to:

- The increased frequency of visual exposure of wind turbine structures;
- The physical scale and extent of the cumulative visual exposure of the two WEFs; and
- The fact that the Paternoster *plateau* may have reached its capacity to accommodate wind energy infrastructure, based on the concept of 'receptor sensitivity'.

Mitigation of this impact is possible, and entails the selective removal or relocation of specifically identified wind turbine positions in relation to specified sensitive visual receptors. The identified wind turbines are indicated and described in **Section 6.2. Cumulative visual assessment.**

Table 12: The potential cumulative visual impact of the wind farms on the visual quality of the landscape.

Nature of Impact: The potential cumulative visual impact of the wind farms on the visual quality of the landscape.		
	Overall impacts 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)**	High **(8)**
Probability	Highly probable **(4)**	Definite **(5)**
Significance	Moderate-High **(60)**	High **(75)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation measures: Planning: ➢ The removal or relocation of specified wind turbine positions.		
Residual impacts: The visual impact will be removed after decommissioning, provided the WF infrastructure is removed. Failing this, the visual impact will remain.		

6.10. The potential to mitigate visual impacts

General mitigation

The primary visual impact, namely the appearance of the WF (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, both during construction and operation of the proposed WF. This will minimise visual impact as a result of cleared areas, power line servitudes 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.

- 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.

- Investigate aircraft warning lights that only activate when the presence of an aircraft is detected.

- 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 WF 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 lay-down 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 will 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 should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications.

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

- Secondary impacts anticipated as a result of the proposed WF (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 are likely to affected, it is recommended that the developer enter into negotiations with the receptor regarding the viability (and receptor’s willingness) of screening of visual impacts at the receptor site. This may entail the planting of vegetation, trees or the construction of screens. Ultimately, visual screening is most effective when placed at the receptor itself.

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

Project-specific mitigation

Section 6.2. (Cumulative visual assessment) and **Section 6.8.3.** (Potential visual impact on Kasteelberg hill, including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road) make specific recommendations related to specified wind turbine positions that need to be removed or relocated. If these recommendations are achievable the specified visual impacts related to these two issues will be effectively mitigated. The relevance of this statement (regarding the Kasteelberg hill and cultural landscape) should ultimately be tested against the recommendations expressed in the final HIA report.

Additional mitigation includes the potential reduction in the overall wind turbine size in order to match the West Coast 1 wind turbine dimensions. This mitigation measure is expected to reduce the overall cumulative visual impact.

7. PHOTO SIMULATIONS

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed Boulders Wind Farm within the receiving environment. The purpose of the photo simulation exercise is to support/verify the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions (i.e. it is not an artist’s impression).

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout.

