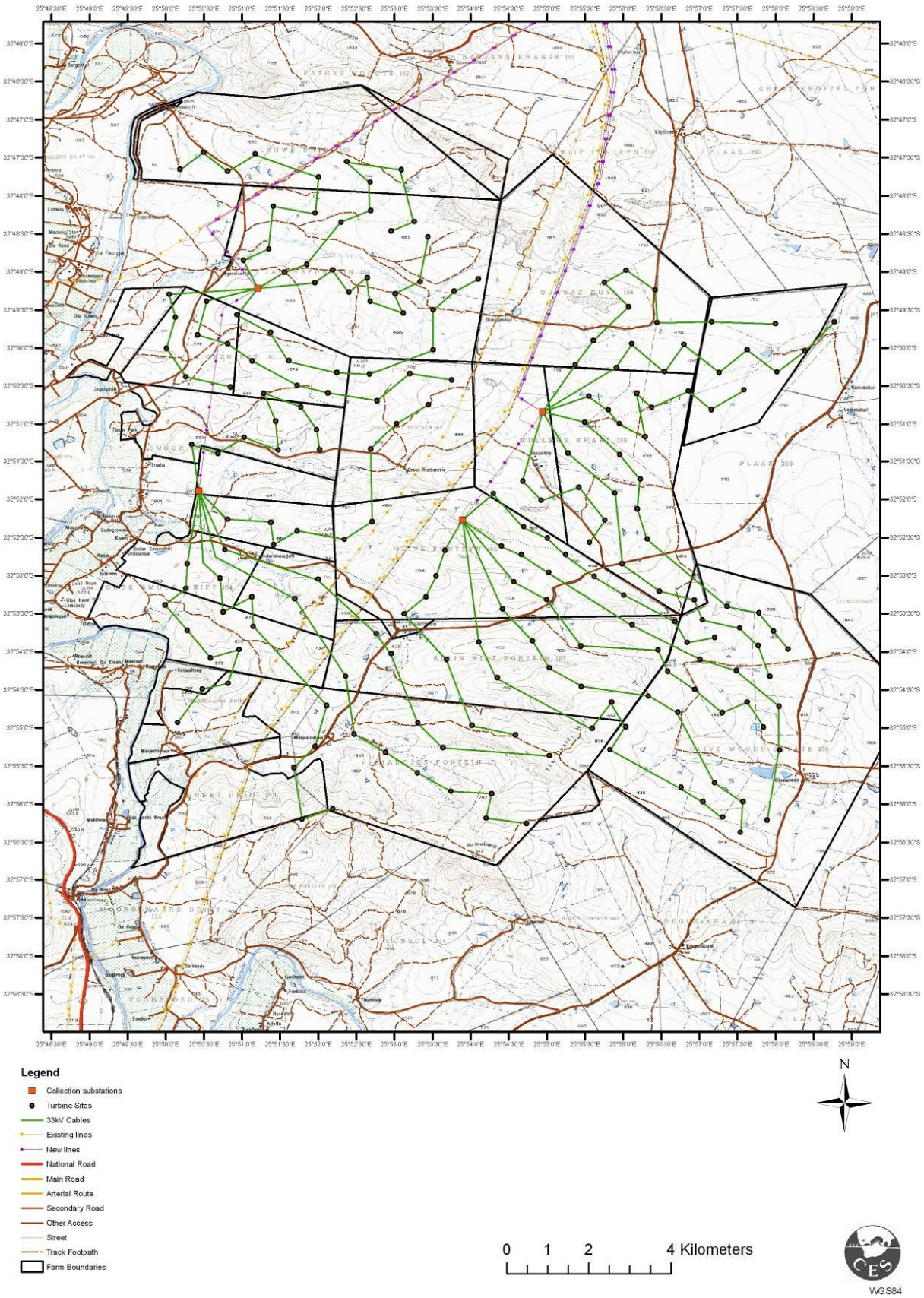

Figure 2-9: Roads associated with the proposed Terra Wind Energy-Golden Valley Project. Note that the green line represents the expected routing of the 33kV underground cables to the sub-station.

Typical wind turbine subsystems include (also refer to Figure 2-10):-

- A *rotor, or blades*, which are the portion of the wind turbine that collect energy from the wind and convert the wind's energy into rotational shaft energy to turn the generator. The speed of rotation of the blades is controlled by the nacelle, which can turn the blades to face into the wind ('yaw control), and change the angle of the blades ('pitch control') to make the most use of the available wind;
- A *nacelle* (enclosure) containing a drive train, usually including a gearbox (some turbines do not require a gearbox) and a generator. The generator is what converts the turning motion of a wind turbine's blades (mechanical energy) into electricity. Inside this component, coils of wire are rotated in a magnetic field to produce electricity. The nacelle is also fitted with brakes, so that the turbine can be switched off during very high winds, such as during storm events. This prevents the turbine from being damaged. All this information is recorded by computers and is transmitted to a control centre, which means that operators do not have to visit the turbine very often, but only occasionally for a mechanical check;
- A *tower*, to support the rotor and drive train; The tower on which a wind turbine is mounted is not only a support structure, but it also raises the wind turbine so that its blades safely clear the ground and so can reach the stronger winds at higher elevations. The tower must also be strong enough to support the wind turbine and to sustain vibration, wind loading, and the overall weather elements for the lifetime of the turbine, and;
- *Electronic equipment* such as controls, electrical cables, ground support equipment, and interconnection equipment.

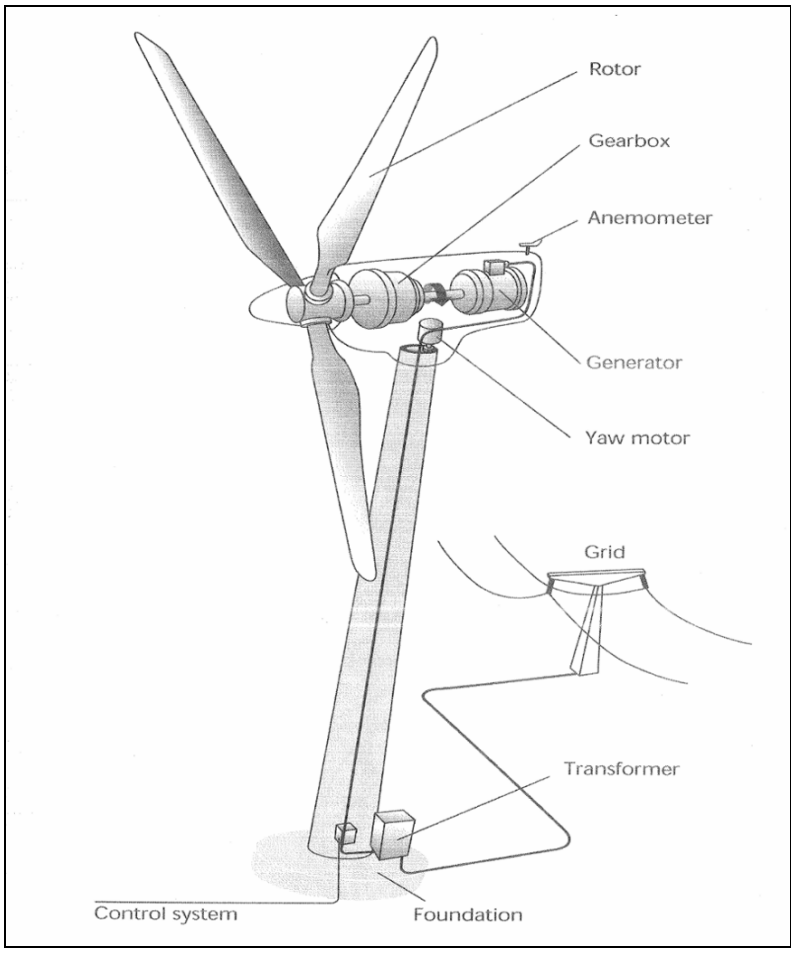

Figure 2-10: Illustration of the main components of a typical wind turbine
Note: The transformer in the figure above would normally be inside the tower (probably at the base).
Source: Terra Wind Energy-Golden Valley (Pty) Limited

