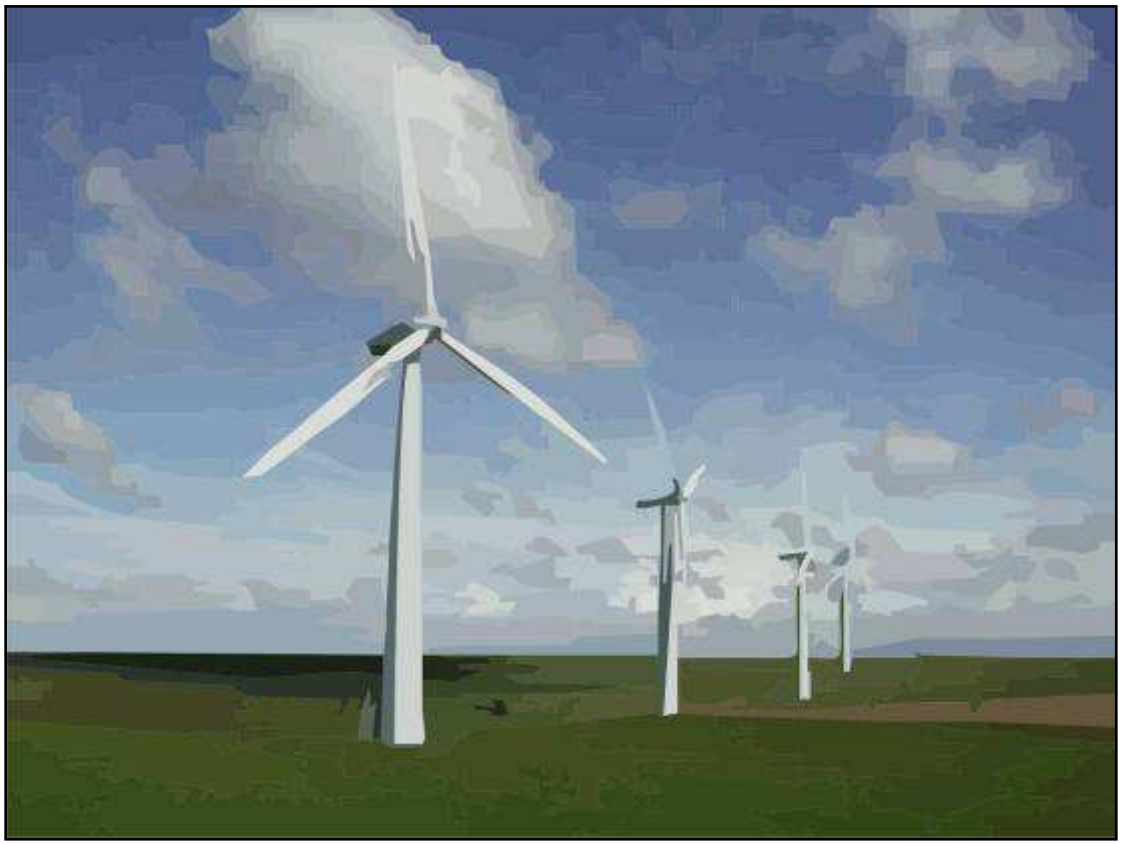
PROPOSED HAPPY VALLEY WIND ENERGY FACILITY
ON A SITE NEAR HUMANSDORP, EASTERN CAPE

VISUAL IMPACT ASSESSMENT



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- July 2011 –

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment in collaboration with V&L Landscape Architects CC.

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

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

The visual assessment team is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, the core elements are more widely applicable.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Happy Valley Wind Energy Facility. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Renewable Energy Investments South Africa is proposing the establishment of a Wind Energy Facility (WEF) on an identified site within the Kouga Local Municipality in the Eastern Cape Province. The site is located north of the N2 national road approximately 2.7 km north-west of Kruisfontein and 8 km north-west of Humansdorp.

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

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

Renewable Energy Investments South Africa intends to construct 13 wind turbines within an identified area of approximately 12,7km².

The WEF will connect to the national grid at the existing Melkhout substation some 8km to the east of the proposed site.

A preliminary layout of the WEF infrastructure is shown on **Map 1**. The proposed positions of the turbines and some of the ancillary infrastructure has been indicated. Additional infrastructure will include the following:

- Internal access roads to each wind turbine;
- A substation;
- A workshop/storage area and
- An overhead power line linking with the Melkhout Substation. Two alignment alternatives are under consideration for this power line:

  - The first alternative follows the alignment of the existing Eskom distribution power lines which cross the site for the whole length of the alignment;
  - The second alternative follows the alignment of the Eskom distribution lines for most of its alignment. For a short section, however, this alternative alignment branches away from the existing Eskom line to follow the N2 for some distance, where after it rejoins the alignment of the Eskom line.

Each turbine is expected to consist of a concrete foundation, a steel tower, a hub (placed at approximately 80m above ground level) and three 44m long blades attached to the hub. Variations of the above dimensions may occur, depending on the preferred supplier or commercial availability of wind turbines at the time of construction. Refer to **Figure 1**.

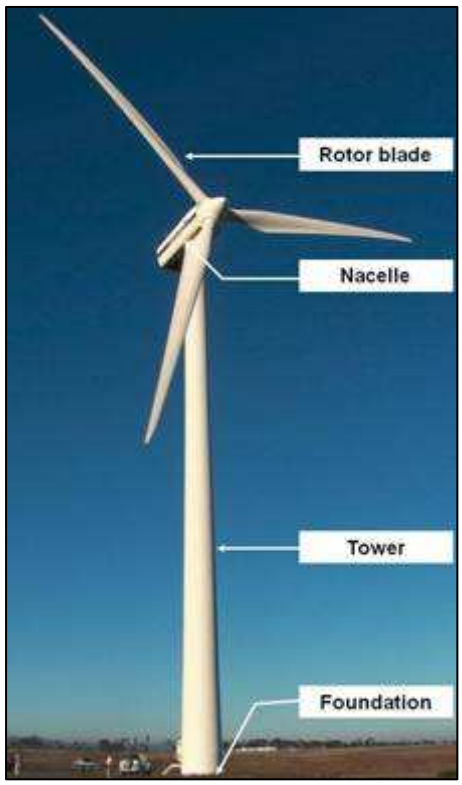


Figure 1: Illustration of the main components of a wind turbine[1]

It is expected, from a visual impact perspective, that the wind turbines would constitute the highest potential visual impact of the WEF.

The construction phase of the WEF is dependent on the number of turbines erected and is estimated at one week per turbine (i.e. approx 4 months). The lifespan of the facility is approximated at 20 to 30 years.

[1] Illustration courtesy of Savannah Environmental.

2. SCOPE OF WORK

The Happy Valley Wind Energy Facility potentially affects two farm portions, namely Farm 810 and Farm 810/1. The proposed development site (total surface area of the farms) is approximately 12.7 km^2.

The final surface area to be utilised for the WEF will be smaller and is dependent on the number of turbines erected, the final site layout and the placement of the wind turbines.

The study area for the visual assessment encompasses a geographical area of 1578 km² (the extent of the maps displayed below) and includes a minimum 20km buffer zone from the proposed development area.

The scope of work for this assessment includes the determination of the potential visual impacts in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure.

Issues related to the proposed Wind Energy Facility include:

- The visibility of the facility to, and potential visual impact on, observers travelling along major routes (i.e. the N2, R102, R62, R330 and R332) as well as secondary roads in close proximity[2] to the proposed WEF and within the region[3].
- The visibility of the facility to, and potential visual impact on, the towns of Humansdorp, Kruisfontein and St Francis Bay as well as on farming settlements and homesteads situated in close proximity to the proposed WEF and within the region. Settlements include *Hartebeesfontein, Geelhoutboom, Kerkplaats, Sandhoek, Leeubos, Bergstroom, Ouvloer, Stillerus, Doringrug, Orange Grove, Gravelridge, Plaatjiesdrift, Groenpunt, Die Berg, Endymion,* etc.
- The visibility of the facility to, and the potential visual impact on conservation areas[4] in close proximity to the proposed WEF (i.e. the Thaba Manzi Game Farm and Lodge and the Jumanji Game Farm) and within the region.
- The potential visual impact of the construction of ancillary infrastructure (i.e. the substation, the power lines, the access roads and the workshop) on observers in close proximity to the facility.
- The potential visual impact of the construction of the proposed WEF and ancillary infrastructure on the scenic visual character of the landscape and the sense of place of the region.
- The potential visual impact of the proposed WEF and ancillary infrastructure on tourist access routes (i.e. the N2), tourist destinations and tourist potential of the region.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the facility.
- Potential visual impacts associated with the construction phase on observers in close proximity to the facility.
- Potential cumulative visual impacts of the WEF.
- Potential residual visual impacts after the decommissioning of the facility.
- The potential to mitigate visual impacts.

[2] For the purpose of this study, close proximity is considered to be within 10km of the proposed WEF.

[3] For the purpose of this study, the region is considered to be beyond the 10km radius of the proposed WEF.

[4] For the purpose of this study, these include both private and public nature reserves, game farms, conservation areas, etc as listed in the SANBI database. They are not limited to conservation areas which have been proclaimed (i.e. municipal and provincial reserves and national parks).

3. METHODOLOGY

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

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The approach utilised to identify issues related to the visual impact included the following activities:

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

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed WEF and related infrastructure mentioned above, as well as offer potential mitigation measures, where required.

The following methodology has been followed for the assessment of visual impact:

- **Determine Potential visual exposure**

  The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed WEF and associated infrastructure were not visible, no impact would occur.

  Viewshed analyses of the proposed WEF facility and the related infrastructure, based on a 20 m interval digital terrain model of the study area, indicate the potential visibility.

- **Determine Visual Distance/Observer Proximity to the facility**

  In order to refine the visual exposure of the facility on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence for each type of structure.

  Proximity radii for the proposed development site are created in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structures in relation to their environment.

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

- **Determine Viewer Incidence/Viewer Perception**

  The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers, then there would be no visual impact. If the visual perception of the structure is favourable to all the observers, then the visual impact would be positive.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed WEF and its related infrastructure.

