APPENDIX D UPDATED SPECIALIST STUDIES

Rheboksfontein Wind Energy Facility

Part Two Amendment: Revised Avifauna Verification and Assessment Update

15 April 2021

Project No.: 0547329

The business of sustainability

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15 April 2021

Rheboksfontein Wind Energy Facility

Part Two Amendment: Revised Avifauna Verification and Assessment Update

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15 April 2021

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Rheboksfontein Wind Energy Facility

Part Two Amendment: Revised Avifauna Verification and Assessment Update

Declaration

This report has been prepared by: Peter Wright (MSc).

I, Peter Wright, declare that -

- I act as the independent specialist;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and

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1.1 Introduction

ENGIE Africa (hereafter referred to as ENGIE) is planning to develop a Wind Energy Facility (WEF) to be called Rheboksfontein WEF (hereafter the Project or WEF), to add capacity to the national electricity grid. Rheboksfontein WEF will be located approximately 3 km west of Darling and 10 km east of Yzerfontein, within the Western Cape Province. The original EIA Report and associated specialist studies were submitted to the relevant Authorities in 2011, and the proposed WEF was subsequently authorised on 2 February 2012 (EA Reference: 12/12/20/1582).

Since completion of the original specialist studies on avifauna, and obtaining the initial Environmental Authorisation (EA), technologies have advanced, and hence ENGIE intends to increase the proposed wind turbine sizes, reduce the number of turbines and adjust the project layout plan to optimise the efficiency of the WEF. The proposed amendments may be construed as a change in the scope of the EA and may result in changes in the associated impacts, thus requiring an amendment application in terms of Part 2 of Chapter 5 of the EIA Regulations 2014 (as amended).

The assessment presents mitigation measures identified to reduce the significance of impacts and support the adaptive manage of impacts on avifauna.

1.2 Data Sources and Revised Analysis

This revised assessment is informed by the baseline and impact assessment reports for the EIA for original Project and subsequent additional assessments. These include:

- Jenkins, A.R. (2010) Rheboksfontein Wind Energy Facility: Avian impact assessment. Report to Savannah Environmental Pty (Ltd).
- Jenkins, A.R., du Plessis, J., Colyn, R., Cooke, P-J, & Benn, G. (2013) Rheboksfontein Wind Energy Facility: avian impact risk assessment and mitigation scheme. Report to Moyeng Energy (Pty) Ltd.
- Jenkins, A.R., Reid, T.A., du Plessis, J., Colyn, Cooke, P., R., Benn, G. & Millikin, R. (2014) Estimating the impact of the proposed Rheboksfontein Wind Energy Facility on the Great White Pelican population of the Cape west coast.
- Jenkins, A.R., Reid, T.A., du Plessis, J., Colyn, R., Benn, G. & Millikin, R. (2018) Combining radar and direct observation to estimate pelican collision risk at a proposed wind farm on the Cape west coast, South Africa. PLoS ONE 13(2): e0192515. https://doi.org/10.1371/journal.pone.0192515
- Bird distribution data of the Southern African Bird Atlas Project 2 http://sabap2.birdmap.africa/

In addition, radar data collected during 2013 and analysed to inform the assessments presented in Jenkins *et al* 2014 have been re-analysed to inform an assessment of the updated Project layout and specifications.

The assessment of impacts on particular species has been informed by additional literature and guidance including SNH, 2018, Birdlife South Africa, 2017, Simmons *et al*, 2020. Potential impacts on great white pelican have also been informed by monitoring studies of sites in Romania where potential impacts on great white pelican were predicted (Hatton *et al*, 2017).

1.3 Baseline Summary

1.3.1 Summary of Habitats and Landuse

The site identified for the establishment of the facility is located 3 km west of Darling within the Western Cape Province. The area originally considered for development of the proposed facility and associated infrastructure, is as follows (also indicating on which portions the revised layout will be):

- Remaining extent of Farm 568 Rheboksfontein;
- Farm 567 Nieuwe Plaats (no turbines on this land);
- Remaining extent of Farm 571 Bonteberg (no turbines on this land, but access routes);
- Portion 1 of Farm 574 Doornfontein;
- Portion 1 of Farm 551 Plat Klip;
- Farm 1199 Groot Berg; and
- Portion 2 of Farm 552 Slang Kop (no turbines on this land, but access routes).

The Project area falls within the Sand Fynbos and Granite Renosterveld types and Swartland Biodiversity Sector Plan Area, which is part of the Fynbos Biodiversity Hotspot in South Africa.

The Project area is dominated by agricultural land but also supports the following habitat types:

- Swartberg Granite Renosterveld
- Fragmented Swartberg Granite Renosterveld
- Hopefield Sand Fynbos
- Wetlands and Riparian Areas
- Alien Tree Patches

The habitats on the project site are largely unchanged since the previous avifauna assessment was completed in 2013.

1.3.2 Designated Sites and IBAs

Nationally designated or internationally recognised sites within 20 km of the Project site are shown in Table 1.1.

Of the two IBAs within 20 km of the Project site, the West Coast National Park and Saldanha Bay Islands IBA supports an assemblage of over 20,000 breeding and non-breeding waterbirds including nationally or internationally important populations of the globally Endangered species African penguin (*Spheniscus demersus*), Cape gannet (*Morus capensis*), Cape cormorant (*Phalacrocorax capensis*), bank cormorant (*Phalacrocorax neglectus*) and black harrier (*Circus maurus*) (Birdlife International, 2020) [1]0. Dassen Island IBA and Ramsar Site supports an assemblage of over 20,000 breeding and non-breeding seabirds as was as nationally or internationally important populations of globally Endangered species African penguin, Cape cormorant and bank cormorant. It supports a nationally important population of great white pelican (*Pelecanus onocrotalus*) as part of the seabird assemblage.

([1]) http://datazone.birdlife.org/site/factsheet/west-coast-national-park-and-saldanha-bay-islands-iba-south-africa/details

Table 1.1 Designated Sites within 10 km of the Project Site

Name	Designation	Distance From Project Site
Jakkalsfontein Private Nature Reserve	Private Nature Reserve	300m
Darling Local Nature Reserve	Local Nature Reserve	3 km
Darling Renosterveld Local Nature Reserve	Local Nature Reserve	3.6 km
Pierre-Jeanne Gerber No 2 Private Nature Reserve	Private Nature Reserve	4 km
West Coast National Park and Saldanha Bay islands	Important Bird and Biodiversity Area (IBA)	4.2 km
Yzerfontein Local Nature Reserve	Local Nature Reserve	7.6 km
West Coast National Park	National Park	7.6 km
Sonquas Fontein Wildlife Private Nature Reserve	Private Nature Reserve	8 km
Grotto Bay Private Nature Reserve	Private Nature Reserve	8.2 km
Bokbaai Nature Reserve	Nature Reserve	14.9 km
Dassen Island	Provincial Nature Reserve, IBA, Ramsar Site	17.2 km

1.3.3 Avifauna Baseline

The avifauna baseline presented in the avifauna impact assessment and subsequent studies for the consented development is summarised below, with additional relevant updates.

1.3.3.1 Avifauna Overview from Consented Development Avian Impact Risk Assessment Report

At least 200 bird species are considered likely to occur with some regularity within the Project site including 44 endemic or near-endemic species, 14 South African Red-Listed Species (Taylor *et al* 2015), and two species – blue crane (*Anthropoides paradiseus)*, and black harrier (*Circus maurus)* which are both endemic and red-listed (Jenkins et al 2013).

Baseline surveys recorded an assemblage of small passerines typical of cereal croplands or coastal heathland, with the most abundant taxa being pipits, larks or flocking granivores.

Numbers of larger birds and raptors fluctuated through the year, with the highest numbers recorded during winter. Blue crane was recorded relatively frequently, particularly during winter when wintering flocks were recorded in the wider area (total count on the Project site was 15 birds). Steppe buzzard (*Buteo buteo*) and jackal buzzard (*Buteo rufofuscus*) were the most commonly recorded raptor with 7 birds each recorded. Breeding raptors recorded in the area included one pair of peregrine falcons (*Falco peregrinus*), one pair of jackal buzzards, and up to eleven pairs of rock kestrels (*Falco rupicolus*). Flight activity was also recorded for, amongst other species, black harrier, martial eagle (*Polemaetus bellicosus*), and lanner falcon (*Falco biarmicus*).

Wetland bird counts were undertaken, focusing on four wetlands close to the Project site. Relatively low numbers (99 birds of 11 species) were recoded, with 40 greater flamingos (*Phoenicopterus roseus*) and no lesser flamingos (*Phoeniconaias minor*), both species that have been recorded in the area previously. A high level of flight activity was recorded for great white pelican (*Pelecanus onocrotalus*), relating to birds breeding at Dassen Island and commuting to feeding areas on the outskirts of Cape Town such as the Vissershok Waste Management Facility.

Based on the results of baseline data gathering and surveys, a list of priority bird species was identified for the Project in Jenkins et al 2013. These priority species are shown in Table 1.2, with updated South African Bird Atlas Project 2 (SABAP 2) reporting rates from the relevant pentads for the Project site (3315_1815, 3320_1815 and 3320_1820). Based on the results of baseline vantage point surveys, flight activity and passage rates for these priority species were recorded, as shown in Table 1.3.

Table 1.2 Priority Bird Species Identified

Common Name	Scientific Name	South African Status (Global Status)	Regional Endemicity	Average SABAP reporting rate (N=193 cards)	Average SABAP 2 reporting Rate (N=151 cards)	Estimated importance of local population	Preferred Habitat	Risk Posed by Wind Farm Development		
								Collision	Electrocution	Disturbance / Habitat Loss
Blue crane	*Anthropoides paradiseus*	Near Threatened (Vulnerable)	Endemic	12.4	61.2	Moderate	Croplands, wetlands	High	-	High
African marsh harrier	*Circus ranivorus*	Endangered (Least Concern)		6.7	10.0	High	Croplands, wetlands	Moderate	-	High
Black harrier	*Circus maurus*	Endangered (Endangered)	Endemic	10.4	15.4	High	Wetlands, Fynbos, croplands	High	-	High
Martial eagle	*Polemaetus bellicosus*	Endangered (Vulnerable)		1.6	8.9	Moderate	Fynbos, croplands	High	High	Moderate
Secretary bird	*Sagittarius serpentarius*	Vulnerable (Vulnerable)		1.6	7.5	Moderate	Croplands	High	-	Moderate
Lanner falcon	*Falco biarmicus*	Vulnerable (Least Concern)		10.9	11.8	Moderate	Croplands, ridges	High	Moderate	High
Peregrine falcon	*Falco peregrinus*	Least Concern (Least Concern)		2.1	3.3	Moderate	Croplands, ridges	High	Moderate	High
Greater flamingo	*Phoenicopterus roseus*	Near-threatened (Least Concern)		9.8	33.5	Moderate	Wetlands, flying through	High	-	Moderate
Lesser flamingo	*Phoeniconaias minor*	Near-threatened (Near-threatened)		6.7	16.4	Moderate	Wetlands, flying through	High	-	Moderate
Great white pelican	*Pelecanus onocrotalus*	Vulnerable (Least Concern)		15.5	33.4	High	Wetlands, flying through	High	-	High

Source: Jenkins *et al*, 2013 updated

Table 1.3 Flights, Total Numbers and Passage Rates of Priority Species Recorded During 178.5 hours of Vantage Point Surveys

Common Name	Scientific Name	Total number of sightings in flight below 150 m	Total number of birds in flight below 150 m	Passage Rate – Birds hr^{-1} in flight below 150 m	Mean Annual Calculated Passage Rates – Birds hr^{-1} 30-150 m
Blue crane	*Anthropoides paradiseus*	13	104	0.58	0.05
Black harrier	*Circus maurus*	3	3	0.02	-
Martial eagle	*Polemaetus bellicosus*	1	1	0.01	0.0006
Lanner falcon	*Falco biarmicus*	3	3	0.02	0.01
Peregrine falcon	*Falco peregrinus*	7	7	0.04	0.006
Greater flamingo	*Phoenicopterus roseusr*	1	1	0.01	0.005
Great white pelican	*Pelecanus onocrotalus*	46	305	1.71	1.29

Source: Jenkins *et al* 2013

1.3.3.2 Pelican Tracking Study Results

As a result of the relatively high flight activity through the Project area by great-white pelican recorded during the baseline visual surveys, Great white pelican was identified as the key avian receptor for the Project. An additional study was therefore undertaken to inform further assessment of the potential collision risk the Project posed to this species. A radar tracking study was undertaken between July 2013 to early March 2014 to provide more detailed information about great white pelican flight activity, and to inform a more detailed collision risk assessment for this species.

The co-observed surveys (ie visual and radar surveys undertaken at the same time) recorded 407 flocks of pelicans comprising 4,539 birds. These observations were combined with the complete radar data set to identify great white pelican tracks, based on a comparison of track characteristics of co-observed tracks and the complete radar track dataset. The combined data set comprised 14,999 radar tracks identified as great white pelican during the study period. This dataset was combined with the Project design at the time (turbine location, height and blade length) to identify 'High Risk Flights' that were at risk of resulting in collisions of great white pelican with turbines. This analysis produced a figure of 5,898 flights annually for great-white pelican (Jenkins *et al*, 2014). The calculated level of flight activity was used to inform a collision risk assessment for the consented development (see Sections 1.5.1 and 1.5.2.

