WIND ENERGY FACILITY IN THE WESTERN CAPE
VISUAL IMPACT ASSESSMENT REPORT

Produced for:
Eskom Holdings Limited

Produced by:
MetroGIS (Pty) Ltd.
PO Box 384, La Montagne, 0184
Tel: (012) 349 2884/5 Fax: (012) 349 2880
E-mail: mgis@metrogis.co.za Web: www.metrogis.co.za

On behalf of:
Savannah Environmental (Pty) Ltd.
PO Box 148, Sunninghill, 2157
Tel: (011) 234 6621 Fax: 086 684 0547
E-mail: karen@savannahSA.co.za Web: www.savannahSA.com

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Lourens du Plessis from MetroGIS (Pty) Ltd. undertook the visual impact assessment in his capacity as a visual assessment and Geographic Information Systems specialist. Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modelling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His GIS expertise are often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

Lourens 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 utilise the principles and recommendations stated therein to successfully undertake visual impact assessments.

Savannah Environmental (Pty) Ltd. appointed MetroGIS (Pty) Ltd. as an independent specialist consultant to undertake the Visual Impact Assessment and neither the author, nor MetroGIS will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Eskom Holdings Limited identified the coastal area north-west of Vredendal in the Western Cape as an ideal location for the construction and operation of a Wind Energy Facility (WEF). The WEF generates electricity by means of wind turbines that harness the coastal and berg wind conditions of the area as a renewable source of energy. Wind energy generation, or wind farming as it is commonly referred too, is generally considered to be an environmentally friendly electricity generation option.

The effectiveness of the WEF, or amount of power generated by the facility, is dependent on the amount 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. Eskom intends to construct up to 100 turbines over an identified area of 25 km^2.

Each turbine consists of a concrete foundation (15m x 15m), a 78m high steel tower, a hub (placed at approximately 80m above ground level) and three 45m long blades attached to the hub. Other infrastructure associated with the facility includes internal service roads, an access road from the R363 provincial road, an 80m x 80m substation (placed within the facility) and a proposed 132 kV transmission line linking the aforementioned substation to the Juno substation near Vredendal.

The photograph below, taken at Eskom's Klipheuwel test facility, indicates the dimensions of a single wind turbine. The turbine displayed in the photograph is slightly smaller than the structures envisaged at the proposed facility. Also note the colour of the turbine (bright white).

The construction phase of the Wind Energy Facility is dependent on the number of turbines erected and is estimated at one week per turbine. The lifespan of the facility is approximated at 20 to 30 years.

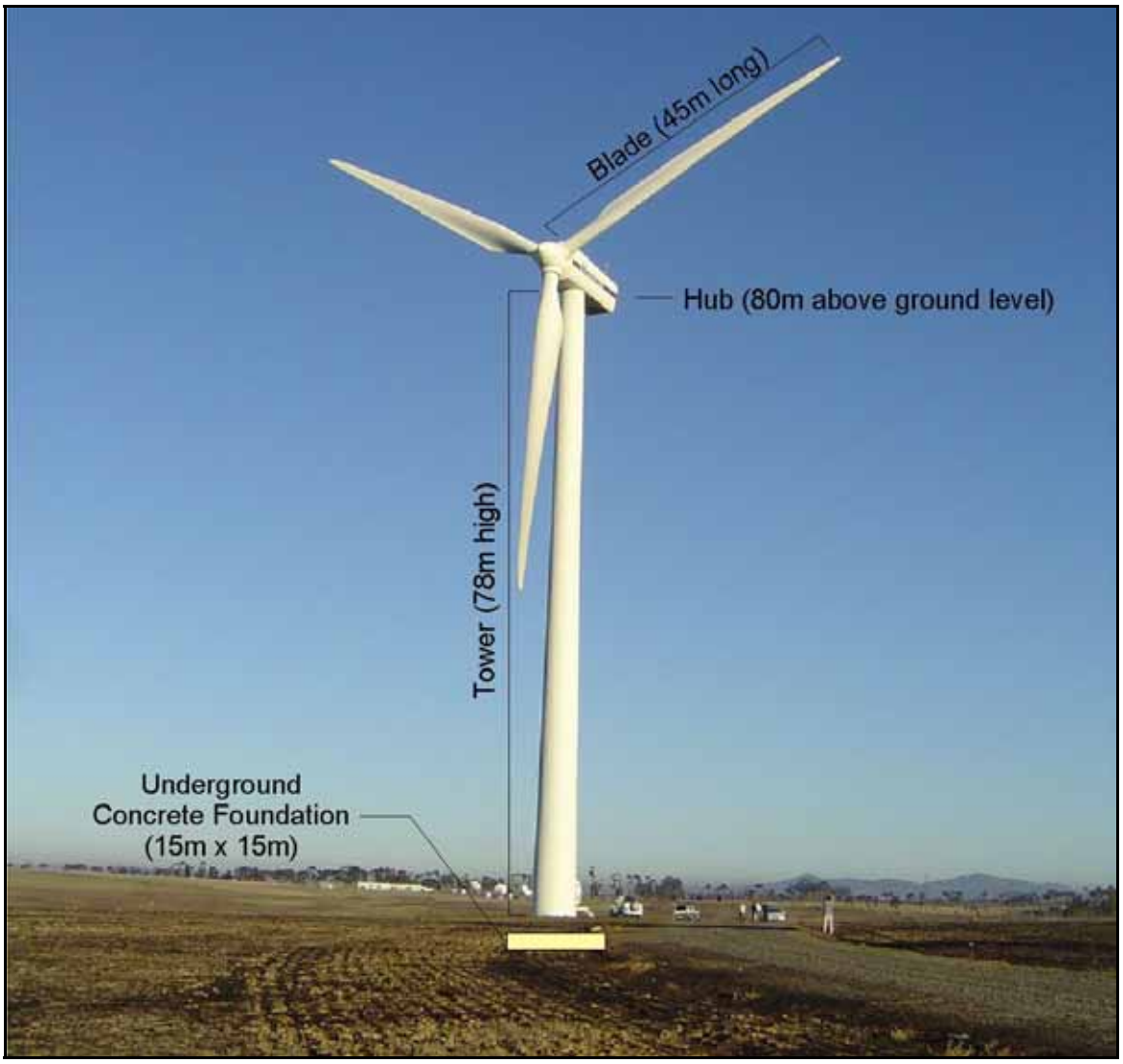

Figure 1: Photograph of a wind turbine indicating the approximate dimensions

2. SCOPE OF WORK

The scope of the work for the WEF project includes a visual impact assessment of the proposed facility and its related infrastructure.

The study area for the visual assessment encompasses a considerable geographical area that includes a 50km buffer zone from the proposed development area. It includes the towns of Bitterfontein, Nuwerus, Koekenaap, Lutzville, Papendorp, Strandfontein, Doringbaai and Vredendal as well as some smaller places of interest such as Brand se Baai, Gert du Toit se Baai, Duiwegat and Die Toring.

3. METHODOLOGY

3.1. General

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.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It

further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The methodology utilised to determine the visual impact included the following activities:

- The creation of a detailed digital terrain model of the potentially affected environment.
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed facility and its related infrastructure could have a potential impact.
- The identification of areas of high observer incidence and potential negative viewer perception.
- The creation of viewshed analyses from each turbine position and the transmission line alternatives 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 turbines, transmission line structures and the substation.
- The creation of photo simulations in order to visualise the envisaged alteration to the receiving landscape.

3.2. Issues Related to the Visual Impact

Specific spatial criteria need to be applied to the visual exposure of the proposed WEF in order to successfully identify the issues related to the visual impact.

Visual Distance / Observer Proximity

The principle of reduced impact over distance is applied in order to determine the core area of visual influence for this type of structure. It is envisaged that the nature of the structure and the relatively natural state of the environment would create a significant contrast that would make the facility visible and recognisable from a great distance.

