INFINITE PLAN 8 WIND ENERGY FACILITY, GRAHAMSTOWN, EASTERN CAPE

ECOLOGICAL SPECIALIST REPORT

Prepared for:	**Prepared by:**
Plan8 (Pty) Ltd Infinite Energy	**Coastal & Environmental Services**
MrZubenJessa Engineering Manager	P.O. Box 934, Grahamstown, 6140 South Africa

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AUTHOR

Ms Leigh-Ann de Wet, Botanical and Ecological Specialist.
Leigh-Ann holds a BSc (Botany and Entomology) as well as a BSc (Hons) and MSc in Botany from Rhodes University. She conducts vegetation sensitivity assessments including vegetation and sensitivity mapping, to guide developments and thereby minimising their impacts sensitive vegetation. Her experience ranges from local Eastern Cape Projects to those in different provinces including but not limited to Kwa-Zulu Natal, Western Cape and Mpumalanga. She has experience in many different vegetation types as well as different levels of vegetation degradation. Leigh-Ann has also worked on international projects for the mining sector, the most recent of which was a botanical study for First Quantum Minerals in Zambia.

EXECUTIVE SUMMARY

The aim of this ecological specialist report is to provide a general description of the natural vegetation of the specific area to be developed, and adjacent areas that will be impacted. To provide a general description of the indigenous fauna of the area, using a habitat approach and based on the natural vegetation of the site. The identification of plant species of special concern and suitable species for rehabilitation are important outcomes.

Plan8(Pty) Ltd, a renewable energy company, plans to develop a wind powered electricity generation facility (known as a 'wind farm') approximately 30km outside of Grahamstown along the N2 in an easterly direction towards East London, in the Eastern Cape Province of South Africa. The area of the proposed wind energy facility comprises a series of ridges which are flat to undulating, surrounding deeply incised valleys and undulating hills. Grahamstown is situated in the eastern part of the Cape Fold Belt and is underlain mainly by rocks of the Witteberg Group of the Cape Supergroup, and the Dwyka and Ecca groups of the Karoo Supergroup. Climate is variable, with most rainfall occurring in winter, with the hottest month, February and the coldest; July.

The vegetation types described by Mucina and Rutherford for the area are Kowie Thicket and Bisho Thornvel: both listed as near threaztened. STEP describes the vegetation types of the area as Grahamstown grassland thicket, Albany Coastal Thornveld and Albany Valley Thicket, all Least Threatened, except for Albany Valley Thicket, listed as Vulnerable. Six vegetation types were found to occur in the area of the wind energy facility on the site visit in November 2010. These included Degraded thicket, occurring over much of the site (low sensitivity), Fynbos, occurring in a restricted section to the southeast of the site (medium sensitivity), Fynbos, thicket, karoo mosaic, occurring on the tops of slopes of the site (medium sensitivity), Rocky fynbos, occurring in very restricted portions of the site (high sensitivity), Thicket, occurring in valley bottoms throughout the site (high sensitivity) and Thicket mosaic, occurring to the north of the site (high sensitivity).

Alien species recorded from the study site included *Echinopsis spachiana* (Schedule 1), *Eucalyptus grandis* (Schedule 2), *Agave americana* (Schedule 2), *Opuntia ficus-indica* (Schedule 1) and *Acacia mearnsii* (Schedule 2). These invaders are required to be removed by law, as they are each Category 1: Declared Weeds or Category 2: Declared Invaders. Thirteen Species of Special Concern were found on site, and it is highly likely that more will be recorded in the construction phase if the development should go ahead.

Lack of pristine terrestrial habitat in the Grahamstown area, particularly due to loss of natural vegetation caused by infestation by alien invasive species as well as urban development, has impacted on terrestrial fauna. Despite this, a few large mammals occur in the region, along with small and medium sized animals. Reptile and amphibians occurring in the area include many species of frogs, tortoises and terrapins, lizards and snakes. Some animal Species of Special Concern are likely to occur in the study area.

Several conservation planning tools are available for the area. These tools allow for the determination of any sensitive and important areas from a vegetation and faunal point of view at the scoping stage of a development. They allow for the fine-tuning of plans and turbine layouts with a view to reducing potential environmental impacts at the planning stage of the development. Consultation of the National Protected Areas Expansion Strategy as well as the Eastern Cape Biodiversity Conservation Plan reveals that the site does not occur in close proximity to national reserves or planned expansion areas, the study area does occur in critical biodiversity area 2 (near-natural landscapes ideally kept as corridors).

Sensitivity analysis confirmed the presence of most of the turbines in areas of low sensitivity, with some in areas of medium sensitivity. No turbines occur in areas of high sensitivity. A summary of the impacts is provided in Table A, below:

Table A: Summary of impacts associated with the proposed Grahamstown Wind Energy Facility

Impacts	Without mitigation			With mitigation		
	Construction phase	Operation phase	No-Go	Construction phase	Operation phase	No-Go
ISSUE 1: Loss of vegetation communities						
1: Loss of Degraded thicket	LOW -	N/A	MOD -	LOW -	N/A	N/A
2: Loss of Fynbos	LOW -	N/A	MOD -	LOW -	N/A	N/A
3: Loss of Fynbos, thicket, karoo mosaic	LOW -	N/A	MOD -	LOW -	N/A	N/A
4: Loss of rocky fynbos	N/A	N/A	N/A	N/A	N/A	N/A
5: Loss of Thicket	N/A	N/A	N/A	N/A	N/A	N/A
6: Loss of Thicket mosaic	LOW -	N/A	MOD -	LOW -	N/A	N/A
ISSUE 2: Loss of Species of Special Concern (SSC) and Biodiversity (general)						
7: Loss of plant SSC	HIGH -	N/A	MOD -	LOW -	N/A	N/A
8: Loss of animal SSC	LOW -	N/A	MOD -	LOW -	N/A	N/A
9: Loss of Biodiversity	MOD -	N/A	MOD -	LOW -	N/A	N/A
ISSUE 3: Disruption of ecosystem function and process						
10: Fragmentation of vegetation and edge effects	LOW -	N/A	LOW -	LOW -	N/A	N/A
11: Invasion of alien species	MOD -	HIGH -	HIGH -	MOD +	MOD +	N/A

Overall, the impacts of the overall development will be negative, mainly due to a loss of vegetation. This loss of vegetation is also important for fauna as it constitutes habitat loss. Positive impacts include the active management of the alien vegetation on the site. Permits will be required for any plant Species of Special Concern that will have to be removed or destroyed in the construction phase. Invasive species should be monitored and controlled throughout the life of the development.

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1. INTRODUCTION

1.1. Objective

To provide a general description of the natural vegetation of the specific area to be developed, and adjacent areas that will be impacted. To provide a general description of the indigenous fauna of the area, using a habitat approach and based on the natural vegetation of the site. The identification of plant species of special concern and suitable species for rehabilitation are important outcomes.

1.2. Terms of reference

The following terms of reference were provided for this report:

- Identify and map the main vegetation types and plant communities;
- Identify and record the main plant species that occur within the project area;
- Identify and record plant species that might be suitable for rehabilitation.
- Where possible identify any Red Data Book (RDB) flora species. In the absence of specific information on RDB species, adopt a habitat approach by identifying areas likely to contain RDB species;
- Assess the extent of alien plant species over the site, and associated risks of alien invasion as a result of the wind energy project;
- Identify any significant landscape features or rare or important vegetation/faunal associations such as seasonal wetlands, seeps or rocky areas that might support rare or important vegetation/faunal associations;
- Identify the main animal communities associated with the plant communities (mammals, and reptiles (birds and bats will be dealt with in separate specialist reports);
- Describe the likelihood of other RDB species or species of conservation concern occurring in the vicinity. In the absence of specific information on RDB species, adopt a habitat approach by identifying areas likely to contain RDB species ;
- Provide a general overview of the project area in terms of connectivity, corridors, rivers and streams and ecological viability in relation to the surrounding region;
- Place the project area within the biodiversity context of the wider area (i.e. provide the “bigger picture”); and
- Identify (as far as is possible from the data collected) the principal ecological processes evident within the project site and its relative importance in determining the biodiversity characteristics present.
- An assessment of the potential direct and indirect impacts resulting from the proposed development and associated infrastructure, both on the footprint and the immediate surrounding area during construction and operation;
- A detailed description of appropriate mitigation measures that can be adopted to reduce negative impacts for each phase of the project, where required.

1.3. Assumptions and Limitations

Study specific assumptions and limitations include:

- Species of special concern are difficult to find and difficult to identify, thus species described in this report do not comprise an exhaustive list. It is almost certain that additional species of special concern will be found during construction and operation of the development.
- Time is a constraint in studies such as these and only a sample of the ecology of the area was taken.
- Impacts are assessed based on current turbine layouts. Should the layout change, the impacts and associated mitigation measures, will need to be revisited.

2. METHODS

2.1. The assessment

The aim of this assessment is to identify areas of ecological importance and to evaluate these in terms of their conservation importance. In order to do so, the ecological sensitivity of areas are assessed as well as the species of special concern that may occur in habitats occurring in the area.

To a large extent, the condition and sensitivity of the vegetation will also determine the presence of animal species of special concern and areas with high faunal biodiversity. It is for this reason that the assessment focuses on the vegetation aspects of the site, and includes only a small section on the fauna recorded from, and expected to live on the site.

Biodiversity has the potential to be very high in this area the Eastern Cape and, as a result, an exhaustive study is not possible to conduct for the area. It is thus not the aim of this study to produce a complete list of all animal and plant species occurring in the region, but rather to examine a representative sample. It is however, important to note areas of high sensitivity as well as species of special concern have been identified as far as possible, either from records from the site or a review of their habitat requirements and whether or not these habitats occur in within the site. The aim of this study is to identify areas of high sensitivity and those that may be subject to significant impacts from the project. Aspects that would increase impact significance include:

- Presence of plant species of special concern.
- Presence of animal species of special concern.
- Vegetation types (which also constitute faunal habitats) of conservation concern.
- Areas of high biodiversity.
- The presence of process areas:
    - Ecological corridors
    - Wetlands (including rivers)
    - Complex topographical features (especially steep and rocky slopes that provide niche habitats for both plants and animals)

2.2. Species of special concern

2.2.1. Plant species of special concern

Data on the known distribution and conservation status for each potential species of special concern has to be obtained in order to develop a list of ‘Species of Concern’. These species are those that may be impacted significantly by the proposed activity. In general these will be species that are already known to be threatened or at risk, or those that have restricted distributions with a portion (at least 50%) of their known range falling within the study area. Species that are afforded special protection, notably those that are protected by CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) are also regarded as Species of Concern (see http://www.cites.org/). Efforts to provide assessments of conservation status (‘red list’ status) of individual species may provide additional valuable information on Species of Concern (see http://www.iucnredlist.org/).

A list of ‘Species of Possible Concern’ is derived from the species list by examining the relevant literature and databases and eliminating those that have a widespread distribution and which are not covered by CITES regulations or red listed. From this initial list, the status of ‘Confirmed Species of Concern’ may be conferred if the species is substantially restricted to the study area based on:

- recent literature (last 10 years) that provides comprehensive information on the distribution range
- examination of herbarium specimens available

Note that all uncertain identifications of species from the study area are regarded as Species of Possible Concern until they can be collected or recollected and studied further. Similarly, all species that are believed to be currently un-described – i.e. new to science – are regarded to be of Possible Concern unless a researcher working on the group in question can confirm that although currently unpublished, the plant is in fact widespread.

2.2.2. Faunal species of special concern

Species of special concern (SSC) in terms of the project area are defined as:

- *Threatened species*:
- species listed in the Endangered or Vulnerable categories in the revised South African Red Data Books (SA RDB – amphibians, du Preez and Carruthers, 2009; reptiles; terrestrial mammals, Apps, 2000); and/or
- species included in other international lists (e.g., 2010 IUCN Red List of Threatened Animals).
    - Definitions include:
        - Critically Endangered (CR) - A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
        - Endangered (EN) - A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
        - Vulnerable (VU) - A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
        - Near Threatened (NT) - A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- *Sensitive species*. Species not falling in the categories above but listed in:
- Appendix 1 or 2 of the Convention of International Trade in Endangered Species (CITES).
- *Endemic species*. Species endemic to South Africa, and more specifically to the Eastern Cape.

2.3. Sample site selection

A sampling protocol was developed that would enable us to evaluate the existing interpretations of the vegetation of the study area, to improve on them if necessary, and to add detailed information on the plant communities present. The protocol took into account the amount of time available for the study, the accessibility of different parts of the area, and limitations such as the seasonality of the vegetation.

A stratified random sampling approach was adopted, whereby initial assumptions were made about the diversity of vegetation, based on initial reconnaissance visits, previous studies or from aerial photographs and satellite imagery and the area stratified into these basic types. In this way the time available was used much more efficiently than in random sampling, but there is a risk of bias and the eventual results may simply ‘prove’ the assumptions. Sample sites within selected areas were chosen at random to ensure adequate coverage of vegetation types or recognised zones within the blocks of the different vegetation types.

In general, the stratification of the site was influenced by obvious features of the vegetation, such as the presence of conspicuous species or vegetation structure. These factors may be largely independent of the floristic make-up of the vegetation, and by definition the biological communities present. Sample plots were analysed by determining the dominant species in each plot, as well as any alien invasive species and potential species of special concern occurring within the plots.

Vegetation communities were then described according to the dominant species recorded from each type, and these mapped and assigned a sensitivity score.

2.4. Vegetation mapping

Vegetation is usually mapped from aerial photographs and/or satellite images, and related to data gathered on the ground.

2.5. Sensitivity assessment

This section of the report explains the approach to determining the ecological sensitivity of the study area on a broad scale. The approach identifies zones of very high, high, moderate and low sensitivity according to a system developed by CES and used in numerous proposed development studies. It must be noted that the sensitivity zonings in this study are based solely on ecological (primarily vegetation) characteristics and social and economic factors have not been taken into consideration. The sensitivity analysis described here is based on 10 criteria which are considered to be of importance in determining ecosystem and landscape sensitivity, and have been used in past studies. The method predominantly involves identifying sensitive vegetation or habitat types, topography and land transformation (Table 2-1).

The study area was zoned into areas which were homogenous in terms of vegetation types. Alternatively topography and drainage areas were used as boundaries for homogenous zones. Once the study area had been zoned, the sensitivity criteria described in Table 2-1 were applied to each zone and scored as HIGH (3), MODERATE (2) or LOW (1). A total score for each zone was then calculated and the overall ecological sensitivity was determined using the following percentage scale:

- 0 - 33.3% : LOW ecological sensitivity
- 33.4 – 64.9% : MODERATE ecological sensitivity
- 65 – 85% : HIGH ecological sensitivity
- 85.1 – 100%: VERY HIGH ecological sensitivity.

Although very simple, this method of analysis provides a good, yet conservative and precautionary assessment of the ecological sensitivity.