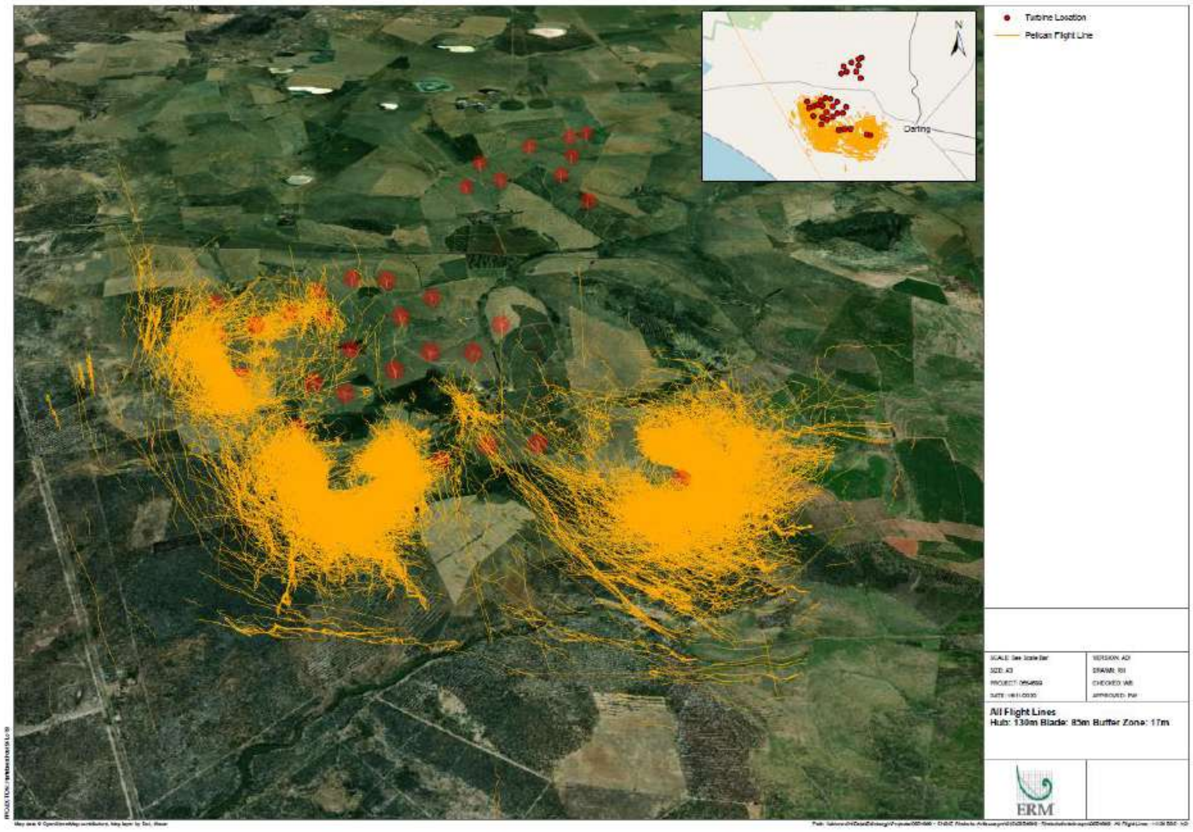
1.3.3.3 Updated Analysis of Radar Tracking Data

In order to inform this updated assessment, the 2013-2014 radar data was re-analysed to update the level of flight activity and the number of 'High Risk Flights' associated with the updated Project parameters. A summary of the data analysis undertaken and the outputs of the analysis are presented in Appendix A. Further detail on the radar study approaches and coverage are presented in Jenkins *et al*, 2014.

An overview of all of the great white pelican flights identified from the updated analysis of the radar is presented in Figure 1.1.

In addition to the radar data for great white pelican flights, radar data for other species were also analysed to obtain the flight activity by other priority species, and identify changes in the level of flight activity from those assessed in the 2013 impact assessment.

Figure 1.1 Great White Pelican Flight Lines from the 2013-2014 Radar Study

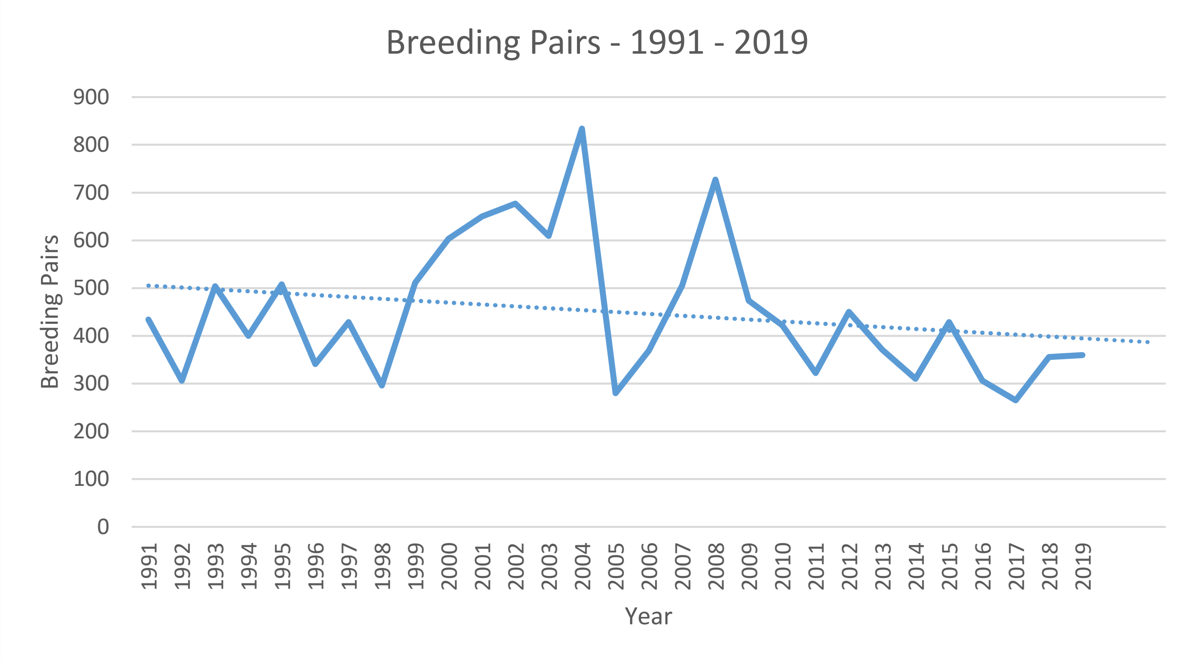


1.3.4 Dassen Island Pelican Population

In order to understand the current great white pelican population at Dassen Island, updated population count data (number of breeding pairs) for Dassen Island was obtained, presented in Figure 1.2. The data on the number of breeding pairs suggests that the breeding population at Dassen Island is slowly declining, rather than being stable as was assumed during the 2013 and 2014 assessments (Jenkins *et al*, 2014).

Jenkins *et al* 2014 noted that the relatively good great white pelican breeding success observed in the early 2000s may have been related to a higher availability of food from agricultural offal from pig farms, and from scavenging at the Visserhok Waste Management Facility, both located north of Cape Town. The closing of a number of pig farms and subsequent loss of a feeding resource in the late 2000s may have affected the breeding success of the population.

Figure 1.2 Dassen Island Great White Pelican Population Data



1.4 Project Description

1.4.1 Summary of Approved Development Proposal

The Project is situated just south of the intersection of the R27 and R315, about 6 km northwest of Darling, Western Cape Province. It covers an area of approximately 39 km^2.

The original development on the site received Environmental Authorisation in February 2012 for a development with a total generating capacity of 129 MW comprising 43 turbines with tower heights between 80- 100 m and turbine blades up to 55m in length.

An amendment of the EA was granted in May 2015 for a development comprising 35 wind turbines, each with a rated output of 2.7 MW, totalling 129 MW. The proposed turbines were 88.5 m in height (at the hub), and with a rotor diameter of up to 122 m. This was the project assessed in the 2014 Avian Impact Risk Assessment (Jenkins *et al* 2014).

Other components of the proposed development were a network of access and service roads, three substations, and three lengths of 132 kV overhead power line 3-5 km in length to connect them within the Project area. The original Project layout is shown in Figure 1.3.

A dedicated 132 kV transmission line, running from the Project to the Dassenburg substation in Atlantis, ~30 km to the south of the site was proposed to connect the Project to the Eskom power grid. The export transmission line was proposed to run parallel with the existing Aurora-Koeberg 400 kV transmission line.

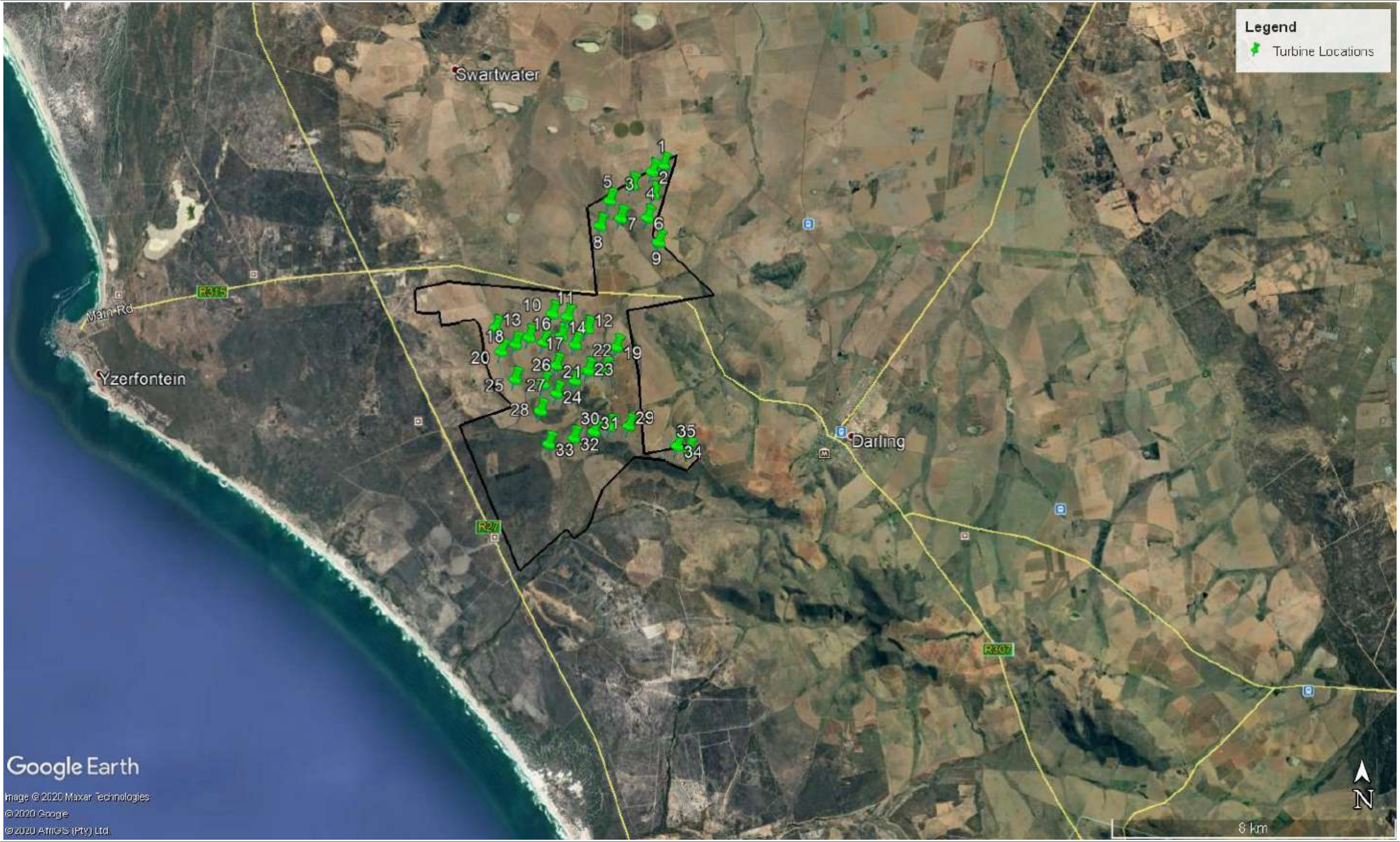
1.4.2 Summary of Revised Development Proposal

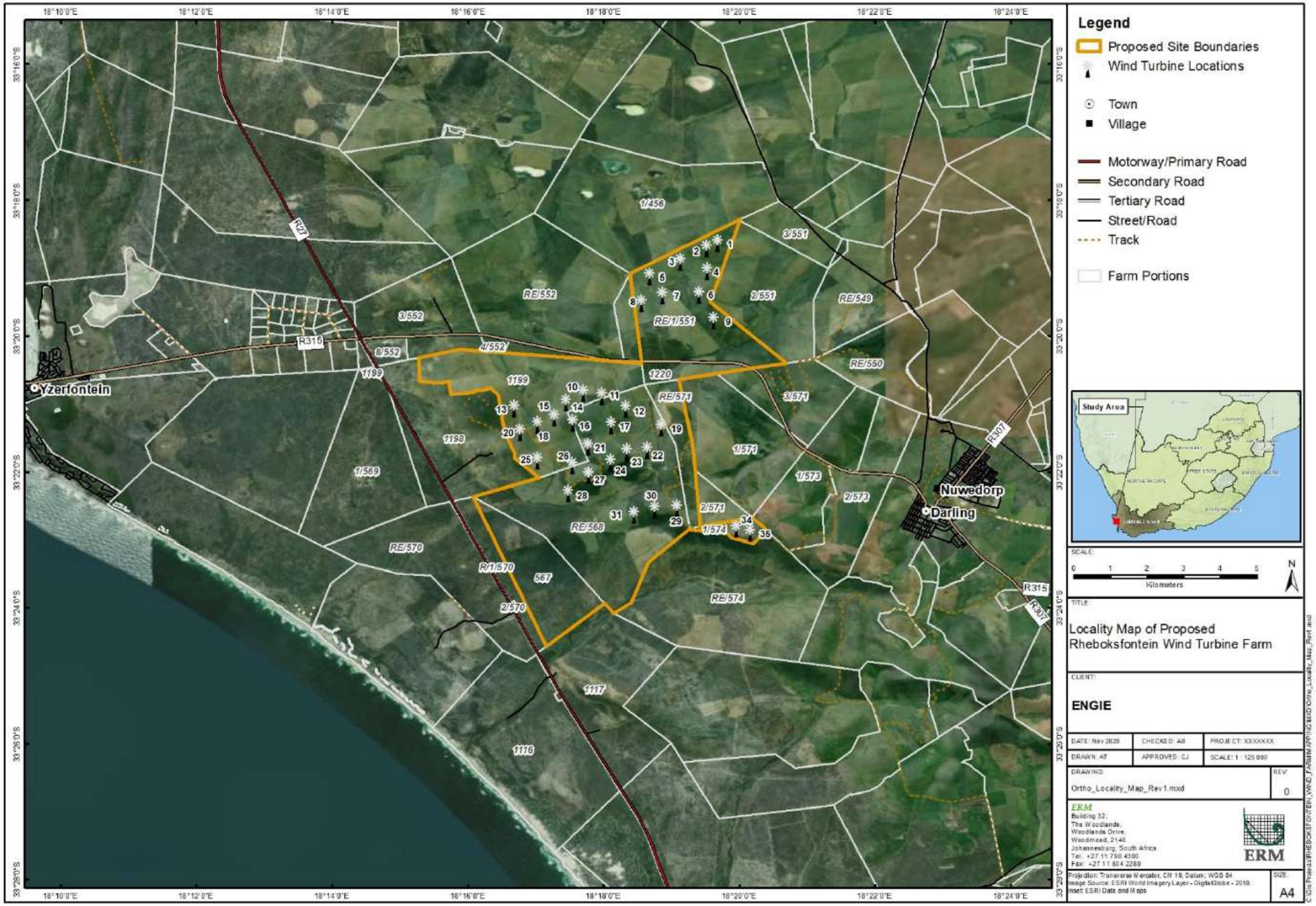
The revised Project is proposed on the same area of land. The revised proposals comprise a reduction in the number of turbines to 33, with a proposed increase in hub height of 130 m and turbine blade length of up to 85 m (rotor diameter of 170 m). Due to the larger turbines proposed, there will be an associated increase of the size of the permanent turbine foundation from 15 mx15 m to 25 mx25 m, with temporary lay down areas of 65 mx50 m.

