**MAINSTREAM RENEWABLE POWER**

# Proposed Development of a Wind Farm near Noupoort, Northern Cape

## Visual Impact Assessment Report, EIR Phase

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# MAINSTREAM RENEWABLE POWER

# PROPOSED DEVELOPMENT OF A WIND FARM NEAR NOUPOORT, NORTHERN CAPE

# VISUAL IMPACT ASSESMENT REPORT (EIA PHASE)

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## 1 INTRODUCTION

SiVEST have been appointed by Mainstream Renewable Power to undertake an EIA study for the proposed development of a wind farm near the town of Noupoort in the Northern Cape. As part of the EIA studies being conducted for the proposed development, the need to undertake a visual impact assessment study has been identified. Accordingly a scoping-level visual impact assessment study was initially conducted to identify all potential visual impacts and issues related to the proposed development. This study has now been followed up with a more detailed visual impact assessment in the EIR phase.

The EIR-phase study aims to identify how the visual environment and in particular the sensitive receptors within the study area may be affected by visual impacts associated with the proposed wind farm, and associated infrastructure (such as power lines). A detailed methodology has been developed to assess the visual impacts associated with the proposed power lines at the level of each receptor.

### 1.1 Project Description

At this stage, it is estimated that the proposed project will encompass the installation of a number of wind turbine generators and their associated components in order to generate electricity that is to be fed into the existing Eskom distribution and/or transmission lines that cross or are located nearby the proposed site. The total power generation capacity limit and the number of wind turbines to be accommodated will ultimately depend on the size of the developable area which will be determined by the EIA. However, it is currently envisaged that 93 wind turbines are to be developed with a cumulative generation capacity of 214 Megawatts (MW). The voltage of the connection lines from the wind farm substation to the grid will be dependent on the total generation capacity and the actual available connection as determined by Eskom. The available

grid connection has a voltage of 66kV to 132kV. Ideally the project would tap into the 132kV line allowing a full 214MW to be fed into the grid. The EIA is being conducted for the full 214MW.

The key components of the project are:

### *1.1.1 Turbines*

The size of the wind turbines will depend on the developable area and the total generation capacity that can be produced as a result. The wind turbines will have a hub height of between 80 to 120m and a rotor diameter of 87 to 120m. The blade rotation direction will depend on wind measurement information received later in the process. The rotation will range from 6 to 20 rpm. The foundation of each wind turbine will be approximately 20m x 20m. The footprint for each wind turbine will therefore be approximately 400m². A hard standing area, of approximately 2 400m², for crane usage will accompany each wind turbine. As already mentioned, it is anticipated at this stage that 93 wind turbines will be constructed.

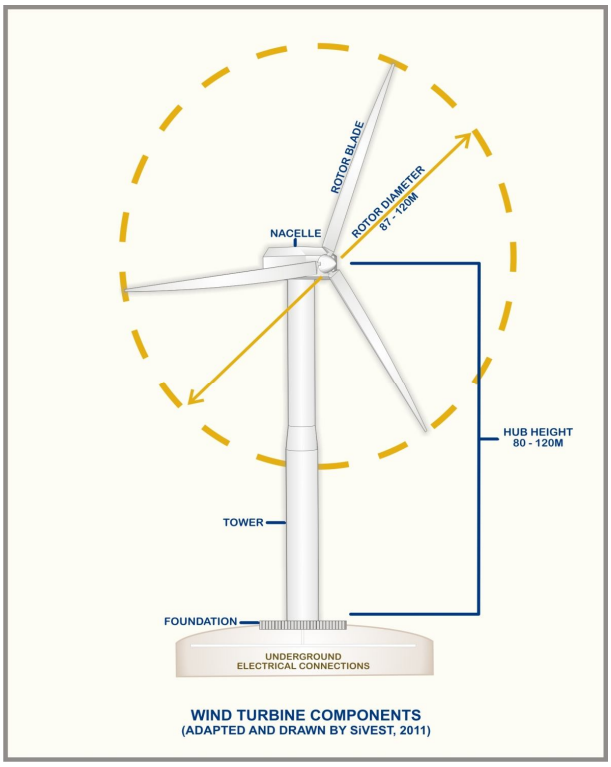



**Figure 1 - Typical Components of a wind turbine.**

### *1.1.2 Electrical Connections*

The wind turbines will be connected to each other and to the substation using buried (up to a 1m depth) medium voltage cables except where a technical assessment of the proposed design suggests that overhead lines are appropriate such as over rivers and gullies. Where overhead power lines are to be constructed, monopole tower structures will be used. The dimensions of the monopole structures will depend on grid safety requirements and the grid operator. No servitudes will be associated with the wind farm infrastructure although servitudes for Eskom infrastructure may be required on site. As previously mentioned, the electrical connection to the grid will be dependent on the total generation capacity and the actual available connection as determined by Eskom. The transmission lines could therefore have a voltage of 66kV to 132kV.

### *1.1.3 Substation*

A new substation (approx. 90 x 120m) and associated transformers will be developed which will supply the generated electricity to the Eskom grid. The transformers' operating voltage may range from 22, to 132kV. The footprint of the substation site will be approximately 10 800m². The substation will be built preferably close to existing distribution line(s). The connection from the substation to the Eskom grid line will be an overhead line and pole. This will be dependent on the location of the substation relative to the existing line(s). Eskom grid line and access servitudes will be required, the sizes of which will depend on the voltage connection.

### *1.1.4 Roads*

The access roads are proposed to be 6-10m wide. The roads will be gravel roads from the site on to the public road. An internal road network to the turbines and other infrastructure will include:

- Turning circles for large trucks.
- Passing points and culverts over gullies and rivers.

Existing roads will be upgraded.

### *1.1.5 Other Infrastructure*

Other infrastructure includes the following:

- Administration and warehouse buildings: A single storey building with a maximum area of 5 000 m² with a warehouse/workshop space and access, office, telecoms space, security

and ablution facilities are to be developed. The buildings will most likely be situated preferably close to the substation.

- Borrow pits (if required).
- Fencing (if required).

## 1.2 Study Site Location

The proposed development site of the wind farm is located to the east of the town of Noupoort. Noupoort is a small Northern Cape Karoo town located between Colesberg and Middelburg on the N9 national road. The site is located to the north of the "Oorlogspoort" district road, which links farming districts to the east and north-east of Noupoort with the town and the N9 road. The site location is indicated in the map below.

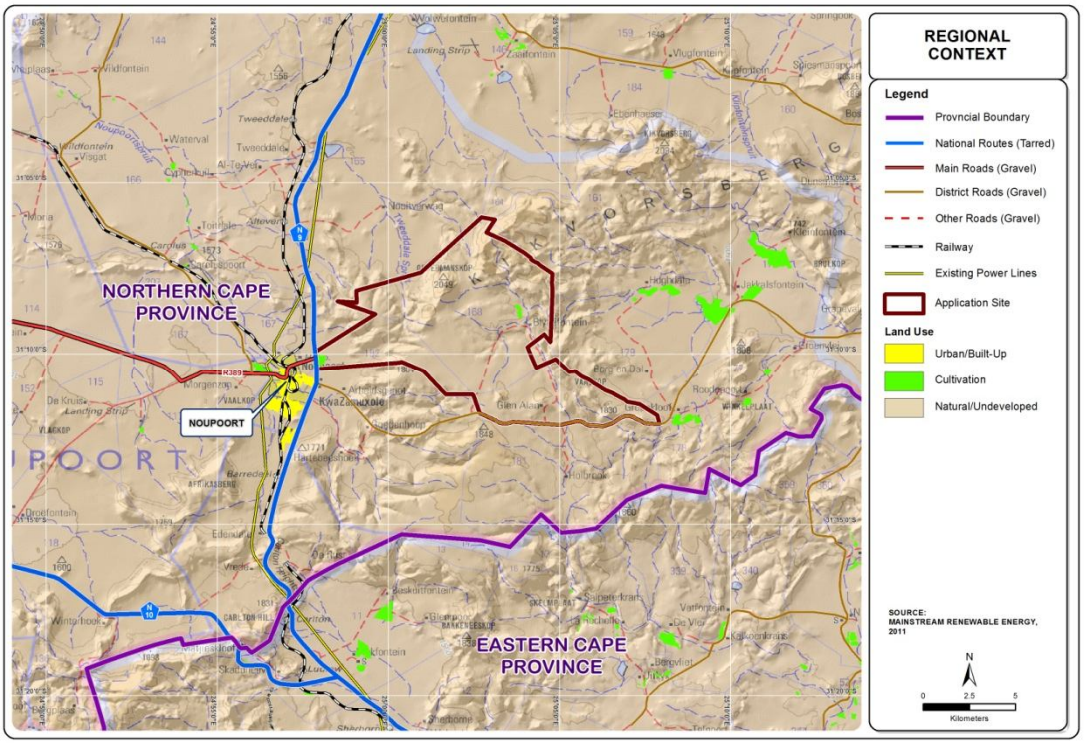



**Figure 2 – Site Location**

## 1.3 Assumptions and Limitations

The identification of visual receptors has been based analysis of the study area by means of a desktop search for households / farmsteads within the study area using Google Earth and 1:50 000 topo-cadastal maps. Where access allowed, these locations were ground truthed to confirm the presence of sensitive receptor locations. It should be noted that not all potential sensitive receptor locations were able to be visited due to access constraints. The 3D visualisation and visual contrast assessments have thus been unable to be undertaken for these locations

It should be noted that not all receptor locations may perceive the proposed wind farm infrastructure in a negative way. Where no receptor or property-specific feedback has been received, a number of broad assumptions have been made in terms of the identification of sensitive receptors; e.g. homesteads / farmsteads in a largely natural setting have been assumed to be likely to be sensitive from a visual perspective.

The assessment of visual impacts and the undertaking of 3D visualisation modelling have been undertaken for receptor locations within a *5km radius* of the proposed wind farm development site, the reason for which is explained in section 6 below.

A matrix has been developed to assist in the assessment of the potential visual impact at each receptor location. The limitations of quantitatively assessing a largely subjective or qualitative type of impact should be noted. The matrix is relatively simplistic in considering four main parameters relating to visual impact, but provides a reasonably accurate indicative assessment of the degree of visual impact likely to be exerted on each receptor location by the proposed wind farm. The results of the matrix should be viewed in conjunction with the visualisation modelling and the visual contrast rating to gain a full understanding of the likely visual impacts associated with the proposed wind farm.

The assessment of receptor-based impacts has been based on the final proposed turbine layout that has been provided by the proponent. It is recognised however that this layout is subject to possible changes based on a number of potential factors, including the final outcomes of the EIA and other technical factors. However the turbine locations are not expected to move significantly. This current layout has been used for the assessment of impacts and the 3D visualisation modelling.

Visualisation modelling has been undertaken for the proposed wind farm. It should be noted that due to budget limitations, the visualisation modelling of the proposed wind farm from all potential receptor locations has not been able to be undertaken. A reflective range of receptor locations for visually sensitive areas has been selected for modelling to provide an indication of the possible

likely impact along different parts of the corridor. It should be noted that this modelling is specific to the individual receptor location, and that even receptors in close proximity to one another may be affected in different ways by the proposed wind farm.

# 2 STUDY APPROACH AND METHODOLOGY

## 2.1 Assessment Methodology

### *2.1.1 Assessment of Study Area Visual Character*

An assessment of the Study Area's visual environment has been included in this report to contextualise the assessment of potential visual impacts and associated sensitivity. The summary includes a description of the physical characteristics of the Study Area that affect the visual environment, as well as an assessment of visual sensitivity. The concept of a cultural landscape in the context of the visual character of the study area is also explored.

### *2.1.2 Identification of Sensitive Receptor Locations*

The visual study has included a refinement of the identification of sensitive receptors considered during the EIR phase of the study from those identified in the Scoping Phase.

All potential receptor locations have been listed in tabular format, with the receptor name, nature of the receptor (e.g. farmstead, accommodation facility etc.) and the current location of the receptor (in the context of distance banding buffers from the site) presented.

### *2.1.3 Visual Impact Rating Matrix*

In order to assess the impact of the proposed wind farm at the level of each sensitive receptor location in the study area a matrix that takes into account a number of factors that have a bearing on visual impact is applied to each receptor location within a 5km radius of the development site. The matrix has been based on a number of factors relevant to the experiencing of visual impacts, and thus provides a combined indicative assessment of the likely visual impact that would be experienced at each receptor location.

### *2.1.4 Visual Contrast Rating and Visualisation Modelling*

An important aspect of any Visual Impact Assessment is the ability to visualise the proposed development within the context of the local landscape. This requires a clear understanding of the likely shape, size, alignment and location of the proposed development.

In order to visualise the proposed turbines comprising the proposed wind farm, it was necessary to provide some form of graphic representation or simulation of the proposed development in the relevant landscape. This involved the compilation of three dimensional, scale models of the towers and power lines using 3D modelling software. Using GIS software and Google Earth, the models were then positioned geographically within selected sections of the proposed wind farm which then allowed for the models to be superimposed on photographs taken from identified key observation locations. Although this process is not 100% accurate, it provides a useful means of visualising the project for professional teams and for interested and affected local communities.

In order to better understand the visual impacts associated with the proposed wind farm, a visual contrast assessment has been undertaken. This is done in order to quantify the degree of visual contrast or change that would be caused by the proposed wind farm and associated infrastructure at a number of key observation locations. Assessing the degree of visual change at key observation points has allowed a further judgement of the degree of 'acceptability' of the visual change to be made, and to suggest further mitigation measures to be suggested.

The visual contrast rating is undertaken by comparing a baseline (current) visual landscape baseline with the new visual landscape setting if the wind farm was to be developed. The methodology used is based upon the US Department of the Interior's Bureau of Land Management visual contrast rating methodology.

# 3 VISUAL CHARACTERISTICS OF THE STUDY AREA

## 3.1 Physical Landscape and Land use-related Characteristics and Visual Implications

Descriptions of the physical landscape characteristics of the study area, namely, topography, vegetation cover and land use, are included below as part of its visual characterisation.

The topography in the wider study area around the site is characterised by a mix of very flat plains (typical of much of the Karoo), as well as areas of much greater relief, including isolated dolerite-capped koppies and hilly terrain. The town of Noupoort (to the west of the site) is flanked by hills / koppies to the east and the west. Generally the areas to the north and west of the town are characterised by flat Karoo plains and isolated koppies. The natural vegetation comprises of very low scrub vegetation due to the natural aridity of the area. These plains are interspersed with farmsteads, the only locations where tall trees have been planted as these do not naturally occur. To the south and east of the town, areas of much more hilly character exist; drivers along the N9 highway travelling south past the town of Noupoort enter an area of much more incised topography after passing through the town. This hilly area around Carlton Heights extends into the area to the east of the town. The terrain to the east of the town (as traversed by the Oorlogspoort Road) rises up into a hilly landscape characterised by a mix of incised valleys and flatter, higher lying plateaux. These hilly areas similarly comprise of low scrubby vegetation, however the higher lying plateaux comprise naturally of open grassland, more typical of wetter grassland areas to the north-east of this area. Much of the development site is comprised by such a higher-lying plateau, which is flanked on most sides by hills and koppies which enclose the visual envelope of the area.

Due to the relatively arid nature of the area's climate, and the presence of outcropping of rock at the surface in many parts of the area, livestock rearing (cattle and sheep) is the predominant rural land use in the wider area on the development site. Only very small areas of suitable substrate and water availability along valley bottoms have been cultivated (for the purpose of growing fodder for livestock). As such the natural vegetation has been retained across the vast majority of the study area.

The nature of the climate and corresponding land use which entails that stocking densities are low has necessitated relatively large farm properties across the area. Thus the area has a very low density of rural settlement, with only a handful of scattered farmsteads occurring across the area. Built form in the rural parts of the study area is thus limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines, fences and the remnants of now abandoned workers' dwellings.

### *3.1.1 Visual Implications*

The mixed nature of the terrain across the study area has differing visual implications. Areas of flat relief (typical Karoo plains and higher-lying grassy plateaux) are characterised by wide ranging vistas, typically to the point at which surrounding hills / koppies enclose the visual envelope or local landscape (i.e. these hills form part of the horizon and areas beyond these hills cannot be seen). An example of this is from the town of Noupoort, where the hills that rise up from the plains to the east of the town frame the view, giving a relatively limited viewshed, whereas a much wider viewshed exists to the north of the town as the flat relief extends for quite a distance. Vistas in the hillier and higher-lying terrain can be more open or more enclosed, depending on the position of the viewer. Within some of the more incised valleys, the viewshed can be extremely limited, whereas from the higher-lying ridge tops or slopes, a much wider view or vista is available over a wide area. Importantly in the context of this study the same is true of objects placed in different elevations and landscape settings, with objects placed on high-elevation slopes or ridge tops being highly visible, and those placed within valleys or enclosed plateaux being visible from a much more restricted area.

The nature of land use in the rural parts of the area has been largely responsible for the area retaining a largely natural or 'pastoral' character, as the natural vegetation has been retained for grazing. The short, scrubby or grassy vegetation that occurs over the entire study area offers no visual screening in itself, and thus terrain / topography is the most important factor in limiting vistas. The only exception to this situation exists at local farmsteads where trees and shrubs that have been planted over many decades around the farmstead have become established, and provide effective screening from the surrounding areas. This is discussed further in the ensuing sections.

## 3.2 Visual Character and the importance of the Karoo Cultural Landscape

As has been explained above, the physical and land use-related characteristics of the study area contribute to its visual character. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as electrical infrastructure. Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a visual baseline in which there is little evidence of human transformation of the landscape. This is not to say that landscapes transformed by man are necessarily visually degraded, as many landscapes and visual settings around the world are a product of hundreds or even thousands of years of human influence, and thus represent a

perceived 'natural visual baseline'. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being very different to a largely natural undisturbed landscape.

Built infrastructure within most of the study area is limited to a low density of gravel access roads, boundary fences, very few farm buildings and other farming infrastructure such as windmills. As explained above, the low density of human settlement and associated low level of change to the natural environment engenders the area with a largely natural visual character which can best be described as a rural or pastoral visual character.

The only divergence from this rural character is in the area around the town of Noupoort. Although it is a small town, Noupoort has a concentration of housing and other buildings such as schools, hospitals and churches, as well as relatively large railway shunting yards to distinguish it from the surrounding rural landscape. The town and its immediate surrounds thus have an urban visual character, which means that it is characterised more by anthropogenic objects (such as buildings and roads) than natural features. However it should be noted that the small population of the town, and its limited spatial extent entail that it is firmly set in a rural setting, and the rapid change from the edge of the town to rangeland or commonage contributes to the limited spatial extent of its particular urban visual character.

