Plate 8-3: Dorsal view of second fossil skull of a small dicynodont preserved within a calcrete nodule (Scale = 16cm) (Smoorsdrift 162, Loc. 338). The skull apparently lacks canine tusks.

Plate 8-4: Extensive zone of large ferruginous calcrete nodules marking an ancient soil horizon at Loc. 338. The skulls found at this locality may have weathered out from the same or a similar horizon (Hammer = 30cm).

Plate 8-5: Overbank mudrocks penetrated by vague, cross-cutting horizontal burrows (Loc.346, Olive Woods Estate) (Hammer = 30cm).

Trace fossils found within or close to the study area include the vaguely striated or annulated horizontal burrows seen at Loc. 346 (Plate 8-5). These are attributable to an unknown invertebrate and may have been generated subaquesously or in wet shoreline sediments associated with a shallow playa lake system. Other vague epichnial furrows and wash-out sole traces (possibly including the arthropod burrow *Scoyenia*) were recorded in association with thin sandstone beds at Loc. 326. The only plant fossils recorded during this study were locally abundant, transported stem fragments of sphenophytes or "horsetails" (Plate 8-6) that are preserved as internal casts within scraped up blocks of mudrock *c*. 2km east of Middleton (Loc. 334). These reed-like plants probably belong to the common fern genus *Phyllotheca* that characterized boggy riverine and lakeside habitats of the Late Permian in Gondwana (*Glossopteris* Flora; Anderson & Anderson 1985).

Plate 8-6: Internal cast of longitudinally-ribbed, "segmented" stem of a sphenophyte ("horsetail" fern). The stem fragment shown is 10cm long. Rubbish-filled borrow pit west of Middleton (Loc. 334).

Fossil heritage within the Karoo Dolerite Suite

The dolerite outcrops in the northern part of the study area are in themselves of no palaeontological significance since these are high temperature igneous rocks emplaced at depth within the Earth's crust. However, as a consequence of their proximity to large dolerite intrusions in the Great Escarpment zone, the Beaufort Group sediments nearby may well have been thermally metamorphosed or "baked" (*i.*e. recrystallised, impregnated with secondary minerals). Embedded fossil material of phosphatic composition, such as bones and teeth, is frequently altered by baking – bones may become blackened, for example (as seen near Bedford to the east of the study area) - and can be very difficult to extract from the hard matrix by mechanical preparation (Smith & Keyser, p. 23 *in* Rubidge 1995). Thermal metamorphism by dolerite intrusions therefore tends to reduce the palaeontological heritage potential of adjacent Beaufort Group sediments.

Fossil heritage within the superficial deposits ('drift')

Karoo drift deposits have been comparatively neglected in palaeontological terms for the most part. However, they may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals (e.g. Skead 1980, Klein 1984, MacRae 1999, Partridge & Scott 2000). Other late Caenozoic fossil biotas from these superficial deposits include non-marine molluscs (bivalves, gastropods, rhizoliths), ostrich egg shells, trace fossils (e.g. calcretised termitaria, coprolites), and plant remains such as peats or palynomorphs (pollens) in organic-rich alluvial horizons.

Drift deposits including silty alluvium along the banks of the Fish River, near-surface calcretes, and various colluvial (slope) deposits were briefly examined for Caenozoic fossil remains, but without success. Calcretized termitaria may be present in some thicker drift successions in the eastern sector of the study region.

8.6.2 Conclusions and Recommendations

The proposed Golden Valley wind farm study area is largely underlain by Late Permian continental sediments of the Middleton Formation (Lower Beaufort Group, Karoo Supergroup) that are potentially highly fossiliferous. However, field scoping and the accompanying desktop study have shown that (a) much of the Beaufort Group outcrop is mantled by relatively unfossiliferous superficial deposits – principally Late Caenozoic alluvium and colluvium; (b) the Beaufort Group is sparsely fossiliferous in this region; (c) the palaeontological sensitivity of these rocks may have been partially compromised by tectonism (*e.g.* folding, faulting) and thermal metamorphism. The likely impact of the proposed development on local palaeontological heritage is therefore inferred to be low (negative), if no mitigation takes place beforehand.

Focused specialist palaeontological mitigation to take place before construction starts is recommended in two small areas of Lower Beaufort outcrop on the farms Smoorsdrift 162 and Gheziret 161 because several scientifically useful fossil skulls have already been collected here (including during the current scoping study), or in the neighbourhood. This mitigation should involve the intensive recording and collection of fossil heritage within the two areas, as well as the recording of pertinent geological data.

Should substantial fossil remains, such as vertebrate bones, teeth or petrified wood, be found or exposed here or anywhere else within the study area during construction, the responsible ECO should safeguard these – *in situ*, if feasible – and alert SAHRA as soon as possible so that appropriate mitigation can be undertaken by a professional palaeontologist at the developer's expense.

8.7 Socio-Economic Impact Assessment

8.7.1 Background

During the review period for the Draft EIR an interested and affected party raised concerns about the potential impact of the proposed wind energy facility on tourism in the area. As this issue was not raised during the Scoping Phase, a specialist socio-economic assessment was not incorporated into the main EIA. It has therefore been decided to discuss the potential impacts in this report.

In addition, and as discussed below, even if such an assessment was conducted for the proposed Golden Valley Wind Energy Facility, evidence from existing literature suggests that the findings, whether positive or negative, would be inconclusive. It is important to note that the focus of this EIA is the proposed Golden Valley Wind Energy Facility rather than the impact of other potential wind farm developments in the area.

8.7.2 Socio-Economic Concerns

The primary concerns, as captured in the Issues and Response Trail (Appendix D of this report), are firstly that the proposed development will negatively impact the tourism of the area and, secondly, that the tourism of another area will thus be boosted. There are two game farms in the area, namely East Cape and Dorn Boom game farms. Further afield are Double Drift Game Reserve and Andries Vosloo Kudu Nature Reserve south of Fort Beaufort and Shamwari Game Reserve near to Addo Elephant National Park.

8.7.3 Impacts on land value

It is unlikely that anyone will be able to provide a reliable estimate as to the significance of any value changes (positive or negative) due to the establishment of the proposed Golden Valley Wind Energy Facility. The primary reason for this is that there are currently no wind farms in the Eastern Cape and so it is not possible to accurately assess the extent to which the value of local private properties have been affected historically.

While estate agents may be able to offer a subjective opinion on the matter, the only really reliable source of information is from studies that have reviewed actual property price trends over a number of years.