A wind turbine obtains its power input by converting the force of the wind into torque (turning force) acting on the rotor blades. The wind then turns the rotor blades, which spin a shaft, which connects to a generator and makes electricity. The amount of energy which the wind transfers to the rotor depends on the density of the air (the heavier the air, the more energy received by the turbine), the rotor area (the bigger the rotor diameter, the more energy received by the turbine), and the wind speed (the faster the wind, the more energy received by the turbine). Provided in the sections that follow is a detailed discussion on the various components of the proposed Terra Wind Energy-Golden Valley Project.

2.2.3 Measurement mast

On 17 February 2010, the competent authority, who in this case was the Department of Environmental Affairs (DEA) – formerly the Department of Environmental Affairs and Tourism (DEAT) - granted the environmental authorisation (Authorisation Register Number: 12/12/20/1715) for Terra Wind Energy-Golden Valley (Pty) Limited to erect four temporary 80m measurement masts on the farms Quaggaskuil, Smoorsdrift, Varkenskuil and Olive Wood Estate to gather wind speed data and correlate these measurements with other meteorological data in order to produce a final wind model of the above-mentioned farms.

Please refer to **Appendix A** for a copy of the Environmental Authorisation from DEA. It is necessary to erect wind measurement masts to gather wind speed data and correlate these measurements with other meteorological data in order to produce a final wind model of the proposed project site. A measurement campaign of no less than 12 months duration is necessary to ensure that a bankable wind resource study can be produced as well as to validate the initial wind turbine mapping.

The four proposed 80-metre masts are a highly versatile meteorological tower designed specifically for wind resource measurements (see Figure 2-11). It is ice-rated for extreme climates, and exceeds EIA-222-F Standards (http://www.nrgsystems.com/sitecore/content/Products/4042.aspx). Superior design and sturdy galvanized steel tube construction make the tower reliable and easy to transport to remote sites.

Tower tube sections slide together, and then tilt up from the ground using a ginpole and winch. No cranes or concrete foundations are required for installation. The tower will be supported with aircraft cable guy wires and anchored with standard screw-in anchors (although depending on soil conditions, another type of the anchor might be used). The mast will have to be ‘marked’ as per the requirements of the Civil Aviation Authority.

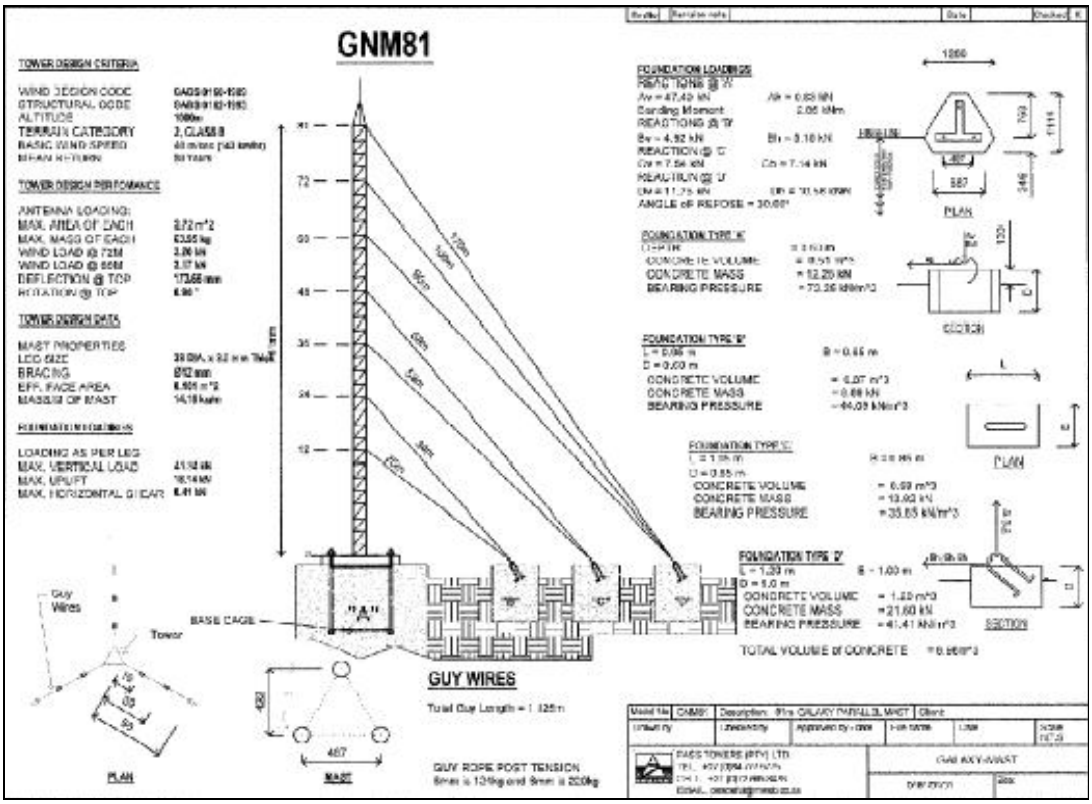

Figure 2-11: Typical measurement mast that will be erected to gather wind speed data with other meteorological data to produce a final wind model of the proposed project site prior to the establishment of a wind farm.

2.2.4 Construction of a typical wind farm

Typically, building a wind farm is divided into three phases namely:-

- Preliminary civil works
- Construction
- Operation

Each of the above-mentioned phases is described in detail in sections 2.2.4.1 – 2.2.4.6 that follow.

2.2.4.1. Preliminary civil works

A temporary area of 35mx25m needs to be established during the preliminary phase of the wind farm for access to the site during the construction phase by machines (bulldozers, trucks, cranes etc). The access roads need to have a minimum internal turning circle of 26-27m.

2.2.4.2. Construction Phase

This phase comprises of the following sub-phases:-

(a) Geotechnical studies and foundation works

A geotechnical study of the area must be undertaken for safety purposes. This comprises drilling, penetration and pressure assessments. For the purpose of the foundations, 500m^3 would need to be excavated for each turbine. These excavations are then filled with steel-reinforced concrete (typically 13 tons of steel rods per turbine). The foundations can vary according to the quality of the soil. The main dimensions for the foundation of a 3MW/100m high wind turbine are shown in Figure 2-12 with underground foundation, tower base, above ground foundation, and ground level.

Terra Wind Energy-Golden Valley (Pty) Ltd will undertake a geotechnical study upon receipt of a positive environmental authorization from the Department. Geotechnical studies are costly and the risk of commissioning a geotechnical study prior to environmental authorization being received is a large risk, in terms of both time and cost.