The proximity radii for the proposed WEF 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 distances calculated for the proximity radii are quite liberal in order to cater for perfect viewing conditions and therefore allowing for a worst-case scenario.

The proximity radii chosen, based on the dimensions of the proposed development area, are:

- 0 - 10km. Short distance view where the WEF would dominate the frame of vision and constitute a very high visual prominence.

- 10 - 25km. Medium distance view where the structures would be easily and comfortable visible and constitute a high visual prominence.

- 25 - 50km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and potentially recognisable. This zone constitutes a medium visual prominence.

- Greater than 50km. Long distance view of the facility where the facility could potentially still be visible thought not as easily recognisable. This zone constitutes a low visual prominence for the facility.

A similar approach was followed for the observer's proximity to the proposed 132 kV Juno-WEF transmission line alternatives. The proximity radii are based on the construction of 25m high steel or concrete monopole towers.

- 0 - 500m. Short distance view where the transmission line structures would dominate the frame of vision and constitute a very high visual prominence.

- 500 - 1500m. Medium distance view where the structures would be easily and comfortable visible and constitute a high visual prominence.

- 1500 - 3000m. Medium to longer distance view where the structures would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.

- 3000 - 5000m. Long distance view of the transmission line where the structures could potentially still be visible thought not as easily recognisable. This zone constitutes a medium to low visual prominence for the transmission line.

- Greater than 5000m. This zone is expected to have a negligible (or no) visual influence in terms of the construction of the transmission line.

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

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 wind energy 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, purpose of sighting, etc. which would create a myriad of options.

For the purpose of this study five areas were identified as having high or higher observer incidences and potential negative viewer perceptions. The identified areas are as follows (see map below):

- The major towns and settlements in the region. These include Vredendal, Lutzville, Koekenaap, Papendorp, etc. and represent areas with the highest concentration of potential observers.

- The second area is the irrigated agricultural land primarily situated adjacent to the Olifants River. The area includes agricultural holdings and smallholdings where the population density is higher than the outlying regions, but not as high as within the urban areas. Ebenezer, Skaapvlei road smallholdings, etc. are included within this area.

- Specific points of interest and individual homesteads comprise the next area of higher observer incidence and potential negative viewer perception. The points of interest include scenic/tourist attractions such as Brand se Baai, Duiwegat, Die Toring, Robeiland and Gert du Toit se Baai along the coast, and the homesteads include Skilpadvlei, Nooitgedag, Skaapvlei, etc.

- The major roads within the region (R363 and R362) connect Vredendal, Lutzville, Koekenaap and Strandfontein with each other whilst the N7 connects the region with Cape Town and the Northern Cape province. These roads account for the most of the traffic in the area and were identified as corridors of high viewer incidence.

- The other roads (secondary roads) in the area account for much less traffic but were also included as a separate zone of high viewer incidence due to the fact that they function as the only connectors between Vredendal and the Atlantic Ocean. People wishing to visit the points of interest, as mentioned above, need to travel along these access roads and may be exposed to the WEF along the way.

A number of additional sensitive visual receptors were also identified due to their inherent aesthetic quality or potential as scenic tourist attractions. The rationale being that the WEF might negatively influence the development potential of these areas. The sensitive areas include:

- The two major rivers (Olifants and Klein Goerap) that function as important bird habitats within this region.

- The coastline. Even though it is extensively mined and not easily accessible the coastline (beaches and cliffs) has an intrinsic value from a visual point of view and a future tourism potential.

- The two nature reserves (Lutzville and Moedveloren) in the area have, due to their conservation status, been identified as potential sensitive visual receptors.

Site Specific Issues

In addition to the spatial criteria mentioned above, another set of issues related to the potential visual impact of the WEF was identified. These issues are often a refinement of the spatial criteria and relate to issues that are not easily quantifiable or spatially presentable. The list of issues include:

- The potential visual impact of operational, safety and security lighting of the facility at night.
- The visual absorption capacity of the natural vegetation.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts.

Figure 2: Areas of high viewer incidence/sensitive visual receptors

4. THE AFFECTED ENVIRONMENT

The location of the proposed area for the development of the Wind Energy Facility includes portions (parts of) of the following farms:

- Portion 5 of Gravewaterkop 158
- Portion 620 of the farm Olifants River Settlement
- Portion 617 of the farm Olifants River Settlement

These farms are located approximately 40km north-west of the town of Vredendal in the Western Cape Province adjacent to the Atlantic Ocean (at least 2km from the coastline/high water mark at the closest boundary). The study area for development is about 16km north of the Olifants River Mouth and encompasses a surface area of 37km^2. The final area of the WEF will be approximately 25km$^{2.}$ Primary access to this region is by means of the N7 national road and the R363

provincial main road and access to the site will be along the Skaapvlei secondary road.

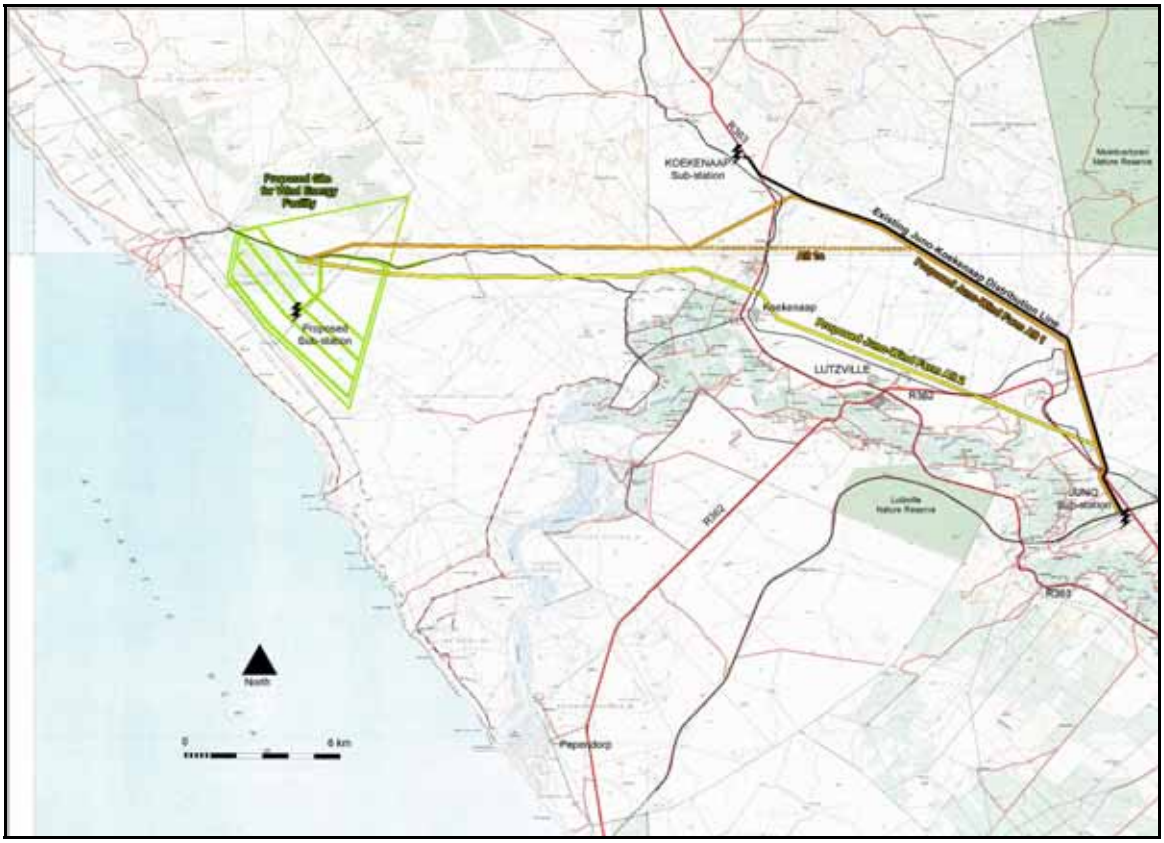

Figure 3: Map indicating the WEF layout and the Juno-WEF transmission line alternatives

The 132 kV transmission line alternatives originate at the Juno substation near Vredendal. Both alternatives cross the R362 and follow the existing Juno-Koekenaap distribution line for a couple of kilometres where after Alternative 2 crosses back over the R362 again in a north-westerly direction. It crosses over the same road again and continues north of Lutzville alongside the railway line until it reaches Koekenaap. It passes east and north of Koekenaap, over the R363 and north of the Skaapvlei road agricultural holdings before heading west towards the WEF. Alternative 2 is roughly 36km long whilst Alternative 1 is slightly longer at 40km. An additional sub-alternative (Alternative 1a as shown on the map above) was identified that would reduce Alternative 1 by 1km (i.e. 39km total length).