The most comprehensive study on the impact of wind farms on nearby property values was produced by the Berkeley Laboratory in 2009 (http://eetd.lbl.gov/ea/ems/re-pubs.html). It included a detailed statistical analysis of property transactions for 7 500 home sales for the period 1996 – 2007 in the USA and concluded that the view of wind farm facilities did not demonstrably impact sales prices. A similar study for Cornwall in the UK concluded that although house prices initially appeared to be impacted negatively, this was not due to the proximity to turbines. While the development of the proposed Terra Wind Energy Golden Valley project may result in a reduction in the value of surrounding properties, it may also be argued that local property prices may benefit through either the expectation of potential income from similar developments in the area or the perception held by some that wind farms are a symbol of a more sustainable future.

8.7.4 Impacts on the private game reserve industry

Although a viewshed analysis was included in the visual impact specialist report (see Volume 2). While the viewshed analysis shows the areas from where the facility will *theoretically* be visible, it does not provide information on the expected visual intrusion. This is assessed by means of the visual exposure which takes into account the distance from the proposed development.

As can be seen from Figure 4.8 in the Visual Specialist report (Volume 2), visual exposure ratings are mostly **low** for the two game farms, East Cape and Dorn Boom. For areas in East Cape game farm within medium visual exposure levels, the topography is such that few areas will have a view of the wind farm (Not Visible category on the map). No buildings, as traced from 2007 SPOT

imagery, showed higher than low levels of exposure, if at all.

There are areas along the ridge just north of the wind farm site where the potential for scenic views are high in terms of topography. The visual exposure along this ridge is **moderate** to **high**. Similarly, any potential scenic views along the ridge bordering the wind farm site to the south will also have a moderate to high visual exposure rating for the wind farm due to its proximity. The visual specialist report asserts that the views from the farmstead Baviaanskrans are marred somewhat by high voltage power lines and large pylons. However, if one were to apply the precautionary principle (i.e. in the absence of reliable data, assume a worst case scenario) then it the potential *visual* impact would be rated as **moderate** to **high**.

It is unlikely that any study at this stage would be able to provide an accurate assessment of the extent to which the visibility of the proposed facility would translate into a negative impact on the economy of the local private game sector or broader eco-tourism operations. A review of available literature on the subject revealed a scarcity of verifiable data from Africa, but a number of studies have been conducted in Europe. Some of the findings of these are presented below.

A 2008 report prepared by the Glasgow Caledonian University for the Scottish Government (www.scotland.gov.uk/publications/2008/03/07113554/0) included a review of almost 50 studies and interviews with 380 tourists. 98% said that the visibility of wind farms would not affect future visits to the area. 48% of interviewees said that they liked to see wind farms, 24% were neutral and the remaining 28% felt that presence of wind turbines would affect future visits. A weakness of this report was that the actual visual exposure was not incorporated into the questions i.e. respondents were simply asked their opinion on the presence or absence of turbines rather than their proximity or level of intrusion on the landscape. The report concluded that although there is some foundation to the belief that wind farms will have an effect on tourism, the effects are small.

In a separate study conducted for the Wales Tourist Board (NFO WorldGroup, 2003), an attempt was made to determine the impact of wind turbines on the Welsh tourism industry which, like the Eastern Cape, relies on scenery, wild landscapes and an unspoilt environment. Stakeholders agreed that wind farms should be sited in locations where their environmental and visual impacts would be minimised but there was considerable division over the definition of a “no-go area”. Although most of the findings were not based on hard data, both positive and negative impacts were expected. Interviews with 266 tourists revealed that 37% of the respondents said that cellphone masts detracted from their experience while 23% said that wind farms and turbines would have a similar negative effect. This figure is similar to that derived from the Scottish survey discussed above.

The report also refers to case studies from Spain where the wind farm sector has seen rapid growth. Interestingly, several independent studies from that country have shown that despite this growth, there has been no negative impact on the local tourism industry. Mention is also made of positive impacts including “green tourism” when an area is promoted by sustainable energy sources.

8.7.5 Conclusions

Although it is acknowledged that case studies from the European context do not make a perfect comparison to the local Eastern Cape context, the findings of the abovementioned studies are nonetheless useful. They serve to provide some insights into the expected reaction of tourists to the presence of wind farms until such time as local case studies, based on reliable data, are available. Based on these European case studies, it appears that while there may be a negative impact on tourism, the actual significance may not be as high as initially expected by the tourism sector. In addition, examples from Spain suggest that the application of new marketing strategies could leverage a competitive advantage for the local eco-tourism sector by promoting the access of local establishments to clean energy.

9 IMPACT ASSESSMENT

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

(j) A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;

(k) Assessment of each identified potentially significant impact, including –

- ***cumulative impacts;***
- ***the nature of the impact;***
- ***the extent and duration of the impact;***
- ***the probability of the impact occurring;***
- ***the degree to which the impact can be reversed;***
- ***the degree to which the impact may cause irreplaceable loss of resources; and***
- ***the degree to which the impact can be mitigated;***

(l) A description of any assumptions, uncertainties and gaps in knowledge;

Please note when reviewing these impacts that some of the assumptions, uncertainties and gaps in knowledge have been included in Chapter 8 above before presenting the key findings of each of the specialist studies. Those included in this Chapter have therefore been limited to those relating to the identification and/or assessment of impacts.

9.1 Construction Phase Impacts

9.1.1 Introduction

In addition to the construction impacts presented below, the EAP also investigated cumulative impacts of establishing four wind farms in the area of Cookhouse, Bedford and Middleton in the Eastern Cape Province.

The numerous wind farms proposed for the area compound the significance of the impacts expected and predicted for the individual wind energy projects. In light of this, the EAP has undertaken to further explore these cumulative impacts; however this exercise does NOT negate the need for a strategic environmental assessment to be undertaken for wind farms across South Africa. This cumulative impact assessment is undertaken as a desktop study and is a preliminary assessment of the potential impacts foreseeable with developing many wind energy facilities in a specified area. These cumulative impacts are assessed according to the same impact criteria detailed in Section 7.2 – Methodology of this report.

There are currently four wind energy facilities proposed for this area – please refer to Figure 9-1 below:

1. Cookhouse Wind Energy Facility
   Applicant: African Clean Energy Developments
   EAP: Savannah Environmental
   Area of Project: Approx. 9 100ha
   Number of Turbines: 200 turbines/400MW

2. Terra Wind Energy-Golden Valley Project
   Applicant: Terra Wind Energy-Golden Valley (Pty) Ltd
   EAP: Coastal & Environmental Services
   Area of Project: Approx. 29 400ha
   Number of Turbines: 214 turbines/500MW

3. Middleton Wind Energy Project
   Applicant: Terra Wind Energy-Middleton (Pty) Ltd
   EAP: Coastal & Environmental Services
   Area of Project: Approx. 27 000ha
   Number of Turbines: 685 turbines/1712.5MW

4. Amakhala Emoyeni Wind Energy Facility
   Applicant: Windlab Developments South Africa (Pty) Ltd
   EAP: Savannah Environmental
   Area of Project: Approx. 27 300ha
   Number of Turbines: 350 turbines/875 MW

The cumulative figures for the four proposed wind energy facilities are as follows:

- Cumulative Footprint Area of the Study: 92 800ha
- Cumulative Number of Turbines: 1 449 turbines
- Cumulative Estimated MW: 3,487,5MW

The cumulative impacts for the construction phase are **not considered** due to the fact that it is highly unlikely that all four wind energy facilities will be constructed at the same time.