The greater study area can thus be considered to be typical of a Karoo or "platteland" landscape that would typically be encountered across the high-lying dry western and central interior of South Africa. Much of South Africa's dry Karoo interior consists of wide open, uninhabited spaces sparsely punctuated by widely scattered farmsteads and small towns. Traditionally the Karoo has been seen by many as a dull, lifeless part of the country that was to be crossed as quickly as possible en route between the major inland centres and the Cape coast. However in the last couple of decades this has been changing, with the launching of tourism routes within the Karoo, and the promotion of tourism in this hitherto little visited, but large part of South Africa. In a context of increasing urbanisation in South Africa's major centres, the Karoo is being marketed as an undisturbed getaway, especially as a stop on a longer journey from the northern parts of South Africa to the Western and Eastern Cape coasts. Examples of this may be found in the relatively recently published "Getaway Guide to Karoo, Namaqualand and Kalahari" (Moseley and Naude-Moseley, 2008) and the promotion of the Mid-Karoo Tourism Route (e.g. http://www.openafrica.org/route/Mid-Karoo-Route) as well as the Karoo Heartland Tourism Marketing Association (Karoo Crawl - www.karooheartland.com). The exposure of the Karoo in the national press during 2011 as part of the debate around the potential for fracking (hydraulic fracturing) mining activities has brought the natural resources, land use and lifestyle of the Karoo into sharp focus, with many potential objectors stressing the need to preserve environment of the Karoo, as well as preserving the 'Karoo Way of Life', i.e. the stock farming practices which are

highly dependent on the use of abstracted ground water (e.g. refer to the Treasure Karoo Action Group website http://treasurethekaroo.co.za/).

These examples of how the Karoo is valued provide a good example of how the typical Karoo landscape can be considered a valuable 'cultural landscape' in a South African context. Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world; the concept of 'cultural landscape' is a way of looking at place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). The cultural landscape concept is a relatively new one in the heritage conservation movement across the world. In 1992 the World Heritage Committee adopted a definition for cultural landscapes:

*Cultural landscapes represent the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal*

Cultural Landscapes can fall into three categories (according to the Committee's Operational Guidelines) (UNESCO, 2005):

i) "a landscape designed and created intentionally by man";
ii) an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The typical Karoo landscape of wide open plains, and isolated relief, interspersed with isolated farmsteads as well as windmills and stock holding pens, is an important part of the cultural matrix of the South African environment. The presence of the Karoo farmstead, as well as the ubiquitous windmill, fence line and herds of sheep is an important representation of how the harsh, arid nature of the environment of this part of the country has shaped patterns of human habitation and interaction with the environment in the form of the predominant land use and economic activity practiced in the area over centuries of human habitation. The presence of, and spatial orientation of small Karoo towns, such as Noupoort, engulfed by an otherwise rural environment, form an integral part of the wider Karoo landscape. As such the Karoo landscape as it exists today has value as a cultural landscape in a South African context. In the context of the types of cultural landscape listed above, the Karoo cultural landscape would fall into the second category, that of an organically evolved, "continuing" landscape.

In the context of the study area, the various landscapes, as visible to the viewer, present excellent examples of such a Karoo cultural landscape. The N9 national road that is the main arterial route through the area, as well as the Oorlogspoort un-surfaced district road, presents a number of typical Karoo, as well as (importantly) highly scenic vistas within the study area. The presence of the hilly terrain to the south, east and west of the town of Noupoort greatly elevates the scenic value of the area, as the landscape is framed by the hills surrounding the town, adding great scenic value to the town and its environs. A significant change to this landscape has the potential to degrade its aesthetic quality and to threaten the conservation or preservation of the particular cultural landscape in a local context. In this context the significant potential visual intrusion posed by the proposed wind farm may have implications for the aesthetic quality and degradation of the visual character and thus the cultural landscape within the study area, although it is recognised that cultural landscapes are not necessarily static, but can be evolving. The potential for impact of the proposed wind farm on the Karoo cultural landscape in a local context is explored in more detail below (refer to section 7 below).

**Figure 3 – A typical vista within the study area**

# 4 VISUAL SENSITIVITY

The visual character as discussed above engenders the study area with a certain level of visual sensitivity. This sensitivity can be defined in the context of change of the visual environment, and the potential for the resource quality to be degraded by a proposed development (such as the proposed development) which could result in change in the visual character of the area. As described above, the visual character of the area is strongly linked to its natural and rural characteristics, with a strong scenic component. A very important factor contributing to the scenic quality of the site is the presence of elevation in terms of the site topography. As described above, the hills on the site mark a distinct landform change from the surrounding plains and flats; due to this distinction these areas will be the parts of the site most visible to surrounding areas, especially as they will tend to draw the focal attention of the viewer when looking onto the site as they mark a contrast from the flatter areas surrounding them. Topographical relief in a flat landscape typically brings a scenic element to that landscape, as scenic quality or visual quality of a landscape typically increases with greater relief, as well as with increasing complexity of visual elements; As stated by Porteous, (1996), the greater the topographical variation, the greater the scenic quality (see also the references quoted in Wu *et al*, 2006). These factors of increased elevation and thus increased visibility, as well as the increased scenic component associated with these landscape features engenders these features with a strong degree of visual sensitivity.

In the context of the wider area there are relatively few anthropogenic objects within the landscape, and those that are present are typically associated with the rural landscape typical of the area. An important component of visual sensitivity is the presence, or absence of visual receptors that may value the aesthetic quality of that landscape. As described below, a number of receptor locations that are potentially sensitive receptors are present in the study area. Although no formal protected areas or leisure / nature-based tourism activities exist within the study area, the context of the study area as a rural area with a low density of human change and influence in the landscape provides the landscape with a certain level of visual sensitivity. In this context, the potential visual impact of the proposed wind farm on the visual environment of the study area must be examined.

## 4.1 Visually sensitive areas on the site in the context of wider environmental sensitivity

During the latter stages of the EIR phase, all EIA team project specialists were requested by the Environmental Assessment Practitioners (EAPs) to indicate environmentally-sensitive areas within the development site. This exercise was undertaken to allow a GIS-based spatial analysis

of sensitive parts of the site to be undertaken to feed into the design of the draft final turbine layout.

As indicated in Section 5 below there are no visual receptors located within the development site itself, the visual assessment of sensitive areas on the site had to be undertaken in a reverse manner. The aim of the assessment was to identify those parts of the site where locating turbines or other infrastructure would be associated with the greatest chance of visual impacts on surrounding areas. Although not specifically sensitive from a visual perspective (as the surrounds of a receptor location would be), these areas are important in a spatial assessment of visual sensitivity as exclusion areas where the turbines should not be placed; i.e. areas to be avoided.

A number of different spatial characteristics were utilised to identify these areas. As indicated in figure 8 below, sensitive receptor locations are located around the site, but a cluster of sensitive receptors is located to the west and south-west of the site in the vicinity of the town of Noupoort. The N9 highway, viewed as a sensitive receptor road also runs to the west of the site. Due to the nature of the topography of the area, the higher ground on the site rises up as a series of hills from the flatter ground in the vicinity of Noupoort and the N9 highway. Viewed from these areas, the site forms an escarpment-like feature, with the highest points of the hills masking the slightly lower elevation plateau to the east of this 'escarpment'. Any infrastructure placed to the west of this 'escarpment edge' (on the town-side or western-facing aspects of this rising ground) would be highly prominent and thus potentially obtrusive due to the nature of the topography. Using GIS analysis and in-field observations, the approximate limit of the viewshed from the town and N9 (i.e. the top of the rising ground or 'escarpment edge') was delineated in GIS. All areas of the site to the west of, and of lower elevation than the 'escarpment edge' were delineated as no-go or exclusion areas. In addition, due to the potential height of the turbines that would be visible from the flats on ground to the east of this 'escarpment edge', a further buffer of 1km to the east of this line was included as a no-go or exclusion area, as indicated in the figure below; the blue line represents the escarpment edge, with the light blue shaded areas representing the no-go areas west of this line and the pink areas the 1km buffer to the east of the escarpment edge.

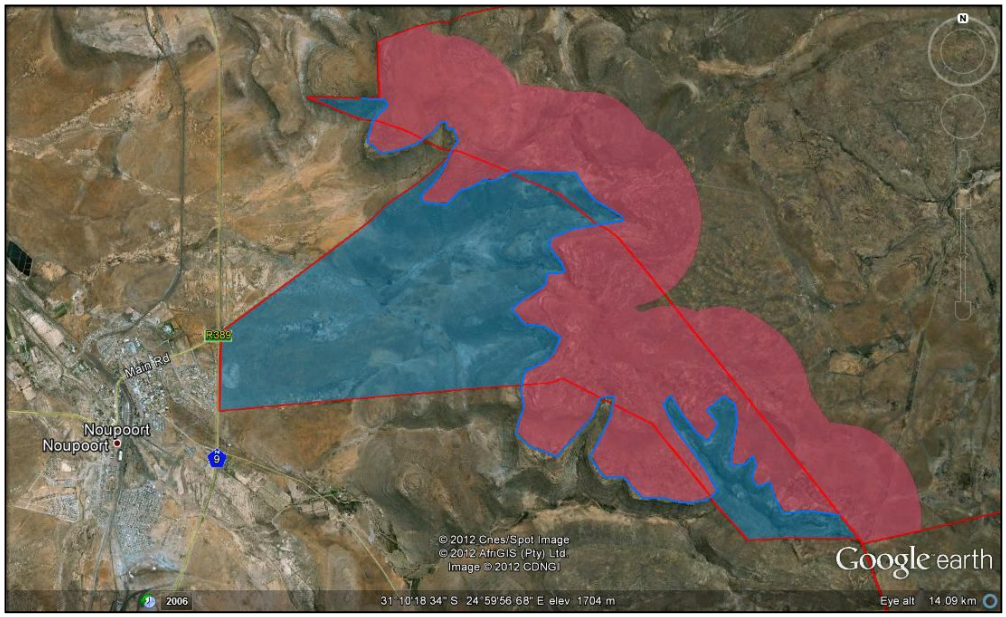



**Figure 4 – Aerial View in Google Earth of the visual exclusion zones west and east of the escarpment edge**

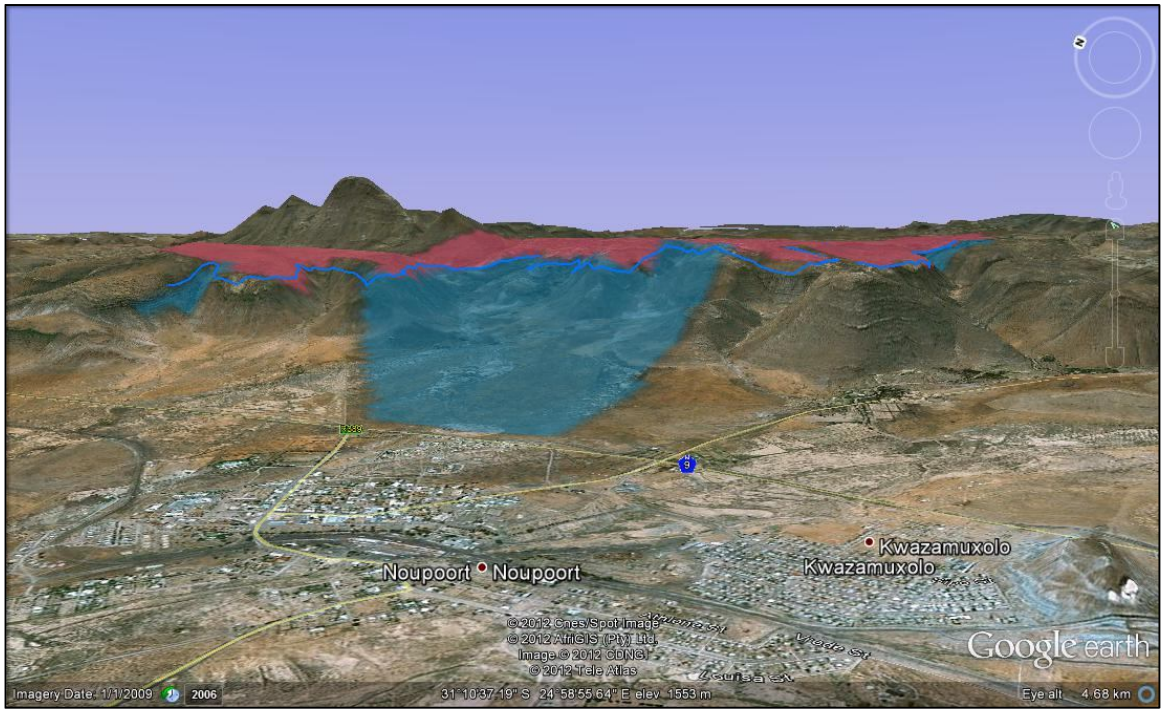



**Figure 5 – Google Earth Image indicating an 'aerial view' of Visual Buffers and Exclusion Zones within the development site (note the terrain elevation factor has been exaggerated for effect)**

The figure above indicates a number of high points on the development site that are highly visible due to their elevation. These high points, in particular Oppermanskop, as well as another high ridge in the northern-most part of the site and a north-south-running ridge in the eastern part of the site are prominent topographical features on the site that are highly visible from large areas in every direction from the site. Analysis of the site reveals that most of these elevated areas are above a contour of 1800m a.s.l. Due to the elevated position and visual prominence, any infrastructure, in particular turbines, placed above this elevation would be highly prominent and also potentially visually intrusive. As such all parts of the site above an elevation of 1800m have been marked as no-go areas from a visual perspective, as indicated in the map below.

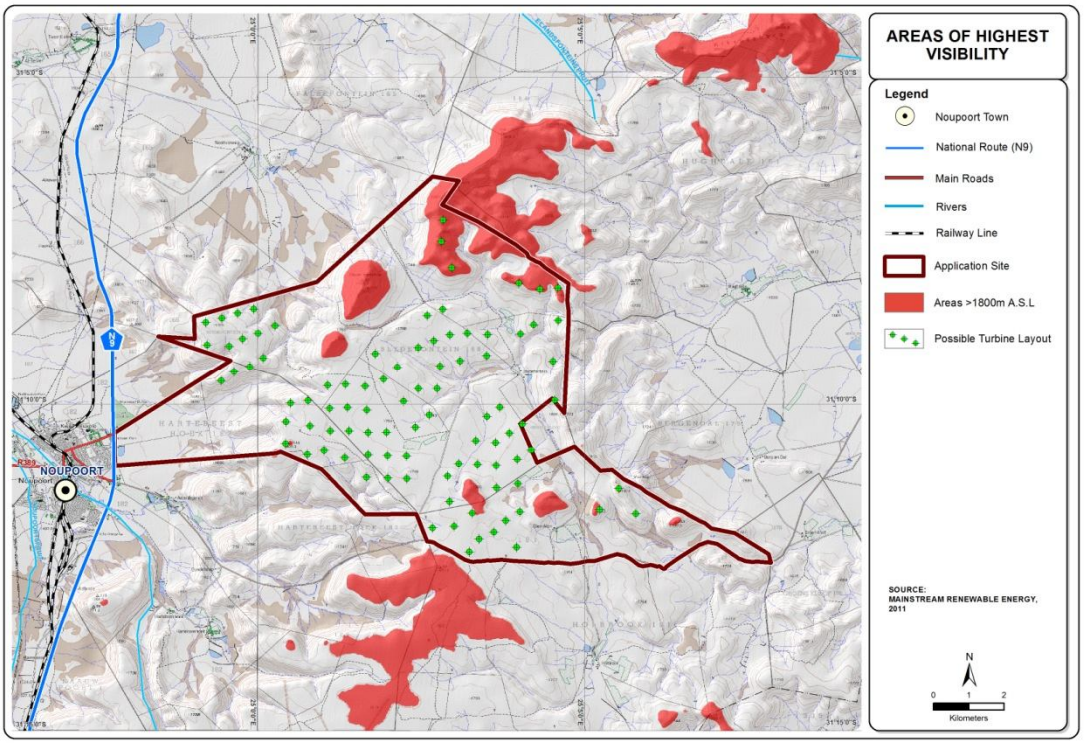



**Figure 6 – Exclusion areas of an elevation greater than 1800m a.s..l**

Lastly the Oorlogspoort Road runs very close to the southern boundary of the site. As mentioned earlier in this report the road climbs up into the hilly ground to the east of Noupoort and is highly scenic. For this reason the road has been designated as a sensitive receptor road. In order to reduce potential intrusion of turbines within the viewshed of the road, a 500m exclusion buffer has been created within the part of the site that lies adjacent to the road.

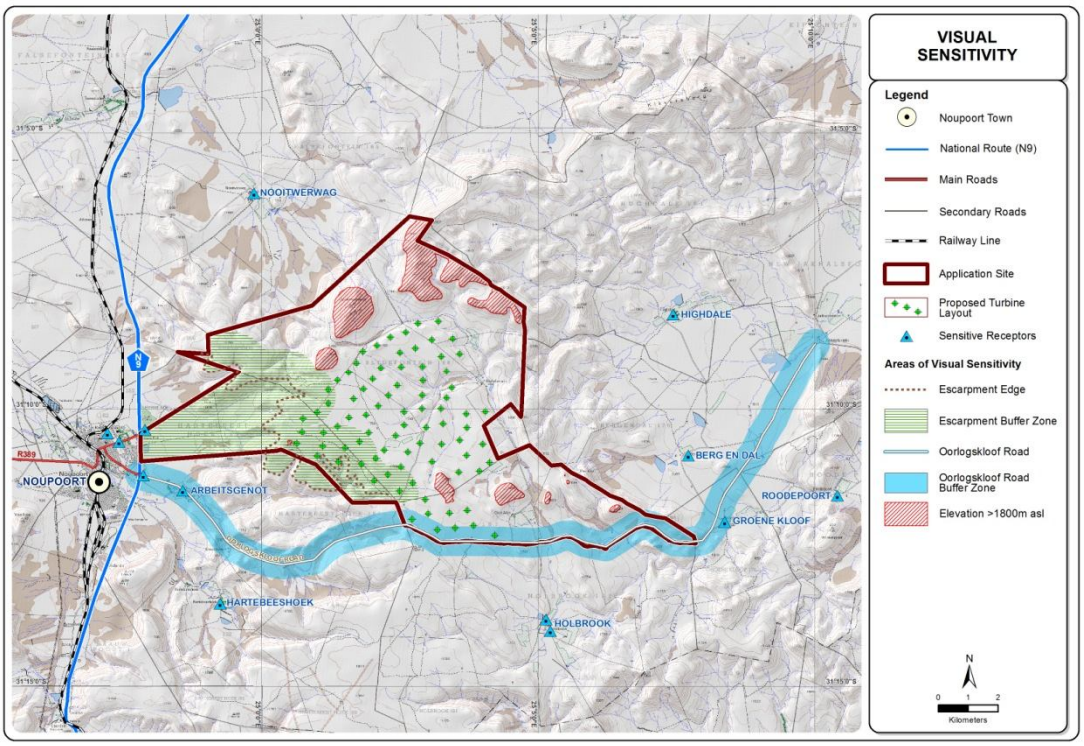



**Figure 7 – Map showing all visual exclusion areas on, and around the development site**

# 5 PRESENCE AND LOCATION OF SENSITIVE RECEPTORS

A sensitive receptor is defined as a receptor which could experience a potential adverse visual impact due to a development such as the proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described below the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the wind turbines into a 'view', which may affect the 'sense of place' associated with a particular landscape. The identification of sensitive receptors was initiated in the scoping phase of the project and has been refined through ground-truthing in this phase of the project.

