Environmental Impact Assessment for the proposed Ubuntu Wind Energy Project near Jeffrey's Bay, Eastern Cape: Final Environmental Impact Assessment Report

Chapter 8: Visual Impacts

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CHAPTER 8. VISUAL IMPACTS

8.1 INTRODUCTION

The findings of the visual specialist study undertaken by Henry Holland of map (this) as part of the EIA being conducted by CSIR for the proposed Windcurrent project near Jeffrey's Bay are presented in this chapter.

8.1.1 Guiding Concepts for Visual Impact Assessments

This VIA is based on guidelines for visual assessment specialist studies as set out by South Africa's Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) (Oberholzer 2005) as well as guidelines provided by the Landscape Institute of the UK (GLVIA 2002). The DEA&DP guideline recommends that a visual impact assessment consider the following specific concepts (from Oberholzer 2005):

- An awareness that 'visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place;
- The considerations of both the natural and cultural landscape, and their interrelatedness;
- The identification of all scenic resources, protected areas and sites of special interest, together with their relative importance in the region;
- An understanding of the landscape processes, including geological, vegetation and settlement patterns, which give the landscape its particular character or scenic attributes;
- The need to include both quantitative criteria, such as 'visibility', and qualitative criteria, such as aesthetic value or sense of place;
- The need to include visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design, and hopefully the quality of the project; and
- The need to determine the value of visual/aesthetic resources through public involvement.

8.1.2 Scope Of Study

8.1.2.1 Terms of Reference

The specific Terms of Reference (CSIR 2011) for the Visual and Landscape Impact Assessment include:

- Conduct a desktop review of available information that can support and inform the specialist study;
- Identify issues and potential visual impacts for the proposed project, which are to be considered in combination with any additional relevant issues that may be raised through the public consultation process;
- Identify possible cumulative impacts related to the visual aspects for the proposed project;
- Assess the potential impact/impacts, both positive and negative, associated with the proposed project for the construction, operation and decommissioning phases; and
- Identify management actions to avoid or reduce negative visual impacts; and to enhance positive benefits of the project.

8.1.2.2 Visual Triggers

(Oberholzer 2005) identifies visual triggers which are used to determine the approach and scope of an impact study. The following triggers, related to the receiving environment, are potentially applicable to this project:

- Areas with protection status, such as national parks or nature reserves;
- Areas with proclaimed heritage sites or scenic routes;
- Areas with important vistas or scenic corridors;
- Areas with visually prominent ridge lines or skylines; and
- Areas of important tourism or recreational value.
- Triggers related to the nature of the project:
- A significant change to the fabric and character of the area; and
- Possible visual intrusion in the landscape.

8.1.2.3 Information Sources

- Documentation supplied by the client and the CSIR;
- ToR for the visual specialist;
- Digital topocadastral data at 1:50 000 scale from the Surveyor General: Surveys and Mapping (including cadastral data such as farm portions and erven);
- South African digital land cover dataset of 2002 (Majeke *et al*. 2002);
- SPOT satellite image mosaic (2007);
- 1:250000 Geology map sheets covering the region;
- Wind turbine model by Pete Young hosted in the Google 3D Warehouse (http://sketchup.google.com/3dwarehouse/details?mid=cc036208d537d6f98967f3aa7f40c33&prevstart=0).
- Google Earth software and data;
- IUCN database of protected areas (http://www.wdpa.org/Download.aspx); and
- STEP vegetation and conservation status data from the South African National Biodiversity Institute (http://bgis.sanbi.org/STEP/project.asp).

8.1.2.4 Assumptions and Limitations

8.1.2.4.1 Spatial Data Accuracy

Spatial data used for visibility analysis originate from various sources and scales. Inaccuracy and errors are therefore inevitable. Where relevant these will be highlighted in the report. Every effort was made to minimize their effect.

8.1.2.4.2 Viewshed calculations

Calculation of the viewsheds does not take into account the potential screening effect of vegetation and buildings. Due to the size and height of the wind turbines, and the relatively low vegetation cover in the region, the screening potential of vegetation is likely to be minimal over most distances.

8.1.2.4.3 Simulated views and Photomontages

In this report a *simulated view* will be defined as a view generated by using 3D computer software using an elevation model and aerial photography. A *photomontage* is a landscape photograph onto which images of the wind turbines are placed using software which maintains the accurate spatial positions of the turbines and their scale in relation to their distance from the point at which the photograph was

taken. The photomontage images used in this report were compiled using landscape photographs taken specifically for this purpose. Simulated views were produced using 3D modelling software (Visual Nature Studio 3 from 3D Nature - http://3dnature.com/), and a digital elevation model (DEM) interpolated from 1:50 000 contours.

8.1.3 Methodology

The key steps followed in the visual study are presented below.

8.1.3.1 Site Visit and Photographic Survey

The field survey (conducted on 21 January 2011) provided an opportunity to:

- Determine the actual or practical extent of potential visibility of the proposed development, by assessing the screening effect of landscape features;
- Conduct a photographic survey of the landscape surrounding the development;
- Take photos for use in photomontage images; and
- Identify sensitive landscape and visual receptors.

Viewpoints were chosen using the following criteria:

- High visibility – sites from where most of the wind farm will be visible;
- High visual exposure – sites at various distances from the proposed site; and
- Sensitive areas and viewpoints such as nature reserves and game farms from which turbines will potentially be seen.

Additionally, photo sites were chosen to aid in describing the landscape surrounding, and potentially affected by, the proposed development.

8.1.3.2 Landscape Description

A desktop study was conducted to establish and describe the landscape character of the receiving environment. A combination of Geographic Information System (GIS), literature review and photographic survey was used to analyse land cover, landforms and land use in order to gain an understanding of the current landscape within which the development will take place (GLVIA, 2002). Landscape features of special interest were identified and mapped, as were landscape elements that potentially may be affected by the development.

8.1.3.3 Visual Impact Assessment

A GIS is used to calculate viewsheds for various components of the proposed development. The viewsheds and information gathered during the field survey are used to define criteria such as visibility, viewer sensitivity, visual exposure and visual intrusion for the proposed development. These criteria are, in turn, used to determine the intensity of potential visual impacts on sensitive viewers. All information and knowledge acquired as part of the assessment process are then used to determine the potential significance of the impacts according to the standardised rating methodology as described in the Terms of Reference provided by the CSIR (also shown in Chapter 4 of this report).

8.1.4 Statement of Competence and Independence

Henry Holland has been applying his Geographic Information Systems knowledge and experience to visual impact assessments since 1997, and has conducted a number of assessments for wind farm developments in the Eastern Cape. These include wind farms near Jeffrey's Bay, St Francis Bay, Grahamstown and Cookhouse. He has extensive practical knowledge in spatial analysis, landscape

analysis and environmental modelling, and has been involved in many environmental management projects as GIS coordinator and analyst since 1992.

Henry has undertaken this work for the Windcurrent project as an independent visual specialist, working in accordance with international and national guidelines for visual impact assessments. He has no vested interest in the proposed project.

BOX 8.1: DECLARATION OF INDEPENDENCE FOR VISUAL ASSESSMENT

I **Henry Holland** declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed Wind Current Ubuntu Wind Energy Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

HENRY HOLLAND

8.2 PROJECT DESCRIPTION

8.2.1 Overview Of Project

WKN-Windcurrent proposes to build a wind energy facility (WEF) of up to 50 wind turbines (depending on the capacity of the turbines) with potential generation capacity of up to 100 MW in an area east of Jeffrey's Bay, Kouga, Eastern Cape. The conceptual layout for the energy facility is shown on the map in Figure 8.1.

8.2.2 Project Components and Activities

8.2.2.1 Construction

The following main components related to construction potentially will cause visual impacts:

- Clearing of land for a construction compound and laydown area. An area will be required to store temporarily up to 150 blades, each 45 to 56 m in length, as well as other large turbine components;
- A site compound for contractors;
- Borrow pits;
- Tall cranes will be required to lift turbine components into position;
- Large trucks will be required to haul turbine components from Port Elizabeth to the site;
- Heavy equipment such as bulldozers, graders, trenching machines and concrete trucks may be required;
- Stable platforms for the cranes need to be constructed;
- Existing roads will be used to access the site; and
- Internal access roads to connect platforms will need to be established.

8.2.2.2 Operational Wind Farm

The following components related to the operation of the wind farm potentially will cause visual impacts:

- Hub heights are between 80 m and 105 m (depending on the capacity of the turbines selected), and rotors are 45 m to 56 m long. The maximum height at blade tip is 150 m high;
- Operations and maintenance building;
- Access roads will follow existing roads where possible;
- Internal access roads to individual turbines; and
- Overhead power lines linking the site to substation (internal power lines will be underground). Overhead lines linking the substation to the existing 132 kV Eskom grid.

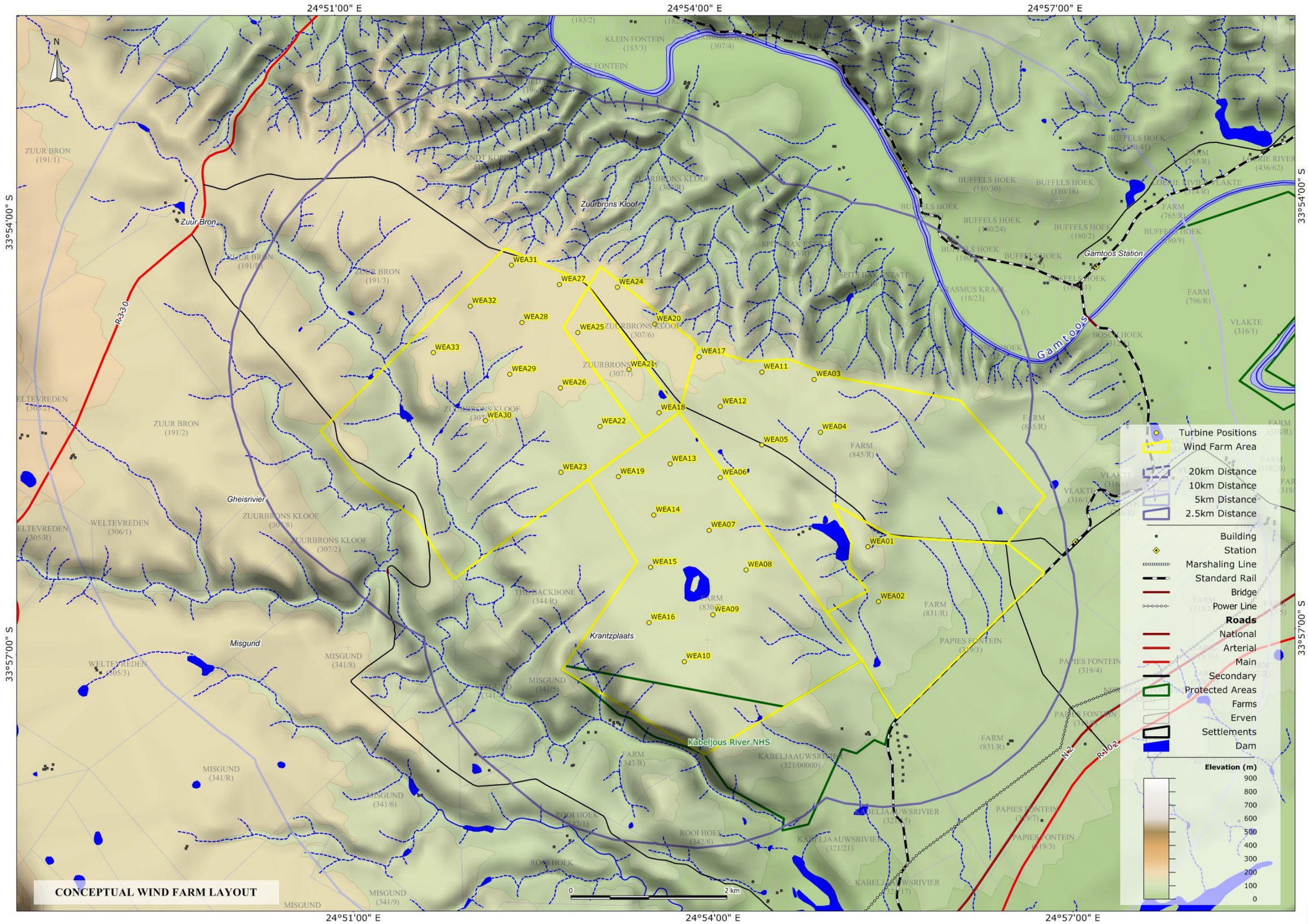

Figure 8.1: **Conceptual layout of the proposed wind energy facility.**

8.3 DESCRIPTION OF RECEIVING ENVIRONMENT

8.3.1 Landscape Baseline

Landscape baseline	A description of the existing elements, features, characteristics, character, quality and extent of the landscape (GLVIA, 2002).