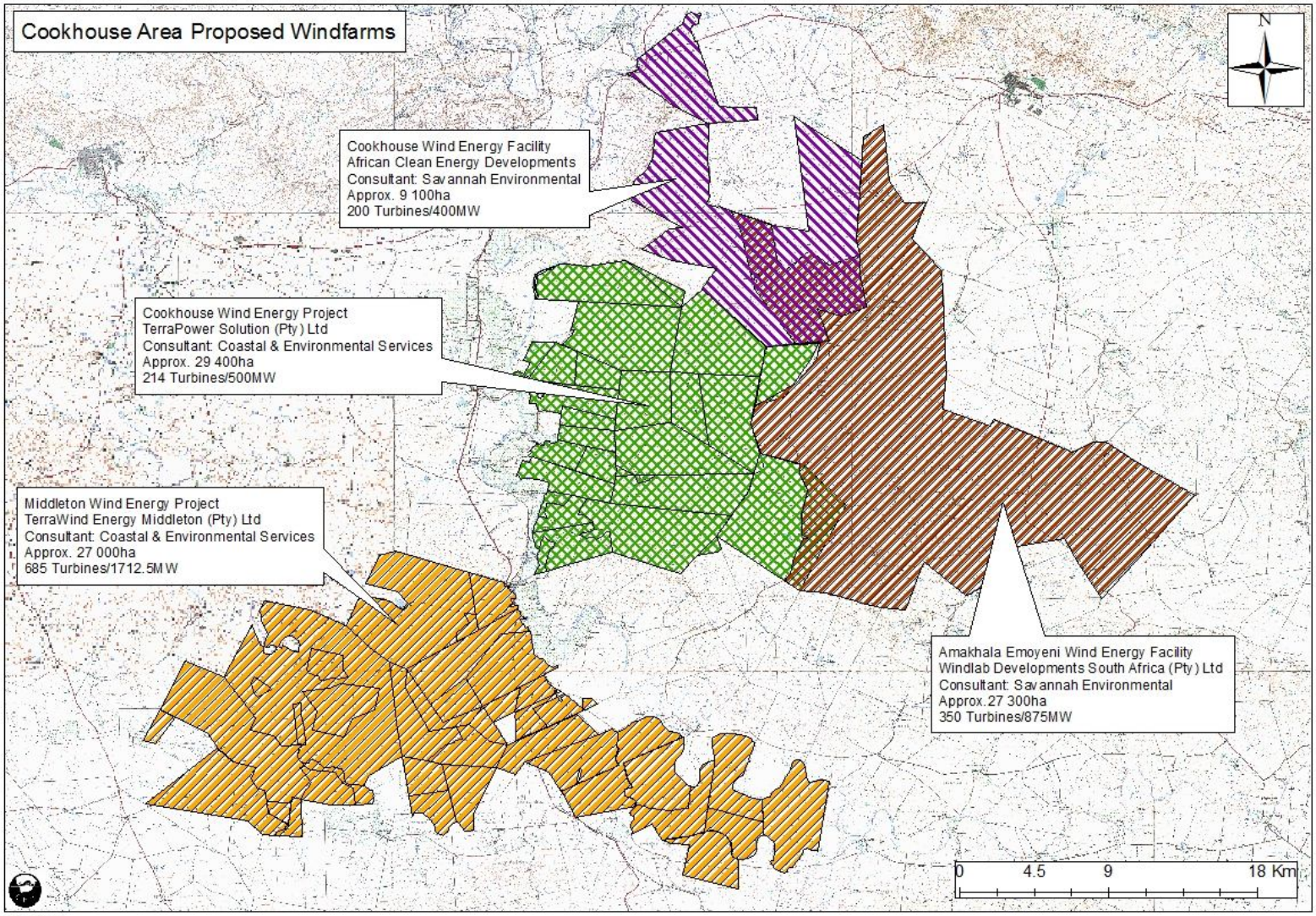

Figure 9.1: Cumulative geographical area covered by the proposed wind energy facilities for the area of Cookhouse, Bedford and Middleton in the Eastern Cape Province

9.1.2 Impact 1: Intrusion of large and highly visible construction activity on sensitive viewers

Cause and Comment
The height of the features being built and the siting on ridges is likely to expose construction activities against the skyline. Large construction vehicles and equipment will be highly visible. An increase in activity, vehicles and workers in an otherwise quiet area will affect views. Traffic will be disrupted while large turbine components are moved along public roads. Activity at night is also probable since transport of large turbine components may occur after work hours to minimise disruption of traffic on main roads. Construction of power lines and pylons in the region was observed during the photographic survey and, considering the number of power lines in the region, this is probably a common sight.

Mitigation and Management
The most obvious causes of this impact cannot be mitigated since the turbines are so tall and they are to be installed on the top of ridges. The duration of the impact is short, though, and there are a number of mitigation measures that will curtail the intensity to some extent:-

- New road construction should be minimised and existing roads should be used where possible.
- The contractor should maintain good housekeeping on site to avoid litter and minimise waste.
- Clearance of indigenous vegetation should be minimised and rehabilitation of cleared areas should start as soon as possible.
- Erosion risks should be assessed and minimised as erosion scarring can create areas of strong contrast which can be seen from long distances.
- Laydown areas and stockyards should be located in low visibility areas (e.g. valley between the ridges) and existing vegetation should be used to screen them from view.
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency. See section on lighting for more specific measures.
- Fires and fire hazards need to be managed appropriately.

Significance Statement
Without mitigation
The duration of the impact is short term (while construction lasts). The extent is *regional* due to the nature of the development (height of towers and siting on ridges) and construction activities will be visible over long distances. The visual impact will be moderate to severe due to the high visual exposure that highly sensitive viewers (residents in or close to the wind farm area, and others in close proximity to the site) will experience during the construction phase. The high voltage power line network which traverses the study area is somewhat similar in scale to the wind farm and construction activity is often exposed against the skyline. However, the individual components of the wind turbines are very large and heavy compared with that of the power line pylons. Laydown areas, access roads, transport vehicles and construction equipment will be much larger and more visible.