(b) Foundation Works
The turbine foundations can vary according to the quality of the soil. The main dimensions for the foundation of a 3MW/100m high wind turbine are shown in the Figure 2-12.

(c) Electrical cabling
As discussed above, electrical and communication cables are run approximately 1m deep, under or immediately alongside the access roads. The routing of these roads is shown in Figure 2-9.

(d) Turbine erection
The process is rapid (around three days per turbine) if the weather conditions permit. This phase is the most complex and costly.

2.2.4.3. Electrical connection

Each turbine is fitted with its own transformer that steps up the voltage usually to 22kv or 33kv. The entire wind farm is then connected through a series of connections to the "point of interconnection" which is the electrical boundary between the wind farm and the municipal or national grid. The national grid might need to be extended to accommodate and evacuate power from the wind energy facility. Most of the off-site grid works will be carried out by Eskom or its sub contractor (line upgrade, connection to the sub-station, burial of the cables etc.).

The electrical connections will be laid in trenches approximately 1 metre deep. There will be numerous of instances where the electrical cables will cross the watercourses on the project site. As such, the EAP has consulted with Department of Water Affairs regarding the requirements in terms of the National Water Act, 1998 (Act 36 of 1998). A copy of the correspondence is attached to this report in Appendix E.

According to the National Water Act, 1998 (Act 36 of 1998), the natural channels are regarded as watercourses. Therefore, the electric duct crossings (each and every one of them) will constitute a water use in terms of this Act, for the following:

- Section 21 (c)- Impeding or diverting the flow of water in a watercourse (if there will be any) and
- Section 21 (i)-Altering the bed, banks, course or characteristics of a watercourse.

These crossings will have an impact on the watercourse (bed & banks) so an authorization is needed. The authorization has not yet been applied for with the Department of Water Affairs and will be sought once the final micro-siting of the turbines has been completed.

2.2.4.4. Timing estimation

The implementation of a wind farm of these approximate dimensions would require:-

- Preliminary phase = 16 weeks (including 8 weeks to let the foundation concrete gain strength)
- Wind turbines erection = 4 weeks (in good low wind weather conditions)
- Commissioning and electrical connection = 4 weeks

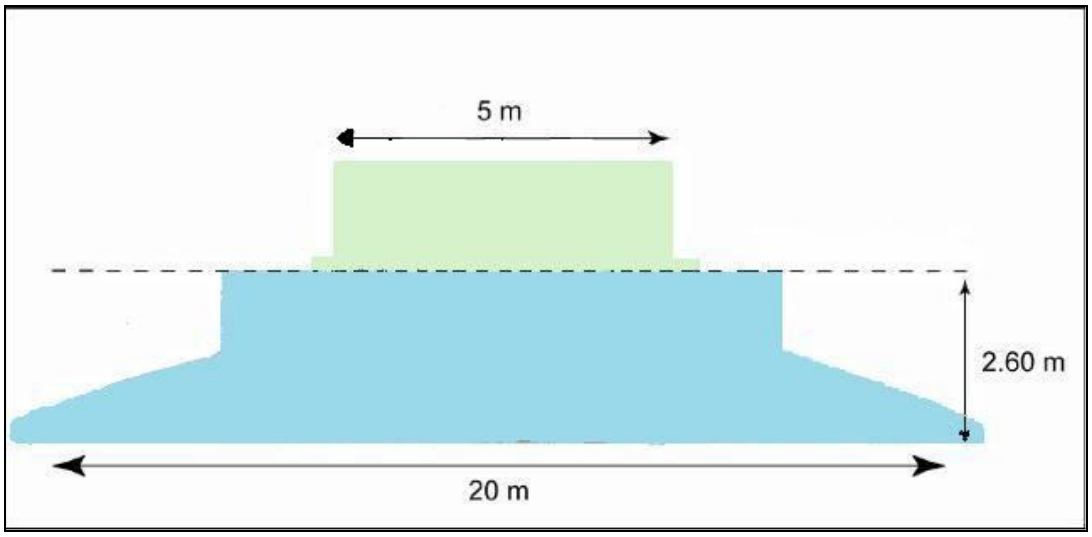

Figure 2-12: The main typical dimensions for the foundation of a 2.5MW/80-100m high wind turbine.
*** Note: Blue area is underground and green area is above ground**

2.2.4.5. Operational phase

During the period when the turbines are up and running, on-site human activity drops to a minimum, and includes routine maintenance requiring only light vehicles to access the site. Only major breakdowns would necessitate the use of cranes and trucks.

2.2.4.6. Refurbishment and rehabilitation of the site after operation

Current wind turbines are designed to last for over 25 years and this is the figure that has been used to plan the life span of a modern wind farm. If refurbishment is economical, the facility life span could be extended by a further 25 years.

Decommissioning of the wind energy facility at the end of its useful life will be undertaken in agreement with the landowners and according to the land use agreement. The intention of the project proponent is to ensure that the usable land and visible images would be removed and restored to their original condition.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

In terms of section 32 (2) of the EIA regulations (2006), *an environmental impact assessment report must include:-*

(d) A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;

In line with the above-mentioned legislative requirement, this Chapter of the EIR provides a description of the natural and socio-economic environments that could potentially be impacted by the proposed Terra Wind Energy-Golden Valley Project.

Descriptions of the physical, biological, social, economic and cultural aspects of the environment are based on a review of relevant literature sources as well as on-site investigations undertaken between February 2010 and June 2010 by the various specialists involved in this EIA.

3.1 The Bio-Physical Environment

3.1.1 Climate and Hydrology

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.

Cookhouse mainly experiences dry warm summers and chilly winters. Most of the rainfall is received in summer months.

There is data available for climatic conditions in Somerset East, which is close to the study site. The annual mean rainfall is 570mm (ranging from 278mm to 994mm), with a March high of 84mm and a June low of 21mm. The mean annual daily temperature is 17.2^{o}C with a mean monthly daily temperature high in January of 22.2^{o}C and low in June and July of 12.6^{o}C.

A number of rivers, drainage lines and canals bisect the affected farms. Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. The Terra Wind Energy-Golden Valley Project is bordered by the Great Fish River in the west.

3.1.2 Topography

The Eastern Cape Province contains a wide variety of landscapes, from the stark Karoo (the semi-desert region of the central interior) 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 border forms part of the Great Escarpment.

Another part of the escarpment lies just north of Bhisho, 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 topography of the study area is dominated by the Fish River floodplain and the Winterberg Mountains (and their extension to the east) north of Somerset East, Cookhouse and Bedford. The lowest points (approximately 450m AMSL) in the region are found in the Little and Great Fish River (Klein- and Groot-Vis) floodplains south of the site, while the highest are found in the mountains north of Somerset East (approximately 1 250m AMSL). The wind farm will therefore be located in

on hills and ridges within a locally lower area within the regional landscape and will be almost completely surrounded by elevated land.

Plates 3-1 to 3-3 provide an idea of the topography of the proposed Terra Wind Energy-Golden Valley Project site.

