PROPOSED MAINSTREAM RENEWABLE ENERGY FACILITY

ON A SITE NEAR POFADDER IN THE NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT - INPUT FOR SCOPING REPORT

Produced for:

South Africa Mainstream Renewable Power Development (Pty) Ltd

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team 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. Although the guidelines have been developed with specific reference to the Western Cape Province of South Africa, the core elements are more widely applicable.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Mainstream Renewable Energy Facility. Neither the author nor MetroGIS will benefit from the outcome of the project decision-making.

1. INTRODUCTION

South Africa Mainstream Renewable Power Development (Pty) Ltd (Mainstream) is proposing the establishment of a wind and solar energy facility energy facility and associated infrastructure on a site located approximately 22km south west of the town of Pofadder within the Khai-Ma Local Municipality of the Northern Cape Province.

The site being considered for the proposed wind energy facility covers an area of approximately 175 km^2. The proposed project will include the following:

- Up to 500 wind turbines, each with a capacity of between 1,5 and 4MW.

  The final turbine capacity and model is dependent what is deemed suitable for the site in relation to, among other things, further studies of the wind regime, terrain, and potential environmental constraints.

- An array of either Photovoltaic (PV) panels or Concentrated Photovoltaic (CPV) panels with a generating capacity of up to 250MW.

A locality map indicating the proposed development site is shown on **Map 1**. Ancillary infrastructure is expected to include the following:

- Foundations to support the turbine towers as well as the PV panels;
- Cabling between the project components, to be lain underground where practical;
- A 400 kV substation and 4 (four) satellite 132 kV substations to facilitate grid connection via a loop-in loop-out connection to the existing Eskom Aggeneys–Aries 400kV power line which traverses the site;
- Internal access roads; and

- A workshop area for maintenance and storage.

A wind energy facility generates electricity by means of wind turbines that harness the wind of the area as a renewable source of energy.

The efficiency of a wind energy facility, or amount of power generated, is dependent on the number of wind turbines erected in the area as well as the careful placement of the turbines in relation to the topography and each other in order to optimise the use of the wind resource.

Each wind turbine is expected to consist of a concrete foundation, a steel tower, a hub or 'nacelle' (120m above ground level housing the generator / turbine) and three 60m long blades attached to the hub.

Variations of these dimensions may occur, depending on the preferred supplier or commercial availability of wind turbines at the time of construction. Refer to **Figure 1**.

Figure 1: Illustration of the main components of a wind turbine[1]

Photovoltaic (PV) technology uses the light energy of the sun to generate electricity though the photovoltaic effect. Individual PV cells are made up of a semiconductor material (such as silicone), which absorbs solar radiation and energises their electrons to produce energy.

The PV cells are linked together to form a PV panel, and an inverter is used to convert the electricity from direct current into alternating current. This alternating current is then fed into the grid.

[1] Illustration courtesy of Savannah Environmental (Pty) Ltd.

CPV technology makes use of concentrating lenses to focus sunlight on tiny, highly efficient, multi junction solar cells. The use of the multi-junction cells renders the efficiency of this system much higher than that of conventional solar cells.

Both wind and solar energy generation are considered to be environmentally friendly electricity generation options.

2. SCOPE OF WORK

The project is proposed on the following farms:

- Portions 1 and Remaining Extent of Farm 209 (Poortje) and
- Portions 1 and 2 of Farm 212 (Namies South)

The scope of work for the proposed facility includes a scoping level visual assessment of the issues related to the potential visual impact. The scoping phase is the process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an impact assessment.

The main purpose is to focus the impact assessment on a manageable number of important questions on which decision-making is expected to focus and to ensure that only key issues and reasonable alternatives are examined.

The study area for the visual assessment encompasses a geographical area of approximately 1935km² (the extent of the maps displayed below) and includes a minimum 20km buffer zone from the proposed site boundary.

3. METHODOLOGY

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General.

The procedure utilised to identify issues related to the visual impact includes the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment.
- The sourcing of relevant spatial data. This includes cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed facility could have a potential impact.
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (scoping report) sets out to identify the possible visual impacts related to the proposed facility.