## 5.1 'Static' Visual Receptors and Key Observation Locations

The table below lists all of the sensitive receptor locations that have been identified throughout the EIA phase that would be potentially visually affected by the proposed wind farm. The table includes those receptor locations within a 5km radius of the development site.

| Sensitive Receptor Location | Distance Band Zone in which Receptor is located |
|---|---|
| Nooitverwag Farmstead | 3-5km |
| Noupoort – Residences on the eastern and northern edge of the town | 500m-1km & 1km-2km |
| Noupoort Golf Course | 0m-500m |
| Households at start of Oorlogspoort Road | 500m-1km |
| Aarbeidsgenot Farmstead | 1km-2km |
| Haartebeeshoek Farmstead | 2km-5km |
| Holbrook Farmstead – upper | 2km-5km |
| Holbrook Farmstead – lower | 2km-5km |
| Roodepoort Farmstead | 1km-2km |
| Groenkloof Farmstead* | 2km-5km |
| Berg-en-dal Farmstead | 2km-5km |
| Hughdale Farmstead | 2km-5km |

5km has been selected as the radius within which receptor locations have been identified, as although the turbines are likely to be visible beyond 5km, any significant visual impact is likely to be experienced within this zone. Beyond 5km, the visual impacts are less significant as the visibility of an object decreases exponentially over larger distances.

* - Groenkloof Farmstead has been listed as a sensitive receptor location, although it should be noted that this is the residence of one of the landowners of the site.

Of these static sensitive receptor locations, as well as certain sensitive receptor roads, a number have been designated as key observation locations – on which the visual contrast rating has been undertaken. These are listed in section 5.3 below.

The map below indicates the location of the sensitive receptors around the site.

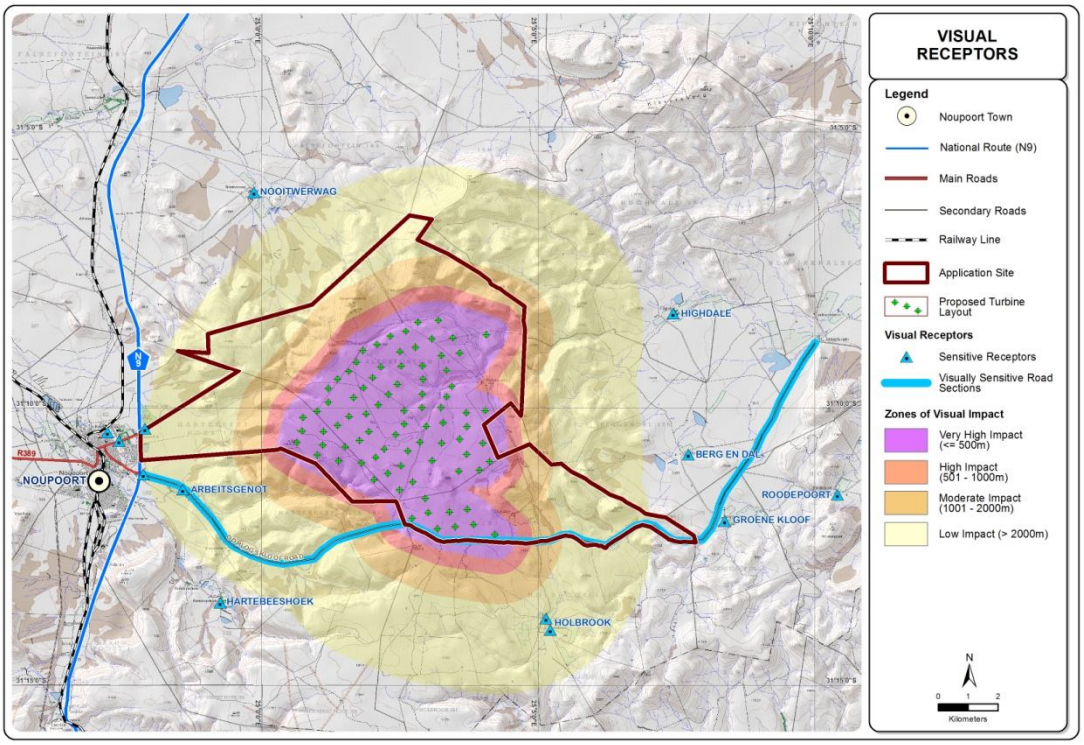



**Figure 8 – Location of Sensitive Receptors and Sensitive Receptor Roads in the Study Area, along with the distance banding from the turbine layout.**

## 5.2 Sensitive Receptor Roads

A number of roads may be considered to be sensitive receptor locations. Motorists travelling along these roads may experience a visual impact associated with the proposed wind farm, especially if the turbines are visually intrusive and detract from the aesthetic quality of the natural landscape through which the motorist is travelling. It is important to note however that the impact would typically be temporary in nature due to the mobile nature of the receptor(s). For this reason the intensity of the impact would be greatly reduced.

As described above, the N9 passes through a very scenic area as it approaches the town of Noupoort, and this road can be considered to be the primary sensitive receptor road through the area, in spite of being a regional arterial road. It is important to note that the road in the Noupoort area marks an important landscape change for motorists travelling south; there is a change from the Karoo flats and plains that are typical of this road and the N1 to the north and south of Colesberg to much more mountainous terrain characterised by the Carlton Heights pass to the south of the town. This mountainous area represents the start of the great escarpment in the area

that separates the high-lying interior from this coastal hinterland to the south. The hills to the east of Noupoort are the first indication of this escarpment area which is highly scenic. Turbines placed in the far western and northern parts of the site are likely to be highly visible for motorists travelling along this road and are likely to draw attention as the view of motorists would be drawn to this area of higher relief. Other sensitive receptor roads include the following:

- the Oorlogspoort un-surfaced district road – this roads climbs up into the highly scenic hilly terrain in the vicinity of the site, although it appears to be utilised primarily as a local farm access road. A section of the road passes very close to the site, thus turbines placed in the southern part of the site, especially on higher ground will be highly visible from the road.
- the R389 provincial (un-surfaced) road that runs to the west of Noupoort – for motorists travelling into Noupoort from the west this road travels directly towards the site. In the setting of flat Karoo plains, the motorist views the hills of the site prominently the closer one drives to Noupoort. These hills dominate the vista in front of the motorist, and turbines placed on top of the higher parts of the site would be highly visible
- a number of local farm access roads which be utilised primarily by the inhabitations the farms and which would include the following:

i) the farm access road to the Nooitgedacht farmstead
ii) the Berg-en-dal and and Hughdale shared access road
iii) the Roodepoort farm access road
iv) the Holbrook Farm access road
v) the Hartebeeshoek farm access road
vi) the Toitdale farm access road

Together certain of the static receptor locations and certain points on the sensitive receptor locations comprise the key observations locations that are further characterised in the section below.

**Figure 9 – View of the hills on the proposed development site from the R389 road to the west of Noupoort**

## 5.3 Landscape Visual Baseline at Key Observation Locations

In order to allow the effect of the visual contrast at the key observation locations within the study area to be assessed, the visual baseline of the landscape at these locations needs to be established. As prescribed by the US Department of Interior's Bureau of Land Management's Visual Resource Management Methodology, it is important to describe the visual baseline of the landscape at each key receptor location in order to allow the objective assessment of the degree of change in visual contrast that would result from the proposed wind farm. This study has used a methodology to establish the degree of visual contrast that is largely based upon the BLM visual contrast rating methodology. This methodology prescribes that a number of basic structural elements of different physical components of the landscape at a key observation location be assessed. These basic elements include:

- Form
- Line
- Colour
- Texture

According to the methodology the landscape is divided into three components of which landscapes are typically comprised:

- Land form (Topographic units)

- Vegetation (including natural vegetation and planted vegetative features such as fields)
- Human Structures (e.g. buildings, power lines, etc.).

A set of tables has been developed which evaluates the visual baseline at each key observation location. As these tables are used in the process of the visual contrast assessment, they are contained in the impact assessment section below. However a brief summary of the visual baseline at each key observation point is contained in the table below.

| **Key Observation Locations** | **Landscape Visual Baseline** |
|---|---|
| Noupoort – Wilmot Street Houses | Strong horizontal lines due to landform (background range of hills) and vegetative (line of exotic trees) that contrast with one another in style and texture. Strong, relatively simple line on horizon created by hills |
| Noupoort – Main Road | Strong banding in landscape due to the road and line of tall trees as dominant features. Bold, but simple horizontal lines dominant with some vertical lines in foreground. Generally dark colouration. Fine-grained texture of hills in background not dominant |
| Noupoort Golf Course entrance | Simple, natural landforms that create indistinct dimensional shape and mass, however the cliffs on the hills and the skyline (horizon) of the hills are a strong focal point. Subtle colours in both landform and vegetation. Fine-grained to uniform texture of hills and flats respectively creates little contrast. Highly natural context |
| N9 highway north of Noupoort* | Simple, natural landforms that create indistinct dimensional shape and mass, however the ridge top lines and skyline (horizon) of the hills are a strong focal point. Subtle colours in both landform and vegetation. Fine-grained to uniform texture of hills and flats respectively creates little contrast. Highly natural context |
| Holbrook Farmstead – upper | Undulating terrain, with weak, horizontal landform lines and weak vegetation lines, with limited contrast in colour and form due to darker exotic trees set against a background of a fine-grained texture of light yellow-green hues due to dominance of grassland vegetation. Highly natural context |
| Berg-en-dal and Hughdale Farms access road | Simple natural landforms with strong horizontal line component; ridge and hills in foreground and background provide focal point, in particular at the horizon. Little contrast in natural vegetation, but clump of exotic trees provides colour, form and line contrast, drawing attention. Highly natural context |
| R389 west of Noupoort* | Slightly complex, natural landforms that create indistinct dimensional shape and mass, however the ridge top lines and skyline (horizon) of the hills are a strong focal point. Subtle colours in both landform and vegetation. Fine- |

| | |
|---|---|
| | grained to uniform texture of hills and flats respectively creates little contrast. Highly natural context |

* - Note these locations are not within 5km of the development area, but have been included to allow the assessment of visual impacts associated with the proposed wind farm on sensitive receptor roads.

# 6 GENERIC VISUAL IMPACTS TYPICALLY ASSOCIATED WITH WIND FARMS

It is important to note that as yet, no large scale wind farms have yet been developed in South Africa, although within a few years wind farms approved recently in the late part of 2011 should be constructed in this country. The development and associated environmental assessment of wind farms in South Africa is relatively new, and thus it is valuable to draw on international experience. Thus this section of the report draws on international literature and web material (of which there is significant material available) to describe the generic impacts associated with wind farms.

A single wind turbine is a massive object and as such is highly visible. The standard turbine height is extremely large, with the hub height (from ground level to the base of the rotors) being between 80 and 120m. This is equivalent to building heights of between 27 and 40 storeys. The rotor blades would extend even higher, these being between 45 and 60m in length (equivalent to an extra 15 to 20 storeys when the rotor is in a vertical orientation). The height of the turbine thus means that the turbine would be typically visible from a large radius. A wind farm consists of a series of turbines spaced apart in groups around the site. The wind farm would thus typically be highly visible.

Much literature has explored public perceptions of wind farms and objection to them. In parts of the world where there has been wind farm development, wind farm developments are subject to opposition based around concerns about the transformation of natural landscapes into 'landscapes of power' (Warren, *et al,* 2005). This relates to the alteration of the visual character of an area, as discussed below.

Wind turbines are not a feature of the natural environment, but are rather representative of its human (anthropogenic) alteration. Thus when placed in a largely natural landscape, a wind farm could be perceived to be highly incongruous in the context of the setting. The height and grouping together of turbines would exacerbate this incongruity with the natural landscape, as the turbines would tend to impinge on views within the landscape. Internationally, studies have demonstrated that there is a direct correlation between the number of turbines and the degree of objection to a

wind farm, with potential opposition to a wind farm being lower when fewer turbines are proposed, with a preference for smaller, clustered groups of turbines over larger-scale installations. (Devine-Wright, 2005).

Internationally, wind farms are often perceived to be a source of visual impact if they affect or change the visual quality of a landscape, particularly in a natural or rural landscape within which the turbines would be considered to be highly incongruous. In the British Isles much of the opposition to wind farms has centred upon this factor; landscape-based impacts of wind farms have been exacerbated by the proposed development of wind farms in exposed upland areas which are valued for their scenic qualities and which are often ecologically sensitive (Warren, *et al,* 2005).

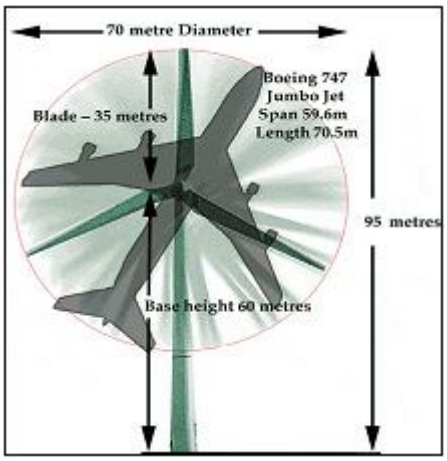
The perception of the viewer /receptor of impact is also very important, as certain receptors may not consider the development of a wind farm to be a visual impact. The perception of visual impacts is thus highly subjective and thus involves 'value judgements' on behalf of the receptor. A study of perceived visual impacts of wind farms in rural areas in the USA has demonstrated this phenomenon; they have argued that visual perceptions in the study area were based upon judgements of symbolic as well as rational aspects of a specific wind farm (e.g. its size, colour, shape, etc.). The assessment concluded that a person's evaluation of visual impact was based upon a combination of perceptions or judgements. These related to the abstract sculptural nature of turbines, their perceived intrusiveness in that specific context and, finally, the degree to which turbines symbolised 'higher' concepts (both positive and negative, such as the degree to which turbines are associated with wider environmental concerns such as climate change (Thayer and Hansen, 1988, as referenced in Devine-Wright,2005).

Visual-related perceptions of wind farms tend to be mixed, with many parties objecting to the wind farms, but conversely other views expressing the graceful nature of wind farms or the beauty associated with the turbines (Devine-Wright, 2005), or viewing wind farms as signs of progress, and importantly viewing wind farms as symbols of 'green' or renewable energy development (Warren, *et al,* 2005). The context of the landscape character, the scenic / aesthetic value of an area, and the types of land use practiced tend to affect the perception of whether a wind farm is an unwelcome intrusion, and thus the sensitivity of receptors to the erection of wind turbines in an area. Wind turbines are often perceived as visual impacts where value is placed on the scenic or aesthetic character of an area, and where activities such as tourism are practised which are based upon the enjoyment of, or exposure to, the scenic or aesthetic features of the area. Sensitivity to visual impacts is typically most pronounced in areas set aside for the conservation of the natural environment (such as protected natural areas or conservancies), or in areas in which the natural character or scenic beauty of the area acts as a draw card for visitors (tourists) to visit the area. Residents and visitors to these areas may perceive a wind farm to be an unwelcome intrusion that would degrade the natural character and scenic beauty of the area, and

which would potentially even compromise the practising of tourism activities in the area. Experience in the UK and internationally has proved that site location of wind farms and the locational setting is critical in terms of how they are perceived (Warren, *et al,* 2005).

Conversely, the presence / existence of other anthropogenic objects associated with the built environment may influence the perception of whether a wind farm is a visual impact. Where buildings and other linear structures such as roads, railways and power lines exist, the visual environment could be considered to be 'degraded' and thus the introduction of a wind turbines into this setting may be considered to be less of a visual impact than if there was no existing built infrastructure visible.

Certain objectors to wind farms mention the "sky space" occupied by the rotors of a turbine. As well as height, "sky space" is an important issue. "Sky space" refers to the area in which the rotors would rotate. The diagram below indicates that the "sky space" occupied by rotors would be similar to that occupied by a jumbo jet (http://www.stopbickertonwindturbines.co.uk/ - page on visual impact).