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

- **Determine the Visual Absorption Capacity of the natural vegetation**

  This is the capacity of the receiving environment to absorb the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

  The VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

  The VAC also generally increases with distance, where discernable detail in visual characteristics of both environment and structure decreases.

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

- **Determine the Visual impact index**

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

4. THE AFFECTED ENVIRONMENT

Regionally, the proposed WEF is located approximately 8 km north-west of Humansdorp within the Eastern Cape Province.

The proposed development site is located on a number of hills (or low mountains) that are on average about 200 m higher than the surrounding landscape (i.e. the average height from the base of the hill to the top of the hill), with the highest point 565 m above sea level.

The dominant topographical units or terrain types of the area are described as *moderately undulating plains and hills* to the south of the study area and *low mountains* to the north.

Three prominent rivers (the Leeubos, the Geelhoutboom and Seekoei Rivers) traverse the study area and form a distinct valley zone draining in a south easterly direction across the study area. Two Dams occur in the region, namely the Churchill Dam to the west of the proposed WEF site, and the Mpofu Dam to the south.

Note: It is uncertain whether any recreation or tourism facilities exist at these dams. The visual assessment assumes that visitor access is possible and permitted, and that the potential exists to develop tourist facilities and amenities of a private or public nature.

The study area includes predominantly rural agricultural land, plantations and pastures in the lower lying river valleys, which form a central strip across the study area, followed by St Francis bay, located in the far south east of the study area. More natural, undeveloped land occurs in the high lying mountainous areas in the north, as well as to the far south of the study area, along the coastline.

Kruisfontein and Humansdorp are the largest towns or urban developments in the study area. A number of farms / homesteads also occur, specifically in the lower lying parts of the river valleys.

The main economic activity is mixed agriculture/farming land uses that include irrigated agriculture and cattle farming. The population density is estimated at approximately 15 people per km^2.[5]

In terms of infrastructure, the study area includes sections of the N2 national road, a number of arterial roads (i.e. the R102 and the R62 running roughly east to west, and the R330 and the R332 running roughly north to south) as well as a number of secondary (local) roads.

Industrial type infrastructure includes two major Distribution Power Lines (one running in a north south direction, and the other in an east west direction) as well as two Distribution Substations. In addition, the Authorised RedCap Kouga WEF lies to the far south of the study area (i.e. some 12km from the proposed Happy valley WEF site), and stretches across an area of more than 35km.

The region has a rural character with a number of individual farming homesteads/dwellings occurring within the study area. It is also a particularly

[5] Department of Environmental Affairs and Tourism (DEAT), 2001. *Environmental Potential Atlas (ENPAT) for the Eastern Cape Province*

picturesque part of the country, and lies in close proximity to the southern seaboard of the country, which is a known tourist destination.

The natural vegetation types, primarily to the north of the study area, are described as *shrubland* with *thicket and bushland* occurring within the valleys and steeper areas. Large tracts of land south of the N2 national road, where the slope is more even, have been transformed through agriculture and cattle farming, and are described as pastures, agricultural fields and plantations. These broad land cover categories are shown on **Map 2**.

A number of protected areas of differing stature exist within the study area. These protected areas, which include both private and public nature reserve, game farms, conservation areas, etc and are not limited to those which have been proclaimed, include the following:

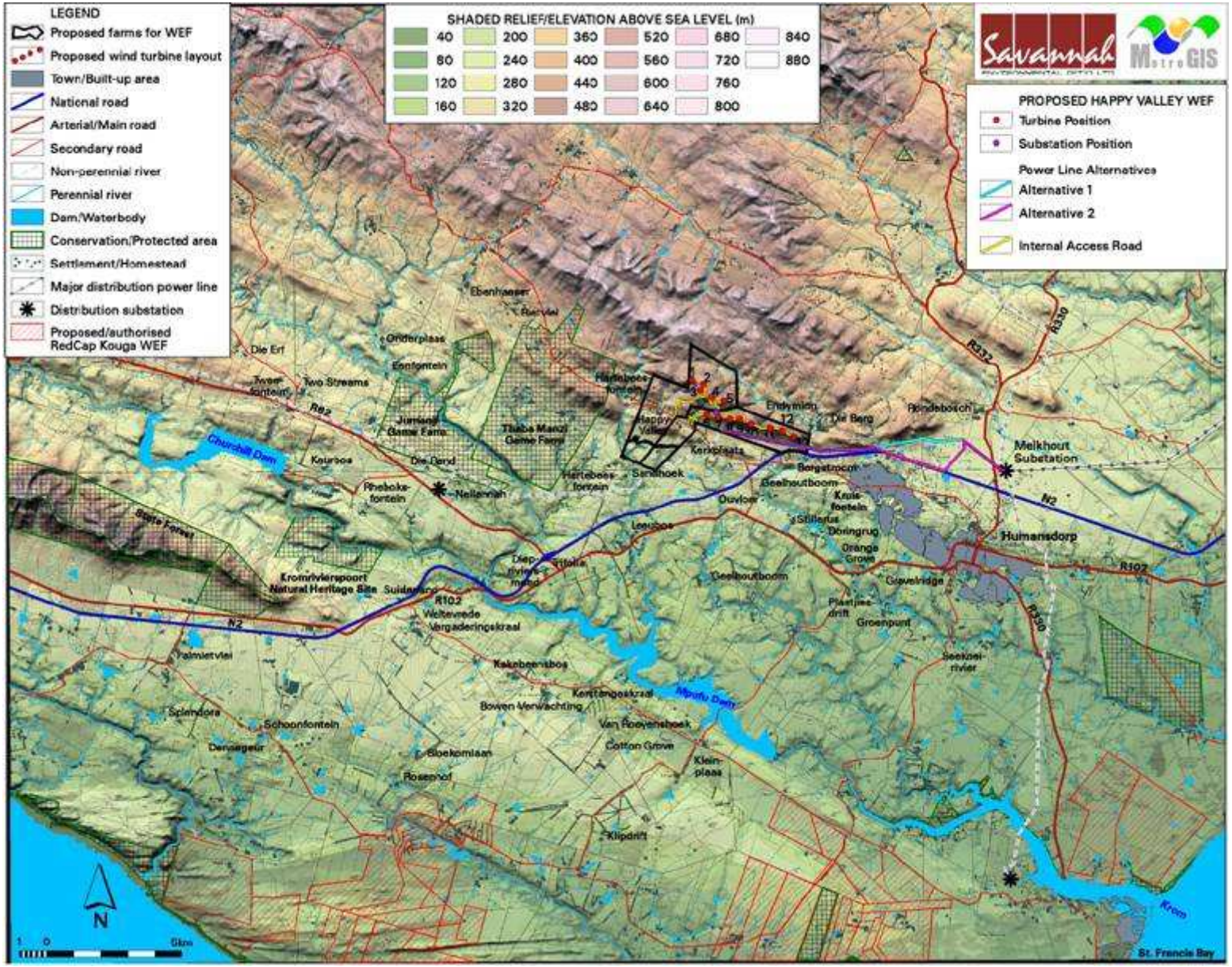
- The Thaba Manzi Game Farm and Lodge, located about 1km to the west of the proposed WEF site at its closest point;
- The Jumanji Game Farm to the west of Thaba Manzi, and located about 5km from the proposed WEF site at its closest point;
- The Kromrivierspoort Natural Heritage Site to the south west of Thaba Manzi, and located some 9km from the proposed WEF site at its closest point;
- A portion of State Forest to the far south west of the WEF site, and located more than 13km from the proposed WEF at its closest point;
- The Huisklip Local Authority Nature Reserve to the south of the State Forest, on the coastline, and located 21km from the proposed WEF at its closest point;
- The Thyspunt Natural Heritage Site in the far south of the study area, and located more than 15km from the proposed WEF at its closest point;
- The Lombardini Game Farm to the far south east of the WEF site, and located about 11km from the proposed WEF at its closest point.

Note: This study does not include any record of the nature or status of facilities present within these protected areas, or if indeed any facilities exist at all. The visual assessment assumes that visitor access is possible and permitted, and that the potential exists to develop tourist facilities and amenities of a private or public nature.