Plate 3-1: The undulating hills of the site proposed for the location of the Terra Wind Energy-Golden Valley Project

Plate 3-2: The undulating hills of the site proposed for the location of the Terra Wind Energy-Golden Valley Project. Note the escarpment in the distance

Plate 3-3: Some very flat areas found on the site proposed for the location of the Terra Wind Energy-Golden Valley Project. The escarpment can be seen in the background

3.1.3 Geology and Soils

Cookhouse and the surrounding areas (including Somerset East) occur in the Karoo Supergroup and comprise mainly the Beaufort Group (Koonap, Middleton and Balfour Formations) with some Karoo Dolerite (Rust, 1998). The Beaufort group overlays the Ecca Group and was deposited on land through alluvial processes. It is characterised by reddish-purple and mottled, greenish, mudstone beds, interbedded with lenticular, creamy and buff coloured sandstone beds.

The mudstone beds are a diagnostic feature of the Beaufort Group. A couple of long Dolerite outcrops occur in the area (Rust, 1998). The Adelaide subgroup occurs as a subgroup of the Beaufort Group, and forms most of the geology of the area. The Adelaide subgroup comprises the Middleton Formation and the Balfour Formation which are made up of layers of a greenish-grey mudstone, shale and sandstone (Mucina and Rutherford, 2006). Plate 3-4 provides a general indication of the rocks around the proposed development area.

The geomorphology of the region is a product of the erosive forces of the Great Fish River and its tributaries working on the underlying, almost horizontal, layers of shale and sandstone. Irregular plains with low to moderate hills dominate the landscape with ridges of high hills cutting across them in a roughly east-west direction. North of the study area the relief is considerably more pronounced and low mountains form a constant background of views to the north.

Mucina and Rutherford (2006) describe the geology and soil for each of the vegetation types in the region (Table 3-1).

Table 3-1: Geology and soils of each of the vegetation types of the study area

Vegetation Type	Geology and Soils
Albany Broken Veld	Mainly shales and some sandstones of various stratigraphic units within the Witteberg Group of the Cape Supergroup and the Beaufort, Ecca and Dwyka Groups of the Karoo Supergroup. Mainly Glenrosa and/or Mispah soils (Fc land type) with some red-yellow, apedal, drained soils, with a high base status, generally <300 mm deep, typical of Ag land type.
Bedford Dry Grassland	Loam or clay-loam soils typical of Fc (most of the region) as well as Db and Fb land types on the mudstones and sandstones of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup).
Great Fish Thicket	Mostly on shallow (< 1 m) clay soils (Glenrosa and Mispah) derived from the Adelaide and Escourt Formations (Beaufort Group, Karoo Supergroup) mudstone and arenite. Half the area falls within the Fc land type, with Fb the only other one of some importance.
Eastern Cape Escarpment Thicket	Mudstones and arenite of the Adelaide Subgroup of the Karoo Supergroup as well as Jurassic dolerite intrusions. The soils derived from these rocks are fine-grained, nutrient-poor silts or more nutrient-rich red clays. Soils are often shallow, on moderate to steep slopes and the surface rock cover is high. The major land types are Fc as well as Ib and Fb.
Southern Karoo Riviere	Recent sandy-clayey alluvial deposits rich in salt occurring on mudrocks and sandstones of the Adelaide Subgroup (Beaufort Group of the Karoo Supergroup) that support soils typical of Ia land type.

Source: Mucina & Rutherford (2006)

Plate 3-4: The reddish mudstones of the Beaufort Group of Cookhouse and the surrounding areas.

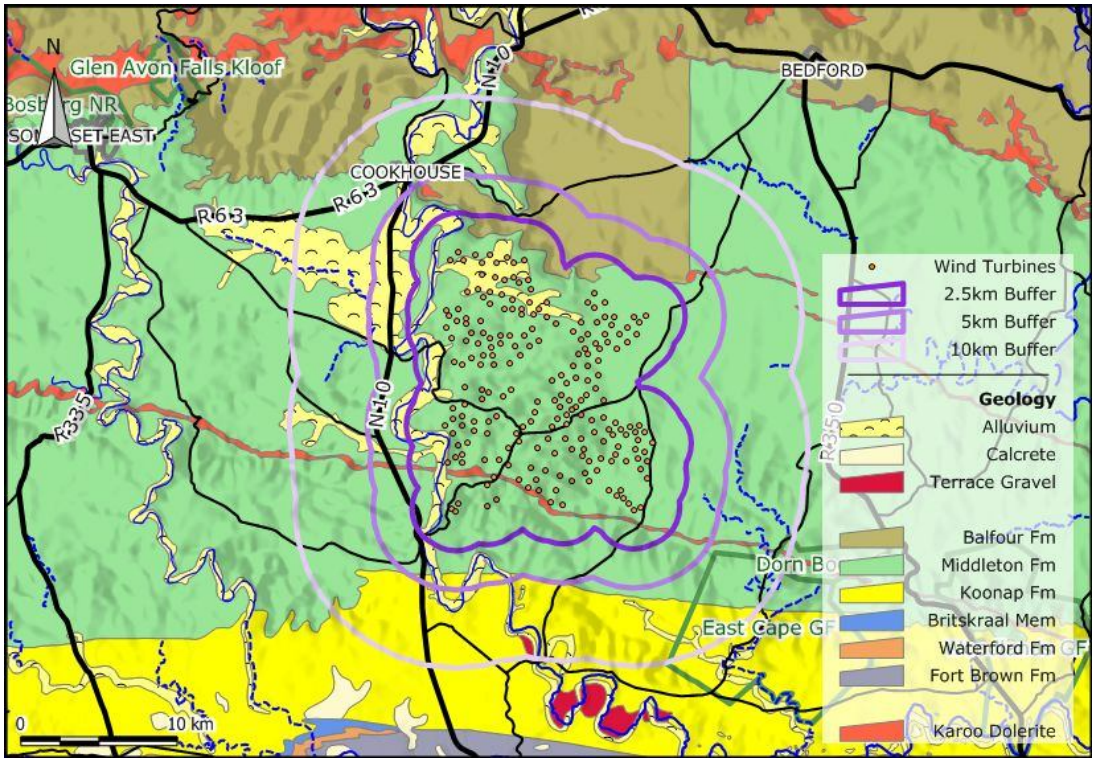

Figure 3-1: Simplified geological map of the area around Cookhouse.

3.1.4 Vegetation and Floristics

Flora

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. Cookhouse falls within the Albany Centre of Floristic Endemism; also known as the Albany Hotspot (Figure 3-2). This is an important centre for plant taxa, and, according to van Wyk and Smith (2001), contains approximately 4 000 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 south by the Indian Ocean, in the east by the Gamtoos–Groot River basin and in the north by the Kei River basin*' (Victor & Dold, 2003).