Table 2-1: Criteria used for the analysis of the sensitivity of the area

CRITERIA		LOW SENSITIVITY 1	MODERATE SENSITIVITY 5	HIGH SENSITIVITY 10
1	**Topography**	Level, or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	**Vegetation -** Extent or habitat type in the region	Extensive	Restricted to a particular region/zone	Restricted to a specific locality / site
3	**Conservation status** of fauna/ flora or habitats	Well conserved independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	**Species of special concern** - Presence and number	None, although occasional regional endemics	No endangered or vulnerable species, some indeterminate or rare endemics	One or more endangered and vulnerable species, or more than 2 endemics or rare species

CRITERIA		LOW SENSITIVITY 1	MODERATE SENSITIVITY 5	HIGH SENSITIVITY 10
5	**Habitat fragmentation** leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not susceptible to fragmentation	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation
6	**Biodiversity** contribution	Low diversity, or species richness	Moderate diversity, and moderately high species richness	High species diversity, complex plant and animal communities
7	**Visibility** of the site or landscape from other vantage points	Site is hidden or barely visible from any vantage points with the exception in some cases from the sea.	Site is visible from some or a few vantage points but is not obtrusive or very conspicuous.	Site is visible from many or all angles or vantage points.
8	**Erosion potential** or instability of the region	Very stable and an area not subjected to erosion.	Some possibility of erosion or change due to episodic events.	Large possibility of erosion, change to the site or destruction due to climatic or other factors.
9	**Rehabilitation** potential of the area or region	Site is easily rehabilitated.	There is some degree of difficulty in rehabilitation of the site.	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce.
10	**Disturbance** due to human habitation or other influences (Alien invasives)	Site is very disturbed or degraded.	There is some degree of disturbance of the site.	The site is hardly or very slightly impacted upon by human disturbance.

A Geographical Information System (GIS) map was drawn up and with the aid of a satellite image the sensitive regions and vegetation types could be plotted. The description of the sample plots helped to map the vegetation, and these descriptions as well as sensitivity ratings were illustrated on the resultant maps.

2.6. Impact assessment

Impact rating methodology

To ensure a direct comparison between various specialist studies, a standard rating scale has been defined and will be used to assess and quantify the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. Five factors need to be considered when assessing the significance of impacts, namely:

- Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

- Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.

- The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.

  The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word ‘mitigation’ means not just ‘compensation’, but also the ideas of containment and remedy. For beneficial impacts,

optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

- The **likelihood** of the impact occurring - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Each criterion is ranked with scores assigned as presented in Table 2-2 to determine the overall **significance** of an activity. The criterion is then considered in two categories, viz. effect of the activity and the likelihood of the impact. The total scores recorded for the effect and likelihood are then read off the matrix presented in Table 2-3, to determine the overall significance of the impact. The overall significance is either negative or positive.

The significance scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of a social nature need to reflect the values of the affected society.

Cumulative Impacts

Cumulative Impacts affect the significance ranking of an impact because it considers the impact in terms of both on-site and off-site sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both on-site and off-site activities take place simultaneously, the total pollution level at may exceed the standards. For this reason it is important to consider impacts in terms of their cumulative nature.

Seasonality

Although seasonality is not considered in the ranking of the significance, if may influence the evaluation during various times of year. As seasonality will only influence certain impacts, it will only be considered for these, with management measures being imposed accordingly (i.e. dust suppression measures being implemented during the dry season).

Table 2-2 Ranking of Evaluation Criteria

EFFECT	**Temporal scale**			**Score**
	Short term	Less than 5 years		**1**
	Medium term	Between 5 and 20 years		**2**
	Long term	Between 20 and 40 years (a generation) and from a human perspective almost permanent.		**3**
	Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there		**4**
	Spatial Scale			
	Localised	At localised scale and a few hectares in extent		**1**
	Study area	The proposed site and its immediate environs		**2**
	Regional	District and provincial level		**3**
	National	Country		**3**
	International	Internationally		**4**
	Severity		**Benefit**	
	Slight / Slightly Beneficial	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) or party(ies)	**1**
	Moderate / Moderately Beneficial	Moderate impacts on the affected system(s) or party(ies)	An impact of real benefit to the affected system(s) or party(ies)	**2**
	Severe / Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) or party(ies)	**4**
	Very Severe / Very Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) or party(ies)	**8**
LIKELIHOOD	**Likelihood**			
	Unlikely	The likelihood of these impacts occurring is slight		**1**
	May Occur	The likelihood of these impacts occurring is possible		**2**
	Probable	The likelihood of these impacts occurring is probable		**3**
	Definite	The likelihood is that this impact will definitely occur		**4**

** In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can't know*

Table 2-3 Ranking matrix to provide an Environmental Significance

Environmental Significance		Positive	Negative
LOW	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent development. These impacts will result in either positive or negative medium to short term effects on the social and/or natural environment	4-7	4-7
MODERATE	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which, in conjunction with other impacts may prevent its implementation. These impacts will usually result in either positive or negative medium to long term effect on the social and/or natural environment.	8-11	8-11
HIGH	A serious impact which, if not mitigated, may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually long term change to the natural and/or social environment and result in severe negative or beneficial effects.	12-15	12-15
VERY HIGH	A very serious impact which may be sufficient by itself to prevent the implementation of the project. The impact may result in permanent change. Very often these impacts are unmitigable and usually result in very severe effects or very beneficial effects.	16-20	16-20

1.2 Example of an environmental significance statement

Impact 1: Impact of noise on human health

Cause and Comment
The noise associated with Heavy Goods Vehicles (HGVs) has the potential to impact on human health. A recommendation for the movement of large vehicles at night may impact on the sleep patterns of local communities.

Mitigation and Management
There are standard mitigation measures to ensure that vehicle noise is kept within acceptable limits. Vehicles should be kept in good repair; they should use standard exhaust and silencing equipment. Drivers should stick to designated speed limits. Roads should be kept in good condition.

Significance Statement

RATING		Temporal Scale		Spatial Scale		Severity of Impact		Risk or Likelihood		Total
	Without Mitigation	Short term	1	Localised	1	Moderate	2	Definite	4	8
	With Mitigation	Short term	1	Localised	1	Slight	1	Unlikely	1	4
Overall Significance without mitigation										**MODERATE**
Overall Significance with mitigation										**LOW**

3. DESCRIPTION OF THE STUDY AREA

3.1. Location of the site

Plan8(Pty) Ltd, a renewable energy company, plans to develop a wind powered electricity generation facility (known as a 'wind farm') approximately 30km outside of Grahamstown along the N2 in an easterly direction towards East London, in the Eastern Cape Province of South Africa. The proposed site is on the farms Gilead, Tower Hill and Peynes Kraal, situated approximately 30km east of Grahamstown. The proposed wind farm is planned to comprise up to a maximum of 32 turbines, each with a nominal power output ranging between 2 and MW (megawatts). The total potential generating capacity of the wind farm will be approximately 80MW, and will feed power into the national electricity grid.

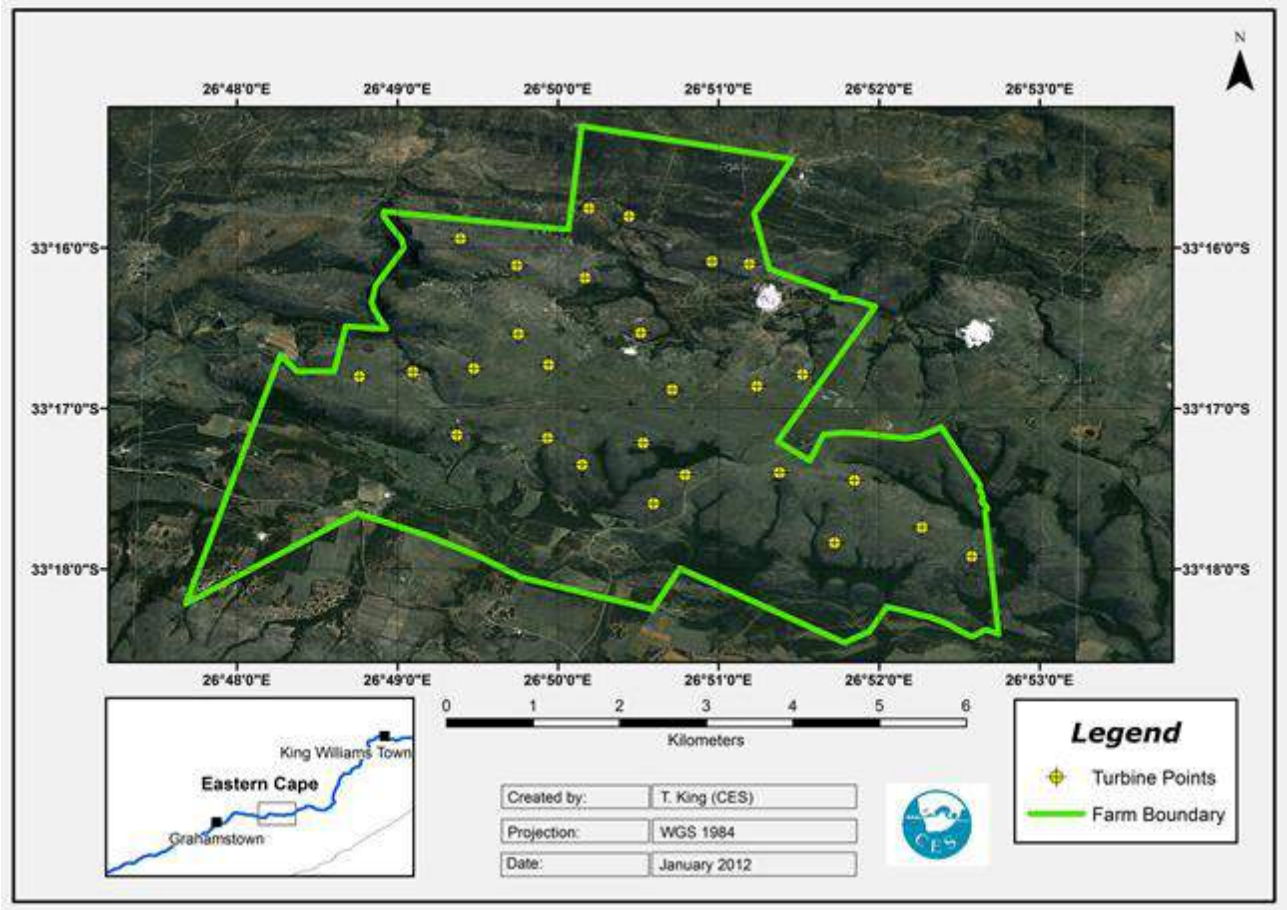

Figure 3-1: Location of the proposed wind energy facility and turbines.

3.2. Topography

The Eastern Cape Province contains a wide variety of landscapes, from the stark Karoo (the semi-desert region of the central interior of the country) to mountain ranges and gentle hills rolling down to the sea. The climate and topography give rise to the great diversity of vegetation types and habitats found in the region. The mountainous area on the northern boundary of the province forms part of the Great Escarpment. Another part of the escarpment lies just north of Bisho, Somerset East and Graaff-Reinet. In the south of the province the Cape Folded Mountains start between East London and Port Elizabeth and continue westward into the Western Cape. As is the situation in KwaZulu-Natal, the Eastern Cape is characterised by a large number of short, deeply incised rivers flowing parallel to each other.

The area of the proposed wind energy facility comprises a series of ridges which are flat to undulating, surrounding deeply incised valleys and undulating hills (Plate 3.1).

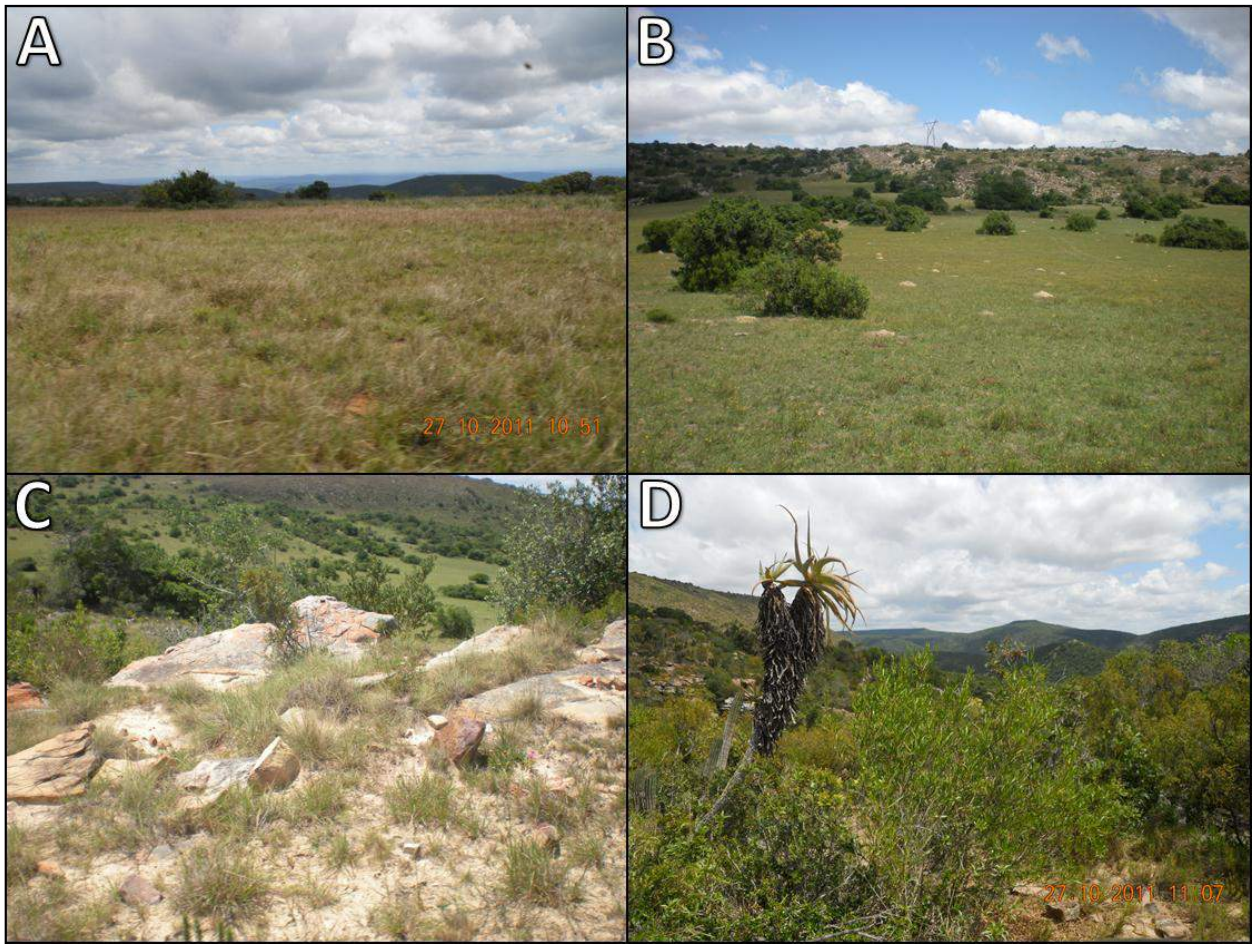

Plate 3.1: A: Flat areas on top of the ridges. B: undulating hills. C: Rocky outcrops on steep slopes and D: deeply incised valleys.

3.3. Geology and soils

Grahamstown is situated in the eastern part of the Cape Fold Belt and is underlain mainly by rocks of the Witteberg Group of the Cape Supergroup, and the Dwyka and Ecca groups of the Karoo Supergroup (Figure 3.2).