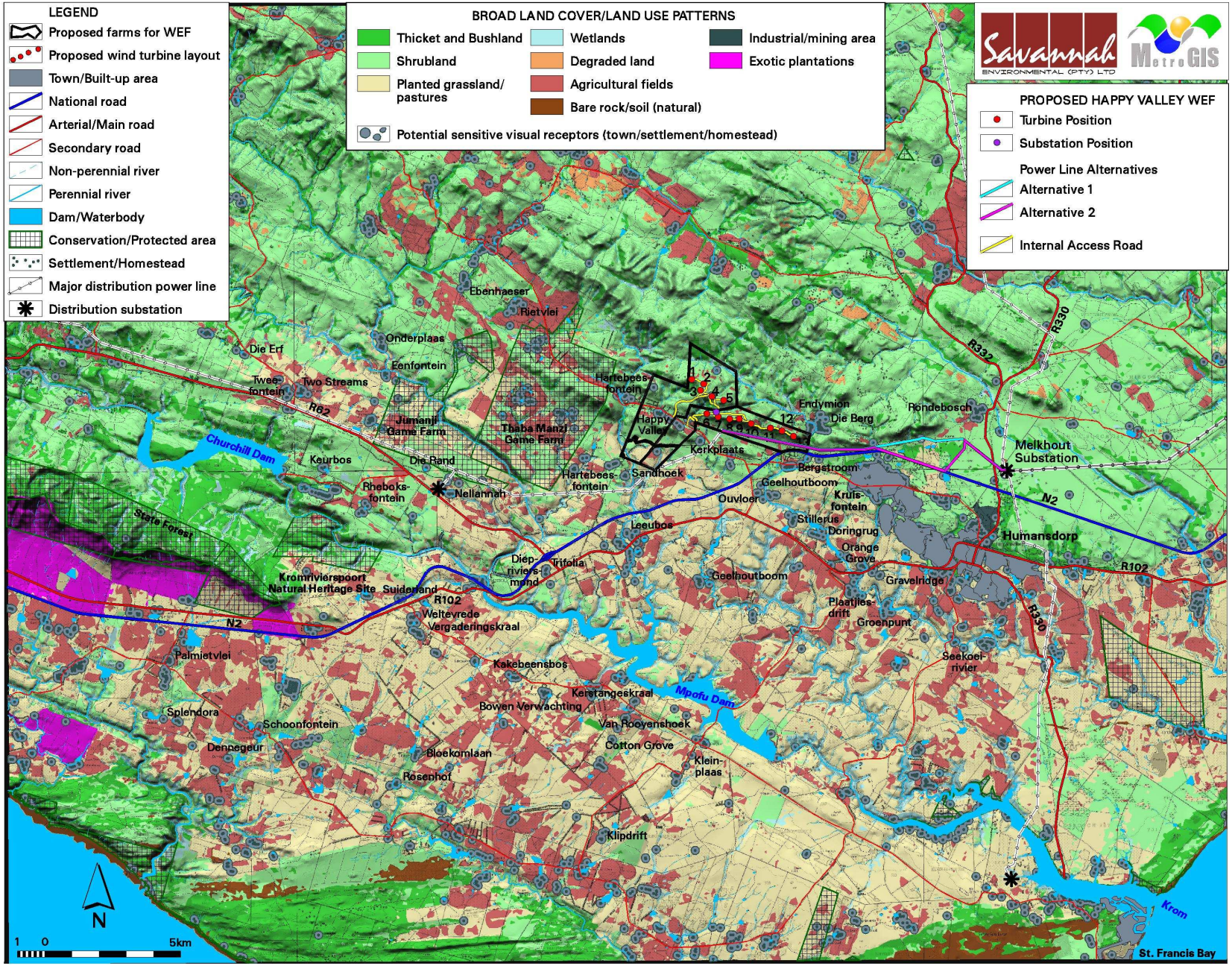
Sources: DEAT (ENPAT Eastern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland) and NLC2000 (ARC/CSIR).

Figure 2: General landscape in close proximity to the WEF. The ridge in the background is the proposed site for the proposed WEF.

Figure 3: General landscape in close proximity to the WEF.



Map 1: Locality Map and proposed layout of the Happy Valley WEF showing the provisional placement of infrastructure and shaded relief (topography and elevation above sea level).



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

5. RESULTS

5.1. Potential visual exposure

The visibility analysis was undertaken from each of the preliminary wind turbine positions (13 in total) at an offset of 80m above average ground level (i.e. the turbine hub height) in order to simulate a worst-case scenario.

The result of the viewshed analysis for the proposed WEF's provisional layout is shown on **Map 3**.

The viewshed analysis not only indicates areas from which the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed). The dark orange areas indicate a high frequency (i.e. 10-13 turbines may be visible), while the light yellow areas represent a low frequency (i.e. 1-2 turbines may be visible).

The highest frequency of potential visual exposure is expected within the drainage valley to the south west, south and south east of the WEF. In this area the topography is less mountainous, with fewer visual barriers. The area is also topographically depressed relative to the WEF site.

The frequency of visual exposure to the turbines is high within most of this zone, with the exception of narrow strips along the actual drainage lines, where the incision of the rivers into the landscape effectively shields these areas from visual exposure.

To the far south east, along the coastal plain, are also large areas that will potentially be exposed to views of the WEF. The frequency of exposure in these areas is also high.

Visibility of the WEF is more limited in extent in the north of the study area. Here there are fewer, and more isolated patches of potential visual exposure. The reason for this is the mountains and ridges which act as a visual shield from the proposed facility. Frequency of visibility in this area is also reduced.

Visibility of the WEF will be high, with a high frequency of exposure for significant stretches of the N2, the R102, the R62, the southern part of the R330 and a number of secondary roads. The northern part of the R330 and the R332 will be mostly shielded from visual impact, with isolated areas having a low to moderate frequency of exposure.

The towns of Kruisfontein and Humansdorp are expected to experience a high frequency of visual exposure, both within the towns and in the surrounding area. St Francis Bay may also experience a high frequency of visual exposure, but is located much further afield (i.e. more than 20km from the proposed WEF).

In addition, a large number of settlements and homesteads, especially those within the river valley zone will be visually exposed, with a high frequency of exposure.

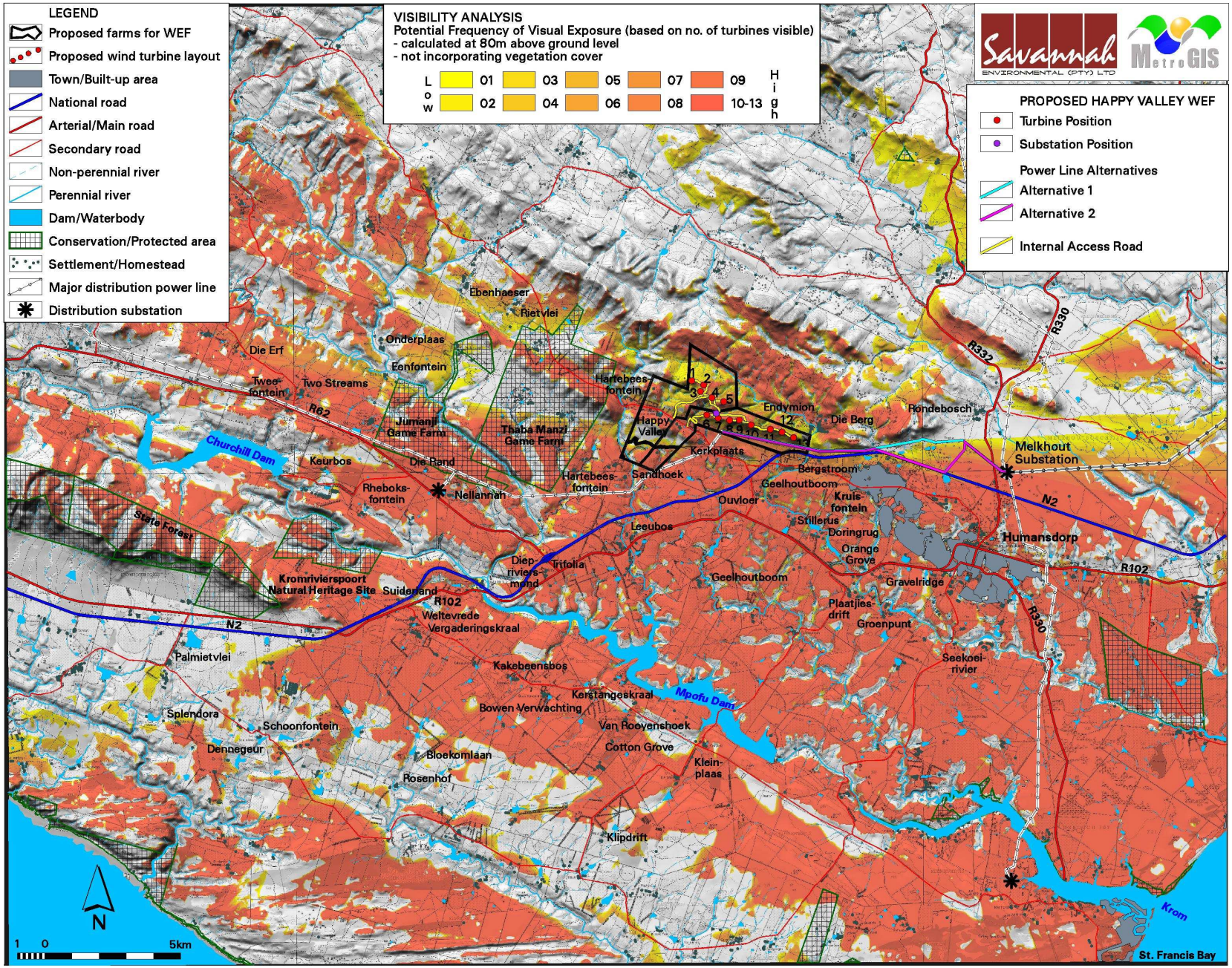
Mpofu dam will experience a high visual exposure to the WEF on its southern banks but the northern banks are shielded by the slope and rolling hills north of the dam. Some isolated areas surrounding the Churchill Dam will have views of the facility.

The proposed WEF will be visible from substantial sections of the Thaba Manzi and Jumanji Game Farms, as well as from parts of the Kromrivierspoort Natural Heritage Site and the State Forest.

Almost the entire Lombardini Game farm lies within an area most likely to experience a high frequency of visual exposure. The Thyspunt Natural Heritage Site and the Huisklip Local Authority Nature Reserve will have very limited areas of visual exposure.

The visibility map clearly illustrates the influence of the topography and the placement of the wind turbines on the ridge on the potential frequency of exposure. The WEF is placed in an elevated position relative to the surrounding landscape, which means it can be viewed from a large area and that the majority of the turbines (i.e. up to 13) will be visible at any one time.

It is envisaged that the structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the WEF and would constitute a high visual prominence, potentially resulting in a high visual impact.



Map 3: Potential visual exposure the proposed Happy Valley WEF.

5.2. Visual distance/observer proximity to the facility

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

The proximity radii (calculated from the boundary lines of the farm selected for the WEF) are shown on **Map 4** and are as follows:

- 0 – 5km - Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
- 5 - 10km - Medium distance views where the facility would be easily and comfortably visible and constitute a high visual prominence.
- 10 - 20km - Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 20 km - Long distance view where the facility would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the facility.

5.3. Viewer incidence/viewer perception

Refer to **Map 4**. Viewer incidence is calculated to be the highest along the national and arterial roads (i.e. the N2, R102, R62, R330 and R332) as well as the secondary roads within the study area. Commuters and tourists using these roads will be negatively impacted upon by visual exposure to the WEF.