Alternative 1 follows the existing distribution line (for a total distance of 20km) until it reaches the R363 south of the Koekenaap substation, where after it crosses this road and head west towards the WEF. Alternative 1a follows the existing distribution line for about 15km before heading due west across the R363 (north of the Keerweder settlement) towards the proposed WEF.

The topography of the area surrounding the WEF and the proposed transmission line alternatives is described as undulating plains with the coastline (or coastal forelands) to the west characterised by steep cliff faces. Two major river valleys occur within the region, these being the Olifants River south of the site and the Klein Goerap River approximately 40km north of the site. Moving inland the terrain becomes more undulating and hilly, and is characterised by hills and low mountains east of the R363.

Figure 4: Shaded Relief Map (indicating topography and elevation above sea level) of the broader study area

The Olifants River valley forms a distinct hydrological feature within the study area. It has to a large degree dictated the settlement patterns in this arid region by providing a source of perennial water for irrigated agriculture. Irrigated cultivation/crops in close proximity to the river is the primary agricultural activity of this district, whilst cattle and sheep farming practises also occur at a less intensive degree. The population density of the region is less than 10 people per km^2 with most of the population concentrated within the small towns. Dry land agriculture occurs over large areas south of the Olifants River as well as over large scattered areas north of the WEF area. The relatively deserted coastline is host to a number of mining houses focussing mainly on diamond and heavy minerals mining.

Figure 5: Cliffs along the rugged coastline west of the proposed WEF (Note: Mining activities in the background)

Large tracts of land within the study area are still in an untransformed state with varying degrees of degradation. The predominant vegetation type or land cover, in terms of surface area, is described as Namaqualand Shrubland and Low Fynbos. These vegetation types are, due to the arid nature of this region, not very dense or tall in growth but rather scattered and low and represent a typical semi-desert environment. Riverine vegetation is found along the Olifants River but has, due to the cultivation of grapes and other crops, been altered to a large degree. Other transformed areas not clearly indicated on the map below (due to scale of capture constraints) include diamond and heavy minerals mining along the coastline. These areas appear as slivers along the coastline on the land cover map whilst larger mining areas, such as the Namaqua Sands mining activities (north of Brand se Baai), is clearly visible at this scale.

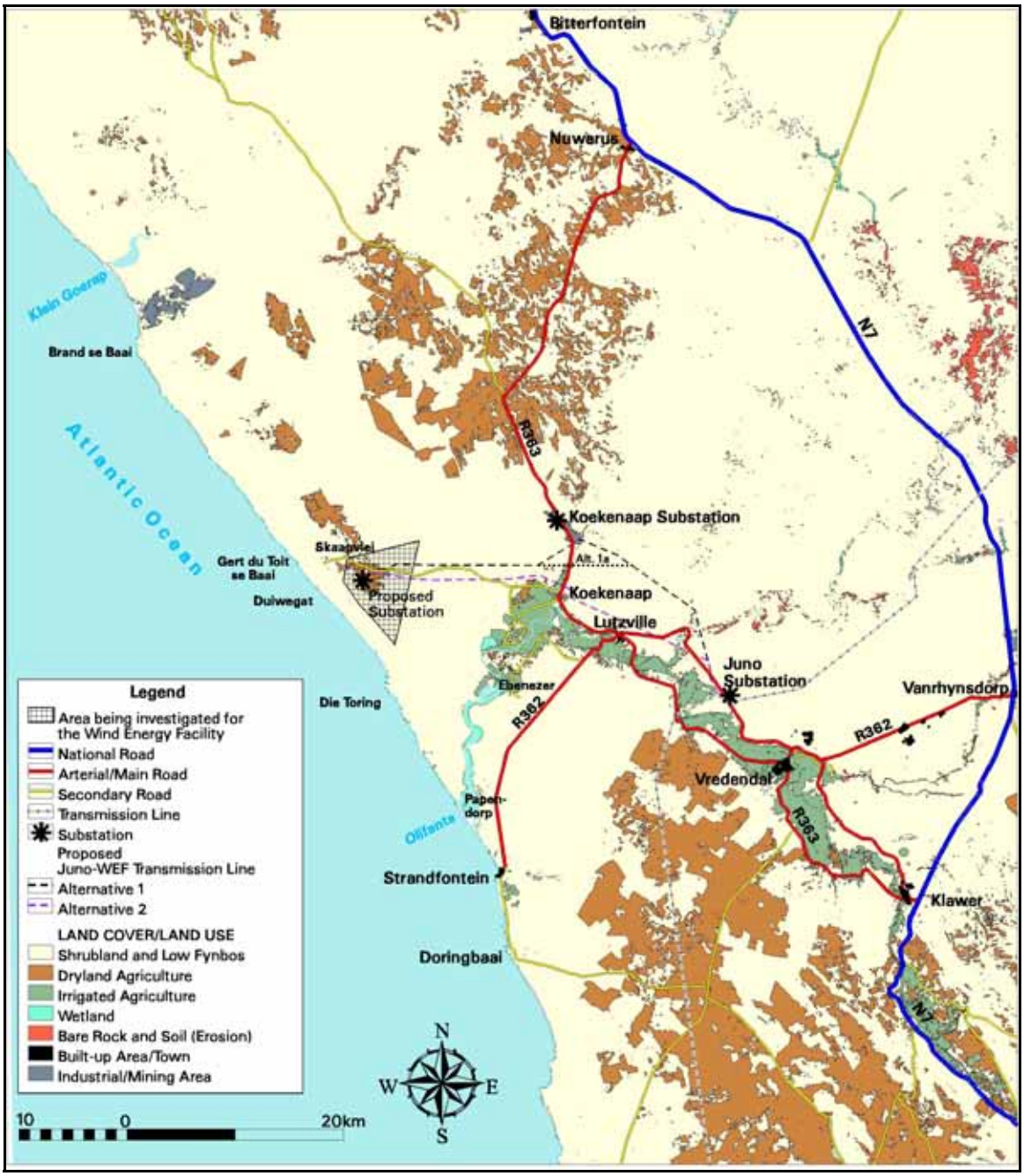

Figure 6: Land Cover/Land Use Map

Sources: DEA&T (ENPAT Western Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2000 (ARC/CSIR) and site observations.

5. VISUAL EXPOSURE

The result of the viewshed analyses for the proposed Wind Energy Facility is shown on the map below. The viewshed analyses were undertaken from each turbine position (100 turbines) at an offset of 80m (tower height) and 125m (tip of blade height) above average ground level. The map below indicates the combined visual exposure and therefore identifies areas from which any number of turbines (with a minimum of one turbine) could potentially be visible. It further differentiates between areas where the tower structure as well as the blades (yellow areas) would be visible as opposed to areas from where only the blades (orange areas) would be visible. A separate viewshed analysis is shown for the substation

infrastructure (calculated at a maximum 20m above ground level) indicating the potential visual exposure of the substation within a 10km radius.