In the general area, the oldest rocks of the Cape Supergroup are the shales and sandstones of the Weltevrede Formation, overlain by resistant quartz arenites of the Witpoort Formation. These quartzites are overlain by fine-grained shales and thin sandstones of the Lake Mentz and Kommadagga subgroups (Jacob et al., 2004). The published geological map of the Grahamstown region (Council for Geoscience, 1995) does not indicate the presence of the Kommadagga Subgroup in the Grahamstown area (Figure 3.2). However, the Miller, Swartwaterspoort and Soutkloof formations of the Kommadagga Subgroup crop out west of Grahamstown, as well as the lowermost Dirkskraal Formation, immediately below the Dwyka Group. The rocks in the Kommadagga Subgroup are mainly shales, with minor greywacke and arenite sandstone units. Feldspar content increases upward in these rocks near the base of the Dwyka Group, reflecting cooler and drier conditions at the onset of glaciation.

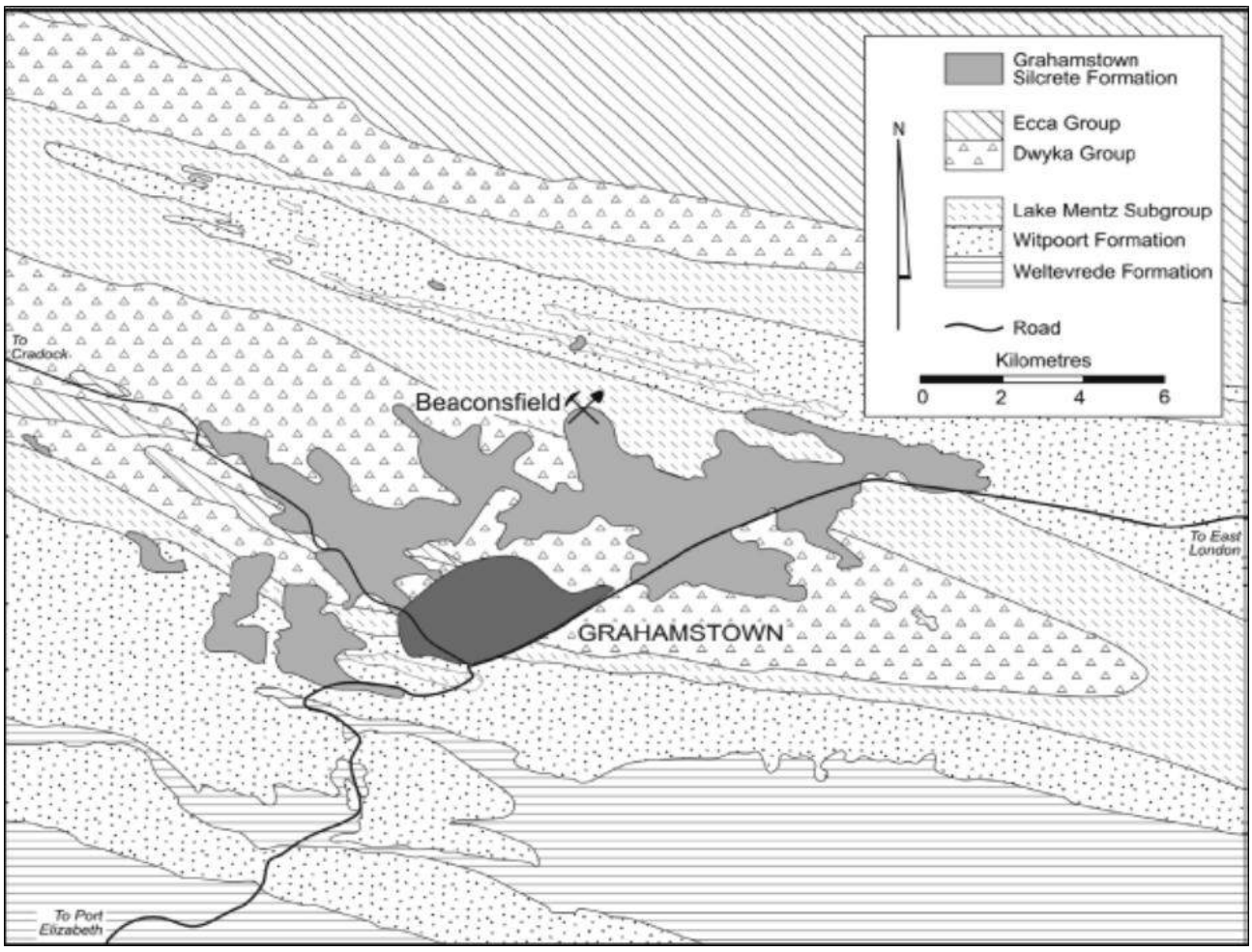

Figure 3.2: Simplified geological map of the area around Grahamstown. Adapted from 1:250 000 scale sheet 3326 Grahamstown
Source: Jacob et al. (2004)

The Witteberg Group rocks are overlain by rocks of the Dwyka Group, the basal unit of the Karoo Supergroup. The contact generally is poorly exposed but probably is paraconformable (Jacob *et al*., 2005). The Dwyka consists mainly of glacial diamictite and is composed of a variety of angular to rounded clasts of various igneous and sedimentary rocks set in a fine-grained, dark, massive argillaceous matrix. The overlying argillaceous and arenaceous rocks of the Ecca Group occur mainly to the north of the area. In the area around Grahamstown, the Dwyka Group forms a syncline whose fold axial trace trends East South East (ESE) (see Figure 4-1). This syncline plunges at a low angle to the West North West (WNW). To the north and south of the syncline, quartzite ridges of the Witpoort Formation form the higher-lying hills that enclose the area where the Grahamstownpeneplain was developed. The peneplain varies in altitude from 620 to 660m above sea level. The original peneplain extended more than 300 km^2. However, only a remnant, about 34 km^2, remains. Remnants of this peneplain owe their preservation to the resistant layer of silcrete, which hinders erosional destruction. Clay deposits underlie the peneplain and represent mainly the deeply weathered profile that developed during Cretaceous to Tertiary times.

3.4. **Climate**

Due to the location of the study area at the confluence of several climatic regimes, namely temperate and subtropical, the Eastern Cape Province of South Africa has a complex climate. There are wide variations in temperature, rainfall and wind patterns, mainly as a result of movements of air masses, altitude, mountain orientation and the proximity of the Indian Ocean.

The Makana region falls in the heart of three major transitional climatic regions:-

- From the south-western region there is a maritime influence of winter rainfall. In this region it changes to spring and autumn rainfall with south easterly winds bringing torrential rains which are very variable and inconsistent.
- From Grahamstown north–eastwards the rainfall changes to a general summer rainfall.
- The interior south of the Winterberg is affected by both these climatic patterns, with cold fronts and little winter rain, but summer rain from sporadic thunder showers.

Winds and alternating cold and warm fronts thus make for a very variable climate throughout the region. Grahamstown normally receives about 466mm of rainfall per year and because it receives most of its rainfall during winter it has a Mediterranean climate. On average Grahamstown receives the lowest rainfall (16mm) in July and the highest (57mm) in March. The monthly distribution of average daily maximum temperatures indicates that the average midday temperatures for Grahamstown range from 18.9°C in July to 26.8°C in February. The region is the coldest during July when the mercury drops to 5.6°C on average during the night.

3.5. Vegetation of the study area

3.5.1. Regional Vegetation

The vegetation types described by Mucina and Rutherford (2006) for the area are Kowie Thicket and BishoThornveld (Figure 3.3):

Kowie Thicket

This vegetation type is restricted to the Eastern Cape Province, in river valleys (Mucina& Rutherford 2006). It occurs on mainly steep and north-facing (dry) slopes. Tall thickets dominated by succulent euphorbias and aloes with a thick understory composed of thorny shrubs, woody lianas (*Capparis, Secamore, Rhoicissus, Aloe*), and shrubby succulents (Crassulaceae, Asphodelaceae). Moister south-facing slopes support thorny thickets dominated by low evergreen trees (*Azima, Carissa, Gymnosporia, Putterlickia*) with fewer succulent shrubs and trees. The herbaceous layer is poorly developed (Mucina& Rutherford 2006).

This vegetation type is listed as **Least Threatened**, with a conservation target of 19% (Mucina& Rutherford 2006). 5% is statutorily conserved and 14% in private conservation areas. 7% is transformed, primarily by cultivation. This vegetation type is the core of the Albany Thicket Biome and the major florisitc node of the Albany Centre of endemism (Mucina& Rutherford 2006).

BishoThornveld

This vegetation type occurs in the Eastern Cape Province inland from the coast from Mthatha to North of East London as far as Fort Beaufort and occurring near Grahamstown (Mucina& Rutherford 2006). BhishoThornveld occurs on undulating planes and shallow drainage valleys. It comprises open savannah characterised by small trees of *Acacia natalitia* with a short to medium, dense, sour grassy understory, usually dominated by *Themedatriandra*. A diversity of other woody species may occur, increasing under conditions of overgrazing. The vegetation type is wide-ranging and fire and grazing are important determinants (Mucina& Rutherford 2006).

This vegetation type is listed at **Least Threatened** by Mucina and Rutherford (2006). The conservation target is 25%, with only 0.2% statutorily conserved and 2% privately conserved. 20% has been transformed, mainly for cultivation, urban development or plantations (Mucina& Rutherford 2006).

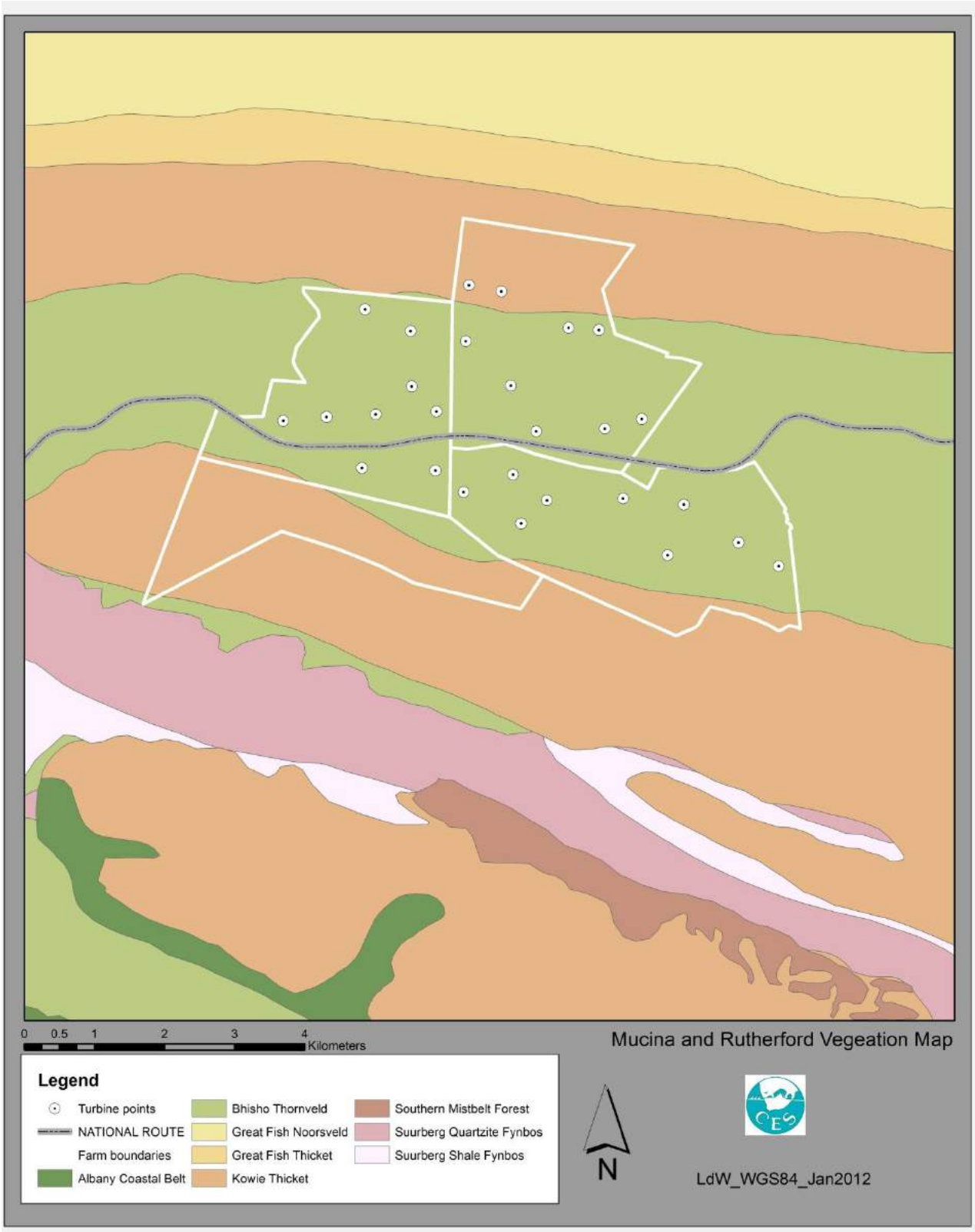

Figure 3.3: Mucina and Rutherford vegetation map of the study area.

STEP describes the vegetation types of the area as Grahamstown grassland thicket, Albany Coastal Thornveld and Albany Valley Thicket (Figure 3.4):

Grahamstown Grassland Thicket

Thicket clumps are typical of Albany Thicket, and contain taaibos (*Rhuspallens*), katdoring (*Scutiamyrtina*), kiepersol (*Cussoniaspicata*) and poison peach (*Diospyrosdicrophylla*) (Pierce &Mader 2006). The grassland matrix has many fynbos elements (*Erica*sp and *Restiotriticeus*) as well as numerous species of rare localised endemic species, such as the genus *Brachystelma*. Grahamstown Grassland Thicket is listed as **Least Threatened** by STEP (Pierce &Mader 2006).

Albany Coastal Thornveld

Albany Coastal Thornveld is dominated by sweet thorn trees (*Acacia karroo*) and a dense grassland dominated by *Themedatriandra, Heteropogoncontortus*and*Tristachyaleucothrix* with an admixture of fynbos elements (Pierce &Mader 2006). This vegetation type is listed at **Least Threatened** by STEP (Pierce &Mader 2006).

Albany Valley Thicket

The dominant tree species of Albany Thicket include doppruim (*Pappeacapensis*) and qwarrie (*Eucleaundulata*) (Pierce &Mader 2006). Characteristic species include the succulents *Aloe africana*and*Kalanchoerotundifolia*. The most distinguishing feature are the tall *Euphorbia tetragona* plants emerging above the canopy. Albany Valley Thicket is listed as **Vulnerable** by STEP (Pierce &Mader 2006).