8.3.1.1 Topography

A map of the topography of the region into which the wind farm will be introduced is presented in Figure 8.2. A number of topographic profiles (indicated on the map) with the wind farm in the centre is shown in Figure 8.3. The topography of the area is dominated by the Gamtoos River valley (Figures 8.3 a and b), Cape Fold Belt mountain ranges and the coastal plain (Figure 8.3 a). The mountains lie mostly north and west of the site (Figure 8.3 a and b), while the sheer drop to the Gamtoos River floodplain forms the northern boundary of the wind farm. The wind farm is situated on an elevated plateau above the coastal plain (Figure 8.3 a and d).

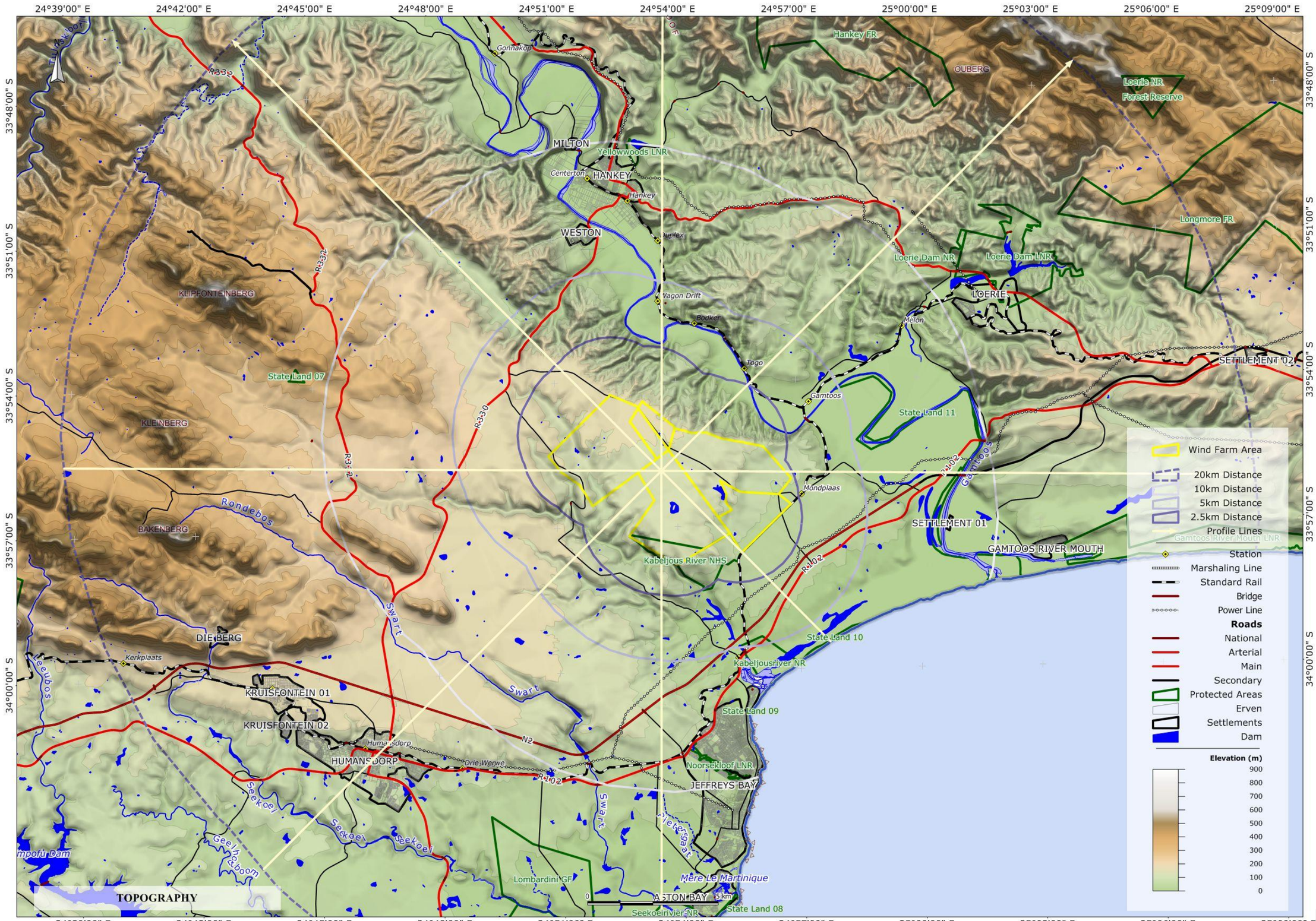

Figure 8.2: **Topographic map showing wind farm area in relation to surrounding settlements and protected areas. Distances of 2.5km, 5km, 10km and 20km from turbines are indicated, as well as topographic profile lines.**

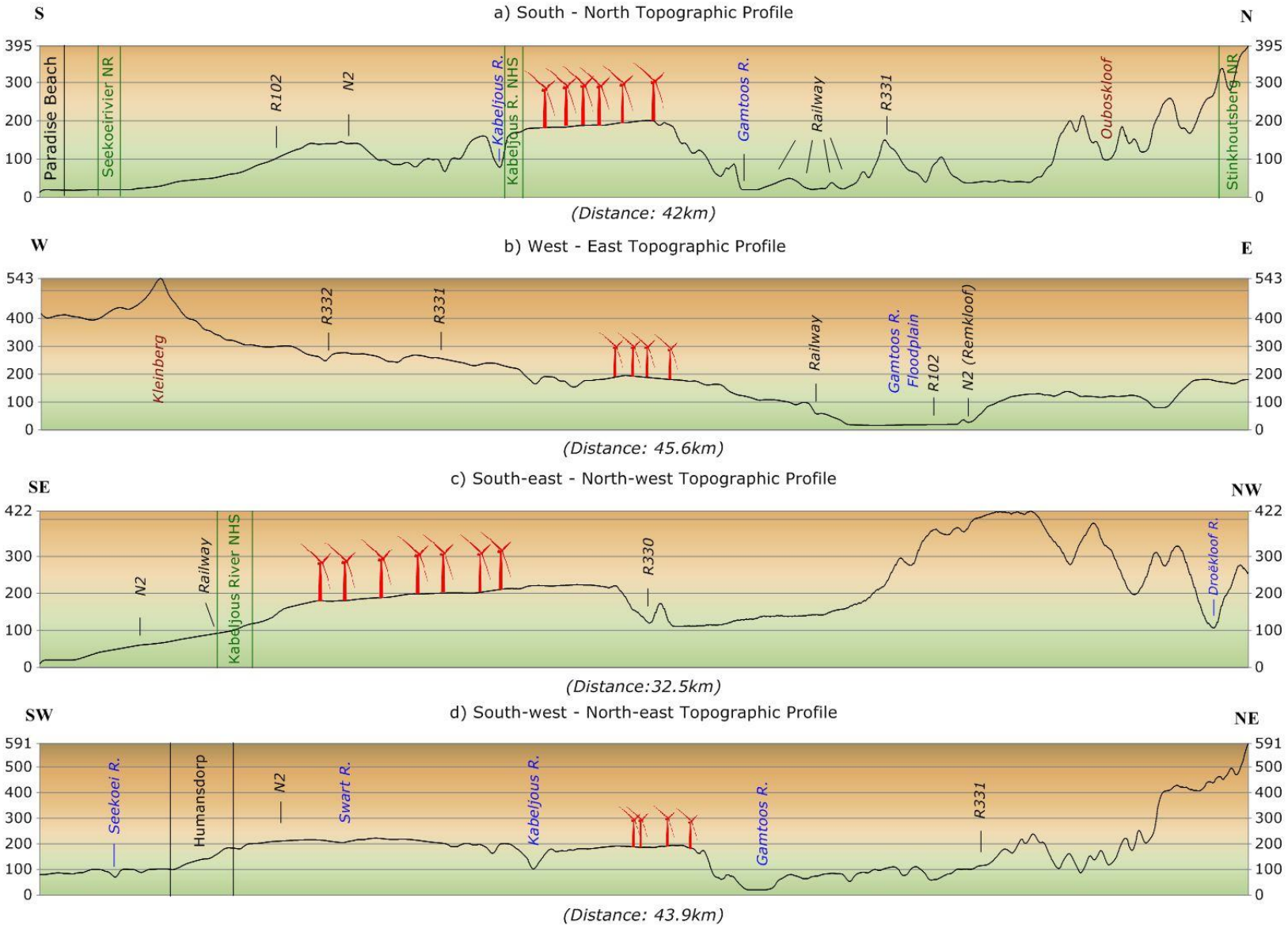

Figure 8.3: **Topographic profiles across the region. Vertical scale exaggerated and different for each profile. Wind turbines (red) in scale in terms of height, not size and provides only an indication of the position of the wind farm in the landscape. See topographic map (Figure 8.) for profile line positions.**

8.3.1.2 Geology

8.3.1.2.1 Alluvium/Sand

The broad Gamtoos floodplain is filled with alluvium eroded from the enormous Gamtoos River catchment. It has deep, arable soil and is heavily cultivated in the study area using irrigation.
Headland-bypass dune fields are common features of the Eastern Cape (Illenberger & Burkinshaw 2008). These dune fields form in corridors across low relief headlands in strong prevailing winds. Examples can be seen near Oyster Bay and Cape St Francis (see Figure 8.4). The fields at Thysbaai and Oyster Bay have become cut off from their sand sources and are becoming vegetated.

8.3.1.2.2 Nanaga Formation

The Nanaga Formation is part of the Algoa Group of rocks and represents palaeo-dune fields. The aelonianite (wind deposited sediment) formed during the early Pleistocene (*ca.* 2 million years ago), a period characterised by a succession of ice ages (transgressions and regressions of sea level) (McCarthy & Rubidge 2006). It consists mostly of calcareous sandstone which weathers to form surficial calcrete or red, clayey soil (Roberts *et al.* 2006). These palaeo dunes form high beach ridges and rolling hills, with crests up to 100m above the valleys between dunes (Illenberger & Burkinshaw 2008).

8.3.1.2.3 Grahamstown Formation

The Grahamstown Formation consists of silcrete which is a combination of sand and pebbles cemented in a matrix of hard siliceous material (Partridge *et al.* 2006). It formed through deep weathering of rocks during a warm humid period in the Cretaceous. These deposits are erosion resistant and will generally produce positive relief.

8.3.1.2.4 Uitenhage Group

The Enon and Kirkwood Formations represent the Uitenhage Group in this region. Rocks from this group were deposited in basins formed along the southern margin of Africa during the break-up of Gondwana. The Enon Formation (the lower most layer) consists mainly of conglomerate with large pebbles and cobbles and were deposited under high energy conditions, generally attributed to initiation of the extensional tectonics prevalent at the time. Above this lie sandstones and mudstones of the Kirkwood Formation which were deposited further from the basin scarps (Shone 2006; McCarthy & Rubidge 2006).

8.3.1.2.5 Cape Supergroup

The Peninsula Formation and Nardouw Subgroup (Table Mountain Group) consist of a sequence of relatively pure sandstone (arenite) layers deposited in shallow seas and fluvial braided plains. Later the sedimentary rocks were altered by compressional tectonic forces and heat to produce hard, erosion resistant metamorphic rocks known as quartzites. The Ceres Subgroup (Bokkeveld Group) was deposited in a deeper marine environment and consists of finer grained material in layers of mudstone and arenite. These rocks tend to weather quicker relative to the harder quartzites and often form valleys between quartzite ridges or mountains.

8.3.1.2.6 Gamtoos Inlier

Rocks of the Gamtoos Group are exposed along the northern flank of the Algoa Basin (Uitenhage Group). These layers were deposited in pre-Cambrian times and imprints of a number of tectonic events obscure accurate interpretation of their origins (Gresse *et al*. 2006).

8.3.1.2.7 Geological History

A number of tectonic events produced the complex topography of the study area. After deposition of the Cape Supergroup rocks, a subduction zone formed along the southern margin of Gondwana. The sediments (Cape Supergroup) on the seafloor were compressed and buckled, and a mountain range similar to that of the Andes was formed (Cape Fold Belt). The break-up of Gondwana occurred during the late Jurassic and Cretaceous Periods along the southern African boundary. Most sedimentation during this time occurred either off-shore (in the Atlantic and Indian Oceans), or in small inland basins formed by extensional tectonics. The Algoa Basin is an example of one of these basins, and it was filled with sediments of the Uitenhage Group. As Gondwana continued to break up the sea flooded into these basins and the southern African continental shelf was developed. Differential erosion of the softer Bokkeveld Group rocks created longitudinal valleys between the mountain ridges formed by harder quartzites of the Table Mountain Group. Various uplift events subsequent to the establishment of the continental shelf caused changes in sea level which produced marine and fluvial terraces along the coast. In particular, two major continental uplift events in the last 20 million years caused major terracing and drainage rejuvenation. Marine terraces were deeply incised during regression of sea level as stream erosion was renewed.