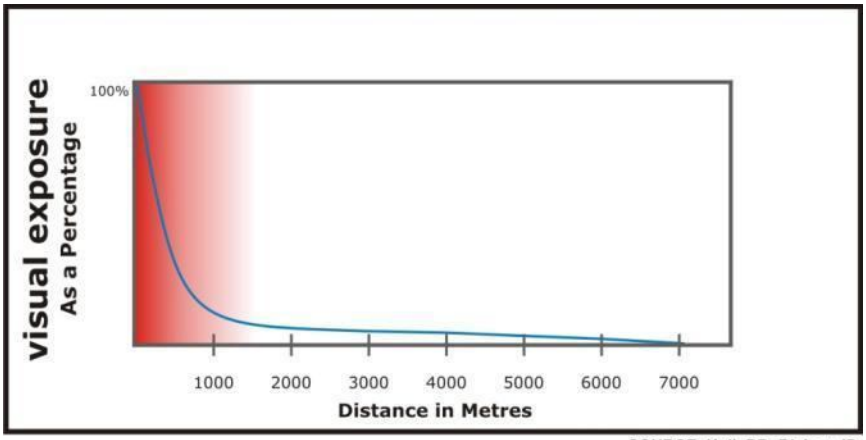



An important component of the visual impact associated with wind turbines is the *movement* of the rotors. Labelled as motion-based visual intrusion, this refers to the inclination of the viewer to focus on discordant, moving features when scanning the landscape. However evidence from surveys of public attitudes towards wind farms suggest that the viewing of moving blades is not necessarily viewed more negatively than views / visualisations of static blades (Bishop and Miller, 2006). The authors of that study suggest two possible reasons for this; firstly when the turbines are moving they are seen as being 'at work', doing good, producing energy, conversely when they are stationary they are an intrusion with no evident purpose. More interestingly the second theory that explains this perception is related to the intrinsic value of the wind in a certain area and how turbines may be an expression or extension of an otherwise 'invisible' presence. Famous winds across the world include the Mistral of the Camargue in France, the Föhn in the

Alps, or the Bise in the Lavaux region of Switzerland. The wind, in this sense, is an intrinsic component of these landscapes, being expressed in the shape of 'bent' trees or drifts of sands, but being otherwise invisible. The authors of the study argue that wind turbines in these environments give expression, when moving, to this quintessential landscape element. In a South African context, this phenomenon may well come to be experienced in areas where wind farms are developed where typical winds, like berg winds, or the south-easter in the Cape are an intrinsic part of the environment. This may be true for Noupoort, where feedback from the public in the initial stages of the public participation process has indicated that it is indeed a very windy place, in which wind turbines would be a very effective way of harnessing this potential energy. In this way, over time, it may well be possible that wind farms may come to form part of the cultural landscape of this area, being a representation of the development of the landscape through the opportunities presented by the natural environment (refer to section 7 below).

Visual impacts can be experienced by different types of receptors, such as people driving along roads, or people living / working in the area in which the wind turbines would be visible. The receptor type in turn affects the nature of the typical 'view' of a potential source of visual impact, with views being permanent in the case of a residence or other place of human habitation, or transient in the case of vehicles moving along a road. The nature of the view experienced affects the intensity of the visual impact experienced.

Viewing distance is a critical factor in the experiencing of visual impacts, as beyond a certain distance, even large developments such as a wind farm tend to be much less visible, and difficult to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially with increasing distance away from the object, with maximum impact being exerted on receptors at a distance of 500m or less. The impact decreases exponentially as one moves away from the source of impact, with the impact at 2000m being a quarter of the impact at 1000m away. At 5000m away or more, the impact would be negligible, as illustrated by the figure below.




SOURCE: Hull, RB; Bishop, ID

Interestingly, the literature does not reveal a direct correlation between those receptors located closest to existing turbines, and the level of objection to the wind farm – i.e. one may expect those most visually exposed to the wind farm to harbour the most negative perceptions towards it. However some case studies contradict this (Devine-Wright, 2005).

Other factors, as listed below can impact the nature and intensity of a potential visual impact associated with a wind farm:

- the location of the wind turbine in the landform setting – i.e. in a valley bottom or on a ridge top. In the latter example the turbine(s) would be much more visible and would 'break' the horizon.
- the presence of macro- or micro-topographical features such as buildings or vegetation that would screen views from a receptor position to the wind farm.
- The number of turbines that form part of a view
- temporary factors such as weather conditions (presence of haze, or heavy mist) which would affect visibility

The second point is very important in a local context as most static receptor locations (farmsteads) have vegetation around them which would effectively restrict views from the farmstead. However this shielding effect is then limited to the farmstead itself with much less restricted views away from it.

It is important to note that visual impacts are only experienced when there are receptors present to experience this impact; thus in a context where there are no human receptors or viewers present there are not likely to be any visual impacts experienced.

## 6.1 Shadow flicker

Shadow flicker is an effect which is caused when shadows repeatedly pass over the same point. It can be caused by wind turbines when the sun passes behind the hub of a wind turbine and casts a shadow that continually passes over the same point as the blade of the wind turbine rotates (http://www.ecotricity.co.uk).

The effect of shadow flicker is only likely to be experienced by people situated directly within the shadow cast by the blade of the wind turbine. As such, shadow flicker is only expected to have an impact on and cause health risks to people residing within houses that are located at a specific orientation and within close proximity to a wind turbine (less than 500m), particularly in areas where there is little screening present. Shadow flicker may also be experienced by and impact on motorist if a wind turbine is located in close proximity to an existing road. The impact of shadow

flicker can be effectively mitigated by choosing the correct site and layout for the wind turbines, taking the orientation of the turbines relative to the nearby houses and the latitude of the site into consideration. Tall structures and trees will also obstruct shadows and prevent the effect of shadow flicker from impacting surrounding residents (http://www.ecotricity.co.uk).

## 6.2 Associated Infrastructure

The new substation (approximately 90m x 120m, with the height of its components being no greater than 10m) and overhead power lines by their nature are large objects and will typically be visible for great distances. Power lines consist of a series of tall towers thus making them highly visible. Like wind turbines, power lines and substations are not features of the natural environment, but are representative of human (anthropogenic) alteration. Thus when placed in largely natural landscapes, they can be perceived to be highly incongruous in this setting. The existing power line infrastructure (to which the wind farm would link) are located to west of the site. As the turbines are proposed to be located in the hilly ground to the east of Noupoort, it is highly likely that the power lines would have to traverse the ridge to the east of town to link the site with the grid network. In this context power line towers may be highly visible, especially as they traverse the edge of the ridge, and may be associated with a significant intrusion factor as they may break the horizon.

Other associated infrastructure may also be associated with visual impacts. The turbines are inter-connected with a series of cables, which are likely to be buried, but which also may take the form of above-ground power lines. These cables may become a visual intrusion if placed in areas of the site that are visible to the surrounding areas, especially those areas that are located on ridge tops and side slopes of these ridges. A trench dug for the cable (both during construction and post-construction once the trench has become back-filled) may become prominent if it creates a linear feature that contrasts with the surrounding vegetation.

In a similar way access roads across the steep side slopes on the site may have an even greater effect. If turbines are placed on ridge tops, it is likely that access roads will be needed to be constructed to transport the turbine components up to the ridge top, and then to access the ridge-top turbine locations, once operational. On steep side slopes, a road may have to be 'cut' into the side slope, creating a prominent linear feature or 'scar' that texturally contrasts sharply with the natural vegetation hillside.

Lastly buildings placed in prominent positions such as on ridge tops may also break the natural skyline, drawing the attention of the casual viewer.

# 7 IMPACT ASSESSMENT

This section explores the likely visibility of the components of the proposed wind farm, and their effect on the viewing areas in the surrounding vicinity. The implications of the revised turbine layout (as compared to an earlier turbine layout) are examined, and the likely impact of the wind farm at each of the sensitive receptor locations is examined using a simplistic matrix that provides an indicative degree of impact. The degree of visual contrast from key observation locations before and after the development is also assessed to assist in the rating of the visual impacts associated with the proposed development. The assessment as undertaken using the visual impact rating matrix and the visual contrast rating require a layout of components as the basis on which to assess impacts, visibility and change, and thus the final proposed layout has been used for these assessments as it is the layout that would most likely be used should the development be approved.

## 7.1 Visual Implications of the Proposed Turbine Layout

In order to gain an understanding of the degree of visibility of the proposed turbines, the proposed turbine layout should be examined. The project proponent provided two layouts for assessment during the course of the EIA; firstly a tentative layout was provided. It is understood that the layout was based upon restrictions imposed by 'buildable' and 'non-buildable' areas on the site, as well as the placement of towers in parts of the site that are most optimal for harnessing potential wind energy. Secondly, a revised final layout was provided by the project proponent towards the end of the impact phase of the EIA. This layout was based on feedback from the EIA team and specialists regarding areas of environmental sensitivity from a number of perspectives in which turbines and associated infrastructure should not be developed. It is useful to compare the two layouts, and to assess the differing degree of visibility that would have been associated with prleliminary layout as compared to the later layout. This is important in a context of this visual impact assessment, as although the first layout was preliminary, it can be treated as a ''worst-case scenario' – i.e. a scenario in which visual sensitivity was not taken into account. The revised layout was based to a large degree on the visual constraints provided to the proponent as part of a wider environmental sensitivity assessment, and thus it can be treated as scenario under which mitigation measures had been applied (although it should be noted that the wind farm may still be associated with degrees of visual impact in spite of this). This comparison forms the basis for the overall visual impact assessment rating as undertaken further on in this report

The provisional layout of the turbines is indicated in the figure 6 above as well as in the figure below:

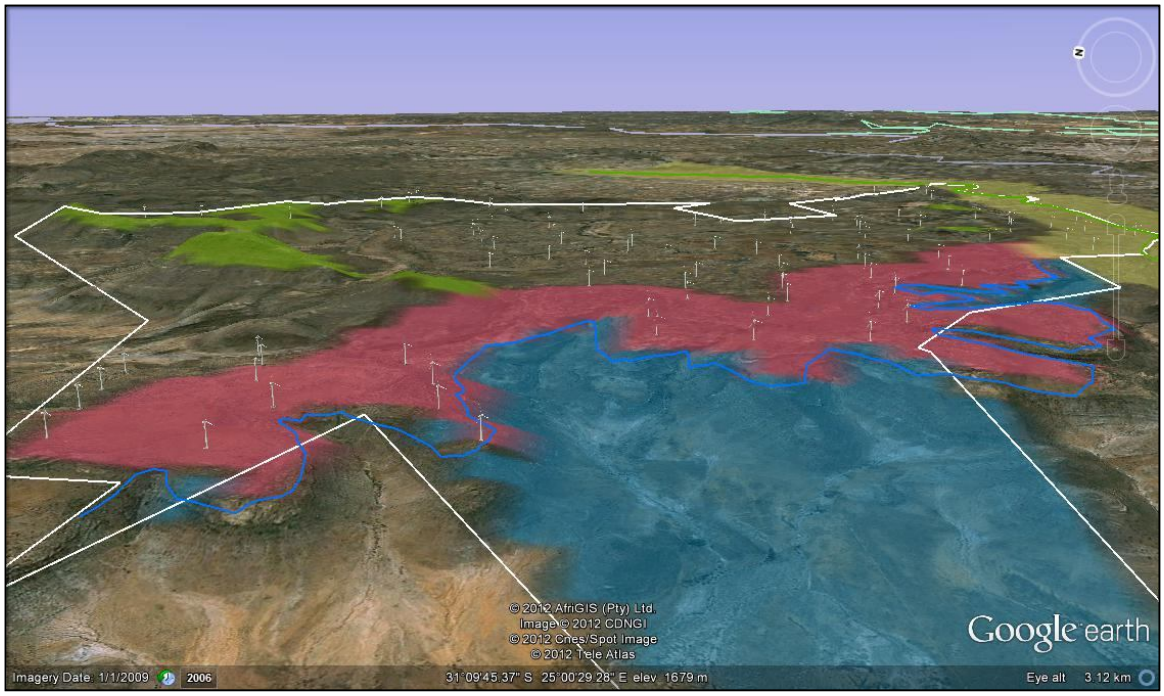



**Figure 10 – Google Earth 'aerial' view of the old turbine layout overlaid above the visually sensitive zones, as viewed from the west**

As can be seen in the figure above, turbines were located across the site, with the greatest concentration being located on the relatively flat ground in the centre to the site (to the west of the Blydefontein farmstead). Others were located in similar terrain to the west of the (now disused) Glen Allen Farmstead close to the Oorlogspoort road. Importantly in a context of visibility, a number of turbines were proposed to be placed on high areas, in particular ridge tops, on the site. The topography of the site entails that these higher areas occur on the outer edges of the site, with a flatter, lower-lying plateau in its centre. These areas were:

- a number of turbines were proposed to be placed on the slopes of a koppie (to the south of Oppermanskop) in the western part of the site, being located on all aspects of the slopes of that koppie. These turbines would have been likely to be highly visible from Noupoort and the N9 that bypasses the town
- a line of turbines were sited on top of a series of ridges to the east of Oppermanskop that form the eastern part of the site. These turbines would have been highly visible from areas to the north of the site and to the east of the site, from where these ridges are visible and in places enclose the viewshed
- three turbines were placed on ridge tops in the south-eastern part of the site, to the east of the disused Glen Alan farmstead. These turbines would have been highly visible from areas to the south and east of the site, as these ridges enclose the visual envelope from these areas

Turbines placed in these areas would have been highly visible, with all or most of the turbine structure being visible. The element of potential intrusion becomes a factor in this context, as these turbines would have featured prominently on the horizon of areas in the surrounds. Many of these areas currently experience a largely natural view of the surrounding landscape, and the introduction of turbines in these locations would have introduced a strong incongruity and contrast factor, as explored below.

On the contrary, many parts of the site are encircled by higher ground, and thus turbines placed within these central parts of the site would have been much less visible, or even not visible at all from surrounding areas, in particular areas in which receptor locations are located.

The spatial layout of the turbines of the site would thus have a very important bearing on the degree of visibility of the turbines, and on the potential visual intrusion factor of the turbines, that would affect the intensity of visual impacts associated with the wind farm. As described in section 4.1 above, visually sensitive areas on the site were delineated based on their visibility from areas surrounding the site, and thus three exclusion zones in which it was strongly recommended that no turbines be placed were identified. The revised layout has mostly taken these exclusion areas into account. The location of the turbines as proposed in the latest layout is indicated in the figure below.

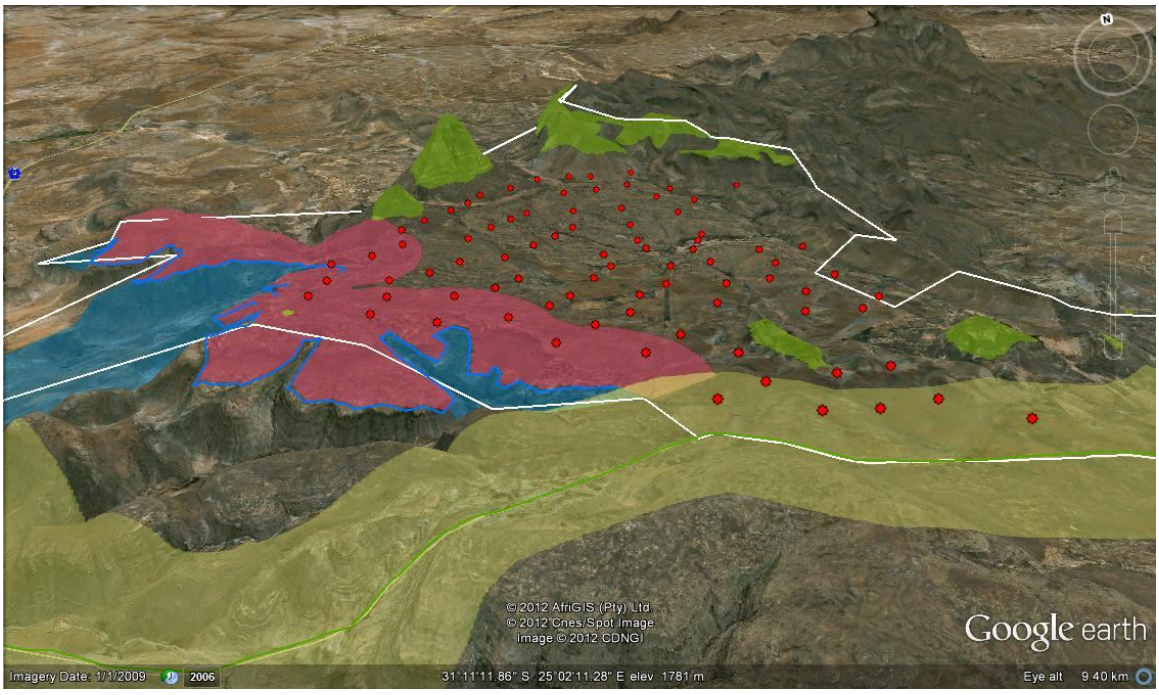



**Figure 11 – Google Earth aerial view of the latest turbine layout in relation to the visual 'no-go' areas (coloured areas)**

It is important to note that no turbines have been placed within the exclusion area to the west of the 'escarpment edge' or above the 1800m contour on the site. The turbines have been mostly excluded from the buffer to the east of (behind) the 'escarpment edge' however a number (19) have been placed within this buffer zone. A number have also been placed within the buffer of the Oorlogspoort Road (4). These turbines could be potentially be highly visible from surrounding areas on the site as these buffer areas are those most likely to be visible. The degree of visibility of the turbines as well as the visual intrusion factor associated with the turbines in these locations is assessed in the sections below. However it is very important to note that the new layout represents a significant improvement from the initial one from a visual perspective, and significantly a number of turbines had been removed from visually sensitive areas. The new layout thus represents a scenario in which mitigation measures have been applied; as demonstrated below some areas around the site will now have no visual exposure to the turbines.

## 7.2 Visual Impact Assessment Matrix for Static Receptor Locations

In order to assist in the assessment of the impact of the proposed s on the sensitive receptor locations listed above that are potentially affected by the development, a matrix that takes into account a number of factors has been developed, and is applied to each receptor location. Additionally visualisation modelling of the proposed wind farms from a number of key sensitive receptor locations has been undertaken to provide a realistic picture of how the visual environment of different parts of the study area may be affected.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the closest turbine location (distance banding)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.) between the receptor and the site
- Visual context

These factors are considered to be the most important factors when assessing the visual impact of a proposed development in the context of the manner in which an static sensitive receptor may be affected. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as an indicative representation of the likely visual impact at a receptor location; the matrix should be viewed in combination with the wind turbine visualisation images and the contrast rating below to gain an understanding of the likely visual impact associated with the wind farm in a certain area. An explanation of the matrix follows.

| Factor | Classes and Scores | | | |
|---|---|---|---|---|
| **Distance of Receptor away from the closest turbine location (distance banding)** | 0-499m<br><br>Score: 4 | 500-999m<br><br>Score:3 | 1-2km<br><br>Score:2 | >2km<br><br>Score:1 |
| **Primary Focus / orientation of receptor** | 'Arc of view' directly towards the turbine layout<br><br>Score:4 | | 'Arc of view' partially towards the turbine layout<br><br>Score:2 | 'Arc of view' in opposite direction towards the turbine layout<br>Score:1 |
| **Presence of Screening Factors** | No screening factors – development site highly visible<br><br>Score:4 | | Screening factors partially obscure view towards the turbine layout<br><br>Score:2 | Screening factors completely block any views towards the turbine layout<br>Score:1 |
| **Visual Context** | Visual context highly natural; no visually 'degrading' factors<br><br>Score:4 | Visual environment rural / pastoral with typical rural infrastructure<br><br>Score:3 | Partially transformed visual context (e.g. outlying residential areas) with partial presence of industrial-type infrastructure<br>Score:2 | Transformed visual context (e.g. industrial) and / or high degree of industrial-type anthropogenic objects present<br><br>Score:1 |

**Table 1 – Explanation of the Visual Impact Rating Matrix**

Categories of impact:

**High Visual Impact = >3-4**

**Medium Visual Impact = >2-3**

**Low Visual Impact = 1-2**

The distance of the viewer / receptor location away from the development is the most important factor in the context of the experiencing of visual impacts. Beyond a certain distance, even large structures such as wind turbines will tend to be much less visible, and are more difficult to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially with increasing distance away from the object, with maximum impact being exerted on receptors at a distance of 500m or less. The impact decreases exponentially as one moves away from the source of impact, with the impact at 1000m being a quarter of the impact at 500m away (see the figure in section 6 above). At 5000m away or more, the impact would be negligible.