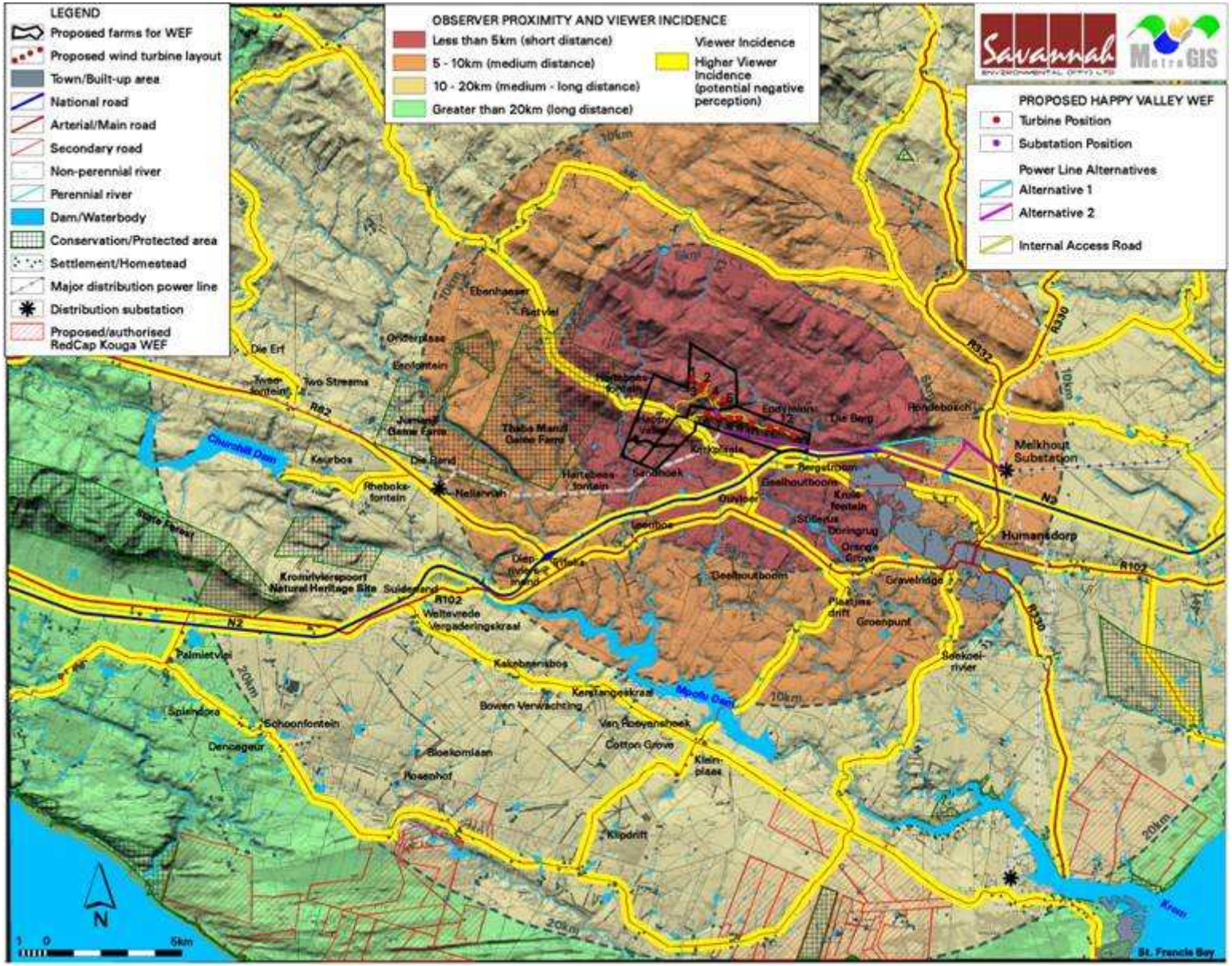
Other than along the above roads, viewer incidence within a 10 km radius of the proposed WEF is concentrated in Humansdorp and Kruisfontein. A handful of homesteads and settlements also lie within the zone, as do the protected areas of Thaba Manzi and Jumanji.

The remainder of the study area (beyond 10km from the proposed WEF) consists predominantly of grazing land (cattle), agricultural land or vacant natural land with potential observers located within homesteads, settlements and several protected areas.

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

The region as a whole has a high tourism value and inherent sense of place based on the rural culture and history. Residents and visitors to this area are therefore seen as sensitive visual receptors upon which the construction of the WEF could have a negative visual impact.

The majority of the study area consists of agricultural lands or protected areas and there is a fair population of random observers or sensitive visual receptors in the form of settlements and homesteads. The severity of the visual impact on these receptors decreases with increased distance from the proposed facility.



Map 4: Observer proximity to the proposed Happy Valley WEF and areas of high viewer incidence.

5.4 Visual absorption capacity of the natural vegetation

Large portions of the natural vegetation types in the study area have been removed to make way for agricultural fields, especially in the low lying valley zone.

The natural vegetation cover, predominantly *shrubland* and *thicket and bushland,* is largely limited to the mountains, ridges, coastal plains as well as the protected areas discussed above.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is deemed to be negligible by virtue of the vegetation and the low occurrence of development. In addition, the position of the turbine structures in relation to the topography renders it impossible for the environment to visually absorb the structure in terms of texture, colour, form and light / shade characteristics.

In the towns and urban areas, however, VAC will be applicable due to the presence of buildings and structures, and will be taken into account.

VAC will not be taken into account outside of the urban areas.

5.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed WEF are displayed on **Map 5**. Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values are assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater magnitude) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

The following is of relevance:

- The visual impact index map clearly indicates a core area of potentially **high** visual impact within a 5km radius of the proposed WEF. This core area is located partly within the river valley zone (in the south) and partly within the ridges and mountain (to the north).

  Potential areas of **very high** visual impact within this 5km radius include the entire lengths of the N2, the R102 and all the secondary roads. In addition, the town of Kruisfontein and its surrounds as well as a number of settlements and homesteads are likely to experience very high visual impact. These homesteads and settlements include the following:

  - Hartebeesfontein (1)
  - Sandhoek
  - Ouvloer
  - Stillerus
  - Doringrug
  - Orange Grove
  - Geelhoutboom (1)
  - Bergstroom

- Kerkplaats
- Happy valley
- Hartebeesfontein (2)
- Geelhoutboom (2)
- Die Berg
- Endymion.

- The extent of potential visual impact is somewhat reduced between the 5km and 10km radius. Areas to the north are largely shielded by the topography, with some patches of potentially low visual impact. Significant areas to the west, south and east of the proposed WEF are, however, exposed to **moderate** visual impact. Visually protected areas are limited to the incised river valleys.

  The entire N2, R102 and R62 as well as long stretches of the R330, R332 and secondary roads between 5km and 10km are likely to experience a **high** visual impact due to the high frequency of observers travelling along these roads. These stretches are mostly limited to the southern part of the study area, within the valley zone.

  In addition to Humansdorp and surrounds, a number of homesteads and settlements are likely to experience a **high** visual impact. These lie within a 10km radius of the proposed development, and include the following:

  - Gravelridge
  - Groenpunt
  - Plaatjiesdrift
  - Geelhoutboom (3)
  - Trifolia
  - Diepriviersmond
  - Nallannah
  - Leeubos.

- Between 10km and 20km, the magnitude of visual impact is mostly reduced to **low**.

  Exceptions are the national, arterial and secondary roads, as well as the homesteads and settlements. Potential visual impact for these receptors is expected to be **moderate**.

- Remaining impacts beyond the 20km radius are expected to be **very low**.

Conservation areas in close proximity to the WEF (i.e. within 10km of the site) include the Thaba Manzi Game Reserve and the eastern parts of the Jumanji Game Farm. Potential visual impact as a result of the proposed WEF is anticipated to be **high** in the mountains immediately to the west of the proposed WEF, and **moderate to low** further to the west.

The remaining conservation areas within the study area (i.e. the Kromrivierspoort Natural Heritage Site, the portion of State Forest, the Huisklip Local Authority Nature Reserve, the Thyspunt Natural Heritage Site and the Lombardini Game Farm) all lie beyond 10km of the proposed WEF site, and may be expected to experience only **low** to **very low** visual impact, if any.

Both the Mpofu and the Churchill Dams lie more than 7km from the proposed WEF site. Both are likely to experience **low** visual impact due to the facility. The

northern bank as well as the upper reaches of the Mpofu Dam may experience a **moderate** visual impact.