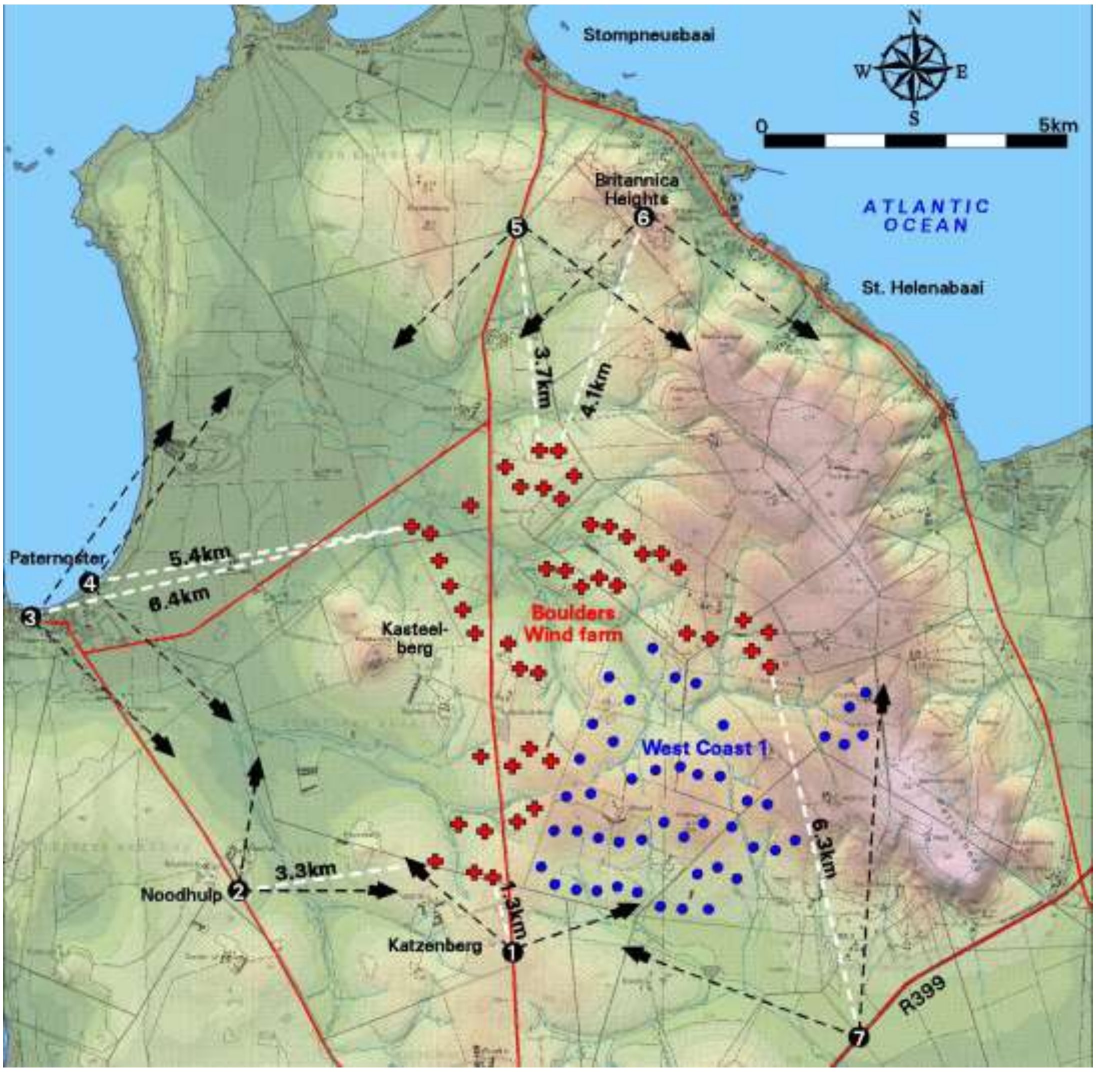
The photograph positions are indicated on **Map 19** below and should be referenced with the photo simulation being viewed in order to place the observer in spatial context.

The simulated views show the placement of the wind turbines during the long-term operation phase of the facility's lifespan. It is assumed that the necessary post-construction phase rehabilitation and mitigation measures, as proposed by the various specialists in the environmental impact assessment report, have been undertaken.

It is imperative that the natural vegetation be restored to its original (current) status for these simulated views to ultimately be realistic. The additional infrastructure (e.g. the proposed power lines, substation, access roads, etc.) associated with the facility is not included in the photo simulations.

The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

The photo simulations are displayed as "before" and "after" views of the affected landscape.



Map 19: Photograph positions.

7.1. Viewpoint 1: before

Figure 16: Photo simulation 1 (before construction).

7.2. Viewpoint 1: after

Figure 17: Photo simulation 1 (after construction). *The closest Boulders Wind Farm turbine is 1.3km from this point*.

7.3. Viewpoint 2: before

Figure 18: Photo simulation 2 (before construction).

7.4. Viewpoint 2: after

Figure 19: Photo simulation 2 (after construction). *The closest Boulders Wind Farm turbine is 3.3km from this point*.

7.5. Viewpoint 3: before

Figure 20: Photo simulation 3 (before construction).

7.6. Viewpoint 3: after

Figure 21: Photo simulation 3 (after construction). *The closest Boulders Wind Farm turbine is 6.4km from this point*.

7.7. Viewpoint 4: before

Figure 22: Photo simulation 4 (before construction).

7.8. Viewpoint 4: after

Figure 23: Photo simulation 4 (after construction). *The closest Boulders Wind Farm turbine is 5.4km from this point*.

7.9. Viewpoint 5: before

Figure 24: Photo simulation 5 (before construction).

7.10. Viewpoint 5: after

Figure 25: Photo simulation 5 (after construction). *The closest Boulders Wind Farm turbine is 3.7km from this point*.