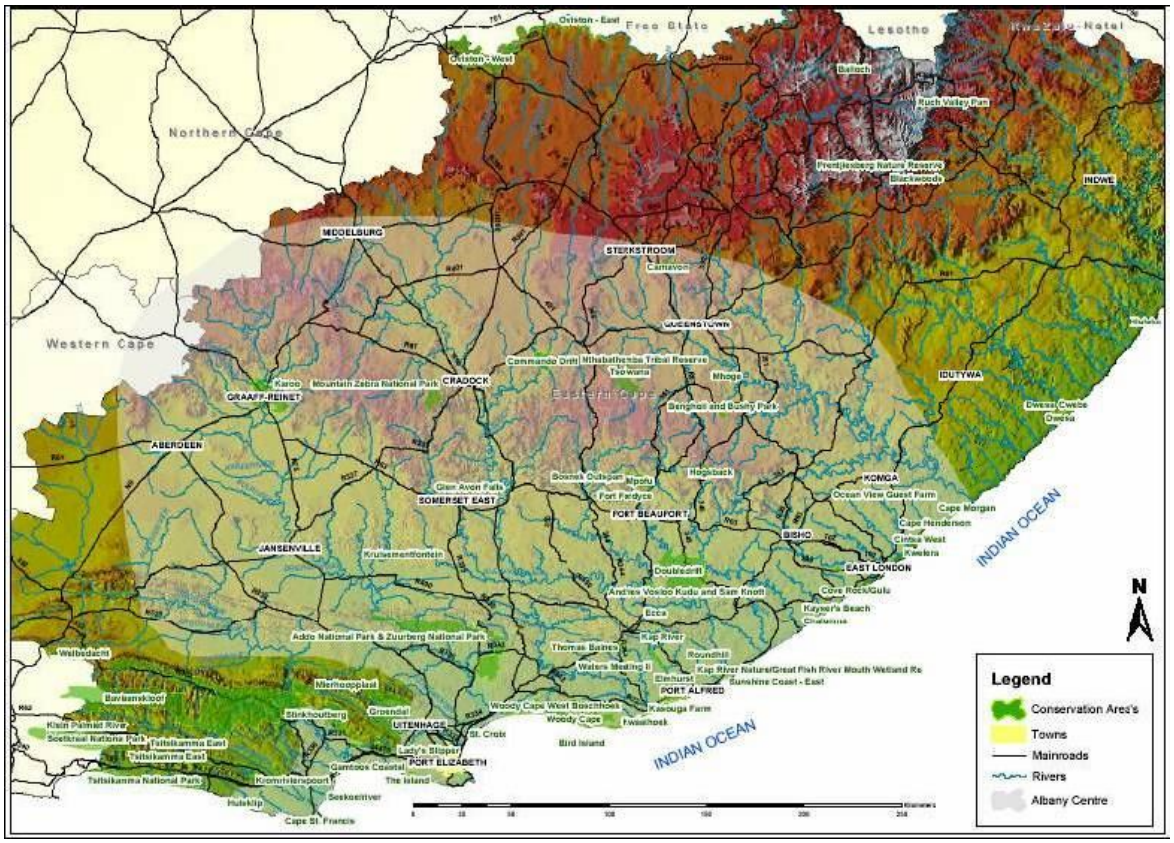

Figure 3-2: The Albany Centre of Endemism, also known as the 'Albany Hotspot', has long been recognised as an important centre of plant species diversity and endemism
Source: van Wyk and Smith (2001)

Mucina and Rutherford (2006) described the species endemic to the area (Table 3-2). In addition to the endemic taxa found in the study area, there are also a number of species which are listed as protected by Victor and Dold (2003) (Table 3-3) that are expected to be found in the study area. Importantly, the list given by Victor and Dold is not complete as little is known about many species. These 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 any members of the family are included as Species of Special Concern (SSC). Victor and Dold (2003) also list a number of other taxa as important. These include members of the Amaryllidaceae (Amaryllids), Iridaceae (Irises), Orchidaceae (Orchids) and Apocynaceae (Lianas), as well as members of the genus *Aloe (*see Plate 3-5*)*.

Table 3-2: Species endemic to the vegetation types found in the study area and Cookhouse surrounds.

Vegetation Type	Species	Protection	Status
Bedford Dry Grassland	No endemics	-	-
Great Fish Thicket	*Euphorbia cumulate*	-	-
	Euryops gracilipes	IUCN	Vulnerable
	Haworthia augustifolia var. *pauciflora*	PNCO 4	Protected
	Haworthia cummingii	PNCO 4	Protected
	Haworthia cymbiformis var. *incurvula*	PNCO 4	Protected
	Haworthia cymbiformis var. *ramose*	PNCO 4	Protected
	Zaluzianskya vallispiscis	-	-
Southern Karoo Riviere	*Isolepis expallescens*	-	-
Eastern Cape Escarpment thicket	No endemics	-	-
Albany Broken Veld	*Brachystelma huttonii*	-	-
	Ornithogalum britteniae	IUCN	Vulnerable
	Ornothogalum perdurans	IUCN	Vulnerable
	Haworthia cymbiformis var. *obtuse*	-	-
	Ceropegia fimbriata subsp. *fimbriata*	IUCN	Vulnerable
	Euphorbia inermis var. *huttoniae*	-	-
	Rhombophyllum albanense	-	-
	Rhombophyllum dyeri	-	-

Table 3-3: Species expected to be found in the study area and surrounds which are listed as protected (but are not endemic).

Vegetation Type	Species	Protection	Status
Bedford Dry Grassland	*Cotyledon orbiculata*	IUCN	Near Threatened
	Pelargonium sidoides	IUCN	Declining
Great Fish Thicket	*Delosperma ecklonii*	IUCN	Rare
	Tetradenia barberae	IUCN	Rare
	Boscia albitruscia	Protected Trees	Protected
	Aloe tenuior	PNCO	Protected
Albany Broken Veld	*Ceropegia fimbriata*	IUCN	Vulnerable
	Euphorbia meloformis	IUCN/ PNCO 4	Near Threatened/ Protected
	Faucaria tigrina	IUCN	Endangered
	Ornithogalum britteniae	IUCN	Vulnerable
	Ornithogalum perdurans	IUCN	Vulnerable
Eastern Cape Escarpment Thicket	*Crassula obovata*	IUCN	Vulnerable
Southern Karoo Riviere	*Amphiglossa callunoides*	IUCN	Near Threatened

Plate 3-5: One of the many Aloe (*Aloe striatus*) plants found in the study area. All species of *Aloe* are protected by the PNCO Schedule 4.

Alien species

Alien species recorded from the study site included *Opuntia ficus-indica*, prickly pear (Plate 3-6), and *Opuntia lindheimeri* (Plate 3-7). These invaders are required to be removed by law, as they are each Category 1: declared weeds. Biological control agents are presently being utilised on the site on each of these species. The Conservation of Agricultural Resources Act, 1983 requires the following regarding category 1 plants:

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.

Plate 3-6: *Opuntia ficus-indica* recorded on the farm Quaggas Kuyl.

Plate 3-7: *Opuntia lindheimeri* recorded on the farm Smoorsdrift

Vegetation

There are two main vegetation classifications for the area. These are Mucina and Rutherford (2006) and the Subtropical Thicket Ecosystem Project (STEP). There are five Mucina and Rutherford (2006) and four STEP Vegetation types for the general Cookhouse area (Table 3-4). Plate 3-8, 3-9 and 3-10 show the vegetation in the study area. Much is degraded due to grazing by livestock and comprises sparse grassland with scattered low shrubs, *Acacia karroo* plants and alien invader species.