4. THE AFFECTED ENVIRONMENT

Regionally, the proposed site for the proposed Mainstream Renewable Energy Facility is located approximately 23km south west of Pofadder in the Northern Cape.

The study area occurs on land that ranges in elevation from about 600m above sea level (a.s.l.) in the north west, to about 1200m a.s.l. in the higher lying south east of the study area.

The topography consists of *Plains* and *Low mountains*. The terrain of the site and immediately surrounding it is quite flat. Parallel mountains extend across the centre of the study area in a roughly east-west direction. These are more pronounced in the west than in the east and north east. The site itself lies at an elevation of about 1050 – 1100 a.s.l. Refer to **Map 1**.

Hydrological features within the study area are limited to non-perennial drainage lines, which flow to the west and north west. The broader study area is situated within the *Namaqua broken veld* and *False succulent karroo* vegetation types[2].

Land cover consists primarily of *shrubland*, interspersed with large areas of *natural grassland*, especially in the south west. Some *thicket* is present on the proposed site and to the east and north east thereof and limited occurrence of *woodland* is evident in the far south west . Refer to **Map 2**.

This arid, semi-desert region receives less than 123mm of precipitation per annum and is therefore greatly devoid of any rain fed agriculture or cultivation. Sheep, goat and game farming occur throughout the region at a less intensive scale.

The site location can be described as remote due to its considerable distance from any major metropolitan centers or populated areas. The study area is sparsely populated (less than 1 person per km2), with the highest concentration of people living in the town of Pofadder.

Very few homesteads and settlements are present within the study area. These include *Lekdam, Samoep, Namies, Onder Namies, Neelsvlei, Dubip and Luttigshoop* within a 10km radius of the proposed site.

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

The N14 national road is located in the north of the study area, just less than 20km from the proposed site, and the R358 bypasses the site some 10-15km to the east. Other than these main roads, a number of secondary roads cross the study area, mainly extending to the west and east.

The only other infrastructure is a power line which traverses the study area (and the site) from west to east.