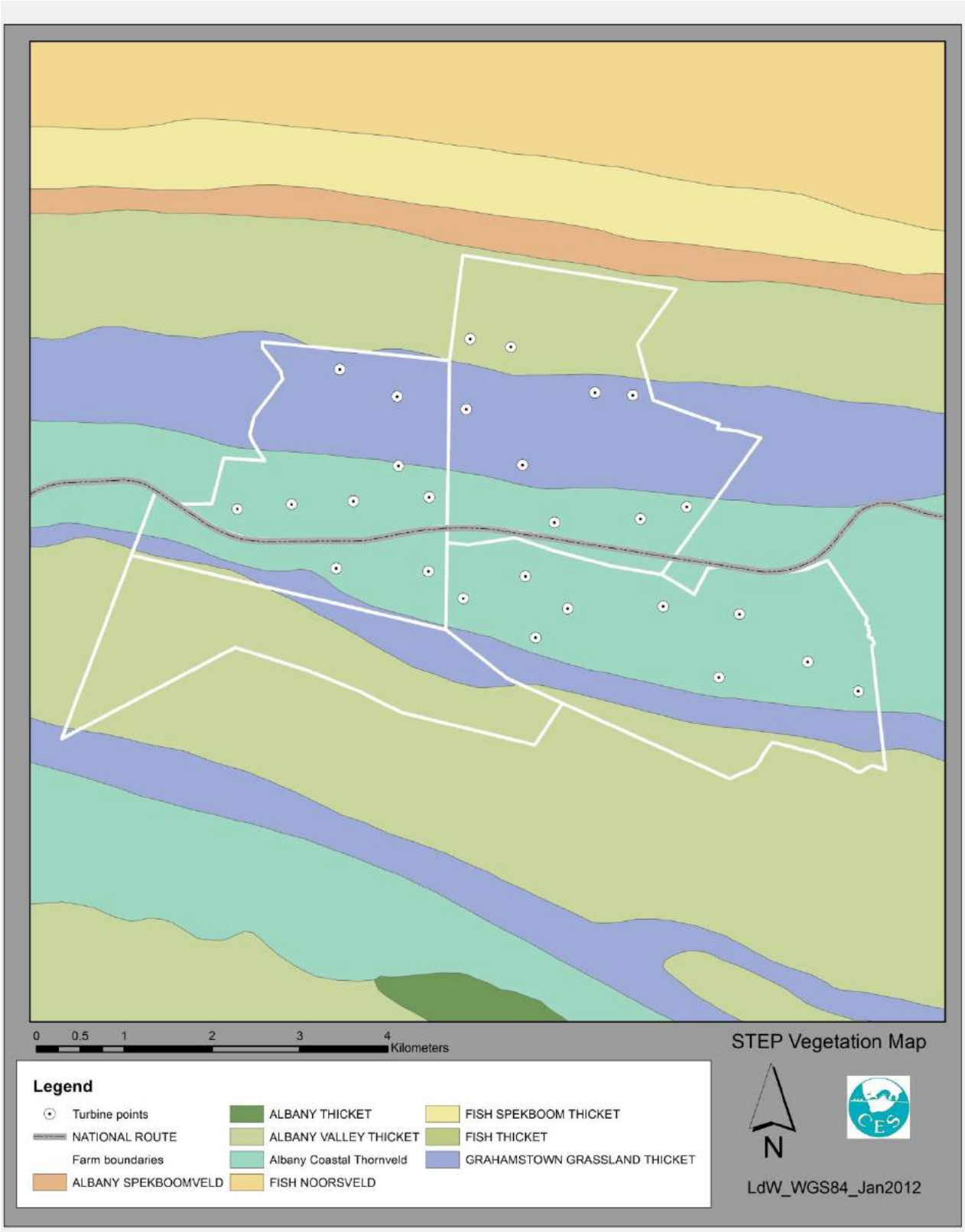

Figure 3.4: STEP vegetation map of the study area.

3.5.2. Vegetation types in the study area

The results of the vegetation assessment have determined the existence of vegetation types within the study site. These vegetation types are presented below.

Degraded thicket

Degraded thicket occurs in a large portion of the site (see figure 3.3). This type of thicket has been well grazed in many areas comprises mainly thicket clumps surrounded by closely cropped grassland (Plate 3.4). Species within the thicket clumps are typical thicket species including *Euclea undulata, Aloe ferox, Rhus* species and various lower level herbaceous and shrub species. The grassy areas of this vegetation type are dominated by *Themeda triandra* and cvarious herbaceous species also occur.

Fynbos

Fynbos occurs in a restricted section to the southeast of the site. This fynbos area is confined to the upper reaches of the hills tending from thicket in the valley bottoms to a fynbos thicket karoo mosaic (see below) at the tops of the ridges. The fynbos is dominated by *Leucospermum cuneiforme,* with scattered *Bobartia orientalis* and several restionaceous plants.

Fynbos, thicket, karoo mosaic

This interesting vegetation type occurs on the tops of the ridges of the site (Figure 3.4). It tends to be quite degraded and is clearly heavily grazed. This vegetation type comprises sparse thicket clumps primarily dominated by *Diospyros dichrophylla*. The surrounding grassland is dominated by *Themeda triandra* and *Bobartia orientalis*, the persistent presence of which is a sign of overgrazing. Karoo elements include various small shrubs, and various herbaceous species commonly found in karoo such as *Blepharis* species.

Rocky Fynbos

Rocky fynbos occurs in very limited areas within the site (Figure 3.4), and as such, was difficult to characterise. Typically it comprises some proteaceous and restionaceous shrubs with some herbaceous plants. Grass is limited in distribution in these areas. Species recorded from this vegetation type include *Dodonaea viscosa* and *Protea repens*.

Thicket

True thicket occurs deep in the valleys of the site. It is a dense, impenetrable stand of a multitude of species including *Eulea unduala, Grewia robusta, Sideroxylon inerme, Aloe ferox* and numerous herbacoues and succulent species including *Adromischus cristatus var. clavifolius, Aizoon glinoides, Blepharis capensis, Bulbine frutescens, Cotyledon campanulata* and many others.

Thicket mosaic

Thicket mosaic occurs to the north of the site and comprises the same thicket elements as thicket (described above) with patches that are cleared and grazed, often with swathes of *Pteronia incana* or blue bush, a sign of overgrazing. Often the presence of *Pteronia incana* in this vegetation type is coupled with other invaders such as *Opuntia ficus-indica* or the prickly pear.

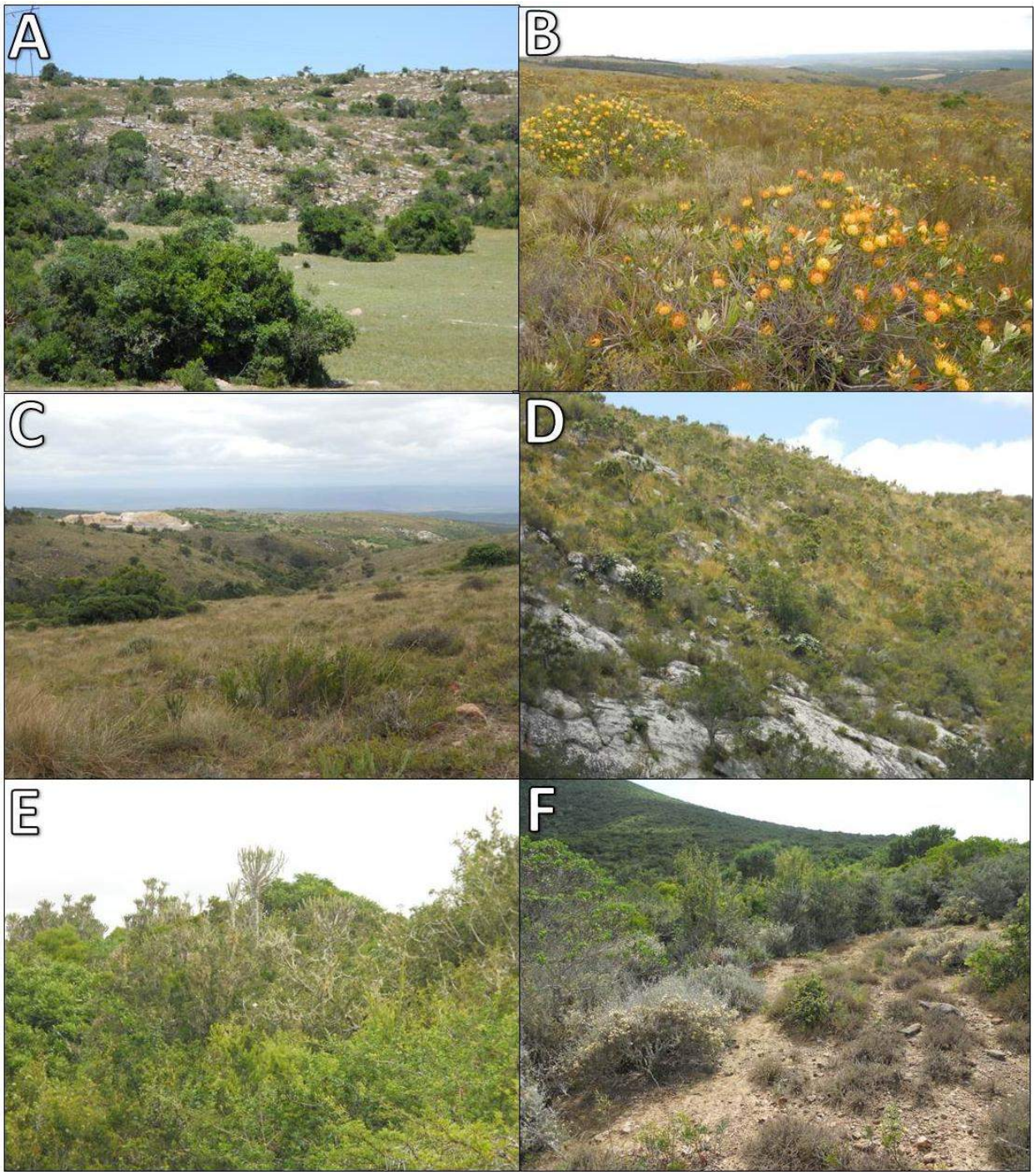

Plate 3.4: Vegetation types from the study area: A: Degraded thicket, B: Fynbos, C: Fynbos, thicket karoo mosaic, D: Rocky Fynbos, E: Thicket and F: Thicket Mosaic.

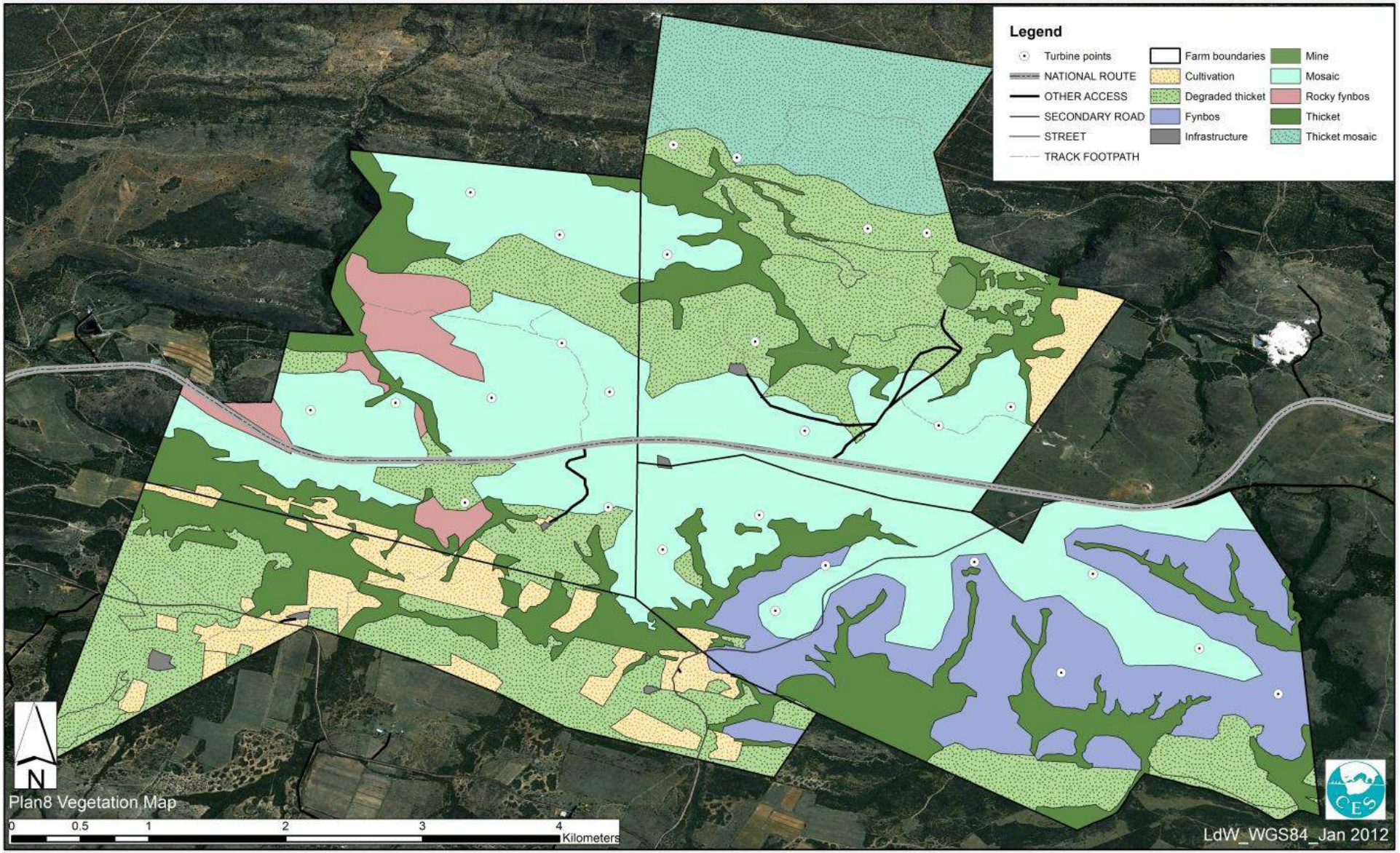

Figure 3.3: Vegetation types occurring in the proposed wind energy facility site.

3.6. **Plant species**

The vegetation of the Eastern Cape is complex and is transitional between the Cape and subtropical floras, and many taxa of diverse phytogeographical affinities reach the limits of their distribution in this region. The region is best described as a tension zone where four major biomes converge and overlap (Lubke *et al.* 1988). The dominant vegetation is Succulent Thicket (Spekboomveld or Valley Bushveld), a dense spiny vegetation type unique to this region. While species in the canopy are of subtropical affinities, and generally widespread species, the succulents and geophytes that comprise the understorey are of karroid affinities and are often localised endemics.

The Makana Municipal area is a region of floral transition and complexity, as it forms a major climatic, topographical, geological and pedological (soil) transition zone where four phytogeographical regions (plant regions) converge. The Cape floral elements extend eastwards along the Cape mountains and diminish in abundance from Grahamstown to the east. The Tongoland-Pondoland flora enters the region along the east coast, and thicket vegetation penetrates up the river valleys. The succulent and sub-desert shrublands of the Karoo-Namib region extend down the dry river valleys from the arid interior. Afromontane elements of grassland and forest vegetation types extend down the mountains of Africa. In many of the plant communities of the area, a great complexity of floral elements is evident, and the area is described as a phytochorologically mixed flora. This means that the area is rich in plant diversity, with numerous interesting plants from a range of plant regions.

Albany, honouring the Duke of York, was the name given to the region (formerly called Zuurveld) around Grahamstown in 1814. This name has been used by botanists and phytogeographers to recognise a centre of endemism, an area with unusually high concentrations of plant species with restricted distributions (van Wyk and Smith, 2001). The Albany Centre is an important area of succulent endemism, many of which are associated with the Xeric thicket vegetation in the region.