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

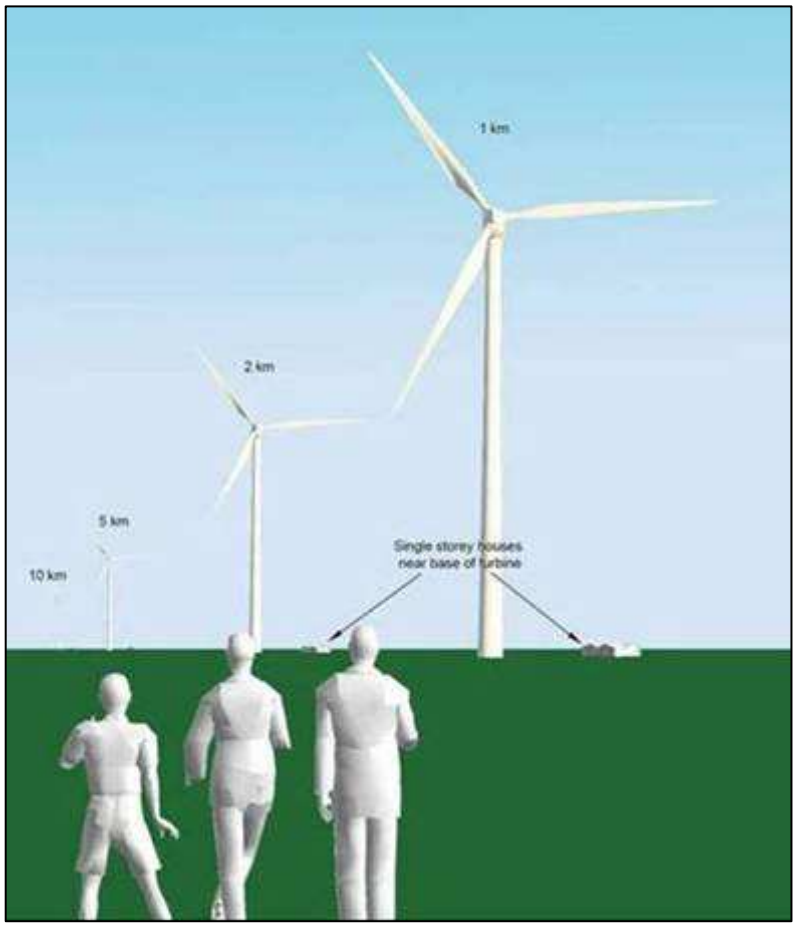
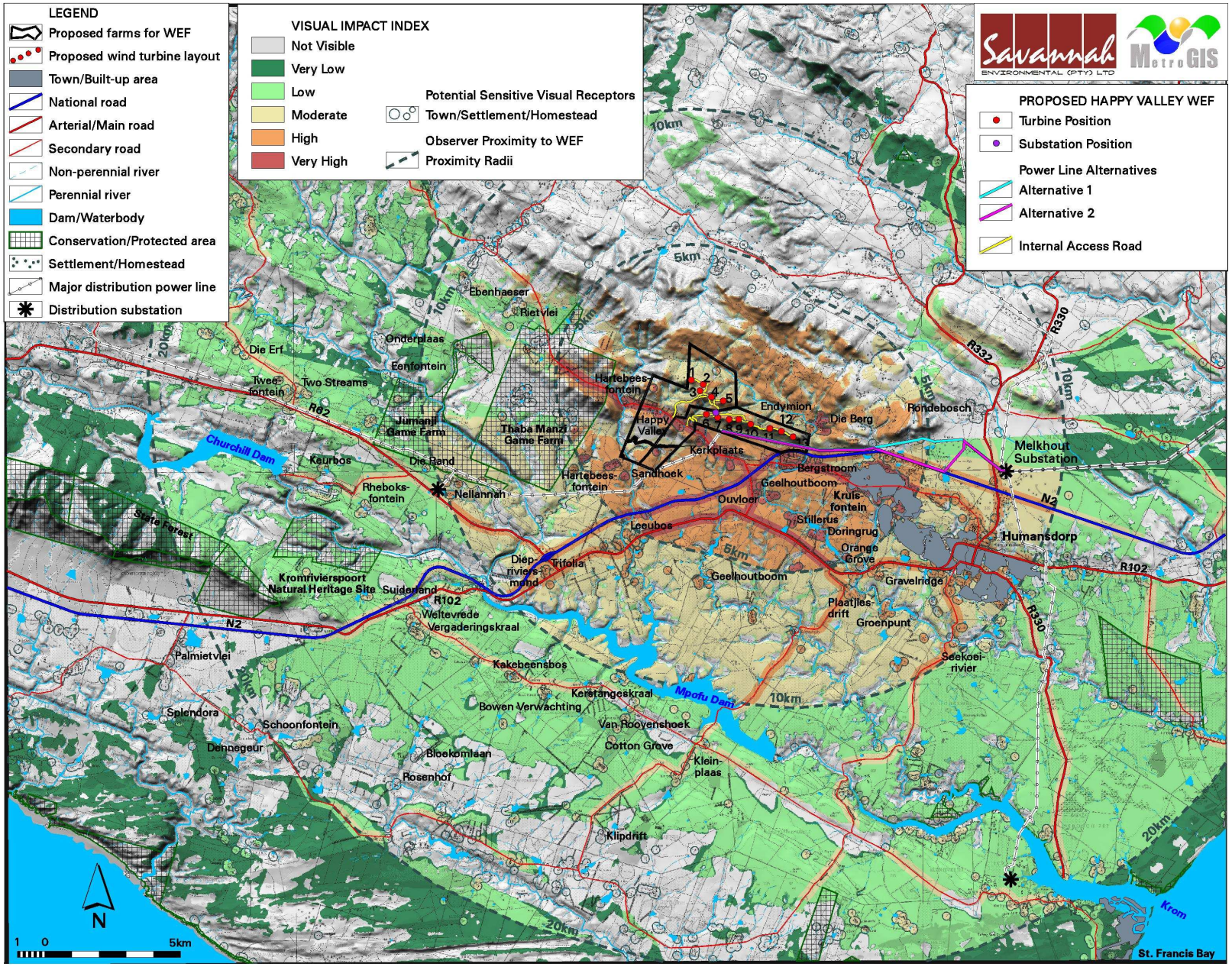


Figure 4: Visual experience of a wind turbine structure at a distance of 1km, 2km, 5km and 10km.



Map 5: Visual impact index of the proposed Happy Valley WEF.

5.6 Visual impact assessment: methodology

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 2: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads in the vicinity of the proposed facility) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1).
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5).
- **Magnitude** - None (= 0), minor (= 2), low (= 4), medium/moderate (= 6), high (= 8) and very high (= 10). This value is read from the visual impact index.
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5).
- **Status** (positive, negative or neutral).
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5).
- **Significance** - low, medium or high.

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

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

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

*Please note that due to the declining visual impact over distance, the **extent** (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.*

No mitigation measures (e.g. painting the structures a sky blue colour) is proposed as the colour scheme and lighting fixtures are legally required by the Civil Aviation Authority and cannot be altered.

5.7 Visual impact assessment: primary impacts

5.7.1 The WEF

Potential visual impact on users of major roads (N2, R102, R62, R330 and R332) and secondary roads in close proximity to the proposed WEF

Potential visual impact on users of national, arterial and secondary roads in close proximity of the proposed WEF (i.e. within 10km) are expected to be **high**. No mitigation is possible.

The table below illustrates this impact assessment.

Table 1: Impact table summarising the significance of visual impacts on users of major and secondary roads in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact on users of major and secondary roads in close proximity to the proposed WEF		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Very high **(10)**	N/a
Probability	Definite **(5)**	N/a
Significance	High **(90)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed WEF.

The potential visual impact on residents of Kruisfontein and on the residents of homesteads and settlements within a 5km 10km radius of the proposed WEF is expected to be **high**. No mitigation is possible.

The table below illustrates this impact assessment.

Table 2: Impact table summarising the significance of visual impacts on residents of towns, settlements and homesteads in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed WEF		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Very high **(10)**	N/a
Probability	Definite **(5)**	N/a
Significance	High **(90)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact on sensitive visual receptors (users of roads and residents of towns, settlements and homesteads) within the region

The visual impact on the settlements and homesteads within the region (beyond the 10km radius) is expected to be of **moderate** significance. No mitigation is possible.

The table below illustrates this impact assessment.

Table 3: Impact table summarising the significance of visual impacts on sensitive visual receptors within the region.

Nature of Impact: Potential visual impact on sensitive visual receptors within the region.		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Moderate **(6)**	N/a
Probability	High **(4)**	N/a
Significance	Moderate **(52)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact on protected areas in close proximity to the proposed WEF.

The potential visual impact on conservation/protected areas within a 10km radius of the proposed WEF (i.e. the Thaba Manzi and Jumanji Game Farms) is expected to be of **moderate** significance. There is no mitigation for this impact.

The table below illustrates this impact assessment.

Table 4: Impact table summarising the significance of visual impacts on protected areas in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact on protected areas in close proximity to the proposed WEF.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	High **(8)**	N/a
Probability	Probable **(3)**	N/a
Significance	Moderate **(48)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact on protected areas within the region.

The potential visual impact on conservation/protected areas beyond the 10km radius of the proposed WEF is expected to be of **low** significance. There is no mitigation this impact.

The table below illustrates this impact assessment.

Table 5: Impact table summarising the significance of visual impacts on protected areas within the region.

Nature of Impact: Potential visual impact on protected areas within the region.		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Low **(4)**	N/a
Probability	Improbable **(2)**	N/a
Significance	Low **(22)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

5.7.2. Ancillary infrastructure

Potential visual impact of internal access roads on observers in close proximity to the proposed WEF.

Within the WEF footprint, existing roads will be used wherever possible. It may, however be necessary to build additional roads either to construct each turbine (construction phase), or to maintain the turbines (operational phase).

The network of roads has the potential of manifesting as a network of landscape scarring, and thus a potential visual impact within the viewshed areas. This is especially relevant for steep slopes where cut and fill is required to build access roads to turbines located in high lying areas and on steep slopes. In steep and hilly areas, the graded slopes would be vulnerable to erosion over time. The effects of erosion also represent a potential visual impact to observers.

No dedicated viewshed has been generated for the access roads, but that the area of potential visual exposure will lie within that of the turbines. They are not likely to be as highly visible as the turbines, however, as some of the roads lie behind the crest of the mountain. This reduces the probability of this impact occurring.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **moderate** significance and may be mitigated to **low.**

Table 6 Impact table summarising the significance of visual impact of internal access roads on observers in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of internal access roads on observers in close proximity to the proposed WEF.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	Moderate **(6)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Moderate **(32)**	Low **(28)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Planning: Layout and construction of roads and infrastructure with due cognisance of the topography. Construction: rehabilitation. Decommissioning: ripping and rehabilitation of the road and servitude.		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact of the substation and workshop areas on observers in close proximity to the proposed WEF.

The substation and workshop could present a visual impact. Areas of vegetation will need to be removed and industrial type structures will be built within a natural environment.

No dedicated viewshed has been generated for the above infrastructure, but that the area of potential visual exposure will lie within that of the turbines. This infrastructure is not likely to be as highly visible as the turbines, however, as the substation lies behind the crest of the mountain, and the scale will be much smaller than that of the turbines. This reduces the probability of this impact occurring.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **low** significance. There is no mitigation for this impact.

Table 7 Impact table summarising the significance of visual impact of the substation and workshop areas on observers in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of the substation and workshop areas on observers in close proximity to the proposed WEF		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Low **(4)**	N/a
Probability	Improbable **(2)**	N/a
Significance	Low **(24)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact of the power line on observers in close proximity to the proposed WEF.

There are two alternatives for the power line which will link with the Melkhout Substation. The first alternative follows the alignment of the existing Eskom distribution power lines for the whole length of the alignment.