With mitigation
The mitigation measures are there to contain the severity of the impact and if adhered to are likely to keep it at moderate. The significance of the impact remains **high** in terms of the suggested rating methodology, although the short duration of the impact should perhaps have more of an effect on the significance rating. Construction will last approximately 16 weeks (including 8 weeks to let the foundation concrete dry, 4 weeks to erect the turbines and a further 4 weeks for final commissioning and electrical connection). Erecting the turbines is potentially the most visible activity as it will most probably be exposed against the skyline. It is also worth noting that the visual impact of at least some of the construction phase is likely to be positive, especially during assembly of the turbine towers. The construction engineering feat of lifting and attaching components weighing more than 50 tons a piece in a highly visible area is bound to be spectacular

(see for example, (Degraw 2009)). Further, most of the sensitive viewers living in close proximity to the turbines have agreed to have turbines on their properties and are presumably informed on the effect of the construction phase on their views (*pers.comm.*CES).

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Short Term	1	Regional	3	Severe	4	Definite	4	**12**	**HIGH -**
With Mitigation	Short Term	1	Regional	3	Moderate	2	Definite	4	**10**	**MODERATE -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.3 Impact 2: Noise during the Construction Phase

Cause and Comment

The impact of the noise pollution that can be expected from the proposed Terra Wind Energy-Golden Valley Project site during the construction phase will largely depend on the climatic conditions at the site. There will be a short-term increase in noise in the vicinity of the proposed project site during the construction phase as the ambient level will be exceeded. Noise during the construction phase could result from the following:-

- There will be an impact on the immediate surrounding environment from the construction activities, especially if pile driving is to be done. This, however, will only occur if the underlying geological structure requires this.
- The area surrounding the construction site will be affected for short periods of time in all directions, should a number of main pieces of equipment be used simultaneously.
- The number of construction vehicles that will be used in the project will add to the existing ambient levels and will most likely cause a disturbing noise.

Mitigation and Management

The impact during the construction phase will be difficult to mitigate. However, the following can be done:-

- All construction operations should only occur during daylight hours if possible.
- No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions.
- Ensuring that construction staff is given “noise sensitivity” training.

It should be noted that, while an effort should be made to time the piling so as to reduce noise impacts (see above), the construction team will also need to ensure that this activity is undertaken before the wind reaches a speed where safety of the construction team would be compromised.

Significance Statement

Without mitigation

The impact of noise during the construction phase would **probably** have ***moderate*** short term negative impacts. This would affect the *local area* and would be of LOW negative significance.

With mitigation

The impact of noise during the construction phase would **probably** have ***moderate*** short term negative impacts. This would affect the *local area* and would be of LOW negative significance.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Short Term	1	Local	1	Moderate	2	Probable	3	**7**	**LOW -**
With Mitigation	Short Term	1	Local	1	Moderate	2	Probable	3	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.4 Impact 3: Disturbance of birds

Cause and Comment
During construction disturbance of avifauna during all of the construction activities has the ability to negatively affect avifauna. This is especially true during breeding of sensitive species. The impact can cause sensitive species to abandon their nest or chicks and as such these species can lose these important additions to many endangered, vulnerable or near threatened populations.

Mitigation and Management
Mitigation for disturbance is much the same as for habitat destruction. In general terms all construction activities should result in the minimum amount of disturbance as possible. This will be detailed in the site specific EMP and will be enforced and overseen by the ECO for the project. During the EMP the avifaunal specialist must identify any breeding sensitive bird species in close proximity to specified turbine and associated infrastructure positions. Specific recommendations must be provided for each case and these must be strictly enforced and followed.

Significance statement
Without mitigation
The impact of disturbance displacement of birds during the construction phase ***may occur*** and wil**l** have ***moderate*** short term negative impacts. This would affect the *study area* and would be of LOW negative significance. Although disturbance is rated as low significance, mitigation must however still be implemented to keep it this way and make sure that sensitive bird species are not affected.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Short term	1	Study Area	2	Moderate	2	May occur	2	**7**	**LOW -**
With Mitigation	Short term	1	Study Area	2	Slight	1	May occur	2	**6**	**LOW -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.5 Impact 4: Loss of bird habitat through vegetation clearing/habitat destruction

Cause and Comment
During construction a large amount of habitat destruction will take place. This will be from the actual footprint of each turbine as well as associated infrastructure such as roads, batching plants, labour camps, power lines, substations and machinery and equipment storage. From an avifaunal

perspective this habitat destruction will result in a loss in habitat for many bird species. Of particular concern is the river and any natural habitat surrounding the river. This is, however, mostly transformed and used for large scale commercial agriculture. As mentioned above, in the micro-habitats section, agricultural lands can be an important habitat for birds and as such should not be discounted simply because the natural vegetation does no longer exist. Of particular concern would be breeding bird species and all care should be taken to avoid habitat destruction and disturbance in the vicinity of any breeding sensitive species.

Mitigation and Management
On a project such as this the possibility for mitigating the impact of habitat destruction is very low. The scale of the project means that it is inevitable that large amounts of habitat destruction will take place. The mitigation for this impact will be to only affect the minimum amount of habitat possible. This means that, where possible, existing roads must be used and batching plants, labour camps, equipment storage, etc should be situated in areas that are already disturbed. A full site specific EMP must also be prepared to specify all of the impacts and mitigation measures and provide a step by step programme to follow for the ECO on site. Specialist avifaunal input must be included into the EMP and this will focus on breeding sensitive species and their locations and the mitigation for this impact.

Significance statement
Without mitigation
The impact of loss of bird habitat through vegetation clearing on the construction site would **probably** have ***moderate*** permanent negative impacts. This would affect the *study area* and would be of MODERATE negative significance.

With mitigation
The impact of loss of bird habitat through vegetation clearing on the construction site **may** have ***moderate*** permanent negative impacts. This would affect the *study area* and would be of MODERATE negative significance.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Permanent	4	Study area	2	Moderate	2	Probable	3	**11**	**MODERATE -**
With Mitigation	Permanent	4	Study area	2	Moderate	2	May occur	2	**10**	**MODERATE -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.6 Impact 5: Loss of Thicket

Cause and Comment
Construction of the wind farm will result in a small amount of loss of the limited areas of Thicket 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 positive.

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.
- Proposed turbine sites are not situated within the few remaining patches of thicket. If any turbines are located in or nearby thicket, they should be moved.

Significance statement
Without mitigation
In the construction phase of this development, the impact will be long term, localised, may occur and will be a slight severity. The overall Significance of the impact will thus be a slight negative.