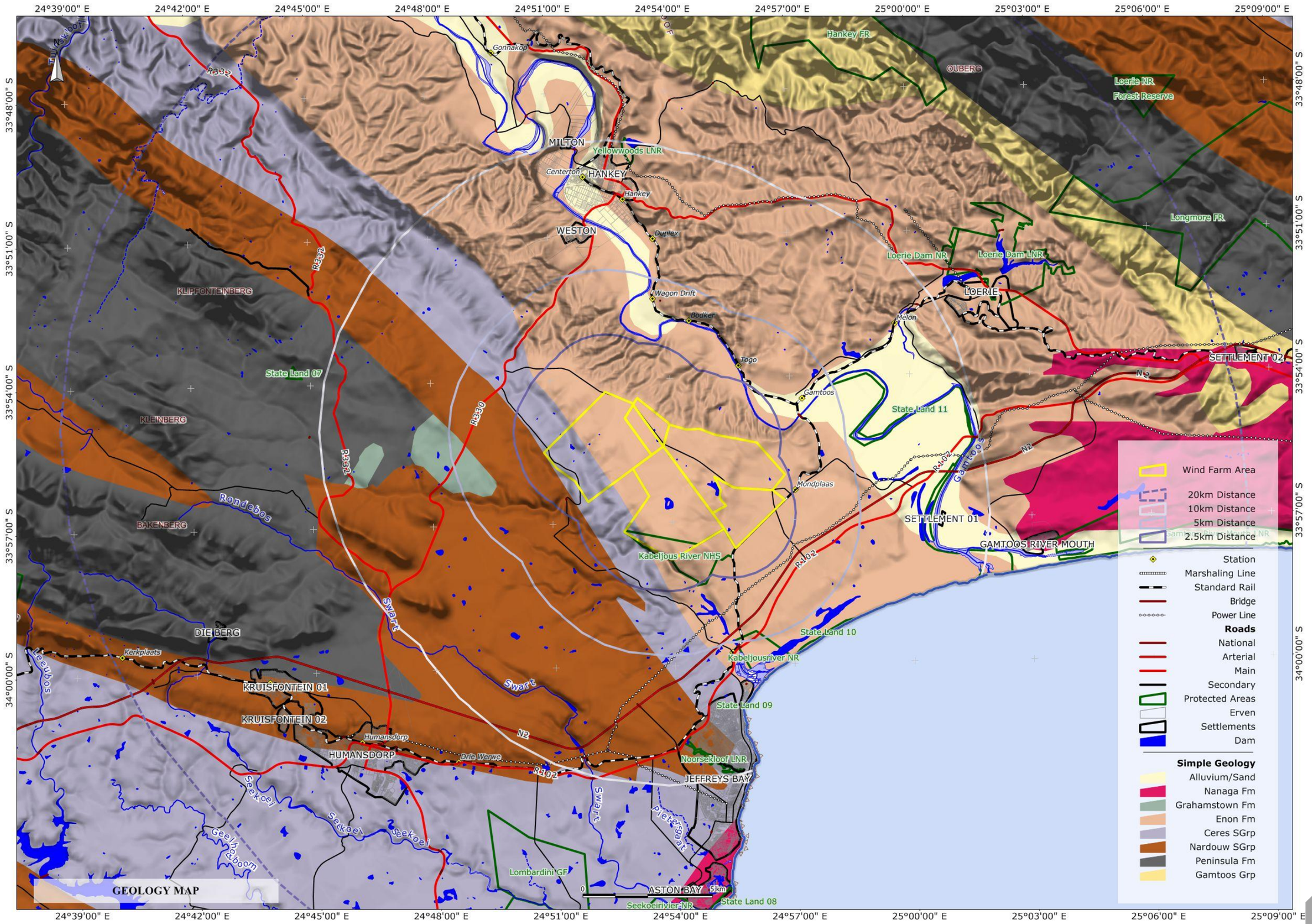

Figure 8.4: **Geology of the region. (Fm - formation; SGrp - subgroup; Grp - group)**

8.3.1.3 Land Cover

Dryland cultivation and stock farming dominate the land use of the region (Figure 8.5). The Gamtoos floodplain is mostly under irrigated cultivation. The natural vegetation for most of the region is fynbos, with thicket and bushland in incised river valleys and north of the Gamtoos River. Some forest plantations also occur in the mountainous terrain north of the wind farm site. Most vegetation has been transformed to some extent by stock farming practises.

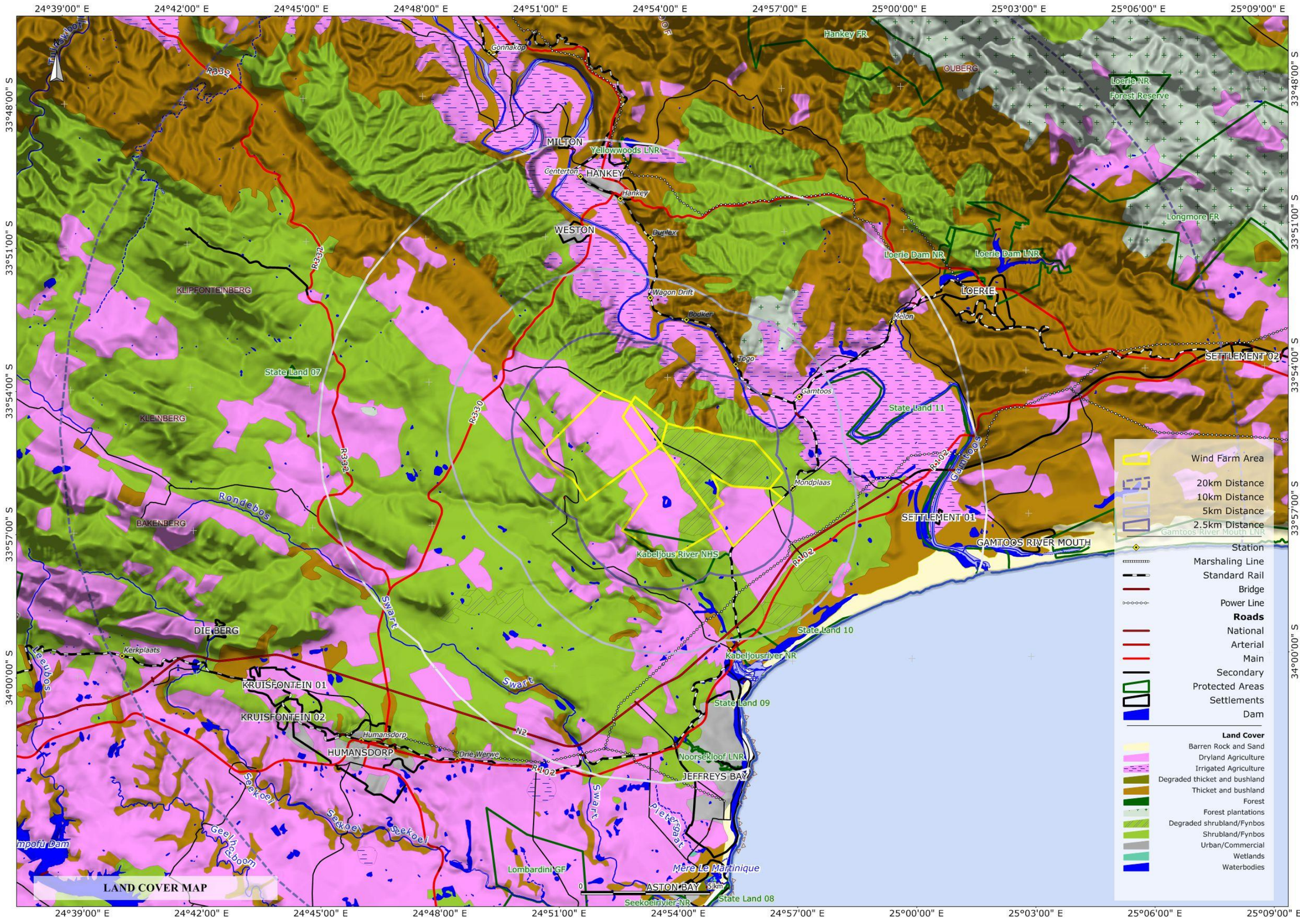

Figure 8.5: **Map of land cover for the region.**

8.3.1.4 Built Environment

Settlements in the interior, such as Humansdorp and Hankey, developed as service centres for the surrounding agricultural industry, while those along the coast are holiday resorts with seasonal variation in population (Figure 8.6). Jeffrey's Bay is a large and growing coastal resort with a considerable permanent population. Coastal resorts in this region have expanded rapidly in the last decade, particularly Jeffrey's Bay.

The Gamtoos River valley is densely populated with smaller land parcels and more farmsteads than the surrounding agricultural land. Density of buildings per area also increases east of the Gamtoos towards Port Elizabeth. Several major roads dissect the region, with the N2 a major route between Cape Town and Port Elizabeth. It represents both the easternmost extent of the Garden Route as well as a major freight route between the two cities. The wind farm locality is surrounded by major settlements and in close proximity to the N2 and R330 routes, as well as a railway line. A power line passes just south of the wind farm area. There are no heavy industrial complexes in the area.

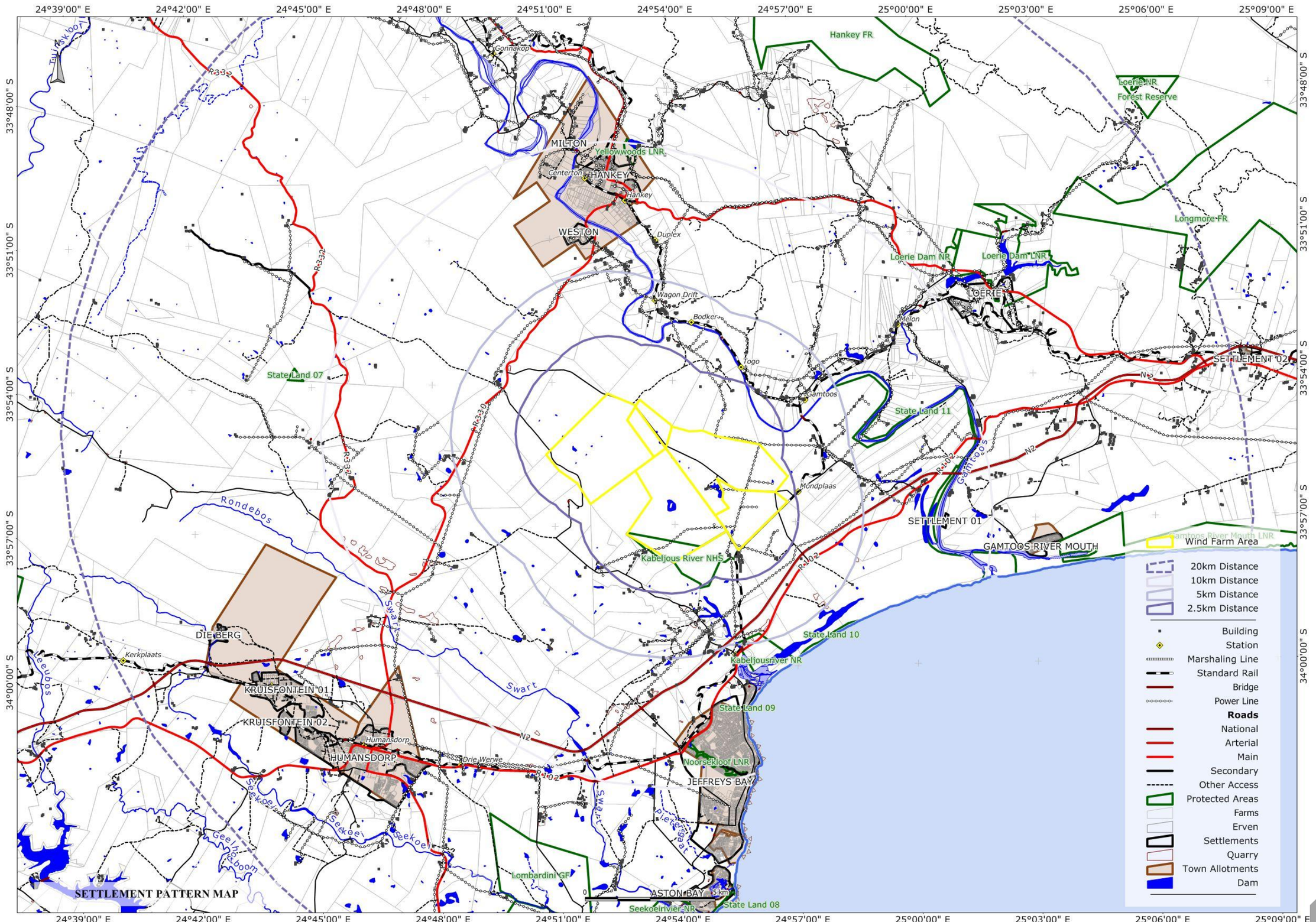

Figure 8.6: **Settlement pattern and large man-made structures in the regional landscape.**

8.3.2 Landscape Character

Landscape character	The distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape (GLVIA, 2002).