The highest rating has thus been assigned to receptor locations that are located within 0-500m of the proposed turbine layout. Beyond 2km, the visual impact associated with wind turbines is likely to less significant, and any receptor location beyond 2km from the proposed turbine layout has been allocated into the lowest class of impact.

The orientation of a receptor becomes important in many cases, as the receptor location is typically oriented in a certain direction, e.g. with views towards a certain area / part of the landscape from a highly frequented area like a porch or garden. The visual impact of a set of a set of wind turbines could be potentially much greater if the turbines intruded into such a view, and thus the highest rating has been given to a situation where the turbines would lie within the 'arc of view / orientation' – i.e. the roughly $180^{o}$ panorama in a human field of view in a certain direction.

The presence of screening factors is equally as important in this context in many circumstances as the distance away from the object being viewed. Screening factors can be vegetation, buildings, as well as topography. For example a grove of trees located between a receptor location and a set of wind turbines could effectively completely shield the turbines from the receptor *in that particular location*. Relative elevation and aspect plays a similar role, as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is close by, but not in its viewshed. The opposite applies, and tall objects such as turbines located on a ridge would be highly visible.

Visual context is the last factor considered in the matrix. This factor attempts to bring in the visual environmental context, which is important, as much of the study area is largely natural in character, with the aesthetic quality of the area and sense of place being an important part of the attraction of the area. Placing a large number of wind turbines in this context has the potential to adversely affect or degrade the natural visual environment of these areas. Receptors in these areas are typically most sensitive to visual changes that would be brought about by a wind farm being developed in this setting. Some parts of the study area are somewhat visually altered from a completely natural state due to agricultural activities such as crop cultivation, planting of pastures etc. Although there is a relative density of anthropogenic (human) infrastructure (e.g.

fences, centre pivots, buildings such as barns and farmhouses) and influence on the landscape (for example the presence of groves of tall exotic trees), this type of 'pastoral' or rural landscape can be perceived as being sensitive to visual impacts associated with more industrial or large-scale infrastructure such as a wind farm. The second most sensitive class is thus assigned to this landscape. The relative degree of intrusion of large-scale or industrial-type infrastructure into a landscape as well as the degree of change of visual environment is reflected in the last two classes of visual context. Urban settings are typically visually 'transformed', and the presence of large anthropogenic objects in this environment would typically not be seen as being as intrusive as a rural or natural environment. Residential areas may be associated with more visual sensitivity, especially those areas present in parts of the study area that have views onto surrounding natural areas. This context is captured in the 3rd class of sensitivity.

Through the matrix a visual a 'Visual Impact Score average' for each receptor location is calculated. This average score is derived by tallying the scores for each of the four classes and averaging these. The visual impact rating for each receptor location is determined by the range of numbers within which this average score falls as listed above. It should be again noted that this rating matrix is a relatively simplified way to assign a likely representative visual impact which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact. The simplified matrix also has certain limitations in that in certain cases the complete screening of the source of the impact from the receptor may not be taken into account. An example of this would be where the nature of the topography completely hides the proposed turbines from view at a receptor location. In order to take this factor and the instances of complete screening of the lines from the receptor into account, an 'override' function has been introduced to the matrix. The override allows the visual rating assigned to a receptor location to be either increased or lowered based on the one of the following factors:

- The receptor location is completely screened from the proposed wind turbines by topographical features such as ridges or slopes
- The development components are outside of the viewshed of the receptor location, and thus are not visible

Google Earth's ground level view function has been used to assess whether the turbines would be visible from the receptor location (3D models of the turbines were imported into Google Earth to provide a realistic view of the turbines).

It should be remembered that the matrix is a receptor-based impact assessment of potential impacts, focussing on factors specific to the location and characteristics of the individual receptor location. The matrix should be viewed in conjunction with the assessment of the visual impacts associated with the proposed turbine layout as undertaken later in this report. The table below presents the results of the visual impact matrix.

| Receptor Location | Distance | Orientation | Screening | Visual Context | Total | Visual Impact Score | Visual Impact Rating | Overriding Factors? | Corrected Visual Rating |
|---|---|---|---|---|---|---|---|---|---|
| **Nooitverwag Farmstead**[++] | 1 | 2 | 2 | 4 | 9 | **2.25** | **MODERATE** | | |
| **Noupoort – Residences on the eastern and northern edge of the town** | 1 | 2 | 2 | 2 | 7 | **1.75** | **LOW** | | |
| **Noupoort Golf Course** | 1 | 2 | 4 | 2 | 9 | **2.25** | **MODERATE** | | |
| **Households at start of Oorlogspoort Road** | 1 | 1 | 2 | 2 | 6 | **1.50** | **LOW** | | |
| **Aarbeidsgenot Farmstead** | 1 | 1 | 2 | 3 | 7 | **1.75** | **LOW** | **Topography shields receptor** | **NO IMPACT** |
| **Haartebeeshoek Farmstead** | 1 | 2 | 2 | 3 | 8 | **2.00** | **LOW** | **Topography shields receptor** | **NO IMPACT** |
| **Holbrook Farmstead – upper** | 1 | 2 | 4 | 3 | 10 | **2.50** | **MODERATE** | | |
| **Holbrook Farmstead – lower** | 1 | 2 | 2 | 3 | 8 | **2.00** | **LOW** | | |
| **Roodepoort Farmstead** | 1 | 1 | 2 | 3 | 7 | **1.75** | **LOW** | **Topography shields receptor** | **NO IMPACT** |
| **Groenkloof Farmstead** | 1 | 1 | 1 | 3 | 6 | **1.50** | **LOW** | **Topography shields receptor** | **NO IMPACT** |
| **Berg-en-dal Farmstead** | 1 | 1 | 1 | 3 | 6 | **1.50** | **LOW** | **Topography shields** | **NO IMPACT** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | receptor | |
| **Hughdale Farmstead** | 1 | 1 | 1 | 3 | 6 | **1.50** | **LOW** | | |

**Table 2 – Visual Impact Assessment at Sensitive Receptor Locations**

[++] - Note that the Nooitverwacht Farmstead was not able to be visited in the field due to access constraints.

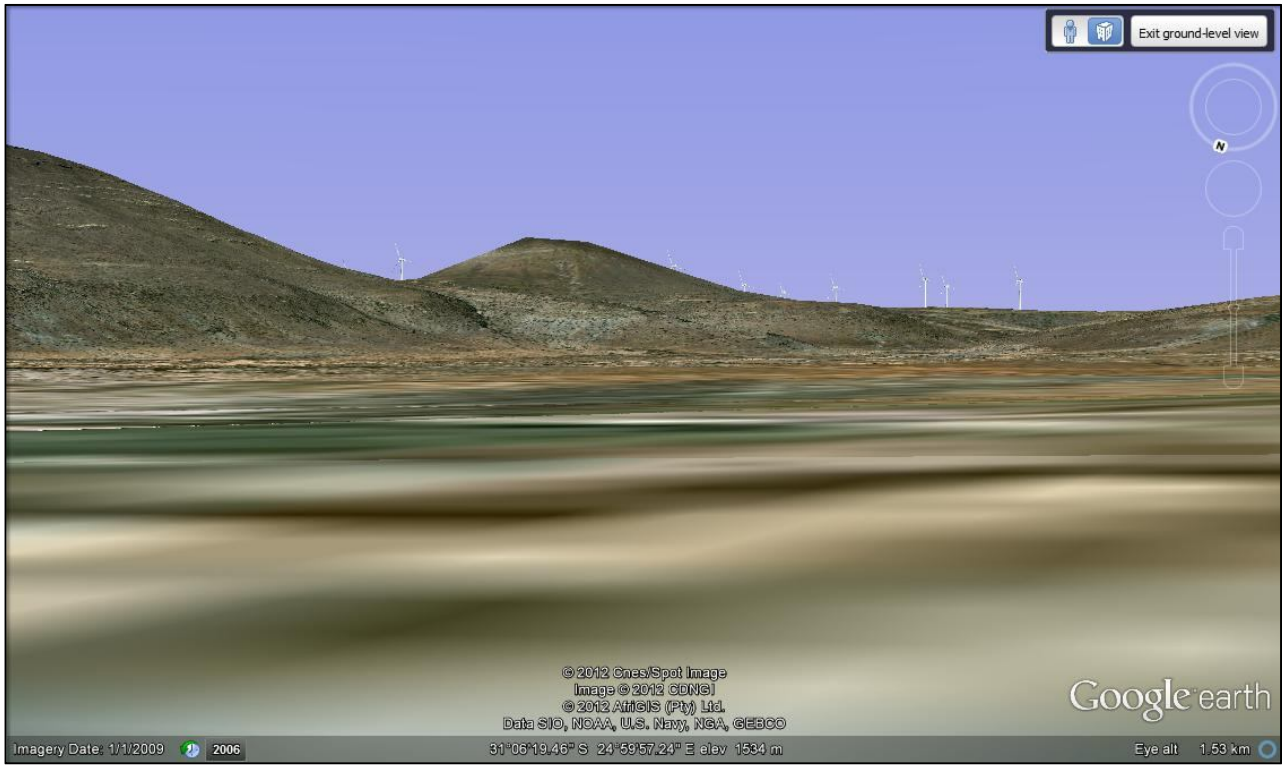



**Figure 12 – Zoomed in Google Earth 'ground level' view of the turbines from the Nooitverwacht Farmstead**

As can be seen from the table above, of the 12 listed sensitive receptor locations located in a 2km radius of the site, none have been assessed to be likely to experience a high degree of visual impact associated with the proposed development. However three locations are likely to experience a moderate visual impact by virtue of their locality and characteristics. The indication given by the matrix is that although the intensity of a visual impact would not be very high at any of the receptor locations, an impact could nonetheless be experienced. This must be understood in the context of the setting at each of the receptor locations, as well as relative 'sensitivity' of the receptor. For example a receptor location which is inhabited by a landowner who stands to benefit financially from the presence of the turbines on his / her property is much less likely to view the turbines as an unwelcome intrusion than another receptor totally unconnected with the proposed wind farm. The remainder of the receptor locations have been assessed to be likely to experience a low degree of impact. The degree of impact that would be experienced is very much dependent on the layout of the turbines on the site if the project were to be developed. The placement of turbines in certain parts of the site located closest to the receptor location, or the placement of turbines on higher-lying ground or on slopes with a certain aspect may greatly increase or decrease the likely visual impact. This factor is further explored below.

At a number of locations however, factors inherent in the landscape; i.e. topography will ensure that the wind farm site in its entirety would be completely shielded from view. Higher ground located close to the receptor location, and lying between the receptor location and the site would block all views towards the site from the receptor location, thus entailing that there would be no visual impact experienced from this location. The revised layout of the turbines is important in this context, as the removal of the turbines from the higher ridges on the eastern part of the site has greatly reduced the visibility of the wind farm in the areas to the east of the wind farm. The exclusion of turbines from these higher areas has been an effective mitigation measure in reducing the potential visual impacts of the wind farm.

In spite of these mitigation measures the wind farm will still be visible from a number of areas around the development site, including Noupoort and the N9 highway as well as the Nooitverwacht Farmstead to the west of the site, and the areas to the south of the site, including parts of the Oorlogspoort Road and the Holbrook Farmstead.

## 7.3 Visual Modelling and Visual Contrast Assessment

In order to better understand the visual impacts associated with the proposed wind farm, a visual contrast assessment has been undertaken. This is done in order to quantify the degree of visual contrast or change that would be caused by the proposed wind farm and associated infrastructure at a number of key observation locations (including static receptor locations and along sensitive receptor roads). The visual (3D) modelling of the turbines on the wind farm site from certain key

observation locations (which are related to sensitive receptor locations) has enabled an accurate, realistic picture of the likely visual contrast that would be caused by the development to be assessed. Assessing the degree of visual change at key observation points will allow a further judgement of the degree of 'acceptability' of the visual change to be made, and to suggest further mitigation measures to be suggested.

It should be noted that the visual contrast rating is undertaken by comparing a baseline (current) visual landscape baseline with the new visual landscape setting if the wind farm was to be developed. As explained in section 5.3 above, the methodology is based upon the US BLM visual contrast rating methodology.

A table indicating the structural elements of different physical components of the landscape that can be individually described to allow an accurate understanding of the visual baseline at each key observation location is presented to give an indication of the visual landscape baseline. This is followed by a table which assesses these components of the landscape under a scenario where the turbines were developed. The degree of visual change / visual contrast that will be created is thus able to be examined. The visual contrast rating methodology requires that a landscape be assigned a tolerance level relating to the degree of acceptable visual change of that landscape (named visual resource management classes in the BLM methodology). This assessment follows the comparative tables. The tolerance levels applicable to the study area are examined below

### *7.3.1 Tolerance Levels relating to degree of acceptable change*

As described above, the study area is largely natural in visual character, with a high scenic component to the landscape. This is set in the context of the Karoo Cultural Landscape in which the matrix of rural components within an otherwise natural landscape has particular aesthetic and cultural value. In this context of value being placed on the naturalness of landscape would entail that emphasis would thus be on preserving the natural character and beauty, in which human objects have spatially limited and non-intensive visual characteristics and prominence. (The merits and potential importance of preserving the current characteristics of the Karoo Cultural Landscape are discussed below). Accordingly the associated objective would be to create as little visual change and contrast to the landscape as possible, by limiting the degree of visual intrusion caused by a development such as the proposed wind farm. Put in another way, the objective would be to only allow development that did not degrade the visual context. The degree of visual intrusion associated with the proposed wind farm is thus important in this context.

Parts of the study area are slightly different in visual character as they are within an urban area characterised by a much greater density of infrastructure. In this context the ability of the landscape to 'accept' a development such as is proposed would be greater, as it would more

easily blend in with the existing visual objects present in that landscape. Accordingly two visual objectives, and thus tolerance levels have been identified for the study area:

| Landscape Context | Visual Change Objective | Tolerance Level |
|---|---|---|
| Rural environments – largely natural landscapes | Maintain the natural character as far as possible and limit intrusion of large-scale human objects | **Low degree** of change in visual contrast permitted |
| Urban environments | Allow visual change / intrusion that is in keeping with the degree and level of human infrastructure present in the landscape | **Moderate degree** of change in visual contrast permitted |

### *7.3.2 Noupoort – Wilmot Street Houses on the eastern edge of town*

**Pre-Construction (Current Visual Baseline)**

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Distinct dimensional shapes created by flats in foreground and line of hills in background<br>▪ Simple form composition of landscape | ▪ A mix of natural vegetation forms (grassy flats), with some angular vegetative elements (e.g. lines of planted trees) | ▪ Structural landscape component is strongly geometric and angular (buildings and telephone lines)<br>▪ Telephone lines are bold vertical and structural features |
| **Line** | ▪ Strong edges and horizontal lines between hills and skyline<br>▪ Relatively simple lines in landscape | ▪ Strong edge and distinct lines along line of trees;<br>▪ Line of trees is a strong focal point that splits the landscape<br>▪ Natural vegetation on hills has very weak lines | ▪ Distinct horizontal and angular lines of telephone line in foreground |
| **Colour** | ▪ Dominant colours are tawny – | ▪ Dominant vegetation light colour is tawny – yellow | ▪ White and Silver hues – non dominant |

| | | | |
|---|---|---|---|
| | yellow and grey hues due to grassland and shrub vegetation | and grey;<br>▪ Contrasts strongly with dark greens of exotic trees and is a focal point | |
| **Texture** | ▪ Smooth or fine-grained texture in background (hills) | ▪ Medium density coarse grained vegetative elements are dominant (exotic trees) | ▪ Sparse, non dominant impact on texture |

## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Distinct dimensional shapes created by flats in foreground and line of hills in background<br>▪ Simple form composition of landscape | ▪ A mix of natural vegetation forms (grassy flats), with some angular vegetative elements (e.g. lines of planted trees) | ▪ Structural landscape component is strongly geometric and angular (buildings and telephone lines)<br>▪ Telephone lines are bold vertical and structural features<br>▪ Most of the body and full rotor diameter of at least 8 turbines is visible – rising above the |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | | | flat top of the hills to the east, breaking the natural form of the hills and the eastern horizon.<br>▪ Power lines towers will be indistinct against the hill slopes and will not break the horizon |
| **Line** | ▪ Strong edges and horizontal lines between hills and skyline<br>▪ Relatively simple lines in landscape | ▪ Strong edge and distinct lines along line of trees;<br>▪ Line of trees is a strong focal point that splits the landscape<br>▪ Natural vegetation on hills has very weak lines | ▪ Distinct horizontal and angular lines of telephone line in foreground<br>▪ Strong vertical lines of turbines will contrast with the horizontal line of the top of the hills but will correspond with the vertical lines of the trees in the middle ground – turbines will provide a visual focal point. |
| **Colour** | ▪ Dominant colours are tawny – yellow and grey hues due to grassland and shrub vegetation | ▪ Dominant vegetation light colour is tawny – yellow and grey;<br>▪ Contrasts strongly with dark greens of exotic trees and is a focal point | ▪ White colouration of the power lines will contrast very strongly with natural hues of the vegetation |
| **Texture** | ▪ Smooth or fine-grained texture in background (hills) | ▪ Medium density coarse grained vegetative elements are dominant (exotic trees) | ▪ Turbines appear evenly spaced, thus providing a textural contrast to the natural landforms |

**Degree of visual contrast caused:**

| | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| **Form** | | X | | |
| **Line** | | X | | |
| **Colour** | X | | | |
| **Texture** | | X | | |

**Degree of visual contrast: Moderate**

The turbines will provide a strong contrast against the horizon that is formed by the top of the horizontal line of hills. Contrast effect and visual intrusion factor associated with the colour change and directional textural difference is reduced however by distance factor and limited spatial extent of turbines against the full length of the horizon.