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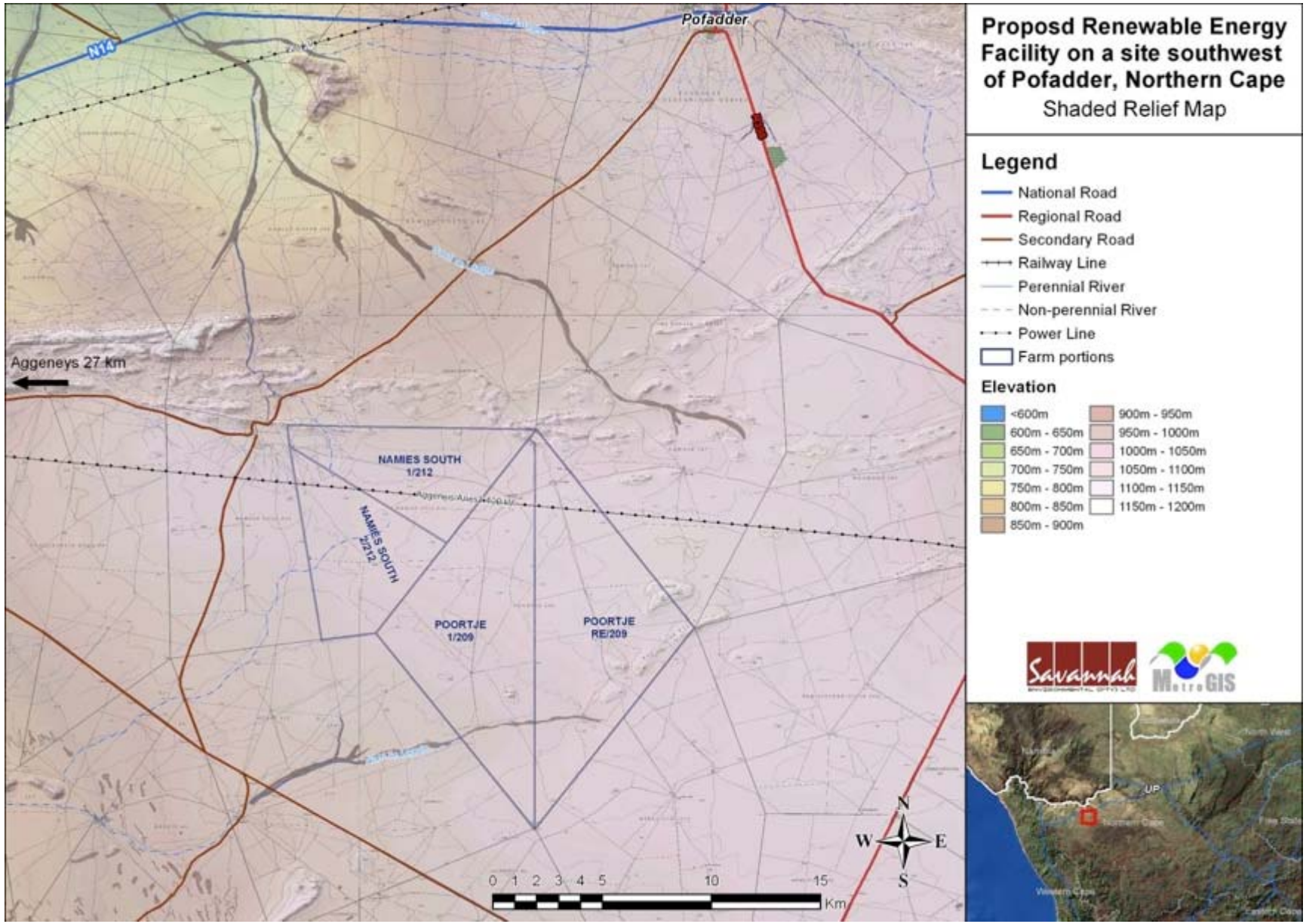
[2] Department of Environmental Affairs and Tourism, 2001. *Environmental Potential Atlas for the NorthernCape Province (ENPAT NorthernCape)*

There are no formally protected or conservation areas present within the study area, but the greater environment has a vast, undeveloped and rugged character. Settlements, where these occur, are very limited in extent and domestic in scale.