Considering the landscape elements discussed above it is possible to identify a number of landscape character types that potentially may be affected by the proposed wind farm (Figure 8.7):

8.3.2.1 Coastal Plain Pristine

Areas on the coastal plain from which few man-made features are visible from and the vegetation is still more-or-less intact. These are mostly confined to west of Cape St Francis, with a patch between Paradise Beach and St Francis Bay, as well as along the coast from Gamtoos River Mouth east towards Sea View. The vegetation consists of thicket and fynbos.

8.3.2.2 Sparse Coastal Plain Agriculture

Agricultural land where homesteads are far apart and few man-made features are visible in the landscape. The topography is relatively flat (palaeo-marine terraces). The wind farm area is located on this landscape character type.

8.3.2.3 Dense Coastal Plain Agriculture

Agricultural land with a higher density of homesteads per area. This is predominantly land used for dairy farming. The topography is still flat and relief relatively low. Man-made structures are common in this region.

8.3.2.4 Floodplain Irrigated and Dryland Agriculture

The Gamtoos River floodplain is under intense irrigated cultivation. The floodplains of other major rivers such as the Elands River are also cultivated, although not necessarily using irrigation.

8.3.2.5 High Density Agriculture

Small holdings and other small farms along the N2 between the Gamtoos River and Port Elizabeth.

8.3.2.6 High Hill Agriculture

Agricultural land on the highlands. The relief is generally more pronounced here with deeply incised drainage lines. Man-made features are less conspicuous. Stock farming is the main land use of this landscape character type.

8.3.2.7 Highland Forestry

Forestry plantations in the mountainous land to the north and west of the wind farm site. The trees grown in these plantations are exotic (alien) species.

8.3.2.8 Low Mountain Pristine

This landscape character type is often located in protected areas in mountainous terrain north of the Gamtoos River (e.g. Baviaanskloof). Visibility of man-made structures is relatively low.

8.3.2.9 Coastal Resorts

Small towns that developed along the coast as a result of seasonal influx of holiday makers. Many of these resorts have expanded rapidly in recent years.

8.3.2.10 Inland Urban

Towns such as Humansdorp and Hankey which developed as service centres for the surrounding agricultural industry and holiday resorts on the coast.

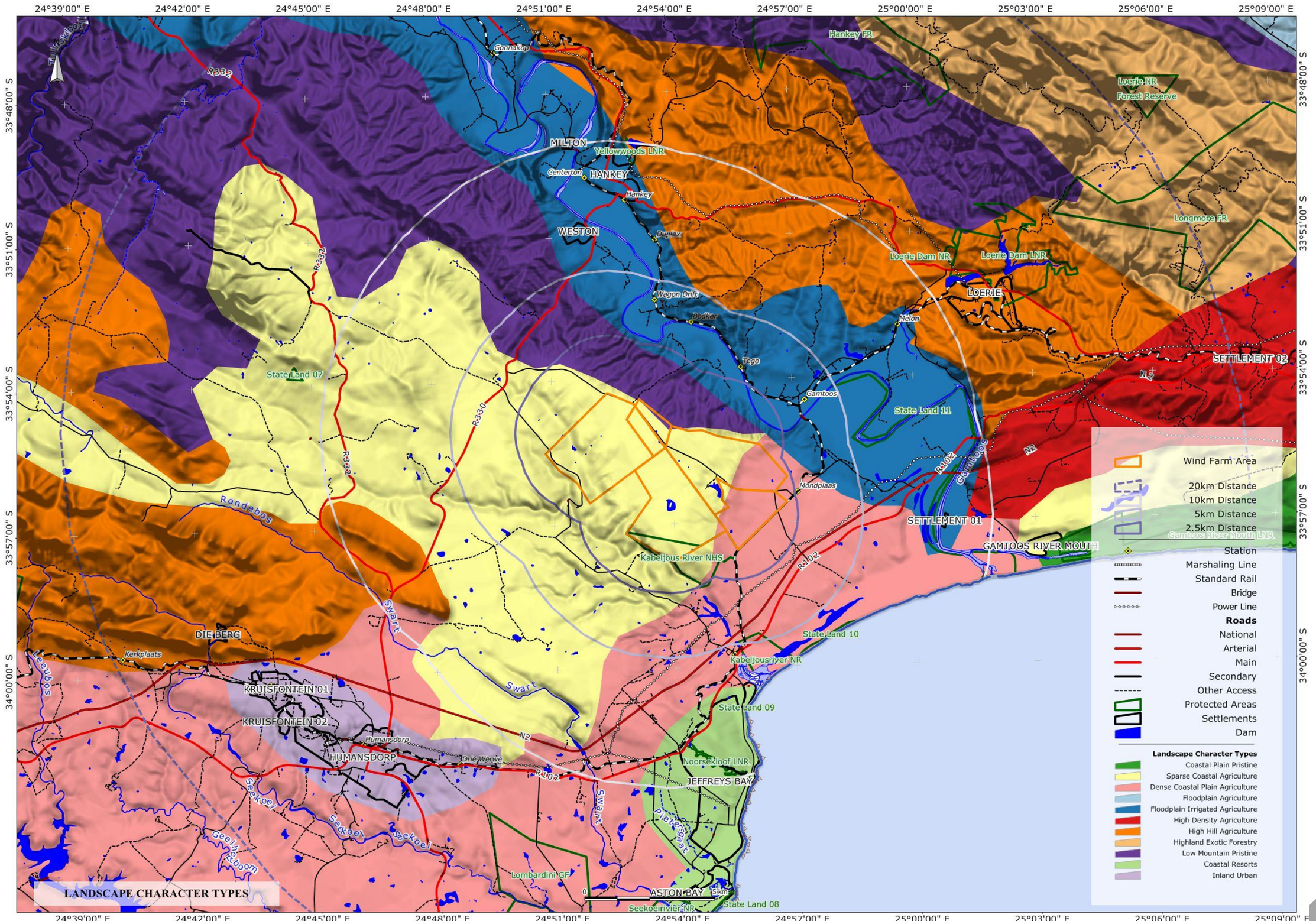

Figure 8.7: **Landscape character types identified for the region using land cover, settlement patterns, topography and the visibility of man-made structures in the landscape..**

8.3.3 Landscape Character Sensitivity

Landscape character sensitivity	This provides an indication of the ability of a landscape to absorb change from the proposed development without changing character. A pristine landscape prized for its natural beauty, or a landscape of high cultural value will have high sensitivity to changes brought about by new developments.

Highly visible wind turbines potentially will alter the landscape character types discussed in the previous section. Most likely are the types Low Mountain Pristine and Coastal Plain Pristine. These are by definition types where man-made structures are relatively uncommon and the natural land cover is preserved. Where wind turbines are visible from within these landscape types their character is likely to be changed. These two landscape character types are therefore seen as **highly** sensitive to changes caused by the proposed development.

The other landscape character types will have a capacity to absorb changes which will depend on a number of factors. Agricultural landscape types will have **low** sensitivity since the wind farm will not impinge on agricultural practices. Similarly, Inland Urban types will have a low sensitivity to changes due to the many man-made structures already in the landscape.

The Coastal Resort landscape type will have a **low** sensitivity to the changes caused by a wind farm within the landscape since the landscape type is already changing character as most of the Kouga coastal settlements like Jeffrey's Bay and St Francis are expanding rapidly.

8.3.4 Visual Absorption Capacity

Visual absorption capacity (VAC)	The capacity for the landscape to conceal the proposed development. The VAC of a landscape depends on its topography and on the type of vegetation that naturally occurs in the landscape. The size and type of the development also plays a role.

The VAC for this project is **low** due to the size of the project and the height of its components, as well as the fact that the turbines will be located on land that is relatively elevated. Vegetation such as high exotic trees and thicket will provide some screening directly next to roads and buildings.

8.4 IDENTIFICATION OF ISSUES AND IMPACTS

The following issues were raised regarding the potential visual impact of the wind farm on Interested and Affected Parties:

- How will this project impact on the view that we currently have from our farm towards the sea and the mountains?
- We would like to raise our concern regarding the proposed establishment of a wind energy facility between the Gamtoos and Kabeljauws Rivers. Our home on the Kabeljauws River faces North in the direction of the project and we fear that our beautiful view will be disturbed. Will you please add our concern onto the project register. If you visit our website www.kabeljauws.co.za you can see the view we are referring too.

These issues will be discussed in section 8.6.1.5.

8.5 PERMIT REQUIREMENTS

There are no permit requirements related to potential visual impact, but the Civil Aviation regulations stipulate the following in terms of turbine colours (Minister of Transport 1997):

> "Wind turbines shall be painted bright white to provide maximum daytime conspicuousness. The colours grey, blue and darker shades of white should be avoided altogether. If such colours have been used, the wind turbines shall be supplemented with daytime lighting, as required."

8.6 ASSESSMENT AND MITIGATION OF IMPACTS

The assessment and mitigation of impacts is conducted according to the following steps:

- Identification of visual impact criteria (key theoretical concepts);
- Conducting a visibility analysis; and
- Assessment of impacts of the project on the landscape and on receptors (viewers) taking into consideration factors such as sensitive viewers and viewpoints, visual exposure and visual intrusion.

8.6.1 Visual Impact Concepts and assessment Criteria

8.6.1.1 Visual assessment criteria used in assessing magnitude and significance

The potential visual impact of the proposed wind farm is assessed using a number of criteria which provide the means to measure the magnitude and determine the significance of the potential impact (Oberholzer 2005). The **visibility** (Section 8.6.1.2) of the project is an indication of where in the region the development will potentially be visible from. The rating is based on viewshed size only and is an indication of how much of a region will potentially be affected visually by the development. A high visibility rating does not necessarily signify a high visual impact, although it can if the region is densely populated with sensitive visual receptors. **Viewer (or visual receptor) sensitivity** (Section 8.6.1.3) is a measure of how sensitive potential viewers of the development are to changes in their views. Visual receptors are identified by looking at the development viewshed, and include scenic viewpoints, residents, motorists and recreational users of facilities within the viewshed. A large number of highly sensitive visual receptors can be a predictor of a high **intensity/magnitude** visual impact although their distance from the development (measured as **visual exposure** – Section 8.6.1.4) and the current composition of their views (measured as **visual intrusion** – Section 8.6.1.5) will have an influence on the significance of the impact.

8.6.1.2 Visibility

Visibility of Project	The geographic area from which the project will be visible, or view catchment area. (The actual zone of visual influence of the project may be smaller because of screening by existing trees and buildings). This also relates to the number of receptors affected (Oberholzer 2005). • *High visibility* - visible from a large area (e.g. several square kilometres). • *Moderate visibility* – visible from an intermediate area (e.g. several hectares). • *Low visibility* – visible from a small area around the project site.

In this report there is also another sense in which 'visibility' is used. Cumulative viewsheds indicate not only where a feature is visible from (the meaning of visibility as used in the definition above), but also how much of the feature will be visible from that point or area.

As expected the visibility is **high** in terms of viewshed area due to the turbine heights and their location on relatively elevated land within the coastal plain. The map in Figure 8. shows the spatial extent of areas with potential views on the wind farm.