For the revised Project, a preliminary revised turbine layout with 35 turbine locations was developed following consideration of areas of high great white pelican flight activity identified in Jenkins *et al* 2014. This revised 35 turbine layout was subjected to a preliminary collision risk assessment. This identified the number of great white pelican 'High Risk Flights' associated with each turbine location with the updated turbine parameters. Based on the outputs of the preliminary collision risk modelling, two of the turbine locations with the highest number of 'High Risk Flights' were removed from the revised development proposals, resulting in the current 33 turbine layout. Compared to the consented development, the revised Project has fewer turbine locations in areas with high volumes of great white pelican flights.

The proposed substations, within project power-lines and export transmission line remain the same as the consented development.

Figure 1.3 Original and Revised Project Layouts




Legend
Proposed Site Boundaries
Wind Turbine Locations
Town
Village
Motorway/Primary Road
Secondary Road
Tertiary Road
Street/Road
Track
Farm Portions
Study Area
Yzerfontein
Nuwedorp
Darling
R27
R315
R307
Kilometers
Locality Map of Proposed Rheboksfontein Wind Turbine Farm
ENGIE
DATE: Nov 2020
CHECKED: AB
PROJECT: XXXXXXX
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1.5 Avifauna Impact Assessment

1.5.1 Summary of EIA Impact Assessment and Subsequent Updates

The 2011 EIA for the consented scheme assessed the following impacts on Avifauna,

- Disturbance of birds during Construction.
- Loss of supporting habitat for birds during Construction.
- Disturbance and displacement during Operation.
- Collision mortality during Operation.

The results of the impact assessment from the 2011 EIA are summarised in **Table 1.4** to **Table 1.7** below (Jenkins, 2010).

Table 1.4 Disturbance of birds during Construction

	Without mitigation	With mitigation
Extent	Local	Local
Duration	Short-term	Short-term
Magnitude	High	Moderate
Probability	Definite	Definite
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Possible	Probably not
Can impacts be mitigated?	Yes	-

Table 1.5 Loss of supporting habitat for birds during Construction

	Without mitigation	With mitigation
Extent	Local	Local
Duration	Permanent	Permanent
Magnitude	Low-Medium	Low
Probability	Definite	Definite
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Possible	Probably not
Can impacts be mitigated?	Yes	-

Table 1.6 Disturbance and Displacement of Birds during Operation

	Without mitigation	With mitigation
Extent	Local	Local
Duration	Long-term	Long-term
Magnitude	Moderate	Moderate
Probability	Highly probable	Highly probable
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Slightly	-

Table 1.7 Collison Mortality during Operation

	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Magnitude	High	Low
Probability	Highly probable	Probable
Significance	**Medium-High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Possibly not
Can impacts be mitigated?	Yes	-

Pre-construction monitoring of avifauna continued in 2012 and 2013 after submission of the EIA.

The results of the post EIA and pre-construction avifauna monitoring were reported in the *Rehboksfontein Wind Energy Facility Avian impact risk assessment and mitigation scheme* report (Jenkins *et al* 2013). A full revised impact assessment was not undertaken, but the commentary presented in Box 1.1 was provided to update the discussion of potential impacts from the Project taking into account the updated baseline information and change in project design to a 35 turbine layout.

Box 1.1 Updated Impact Assessment Discussion Presented in Jenkins et al 2013

The observed avifauna of the study area complied broadly with the predictions of the avian impact study (Jenkins 2010), comprising a fairly low diversity of species but a fairly high biomass of birds (both largely the result of a preponderance of highly modified cereal croplands). Likewise, the initial short-list of priority species was largely confirmed in this study.

For the most part, the impacts identified in the original bird study for the site (Jenkins 2010) adequately describe the nature of possible impact scenarios pertinent to this development, namely:

(i) There is likely to be mortality of Great White Pelicans commuting through the area, using ridge lines targeted by the development for turbine placements as sources of slope lift, and colliding with the turbine blades or any new power lines associated with the facility. It is also possible that the turbine arrays may form a barrier to direct travel for these birds, forcing them to take a different, more energetically expensive route to and from key resource areas.

(ii) There is likely to be disturbance and displacement of resident/breeding or non-breeding flocks of Blue Crane from nesting and/or foraging areas by construction and/or operation of the facility, and/or mortality of these birds in collisions with the turbine blades or associated new power lines while commuting between resource areas (croplands, nest sites, roost sites/wetlands).

(iii) There is likely to be displacement of resident/visiting raptors (especially Black Harrier, Martial Eagle, Peregrine Falcon and Lanner Falcon, and including the endemic Jackal Buzzard) from foraging areas by construction and/or operation of the facility, and/or mortality of these species in collisions with the turbine blades or associated new power lines while slope-soaring along the high-lying ridges or hunting, or by electrocution when perched on power infrastructure.

(iv) There may be mortality of Greater and Lesser Flamingo commuting through the area (probably at night) in collisions with the turbine blades or any new power lines associated with the facility. It is also possible that the turbine arrays may form a barrier to direct ravel for these birds, forcing them to take a different, more energetically expensive route to and from key resource areas.

However, the magnitude of the estimated impact on Great White Pelican is considerably greater than originally thought.

As a result of the additional baseline studies and the potential for greater than predicted impacts to great white pelican, a revised assessment on great white pelican was undertaken. This was informed by an 8 month radar tracking study to record bird activity (particularly pelican activity) across the Project site during the pelican breeding season from mid July 2013 to early March 2014.

The results of the study were presented in the report *Estimating the impact of the proposed Rheboksfontein Wind Energy Facility on the Great White Pelican Population of the Cape West Coast* (Jenkins et al, 2104). The report presented a more detailed assessment of potential collision mortality impacts on great white pelican, considering a number of potential impact scenarios. The report states that, based on an assessment of average flight speed and average turbine speed, an array of 35 turbines with hub height of 88.5 m and blade length of 61 m:

'the predicted pelican collision rate for the proposed wind farm layout ranges from 5-2230, with about 22 Great White Pelican casualties annually perhaps the most likely outcome'.

The report assesses this level of mortality on the Dassen island great white pelican population, assumed in Jenkins *et al* 2104 to be stable, and found that the predicted collision mortality from the Project could result in a change from a stable population to a declining population (Jenkins *et al* 2014).

The report presents the following conclusions:

'1.The data presented here are sufficient to draw quite confident conclusions about the potential collision risk posed to the Dassen Island Great White Pelican population by the construction and operation of the Rheboksfontein Wind Energy Facility. Predictions of actual mortality rates, and of the population-level effects of such mortality, are necessarily less confident, but all indications are that the currently proposed turbine layout would have a significant and unsustainable impact on this regionally unique population of nationally red-listed birds.

2. There is sufficient pattern in the recorded sample of High Risk pelican flights to suggest ways to change the layout and/or operating schedule of selected turbines in the current array in order to (possibly) lower collision risk to more sustainable and acceptable levels. However, confidence around these modelled predictions is lower, and the effects of such changes on the commercial viability of the project are not presently known.

3. Regardless of the mitigation options possibly available (and understanding that these options cannot be guaranteed to work), the proposed wind farm remains directly in the main fly-way used by pelicans as they commute to and from Dassen Island. Given this, and given the strong possibility that the facility will impact negatively on local populations of other red-listed species, careful consideration should be given to abandoning this project.'

Jenkins *et al* 2014 also noted that during the 2013-2014 radar study, flights of black harrier, martial eagle, African marsh harrier and greater flamingo were more frequent in the study area than during the previous baseline studies, and that the potential for impacts to these species should be re-assessed.

1.5.2 2020 Revised Impact Assessment

This revised impact assessment takes into account changes in the proposed project, including the reduction in the number of turbines from 35 to 33, and the selection of larger turbines. Given the findings of the previous avifauna studies and impact assessments, particular attention has been paid to re-assessing the potential impacts on great white pelican. The Impact assessment method is presented in Appendix B. The impact assessment and identification of mitigation measures has been informed by the following guidance and protocols:

- Government of South Africa (2020) Avifauna Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Avifaunal Species by Onshore Wind Energy Generation Facilities Where the Electricity Output is 20 Megawatts or More.
- Jenkins, A.R., Van Rooyen, C.S, Smallie, J.J, Harrison, J.A., M. Diamond, M., Smit-Robinson, H.A., and Ralston, S. (2015) Birds and Wind-Energy Best-Practice Guidelines. Birdlife South Africa/Endangered Wildlife Trust.

1.5.2.1 Construction – Disturbance and Displacement

1.5.2.2 Impact Description

Construction activity (including presence of workforce and vehicles, elevated noise levels, creation of dust) will result in the temporary disturbance of birds from around the Project site, resulting in temporary loss of feeding or nesting habitat.

The revised Project will have similar footprint to that of the consented scheme, with a similar layout but slightly reduced number of turbines. The duration of the construction works will remain similar. Construction activity take place sequentially across the site, meaning that disturbance will be localised and only affect a part of the Project site at any one time. The majority of species affected by disturbance will be common and widespread species that utilise the predominantly agricultural areas in which the Project will be built. Small numbers of species of conservation concern may be displaced from foraging areas (predominantly blue crane, martial eagle, black harrier, African marsh harrier and lanner falcon). However these species in the Project area will be habituated to a degree of human activity associated with agricultural land management undertaken over the majority of the Project site.

The principal difference in the baselines between the consented scheme and the current proposed Project is the report in Jenkinson *et al* 2014 of the establishment of a martial eagle territory to the south of the Project layout since the Project was approved. During surveys to update the habitat and terrestrial biodiversity baseline during September/October 2020, the martial eagle nest was searched for and local communities and landowners were interviewed to ascertain if the martial eagle breeding territory was still present. None of the land owners reported having seen a large raptor nest in the vicinity of the Project, and no sightings of martial eagle or a potential nest were recoded. However, the potential remains that martial eagle may breed in the vicinity of the Project, and additional mitigation measures to reduce disturbance impacts to this territory have been proposed should it still be present.

1.5.2.3 Impact Assessment

The majority of impacts will be of negligible - small magnitude on common and widespread species of low sensitivity, resulting in impacts that are negligible or of **Minor Significance**. Negligible -small magnitude impacts are predicted on a number of species of high sensitivity, namely blue crane, lanner falcon, secretary bird, martial eagle and black harrier resulting in impacts of **Moderate Significance**.

1.5.2.4 Mitigation Measures

Mitigation measures set out in the original EIA and subsequent updated assessment in 2014 are set out below:

- Abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, lowering levels of associated noise, and reducing the size of the inclusive development footprint.
- Minimising the disturbance impacts associated with the construction of the facility, by abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.
- The key species here are blue crane (a summer breeder) and black harrier (a spring breeder), both of which might breed on or close to the site at least occasionally. Ideally, the welfare of these and other sensitive species should be further catered for by a pre-construction walk-through, and by on-going monitoring of the area throughout the construction period.
- Carefully monitoring the local avifauna both during and post-construction (Jenkins *et al*. 2013 and references therein), adding detail and value to the data collected during the present study – ideally using radar to improve the quantity and spatial accuracy of the movement data available - and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report.

In addition to these mitigation measures, the following have been identified during this updated assessment.

- <u>Undertake avifaunal pre-construction monitoring programme to update the baseline avifaunal community of the receiving environment in line with Jenkins *et al* 2015 and in accordance with BirdLife South Africa's Black Harrier Best Practice Guidelines (Simmons *et al,* 2020).</u>
- <u>The avifaunal pre-construction monitoring programme will include:</u>

- A focus on black harrier, great white pelican and dedicated nest survey for the location of potential martial eagle nest/territory;
- Dedicated focal point/nest surveys of breeding black harrier nests within 3-5 km of the site to determine productivity rates which must continue through the construction and operational phases to monitor and determine potential impacts of the development phases on productivity and breeding success.

- Final infrastructure layout, overlaid on the updated avifaunal sensitivities map, mitigation measures, EMPr and curtailment strategy to be distributed to BirdLife South Africa for additional input and comments prior to submission of the final layout to the competent authority for approval.
- No turbines to be placed in areas determined to be of especially high environmental sensitivity during the pre-construction survey.
- Establish a suitable buffer zones around active martial eagle nests identified (subject to confirmation by survey).
- If potential eagle nests are identified within 5 km of the Project site, artificial nest platforms should be established at suitable alternative sites in suitable habitat outside 5 km to encourage birds to move away from the Project.
- The buffer zone should be 5 km for turbine placement, and a 1 km exclusion where no construction activity will be undertaken (following similar exclusion zones set out in Ralston-Paton, 2017) during the martial eagle breeding season (February – November).
- Implement any other breeding raptor buffer zones recommended by pre-construction surveys.
- Contact Cape Nature should there be any evidence of poaching of wildlife observed on site during construction or operation.
- Contact local animal welfare organisations should feral cats be seen on site during construction or operation to reduce predation on bird populations.

1.5.2.5 Residual Impacts

With the proposed mitigation measures set out above, construction activity will result in a temporary small magnitude impact on two high sensitivity receptors, namely martial eagle and black harrier, resulting in impacts of **Minor Significance**.

Table 1.8 Disturbance of birds during Construction

Characteristic	Impact	Residual Impact
Type	Direct	Direct
Extent	Local	Local
Duration	Temporary	Temporary
Scale	Project layout including turbine bases, access tracks and associated infrastructure, plus area of disturbance impact around the layout. Disturbance may occur out to around 1 km from construction activities.	
Reversibility	Reversible (High)	Reversible (High)
Loss of resource	Medium	Small
Magnitude	Medium	Small -Medium
Sensitivity of the Resource/ Receptor	Low - High	Low - High
Significance of Impact	**Moderate**	**Minor**

1.5.2.6 Construction – Habitat Loss

1.5.2.7 Impact Description

During construction, the vegetation under the proposed project infrastructure (including the wind turbines, pads and access roads) will be cleared. This will result in a loss of supporting habitat for bird species within the Project area. With the revised layout, the Project will contain two fewer turbines than the consented scheme, although the area of habitat cleared around each turbine will be larger as a result of the larger turbines used. Overall the area of permanent habitat lost under turbine bases will increase from approximately 0.8 ha to 2 ha. The habitat loss will largely affect agricultural land.

The loss of habitat represents a relatively small component of the over area of similar agricultural habitats in the Project boundary and in the wider Swatrland area.