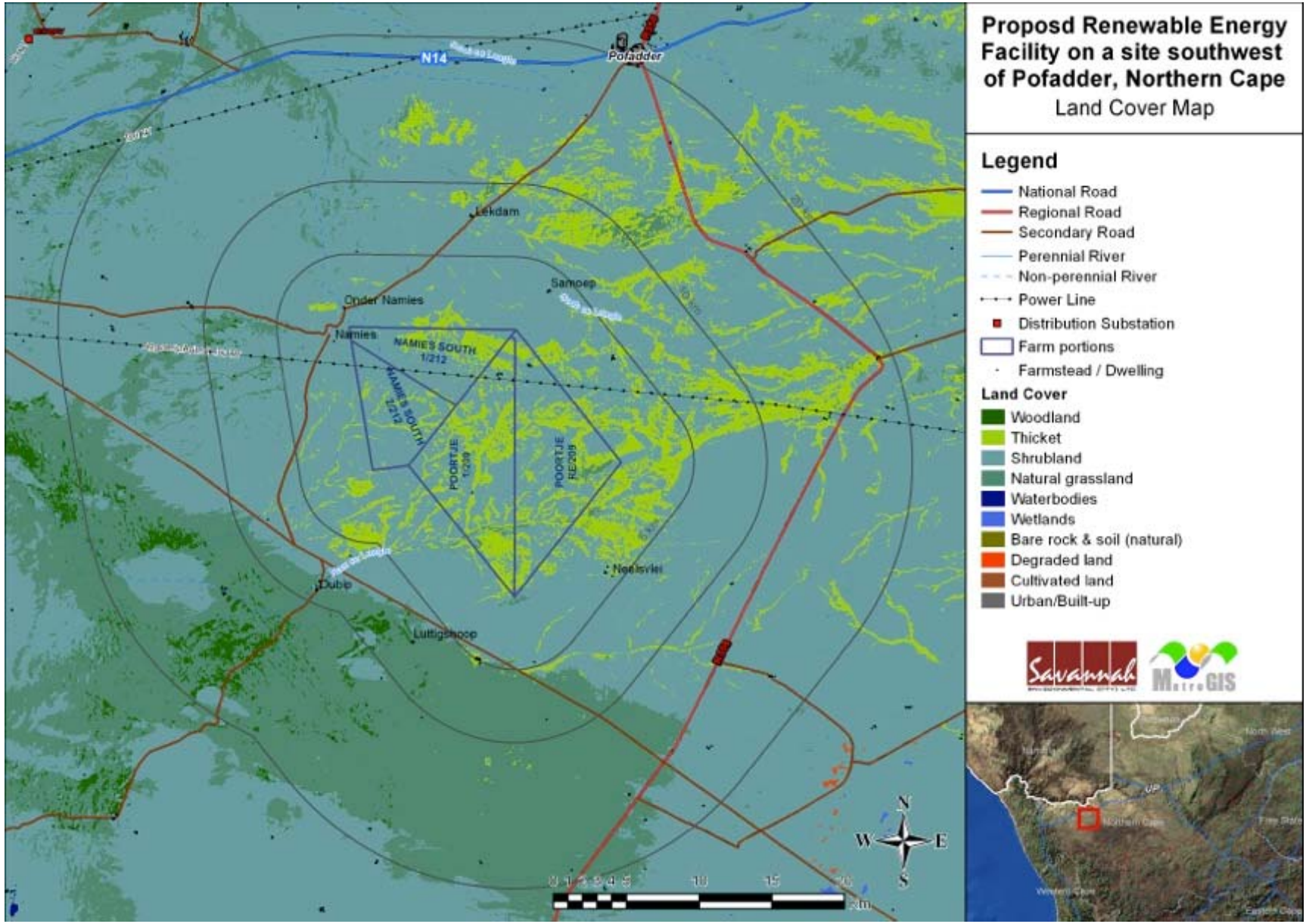
The greater environment with its wide open, undeveloped landscapes is considered to have a high visual quality.

This area itself is not known as a tourist destination, but the N14 and R358 are recognised tourist access routes within the region, giving access to visitors to the Green Kalahari, Namaqualand and Namibia (via Onseepkans).

Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland) and NLC2000 (ARC/CSIR).



Map 1: Location of the proposed facility indicating shaded relief (topography and elevation above sea level) of the study area.



Map 2: Broad land cover and land use patterns of the study area.

5. POTENTIAL VISUAL EXPOSURE

The result of the initial viewshed analyses for the proposed Mainstream Renewable Energy Facility is shown on **Map 3**.

It is expected, from a visual impact perspective, that the wind turbines would constitute the highest potential visual impact of the wind energy facility, therefore, the viewshed analysis for the facility was undertaken from a number of provisional turbine positions as at offsets of 120m above average ground level (i.e. the approximate maximim hub height of the proposed wind turbines).

This was done to determine the general visual exposure of the area under investigation, simulating the proposed turbine structures associated with the facility. It must be noted that the viewshed analysis does not include the effect of vegetation cover or existing structures on the exposure of the proposed wind turbines, therefore signifying a worst-case scenario.

Map 3 indicates areas from which any number of turbines (with a minimum of one turbine) could potentially be visible as well as proximity offsets from the proposed development area. As the PV or CPV infrastructure will be considerably smaller than the turbines, it may be deduced that the potential visual exposure of the PV panels will lie within the viewshed of the turbines.

The following is evident from the viewshed analyses:

- The proposed facility will have a large core area of potential visual exposure on the project site itself, and within a 5km radius thereof. The low mountains to the north and north west of the site offer some visual screening to the areas beyond.