Figure 7: Potential visual exposure of the wind turbines and substation

The map also indicates the proximity radii as discussed previously. This is done in order to highlight the decreasing visual impact of the facility over distance.

The result of the viewshed analysis shows the core area (primary visual catchment) of potentially uninterrupted exposure of the facility as being greatly contained within the 25km buffer zone. The majority of potentially uninterrupted exposure occurs within the 0 - 10km zone. Visibility beyond the 25km mark becomes scattered and broken and ultimately negligible as it nears the 50km buffer distance. Visibility, even on a perfectly clear day, within this zone (25 - 50km), and beyond the 50km mark, would theoretically be possible although highly unlikely to constitute a negative visual impact. In practical terms this rationale implies that although the facility may potentially be visible (due to the flat terrain and the low visual absorption capacity of the natural vegetation) from

sections of the N7 national road (50km away), it would be difficult to distinguish the facility within the larger landscape.

The 0 - 25km zone contains other areas and potential sensitive visual receptors (as mentioned under the section 3.2. Issues Related to the Visual Impact) that would be exposed to the WEF. Some of these include the towns of Koekenaap and Lutzville, sections of the R362 and R363 provincial roads, and other communities such as the Skaapvlei road smallholdings and Ebenezer Kolonie along the Olifants River.

This zone further encompasses a number of homesteads and points of interest, as well as sections of the coastline. Visibility from the coastline would mainly be possible from the top of the cliffs and is unlikely from the beaches and rocky shore due to the sudden drop in topography (nearly 60m) to sea level.

Figure 8: Potential visual exposure of the proposed power line Alternative 1

The substation will primarily be exposed to road users travelling along the Skaapvlei road, the Skaapvlei settlement and the Skilpadvlei homestead. It should however be noted that the substation will be placed centrally amongst the wind turbines and will be dwarfed by the large structures surrounding it. The wind turbines are expected to distract attention from the substation to a large degree.

The proposed visual exposure of the 132kV transmission line alternatives were calculated at regular intervals along each alignment at an offset of 25m above average ground level. The far-search distance was restricted to a 5km radius from the alignment where the visual impact was deemed to be negligible. The type of structure suggested for the construction of the transmission line is a 25m high steel or concrete monopole tower (various derivatives are show in Figure 9).

Figure 9: Examples of monopole transmission line towers

The visual exposure of Alternative 1 and Alternative 1a, shown above, virtually covers the whole 5km buffer radius. This is largely due to the flat nature of the terrain and the low growth of the natural vegetation. The transmission line will be exposed to observers travelling along the R362 and R363. It will also not be exposed to any major populated places due to the transmission line traversing near vacant rural land for the largest part of its alignment.

A similar pattern of visual exposure is encountered when viewing the result of the visibility analysis of the second alternative. The exposure of this alternative however occurs within a closer proximity to built-up areas and settlements such as Lutzville, Koekenaap, the Skaapvlei road agricultural holdings and the farm Skilpadvlei. This alternative will furthermore be more visible from the R362 as it crosses the road three times as opposed to only once for Alternative 1.

No viewshed analysis was undertaken for the access road to the facility as the existing Skaapvlei road will be upgraded and utilised for this purpose.

Figure 10: Potential visual exposure of the proposed poer line Alternative 2

6. RESULTS

6.1. Visual Impact Indexes

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed WEF and two transmission line alternatives are displayed on the following three maps. Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category (as mentioned above) and merged in order to calculate the visual impact index. An area with short distance visual exposure to the proposed facility, a high viewer incidence and a predominantly 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 when evaluating the issues related to the visual impact.

The map below (Figure 11) indicates the visual impact index of the core area of the wind energy facility (100 wind turbines and the substation). The index once again confirms the containment of the visual impact within a 25km radius of the facility indicating possible exposure (beyond 25km) to the facility at the lower end of the index. The area between 10km and 25km radius of the facility is predominantly low to medium with exceptions occurring at homesteads and access roads within this zone. Higher values occur along the R362 south of Lutzville and agricultural holdings and farmland adjacent to the Olifants River (including Ebenezer). These areas would however not have unobstructed views of the WEF, as they all have their own visual clutter brought about by the land use activities and structural developments within these areas.

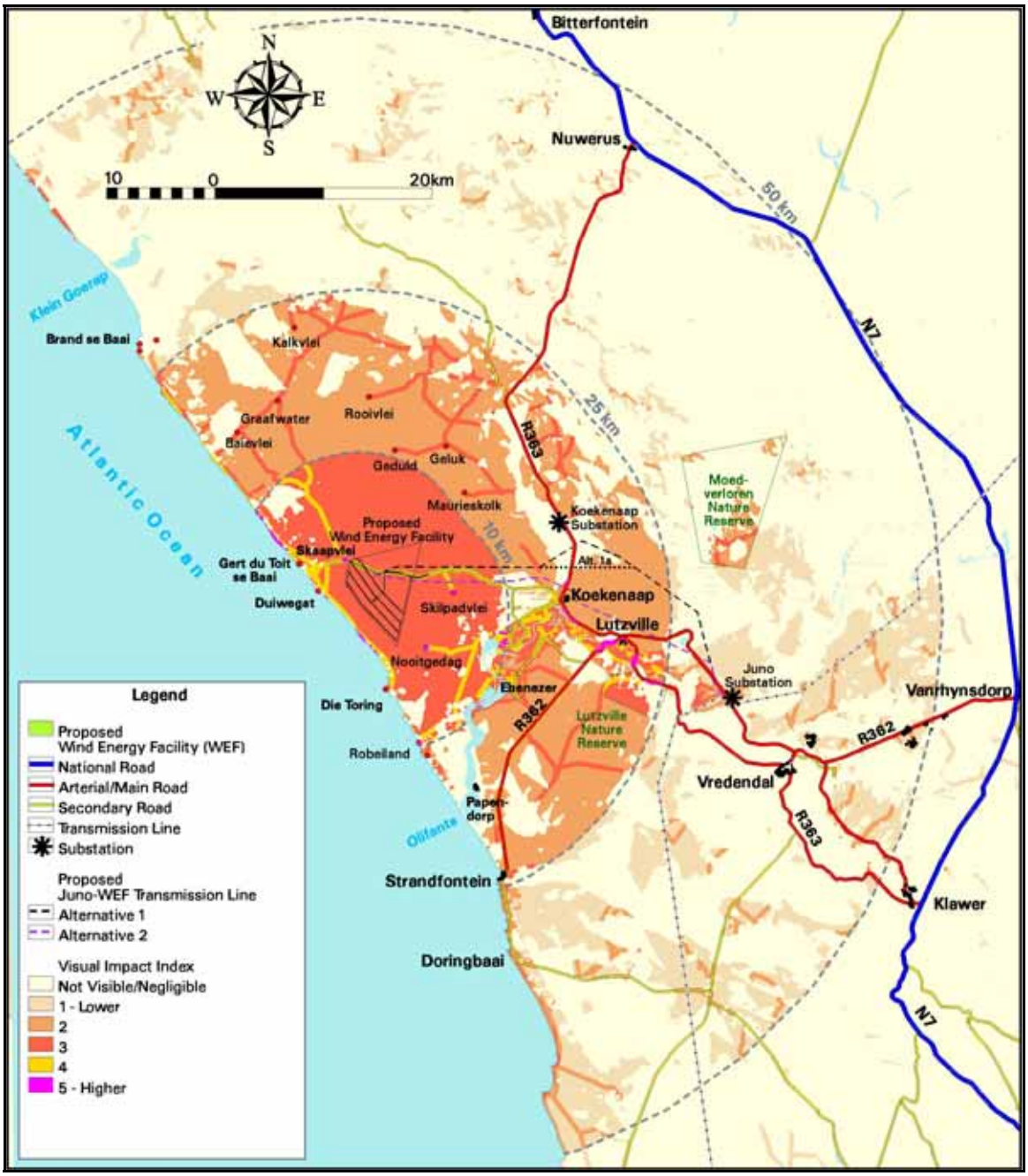

Figure 11: Visual impact index of the proposed wind energy facility

The core area of visual impact for the WEF is indicated within the 10km buffer radius of the facility. Even here, where the view of the facility is unobstructed, the majority of the zone (in terms of size) is indicated as medium on the index. This is due to the fact that this is a near vacant area, largely devoid of random observers. Exceptions occur along the secondary roads within this zone and specifically the Skaapvlei road. Other areas that appear highest on the visual impact index are specific homesteads (Skilpadvlei, Skaapvlei and Nooitgedag) and some sections of the coastline north of Gert du Toit se Baai and north of Die Toring.