Table 3-4: Mucina & Rutherford and STEP vegetation types in the Cookhouse area

Mucina & Rutherford		STEP
Code	**Vegetation Type**	**Vegetation type**
AT11	Great Fish Thicket	Hartebeest Karroid Thicket
		Fish Speckboom Thicket
Gs18	Bedford Dry Grassland	-
AT13	Eastern Cape Escarpment Thicket	Escarpment Thicket
NK14	Albany Broken Veld	Saltaire Karroid Thicket
Azi6	Southern Karoo Riviere	

Plate 3-8: Sparse grassland with low shrubs and a few stunted trees

Plate 3-9: Sparse grassland with scattered *Acacia karroo* plants as well as a few *Opuntia ficus*-indica invaders

Plate 3-10: Grassland with a few *Opuntia lindheimeri* individuals

Vegetation types

Mucina and Rutherford (2006)

(a) Great Fish Thicket

Great Fish Thicket occurs in the Eastern Cape quite extensively in and around the lower Great Fish River and Keiskamma River Valleys. Succulent thicket occurs in steep slopes. Thicket is dominated by *Portulacaria afra* which becomes less dominant and is replaced by *Euphorbia bothae* with increasing aridity. With increasing moisture *P. afra* is replaced by *Euphorbia tetragona* and *E. triangularis.* The vegetation tends to be clumped. This vegetation type is classified as Least Threatened by Mucina and Rutherford (2006). The conservation target is 19%, with 6% conserved and 4% transformed (3% cultivation, 1% urbanization).

(b) Bedford Dry Grassland

This vegetation type occurs in the Eastern Cape. The vegetation type occurs on gently undulating plains and is open, dry grassland interspersed with *Acacia karroo* woodland vegetation. The grassland is dominated by *Digitaria argyrograpta, Tragus koelerioides, Eragrostis curvula* and *Cymbopogon caesius*. It is classified as Least Threatened by Mucina and Rutherford (2006), with a conservation target of 23%. No part of this vegetation type is statutorily conserved and only 1% privately conserved. 3% has been transformed for cultivation. Erosion is high in 25% of this vegetation type.

(c) Eastern Cape Escarpment Thicket

This vegetation type is restricted to the Eastern Cape Province (Mucina and Rutherford, 2006). It occurs along steeply sloping escarpment and mountain slopes, hills and lowlands of the region. It forms semi-open to closed thicket with dominant species *Olea europaeae* and *Acacia natalitia*. The conservation target for this vegetation type is 19%. 7% is conserved both privately and statutorily. This vegetation type has been permanently altered through various means including cultivation and urbanization (Mucina and Rutherford, 2006).

(d) Albany Broken Veld

This vegetation type occurs in the Eastern Cape Province and extends from the Zuurberg Mountains, around the confluence of the Great and Little Fish Rivers extending Eastwards (Mucina and Rutherford, 2006). It occurs on low mountain ridges and hills with an open grassy karroid dwarf shrubland with scattered low trees (*Boscia oleoides, Euclea undulate, Pappea capensis, Schotia afra*), dwarf shrubs (*Becium burchellianum, Chrysocoma ciliate*) and grasses (*Eragrostis obtusa*). This vegetation type is classified as Least Threatened by Mucina and Rutherford (2006) and has a conservation target of 16%, with 12% privately conserved. About 3% has been transformed for cultivation (Mucina and Rutherford, 2006).

(e) Southern Karoo Riviere

This vegetation type occurs in both the Eastern and Western Cape provinces, it is associated with rivers and is embedded in several vegetation types (Mucina and Rutherford, 2006). The vegetation type comprises riverine flats with a complex of *Acacia karoo* or *Tamarix usneoides* thickets and edged by *Salsola* dominated shrubland. This vegetation type is listed as Least Threatened by Mucina and Rutherford (2006), with a conservation target of 24%. Only 1.5% is statutorily and privately conserved, 12% has been transformed for cultivation and building of dams.

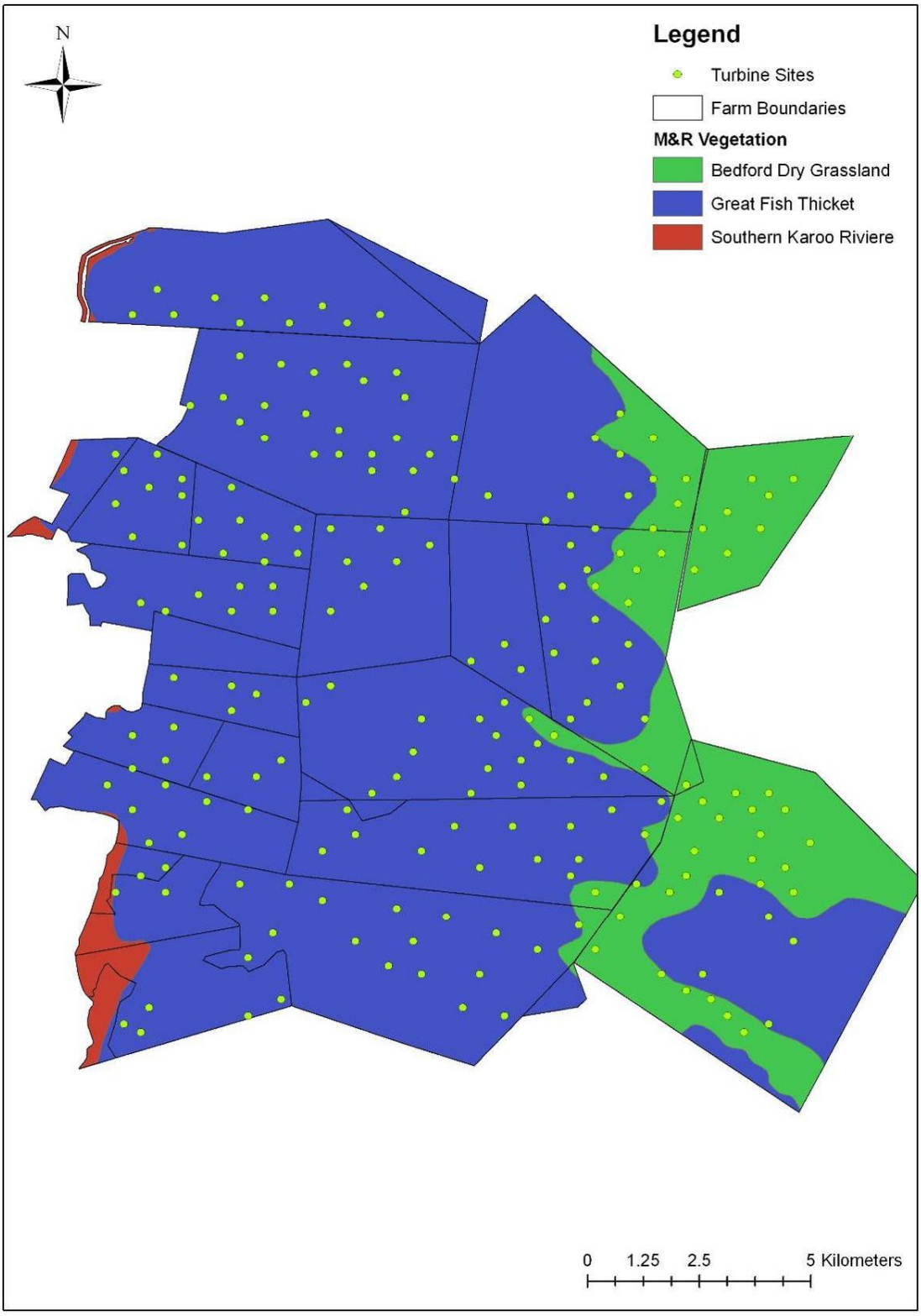

Figure 3-3: Mucina and Rutherford (2006) Vegetation map of the study area, with the location of the proposed turbines as green dots.