  Potintilly sensitive visual receptors within this visually exposed zone include users of the secondary roads to the north west and residents of the settlements of *Namies, Onder Namies*, and *Neelsvlei*.

- Potential visual exposure remains high in the medium distance (i.e. between 5 and 10km), with visually screened areas in the north west (beyond the low mountains).

  Sensitive visual receptors comprise users of secondary roads to the west, north west and south west of the site as well as residents of homesteads and settlements. The latter include *Lekdam, Dubip* and *Luttigshoop*.

- In the longer distance (i.e. beyond the 10km offset), the extent of potential visual exposure is slightly reduced, especially in the north west and north east of the study area. Visually exposed areas tend to be concentrated more in the south.

  Sensitive visual receptors include users of stretches of the N14 in the north, and of the R358 in the east. In addition, users of secondary roads within the study area and residents of homesteads and settlements, particularly in the south, may be visually exposed.

- The town of Pofadder lies more than 20km from the proposed site, but will not be visually exposed to the proposed facility. Other receptor sites at this distance, despite lying within the viewshed, are not likely to visually perceive the facility.

The figure below helps to place the above explanations in context, illustrating what scale a turbine structure will be perceived at different viewing distances.

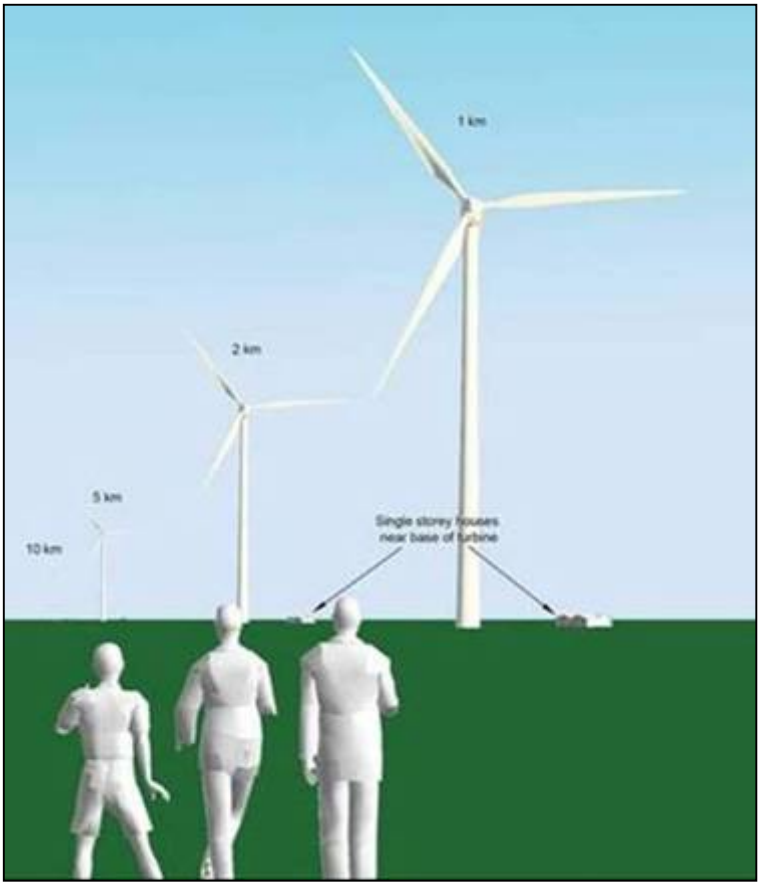
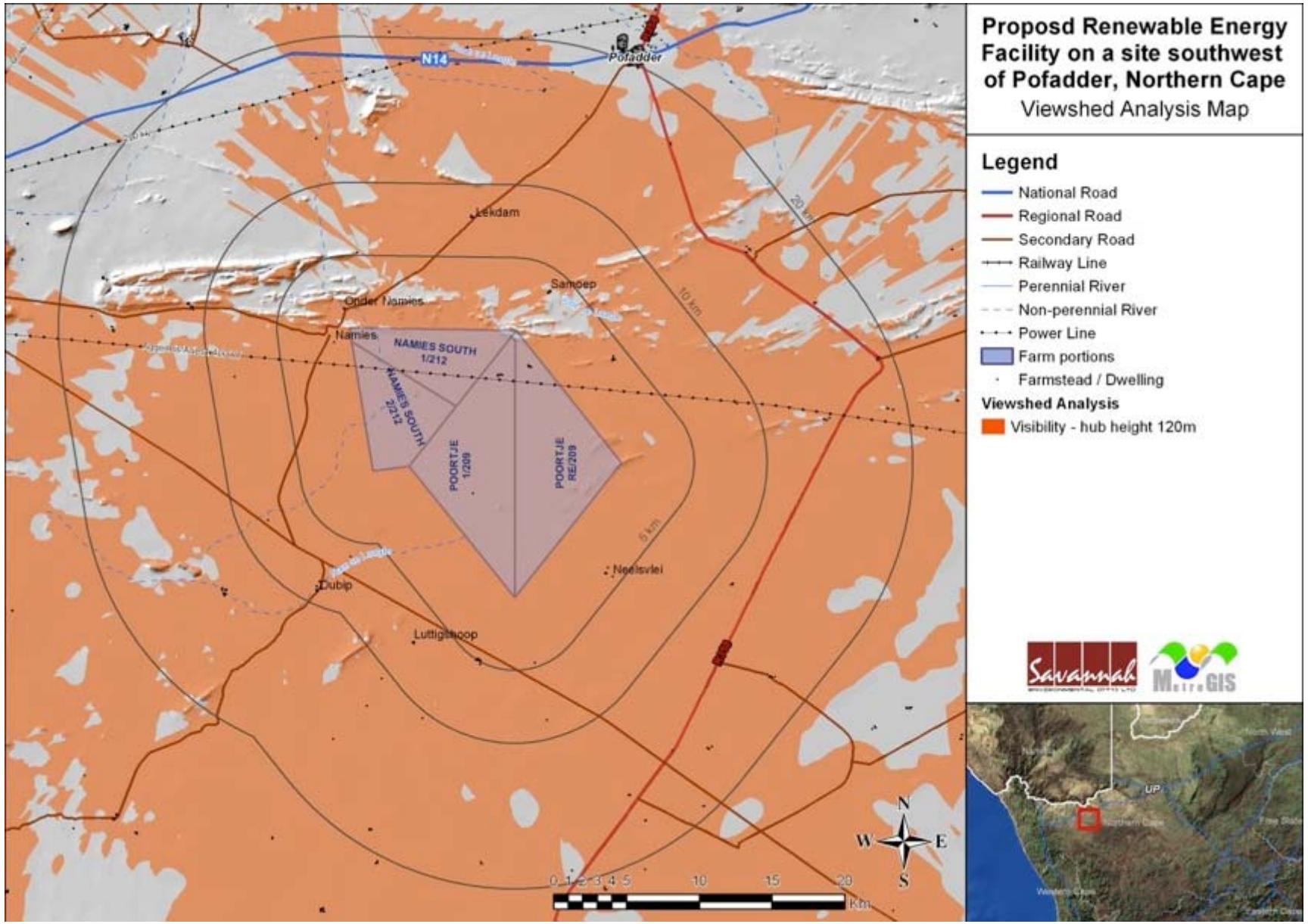


Figure 2: Visual experience of a 100m high wind turbine structure at a distance of 1km, 2km, 5km and 10km.



Map 4: Potential visual exposure of the proposed facility.

6. ANTICIPATED ISSUES RELATED TO VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed Mainstream Renewable Energy Facility include the following:

- The visibility of the facility from, and potential visual impact on observers travelling along main roads (i.e. the N14 and R358) and secondary roads in close proximity[3] to the proposed facility and within the region[4].

- The visibility of the facility from, and potential visual impact on residents of homesteads and settlements in close proximity to the proposed facility and within the region.

- The potential visual impact of ancillary infrastructure (i.e. the substations, internal access roads, workshop and office) on observers in close proximity to the proposed facility.