7.11. Viewpoint 6: before

Figure 26: Photo simulation 6 (before construction).

7.12. Viewpoint 6: after

Figure 27: Photo simulation 6 (after construction). *The closest Boulders Wind Farm turbine is 4.1km from this point.*

7.13. Viewpoint 7: before

Figure 28: Photo simulation 7 (before construction).

7.14. Viewpoint 7: after

Figure 29: Photo simulation 7 (after construction). *The closest Boulders Wind Farm turbine is 6.3km from this point (behind the West Coast 1 WEF turbines).*

8. RELOCATION OF SELECTED WIND TURBINE POSITIONS AS PROPOSED MITIGATION

Section 6.10. (The potential to mitigate visual impacts) of this report refers to *project–specific mitigation* measures aimed at mitigating the visual impacts related to:

- The cumulative visual impact (**Section 6.2**.)
- The potential visual impact on the Kasteelberg hill (**Section 6.8.3.**)

The potential cumulative visual impact is discussed in context of specific receptors within the region, expected to be visually influenced by the construction of the Boulders WF. Where relevant, recommendations are made regarding the mitigation of the cumulative visual impact, primarily by removing or relocating certain wind turbine positions.

A similar approach was followed in addressing the mitigation of the *potential visual impact on Kasteelberg hill (including the cultural landscape and sense of place to the west of the Vredenburg-Stompneus Bay road),* albeit as a recommendation put forward by the HIA (but endorsed by the VIA).

Please refer to the relevant sections for additional background information and more details.

The project proponent has, in response to these proposed mitigation measures submitted an additional revised wind turbine layout, partially adhering to the recommendations as discussed in the above sections of the report. This chapter will investigate the proposed revised layout, and attempt to determine the level of effectiveness of the revisions in mitigating the potential visual impacts.

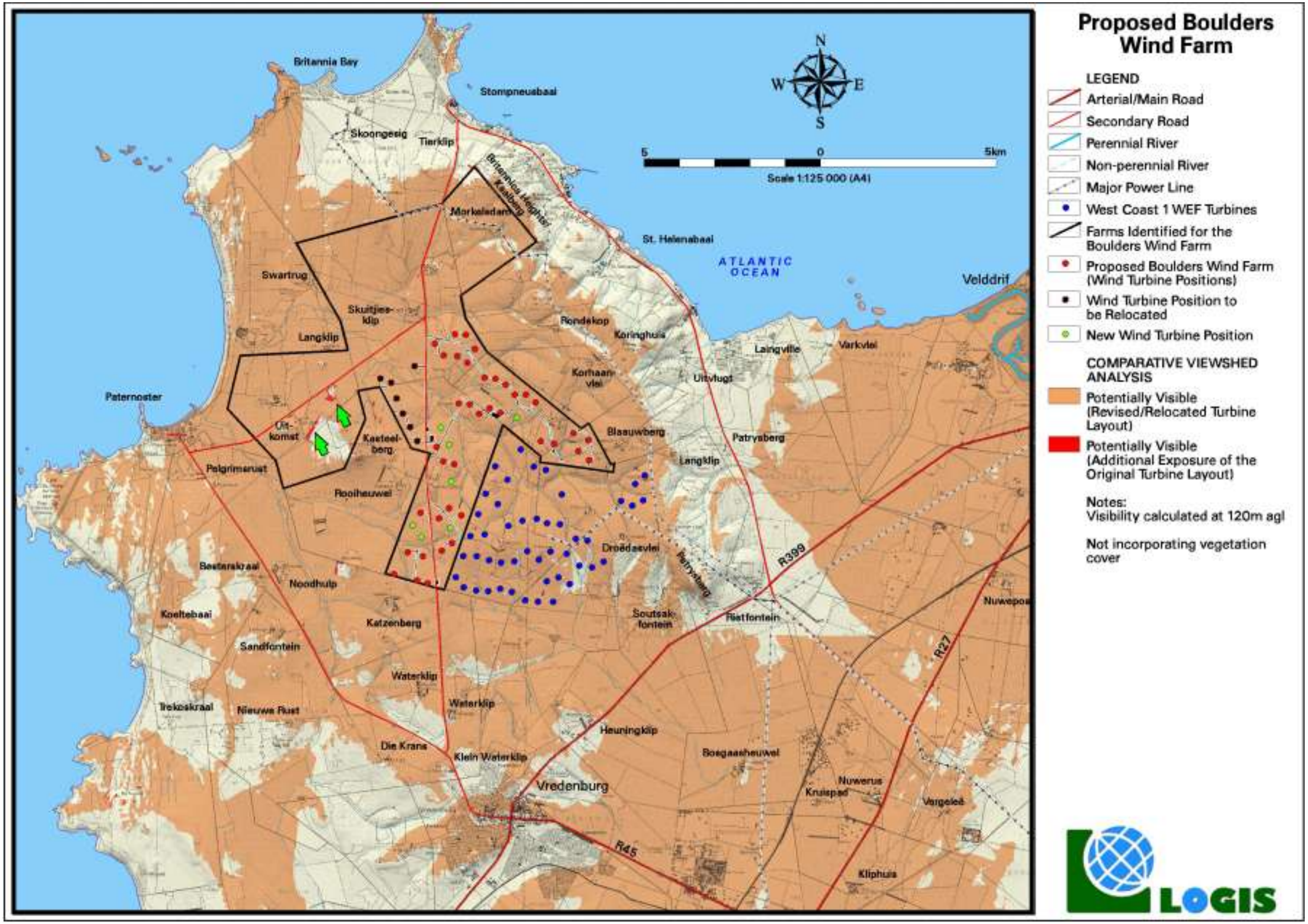
The methodology for the investigation into the effectiveness of the revised layout in mitigating the potential visual impacts includes:

- A comparative viewshed analysis of the original and revised layouts in order to determine the overall change in visual exposure.
- Photo simulations indicating the expected change in frequency and distance of visual exposure.

Comparative viewshed analysis

A viewshed analysis of the two wind turbine layouts are displayed on **Map 20**. The principles and specifications of determining the visual exposure are discussed in greater detail in **Section 6.1.** (Potential visual exposure).

Result
It is clear that the overall visual exposure of the Boulders WF will remain virtually the same for both of the wind turbine layouts. There will be a negligible reduction in the area of visual exposure (red areas indicated with green arrows) within the study area, should the seven most northerly wind turbines west of the Stompneus Bay road be removed. This is due to the generous dimensions (120m hub-height and 165m blade tip height) of the wind turbine structures within the generally flat topography of the region.



Map 20: Comparative viewshed analysis.

Photo simulations

The photo-simulations below focus on the northern section of the Boulders WF where the seven wind turbine positions are to be removed and relocated to the east of the Stompneus Bay road (five turbines) and to the south (two turbines).

The photograph positions are indicated on **Map 19**.

Figure 30: Receptor 4 - wind turbine relocation (top: original layout, bottom: relocated layout).

Approximately 19 wind turbines may be partially visible north (left) of the Kasteelberg hill in the original layout (top photo simulation). This number may be reduced to approximately 14 wind turbines partially visible after the relocation of the seven wind turbine positions (bottom photo-simulation). Two of the relocated wind turbine positions were located behind this hill and do not affect the outcome of the reduction in visible turbines.

This translates to a 26% decrease in the number of visible wind turbines north of the hill.

The closest wind turbine in the original layout was 5.4km from this vantage point. This distance is increased to 7km after the relocation, 1.6km further away. This is an approximate 23% increase in distance to the closest wind turbine located north of the Kasteelberg hill.

Figure 31: Receptor 3 - wind turbine relocation (top: original layout, bottom: relocated layout).

Approximately 22 wind turbines may be partially visible north (left) of the Kasteelberg hill in the original layout (top photo simulation). This number may be reduced to approximately 17 wind turbines partially visible after the relocation of the seven wind turbine positions (bottom photo-simulation). Two of the relocated wind turbine positions were located behind this hill and do not affect the outcome of the reduction in visible turbines.

This translates to a 23% decrease in the number of visible wind turbines north of the hill.

The closest wind turbine in the original layout was 6.4km from this vantage point. This distance is increased to 8km after the relocation, 1.6km further away. This is an approximate 20% increase in distance to the closest wind turbine located north of the Kasteelberg hill.

Figure 32: Receptor 6 - wind turbine relocation (top: original layout, bottom: relocated layout).