The majority of species that will lose supporting habitat are common and widespread species of agricultural areas. However habitat clearance and construction of project infrastructure will result in loss of habitat for a number of species of conservation concern including blue crane, martial eagle, black harrier, African marsh harrier and lanner falcon.

1.5.2.8 Impact Assessment

Construction of the Project will result in approximately 2 ha of habitat loss under the turbines themselves, as well as habitat lost under access tracks and other project infrastructure. Although this loss represents a small area of generally common and widespread agricultural habitat or relatively low biodiversity value, it may result in the loss of small areas of habitat used by small numbers of individuals of bird species of conservation concern. The resultant impact would be of **Moderate Significance.**

1.5.2.9 Mitigation Measures

Mitigation measures set out in the original EIA and subsequent 2014 amendment are set out below:

- Minimising habitat destruction caused by the construction of the facility by keeping the lay-down areas as small as possible, building as few temporary roads as possible, and reducing the final extent of developed area to a minimum. Much of the habitat on site is heavily modified.

1.5.2.10 Residual Impacts

With the mitigation measures in place, the residual impacts are considered to be of **Minor Significance**.

Table 1.9 Loss of supporting habitat for birds during Construction

Characteristic	Impact	Residual Impact
Type	Direct	Direct
Extent	On-Site	On-Site
Duration	Long term	Long term
Scale	Project layout including turbine bases, access tracks and associated infrastructure.	
Reversibility	Partly reversible (Medium)	Partly reversible (Medium)
Loss of resource	Medium	Medium
Magnitude	Small	Small
Sensitivity of the Resource/ Receptor	Low - High	Low - High
Significance of Impact	**Moderate**	**Minor**

1.5.2.11 Operation – Disturbance and Displacement

1.5.2.12 Impact Description

During operation, the presence of the turbines may result in disturbance to and displacement of birds from the Project site. Birds may be displaced by the physical presence of operating turbines and the movement and noise they create. This could result in some birds maintaining a stand-off distance from the turbines and avoiding the area or foraging elsewhere.

Some exclusion of birds from habitat surrounding operating wind farms has been reported from monitoring studies undertaken at wind farms to date, due to the avoidance of the areas closest to the wind turbines and hence displaced from suitable habitat. However there seem to be many species-specific differences, with some species including raptors foraging to within 25 m of operating wind farms, whilst other species including those on passage showing avoidance distances of up to 800 m (Percival, 2001). A number of studies have suggested operational wind farms may result in displacement of raptors, including eagles (e.g. Fielding & Haworth, 2010, Ralston-Patton, 2017)

A review of displacement impacts at South African wind farms found that although some species observed during pre-construction were not observed during the operational phase, and vice versa, there was little conclusive evidence for displacement of priority species from any sites (although the study duration was relatively short) (Ralston-Paton *et al* 2017). In particular the study did not identify a specific pattern in displacement and abundance for raptors and noted that blue crane appeared unlikely to be displaced from wind farm sites, but that passage rates (e.g flights through the wind farm area) did reduce.

1.5.2.13 Impact Assessment

During operation, the presence of the Project turbines and operational activity is likely to result in the displacement of bird across the Project area. The majority of impacts will be of negligible - small magnitude on common and widespread species of low sensitivity, resulting in impacts that are negligible or of **Minor Significance**. Small magnitude impacts are predicted on a number of species of high sensitivity, namely blue crane, lanner falcon, secretary bird martial eagle and black harrier resulting in impacts of **Moderate Significance**.

1.5.2.14 Mitigation Measures

Mitigation measures set out in the original EIA and subsequent 2014 amendment are set out below:

- Abbreviating maintenance times, scheduling activities in relation to avian breeding and/or movement schedules, and lowering levels of associated noise.

In addition to these mitigation measures, the following have been identified during this updated assessment.

- <u>If potential eagle nests are identified within 5 km of the Project site, artificial nest platforms should be established at suitable alternative sites in suitable habitat outside 5 km to encourage birds to move away from the Project.</u>
- <u>The buffer zone should be 5 km for turbine placement, and a 1 km exclusion where no construction activity will be undertaken (following similar exclusion zones set out in Ralston-Paton, 2017) during the martial eagle breeding season (February – November).</u>
- <u>Undertake construction phase avifaunal monitoring, focussing on breeding success and productivity of nesting species, particularly at any identified black harrier nests. Nest monitoring must be conducted in accordance with applicable Best Practice Guidelines and timed appropriately to detect disturbance effects on nesting birds when compared to pre-construction productivity data. If disturbance impacts are detected, appropriate mitigation measures (such restriction of construction activities nearest the nests during key breeding periods) must be</u>

determined by an avifaunal specialist and implemented should the construction phase extend over multiple breeding seasons.

- Implement a policy of zero-disruption of breeding threshold for black harrier and martial eagle for the lifespan of the development. Any nests identified during pre-construction monitoring must continue to be surveyed according to the Black Harrier Best Practice Guidelines that includes a single site visit at the end of the breeding season to record productivity of nests. If negative impacts to productivity are detected an appropriate mitigation strategy (such as curtailment of nearest turbines during key breeding periods) must be determined through consultation with an avifaunal specialist and implemented.

1.5.2.15 Residual Impacts

With the proposed mitigation measures set out below, the presence of the operational Project may result in a long term small magnitude impact on two high sensitivity receptors, namely martial eagle and black harrier, resulting in impacts of **Minor Significance**.

Table 1.10 Disturbance and Displacement of Birds during Operation

Characteristic	Impact	Residual Impact
Type	Direct	Direct
Extent	Local	Local
Duration	Long term	Long term
Scale	Project layout plus area of disturbance impact around the layout. Disturbance may occur out to around 1 km from the operational wind farm.	
Reversibility	Reversible (High)	Reversible (High)
Loss of resource	Medium	Medium
Magnitude	Medium	Medium
Sensitivity of the Resource/ Receptor	Low - High	Low - High
Significance of Impact	**Moderate**	**Minor**

1.5.2.16 Operation – Collision Mortality

1.5.2.17 Impact Description

Once a wind farm is constructed, it may impact on bird populations by causing additional mortality through birds colliding with the turbines or associated structures including overhead lines. Several factors influence the risk of collision, including:

- the location of these structures (ie are they sited on regular local flight paths or migration routes);
- the extent to which birds are flying at heights at which the turbines are operating;
- the extent to which the birds exhibit avoidance behaviour (ie alter their flight path to avoid the structures);
- the extent to which some bird species fly at night, a time when the structures are much less visible;
- the extent to which the birds' flight patterns change naturally during poorer weather conditions, or in the case of raptors when stooping or pursuing prey (Bevanger, 1994), hence making them more susceptible to collisions;
- use of lighting on the turbines which may attract birds to them at night; and

- the extent of habituation.

The impact assessment for the consented development assessed the potential for impacts from collision mortality, and focussed on impacts on great white pelican, as this species had by far the largest number of flights across the site (Jenkins *et al*, 2013). For this assessment of the revised Project, radar data for great white pelican, as well as other priority species, were analysed to assess the collision mortality with the revised project layout and turbine specifications.

Great White Pelican

The previous collision risk assessment of the consented development assessed the collision risk of great white pelican using the radar data to identify the number of 'High Risk Flights' (ie those that are predicted to collide with the turbine based on their placement and size) for the development. It then assessed the number of birds associated with these flights likely to collide with the operations turbines using the Band collision risk model (Band *et al*, 2007). The approach adopted uses a range of variables which affect the outcome of the collision risk modelling to provide a range of potential impact levels, including different bird speed, different rotor speed and different avoidance rates, set out in Table 1.11.

Table 1.11 Parameters Used to Inform Collision Risk Modelling

Great White Pelican Biological Parameters		
Bird Length		162 cm
Wingspan		293 cm
Bird speed		3.2, 12.3, 22.0 ms^{-1}
Turbine Technical Parameters		
	Consented Development	**Revised Project**
Hub Height	120 m	130 m
Rotor Diameter	126 m	170 m
Number of blades	3	3
Rotation period	3.6, 5.5, 11.3 s	5, 9.5, 14 s*
Maximum chord width	4 m	4.3*
Average pitch angle	15º	15º
Avoidance Rate		
No Avoidance		
95% avoidance		
98% avoidance		

*Turbine specifications are not currently available for the 85m blade (170 m turbine radius) assessed, therefore rotation period and maximum chord width for the largest considered similar turbine (Vestas 162 5 MW 81 m blade length) have been used.

Based on the chosen parameters, the most likely outcome of the modelling for the consented development was considered to be an annual mortality of 22 great white pelicans. This prediction was based on the average rotor speed, and average bird speed and an avoidance rate of 95%.

The avoidance rate is one of most important variables in determining the predicted number of collisions. Current SNH guidance (SNH, 2018) recommends using 98% if a species specific rate isn't available (and as great white pelicans are not native to Scotland, avoidance rates have not been published for this species by SNH). The 2013 impact assessment and 2014 radar study use three rates – no avoidance, a conservative 95% avoidance and 98% avoidance. However, recent guidance (SNH 2018, Furness, 2015) proposes higher avoidance rates for large waterbirds in the UK, for swans (99.5%), geese (99.8%) and divers (99.5%). All of these species (like great white pelican) have relatively high wing loading (the weight of the bird divided by the area of its wing), and may point to higher avoidance rates being applicable for large waterbirds which are engaged in direct, commuting flight rather than actively hunting (cf raptors). However, none of the species uses soaring flight, relying on active (flapping) flight so are not direct analogues for pelicans.

There are few published studies or papers on interactions of great white pelicans and wind farms. A conference paper presented by ERM based on operational monitoring of windfarms in Romania reported 140 flights of great-white pelican at collision risk height through a windfarm, with only a single casualty, indicating a high avoidance rate for this species (Hatton *et al* 2017). Given the trend for operational monitoring to result in overall increases in avoidance rates, the higher avoidance rates adopted for other large waterbird species, and the data from operational monitoring of sites with great white pelican in Romania, a revised avoidance rate of 98% has been adopted for this assessment.

The updated avoidance rate was applied to re-analysed radar data of high risk flights. The number of 'High Risk Flights' was calculated using the approach outlined in Jenkins *et al* 2014, by a GIS analysis of the flights intersecting with the turbine blades at each location (in this case a revised 33 turbine layout with hub height of 130 m and blade length of 85 m) with a 17m buffer to account for radar accuracy. The 'High Risk Flights' identified for the revised Project are shown in Figure 1.4.

The number of high risk flights was extrapolated over the entire great white pelican breeding season, and an annual predicted mortality calculated. The results of the collision risk modelling for the revised Project are presented in Table 1.12. Taking the average flight speed and average turbine speed as the most likely outcome, and with the revised avoidance rate of 98%, the predicted annual mortality of the revised layout is 6 great white pelicans per year, much lower than the 22 casualties per year predicted in the pervious assessment (using the average turbine and bird speed) (Jenkins *et al* 2014). Even using the more precautionary 95% avoidance rate, the predicted mortality is lower than that predicted for the consented development (16 casualties per year rather than 22).

The reduction in predicted mortality is largely a result of the redesigning of the layout to move turbines away from areas with higher pelican flight activity associated with slopes likely to generate up drafts (particularly in the south east of the Project site), and the reduction in the overall number of turbines, and the application of a more realistic avoidance rate applied.

Figure 1.4High Risk Flights for the Revised Project

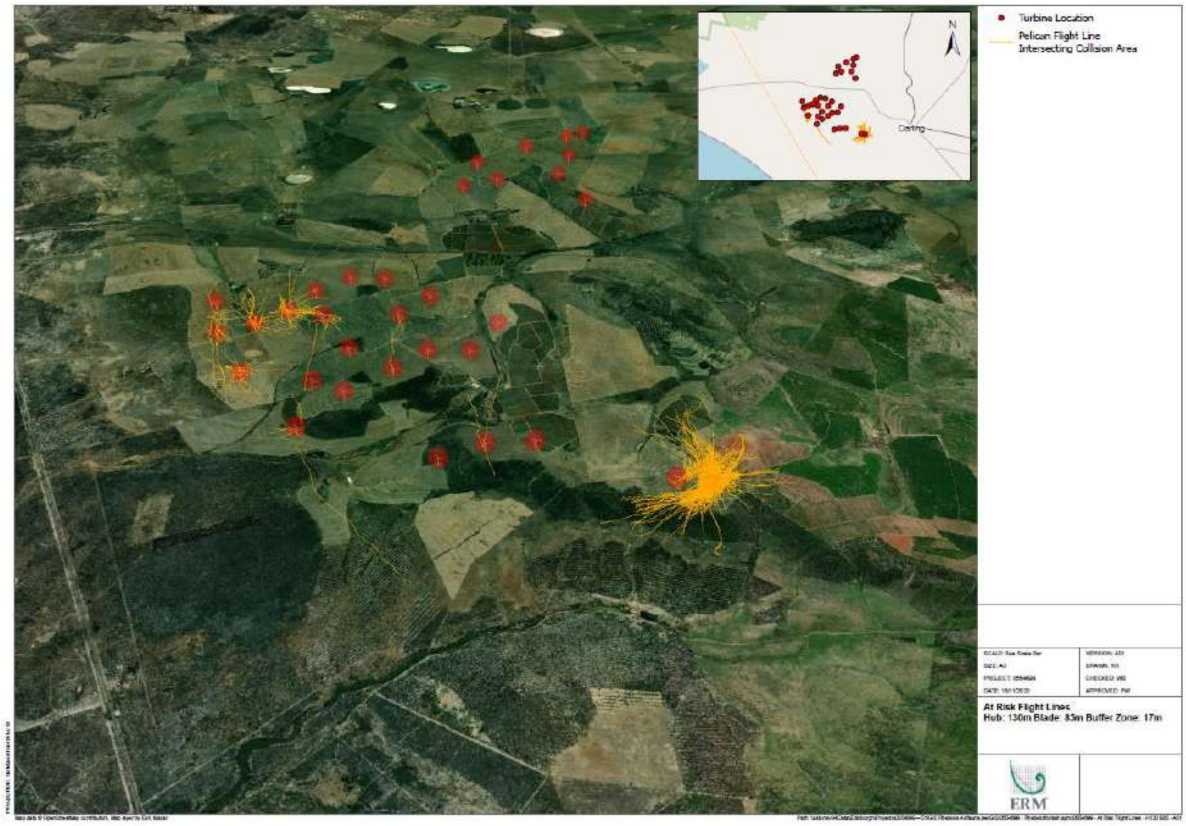


Table 1.12 Collison Risk Model Results

Avoidance Scenario	Bird speed	Rotor Speed		
		Low	**Average**	**High**
No avoidance	Low	712	988	1664
	Average	283	328	472
	High	254	265	320
95% avoidance	Low	36	49	83
	Average	14	16	24
	High	13	13	16
98% avoidance	Low	14	20	33
	Average	6	6	9
	High	5	5	6