- The potential visual impact of the proposed facility on the visual quality of the landscape and sense of place region.

- The potential visual impact of the proposed facility on tourist access routes (i.e. the N14 and R358) within the region.

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

- Potential visual impacts associated with the construction phase on observers in close proximity to the proposed facility.

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

- Potential residual visual impacts after the decommissioning of the proposed facility.

- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may constitute a visual impact at a local and/or regional scale.

These anticipated visual impacts should be assessed in further detail during the EIA phase of the project as this report is only focused on defining the potential visual exposure of the proposed development and identifying the potential issues associated with the visibility of the development.

[3] For the purpose of this study, close proximity is considered to be within 10km of the proposed facility. This would be a medium distance view where the structures would be easily and comfortably visible and constitutes a high visual prominence.

[4] For the purpose of this study, the region is considered to be beyond the 10km radius of the proposed facility. This would be a longer distance view where the facility would become part of the visual environment, but would still be visible and constitutes a medium to low visual prominence.

7. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the proposed Mainstream Renewable Energy Facility will have a visual impact on a limited number of potentially sensitive visual receptors especially within (but not restricted to) a 10km radius of the proposed project development site.

Such visual receptors include people travelling along secondary roads and those residing within the rural homesteads and settlements.

There are no formally protected or conservation areas present within the study area, but the greater environment has a vast, undeveloped and rugged character. Settlements, where these occur, are limited in extent and domestic in scale. The greater environment with its wide open, undeveloped landscapes is considered to have a high visual quality.

This area itself is not known as a tourist destination, but the N14 and R358 are recognised tourist access routes within the region, giving access to visitors to the Green Kalahari, Namaqualand and Namibia (via Onseepkans).

It is therefore recommended that the severity of the potential visual impact be assessed in further detail in the EIA phase. Additional spatial analyses must be undertaken in order to create a visual impact index that will further aid in determining potential visual impact.

Specific spatial criteria need to be applied to the visual exposure of the proposed facility in order to successfully determine visual impact and ultimately the significance of the visual impact. In addition, photo simulations of critical viewpoints will be undertaken where required, in order to aid in the visualization of the envisaged visual impact. In this respect, the proposed Plan of Study for EIA is as follows:

- **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 the turbine structures.

  Proximity radii for the proposed development site 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.

  MetroGIS determined the proximity radii based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure). MetroGIS developed this methodology in the absence of any known and / or acceptable standards for South African wind energy facilities.

  The proximity radii (calculated from the boundary lines of the farm selected for the facility) are as follows:

  - 0 - 5km. Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
  - 5 - 10km. Medium distance view where the structures would be easily and comfortably visible and constitute a high visual prominence.

- 10 - 20km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 20km. Long distance view of the facility where the facility could potentially still be visible, though not as easily recognisable. This zone constitutes a medium to low visual prominence for the facility.

- **Determine 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, then there would be no visual impact. If the visual perception of the structure is favourable to all the observers, then the visual impact would be positive.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed facility 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, and purpose of sighting which would create a myriad of options.

- **Determine the Visual Absorption Capacity of the environment**

  This is the capacity of the receiving environment to absorb or screen 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.

  The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate the potential visual absorption capacity (VAC) of the region. It is therefore necessary to determine the VAC by means of the interpretation of the natural visual characteristics, supplemented with field observations.

- **Determine the Visual Impact Index**

  The results of the above analyses are merged in order to determine where the areas of likely visual impact would occur. These areas are further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

The above exercise should be undertaken for the core wind energy facility as well as the ancillary infrastructure, as these structures (i.e. the substations, internal

access roads, workshop and office) are envisaged to have varying levels of visual impact at a more localised scale.

The site-specific issues (as mentioned earlier in the report) and potential sensitive visual receptors should be measured against this visual impact index and be addressed individually in terms of nature, extent, duration, probability, severity and significance of visual impact.

In addition, cumulative visual impact should be addressed, as well as suggested mitigation measures for all identified impacts (if any).

8. REFERENCES / DATA SOURCES

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