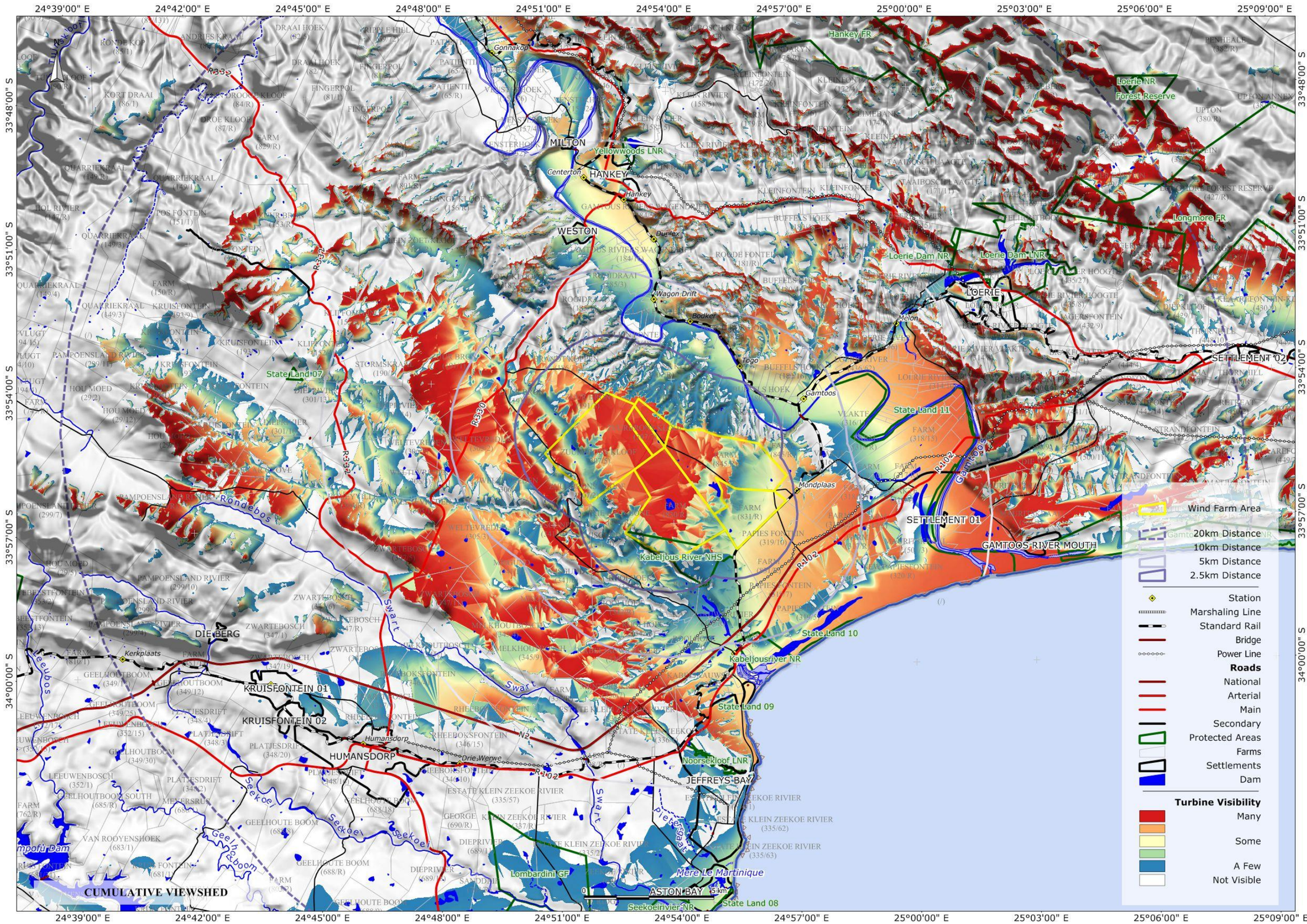

Figure 8.8: **Map showing the cumulative viewshed calculated for 33 wind turbines. Shades of red indicate areas where views of the wind farm will contain most of the wind turbines (potentially all the turbines). Green lines on the map show positions of protected areas. The viewshed calculation does not take into account distance from the wind farm, which will be discussed in the section on visual exposure, and is not a direct reflection of visual impact.**

8.6.1.3 Sensitive Viewers and Viewpoints

Viewer sensitivity	The assessment of the receptivity of viewer groups to the visible landscape elements and visual character and their perception of visual quality and value. The sensitivity of viewer groups depends on their activity and awareness within the affected landscape, their preferences, preconceptions and their opinions.

A rating system provided by the Landscape Institute of the United Kingdom was used to determine viewer sensitivity:

	Definition (GLVIA 2002)
Exceptional	Views from major tourist or recreational attractions or viewpoints promoted for or related to appreciation of the landscape, or from important landscape features.
High	Users of all outdoor recreational facilities including public and local roads or tourist routes whose attention may be focussed on the landscape; Communities where the development results in changes in the landscape setting or valued views enjoyed by the community; Residents with views affected by the development.
Moderate	People engaged in outdoor sport or recreation (other than appreciation of the landscape).
Low	People at their place of work or focussed on other work or activity; Views from urbanised areas, commercial buildings or industrial zones; People travelling through or passing the affected landscape on transport routes
Negligible (uncommon)	Views from heavily industrialised or blighted areas.

The following sensitive viewers or viewpoints were identified:

- Residents of surrounding settlements;
- Residents on farms hosting and surrounding the wind turbines;
- Visitors and viewpoints in surrounding protected areas; and
- Motorists (including tourists) using the N2 and other main roads in the region.

8.6.1.3.1 Residents of surrounding settlements

Current views of residents of Hankey, Milton, Weston and Jeffrey's Bay potentially will be affected by the wind farm. Residents are highly sensitive to changes in their views because they have an interest in the surrounding landscape.

8.6.1.3.2 Residents of surrounding farms

Residents' views and any scenic viewpoints on their farms will be affected according to their visual exposure to the wind farm and the quality of their existing views.

8.6.1.3.3 Protected areas

As can be seen on the map (Figure 8.) there are a number of protected areas which may be affected by the wind farm in terms of altered views. There are no areas officially designated as protected for their scenic views within the study area.

8.6.1.3.4 Motorists

Motorists using the N2, R102, R330 and R332 are likely to have at least occasional views of the wind farm. The R102 and N2 pass within 5km of the wind farm and some wind turbines will be prominent in views.

Motorists are seen as low sensitivity visual receptors since they are unlikely to spend much time studying the landscape. However, tourists travelling the Garden Route will have interest in the landscape.

8.6.1.4 Visual Exposure

Visual exposure	Visual exposure refers to the relative Visibility of a project or feature in the landscape (Oberholzer, 2005). Exposure and visual impact tend to diminish exponentially with distance. The exposure is classified as follows: • *High exposure* – dominant or clearly noticeable; • *Moderate exposure* – recognisable to the viewer; • *Low exposure* – not particularly noticeable to the viewer

The European Wind Energy Association (EWEA) also suggests zones of theoretical visibility (ZTV) as follows (EWEA 2009):

- Zone I – Visually dominant: turbines are perceived as large scale and movement of blades is obvious. The immediate landscape is altered. Distance up to 2km.
- Zone II – Visually intrusive: the turbines are important elements on the landscape and are clearly perceived. Blades movement is clearly visible and can attract the eye. Turbines not necessarily dominant points in the view. Distance between 1 and 4.5 km in good visibility conditions.
- Zone III – Noticeable: the turbines are clearly visible but not intrusive. The wind farm is noticeable as an element in the landscape. Movement of blades is visible in good visibility conditions but the turbines appear small in the overall view. Distance between 2 and 8 km depending on weather conditions.
- Zone IV – Element within distant landscape: the apparent size of the turbines is very small. Turbines are like any other element in the landscape. Movement of blades is generally indiscernible. Distance of over 7 km.

The zones overlap due to the fact that they attempt to incorporate atmospheric or weather conditions. The maps in this section do not show these zones but distance buffers are included to enable readers to apply the EWEA nomenclature.

Visual exposure was calculated using visibility (i.e. how much of the wind farm will be visible) and distance from the nearest wind turbine (Figure 8.9). The combination is calculated statistically using the method described at: http://mapthis-za.blogspot.com/2010/05/visual-exposure-alternative-approach.html. This method is preferred as it is objective and repeatable, and takes the size of the wind farm into consideration. A wind farm which has many turbines exposed against the horizon for a long distance will potentially have a visual exposure for viewpoints far away comparable with that of viewpoints in close proximity but from where only a few turbines are visible.

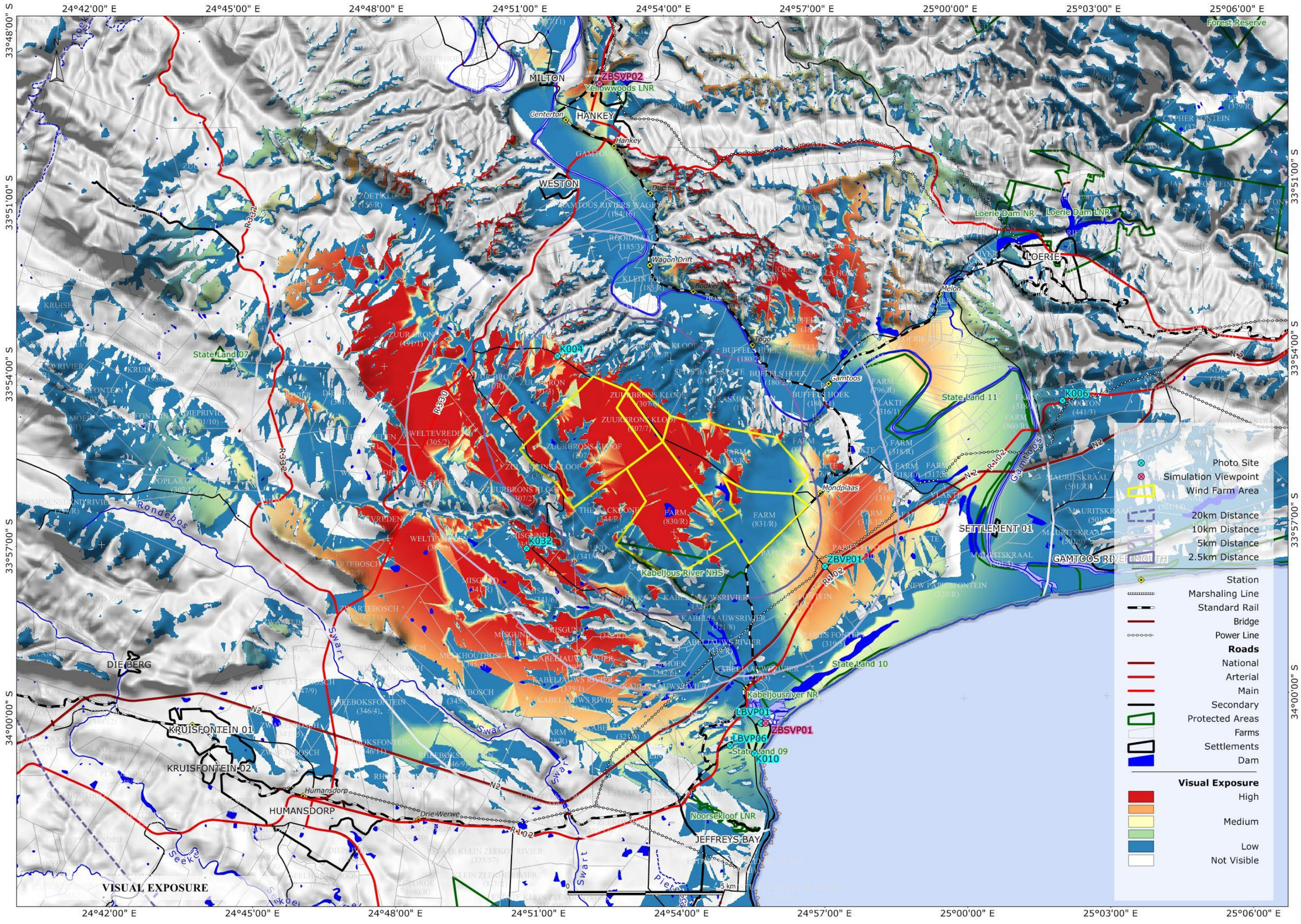

Figure 8.9: **Visual exposure calculated from visibility and distance from nearest turbine. Sites visited during the photo survey are also indicated.**

8.6.1.4.1 Residents of surrounding settlements

Settlements where views of residents may be affected are listed in Table 8.1. The visual exposure indicated is an average for the settlement. Individual residents may have higher exposure, especially for those settlements closer to the wind farm such as Hankey, Jeffrey's Bay and Weston. The screening effect of neighbouring buildings and high vegetation was not taken into account and it is likely that only residents living on the edge of these settlements will be affected.

Table 8.1: Average visual exposure ratings for settlements potentially affected by the WEF.

SETTLEMENT	MIN DIST (KM)	VISUAL EXPOSURE
HANKEY	7.64	Low
MILTON	9.73	Low
SETTLEMENT 01	8.10	Low
JEFFREY'S BAY	6.61	Low
LOERIE	10.53	Low
WESTON	6.06	Low
GAMTOOS RIVER MOUTH	11.18	Low
HUMANSDORP	12.77	Low
ASTON BAY	13.03	Low
KRUISFONTEIN 01	14.56	Low
PARADISE BEACH	14.90	Low
WOLWEHOEK	16.08	Low
PATENSIE	16.73	Low
NOORSHOEK	18.81	Low
KROMME RIVER HOLIDAY RESORT	21.10	Low
KROMME RIVER MOUTH	21.31	Low
ST FRANCIS BAY	21.92	Low
TOWNSHIP 01	25.31	Low

8.6.1.4.2 Protected Areas and Scenic Viewpoints

Protected areas are from the STEP database and the types of protected areas as defined by the STEP project are listed in Table 8.2. The protected areas listed in Table 8.3 will on average (visual exposure per area) have low visual exposure to the proposed wind farm. It is therefore possible that some viewpoints within protected areas will experience high visual exposure to the wind farm. However, most Type 1 protected areas are more than 5 km from the wind farm site.