With mitigation
With mitigation, in the construction phase of the development, with mitigation the impact is not reduced and remains an overall significance of low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long Term	3	Localised	1	Slight	1	May Occur	2	**7**	**LOW -**
With mitigation	Medium term	2	Localised	1	Slight	1	May Occur	2	**6**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Localised	1	Beneficial	4	May	2	**8**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.7 Impact 6: Loss of Bedford Dry Grassland

Cause and comment
Construction of the wind farm will result in loss of Bedford Dry Grassland 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 positive

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.

Significance Statement
Without mitigation:
In the construction phase of this development, the impact will be long term, occurring within the study area, probably and will be a slight impact. The overall Significance of the impact will thus be a moderate negative.

With mitigation:
With mitigation, the loss of Bedford Dry Grassland due to trampling and other construction impacts can be reduced. In the construction phase of the development, with mitigation the impact is reduced to medium term, with a low severity and an overall significance of low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long term	3	Study Area	2	Slight	1	Probable	3	**9**	**MODERATE -**
With mitigation	Medium term	2	Study Area	2	Slight	1	May occur	2	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Study area	2	Beneficial	1	Definite	4	**11**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.8 Impact 7: Loss of Karroid Thicket

Cause and comment
Construction of the wind farm will result in loss of Karroid Thicket 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 a positive.

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.

Significance Statement
Without mitigation:
In the construction phase of this development, the impact will be long term, occurring within the study area, probably and will be a moderate impact. The overall Significance of the impact will thus be a moderate negative.

With mitigation:
With mitigation, in the construction phase of the development, with mitigation the impact is reduced to medium term, with a low severity and an overall significance of low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long term	3	Study Area	2	Moderate	2	Probable	3	**10**	**MODERATE -**
With mitigation	Medium term	2	Study Area	2	Low	1	May occur	2	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Study area	2	Beneficial	1	Definite	4	**11**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.9 Impact 8: Loss of Scrub Grassland

Cause and comment
Construction of the wind farm will result in loss of Scrub Grassland 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 positive.

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.

Significance Statement
Without mitigation:
In the construction phase of this development, the impact will be long term, occurring within the study area, probably and will be a moderate impact. The overall Significance of the impact will thus be a moderate negative.

With mitigation:
With mitigation, in the construction phase of the development, with mitigation the impact is reduced to medium term, with a low severity and an overall significance of low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long term	3	Study Area	2	Moderate	2	Probable	3	**10**	**MODERATE -**
With mitigation	Medium term	2	Study Area	2	Low	1	May occur	2	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Study area	2	Beneficial	1	Definite	4	**11**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.10 Impact 9: Loss of plant species of special concern

Cause and Comment
There are thirteen species of special concern on the study site. These are *Pachypodium bispinosum, Pelargonium sidoides, Crassula perfoliata, Euphorbia globosa, Euphorbia meloformis, Aloe tenuior, Anacampestros* sp, *Euphorbia meloformis, Tritonia* sp, *Watsonia* sp, *Drosanthemum* sp, *Psilocaulon* sp and *Trichodiadema* sp. 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 a moderate positive, assuming the area is well-managed, and grazing kept to a minimum.

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.

Significance statement
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 moderate 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, but the overall significance of the impact remains moderate negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long term	3	Study area	2	Moderate	2	Definite	4	**11**	**MODERATE-**
With mitigation	Long term	3	Study area	2	Slight	1	Definite	4	**10**	**MODERATE-**
NO-GO OPTION										
Without mitigation	Long term	3	Study area	2	Moderately Beneficial	2	Probable	3	**10**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.11 Impact 10: Introduction of alien plant 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.

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, and these should be cleaned before entering the site to prevent alien infestation

Significance Statement
Without mitigation
In the construction phase of the development, the impact will be short term, restricted to the study area and definite, and severe. The impact will have an overall significance of moderate 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 reduce both the likelihood and severity of the impact to 'may occur' and slight respectively. Overall significance of the impact is thus reduced from moderate negative to low negative. Alien invasion is just as likely to occur if no development takes place and mitigation measures for the No-Go option will reduce temporal scale, severity and likelihood as well, giving an overall significance of low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Short-term	1	Study area	2	Severe	4	Definite	4	**11**	**MODERATE -**
With mitigation	Short-term	1	Study area	2	Slight	1	May Occur	2	**6**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Study area	2	Moderate	2	Definite	4	**12**	**HIGH -**
With mitigation	Medium-term	2	Study area	2	Slight	1	May Occur	2	**7**	**LOW -**

9.1.12 Impact 11: Loss of faunal biodiversity

Cause and Comment
Loss of faunal diversity will occur mainly as a result of habitat destruction and resultant restriction in animal movement will reduce the fauna on the site. In addition, workers trapping animals will have an effect on the faunal populations.

If nothing was built on the site the overall impact would be a high positive.

Mitigation and management
Loss of faunal diversity will occur mainly as a result of habitat destruction and resultant restriction in animal movement will reduce the fauna on the site. In addition, workers trapping animals will have an effect on the faunal populations.

If nothing was built on the site the overall impact would be a high positive.

Significance Statement
Without mitigation
Without mitigation in the construction phase of the development, the impact will be long-term, restricted to the study area and probably will occur. Severity of the impact is moderate with an overall significance of moderate negative. This impact was assessed with a medium level of confidence.

With mitigation
With mitigation likelihood is decreased to unlikely and severity of impact is reduced to slight. The overall significance is thus a low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Long-term	3	Study area	2	Moderate	2	Probable	3	**10**	**MODERATE -**
With mitigation	Long-term	3	Study area	2	Slight	1	Unlikely	1	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	Permanent	4	Localised	1	Beneficial	4	Definite	4	**13**	**HIGH +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.13 Impact 12: Loss of faunal 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.

Mitigation and management
Mitigation measures include those described for loss of faunal biodiversity. The impact is likely to be low, however and thus these mitigation measures not required for this impact.

Significance Statement
Without mitigation
Without mitigation in the construction phase of the development, the impact will be permanent, localised and unlikely with a severity of slight and an overall significance of low negative. This impact was assessed with a high level of confidence.

With mitigation
Mitigation measures for this impact are unnecessary as the impact is low negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Permanent	4	Localised	1	Slight	1	Unlikely	1	**7**	**LOW -**
With mitigation	N/A		N/A		N/A		N/A		**N/A**	**N/A**
NO-GO OPTION										
Without mitigation	Permanent	4	Localised	1	Beneficial	4	Definite	4	**13**	**HIGH +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.14 Impact 13: Disturbance / Displacement of Bats

Cause and Comment
Disturbance / displacement from around the turbines may result in reduced breeding productivity or reduced survival if bats are displaced from preferred habitat and are unable to find suitable alternatives. Disturbance may be caused by the presence of turbines, and/or by maintenance vehicles and people, as well as during the construction of the turbines.