Subtropical Thicket Ecosystem Planning (STEP) Project

(a) Hartebeeste Karroid Thicket

Hartebeeste Karroid Thicket is listed as Least Threatened by STEP. This vegetation type consists of fragmented thicket clumps comprising species typical of Fish Valley Thicket (Pierce & Mader 2006). Species typical of Fish Valley Thicket include woody trees such as doppruim (*Pappea capensis*) and gwarrie (*Euclea undulate*) as well as shrubs such as needlebush (*Azima tetracantha*). The Nama-karoo matrix is dominated by ankerkaroo (*Pentzia incana*) and *Becium burchellianum*is a characteristic species.

(b) Escarpment Thicket

Escarpment Thicket is classified as Vulnerable by STEP. The dominant species of this vegetation type include wild olive (*Olea europaeae* subsp. *africana*) and kruisbessie (*Grewia occidentalis*). Also abundant are saffron (*Elaeodendron croceum*) and buffalo-thorn (*Ziziphus mucronata*).

(c) Fish Spekboom Thicket

Fish Spekboom thicket is classified as Vulnerable by STEP. It forms part of the Thicket Biome and the Valley Thicket vegetation type. Valley Thicket grows in areas with relatively intermediate rainfall for Thicket (Pierce & Mader 2006). It can be impenetrable when in pristine condition but overgrazing results in a savanna-like vegetation with occasional trees. Ubiquitous thicket species include: *Pappea cappensis*, *Azima tetracantha* and *Rhus longispina*. There are also many succulent species of which species of *Crassula* and *Aloe* as well as *Portulacaria afra, Euphorbia grandidens* and *Euphorbia tetragonal* are the most common (Pierce & Mader 2006).

Fish Spekboom Thicket, specifically is a variable thicket type with tree euphorbias (*Euphorbia curvirama, Euphorbia grandidens* and *Euphorbia tetragonal*) as well as spekboom (*Portulacaria afra*). In addition, there are also woody shrub species present including: *Pappea capensis, Schotia afra* and *Rhigozum obobvatum*.

(d) Aliwal North Dry Grassland

Aliwal North Dry Grassland is classified as Least Threatened by STEP. It forms part of the Grassland Biome, which consists mainly of grasses, with very few trees or shrubs. If present, trees cover less than 10% (Pierce & Mader 2006). Aliwal North Dry Grassland is pure grassland of sweet grass: *Themeda triandra, Digitaria eriantha, Sporobolus fimbriatus* and *Eragrostis chloromelas* (Pierce & Mader 2006).

STEP vegetation classes

STEP provides management recommendations for each of the classes given to vegetation types. As the study area contains vegetation types listed as Least Threatened (Currently Not Vulnerable), and Vulnerable by STEP, recommendations for these classes are provided below and summarised in Table 3-5.

Currently Not Vulnerable (Class IV)

A vegetation type that has much more extant habitat than is needed to meet its conservation target, is considered Currently Not Vulnerable, or Least Threatened

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 authorisation is required by law.

Table 3-5: Summary of the STEP Project conservation priorities, classifications and general rules (Pierce, 2003)

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

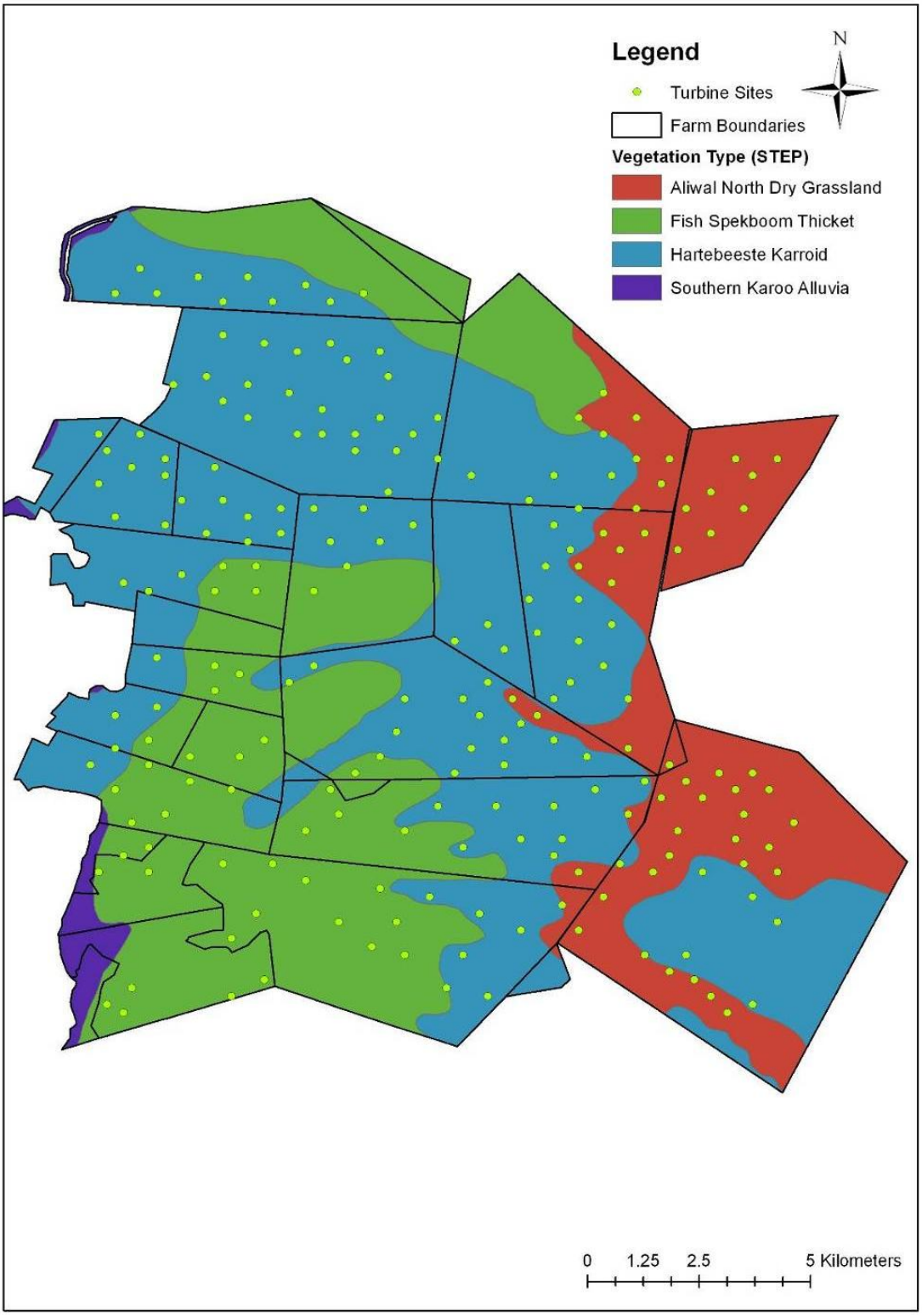

Figure 3-4: STEP vegetation map of the study area with the locations of the proposed turbines in green (from Pierce & Mader, 2006)

From a Spatial planning (Spatial Development Framework - SDF)) 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 due to disturbance of 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).

Vulnerable (III)

Vulnerable ecosystems are those where further disturbance or destruction could harm their health and functioning.