Table 8.2: Protected area types as defined by STEP (from Lombard *et al*. 2003)

STEP PROTECTED AREA TYPE	TYPE DESCRIPTION
Type 1	A protected area owned and run by the State, Province or a local authority. Conservation legislation is strong.
Type 2	Public or private land managed for conservation and other land uses. Conservation legislation is weak or non-existent.
Type 3	Areas potentially available for conservation, owing to the existence of a structure for communication between conservation planners and landowners.

Table 8.3: Average visual exposure of protected areas that may be affected by the wind farm development.

PROTECTED AREA	STEP TYPE	MIN DIST (KM)	VISUAL EXPOSURE
Kabeljous River NHS	2	0.33	Low
Kabeljousriver NR	1	4.81	Low
State Land 11	2	4.98	Low
State Land 10	2	5.99	Medium
State Land 09	2	7.43	Low
Noorsekloof LNR	1	8.01	Low
Yellowwoods LNR	1	9.04	Low
State Land 07	2	10.94	Low
Loerie Dam LNR	1	11.10	Low
Loerie Dam NR	2	11.39	Low
Gamtoos River Mouth LNR	1	12.66	Low
Lombardini GF	3	12.83	Low
State Land 08	2	13.66	Low
Hankey FR	2	13.75	Low
Seekoeirivier NR	1	14.08	Low
Cape St Francis PC 3	3	15.04	Low
Longmore FR	2	15.76	Low
Stinkhoutsberg NR	1	17.23	Low
State Land 05	2	18.45	Low
State Land 06	2	19.97	Low
Kromme Island Estate PNR	2	20.01	Low
State Land 04	2	20.39	Low
Forest Reserve	2	20.83	Low
Loerie NR	1	21.01	Low
Kromme River Mouth PNR	2	21.06	Low
Eastcot PNR	2	21.39	Low
Cape St Francis PC 1	3	21.54	Low
Cape St Francis PC 5	3	21.95	Low
Van Stadensberg NHS	2	23.91	Low
Cape St Francis PC 2	3	25.36	Low
Thyspunt NHS	2	26.77	Low
Baviaanskloof CA	1	28.78	Low

8.6.1.4.3 Motorists

Sections of the N2, R102 and R330 pass through areas with a medium to **high** visual exposure rating. These sections are between 2.5km and 5km from the wind farm and motorists will occasionally have views of many turbines.

8.6.1.4.4 Residents on surrounding farms

It is clear from the visual exposure map for buildings (Figure 8.10 and Appendix 8.1) that there are several buildings which will potentially be **highly** exposed to the project. The analysis does not take into account vegetation such as high trees and thicket surrounding buildings, or the screening effect of neighbouring buildings. If a building, situated landward of the wind farm for example, has a view of the coast and it has a high visual exposure rating then it is likely that the view will contain many turbines.

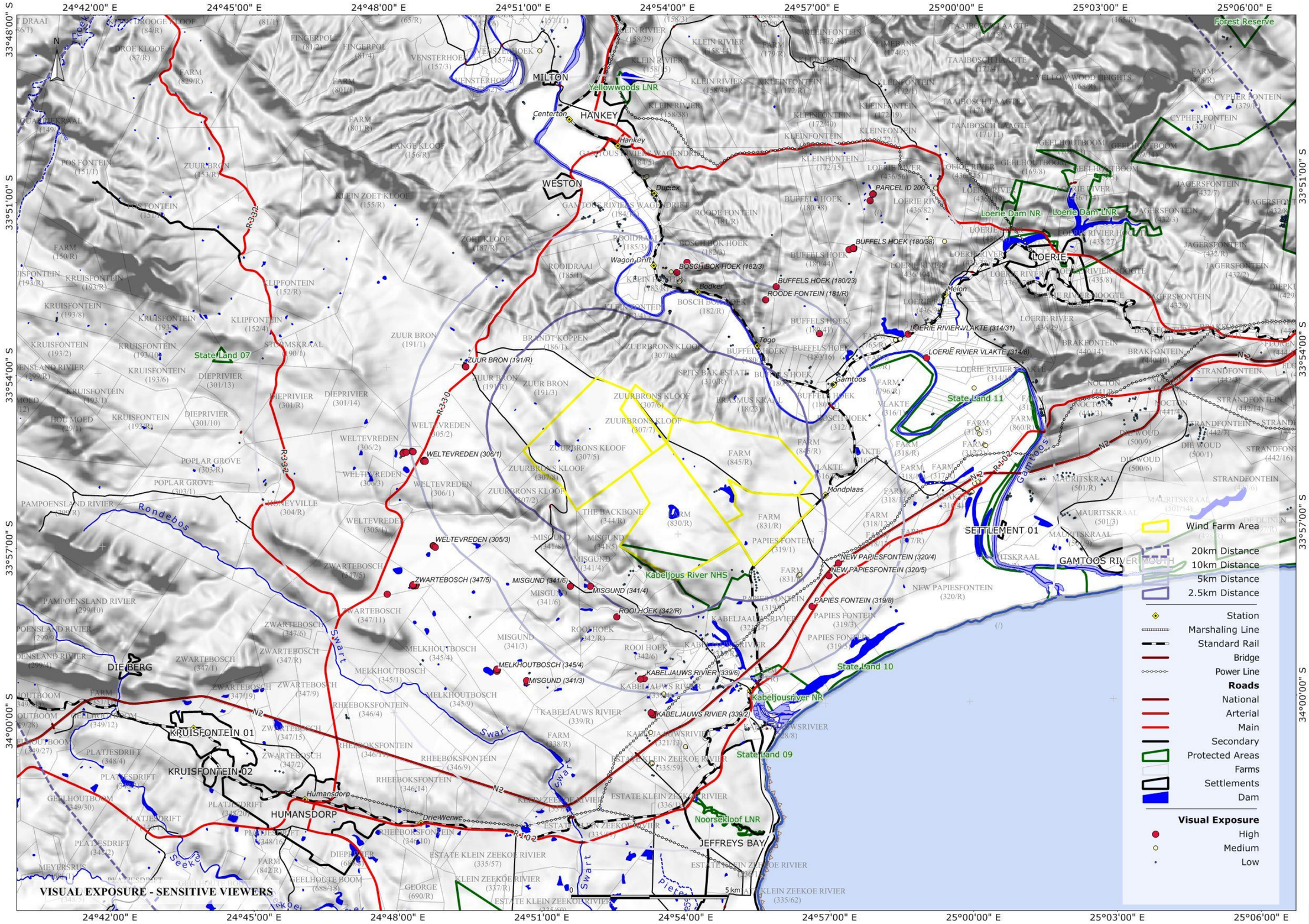

Figure 8.10: **Potential visual exposure for buildings on farms and in informal settlements surrounding wind turbines.**

8.6.1.5 Visual Intrusion

Visual intrusion	Visual intrusion indicates the level of compatibility or congruence of the project with the particular qualities of the area – its *sense of place*. This is related to the idea of context and maintaining the integrity of the landscape (Oberholzer 2005). It can be ranked as follows: *High* – results in a noticeable change or is discordant with the surroundings; *Moderate* – partially fits into the surroundings, but is clearly noticeable; *Low* – minimal change or blends in well with the surroundings.

Sense of place is defined by (Oberholzer 2005) as: '*The unique quality or character of a place..[It] relates to uniqueness, distinctiveness or strong identity.*' It describes the distinct quality of an area that makes it memorable to the observer.

The visual exposure map includes the localities of sites visited during the photographic survey (Figure 8.9).

8.6.1.5.1 Residents of surrounding settlements

There are no settlements closer than 5km from a wind turbine. Visual exposure to the wind farm is low for all settlements, although there will be areas within some settlements which will have a higher exposure rating. This means that those areas potentially will provide views of a large part of the wind farm. This is especially the case with Hankey where some areas could have views of many turbines against the skyline (Figure 8.17b). However, towns normally contain many structures and buildings which produce complex views with highly contrasting elements and colours and from this distance it is likely that the turbines will form only a small aspect of most views.

Jeffrey's Bay, and particularly the Kabeljous-on-Sea suburb on the southern bank of the Kabeljous River estuary, will have areas where views will be affected by the proposed wind farm. Views to the north often contain the Van Stadens mountains as a backdrop. These views are valued by residents and tourist visitors (e.g. Lagune View guest house) for their scenic qualities. The wind farm lies north-west of Kabeljous-on-Sea and it is unlikely that wind turbines will intrude on scenic views to the north. Figure 8.15, Figure 8.16 and Figure 8.17a provide an indication of the intrusive effect on views from Jeffrey's Bay. The views are from the edges of town and most other views will include buildings and other man-made structures. Visual intrusion is expected to be **moderate** rather than high since scenic views to the north across the Kabeljous River estuary are not likely to be affected by the wind farm.

8.6.1.5.2 Residents on surrounding farms

There are farmsteads and viewpoints on farms which currently have very few man-made structures in view, and potentially have scenic views of distant mountains and the ocean which could be affected by the wind farm. In particular, sensitive viewers and viewpoints west and south of the wind farm, with high visual exposure values (Figure 8.9 and Figure 8.10) will have some of their current views **highly** altered by the wind farm. Figure 8.11 and Figure 8.14 show the potential effect of the wind farm on examples of views in these areas.

Views from north of the Gamtoos River floodplain (Figure 8.10) shows that farmsteads on the floodplain are also likely to be affected, but in this case there are more man-made structures in views and views are generally more complex (Figure 8.12). Sensitive viewers here will experience **low** to **moderate** levels of visual intrusion on their views, depending on visual exposure to the wind farm.

Residents living east of the wind farm will often have the N2 and/or R102 in their views, as well as more structures associated with large settlements, such as power lines, towers, quarries and a railway line.

8.6.1.5.3 Protected Areas

Visual intrusion on viewpoints and visitors in protected areas will be similar to that of residents on farms surrounding the wind farm. Visitors to the Kabeljous River Natural Heritage Site will be in close proximity to the wind farm, but due to the topography of the area only parts of a few turbines will be visible from here. These views will be highly altered by the turbines due to their proximity. The Kabeljous River Nature Reserve north of Jeffrey's Bay is more than 5km from the wind farm and exposure values for the reserve are low. Other man-made elements will also be in many views from here, such as cell phone towers, major roads and power lines. State Land 10 (land owned by the State) is a narrow strip of land along the beach north of the Kabeljous River NR. It is 6km from the wind farm and although the visual exposure rating is medium for this protected area it is likely that the wind farm will have a medium to low effect on views from here due to other structures which will also be common in these views. The other protected areas are too far away to have views from within them significantly altered by the wind farm. A **low** visual intrusion on views from protected areas is expected.

8.6.1.5.4 Motorists

Visual intrusion for motorists driving along sections of the R330 will be **high** as there are very few other similar structures in view and the visual exposure ratings on these sections are high. There are also sections along the N2 and R102 for which visual exposure is high, but here motorists will have many other man-made structures and elements in view (Figure 8.13). Visual intrusion will only be high for a short section close to the wind farm.

8.6.1.6 Shadow Flicker

There are no buildings within 500m of a wind turbine and it is unlikely that shadow flicker will be an issue for residents near the wind farm.

a.)

b.)

Figure 8.11: **Panoramic view (a) and photomontage (b) from photo site K004 (2km from nearest wind turbine).**

a.)

b.)

Figure 8.12: **Panoramic view (a) and photomontage view (b) from the R102 east of the Gamtoos River valley (photo site K006 – 11km from nearest wind turbine).**

a.)

b.)

Figure 8.13: **Panoramic view (a) and photomontage (b) from the bridge over the N2 just east of the wind farm (photo site ZBVP01 - 3km from nearest wind turbine).**

Figure 8.14: **View east from photo site K032 (4km from nearest turbine). a) Photo b) Photomontage.**

Figure 8.15: View from Kabeljous-on-Sea village north of Jeffrey's Bay (Photo site LBVP01 - 6.7km from nearest turbine). a) Photo b) Photomontage.

a.)

b.)

Figure 8.16: View (a) and photomontage (b) from Jeffrey's Bay (photo site K010 – 7.5km from nearest wind turbine).