Mitigation and management
Not a great deal can be done to minimise the effects of disturbance displacement from construction activities. However, within reason noise must be kept to a minimum when constructing the wind energy facility.

Significance statement
Without mitigation
In the construction phase without mitigation the impact will occur over the short term, be restricted to the study area and probable with a slight severity. Overall significance is Low Negative.

With mitigation
With mitigation, the severity is still slight, resulting in an overall significance of Low Negative.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Short term	1	Study area	2	Slight	1	Probable	3	**7**	**LOW -**
With mitigation	Short term	1	Study area	2	Slight	1	Probable	3	**7**	**LOW -**
NO-GO OPTION										
Without mitigation	Long term	3	Localised	1	Slight	1	May occur	2	**7**	**LOW +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.15 Impact 14: Loss of bat habitat due to vegetation clearing

Cause and comment
Change to or loss of habitat due to wind turbines and associated infrastructure. A relatively small area of habitat for bats will be completely destroyed in the construction process.

Mitigation and management
The following mitigation measures can be used to minimise the effects of loss of habitat:

- The wind turbines should not be placed on the tops of ridges.
- Every effort should be made to rehabilitate the damaged vegetation to minimise the habitat losses to resident bat species.

Significance Statement
Without mitigation
For the construction phase without mitigation the impact will occur in the short term, will be restricted to the study area and is probable with a severity of slight and an overall significance of Low Negative.

With mitigation
With mitigation the risk is slight and the overall significance is a Low Negative

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without mitigation	Short term	1	Study area	2	Slight	1	Probable	3	**7**	**LOW -**
With mitigation	Short term	1	Study area	2	Slight	1	May occur	2	**6**	**LOW -**
NO-GO OPTION										
Without mitigation	Long term	3	Study area	2	Slight	1	May occur	2	**8**	**MODERATE +**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.1.16 Impact 15: Heritage Impact

Cause and Comment
Wind energy facilities are big developments that can produce a wide range of impacts that will affect the heritage qualities of an area. Typically each turbine can be up to 100m high with blades/rotors up to 50m in radius. Each turbine site needs road access that can be negotiated by a heavy lift crane(s) which means that in undulating topography (such as in the study area) deep

cuttings and contoured roads will have to be cut into the landscape to create workable gradients. During the construction phase each of the turbine sites will have to be leveled off to create a solid platform for cranes as well as a lay-down area for materials. This will involve earthmoving and road construction, followed by the bringing in of materials and plant. The actual construction of the turbines will involve excavation into the land surface to a depth of 3m and over an area of 400m^2 for the concrete base. The pre-fabricated steel tower is bolted on to the base and erected in segments. The nacelle containing the generator is finally attached followed by the rotors. The turbines are connected to underground cables to sub-station (positioned to be determined) where after the generated current will be fed to the nearby Poseidon substation via a 132/400 kV transmission line.

During the construction phase the following physical impacts to the landscape and any heritage that lies on it can be expected:

- Bulldozing of roads to turbines sites with a possibility of cut and fill operations in places.
- Upgrading of existing farm tracks
- Creation of working and lay-down areas close to each turbine site
- Excavation of foundations for each tower
- Excavation of many kilometres of linear trenches for cables
- Erection of a 132/400 kV power line (pole design or route not finalised)
- Construction of electrical infra-structure in the form of one or more sub-stations.

In terms of impacts to heritage, archaeological sites which are highly context sensitive are most vulnerable to the alteration of the land surface. The survey undertaken to inform this assessment has revealed that archaeological sites are very sparse on the landscape which is consistent with earlier work carried out on another proposed wind farm in the area (Halkett and Webley 2009). This means that generally the impacts to archaeological heritage are likely to be of low significance. The clear patterning of archaeological sites in valley bottoms and alluvial plains contrasts with the requirement to erect wind turbines in windy exposed areas such as ridge tops and hill slopes which is in itself a factor that is likely to mitigate damage.

Mitigation and management

The best way to manage impacts to archaeological material is to avoid impacting them. This means micro-adjusting turbine positions where feasible, or routing access roads around sensitive areas. If primary avoidance of the heritage resource is not possible some degree of mitigation can be achieved by systematically removing the archaeological material form the landscape. This is generally considered a second-best approach as the process that has to be used is exacting and time-consuming, and therefore expensive. Furthermore the NHRA requires that archaeological material is stored indefinitely, which has cost implications and places an undue burden on the limited museum storage space available in the province. Although indications are that impacts to archaeological material are likely to be of low significance, it must be noted that it has not been possible to assess the potential impacts of road construction on archaeological sites. Furthermore, turbine positions provided are preliminary. It is recommended that the following mitigation measures are implemented.

- Existing farm tracks must be re-used or upgraded to minimise the amount of change to un-transformed landscape.
- In general terms, construction of turbines and roads in valley bottoms should be kept to a minimum.
- During the detailed planning phase, drawings of proposed road alignments, infrastructure and near-final turbine positions should be submitted to an archaeologist for review and field-proofing. Micro-adjustment of alignments and turbine positions is likely to be sufficient to achieve adequate mitigation.

Significance statement

The significance of impacts during the construction phase to physical heritage such as

archaeological material and built environment is likely to be low as the landscape contains a sparse distribution of sites.

Without mitigation
The impact on heritage in the construction phase **may occur** and have ***moderate*** permanent negative impacts. This would affect the *local area* and would be of MODERATE negative significance.

With mitigation
The impact on heritage in the construction phase is **slight** and will have ***slight*** short-term negative impacts. This would affect the *local area* and would be of LOW negative significance.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Permanent	4	Localised	1	Moderate	2	May Occur	2	**9**	**MODERATE -**
With Mitigation	Short	1	Localised	1	Slight	1	Slight	1	**4**	**LOW -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

The no-go alternative. Not implementing the proposal will result in no impacts to heritage, apart from those impacts caused by natural forces such as erosion**.**

9.1.17 Impact 16: Palaeontological Impacts

Cause and comment
Significant impacts on palaeontological heritage normally occur during the construction phase and not in the operational phase of any development. Excavations made during the course of installing the proposed wind farm turbines and associated developments (*e.g.* roads, powerlines) may well expose, damage, disturb or permanently seal-in scientifically valuable fossil heritage that is currently buried beneath the land surface or mantled by dense vegetation.

The fossil record and inferred palaeontological sensitivity of the three main rock units represented in the study region are summarized in Table 9-1 (Based on Almond *et al*., 2008). Bedrock excavations made during construction of the proposed wind energy facility east of Cookhouse will primarily affect continental sediments of the Middleton Formations of the Late Permian Beaufort Group.