**Degree of acceptability of visual contrast created and visual intrusion factor:**

Although there is a degree of visual intrusion caused by the turbines, the distance factor renders this visual intrusion less intensive. Context of the viewer (urban environment) in which there are existing anthropogenic objects visible is also likely to raise the visual tolerance of the viewer. **The degree of visual contrast is thus in keeping with the tolerance level for this type of visual context.**

*7.3.3 Noupoort – Main Road on eastern edge of town*

## Pre-Construction (Current Visual Baseline)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Distinct dimensional shapes created by wide avenue in foreground and line of hills in background<br>▪ Relatively simple form composition of landscape | ▪ Dominance of angular vegetative elements (lines of planted trees) | ▪ Structural landscape component is strongly geometric and angular (roads, sidewalks and walls) |
| **Line** | ▪ Strong edges and horizontal lines between foreground and background landscape components<br>▪ Numerous bands and relatively simple lines in landscape | ▪ Strong edge and distinct lines along line of trees;<br>▪ Line of trees is a strong focal point<br>▪ Natural vegetation on hills has very weak lines | ▪ Distinct horizontal and vertical, angular lines of telephone lines in foreground |
| **Colour** | ▪ Dominance of dark colours – grey of tarmac and light brown of background hills | ▪ Dominant vegetation colour is dark green fitting into general darker hues of overall landscape | ▪ Light grey hues – non dominant |
| **Texture** | ▪ Fine-grained texture in hills is non-dominant (background) | ▪ Medium density coarse grained and ordered vegetative elements are dominant (exotic trees) and contrast with fine grain of background hills | ▪ Sparse, non dominant impact on texture |

## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Distinct dimensional shapes created by wide avenue in foreground and line of hills in background<br>▪ Relatively simple form composition of landscape | ▪ Dominance of angular vegetative elements (lines of planted trees) | ▪ Structural landscape component is strongly geometric and angular (roads, sidewalks and walls)<br>▪ Most of the body and full rotor diameter of at least 8 turbines is visible – rising above the flat top of the hills to the east, breaking the natural form of the hills and the eastern horizon. |
| **Line** | ▪ Strong edges and horizontal lines | ▪ Strong edge and distinct lines along line of trees; | ▪ Distinct horizontal and vertical, angular lines |

| | | | |
|---|---|---|---|
| | between foreground and background landscape components<br>▪ Numerous bands and relatively simple lines in landscape | ▪ Line of trees is a strong focal point<br>▪ Natural vegetation on hills has very weak lines | of telephone lines in foreground<br>▪ Strong vertical lines of turbines will contrast with the horizontal line of the top of the hills but will correspond with the vertical lines of the trees in the middle ground – turbines will provide a visual focal point. |
| **Colour** | ▪ Dominance of dark colours – grey of tarmac and light brown of background hills | ▪ Dominant vegetation light colour is dark green fitting into general darker hues of overall landscape | ▪ White colouration of the turbines will contrast very strongly with natural hues of the vegetation |
| **Texture** | ▪ Fine-grained texture in hills is non-dominant (background) | ▪ Medium density coarse grained and ordered vegetative elements are dominant (exotic trees) and contrast with fine grain of background hills | ▪ Turbines appear evenly spaced, thus providing a textural contrast to the natural landforms |

**Degree of visual contrast caused:**

| | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| **Form** | | X | | |
| **Line** | | X | | |
| **Colour** | X | | | |
| **Texture** | | X | | |

**Degree of visual contrast: Moderate**

The turbines will provide a strong contrast against the horizon that is formed by the top of the horizontal line of hills. Contrast effect and visual intrusion factor associated with the colour change and directional textural difference is reduced however by distance factor and limited spatial extent of turbines against the full length of the horizon, as well as by visual prominence of objects and trees in the foreground.

**Degree of acceptability of visual contrast created and visual intrusion factor:**

Although there is a degree of visual intrusion caused by the turbines, the distance factor renders this visual intrusion less intense. Context of the viewer (urban environment) in which there are existing anthropogenic objects visible is also likely to raise the visual tolerance of the viewer. **The degree of visual contrast is thus in keeping with the tolerance level for this type of visual context.**

### *7.3.4 Noupoort Golf Course Entrance*

## Pre-Construction (Current Visual Baseline)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – natural flats grade to hills; hills create dimensional shape and mass<br>▪ However dirt road creates element of dimensional shape and provides distance perspective | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Structural landscape component is weak but angular fence line complements dirt road to create a dimensional shape |
| **Line** | ▪ Very indistinct edges in landform, but the cliffs and the nearby skyline of the hills (horizon) forms a horizontal line that is a strong focal point<br>▪ Skyline is a single, bold line, as is dirt road running 'vertically' | ▪ Highly indistinct lines in natural vegetation | ▪ Horizontal, angular lines of fence line |
| **Colour** | ▪ Dominance of yellow to light brown hues in landscape – very little contrast<br>▪ Subtle colours | ▪ Slight contrast between yellows of foreground grassy vegetation on flats and brown hillside vegetation | ▪ Light grey hues – non dominant |
| **Texture** | ▪ Fine-grained texture | ▪ Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | |

## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – natural flats grade to hills creating indistinct dimensional shape and mass<br>▪ However dirt road creates element of dimensional shape | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Foreground structural landscape component is weak but angular fence line complements dirt road to create a dimensional shape<br>▪ Most of the body and full rotor diameter of at least 7 turbines is visible – rising above the flat top of the hills to the east, breaking the natural form of the hills and thus the eastern horizon. |
| **Line** | ▪ Very indistinct edges in landform, but the cliffs and the nearby skyline of the hills (horizon) forms | ▪ Highly indistinct lines in natural vegetation | ▪ Horizontal, angular lines of fence line<br>▪ Strong vertical lines of turbines will contrast very visibly with the horizontal line of the top |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | a horizontal line that is a strong focal point<br>▪ Skyline is a single, bold line, as is dirt road running 'vertically' | | of the hills creating a strong visual focal point. |
| **Colour** | ▪ Dominance of yellow to light brown hues in landscape – very little contrast<br>▪ Subtle colours | ▪ Slight contrast between yellows of foreground grassy vegetation on flats and brown hillside vegetation | ▪ White colouration of the turbines will contrast very strongly with natural hues of the vegetation |
| **Texture** | ▪ Fine-grained texture | ▪ Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | ▪ Turbines appear evenly spaced, thus providing a textural contrast to the natural landforms |

**Degree of visual contrast caused:**

| | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| **Form** | | X | | |
| **Line** | | X | | |
| **Colour** | | X | | |
| **Texture** | | X | | |

**Degree of visual contrast: Moderate**

The turbines will provide a strong contrast against the horizon that is formed by the top of the horizontal line of hills, and which is the natural focal point of the landscape. Contrast effect and visual intrusion factor associated with the colour change and directional textural difference is reduced somewhat however by distance factor and limited spatial extent of turbines against the full length of the horizon.

**Degree of acceptability of visual contrast created and visual intrusion factor:**

There is a similar degree of visual contrast to the above 2 views, however this is set in a highly natural context. The distance factor renders this visual intrusion slightly less intense. Although the context is natural, the limited spatial extent of the cluster of turbines set against the overall length of the horizon entails that the degree of visual intrusion is relatively weak. **The degree of visual contrast is thus in keeping with the tolerance level for this type of visual context. .**

### *7.3.5 N9 highway north of Noupoort*

## Pre-Construction (Current Visual Baseline)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – flats grade to hills creating indistinct dimensional shape and mass<br>▪ Low hills and horizon are main focal points | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Structural landscape component is weak - fence line |
| **Line** | ▪ Indistinct edges in landform, but ridge lines and skyline (horizon) form horizontal lines that are strong focal points | ▪ Highly indistinct lines in natural vegetation | ▪ Horizontal, angular lines of fence line, but this is a weak element |
| **Colour** | ▪ Dominance of dull yellow to light brown hues in landscape – very little contrast<br>▪ Subtle colours | ▪ Slight contrast between yellows of foreground grassy vegetation on flats and brown hillside vegetation | ▪ Light grey hues – non dominant |
| **Texture** | ▪ Fine-grained texture | ▪ Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | |

## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – flats grade to hills creating indistinct dimensional shape and mass<br>▪ Low hills and horizon are main focal points | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Structural landscape component is weak - fence line and very distant, limited view of turbines (only 1 full turbine visible) |
| **Line** | ▪ Indistinct edges in landform, but ridge lines and skyline (horizon) form horizontal lines that are strong focal points | ▪ Highly indistinct lines in natural vegetation | ▪ Horizontal, angular lines of fence line, but this is a weak element<br>▪ Turbine provides vertical element but very indistinct |
| **Colour** | ▪ Dominance of dull yellow to light | ▪ Slight contrast between yellows of foreground | ▪ Light grey hues and white of turbine but non |

| | | | |
|---|---|---|---|
| | brown hues in landscape – very little contrast<br>▪ Subtle colours | grassy vegetation on flats and brown hillside vegetation | dominant |
| **Texture** | Fine-grained texture | Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | ▪ Turbine does not bring any textural change |

**Degree of visual contrast caused:**

| | **Strong** | **Moderate** | **Weak** | **None** |
|---|---|---|---|---|
| **Form** | | | X | |
| **Line** | | | X | |
| **Colour** | | | X | |
| **Texture** | | | | X |

**Degree of visual contrast: Weak**

The turbine(s) that is visible in its entirety is very indistinct, being very distant and only visible through a saddle in the middle ground range of hills, thus the form and texture of the landscape in this view will remain unchanged. Contrast effect and visual intrusion factor associated with the turbines is virtually nil, thus very little visual impact at this point.

**Degree of acceptability of visual contrast created and visual intrusion factor:**

Due to the very low degree of change in visual contrast, there is no visual intrusion associated with the turbines at this point and the degree of change is thus negligible, and thus t**he degree of visual contrast is consistent with the tolerance level for this type of visual context.**

### *7.3.6 Upper Holbrook Homestead*

**Pre-Construction (Current Visual Baseline)**

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Undulating terrain, some complexity of landscape due to 'overlapping' hills | ▪ A mix of natural vegetation forms, with some angular vegetative elements (e.g. lines of planted trees along access road) | ▪ Small structural component is geometric and angular (farmhouse) |
| **Line** | ▪ Weak horizontal lines on skyline<br>▪ Relatively simple lines in landscape<br>▪ Degree of 'band' splitting of | ▪ Dominant grassland vegetation engenders very weak (indistinct) lines;<br>▪ some complexity through exotic trees | ▪ Indistinct horizontal and angular lines |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | landscape by linear access road | | |
| **Colour** | ▪ Dominant colours are light green – yellow hues due to grassland vegetation | ▪ Dominant vegetation light colour is green-yellow;<br>▪ Contrasts strongly with dark greens of exotic trees | ▪ Light green and white hues – non dominant |
| **Texture** | ▪ Smooth or fine-grained texture | ▪ Generally smooth, slightly more coarse but sparse elements from exotic trees | ▪ Sparse, non dominant impact on texture |

## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Undulating terrain, some complexity of landscape due to 'overlapping' hills | ▪ A mix of natural vegetation forms, with some angular vegetative elements (e.g. lines of planted trees along access road) | ▪ Small structural component in the foreground is geometric and angular (farmhouse)<br>▪ Most of the body and full rotor diameter of at least 13 turbines is visible – rising above the flat horizon in the left part of the view, breaking its natural form.<br>▪ Turbines will bring an incongruity to the landscape context with their linear and angular geometry |
| **Line** | ▪ Weak horizontal lines on skyline<br>▪ Relatively simple lines in landscape<br>▪ Degree of 'band' splitting of landscape by linear access road | ▪ Dominant grassland vegetation engenders very weak (indistinct) lines;<br>▪ some complexity through exotic trees | ▪ Strong cluster of vertical lines of turbines will contrast very visibly with broadly horizontal lines in the background of the landscape creating a strong visual focal point. |
| **Colour** | ▪ Dominant colours are light green – yellow hues due to grassland vegetation | ▪ Dominant vegetation light colour is green-yellow;<br>▪ Contrasts strongly with dark greens of exotic trees | ▪ Light green and white hues of structures in foreground and cluster of white of turbines in left of view of landscape provides contrast against natural hues of vegetation |
| **Texture** | ▪ Smooth or fine-grained texture | ▪ Generally smooth, slightly more coarse but sparse elements from exotic trees | ▪ Sparse, non dominant impact on texture overall, but 'clustering' effect of turbines in the left of the view provides a strong focal point |

## Degree of visual contrast caused:

| | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| **Form** | | X | | |
| **Line** | X | | | |
| **Colour** | | X | | |
| **Texture** | X | | | |

**Degree of change in visual contrast: Strong**

The turbines will provide a strong contrast against the left part of the horizon in the view that is formed by flat ground to the left of some undulating hills. The turbines will draw the focus of the viewer away from the hills in the centre which is the natural focal point of the landscape. Contrast effect and visual intrusion factor associated with the colour change and directional textural difference is reduced somewhat however by distance factor and limited spatial extent of turbines against the full length of the horizon. However the number of turbines fully visible will create a cluster effect that is texturally important.

**Degree of acceptability of visual contrast created and visual intrusion factor:**

Although limited to the left of the view, the cluster of turbines will draw the focus of the viewer away from the hills on the horizon and thus will become visually intrusive, a factor which is aggravated by the natural context of the view. The distance factor renders this visual intrusion slightly less intense; however the visual intrusion posed by the turbines is not in keeping with the visual context and thus **the degree of visual contrast is thus not consistent with the tolerance level for this type of visual context.**

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### *7.3.7 Berg-en-dal and Hughdale Farm access roads*

**Pre-Construction (Current Visual Baseline)**

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – natural flats grade to hills<br>▪ Background hills create strong horizontal dimensional shapes and are a visual focal point, esp. the skyline | ▪ Natural, vegetative features are amorphous, but with a contrast created by exotic trees in middle ground between flats and hills | ▪ Structural landscape component is weak but angular fence lines and telephone lines create vertical elements |
| **Line** | ▪ Distinct edges in simple lines of landform features, in particular ridge top lines in foreground and background (skyline) form strong focal points<br>▪ Dirt roads create distinct band in otherwise uniform foreground | ▪ Highly indistinct lines in natural vegetation, but exotic trees provide visual contrast and focal point | ▪ Horizontal, angular lines of fence line and vertical lines of telephone poles draw attention |
| **Colour** | ▪ Dominance of yellow to light brown and some light green hues | ▪ Slight contrast between natural subtle colours of scrub vegetation and the dark greens of the trees | ▪ non dominant |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | in landscape<br>▪ Subtle colours | | |
| **Texture** | ▪ Mostly Fine-grained texture | ▪ Vegetative elements mostly fine-grained, with some uneven random fine-medium elements (bushy vegetation on hills) and clumping of exotic trees which provide contrast | ▪ Limited influence |

**Post Construction (Landscape Context if Wind Farm Developed)**

As above, **as no components of the wind farm will be visible**

**Degree of change in visual contrast: None**

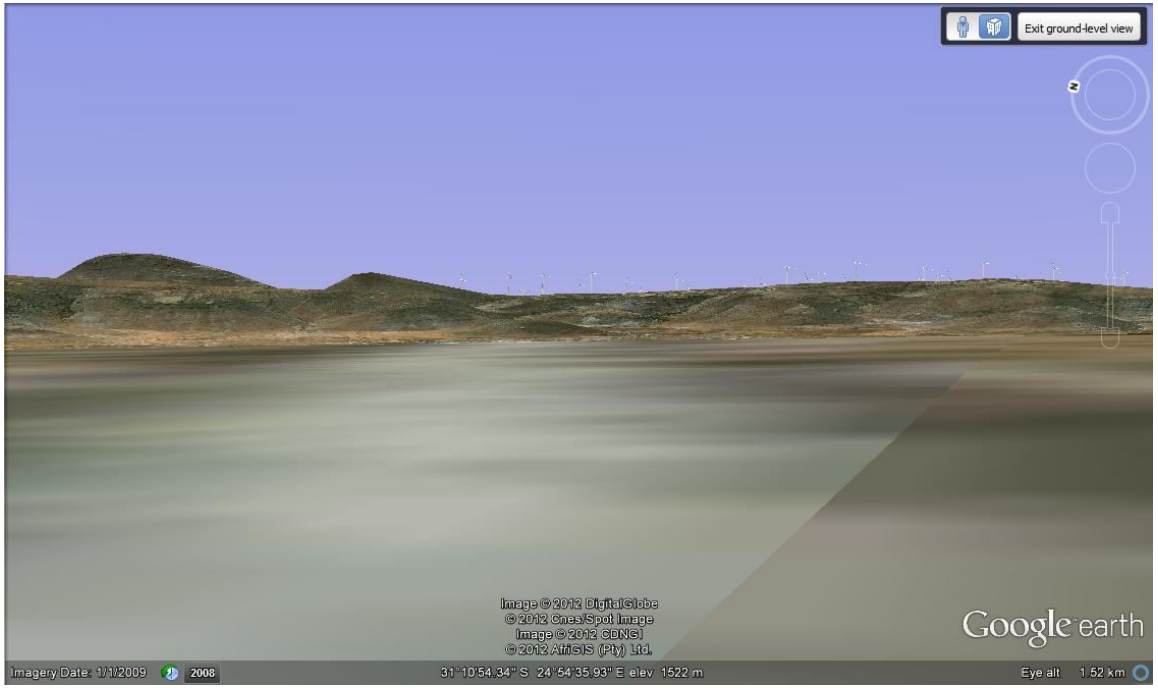
**The degree of visual contrast is thus in keeping with the tolerance level for this type of visual context.**

### *7.3.8 R389 Road west of Noupoort*

**Pre-Construction (Current Visual Baseline)**

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – flats grade to hills creating indistinct dimensional shape and mass<br>▪ Low hills and horizon are main focal points<br>▪ Small degree of landscape | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Structural landscape component is weak - fence line<br>▪ (however structural influence becomes more prominent closer to Noupoort) |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | complexity with Oppermanskop a focal point<br>▪ R389 provides strong band in foreground | | |
| **Line** | ▪ Indistinct edges in landform, but ridge lines and skyline (horizon) form horizontal lines that are strong focal points<br>▪ The road provides a strong 'vertical' band in the foreground, 'splitting' the foreground | ▪ Highly indistinct lines in natural vegetation | ▪ Horizontal, angular lines of fence line, but this is a weak element |
| **Colour** | ▪ Dominance of dull yellow to light brown hues in landscape – very little contrast<br>▪ Subtle colours | ▪ Slight contrast between yellows of foreground grassy vegetation on flats and brown hillside vegetation | |
| **Texture** | ▪ Fine-grained texture | ▪ Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | |




## Post Construction (Landscape Context if Wind Farm Developed)

| | Landform | Vegetation | Structures |
|---|---|---|---|
| **Form** | ▪ Relatively simple form composition of landscape – flats grade to hills creating indistinct dimensional shape and mass<br>▪ Low hills and horizon are main focal points<br>▪ Small degree of landscape complexity with Oppermanskop a focal point | ▪ Natural, amorphous vegetative features characterise the landscape | ▪ Structural landscape component in foreground is weak - fence line<br>▪ Around 20 turbines will be mostly visible in their entirety from this point, rising above the flattish horizon in the right part of the view, breaking its natural form of the horizon. |

| | Landform | Vegetation | Structures |
|---|---|---|---|
| | ▪ R389 provides strong band in foreground | | |
| **Line** | ▪ Indistinct edges in landform, but ridge lines and skyline (horizon) form horizontal lines that are strong focal points<br>▪ The road provides a strong 'vertical' band in the foreground, 'splitting' the foreground | ▪ Highly indistinct lines in natural vegetation | ▪ Strong cluster of vertical lines of turbines will contrast very visibly with broadly horizontal lines in the background of the landscape creating a strong visual focal point. |
| **Colour** | ▪ Dominance of dull yellow to light brown hues in landscape – very little contrast<br>▪ Subtle colours | ▪ Slight contrast between yellows of foreground grassy vegetation on flats and brown hillside vegetation | ▪ White of cluster of turbines in right of view provides contrast against natural hues of vegetation |
| **Texture** | ▪ Fine-grained texture<br>▪ | ▪ Fine-grained, sparse texture of bushy vegetation on hills contrasts slightly with uniform texture of flats in foreground | ▪ Clustering' effect of turbines in the right of the view provides a strong focal point |

**Degree of visual contrast caused:**

| | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| **Form** | | X | | |
| **Line** | X | | | |
| **Colour** | | X | | |
| **Texture** | X | | | |

**Degree of change in visual contrast: Strong**

The turbines will provide a strong contrast against the right part of the horizon in the view that is formed by flat ground to the left of some undulating hills. The cluster of nearly 20 turbines that are more or less fully visible will draw the focus of the viewer away from Oppermanskop hill which is currently the natural focal point of the view (accentuated by the road which is a 'pointer' towards it), thus detracting from the highly natural

context of the landscape. Contrast effect and visual intrusion factor associated with the directional and clustering textural difference is reduced somewhat however by the large distance factor, but this ameliorating factor is counteracted by the large number of turbines that will be visible. .

**Degree of acceptability of visual contrast created and visual intrusion factor:**

Although largely limited to the right of the view, the cluster of turbines will draw the focus of the viewer away from Oppermanskop and thus will become visually intrusive, a factor which is aggravated by the natural context of the view. The distance factor renders this visual intrusion slightly less intense; however the visual intrusion posed by the cluster of a relatively large number of turbines is not in keeping with the visual context and is **thus not in keeping with the tolerance level for this type of visual context.**

## 7.4 Summary of Visual Impacts at Key Observation Locations

The table below provides a summary of the results of the impact assessment at the key observation locations in the study area:

| Key Observation Location | Receptor-based Visual Impact (as per matrix) | Degree of visual contrast in key view (landscape) and consistency with visual change tolerance level |
|---|---|---|
| Noupoort – residences on Wilmot Street | Low | Moderate (Consistent with tolerance level) |
| Noupoort – residences on Main Street | Low | Moderate (Consistent with tolerance level) |
| Noupoort Golf Course | Moderate | Moderate (Consistent with tolerance level) |
| Holbrook Farmstead – Upper | Moderate | Strong (Inconsistent with tolerance level) |
| Entrance Road to Hughdale and Berg-en-dal Farmsteads | No Impact | None (Consistent with tolerance level) |
| N9 north of Noupoort | | Weak (Consistent with tolerance level) |
| R389 west of Noupoort | | Strong (Inconsistent with tolerance level) |

## 7.5 Discussion and Implications for Development (Mitigation Measures)

Analysis of the above tables reveals that the degree of visual contrast and related visual intrusion has been assessed as being inconsistent with the visual change tolerance level (and thus contradicting the visual objective for that particular type of landscape) at a few key observation points in the study area. In these locations this is mainly due to the natural context of the view, into which the intrusion of turbines would be create enough of a contrast to be considered a visual intrusion that would detract from the natural characteristics of the landscape. In this case, the 'breaking of' or intrusion of the turbines onto / above the horizon is the primary factor that is responsible for the creation of the contrast, and thus the visual intrusion. In some cases, the clustering of turbines within part of the view is another contributing factor that creates visual contrast with the natural form of the landscape which dominates most of the views in the wider

study area. Interestingly, this clustering effect is enhanced by distance away from the development site, as the turbines that are visible at those points closer to the site typically appear more spread out and less clustered.

On the contrary, the analysis shows that a number of sensitive receptor locations and key observation locations would not be affected or would be affected very little by the proposed wind farm. At these locations either no components of the proposed wind farm would be visible, or the degree of visibility of the components would be at a scale and of a intensity that would not be significant. In many cases this is due to shielding provided by topography between the receptor and the turbines, and in some instances the distance factor is significant. However it must be acknowledged that the change in the final layout, which excluded higher lying areas from being 'developable', has played a significant part in reducing the impacts associated with the wind farm. This change from the initial layout to the draft final layout has in itself been a very important mitigating factor.

### *7.5.1 Associated mitigation measures – recommended removal of turbines from road buffer*

For the locations where receptor based impact has been assessed to be moderate, or where the degree of contrast that would be created is inconsistent with the visual change tolerance level and associated visual change objective, further mitigation factors can be considered. The primary mitigation measure, as stated above, would be the removal of turbines from certain parts of the site. Section 7.1 above indicates that turbine locations have been placed within certain parts of the visual buffer or recommended turbine exclusion areas. This placing of turbines within the buffer zones to the east of the 'escarpment edge' and within 500m to the north of the Oorlogspoort is important in this regard, as the removal of the turbines from these buffer areas would greatly reduce the visual impacts at the Upper Holbrook Farmstead to acceptable levels (by removing the turbines from the Oorlogspoort Road buffer) and would essentially result in no turbines being visible from the Noupoort area (by removing the turbines from the buffer to the east of the 'escarpment edge'). It is thus strongly suggested that the layout be re-examined in an attempt to remove the turbines from these buffer or exclusion zones. In making this recommendation, it is accepted that visual issues are not the only environmental issues that need to be considered in the layout, and that other environmental factors which have been given more weighting may necessitate that a certain number of turbines would need to be placed in the visual buffer or exclusion zones. It also needs to be stressed again that this current scenario is a significant improvement from an earlier version of the layout in which far more areas would have been visually affected and more areas would have been subject to a more intensive impact. As such under the current scenario, important mitigation measures have already been put in place. Lastly, and ultimately, the 'bigger picture' may need to be considered, of the need to counter-

balance visual landscape preservation imperatives with the need to create development and thus knock-on socio-economic benefits associated with the development of a wind farm.

### *7.5.2 Views expressed by the public / stakeholders with respect to visual impact associated with the wind farm*

From the feedback provided by the public participation process, no visual issues have been raised by any of the stakeholders or public. However this must be qualified with the understanding that the public / stakeholder comment on the EIR-phase has yet to be made, and comments on the potential visual impacts, as identified above may yet emerge. The impression created from some of the feedback from the public (as repeated elsewhere in this report), is that the windy nature of Noupoort would make the area very suitable for a wind farm, and that this would bring welcome development to the town. At this stage it would appear that the public perception of the proposed development is that the socio-economic benefits would outweigh any concerns about visual intrusion, however this view may not be shared by all.

## 7.6 Discussion relating to impact on sensitive receptor roads

Two of the key observation locations are located on roads and the relative impact of the proposed wind farm and associated infrastructure on roads can be discussed. The key roads in the study area (the N9, R389 and Oorlogspoort Road) traverse similar areas to those in which the static receptor locations are located, thus similar trends of visibility will apply to certain stretches of the roads. Thus the Oorlogspoort Road in the area to the east of the site, as well as in the area to the south-west of the site will be completely shielded from the wind farm turbines by topographical factors. A similar situation exists with respect to a relatively long stretch of the N9 road to the north of the town of Noupoort; in this area a series of low ridges that run parallel to the road will restrict views from the road towards the site. A stretch of approximately 7-8km of the road from a point approximately 2km to the north of the town northwards will experience no line of sight to the turbines, thus there will be no visual impact. Areas to the north of this will have a very distant view of the turbines, which will be unlikely to be associated with any degree of visual impact. The topographical factors are significant in reducing the spatial extent of the area in which visual impacts could potentially be experienced.

Conversely, certain stretches of road will have a much greater visual exposure to the turbines, in particular the parts of the Oorlogspoort which run along the southern boundary of the site, and the R389 for travellers heading eastwards into Noupoort. In the former case, a cluster of turbines will be visible to right / left of the field of view for the driver, and will have the effect of “looming large” overhead, in the way that tall buildings would. Importantly, this view would be transient, lasting only a few minutes of continuous driving, and as described above. An approximately 6km stretch

of this road would be subject to views of the turbines before, and after which the turbines would be fully screened from view by the topography. In this short time the likely visual impact experienced would be intense. However the relatively short stretch of road on which motorists would be exposed to the turbines is relatively short in comparison to the overall length of the road as it traverses the study area. In terms of the N9, only a short stretch of the road (around 7km) in the vicinity of the town of Noupoort will be able to view the turbines. To the south topography will shield the turbines completely from view. The R389 will have a much greater visual exposure to the turbines along the length of the road. Although the distance factor from the areas to the west of the town is significant, the clustering effect of the turbines on top of the hills will be a significant factor for motorists travelling eastwards. Over time, the town may come to be associated with renewable energy, and the cluster of turbines visible on the high ground overlooking the time may come to represent this and come to be seen as part of the Noupoort landscape, however this is dependent on many variables and may not occur (refer to section 7.9 below).

Section 7.8 below should be referred to for the impact of the proposed power lines on the Oorlogspoort Road to the west of the site.

## 7.7 Impacts of the turbines related to Shadow Flicker

As described in section 6.1 above, shadow flicker is a potentially important impact that can be associated with wind farms. With the exception of possibly a couple of farm workers, there is currently no-one living on the site of the wind farm. In addition due mainly to the highly rural nature of the surrounds and the low density of human habitation, there are no permanent residences in the immediate vicinity of the development site. Thus no static receptor locations are likely to experience any shadow flicker-related impacts. The only receptor location that may be subject to shadow flicker impacts is the Oorlogspoort Road. The closest turbines under the latest layout are located approximately 230m to the north of the road, thus shadow flicker could theoretically be an issue. However it must be remembered that the receptors on this road will be mobile, and thus any shadow flicker will be unlikely to be experienced as the position of the receptor in relation to each individual turbine will rapidly change. As recommended above, consideration of the moving of the turbines located within the 500m buffer of the road away from the buffer area should be undertaken as a mitigation measure. Under this scenario, and even under the current layout, shadow flicker is unlikely to be a significant phenomenon associated with the proposed wind farm.

## 7.8 Visual Impacts of Associated Infrastructure

### *7.8.1 Access Roads*

The access roads onto the site and within the site (between turbine locations) have not been provided by the proponent, as these are unlikely to have been planned at this stage. As mentioned in an earlier section of this report, roads would typically only be associated with a visual impact if they were to traverse areas of sloping ground on an aspect that was visible to surrounding areas. Due to the topographical nature of the development site, most roads on the site would be shielded from surrounding areas, but the potential was raised for access roads to turbines that may be located on ridge tops to provide a strong visual contrast and draw the attention of a viewer, thus resulting in a visual impact. This would be particularly pronounced if a terrace was to be cut into the mountain side.

The exclusion of turbines from high-lying areas (areas > 1800m asl) has effectively removed the possibility of such roads needing to be constructed. The turbines as proposed in the latest layout are largely located on relatively flat ground; therefore there is not a need for access roads to traverse steep, sloping ground. The visual impact associated with roads is expected to be minimal, however it is strongly recommended that the layout design of access roads on the site avoids higher-lying and sloping ground as far as possible, in order to preserve the natural visual integrity of the site (as viewed from surrounding areas) as far as possible.

### *7.8.2 Underground Cabling*

Underground cabling is very similar to roads in that the 'scar' associated with the cable could create a visual contrast against the backdrop of largely natural vegetation on the site. However as no turbines are to be placed on high ridges / high points on the site, there will be no need for cabling to traverse these areas. Thus there are unlikely to be visual impacts associated with the cabling. In spite of this it is strongly recommended that all reinstated cable trenches should be re-vegetated with the same vegetation as existing prior to the cable being laid, so as to reduce the potential for the development of linear features in the environment that would detract from the natural character of the landscape.

### *7.8.3 Power lines*

The existing grid lies to the west of Noupoort. The link between the site and the grid thus needs to traverse the hills which form the western part of the site. This factor entails that the power lines may be highly visible and potentially visually obtrusive, due to the topographical make up of the viewshed from the town of Noupoort and the N9 highway as discussed elsewhere in this report.

Two potential alignment alternatives have been provided by the project proponent for the power line linkage between the proposed wind farm and the existing electricity grid in the area. Alternative 1 is the more northern alternative, and emanates from the western edge of the turbine layout, running down the 'escarpment' on the western part of the site and then being aligned to the south-west through the flat terrain near the Aarbeidsgenot Farmstead. The second, Alternative 2, is aligned from the southern part of the turbine location, running parallel to the existing Blydefontein farm access road, and then running parallel with the Oorlogspoort road down onto the flatter ground to the west.

Alternative 1 (the northerly alternative) is most likely to be visible from part of the wider area where most receptors are located (the town of Noupoort and the nearby N9 highway). As viewed from this area, the power line would run 'diagonally' down the slope of the hills to the east before running across the flats to reach a point to the south of the town. Alternative 2 would not be visble from this area as is runs down the Oorlogspoort Road and is located further to the south, being out of the viewshed of this part of the town. In the context of the potential visual impact associated with the power lines, one of the key principles when evaluating the visual impact of large structures such as power lines is to determine the degree to which they will 'break the horizon' as objects that break the horizon are much more visible than those which are not visible against the backdrop of the open sky. Depending on the tower locations, the only place where this will occur will be as this alternative crosses the 'lip of the hills' at a point just before the terrain drops. Thus one tower will be likely to 'break the horizon', whereas the other towers will be set against the backdrop of the hillside (see indicative view in the figure below). Importantly, this tower will also appear against the backdrop of the much larger turbines that would also 'break the horizon' at this point, thus the tower would not provide an unnatural visual focal point on its own.

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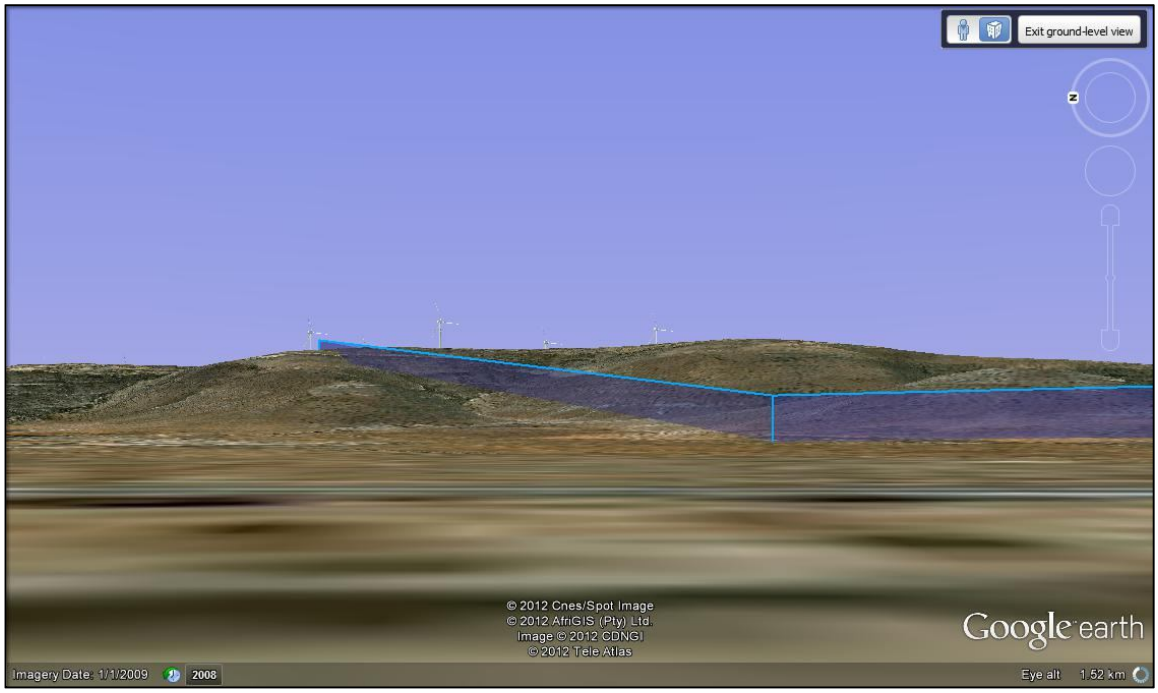


**Figure 13 – Indicative Google Earth ground level view of Alternative 1 of the proposed power line as viewed from the eastern edge of Noupoort**

It should be noted that Alternative 1 also passes relatively close to the Aarbeidsgnot farmstead, and would be likely to be partially visible from that sensitive receptor location.

Alternative 2 runs parallel to the Oorlogspoort Road as it leaves the site, running through the poort up which the road runs. This road has been determined to be a sensitive receptor road as it passes through highly scenic terrain. This scenic character is in evidence as the road runs up the poort along which the power line Alternative 2 is aligned. Although a telephone line runs parallel to the road, the power line would be nuch larger in scale, and would represent a significant visual change to the visual envelope of this road as assessed below.