The visual impact index for the proposed transmission line Alternative 1 is shown below (Figure 12).

Figure 12: Visual impact index of the proposed transmission line Alternative 1

The higher areas of visual impact are indicated within the immediate vicinity of the transmission line (within a 500m buffer zone). Approximately 20km of the transmission line is situated adjacent to the existing Juno-Koekenaap distribution

line whilst most of the line traverses near vacant land with a low viewer frequency. The highest visual impact indicated on the index occurs where the line crosses the R362 near Juno substation and R363 near the Koekenaap substation.

The proposed sub-alternative (Alternative 1a) traverses the R363 in close proximity to the Keerweder populated area (within 1km north of the settlement) and could potentially have a visual impact on this community.

The visual impact index for the proposed transmission line Alternative 2 (Figure 13) displays a similar pattern to the first alternative (i.e. a higher visual impact within a 500m radius of the line).

Figure 13: Visual impact index of the proposed transmission line Alternative 2

The second alternative is however located closer to built-up and residential areas (Koekenaap and the Skaapvlei road smallholdings) and therefore has additional areas of high impact in these areas. It further has a higher visual exposure where

it crosses the R362 three times where it will be exposed to road users for a greater length of time. The line also traverses adjacent to and across the Skaapvlei road and has the potential to visually impact on road users and other homesteads (Kommandokraal) located in close proximity to this road.

6.2. Visual impact assessment

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 issues identified in the ESS. These issues were mentioned under the heading "3.2. Issues related to the visual impact" earlier in this report.

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

- **Extent (E)** - local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration (D)** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude (M)** - low (= 0-4), medium/moderate (= 4-6), high (= 6-8) and very high (= 8-10)
- **Probability (P)** - very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5)
- **Status** (positive, negative or neutral)
- **Significance (S)** - low, medium or high, where the significance is determined by combining the above criteria in the following formula: S = (E+D+M) P

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 (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)

Visual impact on users of major roads (R362, R363 and N7)

The construction and operation of the WEF is expected to have a low visual impact on users of the R362 and R363 and a negligible visual impact on users of the N7.

Table 1: Visual impact on users of major roads

Extent	Duration	Magnitude	Probability	Significance	Status
Regional (R363 & R362) **3**	Long term **4**	Low **2**	Probable **3**	Low **27**	Negative
Regional (N7) **3**	Long term **4**	Low **2**	Improbable **2**	Low **18**	Neutral

Visual impact on users of other roads (secondary roads)

The visual impact on the Skaapvlei road (functioning as the primary connecting road between Vredendal and the coastal/mining areas) is expected to be very

high, as this road will have short distance views of the facility. The visual impact on other secondary/farm access roads within the 10km buffer radius of the WEF is expected to be high. The visual impact diminishes beyond the 10km and becomes medium and medium to low towards the 25km buffer radius.

Table 2: Visual impact on users of other roads

Extent	Duration	Magnitude	Probability	Significance	Status
Local (Skaap-vlei Rd) **4**	Long term **4**	Very High **10**	Highly probable **4**	High **72**	Negative
Local (Other roads < 10km) **4**	Long term **4**	High **6**	Highly probable **4**	Medium-high **56**	Negative
Local (Other roads > 10km) **4**	Long term **4**	Medium - low **4**	Probable **3**	Medium-low **36**	Negative

Visual impact on major towns and settlements

The visual impact on major towns and settlements (Lutzville, Koekenaap and Papendorp) is expected to be low due to the relative long viewing distance from the facility and the presence of existing visual clutter within these areas.

Table 3: Visual impact on major towns/settlements

Extent	Duration	Magnitude	Probability	Significance	Status
Regional **3**	Long term **4**	Low **1**	Probable **3**	Low **24**	Negative

Visual impact on agricultural areas and smallholdings

Agricultural areas and smallholdings west of the Olifants River (including the Skaapvlei road smallholdings) are not expected to be influenced by the WEF as visibility from these areas are highly unlikely. Areas east of the river (such as Ebenezer) can expect a medium to high visual impact. Visibility of the WEF will however be from a minimum distance of 10km.

Table 4: Visual impact on agricultural areas and small holdings

Extent	Duration	Magnitude	Probability	Significance	Status
Regional (East of river) **3**	Long term **4**	Low **2**	Improbable **2**	Low **18**	Neutral
Regional (West of river) **3**	Long term **4**	Medium - high **6**	Probable **3**	Medium **39**	Negative

Visual impact on specific points of interest and individual homesteads

Homesteads within a 10km radius of the facility (Skilpadvlei, Nooitgedag and Kommandokraal) are expected to have a high to very high visual impact whilst homesteads beyond 10km (including Maurieskolk, Geluk, Geduld, Rooivlei, Graafwater and Baievlei) are expected to have a medium to low visual impact.

Specific points of interest or scenic attractions (situated along the coast) affected by the WEF include Duiwegat, Die Toring and Gert du Toit se Baai. These areas

are expected to experience a high visual impact due to their relative close proximity to the facility. Observers traveling to, or in the vicinity of theses areas, are bound to have short distance views of the facility. Robeiland (10km from the facility) is expected to have a medium to low visual impact due to its relatively long distance from the WEF. Brand se Baai will not be visually influenced by the WEF.

Table 5: Visual impact on specific points of interest and individual homesteads

Extent	Duration	Magnitude	Probability	Significance	Status
Local (Skaap-vlei, Nooit-gedag, Komman-dokraal) **4**	Long term **4**	Very High **10**	Highly probable **4**	High **72**	Negative
Local (Home-steads < 10km) **4**	Long term **4**	High **6**	Highly probable **4**	Medium - high **56**	Negative
Local (Home-steads > 10km and Rob-eiland) **4**	Long term **4**	Medium - low **3**	Probable **3**	Medium-low **33**	Negative
Local (Duiwe-gat, Die Toring, Gert du Toit se Baai) **4**	Long term **4**	High **7**	Highly probable **4**	Medium - high **60**	Negative
Local (Brand se Baai) **4**	Long term **4**	Low **1**	Improbable **2**	Low **18**	Neutral

Visual impact on the Olifants and Klein Goerap Rivers

The sunken nature of the Olifants River and the elevated topography of the area surrounding the Olifants River mouth (north of the river) shield the river from the proposed WEF. The Klein Goerap River, located approximately 35km northwest of the facility, will also not be influenced by the WEF. No significant visual impact is envisaged from these areas.

Table 6: Visual impact on Olifants and Klein Goerap Rivers

Extent	Duration	Magnitude	Probability	Significance	Status
Regional (Klein Goerap) **3**	Long term **4**	Low **1**	Improbable **1**	Low **8**	Neutral
Local (Olifants River) **4**	Long term **4**	Low **2**	Improbable **1**	Low **10**	Neutral

Visual impact on the coastline

Sections of the coastline that could be negatively influenced by the WEF and may experience a high to very high visual impact are situated within the 10km buffer

radius from the facility. It must be stressed that the visual impact is more likely to occur on top of the coastal cliff rather than at sea level. This is due to the sudden drop of the topography (roughly 60m) to sea level effectively blocking views to the facility from beaches and the rocky shoreline.