As described above, Grahamstown falls within the Albany Centre of Floristic Endemism; also known as the Albany Hotspot (Figure 3.4). This is an important centre for plant taxa, and, according to van Wyk and Smith (2001), contains approximately 4000 vascular plant species with approximately 15% either endemic or near-endemic (Victor and Dold, 2003). This area was delimited as the '*region bounded in the west by the upper reaches of the Sundays and Great Fish River basins, in the east by the Indian Ocean, in the south by the Gamtoos–GrootRiver basin and in the north by the KeiRiver basin*' (Victor &Dold, 2003)

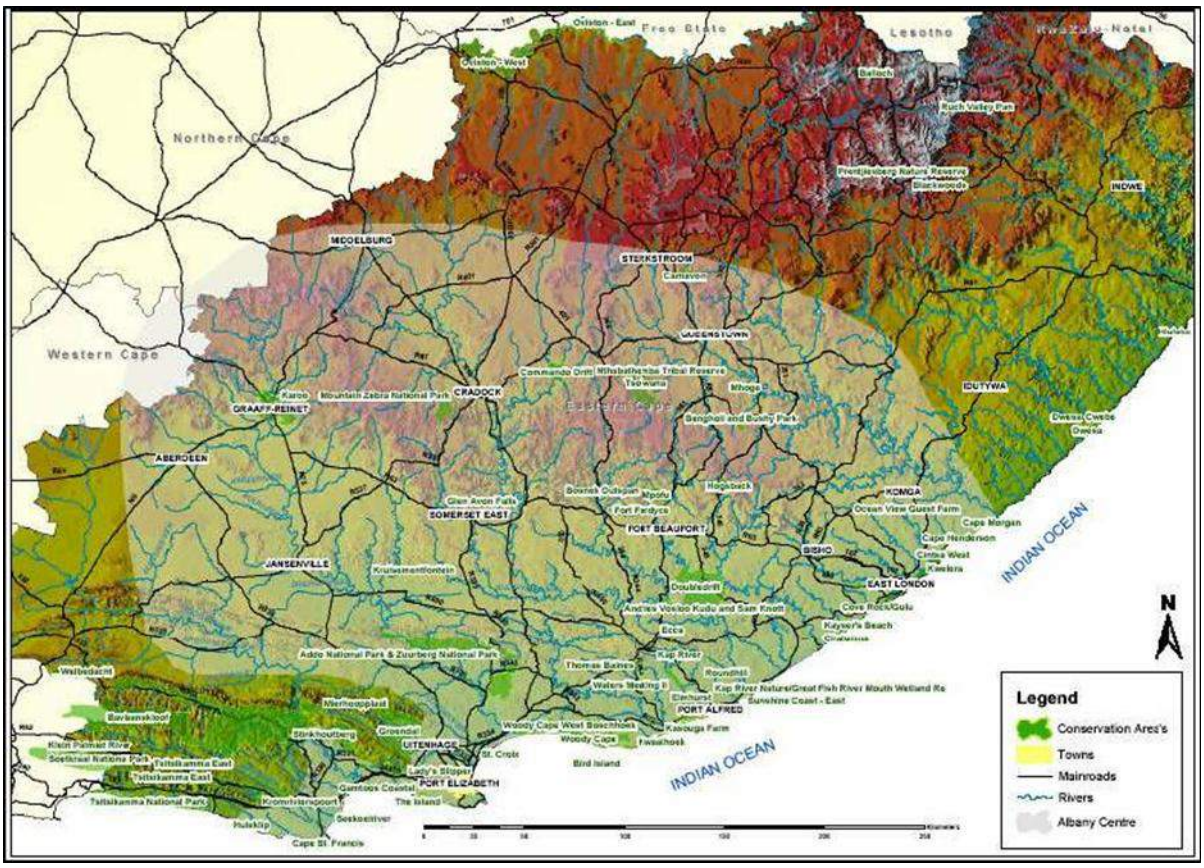

Figure 3.4: The Albany Centre of Endemism, also known as the 'Albany Hotspot', has long been recognised as an important centre of plant species diversity and endemism
(From van Wyk and Smith 2001).

3.6.1. Invasive and problematic species

Alien species recorded from the study site included *Echinopsis spachiana* (Schedule 1), *Eucalyptus grandis* (Schedule 2), *Agave americana* (Schedule 2), *Opuntia ficus-indica* (Schedule 1) and *Acacia mearnsii* (Schedule 2). (Plate 3-4). These invaders are required to be removed by law, as they are each Category 1: Declared Weeds or Category 2: Declared Invaders (The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983). The most recent legislation makes the following recommendations regarding Category 1 plants:

Plate 3.3: Some alien invasive species. A: *Echinopsis spachiana* (Schedule 1), B: *Eucalyptus grandis* (Schedule 2), C: *Agave americana* (Schedule 2), D: *Opuntia ficus-indica* (Schedule 1) and E: *Acacia mearnsii*(Schedule 2).

Combating of category 1 plants (section 15A)

1) Category 1 plants may not occur on any land or inland water surface other than in biological control reserves.

2) A land user shall control any category 1 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
3) No person shall, except in or for purposes of a biological control reserve –
    a. establish, plant, maintain, multiply or propagate category 1 plants;
    b. import or sell propagating material of category 1 plants or any category 1 plants;
    c. acquire propagating material of category 1 plants or any category 1 plants.
4) The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with the requirements of sub-regulation (1) on such conditions as the executive officer may determine in each case.

Combating of category 2 plants (Section 15B)

1) Category 2 plants may not occur on any land or inland water surface other than a demarcated area or a biological control reserve.
2)
    a. The executive officer may on application in writing demarcate an area as an area where category 2 plants may occur, be established and be maintained.
    b. An area in respect of which a water use license for stream flow reduction activities has been issued in terms of section 36 of the National Water Act, 1998 (Act No. 36 of 1998) shall be deemed to be a demarcated area.
3) The executive officer shall demarcate an area for the occurrence, establishment and maintenance of category 2 plants only if –
    a. the category 2 plants in the area are cultivated under controlled circumstances; and
    b. the land user concerned has been authorised to use water in terms of the National Water Act, 1998 (Act No. 36 of 1998); and
    c. the category 2 plants or products of category 2 plants in the area are demonstrated to primarily serve a commercial purpose, use as a woodlot, shelter belt, building material, animal fodder, soil stabilisation, medicinal or other beneficial function that the executive officer may approve; and
    d. all reasonable steps are taken to curtail the spreading of propagating material of the category 2 plants outside the demarcated areas.
4) When an area is demarcated for the occurrence, establishment and maintenance of category 2 plants the executive officer may impose such additional conditions as may reasonably be deemed necessary to keep the category 2 plants in the area in check.
5) No person shall sell propagating material of category 2 plants or any category 2 plants to another person unless such other person is a land user of a demarcated area or of a biological control reserve.
6) No person shall acquire propagating material of category 2 plants or any category 2 plants unless such material or such plants are intended for use in a demarcated area or in a biological control reserve.
7) Propagating material of category 2 plants or category 2 plants shall only be imported or sold in accordance with the provisions of the Plant Improvement Act, 1976 (Act No. 53 of 1976), the Agricultural Pests Act, 1983 (Act No. 36 of 1983) and the environment conservation regulations.
8) A land user shall control any category 2 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
9) Unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland.
10) The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with one or more of the requirements of sub-regulations (1), (3), (5), (6), (8) and (9) on such conditions as the executive officer may determine in each case.

3.6.2. Plant species of special concern

Species endemic to the area are described by Mucina and Rutherford (2006). In addition to the endemic taxa, there are also a number of species expected to be found in the study area, some of which are listed as protected by various conservation bodies. The list is not complete as many species and taxa require additional study. The taxa with many data deficient species include specifically the Mesembranthemaceae family, which Victor and Dold (2003) estimate would have 72 species that should, but do not, occur on the list. Thus all species of the family are included as Species of Special Concern (SSC). Victor and Dold (2003) also include a number of other taxa as important; including members of the Amaryllidaceae (Amaryllids), Iridaceae (Irises), Orchidaceae (Orchids) and Apocynaceae (Lianas), as well as members of the genus *Aloe*.

Potential Species of Special Concern (PSSC) include all those plants listed in terms of the IUCN, CITES and both national and provincial legislation that may occur in the area of study. If any of these species are found to occur on site, they are given the status of Confirmed Species of Special Concern (CSSC). Such a list will be produced in the EIA stage of the proposed development. The list of PSSC includes over 133 species which are listed individually by Victor and Dold (2003), the IUCN red data list, the South African National Biodiversity Institute (SANBI), the Forests Act and the Provincial Conservation Ordinance (PNCO) 16 of 1974 for the Eastern Cape. In addition, the PNCO lists eight plant families and six plant genera that are afforded blanket protection throughout the province.

Confirmed Species of Special Concern (CSSC) have been identified from the site visit (Table 3.1, Plate 3.4). These species have been identified as occurring on site and thus are given confirmed status. It is very likely that more SSC will be found on site in the construction phase of the development, should it go ahead.

Table 3.1: Species of Special Concern recorded from the site

Species name	Protection
Sideroxylon inerme	Forest Act (Protected trees)
Pelargonium reniforme	IUCN
Aloe africana	PNCO, CITES
Aristea abyssinica	PNCO
Aloe maculata	PNCO, CITES
Watsonia sp.	PNCO
Leucospermum cuneiforme	PNCO
Protea repens	PNCO
Bobartia orientalis	PNCO
Satyrium sp.	PNCO
Aloe ciliaris	PNCO, CITES
Aloe striata	PNCO, CITES
Moraea sp.	PNCO

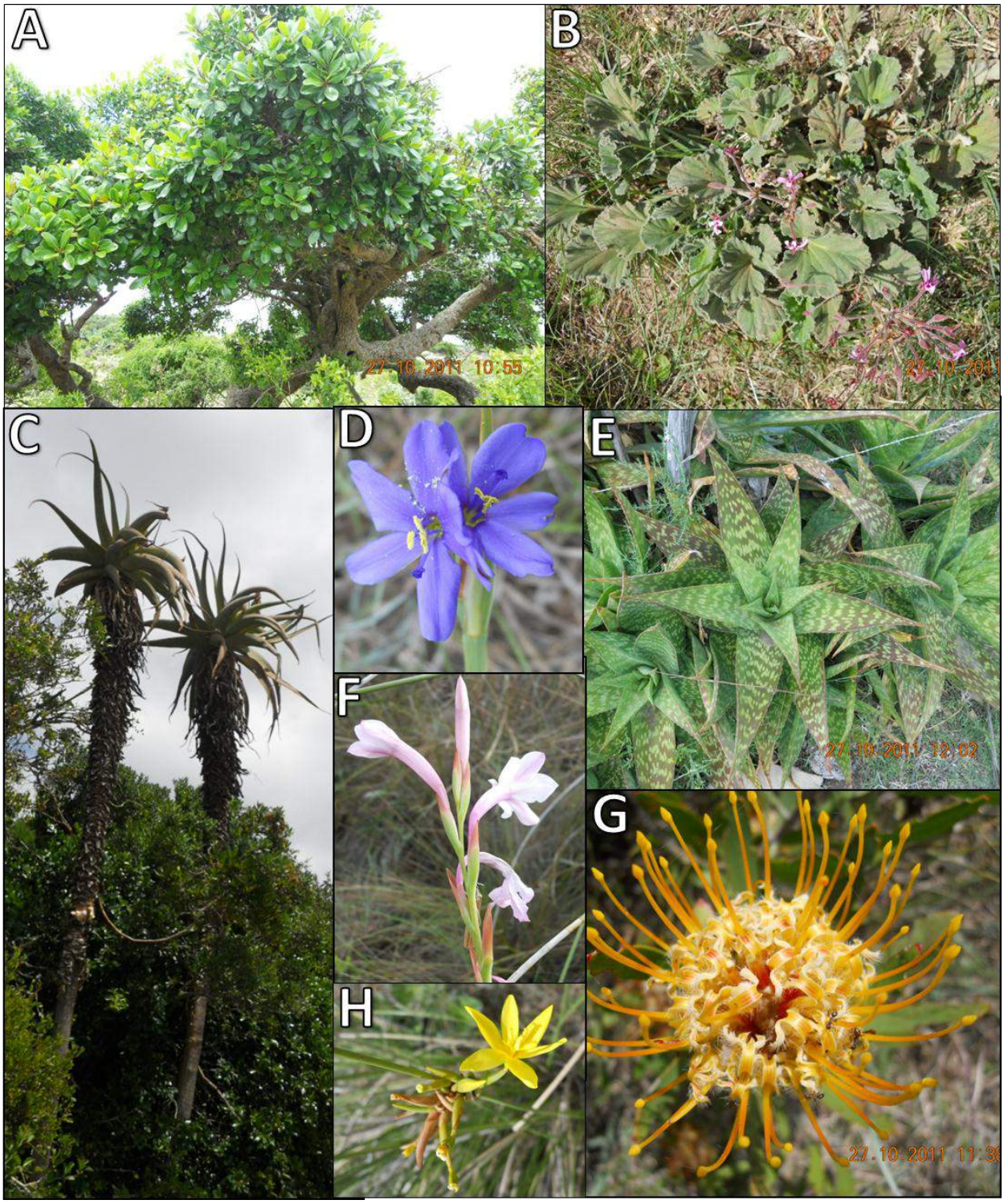

Plate 4.2: Confirmed Species of Special Concern (CSSC). A: *Sideroxylon inerme*(Forest Act), B: *Pelargonium reniforme* (IUCN), C: *Aloe africana* (PNCO, CITES), D: *Aristea abyssinica*(PNCO), E: *Aloe maculata* (PNCO, CITES), F: *Watsonia sp* (PNCO), G: *Leucospermum sp* (PNCO) and H: *Bobaria orientalis* (PNCO).

3.7. Animal species

Lack of pristine terrestrial habitat in the Grahamstown area, particularly due to loss of natural vegetation caused by infestation by alien invasive species as well as urban development, has impacted on terrestrial fauna. Despite this, a few large mammals occur in the region, along with small and medium sized animals. Reptile and amphibians occurring in the area include many species of frogs, tortoises and terrapins, lizards and snakes. Important mammals occurring in the

study area include 5 IUCN Red Data listed species.

Vertebrates

Amphibians and Reptiles

Over one hundred species of reptiles and amphibians occur on the Eastern and Southern Cape Coastal Belt (Branch, 1998). Most are generalists, and represent the transition from temperate to tropical fauna, some montane forms occur in the Cape Fold Mountains (Branch 1998).

Amphibians are an important and often neglected component of terrestrial vertebrate faunas. They are well represented in sub-Saharan Africa, from which approximately 600 species have been recorded (Frost 1985). Currently amphibians are of increasing scientific concern as global reports of declining amphibian populations continue to appear. Although there is no consensus on a single cause for this phenomenon, there is general agreement that the declines in many areas, even in pristine protected parks, are significant and do not represent simple cyclic events. Frogs have been aptly called bioindicator species, whose abundance and diversity is a poignant reflection of the general health and well-being of aquatic ecosystems. They are important components of wetland systems, particularly ephemeral systems from which fish are either excluded or of minor importance. In these habitats, they are dominant predators of invertebrates, many of which may impact significantly on humans (e.g. as vectors of disease).