The closest wind turbine position from this receptor is 4.1km away (located east of the Stompneus Bay road) and will not change with the relocation of the seven wind turbine positions west of this road (i.e. there will be no benefit in terms of increased distance from the wind turbines).

The number of wind turbines located in between this vantage point and the Kasteelberg hill will however be reduced from five to one, leaving this view of the hill less obscured by wind turbine structures.

Conclusion

The relocation of the seven wind turbine positions north-west of the Stompneus Bay road is likely to reduce the potential cumulative visual impact to some extent. The frequency (number of turbines) of visibility to observers at sensitive visual receptor sites, as tested, will be slightly lower and in at least two cases the visibility will be from longer distances.

The relocation of the turbine positions is not expected to influence the overall visual impact of the Boulders WF, due to the fact that the viewshed pattern will largely remain the same, with wind turbines still visible from all of the receptor sites.

However, the following benefits are expected (even if it may be marginal):

- The overall development footprint of the Boulders WF will be more contained after the relocation of the wind turbine positions.
- In some cases the observer proximity to the turbine structures will be greater (i.e. observations will be from longer distances).
- The frequency of visual exposure of wind turbines will be less from the Paternoster receptor sites.

The visual impact on the Kasteelberg hill (cultural-historical site) and views from the Stompneus Bay road to the Atlantic seaboard west of this road will be mitigated at this northern position where the turbine locations are removed. The visual impact will however still manifest itself at the southern section, where it will most likely be aggravated by the addition of two turbines (west of the road) relocated from the north-western section. The acceptability or effectiveness of the relocation of the seven turbines in mitigating the visual impact on the Kasteelberg hill and cultural landscape should ultimately be determined by the HIA that first raised this as a concern.

Considered in its entirety, the relocation of the seven north-westerly wind turbine positions is a step in the right direction due to it partially meeting the mitigation requirements as stipulated in this report. It is therefore more desirable than the original wind turbine layout, in spite of the fact that it falls short of meeting all of the visual impact mitigation requirements.

9. CONCLUSION AND RECOMMENDATIONS

The visual impact assessment 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, photo simulations and the identification of sensitive receptors, the potential visual impacts associated with the Boulders WF. These processes are deemed to be transparent and scientifically defensible when interrogated.

But, visual impact is ultimately a subjective concept. The *subjects* in this case are the residents and visitors of the Paternoster *plateau*, and all Interested and Affected Parties (I&APs) who registered comments, complaints and concerns through the Public Participation Process (PPP) of this EIA process. They, together with the spatial analyses, inform the VIA practitioner as to the severity and ultimately the significance of the potential visual impact.

It is the author's opinion that the construction of the West Coast 1 WEF has sensitised and alerted I&APs to the point where another wind farm on the Paternoster *plateau* may be deemed visually undesirable by some respondents. There are likely to be supporters of the Boulders WF (as renewable energy generation is a global priority) amongst the population of the larger region, but they may at best be indifferent to the construction of another WEF and not as vocal in their support for the wind farm as the detractors thereof.

The construction and operation of the proposed Boulders Wind Farm and its associated infrastructure, will have a high visual impact on the study area, especially within (but not restricted to) a 5-6km 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 the Paternoster *plateau* (i.e. not spill over to St. Helena Bay, Stompneus Bay, Britannia Bay, etc.).

The combined visual impact or cumulative impact of two wind energy facilities (i.e. the existing West Coast 1 WEF and the Boulders Wind Farm) 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 5-6km radius, is expected to be greater than it would be for a single WEF. Wind turbines from the Boulders WF will be visible to receptors that are not currently exposed to these structures, or exposure will be more intrusive (i.e. from shorter distances than the West Coast 1 WEF wind turbines; or greater structure/s visible). Refer to **Section 6.2.** (Cumulative visual assessment).

The result of the assessment of the cumulative visual impact of the proposed Boulders WF and the West Coast 1 WEF is that the construction of all the proposed wind turbines in their proposed locations may pose a high risk to the visual quality and landscape of the Paternoster *plateau*.

If no mitigation is undertaken (i.e. if the identified wind turbines cannot be relocated or removed) the cumulative visual impact may threaten the Paternoster *plateau* as a scenic resource. The application of the revised layout, where the seven wind turbines north-west of the Stompneus Bay road is relocated, is expected to partially reduce the potential cumulative visual impact. This (revised wind turbine layout) should be set as a minimum requirement when considering the application for the construction of the Boulders WF.