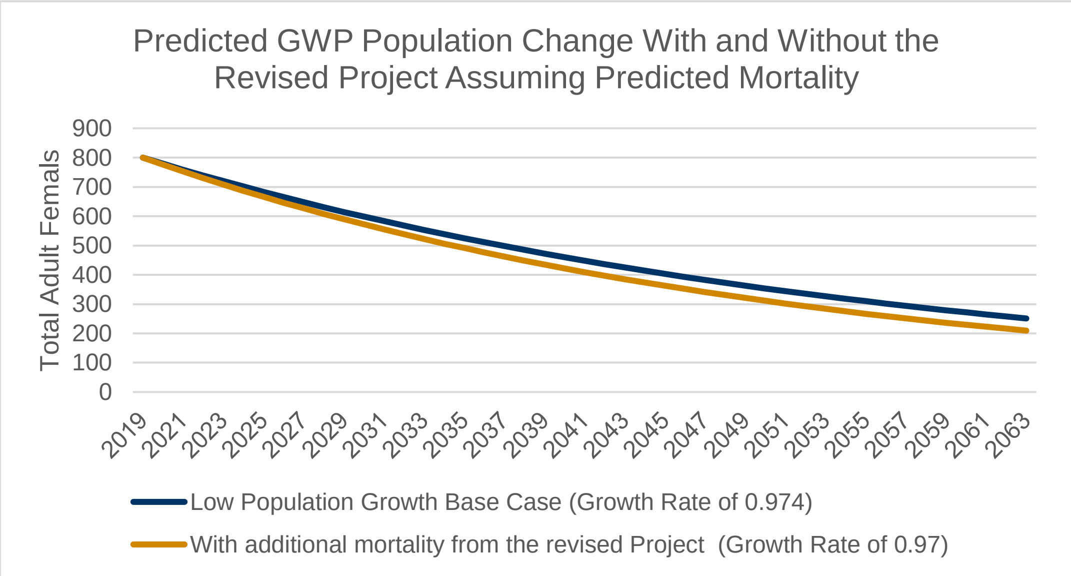
Note: values rounded up or down to nearest whole number.

As part of the impact assessment for the consented development, Jenkins *et al* developed a range of potential population growth rates for the Dassen Island great white pelican population (a relatively stable growth rate of 1.001, a declining growth rate of 0.974 and an increasing population growth rate of 1.036), and assessed the impacts of the additional mortality associated with the consented development. At the time, the Dassen Island pelican population was considered to be stable and so the mortality was applied to a relatively stable growth rate (1.001) (Jenkins *et al*, 2014).

Based on the latest colony count data, the Dassen Island great white pelican population is declining (see Figure 1.2). As a result, the declining growth rate calculated by Jenkins *et al* (2014) has been used to inform the potential effects of the predicted mortality from the revised Project. Based on the observed rate of population decline in shown in Figure 1.2, the calculated declining population growth rate is likely to overestimate the speed of population decline, but has been adopted as a precautionary approach.

Figure 1.5 shows the predicted changes to the Dassen Island great white pelican population, based on the calculated declining growth rate from Jenkins *et al*, together with the predicted population change with the revised development proposals. As the population growth is driven by the availability of adult females in the population, the modelling approach adopted by Jenkins *et al* focuses on changes in the number of adult females.

Figure 1.5 Predicted Changes to the Dassen Island Great White Pelican Population



Based on the results of the updated collision risk model, the revised Project will result in lower impacts on the Dassen Island Pelican population than the consented development.

The revised development is predicted to result in a low annual level of mortality that may over time reduce the Dassen Island pelican population. However counts of the colony indicate that the population is currently in decline, and is predicted to continue to decline without conservation intervention. The additional mortality associated with the revised Project will not substantially change the current population trend, but would lead to a slight increase in the speed of the population decline.

It should be noted however that there is a relatively large degree of variation in the natural population size as indicated by the changes in annual population size shown in Figure 1.2, which suggests that other factors are likely to influence the size of the population and may be as important as drivers of population size as adult female availability (e.g. suitable nest sites at Dassen Island, available food supplies). In addition, estimates for great white pelican indicate that only between 34-57% of the adult population breed in any year (Jenkins *et al* 2014). This also suggest that there may be a relatively large buffer inherent in the population that would prevent population decline despite increased mortality.

Other Priority Species

As set out in Table 1.3. the baseline studies for the consented development recorded very low levels of flight activity for species other than great white pelican, with overall calculated passage rates of between 0.005 and 0.05 birds per hour.

Jenkins *et al* 2014 noted that higher flight activity was observed in the radar study area for some species during the 2013-2014 radar study (particularly black harrier, martial eagle, African marsh harrier and greater flamingo) and recommended reviewing the radar data to identify any changes in the volume of flight activity for these species that might increase the collision risk compared to that assessed in the original impact assessment for the consented development (Jenkins et al 2014).

As a result, all non-great white pelican tracks from the 2013-2014 radar study were analysed to identify flights of priority species within the Project site, and to identify 'High Risk Flights' in line with the approach adopted for great white pelican. The analysis only identified flights of martial eagle (18 flights), African marsh harrier (2 flights) and black harrier (1 flight) within the Project area, and did not identify any 'High Risk Flights'.

The majority of martial eagle flight activity (14 flights) occurred to the south of the Project site where turbines 33 and 35 from the consented development were located close to slopes supporting more natural habitat and higher vegetation that may have provided suitable foraging areas for martial eagle. These turbine positions have been removed from the revised Project, reducing potential interaction with martial eagle, or other species, hunting over these areas or using updrafts from the slopes.

Therefore, as a result of the relatively low flight activity of non-great white pelican priority species recorded during the radar study, the potential collision impacts of the revised Project on other species is considered to be no worse than the consented development, and potentially better as a result of the removal of turbine locations in the south of the consented development close to more natural habitat.

1.5.2.18 Impact Assessment

The majority of impacts from collision mortality will be of negligible to medium magnitude on common and widespread species of low sensitivity, resulting in impacts that are negligible or of **Minor Significance**. Given the removal of two higher risk turbine locations and the very low flight activity recorded during baseline surveys, negligible - small magnitude impacts are predicted on a number of species of high sensitivity, namely blue crane, lanner falcon, black harrier and martial eagle also resulting in impacts of **Minor Significance**. Negligible-small magnitude impacts are predicted on medium sensitivity greater and lesser flamingo resulting in impacts of **Minor Significance**.

Over the lifetime of the project, large magnitude impacts are predicted on high sensitivity great white pelican in the absence of adaptive management and effective mitigation, resulting in impacts of **Major Significance**.

1.5.2.19 Mitigation Measures

Mitigation measures set out in the original EIA and subsequent 2014 amendment are set out below:

- Careful siting of turbines, painting turbine blades, marking power lines, bird friendly power hardware, monitoring priority bird movements and collisions, turbine management sensitive to these data – radar assisted if necessary.
- Ensuring that lighting on the turbines is kept to a minimum, and is coloured (red or green) and intermittent, rather than permanent and white, to reduce confusion effects for nocturnal migrants.
- Removal of the highest risk turbines from the proposed development layout.
- Minimising the length of any new power lines installed, ensuring that all new lines are marked with bird flight diverters (Jenkins *et al.* 2010) from origin to destination (with markers and fittings as per the industry standard), and that all new power infrastructure is adequately insulated and bird friendly in configuration (Bevanger 1994, Lehman *et al.* 2007). Note that current understanding of power line collision risk in birds precludes any guarantee of successfully distinguishing high risk from medium or low risk sections of a new line (Bevanger 1994, Jenkins *et al.* 2010, Barrientos *et al.* 2011). The relatively low cost of marking the entire length of a new line during construction, especially quite a short length of line in an area frequented by collision prone birds, more than offsets the risk of not marking the line, causing unnecessary mortality of birds, and then incurring the much greater cost of retro-fitting the line post-construction. In situations where new lines run in parallel with existing, unmarked power lines, this approach has the added benefit of reducing the collision risk posed by the older line.

- Carefully monitoring the local avifauna both during and post-construction (Jenkins *et al.* 2013 and references therein), adding detail and value to the data collected during the present study – ideally using radar to improve the quantity and spatial accuracy of the movement data available - and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report.
- Ensuring that the results of this study and of subsequent monitoring work are applied to project-specific impact mitigation in a way that allows for the potentially considerable cumulative effects on the local/regional avifauna of further phases of this wind energy project, and of multiple other wind energy projects proposed for this area.
- Should any impacts be detected either during construction or once the wind farm is operational that are deemed sufficiently detrimental to the regional avifauna, the developer must be prepared to apply mitigation options additional to those already listed here. Such additional mitigation might include re-scheduling construction or maintenance activities on site, or shutting down problem turbines either permanently or at certain times of year or under certain weather conditions.

In addition to these mitigation measures, the following have been identified during this updated assessment.

- <u>Undertake pre-construction phase monitoring, focussing on flight activity surveys (Vantage Point surveys) to update the project baseline and inform operational monitoring in line with recommendations in Jenkins *et al* 2015.</u>
- <u>Undertaken operational monitoring in line with the recommendations in Jenkins *et al* 2015 (see Section 1.6) or the latest guidelines at the time of monitoring commencing, as well as replicating the pre-construction monitoring to be conducted following the Black Harrier Guidelines. Operation phase monitoring of black harrier nests must be conducted in line with Black Harrier Guidelines and compared to pre-construction data to determine potential impacts on productivity and breeding success of this species.</u>
- <u>The avifaunal pre-construction monitoring programme will include:</u>
  - <u>Sufficient coverage of daylight hours to record temporal variation in flight activity of great white pelican to supplement existing data on great white pelican movements and update and further inform the formulation of a curtailment strategy (should it be required) during the operational phase;</u>
  - <u>The results of pre-construction surveys will be used to update the EMPr, including operational management and monitoring.</u>
  - <u>The formulation of a curtailment strategy prior to the spinning of turbine blades to ensure no ambiguity exists as to the required scope and triggers for implementation;</u>
  - <u>The production of an updated sensitivity map to inform final layout;</u>
  - <u>The determination of the turbines that pose the highest risk to avifauna to be informed by existing data (i.e. radar and flight activity data) and an assessment of the pre-construction monitoring data;</u>
  - <u>The determination of appropriate mitigation measures applicable to turbines located in or near areas of elevated avifaunal sensitivity and the identification of those turbines affected;</u>
  - <u>Mitigation measures for those turbines identified (at a minimum) must include a requirement for mitigation measures to be implemented prior to construction or the spinning of turbine blades (which-ever is more practical);</u>
  - <u>Where turbines are to be illuminated, mitigation measures must include the installation of intermittent lighting rather than constant and preferably lighting of a coloured nature be used</u>

rather than white light (where permitted and approved by the South African Civil Aviation Authority);

- Mitigation measures for those turbines identified will be to accommodate the painting of a single blade per turbine black or red (on the basis of consultation with and approval from wind turbine Original Equipment Manufacturers and the South African Civil Aviation Authority), however this could cause a visual impact, and should only be considered if deemed necessary after the pre-construction monitoring; and
- Mitigation measures must (at a minimum) include the installation of Shut-down On Demand (Radar Assisted or human operated technology) on the highest risk turbines (to work in conjunction with manual observers during the operational phase) that must be installed prior to the spinning of turbine blades.

- Operational monitoring will inform adaptive management of the Project, with fatality estimates used to test the predicted impacts in relation to collision mortality. Where mortality of priority species is recorded, the Project will develop additional mitigation measures to reduce collision mortality at relevant turbines. The adaptive management mitigation measures will be set out in a Project Environmental Management Programme (EMPr) and will include consideration of:
  - changes in habitat management to influence flight behaviour;
  - seasonal or active shut down of relevant turbines.
- A zero-fatality threshold for great white pelican, martial eagle and black harrier will be implemented for the lifespan of the development. If one or more fatalities of these species are located and determined likely to have resulted from turbine collisions then those turbines likely to have been responsible will be fitted with appropriate mitigation measures. Fatalities of these species will be reported immediately to an avifaunal specialist and to BirdLife South Africa and the Endangered Wildlife Trust following positive identification by an avifaunal specialist. The appropriate mitigation measures to be implemented will be determined by the avifaunal specialist in consultation with BirdLife South Africa based on the latest scientifically supported measures or technologies available at the time of the fatalities. This may include the implementation of the curtailment strategy.

If automated shut-down systems are not implemented on all turbines, avifaunal observers must be employed to increase the coverage of turbine shut-down mitigation systems and work in conjunction with Radar Shut-down On Demand or similar technology deployed. Avifaunal observers must monitor the movement of great white pelican near the facility during the operational phase on a daily basis when great white pelicans are shown by baseline surveys to be present in the Project area, throughout the lifespan of the project. Avifaunal observers must be granted the authority to order the shut-down of selected turbines upon detection of great white pelican(s) (or other priority species including martial eagle or black-harrier) approaching the facility determined to be at risk of collision. The system must be rapid enough to facilitate the timeous shut-down of a turbine if required (e.g. using radio communication to the control room)

Even with adaptive management and curtailment measures in place, the Project may result in a low annual level of collision mortality for the regionally important Dassen Island great white pelican population. This mortality may increase the ongoing decline in the population over the lifetime of the Project. The Project should support compensation measures to offset impacts from the Project, to be informed by operational monitoring of the Project. The specific actions should be agreed with relevant stakeholders (including Cape Nature, Birdlife International and Dassen Island Nature Reserve Management Committee) but could include:

- Undertaking studies to better understand and inform management actions for the population (e.g satellite tagging studies to confirm terrestrial foraging site and threats, mapping of at sea feeding areas and pressures, monitoring of drivers of breeding success);

- management of threats associated with terrestrial feeding areas (e.g agricultural areas and waste management facilities);
- support to protect or manage at sea feeding areas; and
- provision of alternative supplementary feeding sites.

1.5.2.20 Residual Impacts

With adaptive management and mitigation measures in place, impacts on great white pelican are predicted to be of negligible -small magnitude impact and overall of **Minor Significance**. Negligible-small magnitude impacts are predicted on high sensitivity blue crane, lanner falcon, black harrier and martial eagle martial eagle and medium sensitivity greater and lesser flamingo resulting in impacts of **Moderate Significance**.