A relatively rich amphibian fauna occurs in the Eastern and Southern Cape coastal region, where 27 species are found, only three of which are endemic (Branch 1998). A list of amphibian species possibly found in the proposed project area is provided in Table 4-2.

Table 4-2: Common species of frogs to be found in the proposed project site
Source: Branch 1998

Species	Common name	Notes
Pyxicephalusadspersus	Giant Bullfrog	Southern most limit is Port Elizabeth.
Bufopardalis	Leopard toad	Occur in gardens
Buforangeri	Raucous toad	
Hyperoliusmarmoratus	Painted reed frog	Occurs in wetter regions
Xenopuslaevis	Plantanna	Common, aquatic
*Strongylopus*sp.	Stream frogs	Common along river courses.
Rana sp.	River frogs	
*Cacosternum*sp.	Cacos	Common but rarely seen.
*Phrynobatrachus*sp.	Puddle frogs	
Kassinasenegalensis	Kassinas	
Semnodactyluswealei		

The Eastern Cape is home to 133 reptile species including 21 snakes, 27 lizards and eight chelonians (tortoises and turtles) (Branch 1998). Five species of land tortoises occur in the Eastern Cape, three of which occur within the coastal belt. The Eastern Cape has the richest diversity of land tortoises in the world. These three coastal belt species include the leopard tortoise (*Geochelonepardalis*), the angulate tortoise (*Chersinaangulata*) and the parrot-beaked tortoise (*Homopusareolatus*). All three of these tortoise species are listed on the CITES Appendix II list. The cape terrapin (*Pelomedusasubrufa*) is also found in the region (Branch 1998).

There are many lizard species that occur in the region, as shown in Table: 4-3.

Table 4-3: Lizard species occurring in Grahamstown and surrounding areas
Source: Branch 1998.

Species	Common name	Notes
Phyllodactyllusprophyreus	Marbled leaf-toed gecko	Translocated to Grahamstown from Cape Town and surrounds.
Hemidactylusmabouia	Tropical house gecko	Considered invasive in the Eastern Cape
Cordyluscordylus	Cape girdled lizard	CITES Appendix II listed
Acontiasmeleagris	Cape legless skink	
Acontiaspercivalitasmani	Tasman's legless skink	
Bradypodion ventral	Southern dwarf chameleon	CITES Appendix II listed
Varanusniloticus	Water monitor lizard	
Varanusalbigularis	Rock monitor lizard	

Over 30 species of snakes occur in the coastal region, of these, only six species are dangerous (Branch 1998). A list of snakes occurring in the region is provided in Table 4-4.

Table 4-4: Snake species that occur in the proposed project site.

Species	Common name	Notes
Lycophidioncapense	Wolf snake	
Psammophis crucifer	Cross-barred sand snake	
Lamprophisfuliginosus	Brown house snake	
Lamprophisinornatus	Olive house snake	
Pseudaspiscana	Large mole snake	
Philothamnusnatalensis	Water snake	
Philothamnushoplogaster	Water snake	
Lycodonomorphusrufulus	Olive water snake	
Crotaphopeltishotamboeia	Red-lipped snake	
Duberrialutrix	Slug eater	
Psammophisnotostictus	Karoo whip snake	
Psammophylaxrhombeatus	Rhombic skaapsteker	
Bitisarietans	Puff adder	Venomous
Bitisatropus	Berg adder	Venomous
Caususrhombeatus	Night adder	
Najanivea	Cape cobra	Venomous
Homoroselapslacteus	Harlequin snake	
Dispholidustypus	Boomslang	Venomous
Bitisalbanica	Albany dwarf adder	
Lamprophisfuscus	Yellow-bellied house snake	Rare (Red Data List)

Mammals

Large game makes up less than 15% of the mammal species in South Africa and a much smaller percentage in numbers and biomass. In developed and farming areas, this percentage is greatly reduced, with the vast majority of mammals present being small or medium-sized. Of the 62 mammal species known or expected to occur in the region, none are now considered endemic to the coastal region. Although historical records show that many large animals such as various antelope, elephants, hippopotamuses and lions did occur in the region, they no longer do (Perrin 1998). The conservation status of South African mammals has recently been re-assessed. The conservation status of some has been downgraded, with the African wild cat, Aardvark, Blue duiker, and Honey badger are no longer considered threatened. Table 4-6 lists mammal species whose distribution includes the project area and are considered Species of Special Concern (SSC).

Table 4-6: Mammal Species of Special Concern (SCC) with distributions that include the proposed project site.

Species	Common name	IUCN Status
Chlorotalpaduthieae	Duthie's golden mole	Vulnerable
Eidolon helvum	Straw-coloured fruit bat	Near Threatened
Miniopterusschreibersi	Schreiber's long-fingered bat	Near Threatened
Felisnigripes	Black-footed cat	Vulnerable
Equus zebra	Mountain zebra	Vulnerable

Animal species of special concern

The following reptile species which are relevant to the proposed project site are of conservation concern:

- Endemic and Endangered
  - Albany dwarf adder (*Bitisalbanica)*
- IUCN Red Data Species
  - Southern dwarf chameleon (*Bradypodionventrale*)
  - Cape girdled lizard (*Cordyluscordylus)*
  - Leopard or Mountain Tortoise (*Geochelonepardalis*),
  - Angulate Tortoise (*Chersinaangulata*), and
  - Parrot-beaked tortoise (*Homopusareolatus*)
  - Yellow-bellied house snake *(Lamprophisfuscus)*

The following mammals which may occur in the proposed project area are of conservation concern (IUCN):

- Black-footed Cat (*Felisnigripes*)
- Duthie's golden mole (*Chlorotalpaduthieae*)
- Straw-coloured fruit bat (*Eidolon helvum*)
- Schreiber's long-fingered bat (*Miniopterusschreibersi*)
- Mountain zebra (*Equus zebra*)

4. CONSERVATION AND PLANNING TOOLS

Several conservation planning tools are available for the area. These tools allow for the determination of any sensitive and important areas from a vegetation and faunal point of view at the scoping stage of a development. They allow for the fine-tuning of plans and turbine layouts with a view to reducing potential environmental impacts at the planning stage of the development. The tools used are outlined in Table 4.8 below.

Table 4.8: Conservation and planning tools considered for the proposed Grahamstown Wind Energy Project

Tool	Motivation	Relevancy	Figure	Notes
Important Bird Area (IBA)	Important Bird Areas are globally recognized areas essential for the protection of bird species. In order to be classified as an IBA, an area must contain Globally threatened species, restricted range species, biome restricted species or congregations of species.	A separate avifauna impact assessment determines the impacts on birds.	none	A separate avifauna impact assessment determines the impacts of the proposed facility on Birds.
STEP	The Subtropical Thicket Ecosystem Planning Project maps vegetation and assigns each of these a conservation criterion. It is very important in determining sensitivity.	Very relevant	none	The area of the proposed wind energy facility falls into one STEP category: Least Threatened. The planning tools of STEP are described below.
ECBCP CBAs	The Eastern Cape Biodiversity Conservation Plan Critical Biodiversity Areas determines areas in terms of management classes.	Relevant, the proposed project area occurs in a CBA2	Figure 4.1	CBAs and their relevance to the project are described below.
Protected Areas Expansion Strategy	The objective of the PAES is to form an overarching strategic framework for a protected area network that 'conserves a comprehensive, representative and adequate sample of biodiversity and maintains key ecological processes across the landscape	Low relevancy, the project area does not occur close to any areas earmarked for expansion.	Figure 4.2	

	and seascape.' The areas earmarked by this study should be protected.			
Protected Areas	Protected areas are areas that are already conserved. Areas in close proximity to the proposed development may be affected by the development and thus must be taken into account.	Low relevancy, the closest formal protected area is over 20kms away.	Figure 4.2	

4.1. Subtropical Thicket Ecosystem Planning (STEP) Project

The STEP Project covers the south-eastern Cape region, which extends from the Kei River to Riversdale. The project area covers the unique, indigenous vegetation type known as thicket, with the aim being to assess the region's biodiversity. The assessment measured how much of the thicket vegetation had been damaged or destroyed through anthropogenic impacts and determined the degree to which biodiversity is endangered in different areas. The project aims to guide the necessary but destructive development away from areas of endangered biodiversity and promote sustainable land use.
In terms of STEP (2004), a feature that has much more extant habitat than is needed to meet its target, is considered Currently Not Vulnerable OR Least Threatened (Table 4.2).

For Currently Not Vulnerable vegetation, STEP recommends three Land use management procedures, these include:

1. Proposed disturbance or developments should preferably take place on portions which have already undergone disturbance or impacts rather than on portions that are undisturbed or unspoilt by impacts.
2. In response to an application for a non-listed activity which will have severe or large-scale disturbance on a relatively undisturbed site (unspoilt by impacts), the Municipality should first seek the opinion of the local conservation authority.
3. For a proposed "listed activity", EIA 2.1 authorisation is required by law.

From a Spatial planning (forward planning – Spatial Development Framework (SDF's)) point of view, for Currently Not Vulnerable vegetation, STEP presents two restrictions and gives examples of opportunities. The two spatial planning restrictions are as follows:

1. Proposed disturbance or developments should preferably take place on portions which have already undergone disturbance or impacts rather than on portions that are undisturbed.
2. In general, Class IV land can withstand loss of disturbance to natural areas through human activities and developments.

Opportunities depend on constraints (such as avoidance of spoiling scenery or wilderness, or infra-structure limitations) Class IV land can withstand loss of, or disturbance to, natural areas. Within the constraints, this class may be suitable for a wide range of activities (e.g. extensive urban development, cultivation, tourist accommodation, ecotourism and game faming).

Table 4.2: Summary of the STEP Project conservation priorities, classifications and general rules
Source: Pierce, 2003

Conservation priority	Classification	Brief Description	General Rule

Conservation priority	Classification	Brief Description	General Rule
IV	Currently not vulnerable area	Ecosystems which cover most of their original extent and which are mostly intact, healthy and functioning	Depending on other factors, this land can withstand loss of natural area through disturbance or development
III	Vulnerable area	Ecosystems which cover much of their original extent but where further disturbance or destruction could harm their health and functioning	This land can withstand limited loss of area through disturbance or development
II	Endangered area	Ecosystems whose original extent has been severely reduced, and whose health, functioning and existence is endangered	This land can withstand minimal loss of natural area through disturbance or development
I Highest Priority	Critically endangered area	Ecosystems whose original extent has been so reduced that they are under threat of collapse or disappearance. Included here are special ecosystems such as wetlands and natural forests	This Class I land can NOT withstand loss of natural area through disturbance or development. Any further impacts on these areas must be avoided. Only biodiversity-friendly activities must be permitted.
High Priority	Network Area	A system of natural pathways e.g. for plants and animals, which if safeguarded, will ensure not only their existence, but also their future survival.	Land in Network can only withstand minimal loss of natural area through disturbance and developments
Highest Priority	Process Area	Area where selected natural processes function e.g. river courses, including their streams and riverbanks, interfaces between solid thicket and other vegetation types and sand corridors	Process area can NOT withstand loss of natural area through disturbance and developments
	Municipal reserve, nature reserve, national parks	Protected areas managed for nature conservation by local authorities, province or SA National Parks	No loss of natural areas and no further impacts allowed
Dependant on degree on existing impacts	Impacted Area	Areas severely disturbed or destroyed by human activities, including cultivation, urban development and rural settlements, mines and quarries, forestry plantations and severe overgrazing in solid thicket.	Ability for this land to endure further disturbance of loss of natural area will depend on the land's classification before impacts, and the position, type and severity of the impacts

4.2. Land use and the Eastern Cape Biodiversity Conservation Plan (ECBCP)

The Eastern Cape Biodiversity Conservation Plan (ECBCP) is responsible for mapping areas that are priorities for conservation in the province, as well as assigning land use categories to the existing land depending on the state that it is in (Berliner et al. 2007).

Critical Biodiversity Areas (CBA) are defined by Berliner et al. (2007) as:"CBAs are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning". Biodiversity Land Management Classes (BLMCs) are also used in the plan: "Each BLMC sets out the desired ecological state that an area should be kept in to ensure biodiversity persistence. For example, BLMC 1 refers to areas which are critical for biodiversity persistence and ecosystem functioning, and which should be kept in as natural a condition as possible". Table 4.8 shows how the BLMCs relate to the CBAs.

Table 4.8: Terrestrial Critical biodiversity Areas and Biodiversity Land Management Classes as described by the Eastern Cape Biodiversity Conservation Plan.

CBA map category	Code	BLMC	
Terrestrial CBAs and BLMCs:			
Protected areas	PA1	BLMC 1	Natural landscapes
	PA2		
Terrestrial CBA 1 (not degraded)	T1		
Terrestrial CBA 1 (degraded)	T1	BLMC 2	Near-natural landscapes
Terrestrial CBA 2	T2		
	C1		
	C2		
Other natural areas	ONA T3	BLMC 3	Functional landscapes
	ONA		
Transformed areas	TF	BLMC 4	Transformed landscapes

Table 4.9: Terrestrial BLMCs and Land Use Objectives (source: Berliner et al. 2007)

BLMC	Recommended land use objective
BLMC 1: Natural landscapes	Maintain biodiversity in as natural state as possible. Manage for no biodiversity loss.
BLMC 2: Near natural landscapes	Maintain biodiversity in near natural state with minimal loss of ecosystem integrity. No transformation of natural habitat should be permitted.
BLMC 3: Functional landscapes	Manage for sustainable development, keeping natural habitat intact in wetlands (including wwtalnd buffers) and riparian zones. Environmental authorisations should support ecosystem integrity.
BLMC 4: Transformed landscapes	Manage for sustainable development.

Ten principles of land use planning for biodiversity persistence

1. Avoid land use that results in vegetation loss in critical biodiversity areas.
2. Maintain large intact natural patches – try to minimise habitat fragmentation in critical biodiversity areas.
3. Maintain landscape connections (ecological corridors) that connect critical biodiversity areas.
4. Maintain ecological processes at all scales, and avoid or compensate for any effects of land uses on ecological processes.
5. Plan for long-term change and unexpected events, in particular those predicted for global climate change.
6. Plan for cumulative impacts and knock-on effects.
7. Minimise the introduction and spread of non-native species.
8. Minimize land use types that reduce ecological resilience (ability to adapt to change), particularly at the level of water catchments.
9. Implement land use and land management practices that are compatible with the natural potential of the area.
10. Balance opportunity for human and economic development with the requirements for biodiversity persistence.