The ideal mitigation scenario would however include the removal or relocation of all the wind turbines west of the Vredenburg to Stompneus Bay road and an investigation into the potential overall reduction in the wind turbine size, in order to match the dimensions of the West Coast 1 wind turbines.

Overall, the significance of the visual impacts is expected to range from high as a result of the generally undeveloped character of the landscape, to low. The facility would be visible within an area that contains certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements 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 6.10**). Mitigation will be effective in terms of lighting, construction, the potential mitigation of the visual impacts on the Kasteelberg hill, cultural/historical landscape and views of the Atlantic seaboard at Paternoster from the Vredenburg-Stompneus Bay road, and the cumulative visual impact. This latter mitigation would entail the relocation or removal of identified wind turbines from the proposed layout.

It is recommended that the project proponent investigate the viability of relocating these wind turbines in light of the conclusions of the VIA, as well as the potential to reduce the overall wind turbine size in order to match the West Coast 1 wind turbine dimensions. Failing this the Boulders Wind Farm may not offer an ideal operating scenario from a visual impact perspective. See Impact Statement below.

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.

10. IMPACT STATEMENT

The findings of the Visual Impact Assessment undertaken for the Proposed Boulders Wind Farm is that the visual environment surrounding the site, especially within a 5-6km radius, will be visually impacted upon for the anticipated operational lifespan of the facility (i.e. 20 - 25 years).

This impact is applicable to the individual Boulders Wind Farm and to the cumulative visual impact of the facility in relation to the existing West Coast 1 WEF, where the combined frequency of visual impact may be greater.

The following is a summary of impacts remaining:

- The construction of the Boulders Wind Farm is expected to have a **high** visual impact on observers/visitors residing at homesteads within a 5-6km radius of the wind turbine structures. No mitigation of this impact is possible.

- The construction of the Boulders Wind Farm is expected to have a **high** visual impact on observers traveling along the roads within a 5-6km radius of the wind turbine structures. No mitigation of this impact is possible.

- The construction of the Boulders Wind Farm could have a **high** visual impact on the Kasteelberg hill, the cultural landscape and sense of place related to this cultural/historical feature, and views of the Atlantic seaboard at Paternoster from the Vredenburg-Stompneus Bay road. Mitigation of this impact is possible and entails the relocation of the wind turbines west of this road to the east of the road. The post mitigation visual impact is expected to be of **low** significance. The recommendations expressed in the final HIA report should be consulted in order to inform decision-making regarding the potential impact on this cultural-historical feature.

- The construction of the Boulders Wind Farm could have a **moderate-high** visual impact on observers traveling along the roads and residents of homesteads within the region (5 - 10km radius of the wind turbine structures). The significance rating of the visual impact is dependent on the observer's potential indifference (**moderate**) or aversion/sensitivity (**high**) to the proposed wind farm development. No mitigation of this impact is possible.

- Construction activities may potentially result in a **moderate** temporary visual impact that may be mitigated to **low**.

- The significance of shadow flicker is anticipated to be **low** to **negligible**.

- The anticipated lighting impact is likely to be of **moderate-high** significance and may be mitigated to **moderate**. The significance rating of the visual impact is dependent on the observer's potential indifference (**moderate**) or aversion/sensitivity (**high**) to the proposed wind farm development.

- 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 is expected to be of **moderate** significance, due to the relatively low viewer incidence within close proximity to the proposed wind farm. No mitigation of this impact is possible (i.e. the structures will be visible regardless).

- The cumulative visual impact of the West Coast 1 WEF and the Boulders WF is expected to be of **high** significance. Mitigation of this impact is possible, and entails the selective removal or relocation of specifically identified wind turbine positions in relation to specified sensitive visual receptors. Additional to this the potential reduction in size of the proposed turbine structures should be considered. The post mitigation cumulative visual impact is expected to be of **moderate-low** significance. The application of the revised layout, where the seven wind turbines north-west of the Stompneus Bay road is relocated, is preferred and is expected to partially reduce the potential cumulative visual impact.

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. The only exceptions are the potential mitigation of the visual impact on the Kasteelberg cultural/historical landscape and the potential cumulative visual impact.