The second alternative follows the alignment the Eskom distribution lines for most of its alignment. For a short section, however, this alternative alignment branches away from the existing Eskom line to follow the N2 for some distance, where after it rejoins the alignment of the Eskom line.

The Alternatives have been indicated on **Map 6**. This map also shows the potential visual exposure of the power lines, which has been calculated at a height of 30m above ground level, for a distance of 5km on either side of the alignment.

It is clear from this map that the power line will be highly visible to the south, with less visual exposure to the north due to topography. Visual receptors include users of the N2, R102, R330, R332, Kruisfontein and a number of homesteads / settlements. It is noteworthy that the viewshed for the power line falls largely within that of the proposed turbines.

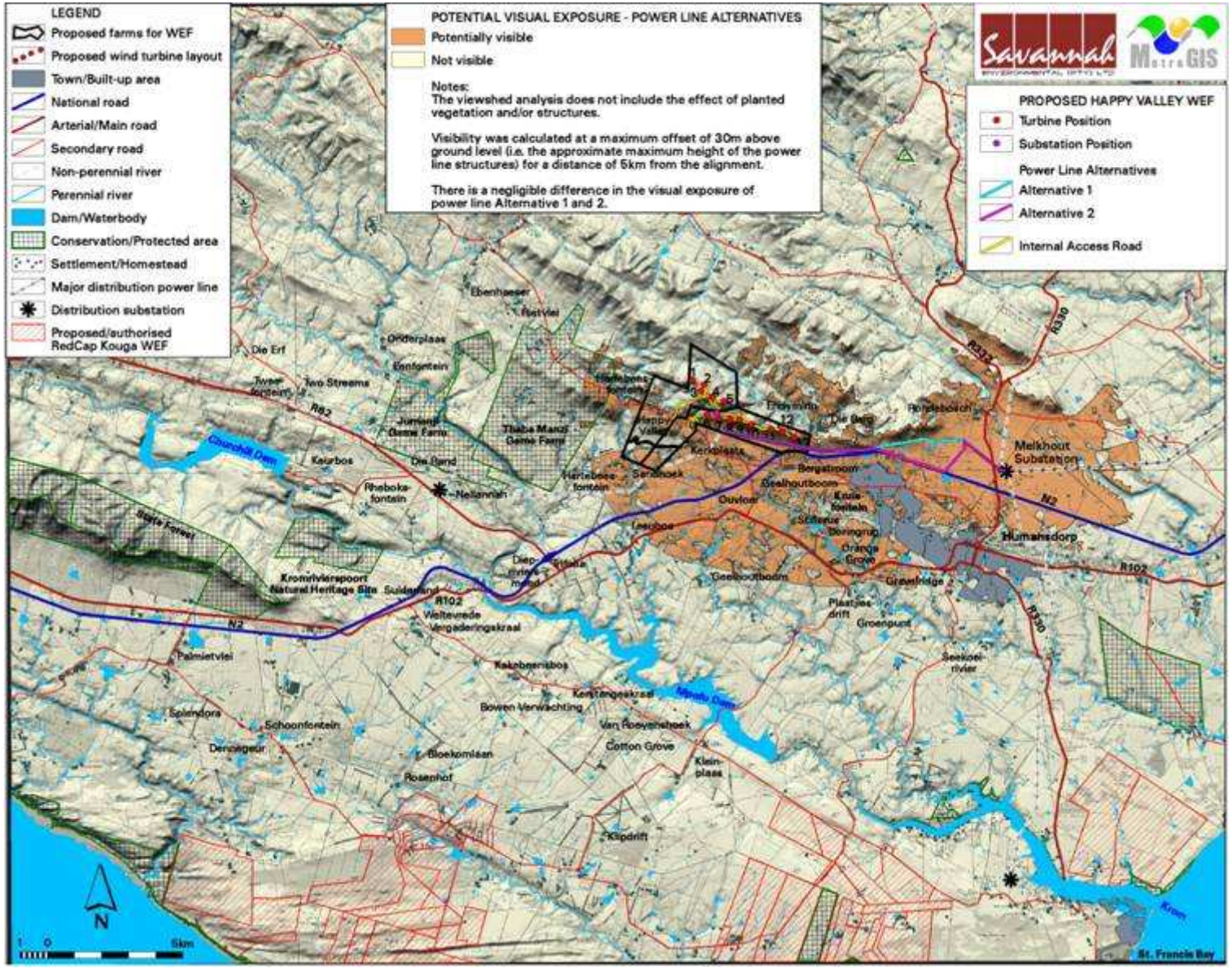
There is a negligible difference between the exposure of Alternative 1 and 2, meaning that either option will result in potential visual impact. However, Alternative 1 follows an existing power line alignment (Melkhout/Langkloof 1 66kV) for its entire length, while Alternative 2 does not. Also Alternative 2 is likely to have a greater impact on users of the N2, as it runs adjacent to the road for much of the alignment distance.

In this respect, Alternative 1 is considered preferable to Alternative 2 from a visual perspective as the existing infrastructure may help to 'absorb' the visual impact somewhat. Other than the selection of the preferred alternative, there is no mitigation for this impact.

The table overleaf illustrates the assessment of this anticipated impact, which is likely to be of **moderate** significance.

Table 8 Impact table summarising the significance of visual impact of the power line on observers in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of the power line on observers in close proximity to the proposed WEF.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Moderate **(6)**	N/a
Probability	High **(4)**	N/a
Significance	Moderate **(56)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Planning: selection of Alternative 1 for the power line alignment. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of the new power lines will increase the cumulative visual impact of power lines within the region, specifically in terms of the two existing Major Distribution Lines, which bypass the site in close proximity. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: The visual impact will be removed after decommissioning, if the power lines are also removed. If this is not the case, then the visual impact will remain.		



Map 6: Potential visual exposure the proposed power line options.

5.7.3. Lighting impacts

Potential visual impact of lighting at night on visual receptors in close proximity of the proposed WEF.

The receiving environment has a relatively small number of populated places (i.e. Kruisfontein, Humansdorp and settlements / farmsteads) and it can be expected that the light trespass and glare from the security and after-hours operational lighting (flood lights) for the substation and other WEF infrastructure will have some significance.

Furthermore, the sense of place and rural ambiance of the local area increases its sensitivity to such lighting intrusions. It is also important that note be taken of the eco-tourist destinations within close proximity to the proposed WEF namely Thaba Manzi and Jumanji Game Farms This potential impact is further aggravated by the fact that the WEF is located in such an elevated position.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The WEF may contribute to the effect of sky glow in an otherwise dark environment.

The table overleaf illustrates the assessment of this anticipated impact, which is likely to be of **high** significance, and may be mitigated to **moderate.**

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

Nature of Impact: Potential visual impact on of lighting at night on visual receptors in close proximity of the proposed WEF.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	Moderate **(6)**
Probability	High **(4)**	Probable **(3)**
Significance	High **(64)**	Moderate **(42)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Planning: pro-active lighting design and planning Planning: mounting aircraft warning on the turbines representing the outer perimeter of the facility. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact of lighting within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site..		
Residual impacts: None. The visual impact of lighting will be removed after decommissioning.		

5.7.4. Construction impacts

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

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

Mitigation entails proper planning, management and rehabilitation of the construction site to forego visual impacts.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **moderate** significance, and may be mitigated to **low.**

Table 10: Impact table summarising the significance of visual impact of construction on visual receptors in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of construction on visual receptors in close proximity to the proposed WEF.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Very short term **(1)**	Very short term **(1)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	High **(4)**	Improbable **(2)**
Significance	Moderate **(44)**	Low **(18)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Construction: Proper planning, management and rehabilitation of the construction site		
Cumulative impacts: None.		
Residual impacts: None.		

5.8 Visual impact assessment: secondary impacts

5.8.1 The WEF

Potential visual impacts on the visual character and sense of place of the region.

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc) play a significant role.

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

Specific aspects contributing to the sense of place of this region include the pastoral visual quality of the farmland as well as the scenery beauty of the landscape and the mountains.

The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be **moderate**. There is no mitigation for this impact.

The table below illustrates the assessment of this anticipated impact.

Table 11: Impact table summarising the significance of visual impacts on the visual character and sense of place of the region.

Nature of Impact: Potential visual impact on the visual character and sense of place of the region.		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	High **(8)**	N/a
Probability	Probable **(3)**	N/a
Significance	Moderate **(45)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Potential visual impact of the proposed facility on tourist routes, tourist destinations and tourism potential within the region.

The region has a rural character and is located within a particularly picturesque part of the country. It is in close proximity to the southern seaboard, which is a known tourist destination.

The tourism potential of the region may not yet be optimised, but tourist facilities are sure to exist within the greater study area, especially along the coast. There is certainly potential for more to develop.

In addition, the N2 is a well known and well used tourist access route, and many arterial and secondary roads make for scenic drives.

Visual intrusion through the development of industrial type infrastructure within this environment could have a negative effect on the area's tourism value and potential.

The anticipated visual impact of the facility on existing tourist routes, as well as on the tourism potential of the region, is expected to be **moderate**. There is no mitigation for this impact.

The table below illustrates the assessment of this anticipated impact.

Table 12: Impact table summarising the significance of visual impacts on tourist routes, tourist destinations and tourist potential within the region.

Nature of Impact: Potential visual impact of the proposed facility on tourist routes, tourist destinations and tourist potential within the region.		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Moderate **(6)**	N/a
Probability	Probable **(3)**	N/a
Significance	Moderate **(39)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorised RedCap Kouga WEF located to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

5.9. The potential to mitigate visual impacts

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

  Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent.

- Mitigation of secondary visual impacts associated with the construction of roads includes the use of existing roads wherever possible.

  Where new roads are required, these should be planned taking due cognisance of the topography. Roads should be laid out along the contour wherever possible, and should never traverse slopes at 90 degrees. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Roads should be positioned behind (i.e. on the north side) of the crest of the ridge wherever possible.

  Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

- The proposed power line must follow the alignment Alternative 1 in order to consolidate linear infrastructure and to minimise potential visual impact.