These sediments underlie the great majority of the study area and are renowned for their rich fossil heritage of terrestrial vertebrates (most notably mammal-like reptiles or therapsids), as well as fish, amphibians, molluscs, trace fossils (*e.g.* trackways) and plants (*e.g.* petrified wood). Caenozoic surface sediments in the study area (*e.g.* alluvium, colluvium) are generally of low palaeontological sensitivity, while the Karoo dolerite intrusions do not contain fossil remains at all.Although the direct impact of the proposed project will be local, fossils within the Beaufort Group are of importance to national as well as international research projects on the fossil biota of the ancient Karoo and the end-Permian mass extinction.

Table 9-1: Sensitivity of Fossil Heritage of Rock Units represented within Cookhouse study area

FORMATION & AGE	FOSSIL HERITAGE	PALAEON-TOLOGICAL SENSITIVITY	RECOMMENDED MITIGATION FOR NEW DEVELOPMENTS
Superficial deposits (colluvium, alluvium *etc*) **Late Caenozoic**	Sparse remains of vertebrates (*e.g.* mammalian bones, teeth), trace fossils (calcretized termitaria, rhizoliths), freshwater molluscs, microfossils (*e.g.* palynomorphs)	LOW	None
Karoo Dolerite Suite **Early Jurassic**	None (igneous intrusions)	ZERO	None
Middleton Formation (Lower Beaufort Group) **Late Permian**	Rich continental biota of reptiles, therapsids, amphibians, fish, molluscs, petrified wood and plant debris & trace fossils	HIGH TO LOCALLY VERY HIGH	Intensive recording and collection of fossil material within designated high sensitivity areas demarcated on map (Fig. ** below)

Mitigation and management

Where rich or unusual fossil remains are likely to be present within the Beaufort Group rocks, study and judicious sampling of the sediments and their enclosed fossils by a qualified palaeontologist *before* construction starts is usually recommended. However, the greater part of the proposed wind farm development at Cookhouse is not considered as posing a serious risk to local fossil heritage because:

- deep or voluminous bedrock excavations are unlikely to be required for the installation of wind turbines, electricity powerlines and ancillary developments, with the possible exception of any borrow pits;
- an extensive, and often thick, mantle of comparatively unfossiliferous drift deposits (alluvium, colluvium) covers the more sensitive Beaufort Group rocks over much of the region;
- fossil remains are apparently much scarcer within the Beaufort Group succession in the study area compared with similar-aged outcrops further west within the Great Karoo (as borne out by this and a previous, independent palaeontological field study).
- the Beaufort Group in the study region has been extensively affected by Permotriassic tectonism (folding, faulting, some cleavage development) and locally by thermal metamorphism due to Jurassic dolerite intrusion, perhaps reducing the palaeontological sensitivity of these rocks (*N.B.* These last effects may not be very significant in practice).

Nevertheless, it is recommended that specialist palaeontological mitigation be carried out at least within the two small areas demarcated in the satellite image in the Specialist Volume. The proposed specialist mitigation should involve the intense recording and judicious collection of fossil material within the designated two areas, as well as the recording of pertinent geological data (e.g. sedimentological information). Note that the palaeontologist involved will be required to obtain beforehand a palaeontological collection permit from SAHRA and to arrange a suitable repository for any fossils collected (*e.g.* Albany Museum, Grahamstown, BPI, Wits University, Johannesburg or Iziko: South African Museums, Cape Town). Should substantial fossil remains, such as vertebrate bones, teeth or petrified wood, be found or exposed anywhere within the study area during construction, the responsible ECO should safeguard these – *in situ*, if feasible – and alert

SAHRA as soon as possible so that appropriate mitigation can be undertaken by a professional palaeontologist at the developer's expense.

Note that *providing* appropriate mitigation is carried out, as outlined here, the Terra Wind Energy Golden Valley Project development should usefully contribute to our understanding of the rich palaeontological heritage of the Great Karoo region.

Significance Statement
According to the CES significance rating scheme the overall impact of the proposed Terra Wind Energy Golden Valley Project on palaeontological heritage is assessed as LOW. This accords with "an acceptable impact for which mitigation is desirable but not essential". Failure to mitigate will probably result in the loss of local fossil heritage, while mitigation will probably provide new palaeontological data that is of regional significance (a moderately beneficial outcome). The no-go option will have a low negative impact compared with construction of the wind farm accompanied by recommended specialist mitigation, since the opportunity to collect further palaeontological data will be lost for the time being.

Without Mitigation
The palaeontological impacts in the construction phase would be **probable** and have ***moderate*** permanent negative impacts. This would affect the *local area* and would be of LOW negative significance.

With Mitigation
The palaeontological impacts in the construction phase would be **probable** and have ***moderate*** permanent negative impacts. This would affect the *regional area* and would be of MODERATE positive significance.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
CONSTRUCTION PHASE										
Without Mitigation	Permanent	4	Localised	1	Moderate	2	Probable	3	**10**	**LOW -**
With Mitigation	Permanent	4	Regional	3	Moderately Beneficial	2	Probable	3	**12**	**MODERATE +**
NO-GO OPTION										
Without mitigation	Long term	3	Study area	2	Moderate	2	Probable	3	**13**	**LOW -**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.2 Operational Phase Impacts

9.2.1 Introduction

As discussed in the previous section, the EAP also investigated the cumulative impacts for the operational phase of establishing four wind farms in the area of Cookhouse, Bedford and Middleton in the Eastern Cape Province. The cumulative impact is discussed together with the individual impact it pertains to.

9.2.2 Impact 1: Change in the agricultural landscape as a result of establishing a wind farm

Cause and Comment
The current landscape character is that of commercial stock and irrigated farming. The landscape character has a low sensitivity to the change that will be caused by introduction of a wind farm. It is expected that land use of stock farming will not be altered by introduction of wind turbines in the

area. However, this is a large wind farm and the landscape aspect will be affected, especially initially when the wind farm is still a new feature in the landscape.

Mitigation and Management
There are no mitigation measures that will change the significance of the landscape impact other than avoiding the site entirely. A reduction in wind turbine numbers are unlikely to have an appreciable effect since even a few wind turbines will still have high visibility.

Significance Statement
The duration of the impact is long term (not permanent) since the turbines can be removed from the landscape after their life span of 40 years has been reached. The spatial scale is regional due to the visibility and size of the project. The severity of the impact is expected to be moderate since the landscape character sensitivity is low but the wind farm is particularly large. The likelihood of the impact occurring is probable (and not definite) since it is not yet known what the impact of a wind farm on an agricultural landscape will be in South Africa. The significance of the landscape impact is therefore expected to be **moderate.**

Without mitigation
In the agricultural landscape in the operation phase would be **probable** and have ***moderate*** long-term negative impacts. This would affect the *regional area* and would be of MODERATE negative significance.