Ocean views from the coastal cliffs looking west and/or south (i.e. towards the Atlantic Ocean and away from the facility) will not be influenced by the WEF. Ocean views from coastal areas south of the facility that include a northern aspect (e.g. Die Toring looking northwards along the coastline) will however experience a degree of visual interference. Setting the WEF further away from the coastline (e.g. from 2km to 4km) may go some way in mitigating these visual impacts although it would adversely affect the electricity generating capacity of the facility.

The author is of the opinion that the construction and operation of the facility would not, from a visual point of view, limit or negatively influence this coastal region's future tourism development potential. The WEF may even become an attraction in this otherwise vast and desolate region.

Table 7: Visual impact on the coast line

Extent	Duration	Magnitude	Probability	Significance	Status
Local (0 - 10 km) **4**	Long term **4**	High - very high **8**	Highly probable **4**	High **64**	Negative
Regional (10 - 25 km) **3**	Long term **4**	Medium - high **6**	Probable **3**	Medium **39**	Negative

Visual impact on nature reserves (Lutzille and Moedverloren nature reserves)

Both the nature reserves are located relatively far from the proposed WEF (Lutzville at approx. 20km and Moedverloren beyond 25km). Visual impacts on these reserves are highly unlikely due to the apparent distance between the reserves and the WEF and the presence of other infrastructure in the more immediate vicinity of the reserves.

Table 8: Visual impact on nature reserves

Extent	Duration	Magnitude	Probability	Significance	Status
Regional **3**	Long term **4**	Low **1**	Probable **3**	Low **24**	Negative

Transmission line alternatives

The visual impacts associated with the construction of a 132 kV transmission line to the Juno substation occur at a more local extent. This is due to the less visually intrusive nature of the proposed monopole transmission line towers suggested for this line. These structures are less obtrusive than the more commonly used lattice structures that are more bulky in appearance and therefore more visible. The visual exposure (within a 5km radius) of the two alternatives and one sub-alternative indicated a similar pattern due to the homogeneous nature of the topography and the low visual absorption capacity of the natural vegetation.

The determination of the potential visual impact and selection of the preferred alternative for the transmission line was based on the following comparative criteria:

- The length of the alignment

- The proximity and exposure to major roads (based on the number of road crossings)
- The proximity and exposure to populated places
- The consolidation of existing linear infrastructure (existing power line servitudes, access roads, etc.)

A comparative table indicates a summary of the above criteria. Positive values were awarded for opportunities and negatives where constraints were identified.

Table 9: Transmission line alternatives comparison

Alter-native	Length (Total)	Proximity to major roads	Proximity to populated places	Consolidation of existing infrastructure	Total Value
1	40km **(-1)**	2 crossings **(-2)**	Remote **(+1)**	High potential (up to 20km) **(+2)**	**(0)** Preferred
1a	39km **(0)**	2 crossings **(-2)**	Close proximity to Keerweder **(-1)**	Average potential (15km) **(+1)**	**(-2)** Acceptable
2	36km **(+1)**	4 crossings **(-4)**	Close proximity to Koekenaap, Skaapvlei Rd. smallholdings, Skilpadvlei & Kommando-kraal **(-4)**	Low potential (less than 3.5km) **(-1)**	**(-5)** Not preferred

Based on the above comparative criteria the preferred alternative for the transmission line is Alternative 1. The visual impacts of the alternatives are listed in the table below.

Table 10: Visual impacts of the transmission line alternatives

Extent	Duration	Magnitude	Probability	Significance	Status
Local **4** (Alt. 1)	Long term **4**	Medium **5**	Probable **3**	Medium **39**	Negative
Local **4** (Alt. 1a)	Long term **4**	Medium - high **7**	Highly probable **4**	Medium - high **75**	Negative
Local **4** (Alt. 2)	Long term **4**	High **8**	Highly probable **4**	High **80**	Negative

6.3. Other issues related to the visual impact of the WEF

Lighting impacts

The area earmarked for the placement of the wind energy facility and the surrounding areas (for a radius of approximately 10 km is) is not densely populated. The effects of security and after-hours operational lighting (flood lights) of the substation, in terms of light trespass and glare, are therefore lower in significance due to the near absence of sensitive visual receptors. Specific settlements (homesteads) in closer proximity of the WEF include Skaapvlei, Skilpadvlei and Nooitgedag. Proximity to the substation from these homesteads range from 4.5km to 7km.

This should however not distract from the careful planning and sensitive placement of light fixtures for the facility, designed to contain rather than spread the light. It is necessary to be pro-active in the mitigation of potential lighting impacts on future developments in the region.

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 125m high (including blades) 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. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low. Indications are that the facility may not be required to fit a light to each turbine, but rather place synchronous flashing lights on the turbines representing the outer perimeter of the facility. In this manner less warning lights can be utilised to delineate the facility as one large obstruction, thereby lessoning the potential visual impact. The regulations for the CAA's *Marking of Obstacles* should be strictly adhered too, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

Source: Civil Aviation Authority

Another potential lighting impact is the phenomenon 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. The WEF may contribute to the effect of sky glow in an otherwise dark environment.

Table 11: Visual impacts of lighting

Extent	Duration	Magnitude	Probability	Significance	Status
Local **4** (Glare: flood-lights)	Long term **4**	Medium **4**	Probable **3**	Medium **36**	Negative
Local **4** (Glare: aircraft warning lights)	Long term **4**	Medium **4**	Probable **3**	Medium **36**	Negative
Local **4** (Spill light)	Long term **4**	Low **2**	Improbable **2**	Low **20**	Negative
Regional (Sky glow) **3**	Long term **4**	Medium - low **4**	Improbable **2**	Low **22**	Negative

Visual absorption capacity of the natural vegetation

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 natural vegetation of the region. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, supplemented with field observations.

The vegetation units (see Figure 3) present in the study area surrounding the WEF range from 0.2m to 2m in height. This, coupled with the sparse distribution of the plant species and the dimensions of the facility, it was determined that the VAC is low to negligible for virtually the entire study area.

Potential visual impacts associated with the construction phase

The construction phase of the WEF is approximated at roughly two years (one week per turbine) should all 100 turbines be erected. This is obviously dependent

on a number of external factors that may not always be controlled by either Eskom or the preferred contractors. During this time heavy vehicles will frequent the otherwise deserted roads and may cause, at the very least, a visual nuisance to other road users and land owners in the area.

Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:

- Reduce the construction period through careful planning and productive implementation of resources.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
- Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
- Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

The potential to mitigate visual impacts

The primary visual impact, namely the appearance and dimensions of the wind energy facility (mainly the wind turbines) is not possible to mitigate. The functional design of the structures and the dimensions of the facility 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 potential for mitigation is thus low or non-existent.

The mitigation of secondary visual impacts, such as security and functional lighting, construction activities, etc. may be possible and should be implemented and maintained on an ongoing basis.

6.4. Overall visual impact

The mathematical formula utilised to calculate the significance weighting for each of the abovementioned visual impacts can be used to similarly calculate the average (or overall) visual impact of the wind energy facility. The resulting total of the facility (excluding the transmission line alternatives) yielded a value of 35.8 points, indicating the total significance weighting as a medium visual impact (where the impact could influence the decision to develop in the area). This result should however not distract from the individual visual impacts and impact weightings as previously stated. The diversity of visual impacts, mainly due to varying viewing distances from the facility, does not lend itself to the calculation of an average visual impact. The focus should ideally be on the significance weighting of individually identified potential visual impacts.

7. PHOTO SIMULATIONS

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the WEF within the receiving environment. It indicates the visual significance of the alteration of the landscape from various sensitive visual receptors and over varying distances. The simulations were modeled on the wind farm layout (shown below) as supplied by

Eskom and is based on the wind turbine dimensions as previously indicated. The photo simulations were done for a total of 100 wind turbines.