It is clear from the above (when weighing the visual advantages and disadvantages) that it would be difficult to endorse the construction of the Boulders WF from a visual impact perspective. If no mitigation is undertaken the potential visual impacts and especially the potential cumulative visual impacts may exceed acceptable levels within the context of the receiving environment.

In spite of the above statement this does not imply that the Boulders WF project is fatally flawed. If the Paternoster plateau and/or Kasteelberg cultural/historical landscape had formal environmental or heritage protection status (e.g. if it was a Protected Heritage Site or National/Natural Heritage Site) it would have been considered a fatal flaw from a visual impact (and land use conflict) perspective. This does not, however, exonerate the project proponent and authorities from considering the potentially high levels of visual impact associated with the wind farm project (as proposed), when reviewing the desirability of the proposed development within the receiving environment.

11. 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 tables overleaf).

Table 13: Management programme – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Boulders Wind Farm.		
Project Component/s	The WF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop and power lines).	
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 5km 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.	Project proponent/ design consultant	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	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	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 WF and the ancillary infrastructure. The following is recommended: ○ Limit aircraft warning lights for the proposed WF to the turbines on the perimeter, thereby reducing the overall requirement (CAA regulations/conditions permitting). ○ Investigate aircraft warning lights that only activate when an aircraft is detected. ○ Shield the sources of light by physical barriers (walls, vegetation, or the structure itself); ○ Limit mounting heights of fixtures, or use foot-lights or bollard lights; ○ Make use of minimum lumen or wattage in fixtures; ○ Making use of down-lighters or shielded fixtures; ○ Make use of Low Pressure Sodium lighting or other low impact lighting. ○ Make use of motion detectors on security lighting, so allowing the site to remain in darkness until lighting is required for security or maintenance purposes.	Project proponent / design consultant	Early in the planning phase.
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 5km) and within the region.	

Monitoring	Not applicable.

Table 14: Management programme – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Boulders Wind Farm.		
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 / contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	Project proponent / contractor	Early in the construction phase.
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	Project proponent / contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Project proponent / 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 / 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 / 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 / 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 / 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 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 15: Management programme – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Boulders Wind Farm.		
Project Component/s	The WF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop and power lines).	
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 16: Management programme – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Boulders Wind Farm.		
Project Component/s	The WF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop and power lines).	
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, substation, power lines, 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.	

12. REFERENCES/DATA SOURCES

Aurecon Consulting, 2011. *The Proposed Saldanha WEF Scoping Report.*

CSIR, 2017. *Delineation of the first draft focus areas for Phase 2 of the Wind and Solar PV Strategic Environmental Assessment.*

CSIR, 2015. *The Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa.*

Chief Directorate National Geo-Spatial Information, varying dates. *1:50 000 Topo-cadastral Maps and Data.*

DEA, 2014. *National Land-cover Database 2013-14 (NLC2013-14).*

DEA&DP, 2011. Provincial Government of the Western Cape. *Guideline on Generic Terms of Reference for EAPS and Project Schedules.*

DEA&DP, 2016. *Western Cape Regional Environmental Assessment for Wind Energy Facility Developments.*

Department of Environmental Affairs and Tourism (DEA&T), 2001. *Environmental Potential Atlas (ENPAT) for the Western Cape Province.*

https://www.windpowerengineering.com/projects/site-assessment/assessing-cumulative-visual-impacts-for-wind-projects/

http://www.pinchercreekecho.com/2015/04/29/md-of-pincher-creek-takes-on-wind-turbine-lights

Landscape Institute, 2018. *Guidelines for Landscape and Visual Impact Assessment (3rd edition).*

LUC (Environmental Planning, Design and Management), 2014. *Cumulative Landscape and Visual Assessment of Wind Energy in Caithness.*

National Botanical Institute (NBI), 2004. *Vegetation Map of South Africa, Lesotho and Swaziland (Unpublished Beta Version 3.0)*

Oberholzer, B. (2005). *Guideline for involving visual and aesthetic specialists in EIA processes: Edition 1.*

Savannah Environmental, 2010. *The West Coast One WEF Visual Impact Assessment.*

Scottish Natural Heritage, 2012. *Assessing the cumulative impact of onshore wind energy developments*.

The Environmental Impact Assessment Amendment Regulations. In Government Gazette Nr 33306, 18 June 2010.