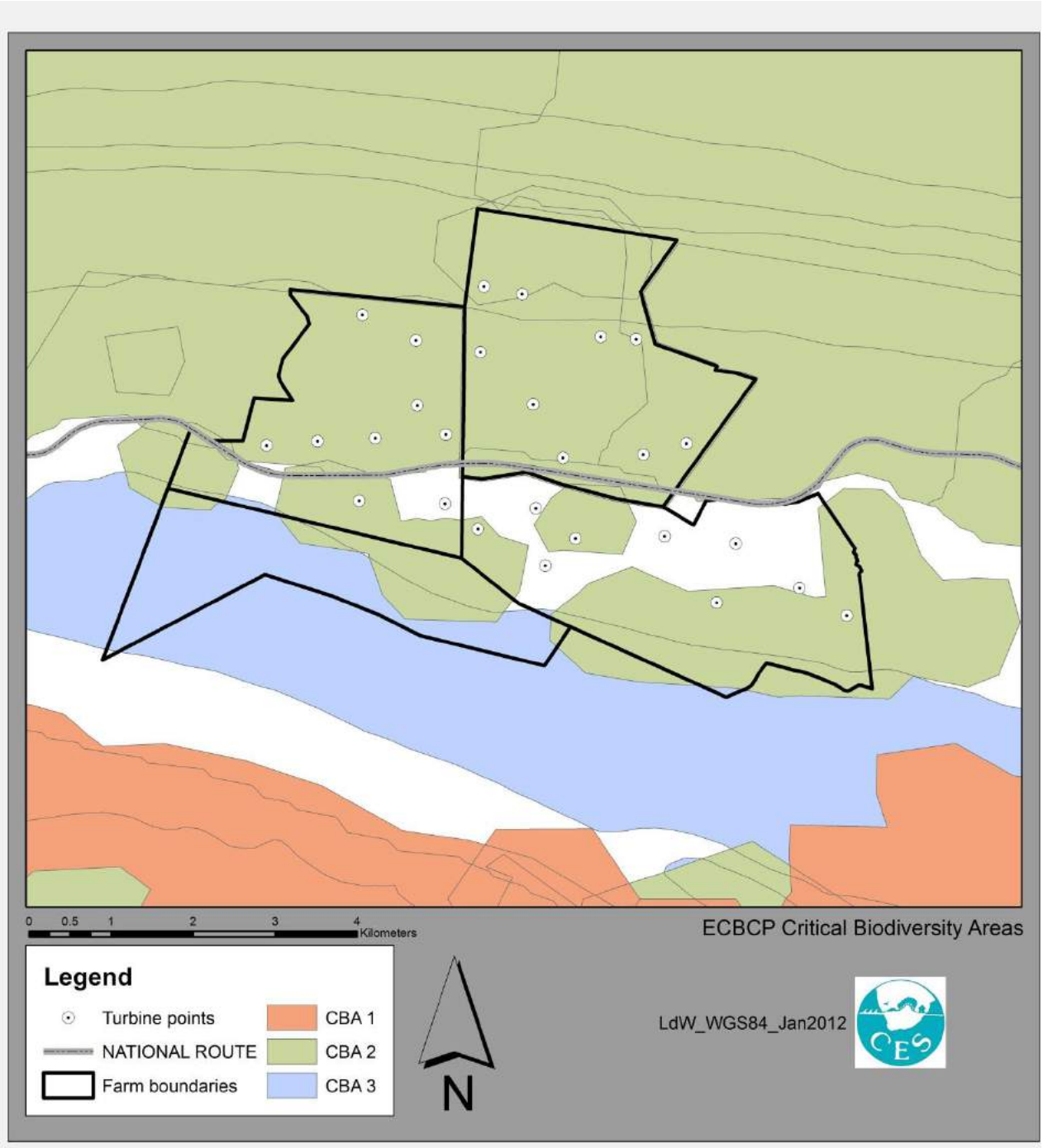

Figure 4.1: Eastern Cape Biodiversity Conservation Plan (ECBCP) map indicating Critical Biodiversity Areas (CBAs) in relation to the proposed wind energy project.

4.3. Protected areas expansion strategy

A National Spatial Biodiversity Assessment was conducted in 2004, revealing a lack of protection for a representative sample of the country's biodiversity, nor conserving adequate process areas. The Protected Areas Expansion Strategy allows for increased conservation of these aspects of the country in order to meet national biodiversity targets. The strategy outlines two methods of expanding the current National Protected Areas:

- For public land, the declaration of available, under-utilised and strategic parcels of public land in concordance with the relevant legal requirements for disposal of such land;
- For private land, contractual agreements with the affected landowners.

Areas earmarked for expansion should not be developed as they could constitute National Parks in the future.

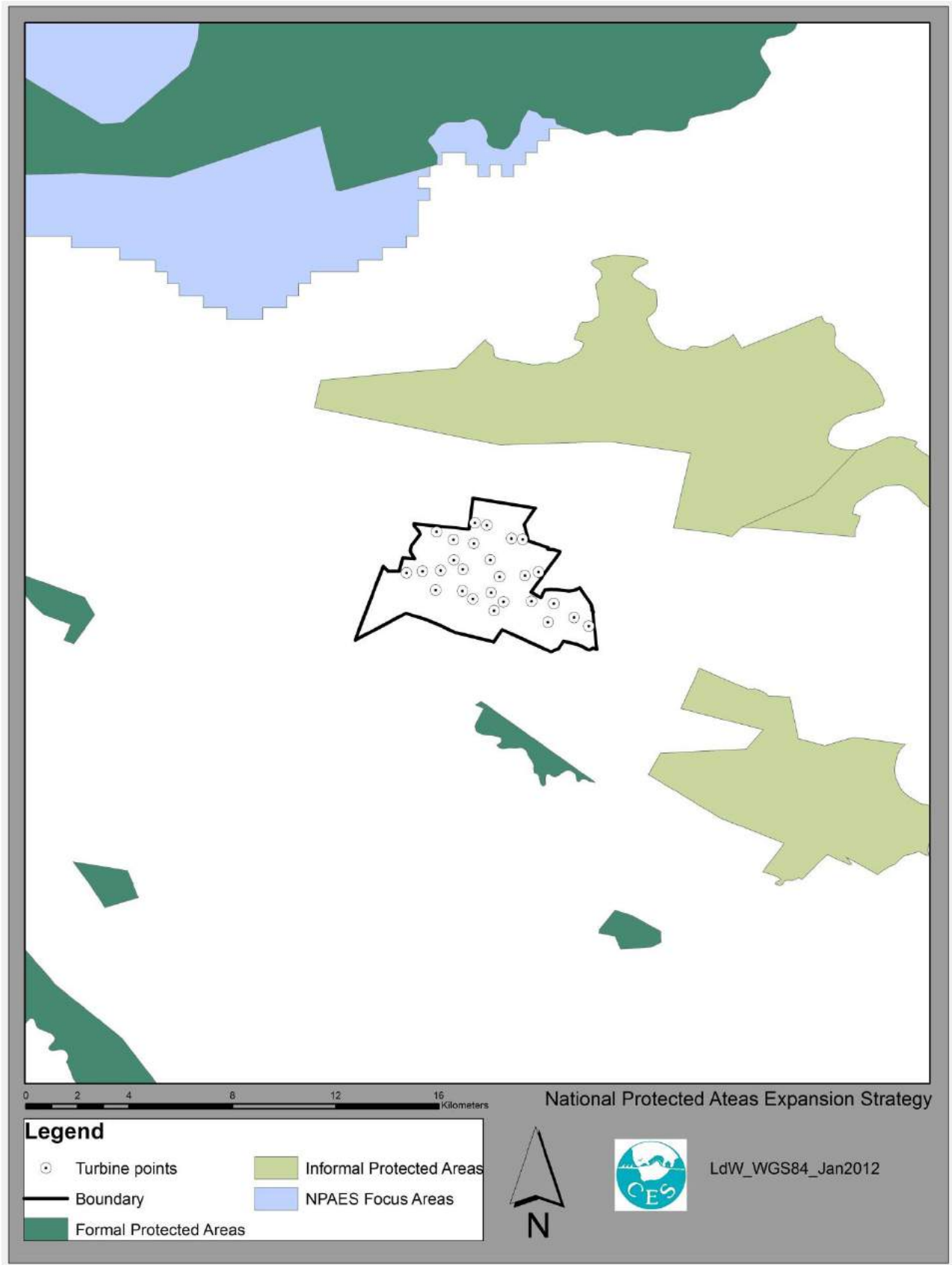

Figure 4.2: Protected areas and National Protected Area Expansion Strategy (NPAES) focus areas in the vicinity of the proposed development.

5. SENSITIVITY

5.1. Features on conservation concern

Wetlands and rivers constitute features of conservation concern as they are process areas. They are essential for ecosystem function and process and provide niche habitats for a variety of plants and animals.

Steep slopes and **rocky areas** also constitute important features for conservation concern as they provide areas that are difficult to rehabilitate and are easily affected by changes in land use, with erosion being an important impact factor.

5.2. Sensitivity

The sensitivity map was developed by identifying areas of high, low and medium areas of sensitivity (Figure 5.1). Areas of **high sensitivity** include process areas such as rivers, wetlands and streams that are important for ecosystem functioning including surface and ground water as well as animal and plant dispersal. High sensitivity is also given to areas that have high species richness and are not hugely impacted by current land use and are not degraded. High sensitivity areas also contain the majority of species of special concern found in the area. **Medium sensitivity** is given to areas that, despite being somewhat degraded, still provide a valuable contribution to biodiversity and ecosystem functioning as they are not very degraded and have a relatively high species richness, these areas may also contain species of special concern. **Low sensitivity** is given to areas that are highly impacted by current land use and thus highly degraded and provide no value to the ecosystem and are highly unlikely to harbour any species of special concern.

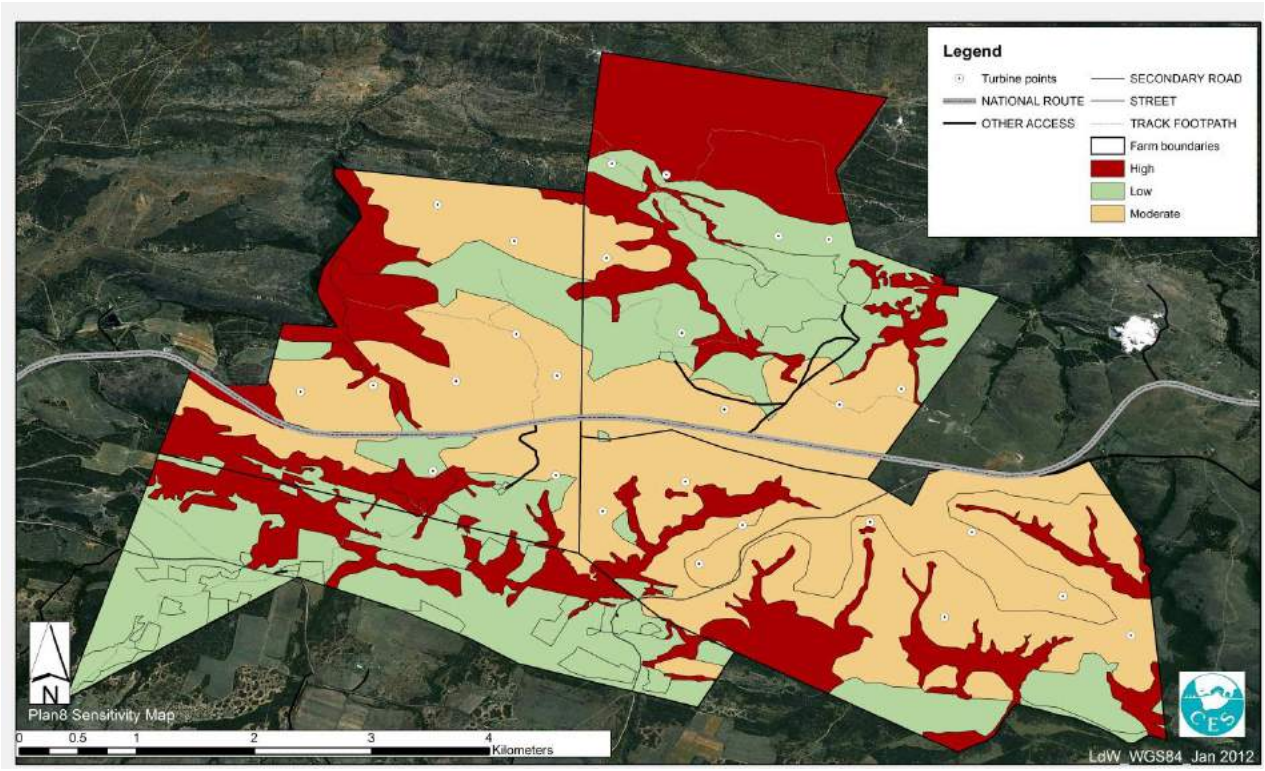

Figure 5.1: Sensitivity map of the study area.

6. IMPACTS IDENTIFIED AND ASSESSED

There are several issues that will arise as a result of the proposed project, these include:

Issue 1 - Loss of vegetation communities: this includes the loss of each of the vegetation community types identified on the site, as a result of the clearing of the land for construction. This issue describes only the direct loss of the vegetation communities and no associated loss of animal nor plant species of special concern, nor the effect on ecosystem functioning or the loss of habitats.

Issue 2 - Loss of species of special concern and biodiversity: this includes loss of both animal and plant species of special concern over the entire site, including all vegetation community types. It also encompasses the loss of biodiversity as a whole, which includes all species that occur on site taking into account their contribution to the biodiversity of the surrounding area and within the site.

Issue 3 - Disruption of ecosystem function and process: this includes the impacts on process areas, and those areas important to ecosystem function either being completely eliminated by the proposed development, or secondary impacts on these systems as a result of the proposed development. This issue encompasses the effect of the inevitable introduction of alien vegetation on the site and the impact of edge effects; the change in vegetation as a result of large-scale clearing and exposing relatively undisturbed areas to transformation.

The study we have undertaken provides the necessary information for us to assess the impacts of the proposed project on the vegetation and the flora at various relevant spatial and temporal scales. The individual impacts can be grouped together as a series of key environmental issues. All of the issues relate to the removal of the existing vegetation cover within the footprint area of the wind turbines. At the spatial scale of the wind energy facility footprint, the impacts described below will not be considerable, but nonetheless these need to be seen in the context of the study area as a whole or at still larger spatial scale. Impacts of the current land use are taken into account in order to provide a comparison between wind energy facility impacts and those that are already occurring. Associated impacts on the broader study area caused by the associated development of infrastructure such as transport routes, and by secondary impacts due to human factors, are not considered in this report.

Impacts are assessed based on current turbine layouts. Should the layout change, the impacts and associated mitigation measures, will need to be revisited.

Impacts of the wind energy facility

ISSUE 1: Loss of vegetation communities

Construction of the wind farm will result in loss of a small amount of vegetation on the site. This loss will occur as a result of trampling of the vegetation as well as extra clearing needed for construction. Mitigation measures can be used in order to reduce the trampling and rehabilitate the vegetation respectively.

If nothing were built on the site, the overall significance would be negative. This would be due to the continuation of the current land use, grazing, which is already having a negative impact on the vegetation of the site.

Mitigation and management

Mitigation measures include the following: Keep removal of vegetation to a minimum. Do not remove vegetation in areas set aside for conservation within the site (should an area be set aside for conservation, this is recommended).

Impact 1: Loss of Degraded Thicket

Five turbines occur in this vegetation type, with two bordering very closely on this vegetation type. It is considered a low sensitivity area due to its degraded nature and, as turbine footprints are small; impacts are low.

Without mitigation:
In the construction phase of this development, the impact will be permanent, localised, may occur and will be a slight severity. The overall Significance of the impact will thus be a low negative. This impact was assessed with a high level of confidence.