For Vulnerable vegetation, STEP recommends four Land use management procedures, these include:

1. As a rule, developments with limited area or impacts should be allowed on Class III land.
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. Proposed disturbance or developments should preferably take place on sites which have undergone disturbance or impacts rather than on sites that are undisturbed.
4. For a proposed listed activity, EIA authorisation is required by law.

From a Spatial planning (Spatial Development Framework - SDF) point of view, for Vulnerable vegetation, STEP presents three restrictions and gives examples of opportunities. The three spatial planning restrictions are as follows:

1. In general, Class III land can withstand only limited loss of natural area or limited disturbance through human activities and developments.
2. Proposed disturbance or developments should preferably take place on sites which have undergone disturbance or impacts rather than on sites that are undisturbed.
3. In general, Class IV land should be developed in preference to Class III land.

Depending on constraints (such as avoidance of spoiling scenery or wilderness, or infra-structure limitations), Class III land can withstand a limited loss of, or disturbance to, natural areas. Within the constraints, this class may be suitable for a moderate range of activities that are either compatible with the natural environment (e.g. sustainable stock-farming, ecotourism, game farming and wilderness) or of limited extent (e.g. small-scale housing or urban development, small-scale cultivation).

3.1.5 Birds

Nine bird species are endemic to South Africa, but there are no Eastern Cape endemics. However, there are 62 threatened species within the Eastern Cape Province (Barnes, 2000). Most of these species occur in grasslands or are associated with wetlands, indicating a need to conserve what is left of these ecosystems (Barnes, 2000). A number of inland species are found from the Karoo region e.g. Acacia pied barbet, common Ostrich, Cape Penduline Tit, Southern Black Korhaan and Blue Cranes (Plate 3-11). The greatest abundance of birds is found in Valley Thickets and in the Aloe flowering season with Sunbirds being extremely conspicuous. Mountain ridges have the

species of the fynbos biome e.g. Cape Sugarbirds. In the forests and on grassland slopes, Knysna Turaco, Narina Trogons, Dark-backed Weavers, Canaries and African Goshawks are some of the birds found. Many birds occur in the bushveld, savanna, bush clamps and thicket areas. Table 3-6 lists threatened bird species likely to occur in the Cookhouse region.

Plate 3-11: A flock of Blue Cranes (*Anthropoides paraisea*) seen between Somerset East and Cookhouse. Blue Cranes are possibly the most important bird species of the region.

Table 3-6: Threatened bird species likely to be encountered in Cookhouse and surrounds.

Common name	Latin name	Conservation status
Bearded vulture	*Gypaetus barbatus*	Endangered
Black Harrier	*Circus Maurus*	Near-threatened
Black Stork	*Ciconia nigra*	Near-threatened
Blackwinged Plover	*Vanellus melanopterus*	Near-threatened
Blue Crane	*Anthropoides paraisea*	Vulnerable
Blue Korhaan	*Eupodotis caerulescens*	Near-threatened
Broadtailed Warbler	*Schoenicola brevirostris*	Near-threatened
Bush Blackcap	*Lioptilus nigricapillus*	Near-threatened
Cape Parrot	*Poicephalus robustus*	Endangered
Cape Vulture	*Gyps coprotheres*	Vulnerable
Corncrake	*Crex crex*	Vulnerable
Crowned Eagle	*Stephanoaetus coronatus*	Near-threatened
Delegorgue's Pigeon	*Columba delegorguei*	Vulnerable
African Grass Owl	*Tyto capensis*	Vulnerable
Greater Flamingo	*Phoenicopterus ruber*	Near-threatened
Ground Hornbill	*Bucorvus leadbeateri*	Vulnerable
Halfcollared Kingfisher	*Alcedo semitorquata*	Near-threatened
Kori Bustard	*Ardeotis kori*	Vulnerable
Lanner Falcon	*Falco biarmicus*	Near-threatened
Lesser Flamingo	*Phoenicopterus minor*	Near-threatened
Lesser Kestrel	*Falco naumanni*	Vulnerable
Ludwig's Bustard	*Neotis ludwigii*	Vulnerable
African Marsh Harrier	*Circus ranivorus*	Vulnerable
Martial Eagle	*Polemaetus bellicosus*	Vulnerable
Pallid Harrier	*Circus macrourus*	Near-threatened
Peregrine Falcon	*Falco peregrinus*	Near-threatened
Secretary Bird	*Sagittarius serpentarius*	Near-threatened
Stanley's Bustard	*Neotis denhami*	Vulnerable
Stripes Flufftail	*Sarothrura affinis*	Vulnerable
Wattled Crane	*Burgeranus carunculatus*	Endangered
Whitebacked Night Heron	*Gorsachias leuconotus*	Vulnerable
Whitebellied korhaan	*Eupodotis cafra*	Vulnerable

Source: Barnes (2000)

3.1.6 Reptiles

The Eastern Cape is home to 133 reptile species including 21 snakes, 27 lizards and eight chelonians (tortoises and turtles). The majority of these are found in Mesic Succulent Thicket and riverine habitats. The list of reptiles of special concern is very significant since it includes five endemic species (two of which are endangered), eight Committee for International Trade in Endangered Species (CITES) listed species, one rare species and four species at the periphery of their range. More than a third of the species are described as relatively tolerant of disturbed environments, provided migration corridors of suitable habitat are maintained to link pristine habitats. The Eastern Cape is home to 133 reptile species including 21 snakes, 27 lizards and eight chelonians (tortoises and turtles) (Plate 3-12). The majority of these are found in Mesic Succulent Thicket and riverine habitats. Table 3-7 provides an indication of the threatened and endemic reptile species with distribution ranges that include the Cookhouse area.

Plate 3-12: An Agulate tortoise (*Chersina angulata*) found in the Cookhouse area.

Table 3-7: Threatened and endemic reptiles likely to occur in the Cookhouse region

Latin name	Common Name	Notes
Acontias meleagris orientalis	Golden legless skink	Eastern Cape endemic
Nucras taeniolata	Striped Scrub lizard	
Tropidosaura Montana subp. *rangeri*	Common mountain lizard	Eastern Cape Endemic
Bradypodion ventrali	Southern Dwarf Chameleon	Eastern Cape Endemic
Afroedura karroica	Inland rock gecko	Eastern Cape Endemic
Afroedura tembulica	Queenstown rock gecko	Eastern Cape Endemic
Goggia essexi	Essex's Dwarf Leaf-toed Gecko	Eastern Cape Endemic

Source: CSIR (2004)

3.1.7 Amphibians

Amphibians are well represented in sub-Saharan Africa, from which approximately 600 species have been recorded. A relatively rich amphibian fauna occurs in the Eastern Cape, where a total of 32 species and sub-species occur. This represents almost a third of the species known from South Africa.

Knowledge of amphibian species diversity in the Cookhouse region is limited and based on collections housed in national and provincial museums. It is estimated that as many as 17 species may occur. Table 3-8 lists species of frogs that are endemic or of conservation concern, and occur in the Cookhouse region.

Table 3-8: Threatened and endemic frogs likely to occur in the Cookhouse area

Latin name	Notes
Anhydrophryne rattrayi	Endangered (Eastern Cape endemic)
Bufo amatolicus	Endangered (Eastern Cape endemic)
Bufo pardalis	Eastern Cape endemic

Source: CSIR (2004)