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

  The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

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

  - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
  - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
  - Making use of minimum lumen or wattage in fixtures;

- Making use of down-lighters, or shielded fixtures;
- Making use of Low Pressure Sodium lighting or other types of low impact lighting.
- Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

- Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:

  - Reduce the construction period through careful planning and productive implementation of resources.
  - Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
  - Ensure that rubble, litter and disused construction materials are managed and removed regularly.
  - Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
  - Reduce and control construction dust through the use of approved dust suppression techniques.
  - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
  - Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.

- Secondary impacts anticipated as a result of the proposed WEF (i.e. visual character and sense of place) are not possible to mitigate.

- There is no mitigation to ameliorate the negative visual impacts on tourist routes and destinations, and on the Thaba Manzi and Jumanji Game Reserves. A land use conflict exists with regard to these private game reserves, as the visual intrusion will impose some limitation on conservation based development and tourism opportunities in the future

- Once the WEF has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an ongoing basis.

6. PHOTO SIMULATIONS

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed happy Valley WEF within the receiving environment.

The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout as indicated on **Figure 2** and **Map 1** respectively.

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

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

It is imperative that the natural vegetation be restored to its original (current) status for these simulated views to ultimately be realistic. These photographs can therefore be seen as an ideal operational scenario (from a visual impact point of view) that should be aspired to. The additional infrastructure (e.g. the proposed power lines, substation, access roads, etc.) associated with the facility is not included in the photo simulations.

Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the turbines are viewed. Each panoramic overview indicates the section that was enlarged to show a more detailed view of the WEF.

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

The following technical data are of relevance:

- The camera used to take the initial photographs is a standard Canon EOS 1000D with an 18-55mm lens. Photos intended for panoramas are taken with focal length at 55mm to minimize edge distortion and to facilitate the panoramic software’s stitching process.

- Canon’s stitching software (Photostitch v3.1.21) is used to create the panoramas. This software automatically compensates for slight variations in the focal length on each photo used in the panorama (i.e. the camera model, focal length, F-number, etc are embedded into each photo, so the software recognizes these parameters and adjusts the output image accordingly).

- The photo simulation process begins with the DTM, as this is effectively the "ground surface" of the virtual environment. The accuracy of the DTM in representing the Earth's surface is very much dependent on the quality of available contour data as this is what it is derived from. The raster DTM that is used to show shaded relief in a map is usually the same dataset that is used as the virtual ground surface.

- The DTM is visualised in 3D with an application called ArcScene. ArcScene works in much the same way as ArcMap except that the geometry and attributes of shapefiles cannot be edited, and of course, that is displayed

in a Cartesian plane. Any existing shapefile can be added into the 3D environment and will automatically be displayed in its correct geographic position. Shapes that do not contain Z-values (height above mean sea level) can be assigned height values using the DTM. Point shapefiles, for example, will typically already have X/Y coordinates but can be placed at the virtual ground level, or at any height above ground level as specified in the attribute table. Lines and polygons work in the same way, thus enabling any vector shapefile to be "draped" onto the 3D terrain surface. Furthermore, points can be extruded to create lines of any specified length; lines may be extruded to create 3D polygons; and 3D polygons may be extruded to create 3D volumes.

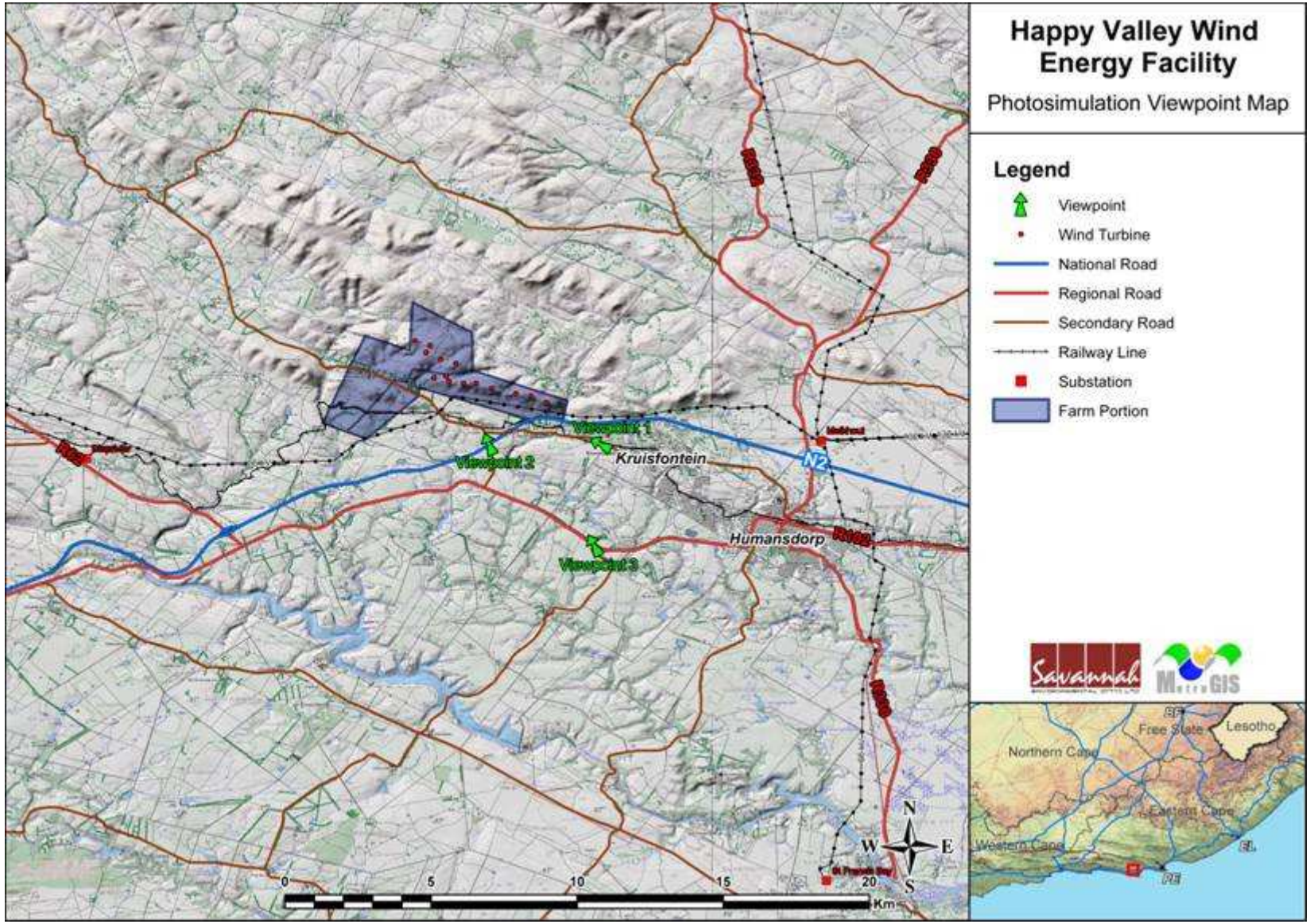
- 3D models from such applications as 3D StudioMax or Sketchup are compatible with the ArcScene environment and work by assigning a model to be rendered at points geographically specified by a point shapefile. Each model itself consists of many polygons, and depending on the number of models used, can impact severely on a computer's performance in displaying the virtual environment.

- For the purposes of placing wind turbines onto a virtual landscape, a layout of the exact turbine positions is required in the form of a point shapefile. This shapefile is added three times to the environment. The first instance is displayed as a point at ground level to indicate where the turbine tower meets the ground level. The second instance is extruded to half the height of the tower and displayed in a certain colour. The third instance is extruded from half to the full height of the tower and displayed in a different colour. Thus, from any virtual viewpoint on the landscape, it can be determined which turbines will be in full view and which will be partially obscured by undulations of the terrain. The terrain can also be made semi-transparent to check whether anything is completely obscured.

- Each photo viewpoint is then recreated within the virtual environment by setting the "camera" coordinates to those of the GPS coordinates logged when each photo was taken. Several other data may be added for landmark purposes, such as roads, rivers, power lines, or even trees if they can be accurately digitized. The virtual output is then rendered at a focal length matching that of the photos originally used to create the panoramas (using a field-of-view calculator that also compensates for the digital equivalent of 35mm film cameras). Several virtual "snapshots" are taken in sequence in the same manner as for the panoramic photos as the virtual output suffers from the same edge distortion as a photo. These are then stitched in the same manner as the photographs.

- Both the panoramic photos and the virtual simulation output are now graphic formats that are loaded into Adobe Photoshop. Some enhancements of the panoramas may be necessary as weather conditions tend to adversely affect image quality. The horizon and landscape of the virtual viewpoint is then matched up to what can be seen in the panoramas and sample images of the wind turbines are then overlaid where the extruded points are visible. Scaling is maintained since the top and mid-point of the tower are usually visible, so the ground point can be established even though it may be obscured by the landscape. Some graphic editing is usually necessary to address such things intervening vegetation or power lines as well as sufficient blurring to mimic the effect of distance.

- The scene is then typically rendered twice as "before" and "after" views.



Map 7: Photograph positions for Photo Simulations.

6.1 West north-westerly view

Viewpoint 1 (short distance view)

Viewpoint 1 is located on the secondary (extension of Felix Street) road which runs south of the N2. The point from which the photo was taken is approximately 1km to the west of the outskirts of Kruisfontein. This position is approximately 2.4km away from the closest turbine. This is indicative of a close range view that residents and commuters travelling west from the town of Kruisfontein will see of the WEF.

This view may be considered similar to that observed from the N2, which lies less than 1km to the north, as well as from Kruisfontein.

The viewing direction is north-westerly and 9 turbines are fully to partially visible in the landscape.

Figure 5a: Pre construction panoramic overview from Viewpoint 1
This viewpoint is located 2.4km away from the closest turbine.

Figure 5b: Post construction panoramic overview from Viewpoint 1 (indicating enlarged photograph sections).
This viewpoint is located 2.4km away from the closest turbine.

Figure 5c: View 1a (enlarged photograph section from Viewpoint 1).