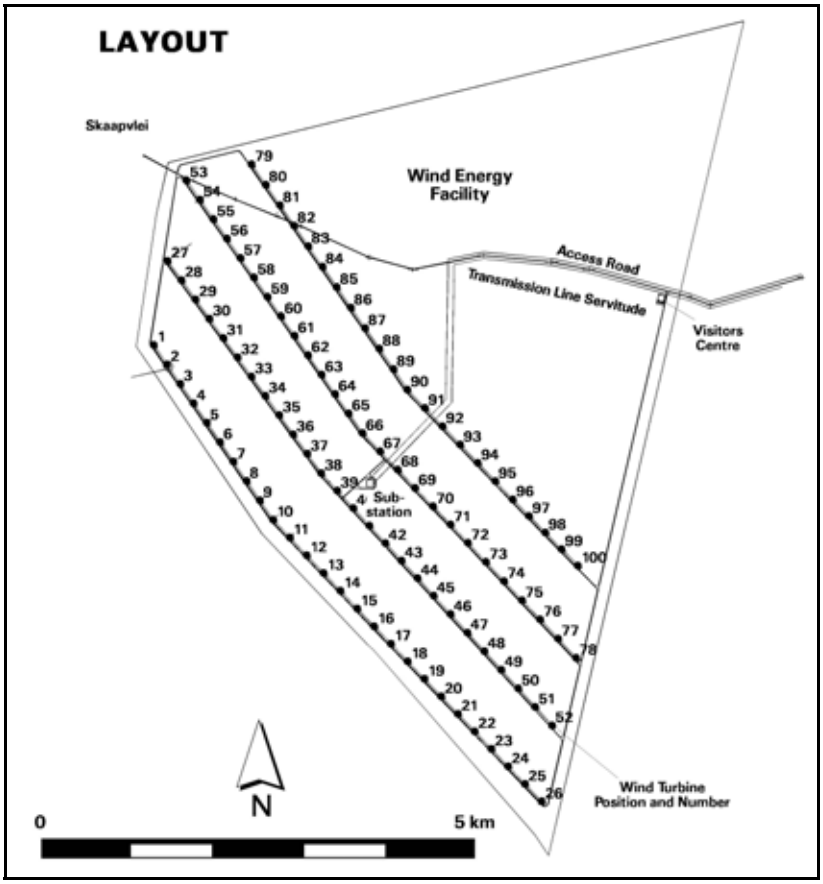

Figure 14: Proposed wind energy facility layout

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 photograph positions are indicated on the map below and should be referenced with the photo simulation being viewed in order to place the observer in spatial context. The approximate viewing distances indicated, were measured from the center point of the wind turbine layout (i.e. the substation site). It is therefore an average distance (some of the turbines may be closer to the viewer and others further away).

The simulated views show the placement of the wind turbines during the longer-term operational 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, has been undertaken. It is imperative that the natural vegetation be restored to its original status for these simulated views to ultimately be realistic. These photographs can therefore be seen as an ideal operational scenario (from a visual impact point of view) that should be aspired to.

Most of the views consist of a number of photographs spliced together. In some instances only partial views may be displayed due to size constraints. If the document is viewed in an electronic format (i.e. in Microsoft Word), the photographs (figures 16 to 24) should be viewed at 200% zoom for maximum effect.

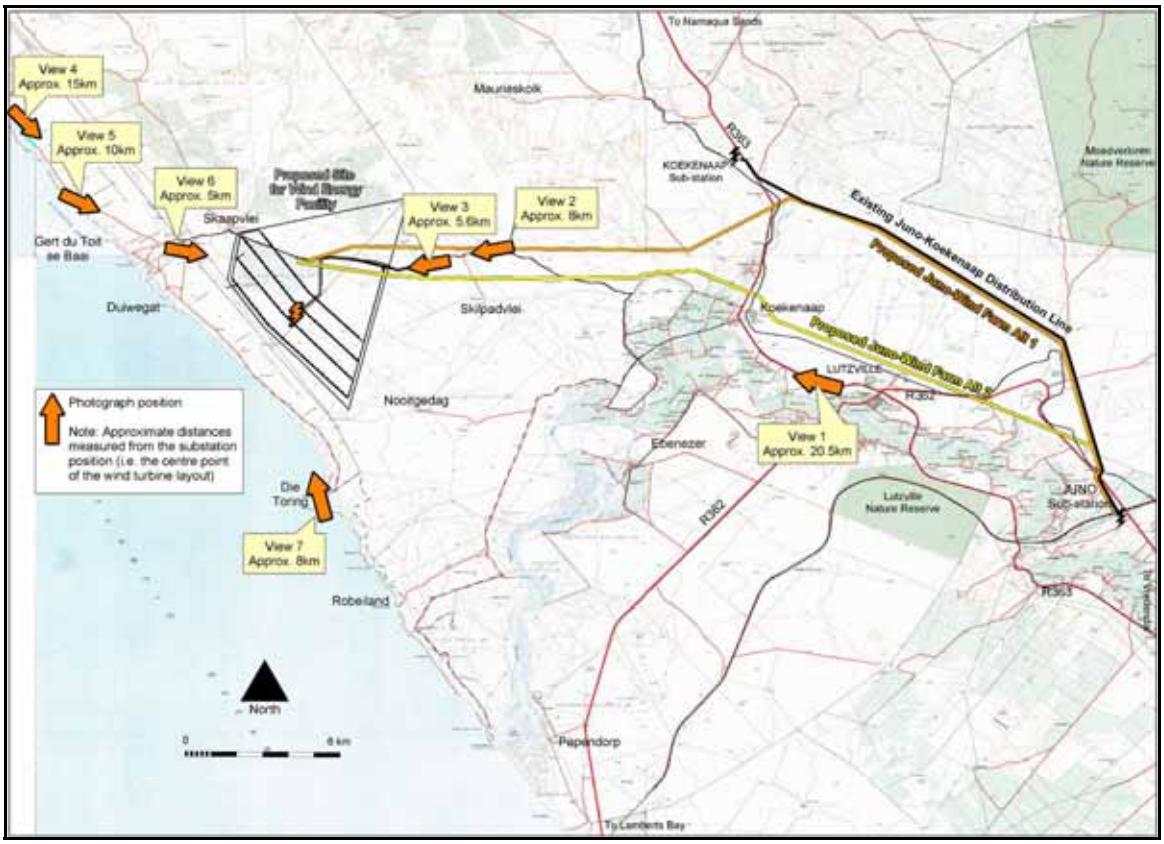

Figure 15: Photograph positions

View 1 - Medium to long distance view from the R363

The photograph was taken from the R363 road between Lutzville and Koekenaap at approximately 20.5km (line of sight) from the facility. The wind turbines appear as indiscernible dots on the horizon in the center of the photo. It is highly unlikely that the uninformed observer would be able to identify the structures being viewed. The presence of these structures may however pique the observer's curiosity as to the nature and purpose of the structures. It should also be noted that a number of structures (fence poles, telephone poles, etc.) and developments appear in the foreground. These features or visual clutter will obstruct (and distract from) clear views of the facility from this road at varying degrees along the route.

Figure 16: Photo simulation - View 1 (average distance 20.5km)

View 2 - Medium to short distance view from Skaapvlei road

The Skaapvlei road will be the access road to the wind energy facility. This road also functions as the primary access to the coastal areas (Brand se Baai, Duiwegat, Die Toring, Gert du Toit se Baai, etc.) west and north of the proposed wind farm. Observers traveling west along this road will become aware of the wind farm at a distance of approximately 10km (based on the visibility analysis). The photo simulation below shows the wind turbines at an average distance of 8km. The structures become recognisable as wind turbines and feature prominently in the landscape. This is due to the fairly large horizontal extent (8.5km) of the turbine layout (i.e. the width of the facility and the aspect of the view). It is however still difficult to judge the scale of the facility at this distance due to the lack of other familiar structures or prominent topographical features.