Table 1.13 Collison Mortality during Operation

Characteristic	Impact	Residual Impact
Type	Direct	Direct
Extent	Local - Regional	Local - Regional
Duration	Long term	Long term
Scale	Collision mortality will affect different numbers of individuals of different species over the lifetime of the Project.	
Reversibility	Partly reversible (Medium)	Partly reversible (Medium)
Loss of resource	Medium	Medium
Magnitude	Small - Large	Small - Medium
Sensitivity of the Resource/ Receptor	Low - High	Low - High
Significance of Impact	**Minor - Major**	**Minor**

1.5.3 Cumulative Impact Assessment

There are a number of Wind Farms in the vicinity of the Project including the Darling Windfarm outside Darling (approximately 2 km northwest), and the Hopefield Wind Farm outside Hopefield (approximately 22 km northeast). Further north is the West Coast One Wind Farm near Vredenburg (approximately 55 km northwest),

There are also a number of applications for wind energy facilities on the West Coast, with two in the vicinity of the Rheboksfontein Wind Energy Facility, i.e. an application to expand the Darling Windfarm, which currently consists of 4 wind turbines, and is proposed to be extended by 16 wind turbines to a total of 20; and the proposed Clover Valley Renewable Energy Facility (applicant: Western Wind Energy (Pty) Ltd), located approximately 15 km south of the Project.

Of the existing developments identified, both West Coast One and the Hopefield Wind Farm are considered to be sufficiently far from the Project to be unlikely to result in cumulative impacts with the same receptors. Baseline studies of the Darling Wind Farm identified relatively low rates of pelican movements compared to those observed crossing the Rheboksfontein site, with passage rates of 0.27 birds hr^{-1} recorded, with the majority of pelican movements passing to the south of the Darling site (Jenkins *et al*, 2011). This findings was confirmed during the 2013-2014 study which included visual tracking of flocks of pelicans from the coast (Jenkins *et al*, 2014). Given the relatively low level of pelican passage rates at the Darling Wind Farm, and the lower level of predicted pelican impacts from the revised Project, cumulative impacts are predicted to be lower than for the consented development.

The potential for cumulative impacts on great white pelican exists with the proposed extension to the Darling Windfarm, and the Clover Valley Renewable Energy Facility. If the proposed extension of the Darling Wind Farm extends the turbine locations southwards into areas of higher great white pelican flight activity, there is the potential for higher cumulative collision impacts. Similarity if the Clover Valley Renewable Energy Facility includes turbines situated on the same north-south great white pelican commuting route that the Project lies on, cumulative collision impacts could occur. For both developments, the results of baseline studies and collision risk modelling to inform the EIA should be assessed, when available, to assess cumulative collision impacts with the Project.

1.6 Monitoring

Operational monitoring of the Project should be undertaken in line with the recommendations in Jenkins *et al* 2015 including:

- Undertake pre-construction phase monitoring, focussing on flight activity surveys (Vantage Point surveys) to update the project baseline and inform operational monitoring in line with recommendations in Jenkins *et al* 2015.
- Flight activity survey monitoring during the first two years of operation, to be reviewed annually thereafter.
- Carcass monitoring during the first five years of operation, to be reviewed annually thereafter.
- Carcass monitoring must include consideration of searcher efficiency and scavenger removal, in line with recommendations in Jenkins *et al*, 2015. The results must be used to produce fatality estimates for the Project (in line with Jenkins et al 2015 or more recent approaches such as GenEst (USGS, 2018).
- Annual monitoring reports should be produced as well as interim quarterly reports.

1.7 Conclusion

The Project site predominantly support a range of common and widespread bird species which are unlikely to be significantly affected by the development. A small number of priority species at greater risk of significant impact have been identified using the Project site and surrounding area. Key among these are the raptor species martial eagle, black harrier and African marsh harrier which are likely to primarily use remaining areas of natural vegetation but also agricultural areas to hunt, greater and lesser flamingo which use and travel between coastal and inland waterbodies, blue crane which predominantly uses agricultural areas particularly in the non-breeding season, and great white pelican which flies through the Project area to and from the breeding colony at Dassen Island.

The Project will result in some disturbance and displacement of bird species during construction and operation. This will likely be limited to a relatively small area around the Project site with the majority of species used to some level of disturbance as a result of the agricultural nature and associated of much of the Project site. Impacts for the proposed revised Project are considered to be no greater than for the consented development.

The Project will result in the loss of a relatively small area of agricultural habitat under the turbine bases, access tracks and other Project infrastructure. The area of habitat lost will be slightly larger than for the consented development, however the significance of impacts are considered to be no greater.

Impacts from collision mortality are predicted for great white pelican from the Project, with the collision risk modelling undertaken predicting 6 birds per year will collide. This level of mortality is lower than that predicted for the consented development, however if un-mitigated may still result in declines in the Dassen Island great white pelican population. Mitigation and active management measures have been identified to compensate for impacts, underpinned by operational monitoring of the Project.

APPENDIX A REVISED RADAR DATA ANALYSIS AND COLLISION RISK MODELLING APPROACH

25th November 2020

REVISED RADAR DATA ANALYSIS AND COLLISION RISK MODELLING APPROACH

INTRODUCTION

This Appendix sets out the approach used to update the analysis of radar data and collision risk modelling for the avifauna verification and assessment update used to inform the amendment application in terms of Part 2 of Chapter 5 of the EIA Regulations 2014 (as amended) for the Rheboksfontein Wind Energy Facility (WEF) (hereafter the Project).

BACKGROUND

The EIA for the consented development and previous amendments was informed by the following studies:

- Jenkins, A.R. (2010) Rheboksfontein Wind Energy Facility: Avian impact assessment. Report to Savannah Environmental Pty (Ltd).
- Jenkins, A.R., du Plessis, J., Colyn, R., Cooke, P-J, & Benn, G. (2013) Rheboksfontein Wind Energy Facility: avian impact risk assessment and mitigation scheme. Report to Moyeng Energy (Pty) Ltd.
- Jenkins, A.R., Reid, T.A., du Plessis, J., Colyn, Cooke, P., R., Benn, G. & Millikin, R. (2014) Estimating the impact of the proposed Rheboksfontein Wind Energy Facility on the Great White Pelican population of the Cape west coast.

The 2014 study contained an assessment of collision risk impacts of the Project on great white pelican (*Pelecanus onocrotalus*), informed by the results of a radar study undertaken between mid July 2013 to early March 2014. The 2013-2014 radar study also collected data on the flight activity of non-pelican species, which was not analysed for the consented development (Jenkins et al, 2014)

Since completion of the original specialist studies on terrestrial fauna and flora, and obtaining the initial Environmental Authorisation (EA), technologies have advanced, and hence ENGIE intends to increase the proposed wind turbine sizes, reduce the number of turbines and adjust the project layout plan to optimise the efficiency of the WEF.

In order to assess the potential impacts of the updated Project , an revised collision risk assessment was undertaken, using the updated Project layout and turbine parameters and the 2013-2014 radar data to determine whether the impacts of the revised Project will be greater, lesser or in line with those predicted for the consented development.

SCOPE OF THE ASSESSMENT

The revised assessment comprised two components

- • Re-analysis of great white pelican flight activity and collision risk associated with the revised Project;
- • Re-analysis of non-pelican flight activity and collision risk associated with the revised Project.

GREAT WHITE PELICAN ANALYSIS

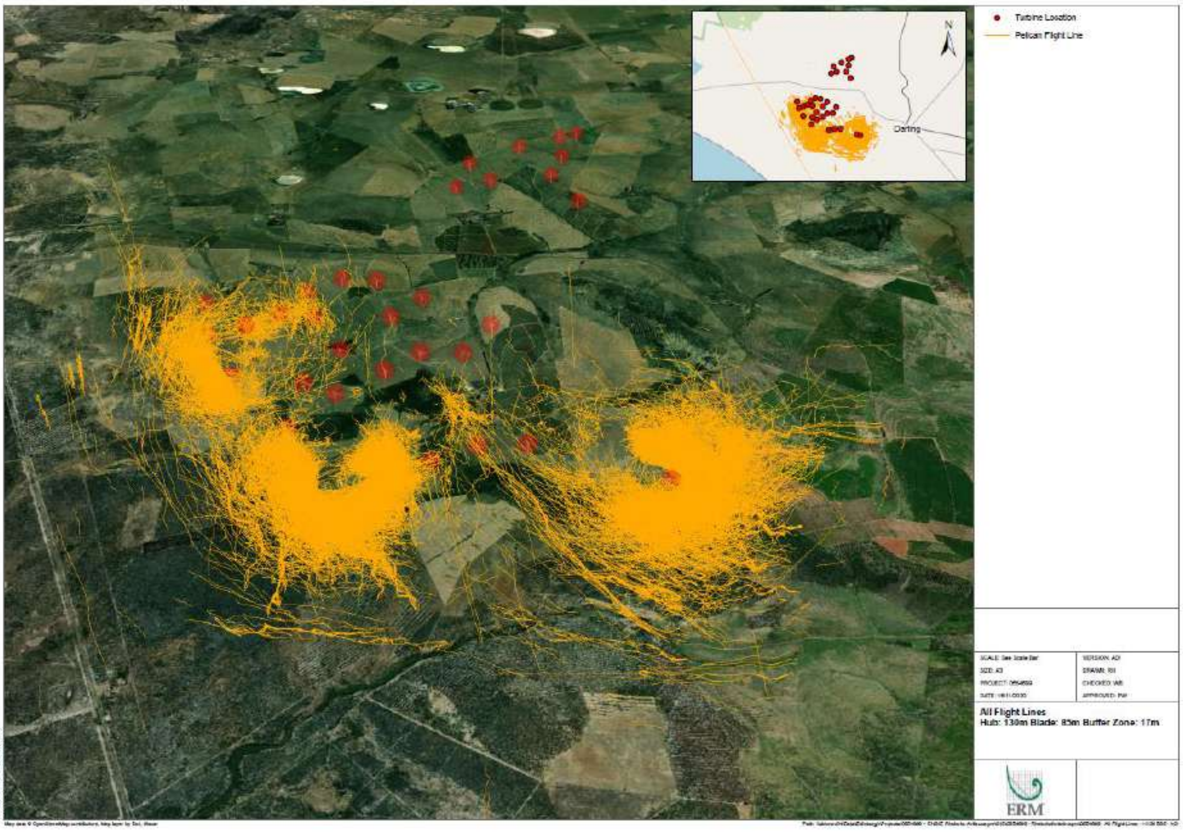
Wherever possible, the approach adopted for the re-analysis mirrored that set out in Jenkins et al 2014 in order to allow as consistent an approach to the updated assessment as was feasible. Where the provided data did not allow exactly the same approach to be taken, or where subsequently information or approaches required an alternative approach, a robust alternative was developed.

Analysis of Flight Activity

Flight track data from the radar study was obtained from EchoTrack who undertook the original radar work and initial analysis. Data were obtained for each of the 6 sampling periods that made up the study. Data were already identified as 'great white pelican flights', or 'Non-pelican' flights and supplied as individual data points allocated to an individual flight. The radar point data was imported into ESRI Arc GIS software and converted into flight tracks. The analysis identified more individual great white pelican flights in the data set than the 14,459 reported by Jenkins *et al* (2014). In order to take a precautionary approach however, all flight lines in the data were taken forward for further analysis.

An overview of all of the great white pelican flights identified from the updated analysis of the radar is presented in Figure A.1.

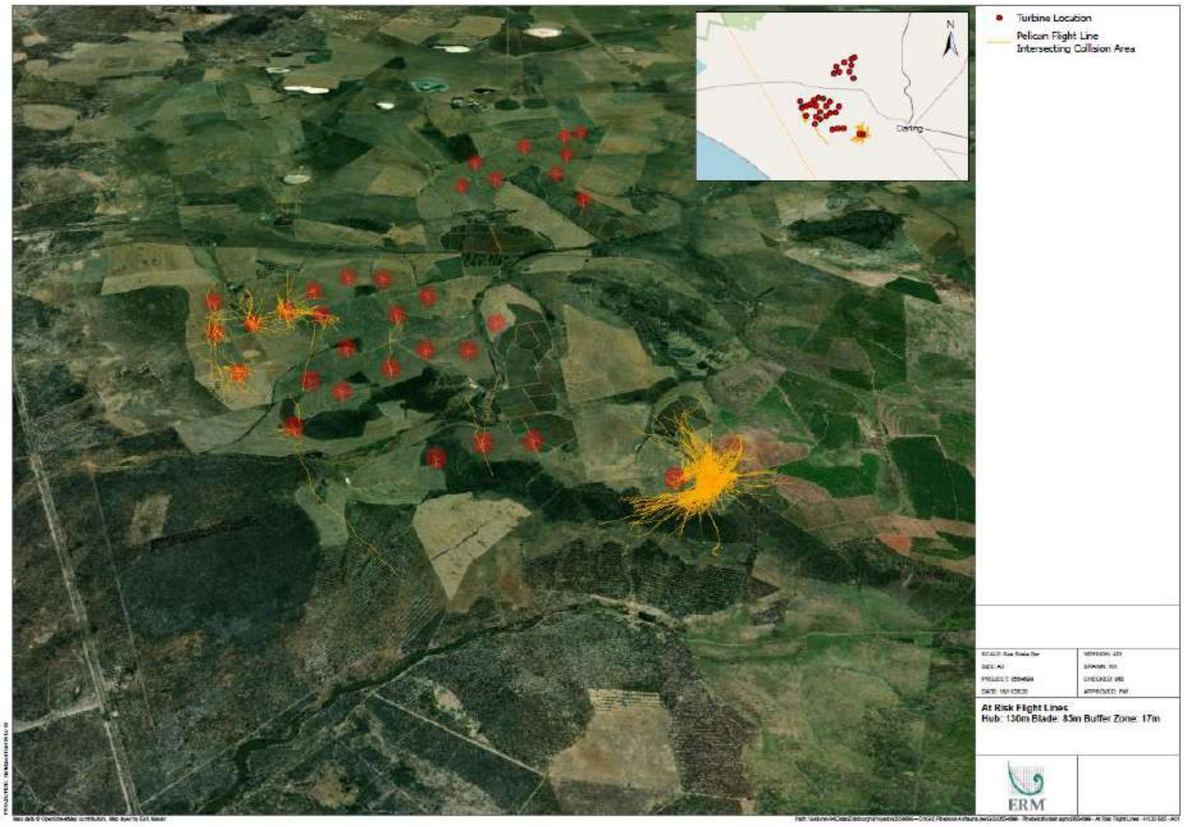
Figure A.1 Great White Pelican Flight Lines from the 2013-2014 Radar Study



Identifying High Risk Flights

The approach followed that set out in Jenkins *et al* (2014). The flight line track data was analysed using GIS software to identify those flights which would intersect with the rotor swept area of each turbine. The rotor swept area was taken as a sphere of 170 m (based on the turbine radius) located at 130 m hub height at each turbine location. A 17 m buffer was added to the rotor swept area to account for the 17 m accuracy of the radar used in the radar study. Those flight lines that intersected with the rotor swept area were considered to be ‘High Risk Flights’. The ‘High Risk Flights’ identified for the revised Project are shown in Figure A.2. Of the 33 turbine locations in the revised Project layout, 13 have great white pelican High Risk Flights associated with them in radar data.