Cumulative Impact Statement
The development of multiple wind energy facilities in the area has the potential for cumulative impact on the change in the agricultural landscape. The visual impact of the proposed wind farm is reduced due to Eskom's transmission lines that presently transverse the proposed site, thus the area has already been impacted, and no longer be seen as a pristine agricultural landscape. The cumulative impact will compound this moderate impact into a high impact. The cumulative impact is therefore assessed to be of high concern. There are no mitigatory measures available to reduce the impact.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
OPERATIONAL PHASE										
Without Mitigation	Long Term	3	Regional	3	Moderate	2	Probable	3	**11**	**MODERATE -**
With Mitigation	Long Term	3	Regional	3	Moderate	2	Probable	3	**11**	**MODERATE -**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**
CUMULATIVE IMPACT										
Without mitigation	Long Term	3	Regional	3	Moderate	2	Definite	4	**12**	**HIGH -**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.2.3 Impact 2: Intrusion of large wind turbines on the existing views of sensitive visual receptors

Cause and Comment
Most of the viewers/viewpoints identified (as per section 6.5.3.4) in this report are highly sensitive to changes in their views. However, the region has a low population density and the proposed site is far removed from visually sensitive areas such as pristine wilderness sites and protected areas. A large network of high voltage power lines radiates across most of the study area and pylons are

visible from most viewpoints. The wind farm will alter a number of views due to its size (spatial extent and the height of the turbines) and visibility (located on ridges). There are a few visual receptors (viewers and viewpoints) for which the visual intrusion will be very high (residents living on or close to the wind farm area), although they have agreed to turbines on their properties.

Mitigation and Management
Most of the viewers/viewpoints identified in this report are highly sensitive to changes in their views (as determined and discussed in section 6.5.3.4). There are no mitigation measures that will change the significance of the intrusion impact other than avoiding the site entirely. A reduction in wind turbine numbers are unlikely to have an appreciable effect since even a few wind turbines will still have high visibility.

Significance Statement
Without mitigation
The impact of intrusion of large wind turbines on the existing views of sensitive visual receptors in the operation phase would be **definite** and have ***moderate*** long-term negative impacts. This would affect the *regional area* and would be of HIGH negative significance.

With mitigation
The impact of intrusion of large wind turbines on the existing views of sensitive visual receptors in the operation phase would be **definite** and have *moderate* long-term negative impacts. This would affect the *regional area* and would be of HIGH negative significance.

The duration for the impact is **long term** since the life span of a wind turbine can be up to 40 years after which it can be dismantled, or upgraded. The extent of the impact is **regional** since residents and other sensitive viewers will potentially view the wind farm from different areas in the region. Many existing views will be altered by the wind farm. It is not clear whether the change will be perceived as positive (i.e. as a symbol of sustainable and environmentally less harmful energy harvesting) or negative, since opinions on the visual aesthetics of wind farms differ widely. It is expected that the **severity** of the impact will be high for a number of residents who live on or very close to the wind farm area (many of whom presumably are in favour of the wind farm). For most of the other sensitive viewers discussed above the severity will be **moderate to low**. The impact will **definitely** occur. The overall significance of the visual impact on sensitive viewers is **high**.

Cumulative Impact Statement
The impact statement remains the same as for the single wind energy project as assessed above due to the fact that the change could be perceived as positive (i.e. as a symbol of sustainable and environmentally less harmful energy harvesting) or negative, since opinions on the visual aesthetics of wind farms differ widely. There are no mitigation measures available.

Impact	Effect						Risk or Likelihood		Total Score	Overall Significance
	Temporal Scale		Spatial Scale		Severity of Impact					
OPERATIONAL PHASE										
Without Mitigation	Long Term	3	Regional	3	Moderate	2	Definite	4	**12**	**HIGH**
With Mitigation	Long Term	3	Regional	3	Moderate	2	Definite	4	**12**	**HIGH**
NO-GO OPTION										
Without mitigation	N/A		N/A		N/A		N/A			**N/A**
With mitigation	N/A		N/A		N/A		N/A			**N/A**
CUMULATIVE IMPACT										
Without mitigation	Long Term	3	Regional	3	Moderate	2	Definite	4	**12**	**HIGH**
With mitigation	N/A		N/A		N/A		N/A			**N/A**

9.2.4 Impact 3: Impact of shadow flicker on residents in close proximity to wind turbines

Cause and Comment
The impact of shadow flicker[1] caused by wind turbines appears to be a minor issue in most countries where wind farms are common. There is no official set of regulations governing the levels of exposure to shadow flicker and it is unclear what the health risks are. Most reports on shadow flicker suggest that the threshold for a significant impact is 30 hours per year or more and many countries have adopted this as an informal regulation, following a court judgement made in Germany (EDR 2009).

Mitigation and Management
The following mitigation measures can reduce the impact of shadow flicker:

- Trees are an effective measure against shadow flicker and if residents are willing trees can be planted to reduce flickering.
- Alternatively, a sensor can be installed at homes potentially affected by shadow flicker which shuts down the turbine on the rare occasion that the conditions are such that shadow flicker can occur (Portwain 2008). It is unclear how practical this is as a solution but it should be investigated.
- Adjust layout of the wind farm (site of turbines) to lower the number of residents affected by shadow flicker.

Significance Statement
Without mitigation
The impact of shadow flicker on residents in close proximity to wind turbines would be **unlikely** and have ***severe*** long-term negative impact. This would affect the *local area* and would be of MODERATE negative significance.

With mitigation
The impact impact of shadow flicker on residents in close proximity to wind turbines would be unlikely and have *moderate* long-term negative impacts. This would affect the *local area* and would be of LOW negative significance.

Cumulative Impact Statement
As the number of wind energy facilities increase, so could the effect of shadow flicker due to the number of wind turbines and their heights in a single area. However, the Cookhouse, Bedford and Middleton area is a rural/agricultural region and therefore is unlikely to have many viewers. The topography of the landscape in the area where the wind farm is to be located is such that many viewers within the wind farm area will see only a few turbines at a time relative to viewers outside the area and west of Cookhouse. This is due to the fact that the wind farm will be located in an area with irregular relief and which is lower than most of the surrounding region. There are no mitigation measures available to address on a cumulative scale. Thus mitigation should be considered by the individual proponents as suggested above.

[1] An impact particular to wind turbines is very large moving shadows created by the giant blades when the sun is low on the horizon