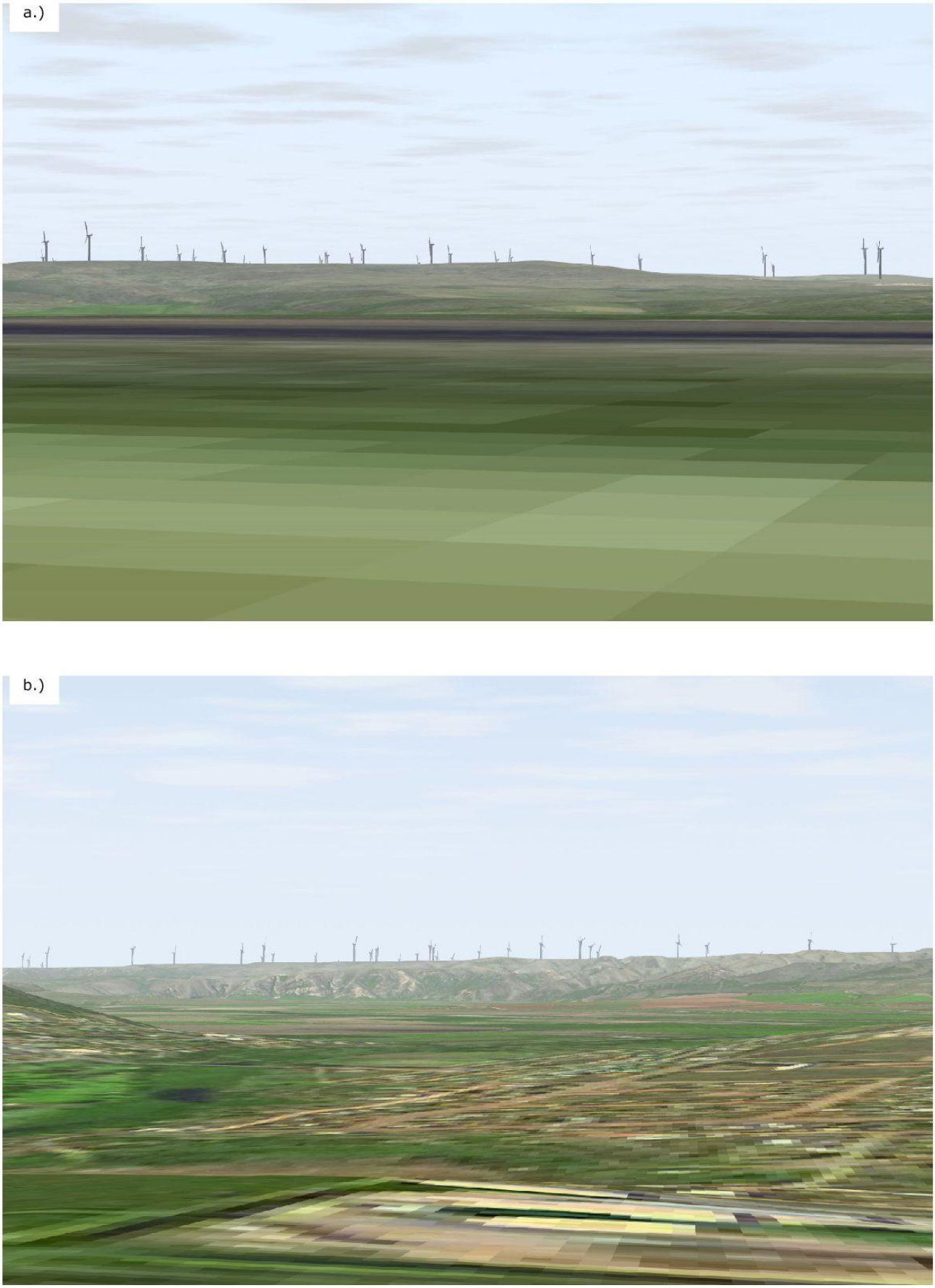

Figure 8.17: 3D simulations of viewpoints. a.) View towards the north-north-west from Lagune View (Kabeljous-on-Sea) (ZBSVP01 – 6.7km from nearest wind turbine) – see also Figure. b.) View south from northern edge of Hankey (ZBSVP02 – 10km from nearest wind turbine).

Table 8.4: Summary of visual impact criteria

Criteria	*Impact*
Viewer Sensitivity	Residents of settlements – Highly sensitive to changes in their views. Residents on surrounding farms – Highly sensitive to changes in their views. Scenic viewpoints and protected areas – Highly sensitive to the introduction of human-induced changes to views. Motorists – Low sensitivity due to short exposure time and the fact that their focus on landscape is reduced. Tourists will have more attention on the landscape and are seen as highly sensitive viewers.
Visibility of Development	**High** due to the tall structures and their position in the topography.
Visual Exposure	Residents of surrounding settlements – **Low** due to their distance from the wind farm. Views from some areas in Hankey and Jeffrey's Bay may be more exposed to the development. Residents on surrounding farms – **high** visual exposure for a number of sensitive viewers due to their proximity to the wind farm site. Protected areas – **Low** visual exposure for protected areas due to their distance from the development site. However, some areas in the Kabeljous River natural heritage site are very close to wind turbine positions. Motorists – **high** for sections of the N2, R102 and R330.
Visual Intrusion	Residents of surrounding settlements – **Low** for most surrounding settlements due to low visual exposure and complexity of views. **Medium** for Kabeljous-on-Sea since there are scenic views which may be affected by the wind farm. Residents on surrounding farms – **high** visual intrusion is expected for residents west of the wind farm site with high or moderate visual exposure since there are few man-made structures in existing views, and there are scenic views of the mountains and ocean which may be affected by the wind farm. Protected areas – **Low** visual intrusion due to low visual exposure. Kabeljous River natural heritage site may experience high visual intrusion in a few places due to its proximity to the wind farm. Motorists – High for sections of the R330.

8.6.2 Significance of Visual Impact On The Landscape

Landscape impacts	Change in the elements, characteristics, character and qualities of the landscape as the result of development (GLVIA, 2002). These effects can be positive or negative, and result from removal of existing landscape elements, addition of new elements, or the alteration of existing elements.

8.6.2.1 Impact 1: Impact of introducing highly visible wind turbines into a mixed agricultural and coastal resort landscape

Cause and Comment

Most of the landscape character types of this region have a low sensitivity to changes brought about by the introduction of a wind farm. Agricultural landscapes will remain agricultural landscapes since they will still function in the same way as before (especially for stock farming). In other countries it is normal to see wind turbines in agricultural landscapes. The coastal resort towns of the Kouga region are changing character as many of them expand and merge, developing from small sea-side villages into coastal resort towns with large commercial centres and light to medium industry. There are highly sensitive landscape character types in the region which may be altered by tall wind turbines.

Mitigation Measures

There are no mitigation measures that will change the significance of the landscape impact other than avoiding the site entirely. A reduction in wind turbine numbers is unlikely to have an appreciable effect since even a few wind turbines will still be highly visible. It is also likely that a wind farm will become a tourist attraction and the impact is therefore not necessarily negative. A visitor centre with information on the wind farm as well as tours to wind turbines may enhance its positive aspects. Local residents will most likely (based on similar developments in other countries) become used to the wind turbines within months.

Significance Statement

The operational lifetime of the wind farm is between 20 and 40 years after which it is relatively easy to disassemble the structures and remove the highly visible components (i.e. turbines). It is possible to extend the lifetime of the wind farm by upgrading or replacing turbines. In light of the indeterminate nature of the wind farm lifetime this author is assuming a *long term* duration of the impact rather than permanent since it is a simple procedure to remove these highly visible components from the landscape when compared with other developments of a similar scale such as nuclear plants or power stations. The extent is *regional* due to the visibility and size of the project. The intensity of the impact is expected to be *low* since the landscape character sensitivity of the agricultural and coastal resort character types are low, and the highly sensitive pristine landscape types are far enough away for the effect on these to be low. The probability of the impact occurring is *high* due to the size of the wind farm and its components, and their high visibility. The significance of the landscape impact according to the rating methodology is therefore expected to be **medium** due to the long duration and regional extent of the impact. Confidence in this assessment is *medium* to *high* since knowledge, information and experience in the Kouga region is extensive, but all research on wind farms and their effect on landscapes refer to countries other than South Africa. There are enough similarities to be able to make inference, but until wind farms are more common in South African landscapes there will always be some uncertainty in their impact on existing landscapes.

Table 8.5: Significance of impact on an agricultural landscape caused by introduction of a wind farm.

Direct Impacts							
Mitigation	Spatial Extent	Intensity	Duration	Probability	Significance & Status		Confidence
					Without Mitigation	With Mitigation	
Visual Impact: Impact on agricultural/coastal resort landscape character types							
No mitigation due to the size and visibility of wind turbines.	Regional (at least visible to 20km on a clear day)	Low – landscape character types have a low sensitivity to the development type	Long term/permanent – can be completely dismantled after 20 years.	High – the height and visibility of the turbines means that it is highly likely that some impact will occur.	Medium due to long term and regional extent of the impact.	Medium	Medium to high – research commonly refer to other countries such as Europe and the USA.

8.6.3 Significance of visual impact on viewers

Visual impacts	Changes to the visual character of available views resulting from the development that include: obstruction of existing views; removal of screening elements thereby exposing viewers to unsightly views; the introduction of new elements into the viewshed experienced by visual receptors and intrusion of foreign elements into the viewshed of landscape features thereby detracting from the visual amenity of the area

8.6.3.1 Impact 2: Visual intrusion on views of sensitive visual receptors of constructing a wind farm

Cause and Comment

The height of the features being built and the siting on the relatively flat coastal plain landscape is likely to expose construction activities against the skyline (Figure 8.18). Large, abnormal freight vehicles and equipment will be visible. Traffic may be disrupted while large turbine components are moved along public roads. Activity at night is also probable since transport of large turbine components may occur after work hours to minimise disruption of traffic on main roads.

Figure 8.18: Construction of the existing Coega wind turbine (2km away).

Mitigation Measures

The most obvious causes of impacts resulting from construction activities cannot be mitigated since the turbines are so tall and they are to be installed on the top of ridges close to settlements and busy roads. The duration of the impact is short, though, and there are a number of mitigation measures that will curtail the intensity to some extent:

- Dust suppression is important as dust will raise the visibility of the development.
- New road construction should be minimised and existing roads should be used where possible.
- The contractor should maintain good housekeeping on site to avoid litter and minimise waste.
- Clearance of indigenous vegetation should be minimised and rehabilitation of cleared areas should start as soon as possible.
- Erosion risks should be assessed and minimised as erosion scarring can create areas of strong visual contrast with the surrounding vegetation, which can often be seen from long distances since they will be exposed against the hillslopes.
- Laydown areas and stockyards should be located in low visibility areas (e.g. valleys between ridges) and existing vegetation should be used to screen them from views where possible.
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency. See section on lighting for more specific measures.
- Fires and fire hazards need to be managed appropriately.
- If practical, notify locals when turbines are being assembled, and invite them to a viewing of the construction process.

Significance Statement

The duration of the impact is *short term* (while construction lasts). The extent is *regional* due to the nature of the development (height of towers and siting on ridges and higher ground) and construction activities will be visible over long distances. The intensity of the visual impact will be *high* since many highly sensitive visual receptors will be affected by the impact. The probability of the impact occurring is *definite* since construction of the turbines will be outlined against the skyline (or the sea) for many of the viewers, and is likely to be viewed with some curiosity. The mitigation measures are there to contain the severity of the impact. The significance of the impact is **high** due to the regional extent and high intensity of the impact. Construction will last approximately 12 to 15 months, of which several weeks are spent erecting the turbines (under favourable weather conditions) – potentially the most visible activity as it will most probably be exposed against the skyline. It is also worth noting that the visual impact of at least some of the construction phase is likely to be positive, especially during assembly of the turbine towers. The construction engineering feat of lifting and attaching components weighing more than 50 tons a piece in a highly visible area is bound to be spectacular (see for example Degraw 2009 or filmsfromyes2wind 2010).

Table 8.6: Significance of wind farm construction activities on sensitive viewers

Direct Impacts							
Mitigation	**Spatial Extent**	**Intensity**	**Duration**	**Probability**	**Significance & Status**		**Confidence**
					Without Mitigation	**With Mitigation**	
Visual Impact: Impact on sensitive visual receptors due to the construction of a wind farm.							
Limited mitigation to contain the severity of the impact.	Regional (at least visible to 20km on a clear day)	High – construction will be outlined against the sky from most viewpoints.	Short term – it should take less than a year to construct the highly visible component of the wind farm.	Definite – the high visibility of construction activity on wind turbines ensures that there will be a visual impact.	High due to the high intensity of the impact and the number of sensitive viewers who will be affected. The impact is not necessarily negative though and some viewers will find the construction activity fascinating.	High	Medium to high – research commonly refer to other countries such as Europe and the USA.