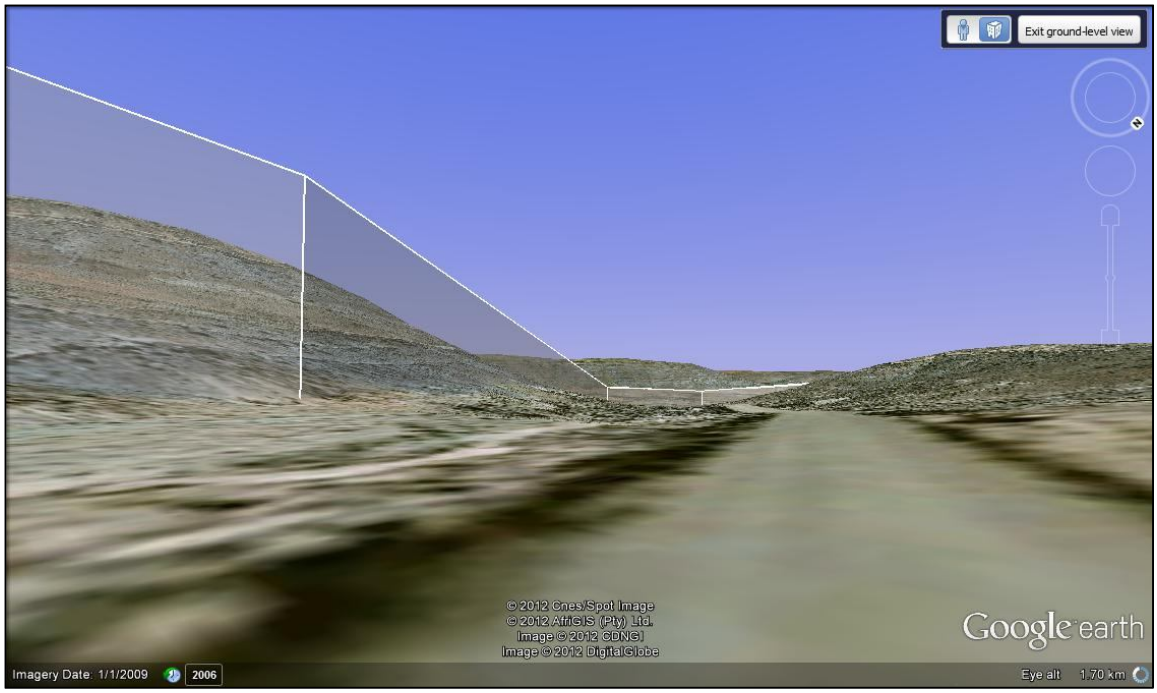


**Figure 14 - Indicative Google Earth ground level view of Alternative 2 of the proposed power line as viewed from the Oorlogspoort road looking down to where the road drops into the Noupoort Valley**

The potential impact of the lines in terms of their visual contrast is undertaken below:

| **Noupoort – (Eastern Edge of town) – Alternative 1** | |
|---|---|
| **Existing Visual Baseline** | **Post-construction Visual Setting** |
| Strong horizontal lines due to landform (background range of hills) and vegetative (line of exotic trees) that contrast with one another in style and texture. Strong, relatively simple line on horizon created by hills | Strong horizontal lines due to landform (background range of hills) and vegetative (line of exotic trees); contrast with strong vertical line elements provided by at least 5 turbines and a number of power line towers. Natural subdued hues of vegetation and ridges contrasts strongly with bright white of turbines and blades and silver of towers. Ordered nature of turbines and towers provides a strong visual contrast with uneven, random texture of the natural environment |
| **Degree of change in Visual Contrast: Moderate** | |
| | |

| Noupoort – (Eastern Edge of town) – Alternative 2 | |
|---|---|
| **Existing Visual Baseline** | **Post-construction Visual Setting** |
| Simple, natural landforms with strong horizontal lines (ridge tops and outcrops on hills) that create distinct dimensional shape and mass; ridge top lines and skyline (horizon) of the hills are a strong focal point. Subtle colours in both landform and vegetation. Fine- grained to uniform texture of hills and flats respectively creates little contrast only existing contrast provided by banding of road. Highly natural context | Simple, natural landforms with strong horizontal lines (ridge tops and outcrops on hills) that create distinct dimensional shape and mass; ridge top lines and skyline (horizon) of the hills are a strong focal point. However towers along road add to banding effect of road and introduce a strong, attention-drawing visual element, Subtle colours in both landform and vegetation, contrasting with silver-metallic colour of towers. Fine- grained to uniform but unordered texture of hills and flats respectively contrasts with uniformity of tower spacing. |
| **Degree of change in Visual Contrast: High** | |

As can be seen above, the degree of change in visual contrast associated with the Alternative 2 power line running along the Oorlogspoort Road is higher than that that associated with the Alternative 1 power lines running down the escarpment edge. It must be remembered that the above comparison is based on 2 specific locations, but the assessments are representative of the visual contrast over a wider area. It should also be noted that the visual impact of the Alternative 1 power line as viewed from the eastern edge of Noupoort would be 'lessened' in a sense due to the cumulative, and much greater impact of the turbines that would be visible from this location, as opposed to if the power lines were the only new feature. Taking the above factors into account, Alternative 1 is thus preferred from a visual perspective for the power lines as it would be associated with a combined visual impact, rather than being a new stand-alone impact in an otherwise non-impacted area

### *7.8.4 Substation*

The proposed final draft layout indicates that two locations for the substation have been designated with the preferred site being sited in the middle of the site in an area of flat, open grasslands. The height of the substation components is not known, but assigning the substation components a total height of 20m above the ground allows a worst-case scenario analysis to be undertaken of the areas from which the substation would be visible. This Google Earth-based analysis has shown that the neither substation locations would be visible from the Holbrook farmstead, or from the receptor locations to the west or east of the site, due to the shielding effect of topography. In spite of its relative proximity to the road, the preferred substation wouldnot be visible from parts of the Oorlogspoort Road as it runs along the development site boundary. Even

if the substation were to be able to be viewed it would be dwarfed by the large number of turbines that would be visible from the road. As such the substation is not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

## 7.9 Implications of the Proposed Development in the Karoo Cultural Landscape Context

The implications of the above findings in terms of the nature and intensity of the potential visual impact of the wind farm can be discussed in the context of the wind farm's effect on the Karoo Cultural Landscape as is present in the Study Area. As the presence and intensity of visual impacts is spatially varied across the Study Area, it is difficult to make an overall comment on the impact in this context. Thus in order to do so, the area has been divided up into three distinct landscape zones:

- The area to the west and north of the development site (i.e. Noupoort and surrounds, N9 and surrounding farms)
- The area to the south of the development site (i.e. the Oorlogspoort Road, and surrounding farms)
- The area to the east of the development site (i.e. the Oorlogspoort Road and surrounding farms)

### *7.9.1 Area to the west and north of the development site*

A number of turbines as well as the power line that descends the hills on the east of the site, will be visible from this area. The impact assessment above has indicated that the turbines will be visible from a number of locations to the west and north of the site; while the topography on the site and that in the surrounding area will help to mask certain of the turbines, a cluster of turbines will be visible on top of the hills on the site from a number of areas to the north and west of the site. While the turbines will be a visual focal point at a point of high elevation comparative to the areas to the west and the north, the distance factor between the turbines and these viewing areas is likely to reduce the intensity of this impact, and limit it to one part of the landscape spectrum visible to a casual viewer. In no part of this area is the landscape likely to be completely dominated by the wind farm, and as such there is unlikely to be a complete transformation of the visual character. This is further ameliorated by the visual context of a large part of this area in the vicinity of the town of Noupoort, where the visual environment is altered by a greater density of human objects and infrastructure. It is unlikely that the visual integrity of the area, as associated with the Karoo Cultural Landscape would be compromised by the development of the wind farm in this area, as the visual components of the rural parts of the landscape as currently existing are likely to largely remain unchanged. The wind farm would represent a new component within this context, rather than changing the visual baseline significantly.

### *7.9.2 Area to the south of the development site*

The area to the south of the development site, as traversed by the Oorlogspoort Road and in which a few farmsteads are located is highly natural in character. The exclusion of the turbines from most of the buffer area to the north of the Oorlogspoort Road, coupled with the shielding influence of topography entails that the visual impact associated with the turbines is likely to be low or negligible in a number of areas in which sensitive receptors are located. However the turbines are likely to be visually dominant from at least one key observation location (the Upper Holbrook Farmstead) and from a stretch of the Oorlogspoort Road. The wind farm components are likely to be more dominant in the landscape that from the areas to the north and west of the site due to the slightly closer proximity of these areas, but the turbines will still not completely dominate the landscape in most parts of this area, rather being a visibly notable component of it. Only along stretches of the Oorlogspoort Road will the turbines be completely visually intrusive. The visual integrity of the area will not be completely altered, in spite of its very natural state. Importantly, the transience of the views of the proposed wind farm for travellers along the Oorlogspoort Road is also likely to ameliorate the visual intrustion factor associated with the turbines. It is unlikely that the visual integrity of the area, as associated with the Karoo Cultural Landscape would be compromised by the development of the wind farm in this area, as the visual components of the rural parts of the landscape as currently existing are likely to largely remain unchanged.

### *7.9.3 Area to the east of the development site*

This part of the study area is least likely to be visually impacted by the proposed development, due mainly to the combination of the proposed turbine layout and the nature of the topography on the site by which the turbines are shielded from view by a high-elevation ridge that runs roughly parallel to the eastern boundary of the development site. The development will thus not bring any visual and aesthetic change to this area, as there will be no visual intrusion associated with its components. The typical Karoo landscape in this very sparsely populated part of the study area will thus remain as it exists now, and none of the scenic quality of the landscape will be compromised, as it may have been if the turbines had been highly visible and intrusive. It should be noted however that this area does not exist in isolation to the surrounding areas, and that people who reside or who travel through to access areas to the west this area will need to access parts of the study area that will be affected by the proposed wind farm. As such this will be part of the wider cultural landscape that may be affected by the proposed wind farm, but the relatively low degree of visual intrusion factor as reported above is an important factor.

### *7.9.4 Overall comment on the potential future evolution of the Karoo Cultural Landscape as it relates to energy generation facilities*

Much of the renewable energy developments, in particular solar power are being planned for the Northern Cape, Eastern Cape and Western Cape Karoo districts where there is an abundance of solar and wind resource that can be utilised. Depending very much on the density and geographical spread of renewable energy developments that are developed across the Karoo in the next few decades, the Karoo may well come to be associated with renewable energy generation plants as an integral part of the landscape. This is potentially important in the context of the Karoo Cultural Landscapes – it is important to remember that cultural landscapes can evolve over time, or be 'continuing', as per the definition of this type of cultural landscape. The fact that renewable energy developments are able to take advantage of two abundant natural resources that up until now have largely (with the exception of windmills) been underutilised, and also able to bring job creation and development into an a part of the country which apart from mining and sheep rearing has hitherto been unable to be greatly developed, may entail that renewable energy projects are seen in a highly positive manner, thus undermining any negative visual connotations that may otherwise have been associated with the very large and potentially visually-intrusive wind turbines in particular. Over time wind farms may thus become an intrinsic part of the Karoo Cultural Landscape, representing humankind's utilisation of, and adaptation to the harsh environment of the Karoo. There may be an innate contradiction in this scenario, in that wind farms in particular would have the potential to visually alter the natural character and low human footprint in this landscape, the characteristic which provides such a great degree of the Karoo's attractiveness. In addition, the public reaction to wind power overall once developed, in at this stage unknown. However it is not unreasonable to suggest that renewable energy generation may become synonymous with a Karoo landscape and as such part of a future, evolved cultural landscape. Under this scenario, visual intrusion associated with a wind farm as is proposed in the Noupoort area may have little impact on change, or degradation of the Karoo Cultural Landscape.

## 7.10 Overall Visual Impact Rating Table for the Environmental Impact Report

| IMPACT TABLE | | |
|---|---|---|
| Environmental Parameter | Visual Impact | |
| Issue/Impact/Environmental Effect/Nature | The proposed wind farm could create a visual impact on sensitive receptors in the study area by creating visual change and visual intrusion | |
| *Extent* | Local / District (2) | |
| *Probability* | Definite (4) | |
| *Reversibility* | Barely reversible (3) | |
| *Irreplaceable loss of resources* | Significant loss of resources (3) | |
| *Duration* | Long term (3) | |
| *Cumulative effect* | Low cumulative impact (2) | |
| *Intensity/magnitude* | High (3) | |
| *Significance Rating* | **High Negative Impact** | |
| | Pre-mitigation impact rating | Post mitigation impact rating |
| Extent | 2 | 2 |
| Probability | 4 | 2 |
| Reversibility | 3 | 2 |
| Irreplaceable loss | 3 | 2 |
| Duration | 3 | 3 |
| Cumulative effect | 2 | 1 |
| Intensity/magnitude | 3 | 1 |
| Significance rating | -51 (high negative) | -12 (low negative) |
| Mitigation measures | See section 8 below | |

# 8 MITIGATION MEASURES AND INFRASTRUCTURE LOCATION / PLACEMENT RECOMMENDATIONS

As part of the identification of potential mitigation measures that would lessen the visual impacts of the proposed wind farm, it is useful to examine the process undertaken by the EIA project team during the EIA phase to identify all environmentally-sensitive parts of the development site, in order to inform the design of the draft final turbine layout on the site.

## 8.1 Implications of Visual-environmentally-sensitive areas on the site

Section 6 above has described the areas on the site associated with the greatest potential visual exposure to the areas surrounding the site. In brief these areas are:

- the area to the west of the 'escarpment edge' – i.e. the part of the site on the rising ground to the east of Noupoort and the N9 highway
- a buffer of 1km east of this 'escarpment edge'
- a buffer 1km into the site from the Oorlogspoort Road on the southern boundary of the site

The exclusion areas as described above are those areas on the site where the placement of turbines would be most likely to result in visual impacts on the surrounding receptors. It is thus very important that these areas be maintained as exclusion zones in which no turbines or as few turbines as possible are placed. The assessment has found that turbines placed in these buffer zones (as per the final draft layout), in particular the buffer zone to the east of the escarpment edge and the buffer zone to the north of the Oorlogspoort Road will be responsible for the most significant visual impacts associated with the proposed development. It is thus recommended that consideration be given to removing the turbines from these buffer zones that would further reduce the visual impacts on certain areas surrounding the site.

## 8.2 Recommended power line routing recommendations

The assessment has found that the degree of change in visual contrast associated with the Alternative 2 power line running along the Oorlogspoort Road is higher than that that associated with the Alternative 1 power lines running down the escarpment edge (the more northerly alignment). It must be remembered that the above comparison is based on 2 specific locations,

but the assessments are representative of the visual contrast over a wider area. It should also be noted that the visual impact of the Alternative 1 power line as viewed from the eastern edge of Noupoort would be 'lessened' in a sense due to the cumulative, and much greater impact of the turbines that would be visible from this location, as opposed to if the power lines were the only new feature. Taking the above factors into account, Alternative 1 is thus preferred from a visual perspective for the power lines as it would be associated with a combined visual impact, rather than being a new stand-alone impact in an otherwise non-impacted area

# 9 CONCLUSIONS

The visual impact assessment for the proposed Noupoort Wind Farm has used a number of methods to assess the visual impact associated with the proposed development. A rating matrix has been used to provide an indicative rating of the visual impact of the proposed development at the individual receptor location, and the visual contrast methodology (using wind turbine visualisations) has been utilised to gain a more accurate understanding of the manner in which the wind farm components would visually intrude into the landscape at a number of key observation locations. The use of this methodology has also allowed the assessment to gain an understanding of whether the degree of visual change and intrusion at these key receptor locations would be consistent with objectives for preserving the aesthetic qualities in that lasndscape context.

The assessment has been undertaken based on the final draft layout for the wind farm that was made available for assessment in the final stages of the EIA. It is a critical factor that this layout was designed based on a consideration of a number of visual sensitivity factors, in particular areas on which turbines would be most visible to surrounding areas in which sensitive receptors are present. Although not all 'exclusion areas' were avoided, certain critical areas were not developed, and as such it is very important to note that this new layout represents a scenario under which visual mitigation measures have been applied.

In spite of the changes to the layout to avoid certain parts of the site, the assessment has identified that certain key observation locations will be subject to a visual contrast and thus visual intrusion that is inconsistent and higher with the tolerance level for the landscape context of the observation location. These locations are those receptor locations in natural contexts located to the west of the site (away from the town of Noupoort which has been assessed to be subject to an acceptable level of change) and a farmstead to the south of the site. These impacts can be effectively ameliorated by further altering the turbine layout by removing turbines from the parts of the two buffer zones (that to the east of the 'escarpment edge' and that to the north of the Oorlogspoort Road) in which turbines have been placed. It is thus recommended that

consideration be given to removing turbines from these locations, as this would result in an acceptable degree of visual change and intrusion associated with the wind farm at all locations, although it is recognised that other environmental factors may override visual factors.

# 10 REFERENCES


- Bishop, I.D., & Miller, D.R., 2006. Visual assessment of off-shore wind turbines: The influence of distance, contrast, movement and social variables, Renewable Energy 32 814–831
- Breedlove, G., 2002. A systematic for the South African Cultural Landscapes with a view to implementation. Thesis – University of Pretoria.
- Devine-Wright, P., Beyond NIMBYism: towards an Integrated Framework for Understanding Public Perceptions of Wind Energy, Wind Energy (Online Journal)
- Moseley,S., and Naude-Moseley,B., 2008. Getaway Guide to the Karoo, Namaqualand and Kalahari, Sunbird,
- Porteous, 1996. Environmental Aesthetics: Ideas, politics and planning, Routlege
- Thayer, R.L., Hansen, H., 1998. Wind on the land: renewable energy and pastoral scenery vie for dominance in the siting of wind energy developments. Landscape Architecture; 78: 69–73.
- UNESCO (2005) Operational Guidelines for the Implementation of the World Heritage Convention. UNESCO World Heritage Centre. Paris.
- United States Department of the Interior – Bureau of Land Management – Manual 8431 – Visual Resource Contrast Rating
- Warren,C.R., Lumsden, C.,O' Dowd, S., & Birnie, R.V., 2005. 'Green On Green': Public Perceptions of Wind Power in Scotland and Ireland, Journal of Environmental Planning and Management,Vol. 48, No. 6, 853 – 875
- Wu, Y., Bishop, HH., & Sposito, V., 2006. Using GIS in Landscape Visual Quality Assessment, Applied GIS, Volume 2, Number 3, Monash University Epress

Appendix A

# MAPS

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