A similar view (visual experience) of the facility can be expected from the Skilpadvlei homestead and farm as displayed in views 2 and 3.

Figure 17: Photo simulation - View 2 (average distance 8km)

View 3 - Short distance view from Skaapvlei road

As the observer continues west along the Skaapvlei road the wind turbines will be unmistakable and the facility will fill the frame of vision. The photograph below (taken from an average distance of 5.6km) is a partial view of the facility (i.e. more turbines appear on either side of the photo). The closest turbines (no's. 95 to 98) are about 4.2km from this viewpoint.

Figure 18: Photo simulation - View 3 (average distance 5.6km)

Views 4 and 5 - Medium to long distance views from coastal road

The approach to the facility, travelling south-east along the coastal road (from Brand se Baai to the WEF/Koekenaap), yielded similar results as indicated above (views 1 to 3). The difference in terrain (undulating plains) however dictates that only portions of the turbines are exposed. View 4 once again shows indiscernible white dots on the horizon whilst view 5 exposes the blades of some (only about 15) of the turbines.

Figure 19: Photo simulation - View 4 (average distance 15km)

Figure 20: Photo simulation - View 5 (average distance 10km)

View 6 - Short distance view from the Skaapvlei area

The photo simulation from viewpoint 6 is displayed in figures 21 to 23. The views (from top to bottom) show the wind turbines as viewed from left to right (north to south). The average distance to the center of the wind turbine layout is indicated as 5km, but the closest turbines (no's. 1, 27 and 53) are at a distances ranging from 1.7km to 2km. The first photo includes the Skaapvlei settlement to the left (north) of the facility at a distance of about 650m from the closest turbine.

The viewing aspect of the wind turbines is different from view 3 (figure 18 above) in the sense that the facility is viewed from the shortest side (i.e. along the length of the rows of turbines). This has as an effect the denser appearance of the wind turbines in neat rows and subsequently increases the visual impact of the facility. Figure 23 offers a good example of the staggered effect (to the extreme right of

the facility) of the turbines viewed from this angle. Also note the Atlantic Ocean (Die Toring) to the far right of the photograph.

Observers from the farm Nooitgedag south-east of the facility is expected to have a similar view (visual experience) of the wind energy facility as shown in these photo simulations.

Figure 21: Photo simulation - View 6A (average distance 5km)

Figure 22: Photo simulation - View 6B (average distance 5km)

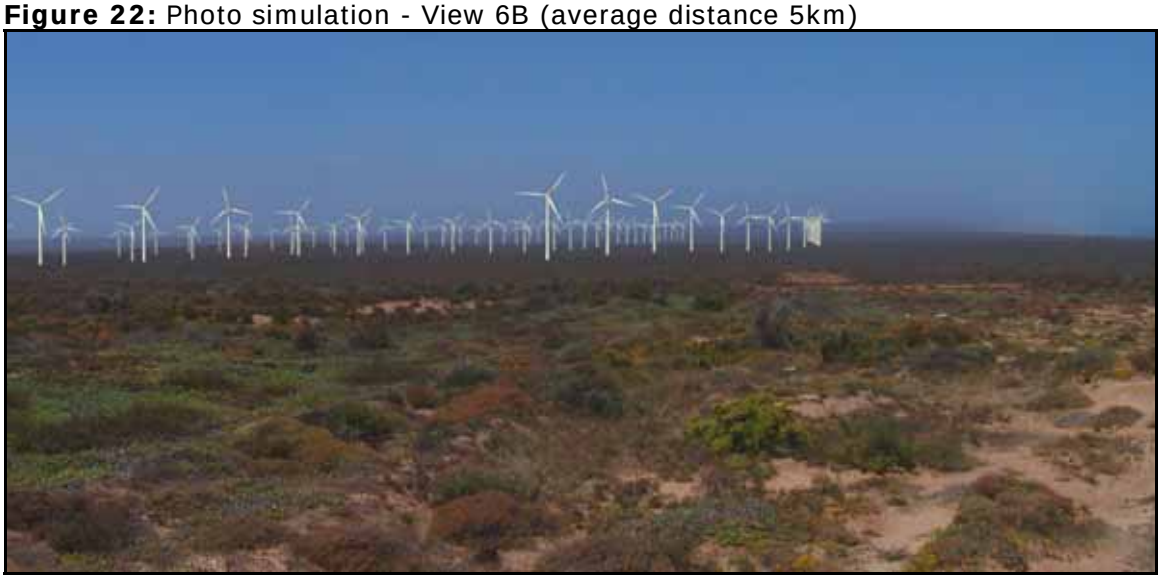

Figure 23: Photo simulation - View 6C (average distance 5km)

View 7 - Medium to short distance coastal view from Die Toring

Section *6.2. Visual Impact Assessment* addressed the potential visual impact of the WEF on the coastline. View 7 from Die Toring is a good example of the potential visual exposure of the wind turbines to a place of interest along the coastline. The photograph was taken from Die Toring at approximately 20m elevation above sea level. The average distance from the center of the facility is 8km whilst the closest turbine (no. 26) is about 4.6km. The appearance of the turbines is not as crisp and defined as seen in view 6. This is due to the observer viewing the facility in a north-westerly direction (i.e. looking into the sun) and the presence of a misty haze from the Atlantic Ocean.

A closer inspection of the photograph (top right-hand corner) reveals the blades of the turbines situated closest to the observer. This illustrates the degree to which the cliffs shield the facility from the coastline. As the observer descends further down towards sea level more turbines would be concealed. Moving further up the almost 60m high coastal foreland (i.e. away from the coastline), would alternately expose more turbines. Also note the degraded nature of the cliffs where mining activities take place.

Figure 24: Photo simulation - View 7 (average distance 8km)

8. CONCLUSION / RECOMMENDATIONS

The placement of the wind energy facility and its associated infrastructure will have a visual impact on the natural scenic resources of this region. The natural and relatively unspoiled wide-open views surrounding the WEF will be transformed for the entire operational lifespan (approximately 30 years) of the plant. The author is however of the opinion that the WEF has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy to generate power and is therefore generally perceived in a more favourable light. It does not omit any harmful byproducts or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a novel and futuristic design that invokes a curiosity factor not present with other conventional power generating plants. The advantage being that the WEF can become an attraction or a landmark within the region that people would actually want to come and see. As it is virtually impossible to hide the facility, the only option would be to promote it.

This opinion should however not distract from the fact that the facility would be visible for a large area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial style structures.

There are not many recommendations as to the mitigation of the visual impact of the core facility (mainly the wind turbines) as no amount of vegetation screening or landscaping would be able to hide structures of these dimensions. The facility and its surrounds should generally be maintained in a neat and appealing way. This applies to the associated infrastructure (transmission line, substation, site office, access road, etc.) of the WEF as well.

The construction phase of the facility should be sensitive to potential observers in the vicinity of the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility. Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The watering of the access road, or ideally the tarring of the road, timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

A lighting engineer should be consulted to assist in the planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass.

The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.

9. REFERENCES

Civil Aviation Authority (CAA), *SA-CATS AH 139.01.33:Obstacle Limitations and Markings Outside Aerodrome or Heliport (Marking of Obstacles)* and *Aviation Act, 1962 (Act No. 74 of 1962) Thirteenth Amendment of the Civil Aviations Regulations (CAR's) 1997*

Chief Director of Surveys and Mapping, varying dates. *1:50 000 Topo-cadastral Maps*

CSIR/ARC, 2000. *National Land-cover Database 2000 (NLC 2000).*

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

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

Stephen Townshend, 2007. *Photo Simulations*