With mitigation:
With mitigation, in the construction phase of the development, the impact is remains an overall significance of low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Permanent	Localised	Slight	May occur	**LOW -**
With mitigation	Permanent	Localised	Slight	Slight	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 2: Loss of Fynbos

Four turbines occur in this vegetation type, with one bordering very closely on this vegetation type. It is considered a medium sensitivity area due to the presence of species of special concern, as turbine footprints are small; impacts are relatively low.

Without mitigation:
In the construction phase of this development, the impact will be permanent, localised, may occur and will be a slight severity. The overall Significance of the impact will thus be a low negative. This impact was assessed with a high level of confidence.

With mitigation:
With mitigation, in the construction phase of the development, the impact is remains an overall significance of low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Permanent	Localised	Slight	May occur	**LOW -**
With mitigation	Permanent	Localised	Slight	Slight	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					

Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 3: Loss of Fynbos, thicket, karoo mosaic

Sixteen turbines occur in this vegetation type, with two bordering very closely on this vegetation type. It is considered a low sensitivity area due to the level of degradation due primarily to overgrazing, but also, to a lesser extent, to the invasion by alien species. As turbine footprints are small; impacts are relatively low.

Without mitigation:
In the construction phase of this development, the impact will be permanent, localised, may occur and will be a slight severity. The overall Significance of the impact will thus be a low negative. This impact was assessed with a high level of confidence.

With mitigation:
With mitigation, in the construction phase of the development, the impact is remains an overall significance of low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Permanent	Localised	Slight	May occur	**LOW -**
With mitigation	Permanent	Localised	Slight	Slight	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 4: Loss of Rocky Fynbos

No turbines are situated in this vegetation type; this impact is thus not applicable.

Impact 5: Loss of Thicket

No turbines are situated in this vegetation type; this impact is thus not applicable.

Impact 6: Loss of Thicket Mosaic

One turbine occurs in this vegetation type. It is considered a high sensitivity area due to the numbers of species of special concern occurring here. As turbine footprints are small; impacts are low.

Without mitigation:
In the construction phase of this development, the impact will be permanent, localised, may occur and will be a slight severity. The overall Significance of the impact will thus be a low negative. This impact was assessed with a high level of confidence.

With mitigation:

With mitigation, in the construction phase of the development, the impact is remains an overall significance of low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Permanent	Localised	Slight	May occur	**LOW -**
With mitigation	Permanent	Localised	Slight	Slight	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

ISSUE 2: Loss of species of special concern and biodiversity (general)

Impact 7: Loss of plant species of special concern

Cause and Comment

There are, on the study site, thirteen species of special concern. There may be many additional species of special concern that will be found on site during construction that were not found during this study. These should be relocated of they need to be removed, and the required permits obtained in order to do so.

If nothing was built on the site the overall impact would be negative. This would be due to the continuation of the current land use, grazing.

Mitigation and management

It is recommended that areas containing species of special concern be noted and every effort made to reduce the impacts of construction on these sections of vegetation. SSC in any area to be cleared should be identified and rescued. Some SSC will not transplant. These individuals should, as far as possible, be left untouched.

Without mitigation:

Without mitigation in the construction phase of the project the impact will be restricted to the study area, long term and definite with a moderate impact, resulting in an overall significance of high negative. This impact was assessed with a high level of confidence.

With mitigation:

With mitigation the severity of the impact is decreased from moderate to slight and the risk from definite to probable, reducing the overall significance of the impact to low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Long term	Study area	Moderate	Definite	**HIGH -**
With mitigation	Long term	Study area	Slight	Probable	**LOW -**
Operation phase					

Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 8: Loss of animal species of special concern

Cause and Comment
There are a number of species of special concern that occur within the study site. This development is unlikely to affect any of these as few are restricted to the site specifically. For the No-Go option, the impact will be negative. This would be due to the continuation of the current land use.

Mitigation and management
If any fencing is to be done; the fences should have enough space between wires for small animals to move across them uninhibited. Workers should also be educated on conservation and should not be allowed to trap animals on site.

Without mitigation:
Without mitigation in the construction phase of the development, the impact will be long term, restricted to the study area and may occur with a slight severity and an overall significance of low negative. This impact was assessed with a high level of confidence.

With mitigation:
Mitigation measures reduce the risk to unlikely, but the overall significance remains a low negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Long term	Study area	Slight	May occur	**LOW -**
With mitigation	Long term	Study area	Slight	Unlikely	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 9: Loss of biodiversity

Cause and Comment
This will occur as a result of the loss of some of the vegetation on site. Species other than just species of special concern will be affected; both floral and faunal. For the No-Go option, the impact will be negative. This would be due to the continuation of the current land use.

Mitigation and management
An area within the site that can be set aside for conservation and actively managed as a corridor area would be ideal to mitigate loss of biodiversity. It is recommended that as much as possible of the high sensitivity areas be set aside as conservation areas and be managed as such by the land owners and wind farm developers.

Without mitigation:
Without mitigation in the construction phase of the development, the impact will be permanent, restricted to the study area and may occur with a moderate severity and an overall significance of moderate negative. This impact was assessed with a high level of confidence.

With mitigation:
Mitigation measures reduce the risk to unlikely and the severity to slight, reducing the overall significance to negative.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Permanent	Study area	Moderate	May occur	**MODERATE -**
With mitigation	Permanent	Study area	Slight	Unlikely	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Moderate	Probable	**MODERATE -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

ISSUE 3: Disruption of ecosystem function and process

Cause and comment

The habitats that exist in the project area, together with those of the surrounding area that are linked, form part of a functional ecosystem. An ecosystem provides more than simply a 'home' for a set of organisms, and can be viewed as an arena where biological and biophysical processes such as nutrient cycling, soil formation, reproduction, migration, competition, predation, succession, evolution and migration take place. Destruction or modification of habitats causes disruption of ecosystem function, and threatens the interplay of processes that ensure environmental health and the survival of individual species. This issue deals with a collection of complex ecological impacts that are almost impossible to predict with certainty, but which are nonetheless important.

Fragmentation is one of the most important impacts on vegetation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. In terms of current land use, this impact occurs when large areas are cleared for agriculture or large areas of vegetation are overgrazed.

The removal of existing vegetation creates 'open' habitats that will inevitably be colonised by pioneer plant and animal species. While this is part of a natural process of regeneration, which would ultimately lead to the re-establishment of a secondary vegetation cover, it also favours the establishment of undesirable species in the area. These species are introduced along transport lines, by the transportation into the area of goods and equipment, and by human and animal movements in the area. Once established, these species are typically very difficult to eradicate and may then pose a threat to the neighbouring ecosystem. This impact is likely to be exacerbated by careless management of the site and its facilities, e.g. organic waste disposal and inadequate monitoring. Many such species are, however, remarkably tenacious once they have become established.

Impact 10: Fragmentation of vegetation and edge effects

Cause and Comment
This impact is unlikely to occur if the development is managed effectively. Considering the nature of wind turbines, it is unlikely that fragmentation will occur if the natural vegetation is left beneath them and the building of roads kept to a minimum.

Mitigation and management
As mentioned above, fragmentation is unlikely to occur due to the nature of the development. However, it is important to make sure all fences have wide enough mesh to let small animals through, and that large areas of vegetation are not cleared, especially for roads.

For the No-Go option, the impact will be negative. This would be due to the continuation of the current land use.

Without mitigation:
Without mitigation the impact will be unlikely, in the long term and restricted to the study area and slight. Overall significance will be a low negative.

With mitigation:
With mitigation the temporal scale would be reduced from long term to short term, thus the overall significance remains a low negative. This impact was assessed with a high level of confidence.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Long term	Study area	Slight	Unlikely	**LOW -**
With mitigation	Short term	Study area	Slight	Unlikely	**LOW -**
Operation phase					
Without mitigation	N/A	N/A	N/A	N/A	**N/A**
With mitigation	N/A	N/A	N/A	N/A	**N/A**
No-Go					
Without mitigation	Long term	Study area	Slight	Unlikely	**LOW -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 11: Invasion of alien species

Cause and Comment
As with all building operations, the introduction of alien and invader species is inevitable; with disturbance comes the influx of aliens. Alien invader species need to be consistently managed over the entire operation phase of the project.

Mitigation and management
Mitigation measures to reduce the impact of the introduction of alien invaders, as well as mitigation against alien invaders that have already been recorded on the site should be actively maintained throughout both the construction and operation phases. Removal of existing alien species should be consistently done. Also, rehabilitation of disturbed areas after the construction of the wind energy facility should be done as soon as possible after construction is completed. Invasive plant species are most likely to enter the site carried in the form of seeds by construction vehicles and staff; these should be cleaned before entering the site to prevent alien infestation.

Without mitigation:
In the construction phase of the development, the impact will be short-term, restricted to the study

area and definite, with a severe severity. The impact will have an overall significance of moderate negative. In the operation phase of the project, the impact will be permanent, restricted to the study area, definite and with a severe severity. Overall significance would be a high negative. Should the proposed development not go ahead (the No-Go option), the impact would be permanent, definite and restricted to the study area with a severity of moderate and an overall significance of high negative. This impact was assessed with a high level of confidence.

With mitigation:
In the construction phase of development, mitigation measures will result in an overall positive impact. For the operation phase of development; mitigation measures will result in an overall positive impact.

Significance statement

Impact	Effect			Risk or Likelihood	Total Score
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction phase					
Without mitigation	Short term	Study area	Severe	Definite	**MODERATE -**
With mitigation	Short term	Study area	Moderately beneficial	Definite	**MODERATE +**
Operation phase					
Without mitigation	Permanent	Study area	Severe	Definite	**HIGH -**
With mitigation	Permanent	Study area	Moderately beneficial	Definite	**MODERATE +**
No-Go					
Without mitigation	Permanent	Study area	Moderate	Definite	**HIGH -**
With mitigation	N/A	N/A	N/A	N/A	**N/A**

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Current status

The vegetation on the proposed wind energy facility site is mostly in fair condition. There are a few invader species along with some degraded vegetation, both of which could potentially result in further degradation of the site in the future. There is a danger of overgrazing and alien invasion becoming a serious problem. There are a number of plant species of special concern, and a high species diversity, which indicate an ecosystem that may still be restored.

7.2. Comparison of impacts

Because of the very nature of a wind farm, it is suspected that many of the impacts will be reduced with effective management of the site as well as the utilization of rehabilitation after construction. For the plant species of special concern, it is recommended that any of these species are identified and rescued before building commences.

In addition to this, any extra land needed for the construction phase of the development that will not be used during the operation phase of the development should be rehabilitated after construction is completed. Table 7.1 below outlines the impacts.

Overall, the impacts of the overall development will be negative, mainly due to a loss of vegetation. This loss of vegetation is also important for fauna as it constitutes habitat loss. Positive impacts include the active management of the alien vegetation on the site.

Table 7.1: Summary table of all 11 impacts on flora and vegetation and fauna in the proposed Grahamstown wind energy facility site .

Impacts	Without mitigation			With mitigation		
	Construction phase	Operation phase	No-Go	Construction phase	Operation phase	No-Go
ISSUE 1: Loss of vegetation communities						
1: Loss of Degraded thicket	LOW -	N/A	MOD -	LOW -	N/A	N/A
2: Loss of Fynbos	LOW -	N/A	MOD -	LOW -	N/A	N/A
3: Loss of Fynbos, thicket, karoo mosaic	LOW -	N/A	MOD -	LOW -	N/A	N/A
4: Loss of rocky fynbos	N/A	N/A	N/A	N/A	N/A	N/A
5: Loss of Thicket	N/A	N/A	N/A	N/A	N/A	N/A
6: Loss of Thicket mosaic	LOW -	N/A	MOD -	LOW -	N/A	N/A
ISSUE 2: Loss of Species of Special Concern (SSC) and Biodiversity (general)						
7: Loss of plant SSC	HIGH -	N/A	MOD -	LOW -	N/A	N/A
8: Loss of animal SSC	LOW -	N/A	MOD -	LOW -	N/A	N/A
9: Loss of Biodiversity	MOD -	N/A	MOD -	LOW -	N/A	N/A
ISSUE 3: Disruption of ecosystem function and process						
10: Fragmentation of vegetation and edge effects	LOW -	N/A	LOW -	LOW -	N/A	N/A
11: Invasion of alien species	MOD -	HIGH -	HIGH -	MOD +	MOD +	N/A

7.3. Plant removal\rehabilitation

It is recommended that a botanist/ecologist is on site to determine if any of the species of special concern or protected species occurs where the turbines and associated infrastructure are positioned. Before the clearing of the site is authorised, the appropriate permission must be obtained from the Department of Water Affairs (DWA) for plants listed in the National Forests Act, and from the Department of Economic Development and Environmental Affairs (DEDEA) for the destruction of the Provincial Nature Conservation Ordinance (PNCO) Schedule 4 protected species.

In order to acquire a permit to destroy or remove plant species that fall under the National Forest Act an application form will need to be submitted to DWA. A letter needs to be drafted and sent to DEDEA prior to the destruction\removal of any PNCO Schedule 4 species: This letter must list the species that will be removed or destroyed and the reason for their removal or destruction.

These permits may be subject to certain conditions, for example allowing various nurseries to collect plants before vegetation clearance commences; the removal of certain species for rehabilitation purposes, etc. The plants can also be removed and placed a nursery for use in rehabilitation purposes. If a species is identified for relocation, individuals of the species will need to be located within the proposed site, before vegetation clearing commences, and carefully uprooted and removed by a skilled horticulturist. Prior to removal, however, suitable relocation areas need to be identified, either within the site or in other disturbed areas on the property. Individual plants that cannot be relocated at the time of removal should be moved to the nursery. It should be noted that many critical SSC are plants that will not be able to be successfully uprooted and replanted at all (Phillipson, 2002), or at best may have a low survival rate. In all cases the species will require very careful treatment to give them the best chances of survival, and specialist horticultural knowledge will be needed.

7.4. Invasion of alien species

Any form of disturbance to the natural vegetation provides a gateway for alien species to invade the site of disturbance. In this regard, it is recommended that a strict monitoring plan be implemented to prevent the additional spread and the continued removal of alien species such as those of *Opuntia ficus-indica* and *Acacia* species, which are already present on site.

7.5. Micro-siting of turbines

Turbine micro-siting should be done bearing in mind the impacts and ecological sensitivity of the proposed location of the turbines. In areas of low sensitivity, turbines can be located as their impact will be low and the control of alien invasive species and any rehabilitation will have a comparatively positive impact. Turbines places in areas of medium sensitivity should be carefully positioned and built so that they have as little impact as possible, as areas of medium sensitivity are valuable for ecosystem functioning. Areas of high sensitivity should be avoided completely when micro-siting turbines as they are very important for ecosystem integrity and functioning and are usually restricted in size, lending them great importance. It should also be noted that turbines should not be places in drainage regions or within rivers as these are process areas and their functioning should not be effected in any way.

7.6. Operational phase recommendations

- Continued monitoring of the site for potential alien invasion, especially of plant species already established, and their continued active control.
- Maintenance of areas set aside within the site for conservation to make sure these are not being impacted further in any way.
- Rehabilitation of any areas needed for the construction phase, but not for the operation phase of the development.

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