Figure A.2 High Risk Flights for the Revised Project



Assigning Flock Size

In the analysis presented in Jenkins *et al* 2014, for the majority of flights, the radar separated aggregations of birds into the unique tracks of each individual (i.e a flock size of ‘1’). Where flocks were at a distance to the radar and flying obliquely, or when tracks were in very close proximity to each other the radar assigned them to two broad flock size categories: 2-10 birds, and >10 birds.

In order to covert these flock sizes to a specific number of birds to inform the number of birds at risk of collision associated with each flight track, Jenkins *et al* multiplied records of flights of pelican flocks by the mean flock size for its respective category (e.g 2-10 birds or >10 birds) recorded by direct observation for the relevant sample period.

In the data supplied by EchoTrack for the revised assessment the flock size of individual flights was not provided and had apparently been lost since the original analysis was undertaken. In order to account for the flock size associated with High Risk Flights, the average flock size of all ‘High Risk Flights’ associated with each turbine location in the consented layout was extracted from the data presented in Jenkins et al 2014. The average flock size of High Risk Flights for the closest turbine with ‘High Risk Flights’ in the consented layout was then applied to ‘High Risk Flights’ for each turbine in the revised Project. Average flock size data was available from the same turbine location in the consented and revised project layout for 10 of the 13 turbine locations with High Risk Flights. These three turbines accounted for four 'High Risk Flights' in total (approximately 0.3% of the total High Risk Flights recorded in the radar data) and so the use of a nearby turbine location to calculate average flock size is considered to be a reasonable approach which does not materially affect the outcome of the analysis.

Calculating Total Predicted At Risk Flights Per Year

Jenkins *et a*l (2014) used a general linear model (GLM) to model the number of High Risk Flights for the project over the course of a pelican breeding season, based on the sample of radar data collected during the six sampling periods. The number of High Risk Flights were correlated with a number of environmental variables and extrapolated over the complete 8 month breeding season. Using thi approach, Jenkins et al estimated there would be 5,898 High Risk Flights associated with the consented Project layout. For this analysis, rather than generate a GLM, the number of flights recorded per hour during the total number of hours of the radar operation was extrapolated across the duration of the whole great white pelican breeding season (only taking account of daylight hours as pelicans were found to only be active during the day) to give a total number of High Risk Flights. Data for the number of hours of survey, and the duration of the great white pelican breeding season were taken from Jenkins et al (2014).

To validate this approach, the number of High Risk Flights for the consented layout and turbine specifications were calculated and extrapolated in the same way. Using this approach, the analysis estimated 6,224 High Risk Flights for the consented development, slightly higher than estimated in Jenkins *et al* (2014), indicating that the adopted approach produced results that were in line with, and slightly more precautionary than those presented in Jenkins *et al* (2014).

Once the validation has been undertaken, the total number of flights for the revised Project was calculated at 3,951 High Risk Flights. The reduction in the total number of High Risk Flights associated with the revised Project layout despite the larger turbines used, is considered to be a result of reducing the overall number of turbines, and removing the majority of turbines located in the areas of highest great white pelican flight activity.

The calculation of total at risk flights per year is presented in Table A.1.

Table A.1 Total At Risk Great White Pelican Flights Per Breeding Season

Turbine Number	No. High Risk Flights	Average Flock Size from Closest Turbine in Consented Development with High Risk Flights*	No. At Risk Birds (No. High Risk Flights flight x Average Flock Size)	Sample Period Duration (hr)*	Risk flights per hour (h^{-1})	Total duration of pelican active season (hr)*	Total Predicted At Risk Flights Per Year
14	1	1.27	1.27	395.9	0.003207881	2920	9.4
15	20	1.27	25.4	395.9	0.064157616	2920	187.3
16	7	1.57	10.99	395.9	0.027759535	2920	81.1
18	18	1	18	395.9	0.045466027	2920	132.8
20	11	2.72	29.92	395.9	0.07557464	2920	220.7

Turbine Number	No. High Risk Flights	Average Flock Size from Closest Turbine in Consented Development with High Risk Flights*	No. At Risk Birds (No. High Risk Flights flight x Average Flock Size)	Sample Period Duration (hr)*	Risk flights per hour (h^{-1})	Total duration of pelican active season (hr)*	Total Predicted At Risk Flights Per Year
24	1	1	1	395.9	0.00252589	2920	7.4
25	17	1	17	395.9	0.042940136	2920	125.4
26	1	1	1	395.9	0.00252589	2920	7.4
28	7	2.58	18.06	395.9	0.04561758	2920	133.2
29	1	1	1	395.9	0.00252589	2920	7.4
30	2	1	2	395.9	0.005051781	2920	14.8
34	61	1	61	395.9	0.154079313	2920	449.9
35	349	1	349	395.9	0.881535741	2920	2574.1
Total	**496**	**-**	**535.6**	**-**	**-**	**-**	**3,950.7**

*Value taken from Jenkins *et al* 2014

Updated Collision Risk Model

The Band Collison Risk Model (Band *et al* 2007) was used to estimate the collision risk for the Project. The collision risk modelling was undertaken using the same parameters set out in Jenkins *et al* 2014 where still relevant. For the updated turbine specification, data was obtained from manufacturers of a number of turbines under consideration. The final turbine selected for assessment of the revised Project is a larger turbine than is currently available, but one that, from discussions with turbine suppliers, is expected to be available over the next 5 years. In order to 'future proof' the assessment, the hub height and blade length (130 m and 85 m respectively) of this larger future turbine was selected for the collision risk model. The maximum chord (horizontal depth of the blade as viewed head on) and rotation period for a blade of this size is not currently know, so the chord of the largest currently available considered turbine was selected as a proxy (the Vestas 162 5 MW, 81 m blade length). Given the variation in maximum chord and rotation period in similar sized turbines considered for the Project, this is considered to be a reasonable and robust approach.

The parameters used in the collision risk modelling are set out in Table A.2 below.

Table A.2 Collision Risk Model Paramaters

Great White Pelican Biological Parameters		
Bird Length		162 cm
Wingspan		293 cm
Bird speed		3.2, 12.3, 22.0 ms^{-1}
Turbine Technical Parameters		
	Consented Development	**Revised Project**
Hub Height	120 m	130 m
Rotor Diameter	126 m	170 m
Number of blades	3	3
Rotation period	3.6, 5.5, 11.3 s	5, 9.5, 14 s*
Maximum chord width	4 m	4.3*

Great White Pelican Biological Parameters		
Average pitch angle	15º	15º
Avoidance Rate		
No Avoidance		
95% avoidance		
98% avoidance		

Selected Avoidance Rate

The avoidance rate is one of most important variables in determining the predicted number of collisions. Current SNH guidance (SNH, 2018) recommends using 98% if a species specific rate isn't available (and as great white pelicans are not native to Scotland, avoidance rates have not been published for this species by SNH). The 2013 impact assessment and 2014 radar study use three rates – no avoidance, a conservative 95% avoidance and 98% avoidance. However, recent guidance (SNH 2018, Furness, 2015) proposes higher avoidance rates for large waterbirds in the UK, for swans (99.5%), geese (99.8%) and divers (99.5%). All of these species (like great white pelican) have relatively high wing loading (the weight of the bird divided by the area of its wing), and may point to higher avoidance rates being applicable for large waterbirds which are engaged in direct, commuting flight rather than actively hunting (cf raptors). However, none of the species uses soaring flight, relying on active (flapping) flight so are not direct analogues for pelicans.

There are few published studies or papers on interactions of great white pelicans and wind farms. A conference paper presented by ERM based on operational monitoring of windfarms in Romania reported 140 flights of great-white pelican at collision risk height through a windfarm, with only a single casualty, indicating a high avoidance rate for this species (Hatton *et al* 2017). Given the trend for operational monitoring to result in overall increases in avoidance rates, the higher avoidance rates adopted for other large waterbird species, and the data from operational monitoring of sites with great white pelican in Romania, the revised assessed has used an avoidance rate of 98%.

Estimated Collision Risk

Based on the total number of High Risk Pelican Flights calculated for the revised Project, the Band collision risk model was run for multiple sets of parameters, in line with the approach adopted for the assessment of the consented development. Combinations of bird speed (slow, average and fast) and turbine speed (slow, average and fast) set out in Table 2.2 were undertaken. The results are presented in Table A.3.

Table A.3 Collison Risk Model Results

Avoidance Scenario	Bird speed	Rotor Speed		
		Low	Average	High
No avoidance	Low	712	988	1664
	Average	283	328	472
	High	254	265	320
95% avoidance	Low	36	49	83
	Average	14	16	24
	High	13	13	16
98% avoidance	Low	14	20	33
	Average	6	6	9
	High	5	5	6

Taking the average flight speed and average turbine speed as the most likely outcome, and with the revised avoidance rate of 98%, the predicted annual mortality of the revised layout is 6 great white pelicans per year, much lower than the 22 casualties per year predicted in the pervious assessment (Jenkins et al 2014). Even using the more precautionary 95% avoidance rate, the predicted mortality is lower than that predicted for the consented development (16 casualties per year rather than 22).

Analysis of Other Species

Jenkins *et al* 2014 noted that higher flight activity was observed in the radar study area for some species during the 2013-2014 radar study (particularly black harrier, martial eagle, African marsh harrier and greater flamingo) than in previous baseline surveys and recommended reviewing the radar data to identify any changes in the volume of flight activity for these species that might increase the collision risk compared to that assessed in the original impact assessment for the consented development (Jenkins *et al* 2014).

As a result, all non-great white pelican tracks from the 2013-2014 radar study were analysed to identify flights of priority species within the Project site, and to identify 'High Risk Flights' in line with the approach adopted for great white pelican. The analysis only identified flights of martial eagle (18 flights), African marsh harrier (2 flights) and black harrier (1 flight) within the Project area, and did not identify any 'High Risk Flights'.

The majority of martial eagle flight activity (14 flights) occurred to the south of the Project site where turbines 32 and 33 were located close to slopes supporting more natural habitat and higher vegetation that may have provided suitable foraging areas for martial eagle. These turbine positions have been removed from the revised Project.

Therefore, as a result of the relatively low flight activity of non-great white pelican priority species recorded during the radar study, the potential collision impacts of the revised Project on other species is considered to be no worse than the consented development, and potentially marginally better as a result the removal of turbine locations in the south of the consented development close to more natural habitat.

APPENDIX B IMPACT ASSESSMENT METHODOLOGY

25th November 2020

IMPACT ASSESSMENT METHODOLOGY

An ‘impact’ is any change to a resource or receptor caused by the presence of a Project component or by a Project-related activity. Impacts can be negative or positive. Impacts are described in terms of their characteristics, including the impact’s type and the impact’s spatial and temporal features (namely extent, duration, scale and frequency). Terms used in the characterisation of impacts are described Table 0-1.

Table 0-1 Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	**Direct -** Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (ie, between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality). **Indirect -** Impacts that result from other activities that are encouraged to happen as a consequence of the Project (ie, in-migration for employment placing a demand on resources). **Induced -** Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project. **Cumulative -** Impacts that act together with other impacts (including those from concurrent or future third party activities) to affect the same resources and/or receptors as the Project.
Duration	The time period over which a resource/ receptor is affected.	**Temporary -** (less than 3 years ie, negligible/ pre-construction). **Short term -** (less than 5 years ie, production ramp up period). **Long term -** impacts that will continue for the life of the Project, but ceases when the Project stops operating. **Permanent -** (period that exceeds the life of plant ie, irreversible).
Extent	The reach of the impact (ie, physical distance an impact will extend to).	**On-site -** impacts that are limited to the Project site. **Local -** impacts limited to the Project site and adjacent properties. **Regional -** impacts that are experienced at a regional scale. **National -** impacts that are experienced at a national scale. **Trans-boundary/ International** - impacts that are experienced outside of South Africa.
Scale	Quantitative measure of the impact (ie, size of the area impacted, fraction of a resource that is affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.

Determining Magnitude

Once impacts are characterised they are assigned a ‘magnitude’. Magnitude is a function of some combination (depending on the resource/ receptor in question) of the following impact characteristics:

Extent;

Duration; and

Scale.

Magnitude (from Small to Large) is a continuum. Determination of an impacts magnitude involves to some degree quantification but also professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is described. Magnitude designations for negative effects are Negligible, Small, Medium and Large. The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue.

In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a Positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a Negligible Magnitude.

Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

Large Magnitude Impact affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A Large Magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

Medium Magnitude Impact affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A Medium magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.

Small Magnitude Impact affects a specific area, system, aspect (physical), group of localised individuals within a population (biological), and at sufficient magnitude, resulting in a small increase in measured concentrations (to be compared with legislated or international limits and standards specific to the receptors) (physical). This will be over a short time period (one plant/ animal generation or less but does not affect other trophic levels or the population itself), and in a localised area.

Determining Receptor Sensitivity

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered.

Where the receptor is biological or cultural (ie, the marine environment or a coral reef), its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of receptor is Low, Medium and High.

For ecological impacts, sensitivity is assigned as Low, Medium or High based on the conservation importance of habitats and species. For the sensitivity of individual species, Table 0-2 presents the criteria for deciding on the value or sensitivity of biological receptors.

Table 0-2 Biological and Species Value / Sensitivity Criteria

Sensitivity	Low	Medium	High
Criteria	Not protected or listed as common/ abundant; or not critical to other ecosystem functions ie, key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions e.g. CITIES Listed as rare, threatened or endangered e.g. IUCN

Note: The criteria are applied with a degree of caution. Seasonal variations and species lifecycle stage will be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods. This table uses listing of species ie, IUCN) or protection as an indication of the level of threat that this species experiences within the broader ecosystem (global, regional, local). This is used to provide a judgement of the importance of affecting this species in the context of Project-level changes.

Reversibility and Loss of Resource

As required by the South African EIA Regulations the following additional items should be considered in the assessment of impacts and risks identified:

The degree to which the impact and risk can be reversed (this is rated on a scale of High, Medium, or Low);

The degree to which the impact and risk may cause irreplaceable loss of resources (this is rated on a scale of High, Medium, or Low).

Assessing Significance

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in Figure B**.1**.

Figure B.1 Impact Significance

Magnitude of Impact		Sensitivity/ Vulnerability/ Importance of Resource/ Receptor		
		Low	Medium	High
	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/ receptors, and all impacts to these resources/ receptors, as the resource/ receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. Box 0-1 provides a context for what the various impact significance ratings signify.