Figure 5d: View 1b (enlarged photograph section from Viewpoint 1).

6.2 North north-westerly view

Viewpoint 2 (short distance view)

Viewpoint 2 is located on a secondary road which intersects the N2 about 5km west of Kruisfontein. This position lies approximately 1.2km from the closest turbine and is indicative of what will be seen by residents and commuters moving between the outlying farmstead of Ouvloer, Kerkplaats and Happy Valley.

This view may be considered similar to that observed from the N2, which lies immediately to the south of the viewpoint.

The viewing direction is north north-westerly and all 13 turbines may be fully to partially visible in the landscape.

Figure 6a: Pre construction panoramic overview from Viewpoint 2
This viewpoint is located, 1.2km from the closest turbine.

Figure 6b: Post construction panoramic overview from Viewpoint 2, (indicating enlarged photograph sections).
This viewpoint is located, 1.2km from the closest turbine

Figure 6c: View 2a (enlarged photograph section from Viewpoint 2).

Figure 6d: View 2b (enlarged photograph section from Viewpoint 2).

Figure 6e: View 2c (enlarged photograph section from Viewpoint 2)

Figure 6f: View 2d (enlarged photograph section from Viewpoint 2)

6.3 North-westerly view

Viewpoint 3 (medium distance view)

Viewpoint 3 is located on the junction of the R102 and the road that runs past Plaatjiesdrift. This photo was taken from a position approximately 5km away from the closest turbine and is indicative of what will be seen from a medium distance by those travelling north on the secondary road.

This view may be considered similar to that which may be observed from the R102, as well as from Humansdorp.

The viewing direction is north-westerly and all 13 turbines may be fully to partially visible in the landscape.

Figure 7a: Pre construction panoramic overview from Viewpoint 3.
This viewpoint is located 5km away from the closest turbine.

Figure 7b: Post construction panoramic overview from Viewpoint 3 (indicating enlarged photograph sections).
This viewpoint is located 5km away from the closest turbine

Figure 7c: View 3a (enlarged photograph section from Viewpoint 3).

Figure 7d: View 3b (enlarged photograph section from Viewpoint 3).

7. CONCLUSION AND RECOMMENDATIONS

The construction and operation of the Happy Valley Wind Energy Facility and its associated infrastructure will have a visual impact on the natural scenic resources and rural character of this region.

The author is, however, of the opinion that the WEF has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

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

However, this opinion should not distract from the fact that the facility would be visible within an area that is generally seen as having a high quality natural and rural landscape character.

The ridges in the greater study area represent scenic and sensitive topographical features with limited existing visual disturbance. The proposed development is expected to transform the natural character of those ridges earmarked for the proposed WEF for the entire operational phase of the facility.

In terms of tourism, the N2 is a known tourist access route to the east coast and the scenic nature of the area lends it tourist potential, albeit unrealised at present.

In addition, there is some conservation value of within the region. Although the Thaba Manzi and Jumanji Game Farms and the Kromrivierspoort Natural Heritage Site are not proclaimed conservation areas, there will be some visual impact on these natural and undeveloped environments.

The facility would thus be highly visible within an area that incorporates various sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive.

There are not many options as to the mitigation of the visual impact of the core facility. The entirety of the proposed site is situated on a ridge and no amount of vegetation screening or landscaping would be able to hide structures of these dimensions situated on this site.

The following (as detailed in section 5.9) is, however recommended:

- Mitigate secondary visual impacts associated with the construction of roads through the use of existing roads wherever possible.

  Where new roads are required, these should be planned taking due cognisance of the topography. Roads should be laid out along the contour wherever possible, and should never traverse slopes at 90 degrees. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Roads

should be positioned behind (i.e. on the north side) of the crest of the ridge wherever possible.

Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

- The proposed power line must follow the alignment Alternative 1 in order to consolidate linear infrastructure and to minimise potential visual impact.

- Mount aircraft warning lights on the turbines representing the outer perimeter of the facility (where this is possible). In this manner, less warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact.

  The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

- Mitigate other lighting impacts through the pro-active design, planning and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for the turbines and the ancillary infrastructure will go far to contain rather than spread the light.

- Mitigate visual impacts associated with the construction phase, albeit temporary, through proper planning, management and rehabilitation of the construction site.

- Once the WEF has exhausted its life span, remove the main facility and all associated infrastructure not required for the post rehabilitation use of the site and ensure that all disturbed areas are appropriately rehabilitated.

In addition, it is recommended that open and direct discussions should be held with the owners of the Jumanji and Thaba Manzi Game Farms regarding the potential future limitations on conservation based development and tourism opportunities as a result of the expected visual impact of the WEF.

8. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Happy Valley Wind Energy Facility, it is acknowledged that the rural, natural and relatively unspoiled wide-open views surrounding the site will be transformed for the entire operational lifespan (20 years) of the facility.

The following is a summary of impacts remaining, assuming mitigation as recommended is exercised:

- The potential visual impact of the facility on users of national, arterial and secondary roads in close proximity to the proposed facility will be of **high** significance.
- The anticipated visual impact on residents of towns, settlements and homesteads in close proximity to the proposed facility will be of **high** significance.

- Within the greater region, the potential visual impact on sensitive visual receptors (i.e. users of roads and residents of towns, settlements and homesteads) will be of **moderate** significance.
- Conservation / protected areas in close proximity to the proposed facility will experience visual impacts of **moderate** significance, while those within the greater region will experience visual impacts of **low** significance.
- In terms of ancillary infrastructure, the anticipated visual impact of the substation and workshop will be of **low** significance, as will that of the internal access roads. Visual impacts of the proposed power line will be of **moderate** significance.
- Anticipated visual impacts related to lighting will be of **moderate** significance.
- Similarly, the visual impact of construction is also expected to be of **low** significance.
- In terms of secondary visual impacts, the significance of the anticipated impact on the visual character and sense of place of the region will be of **moderate** significance, as will the anticipated impact on tourist routes, tourist destinations and tourism potential.

Considering all factors, it is the opinion of the author that the proposed site is not visually suited to the development of a WEF. This is due to its visually prominent location, coupled with the pastoral character and inherent scenic beauty of the natural features and of the greater study area. The location of turbines on the ridge line in this visually exposed environment results in a high visual prominence and an undesirable negative visual impact.

The anticipated visual impact does not, however, constitute a fatal flaw for the proposed Happy Valley WEF. This is due specifically to the localised area of potential high visual impact (i.e. within 5km), the relatively low incidence of visual receptors and the small scale of the proposed facility. This impact is also not likely to detract from the regional tourism appeal, numbers of tourists or tourism potential of the existing centres such as St Francis Bay.

9. MANAGEMENT PLAN

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

Table 13: Management plan – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Happy Valley Wind Energy Facility.

Project component/s	The WEF and ancillary infrastructure (i.e. power line, substation, workshop and internal access roads).
Potential Impact	Primary visual impact of the facility due to the presence of the turbines, the substation, the workshop, the power line and the access roads in the landscape as well as the visual impact of lighting at night.
Activity/risk source	The viewing of the above mentioned by observers on or near the site as well as within the region.
Mitigation: Target/Objective	Optimal planning of infrastructure so as to minimise visual impact.

Mitigation: Action/control	Responsibility	Timeframe
Make use of existing roads wherever possible.	Renewable Investments SA / design consultant	Planning.
Implement an environmentally responsive planning approach to roads and infrastructure to limit cut and fill requirements. Plan with due cognisance of the topography. Position roads behind (i.e. on the north side) of the crest of the reidge wherever possible.	Renewable Investments SA / design consultant	Planning.
Implement power line alignment Alternative 1.	Renewable Investments SA / design consultant	Planning.
Mount aircraft warning lights on the turbines representing the outer perimeter of the facility (where this is possible). The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to	Renewable Investments SA / design consultant.	Planning.
Consult a lighting engineer in the planning and placement of light fixtures for the turbines and the ancillary infrastructure.	Renewable Investments SA / design consultant	Planning

Performance Indicator	No internal access roads are visible from surrounding areas and lighting impact is minimal.
Monitoring	Not applicable.

Table 14: Management plan – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Happy Valley Wind Energy Facility.		
Project component/s	Construction site.	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing.	
Activity/risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Reduce the construction period through careful planning and productive implementation of resources.	Renewable Investments SA / contractor	Construction
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing.	Renewable Investments SA / contractor	Construction
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Renewable Investments SA / contractor	Construction
Ensure that rubble, litter and disused construction materials are managed and removed regularly.	Renewable Investments SA / contractor	Construction
Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way	Renewable Investments SA / contractor	Construction
Reduce and control construction dust through the use of approved dust suppression techniques.	Renewable Investments SA / contractor	Construction
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Renewable Investments SA / contractor	Construction
Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.	Renewable Investments SA / contractor	Construction
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction. Monitoring of rehabilitated areas post construction.	

Table 15: Management plan – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Happy Valley Wind Energy Facility.		
Project component/s	The WEF and ancillary infrastructure (i.e. power line, substation, workshop and internal access roads).	
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.	
Activity/risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	Responsibility	Timeframe
Maintain the general appearance of the facility in an aesthetically pleasing way.	Renewable Investments SA / operator	Operation.
Monitor rehabilitated areas, and implement remedial action as and when required.	Renewable Investments SA / operator	Operation.
Performance Indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of rehabilitated areas.	

Table 16: Management plan – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Happy Valley Wind Energy Facility.		
Project component/s	The WEF and ancillary infrastructure (i.e. power line, substation, workshop and internal access roads).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Infrastructure required for post decommissioning use of the site and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	Responsibility	Timeframe
Remove infrastructure not required for the post-decommissioning use of the site,	Renewable Investments SA / operator	Operation.
Rip and rehabilitate access roads not required for the post-decommissioning use of the site.	Renewable Investments SA / operator	Operation.
Monitor rehabilitated areas, and implement remedial action as and when required.	Renewable Investments SA / operator	Operation.
Performance Indicator	Site with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of rehabilitated areas.	

10. REFERENCES/DATA SOURCES

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