8.6.3.2 Impact 3: Intrusion of large highly visible wind turbines on the existing views of sensitive visual receptors

Cause and Comment

The region has a mixture of agricultural landscape (including settlements which developed as agricultural service centres) and coastal holiday resort towns with a large seasonal influx of holiday makers and tourists. Some settlements such as Humansdorp and Jeffrey's Bay are expanding at a high rate and commercial and industrial developments are becoming part of the visual landscape. Most of the region inland from these settlements is still used for agriculture (mainly stock farming on the higher ground, with irrigated and dry land crops in some of the river floodplains) although game farming is replacing stock farming in some areas. Large man-made structures are still scarce and are mostly limited to major roads, power lines and a few quarries. Other structures common to views in the region are communication towers, chicken broiler housing and farmsteads/buildings.

There are scenic views with distant mountains or the ocean as a backdrop, and a wind farm will potentially be intrusive on these, especially if these views include few other structures. Areas west of the wind farm site have sense of remoteness which will be affected if wind turbines are introduced into the region.

Mitigation Measures

There are no mitigation measures that can reduce the impact significantly unless the site is avoided but there are a number of measures that can enhance the positive aspects of the impact. It has been shown that uncluttered sites are preferred for wind farms (Gipe 1995; Stanton 1996; Vissering 2005). In view of this the following mitigation measures and suggestions may enhance the positive visual aspects of the development:

- Ensure that there are no wind turbines closer than 500 m to a residence.
- Maintenance of the turbines is important. A spinning rotor is perceived as being useful. If a rotor is stationary when the wind is blowing it is seen as not fulfilling its purpose and a negative impression is created (Gipe 1995).
- Signs near wind turbines should be avoided unless they serve to inform the public about wind turbines and their function. Advertising billboards should be avoided.
- According to the Aviation Act, 1962, Thirteenth Amendment of the Civil Aviation Regulations, 1997: "Wind turbines shall be painted bright white to provide maximum daytime conspicuousness. The colours grey, blue and darker shades of white should be avoided altogether. If such colours have been used, the wind turbines shall be supplemented with daytime lighting, as required."
- Lighting should be designed to minimise light pollution without compromising safety. Investigate using motion sensitive lights for security lighting. Turbines are to be lit according to Civil Aviation regulations (see impact 4, section 8.6.3.3).
- An information centre (provided that it is located in a low visibility area) and trails along the wind farm can enhance the project by educating the public about the need and benefits of wind power. 'Engaging school groups can also assist the wind farm proponent, as energy education is paramount in developing good public relations over the long term. Instilling the concept of sustainability, and creating awareness of the need for wind farm developments, is an important process that can engage the entire community' (Johnston 2001). This has also been borne out by a more recent study on the effect of wind farms on tourism in which respondents said they would visit wind farms as long as there was an information centre (Frantál & Kunc 2010).

Significance Statement

The operational lifetime of the wind farm is between 20 and 40 years after which it is relatively easy to disassemble the structures and remove the highly visible components (i.e. turbines). It is possible to extend the lifetime of the wind farm by upgrading or replacing turbines. In light of the indeterminate nature of the wind farm lifetime this author is assuming a *long term* duration of the impact rather than permanent since it is a simple procedure to remove these highly visible components from the landscape when compared with other developments of a similar scale such as nuclear plants or power stations. A wind farm is not a permanent structure and it can be dismantled completely (refer to Section 6.2.1)." The extent of the impact is *regional* since the turbines will be visible from more than 20km away on clear days. Due to the high visual intrusion that is expected on the views of some of the highly sensitive visual receptors in the region, the intensity of the impact is expected to be *high*. The status in this case will depend on the viewer's opinion on the aesthetic and symbolic appeal of wind turbines and is also likely to change from negative to positive if acceptance of the development follows international experience. It is *definite* that the impact will occur due to the high visibility of the turbines and the high visual exposure that some highly sensitive viewers in the surrounding region will experience. The overall significance of the visual impact on sensitive viewers is **high**.

Table 8.7: Significance of the visual impact of the proposed wind farm on sensitive viewers

Direct Impacts							
Mitigation	**Spatial Extent**	**Intensity**	**Duration**	**Probability**	**Significance & Status**		**Confidence**
					Without Mitigation	**With Mitigation**	
Visual Impact: Intrusion of a wind farm on the views of sensitive visual receptors.							
Limited mitigation.	Regional (at least visible to 20km on a clear day)	High – the views of a number of highly sensitive viewers surrounding the wind farm will be severely affected due to high visual exposure and intrusion.	Long term/permanent – the lifetime of the wind farm is expected to be at least 20 years after which the turbines can be dismantled and removed.	Definite – there are no other similar structures in the region.	High due to the high intensity of the impact and the number of sensitive viewers who will be affected. The impact is not necessarily negative and will vary from viewer to viewer.	High	Medium to high – research commonly refer to other countries such as Europe and the USA.

8.6.3.3 Impact 4: Impact of night lights of a wind farm on existing nightscape

Cause and Comment

Wind farms are required by law to be lit at night as they represent hazards to aircraft due to the height of the turbines. Marking of turbines depends on wind farm layout and not all turbines need to be lit. Marking consists of a red flashing light of medium intensity (2000 candela). The marking requirements from the South African Civil Aviation Authority(SACAA) will be adhered to.

According to this author's interpretation of the Civil Aviation Regulations the wind farm layout will entail lighting of at least 28 turbines. These lights are not bright and are unlikely to contribute to sky-glow or light pollution in the region, but they will be highly visible due to their height. Views towards the sea across the wind farm will be affected, but the background sky-glow caused by coastal villages and chokka boats, and existing tower lights is likely to reduce the impact. Views from east to west are likely to be more affected although there are many lights in the foreground including lights from traffic on the N2.

Mitigation Measures

The aviation standards have to be followed and no mitigation measures are applicable in terms of marking the turbines. Lighting of ancillary buildings and structures should be designed to minimise light pollution without compromising safety. Motion sensitive lighting can be used for security purposes.

Significance Statement

Extent is difficult to determine and since these are medium intensity lights the extent of the impact is expected to be *local* even though they may be visible over a longer distance. Duration is *long term or permanent.* The intensity of the impact is expected to be *moderate* (for a few farm residents living close to the turbines) to *low*. Likelihood is *probable* for residents living close to the wind farm and having views of turbines, and *unlikely* for other viewers due to existing lights and sky-glow. The significance of the impact is **low** to **moderate** due to the long term of the development.

Table 8.8: Significance of the impact of night lighting of the wind farm on sensitive viewers

Direct Impacts							
Mitigation	**Spatial Extent**	**Intensity**	**Duration**	**Probability**	**Significance & Status**		**Confidence**
					Without Mitigation	**With Mitigation**	
Visual Impact: Impact of night lighting of wind farm on sensitive viewers							
Mitigation options are limited by aviation standards	**Local** since it's unlikely that the lights will be noticed from further than 5km away.	**Low** to **moderate** depending on the viewer's distance away from the wind farm.	**Long term/permanent** – lifetime of the wind farm.	**Probable** due to the visibility of the turbines.	**Medium** due to the long duration of the impact.	**Medium**	**Medium** to high – research commonly refer to other countries such as Europe and the USA.

8.7 CONCLUSIONS AND RECOMMENDATIONS

The wind farm will be built on a highly visible plateau above the N2, and it will potentially be visible over a large region. Viewers who will be most affected by the wind farm are those living on farms surrounding the development site, especially for viewpoints west and south of the site where existing views contain relatively few man-made structures and a sense of remoteness prevails. However, there are not many sensitive viewers in these areas who will be highly exposed to the wind farm. Views from Jeffrey's Bay are unlikely to be highly impacted since scenic views are normally directed at the mountains in the north or the ocean. Protected areas in the region are generally too far from the site to be highly impacted.

8.8 APPENDIX

Appendix 8.1: Sensitive viewers who will experience high visual exposure to the wind farm

BUILDING	MIN DIST (m)	VISUAL EXPOSURE	LONGITUDE	LATITUDE
MISGUND (341/4)	2796.75	High	24.8692	-33.9646
ROOI HOEK (342/R)	2909.60	High	24.8781	-33.9736
NEW PAPIESFONTEIN (320/5)	3221.10	High	24.9521	-33.9629
NEW PAPIESFONTEIN (320/4)	3278.41	High	24.9555	-33.9593
MISGUND (341/6)	3309.57	High	24.8622	-33.9645
PAPIES FONTEIN (319/8)	3509.69	High	24.9459	-33.9717
ZUUR BRON (191/R)	3690.38	High	24.8276	-33.9003
ZUUR BRON (191/R)	3715.34	High	24.8274	-33.9001
BOSCH BOK HOEK (182/3)	4033.51	High	24.9015	-33.8743
ROODE FONTEIN (181/R)	4418.56	High	24.9319	-33.8827
BOSCH BOK HOEK (182/R)	4419.39	High	24.9091	-33.8730
BUFFELS HOEK (180/23)	4425.30	High	24.9504	-33.8927
KABELJAUWS RIVIER (339/6)	4436.24	High	24.8872	-33.9916
BOSCH BOK HOEK (182/3)	4439.90	High	24.9051	-33.8714
KABELJAUWS RIVIER (339/4)	4467.24	High	24.8859	-33.9917
BOSCH BOK HOEK (182/R)	4513.20	High	24.9102	-33.8726
WELTEVREDEN (306/1)	4789.88	High	24.8127	-33.9273
WELTEVREDEN (306/1)	4797.08	High	24.8125	-33.9271
WELTEVREDEN (306/1)	4822.88	High	24.8122	-33.9272
WELTEVREDEN (306/1)	4841.85	High	24.8121	-33.9274
BUFFELS HOEK (180/23)	4925.61	High	24.9357	-33.8790
WELTEVREDEN (306/1)	5085.52	High	24.8086	-33.9245
WELTEVREDEN (306/1)	5117.60	High	24.8083	-33.9244
WELTEVREDEN (306/1)	5311.66	High	24.8062	-33.9247
WELTEVREDEN (306/1)	5381.66	High	24.8054	-33.9246
WELTEVREDEN (306/1)	5416.00	High	24.8051	-33.9250
KABELJAUWS RIVIER (339/2)	5485.84	High	24.8893	-34.0015
KABELJAUWS RIVIER (339/2)	5528.75	High	24.8907	-34.0020
KABELJAUWS RIVIER (339/2)	5532.38	High	24.8896	-34.0020
KABELJAUWS RIVIER (339/2)	5545.86	High	24.8905	-34.0022
KABELJAUWS RIVIER (339/2)	5549.25	High	24.8901	-34.0022
WELTEVREDEN (305/3)	5906.64	High	24.8156	-33.9523
WELTEVREDEN (305/3)	5927.01	High	24.8149	-33.9518
WELTEVREDEN (305/3)	5931.53	High	24.8150	-33.9520
MISGUND (341/3)	6361.48	High	24.8463	-33.9915
MISGUND (341/3)	6365.03	High	24.8464	-33.9917
MISGUND (341/3)	6385.40	High	24.8464	-33.9919
LOERIE RIVIER VLAKTE (314/31)	6752.12	High	24.9812	-33.8934

MELKHOUTBOSCH (345/4)	6796.24	High	24.8362	-33.9879
MELKHOUTBOSCH (345/4)	6804.18	High	24.8364	-33.9881
MELKHOUTBOSCH (345/4)	6805.29	High	24.8362	-33.9880
MELKHOUTBOSCH (345/4)	6845.65	High	24.8360	-33.9883
MELKHOUTBOSCH (345/4)	6846.22	High	24.8362	-33.9885
MELKHOUTBOSCH (345/4)	6858.46	High	24.8359	-33.9885
LOERIE RIVIER VLAKTE (314/8)	6993.88	High	24.9874	-33.9004
LOERIE RIVER (436/62)	7084.19	High	24.9841	-33.8917
ZWARTEBOSCH (347/5)	7096.79	High	24.8087	-33.9629
BUFFELS HOEK (180/38)	7104.26	High	24.9613	-33.8686
ZWARTEBOSCH (347/5)	7141.82	High	24.8085	-33.9633
ZWARTEBOSCH (347/5)	7181.13	High	24.8079	-33.9632
ZWARTEBOSCH (347/5)	7185.53	High	24.8076	-33.9630
BUFFELS HOEK (180/38)	7206.62	High	24.9629	-33.8685
ZWARTEBOSCH (347/5)	7211.73	High	24.8076	-33.9634
BUFFELS HOEK (180/38)	7215.90	High	24.9627	-33.8683
ZWARTEBOSCH (347/5)	7226.26	High	24.8074	-33.9634
BUFFELS HOEK (180/38)	7235.75	High	24.9629	-33.8681
ZWARTEBOSCH (347/5)	8023.72	High	24.7986	-33.9655
PARCEL ID 200	8780.56	High	24.9689	-33.8546
PARCEL ID 200	8993.93	High	24.9698	-33.8528
PARCEL ID 200	9023.84	High	24.9701	-33.8527