Box 0-1 Context of Impact Significances

An impact of **Negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **Minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **Moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **Major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie, ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

Mitigation Potential and Residual Impacts

A key objective of an EIA process is to identify and define socially, environmentally, technically acceptable, and cost feasible measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Box 0-2. The priority is to first apply mitigation measures to the source of the impact (ie, to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie, to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures. The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Box 0-2.

Box 0-2 Mitigation Hierarchy

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project ie, avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity.

Abate on Site: add something to the design to abate the impact ie, pollution control equipment.

Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site ie, traffic measures.

Repair or Remedy: some impacts involve unavoidable damage to a resource ie, material storage areas) and these impacts require repair, restoration and reinstatement measures.

Compensate in Kind; Compensate through Other Means where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate ie, financial compensation for degrading agricultural land and impacting crop yields.

Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

Cumulative Impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact. How the impacts and effects are assessed is strongly influenced by the status of the other activities (ie, already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

Projects that are already in existence and are operating;

Projects that are approved but not as yet built or operating; and

Projects that are a realistic proposition but are not yet built.

Assessing Significance of Risks for Accidental / Unplanned Events

The methodology used to assess the significance of the risks associated with unplanned events differs from the impact assessment methodology set out in this report. Risk significance for unplanned events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing control and mitigation measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects.

Definitions used in the assessment for likelihood and consequence are set out in Box 0-3.

Box 0-3 Risk Significance Criteria for Accidental / Unplanned Events

Likelihood

Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:

Low: the event or incident is reported in the telecommunication industry, but rarely occurs;

Medium: the event or incident does occur but is not common; and/or

High: the event or incident is likely to occur several times during the project's lifetime.

Consequence

The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in unplanned events is similar to significance (magnitude x sensitivity) of planned events and is classified as either a:

Minor consequence: impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required;

Moderate consequence: impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or

Major consequence: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in Table 0-3 is used to determine the risk significance for unplanned events. The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 0-3 Accidental Events Risk Significance

Risk Significance Rating				
Likelihood		**Low**	**Medium**	**High**
Consequence	**Minor**	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of unplanned events occurring. However, the mitigation strategy to minimise the risk of the occurrence of unplanned events is outlined in Box 0-4.

Box 0-4 Mitigation Strategy for Accidental Events

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through:

Reducing the likelihood of the event ie, preventative maintenance measures, emergency response procedures and training);

Reducing the consequence; and

A combination of both of these.

Recovery/ remediation: includes contingency plans and response:

Emergency Response Plans; and

Tactical Response Plans

Assumptions and Limitations

Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIA deals with the future there is, inevitably, some uncertainty about what will actually happen in reality. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties could not be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided.

In line with best practice, this EIA process has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the Project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists has used professional experience to judge whether a significant impact is likely to occur or not. Throughout the assessment, this conservative approach has been adopted to the allocation of significance.

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4 August 2020

Amy Barclay
ERM (Pty) Ltd
1st Floor Great Westerford
240 Main Road
Rondebosch
Cape Town
7700

Dear Ms Barclay

RE: PROPOSED AMENDMENTS TO THE RHEBOKSFONTEIN WIND ENERGY FACILITY NEAR DARLING, SOUTH AFRICA

Engie Africa currently has Environmental Authorisation (EA) for the proposed Rheboksfontein wind energy project in the Western Cape of South Africa, but due to internal considerations, Engie intends to make amendments to the proposed infrastructure, including a reduction in the number of turbines, and is required to undertake a part two environmental authorisation (EA) amendment in terms of the Environmental Impact Assessment (EIA) Regulations, Listing Notice 2, GNR 326 of the National Environmental Management Act, (NEMA), as amended. Outeniqua Geotechnical Services previously conducted a specialist Geological Report, dated August 2010, for the project (Ref. OGS2010-08-18-2). We have assessed the proposed amendments in the light of the previous study and can offer the following comment:

- A reduction in number of turbines will contribute <u>positively</u> to direct and cumulative impacts on soil degradation, resulting in an overall <u>low significance</u> with mitigating measures in place.
- Any changes in the type or size of turbine will have <u>no significant additional impact</u> on the outcomes of the previous geological study.

The mitigating measures and geotechnical constraints presented in the report are still valid.

Yours faithfully

Iain Paton Pr Sci Nat Pr Tech Eng

ACO Associates cc
Archaeology and Heritage Specialists

Postal: 8 Jacobs Ladder, St James, 7945
Physical: Unit D17, Prime Park, 21 Mocke Road, Diep River 7800
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Date: 16 November 2020

Ms Amy Barclay
ERM Southern Africa Proprietary Limited
1st Floor Great Westerford
240 Main Road Rondebosch
7700
Cape Town

BY EMAIL

Dear Ms Barclay

RHEBOKSFONTEIN WIND ENERGY FACILITY ENVIRONMENTAL AUTHORISATION AMENDMENT: HERITAGE SPECIALIST IMPACT STATEMENT

The Rheboksfontein Wind Energy Facility (WEF), to be constructed on various farms approximately 3 km west of Darling in the Western Cape, received environmental authorization (EA) from the then Department of Environmental Affairs (DEA) on 2 February 2012.

The EA gave approval for the construction of 43 wind turbines, each between 80 and 100 m in height, with a rotor diameter of up to 112 m, blade lengths of up to 55 m and a total generating capacity of 129 MW. Approval was also given for, *inter alia*, a 15 x 15 m turbine footprint and 40 x 40 m temporary construction laydown area for each of the 43 turbines, internal roads linking the turbines and other infrastructure on the site, two substations, underground cabling between the turbines and the substations and an overhead powerline linking the WEF with the Dassenberg substation in Atlantis.

On 25 May 2015 the DEA approved an EA amendment application in terms of which the authorized turbine capacity of the Rheboksfontein WEF was reduced to 35 turbines, each up to 120 m in height and with a rotor diameter of 132 m and a blade length of 63 m. The total generating capacity of the WEF remained 129 MW based on the use of 3 MW generating units.

To keep pace with and reflect developments in turbine technology and generating capacity the project developer, ENGIE, wishes to further amend the environmental authorization for the WEF to increase turbine rotor diameter to 170 m, turbine hub height to 130 m and the turbine footprints to 25 x 25 m each. The WEF layout will remain unchanged except that turbines 32 and 33 will be removed.

A Basic Assessment for the proposed amendment to the project is not required but specialist impact statements must accompany the Part 2 Amendment Application to confirm whether the increase in turbine rotor diameter will result in additional impacts that were not assessed in the original environmental assessment and to recommend, where necessary, additional mitigation measures for inclusion in the EMPr. The specialist impact statements must be accompanied, if required, by new impact ratings.

The heritage impact assessment (HIA) produced by ACO Associates in 2010 (Orton 2010) as part of the Environmental Impact Assessment (EIA) process considered palaeontological and archaeological heritage resources, the historical built environment, graves and cultural landscapes and sense of place.

An assessment of the visual impacts of the proposed WEF on the surrounding landscape was undertaken by an independent specialist and did not form part of the HIA.

The findings of the HIA were:

- Palaeontology: No palaeontological material will occur in the Cape Granite Suite rocks that underlie most of the WEF, nor were fossils expected or noted in the Holocene sands that blanket most of the site.

- Archaeology: Archaeological material was found to be rare and widely scattered across the WEF. Only one concentration of artefacts (Rheboksfontein 1) worthy of being called a site was recorded on the crest of the ridge that overlooks the coastal plain and in the lee of a small granite dome. The site contains both indigenous (mainly Later Stone Age (LSA)) and colonial artefacts and was assessed to be of significance, with the potential to provide information that would improve our understanding of the pre-colonial history of the area. Since it was directly threatened by one of the turbines, the HIA recommended that it required mitigation.
  Most other surface archaeological finds were isolated artefacts relating to the Early Stone Age (ESA) and LSA and these were assessed to be of no significance beyond indicating the presence of Stone Age people in the landscape in the past.

- Built Environment: Several clusters of buildings are present within the WEF, most directly related to three main farm complexes (Wildschutsvlei, Grootberg and Rheboksfontein), with a few isolated buildings also noted. The majority of the farm buildings were modern, and of little heritage significance, but a few older buildings were noted, the most significant being the primary residence on Rheboksfontein the core of which appears to originally date to the 18^{th} century.

- Graves: No farm graveyards are known to be present within the proposed WEF site and just one grave was located on a hilltop on Wildschutsvlei during the heritage survey. The grave dates from 1983, is thus less than 60 years old and therefore not covered by the National Heritage Resources Act (No 25 of 1999).

- Cultural Landscapes and Sense of Place: The region's landscape is strongly dominated by agriculture - wheat farming and grazing – and modifications to the landscape almost exclusively revolve around agriculture and farm complexes. The presence of several tree lines or clusters of large trees related to the agricultural use of the area, and which contribute to the cultural landscape and sense of place, was noted in the HIA.

The HIA made the following assessment of impacts of the proposed WEF on heritage resources:

- No fossils are likely to be intersected by the proposed development and no palaeontological impact assessment was therefore considered necessary.
- The Rheboksfontein 1 archaeological site was very close to a proposed turbine location and an impact to this site was assessed to be highly probable.
- All impacts to the built environment would be indirect, relating to the context and sense of place in which the structures find themselves.
- Overall the impacts to heritage resources were not considered to be highly significant, provided the mitigation measures recommended in the HIA were implemented.

The following heritage mitigation measures were proposed in the HIA:

- Archaeological test excavations and subsequent mitigation must be carried out for site Rheboksfontein 1, unless the nearby turbine can be shifted or omitted.
- A VIA must determine the extent and significance of visual impacts to both the scenic qualities of the landscape and to specific places of concern, including the view westwards from the Rheboksfontein farmhouse.
- Tree lines should be protected as far as possible, with particular importance being attached to the three highlighted in the HIA.

The current, authorized layout of the Rheboksfontein WEF addressed issue of the turbine close to Rheboksfontein 1, as well as the visual concerns related to the view westwards of the Rheboksfontein farmhouse through the reduction in the number of turbines planned in this area.

Heritage Specialist Impact Statement:

This EA amendment application for the Rheboksfontein Wind Energy Facility arises from the proposal to increase the turbine rotor diameter, hub height and turbine footprint of the 35 authorized turbines. There are no other changes proposed to the facility, except a possible reduction in the number of turbines arising from of an increased generating capacity as a result of the larger turbines.

It is our reasoned opinion that the proposed use of larger turbines will occasion no additional impacts on heritage resources to those identified in the HIA and addressed in the recommended mitigation measures.

The possible visual impacts of the increase in rotor diameter and hub height on heritage resources is the subject of the visual specialist's statement is not addressed here.

From a heritage resources perspective, the proposed amendment to the environmental authorization for the Rheboksfontein WEF are considered acceptable.

Yours sincerely

John Gribble
Senior Archaeologist and Heritage Consultant

References:

Orton, J. 2010. *Heritage Impact Assessment for the Proposed Rheboksfontein Wind Energy Facility, Malmesbury Magisterial District, Western Cape*. Unpublished report for Savannah Environmental (Pty) Ltd. ACO Associates. Cape Town.

ADDENDUM TO ENVIRONMENTAL NOISE IMPACT ASSESSMENT

Review of an updated layout dated for the Rheboksfontein Wind Energy Facility, Western Cape Province

Study done for:

savannah environmental

Prepared by:

EAR Enviro Acoustic Research

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This Report should be cited as:

De Jager, M. 2018: "*Addendum to Environmental Noise Impact Assessment: Review of an updated layout dated for the Rheboksfontein Wind Energy Facility, Western Cape Province*". Enviro-Acoustic Research, Pretoria

Client:

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Report no:

SE-ERWEF/ENIAR/201811-Rev 0

Authors:

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Review:

Johan Maré *(MSc. Microbiology, Pri Sci Nat (400092/91))*

Date:

November 2018

EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was requested to review an updated layout for the proposed Rheboksfontein Wind Energy Facility (WEF).

Noise rating levels were calculated considering a potential worst-case scenario, with this report assessing the significance of the potential noise impact that the facility may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

While this is a stand-alone report, this addendum report must be read with the previous report, especially the report dated August 2010 containing details of the ambient sound levels measured in the vicinity of this WEF.

PROJECT DESCRIPTION

Engie (the developer) proposes the establishment of a wind energy facility and associated infrastructure with a revised turbine layout on various farms and farm portions near the town of Darling, Western Cape. The study area is approximately 70 km^2, with the area investigated in terms of the noise impact covering approximately 132 km^2.

Environmental Authorization (AE) was granted in 2012 for the Rheboksfontein WEF. The AE allowed for up to 43 Wind Turbine Generators (WTGs). The layout has again changed due to boundary buffer requirements (1.5x tip height) relating to the higher proposed hub height of the WTGs. The developer is using a hub height of 120 m with a 160 m rotor diameter.

NOISE IMPACT DETERMINATION AND FINDINGS

The potential noise impact was evaluated using a sound propagation model. Conceptual scenarios were developed for the operational phases, considering a worst-case scenario as well as a mitigated scenario, using actual sound power emissions of a WTG that may be used by the developer.

Comparing the significance of the noise impact with the findings of the 2013 report, it is noted that the significance is higher. This is likely because a worst-case scenario was evaluated, with the WTG generating the maximum noise level even at low wind speeds as well as the relocation of two wind turbines closer to NSDs 11 and 12. The use of a WTG with a sound power emission level curve similar to the Vestas V150 4.2 MW will reduce the noise level as well as the significance of the noise impact. Such a WTG should have a maximum sound power emission level less than 107.4 dBA.

It is concluded that, for the worst-case scenario evaluated:

- The significance of the operational daytime noises will be low.
- The significance of the operational night-time noises may be medium.

Mitigation is available and by selecting a quieter wind turbine, the noise level will reduce which will result in a lower significance. While the noises from the WTGs may increase the ambient sound levels, the increase will be less than 7 dBA at the closest NSD and will not result in a disturbing noise impact.

RECOMMENDATIONS

Considering the findings of this assessment, the amendment to the WTG locations and specifications is not considered to be a fatal flaw. The amendment in the layout may change the findings of the original Environmental Noise Impact Assessment report (de Jager, 2013) and mitigation is of critical importance. By using a quieter WTG, the significance will be reduced to low, and the amendment in layout and WTG specifications can be authorized.

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		Relevant Section in Specialist study
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	**Section 1**
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	**Section 1**
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Section 2** *(also separate document to this report)*
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	**Section 3.1**
(cA)	an indication of the quality and age of base data used for the specialist report;	Review of new layout.
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Review of new layout.
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Review of new layout.
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Section 8**
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**Section 5.1 and 8.1**
(g)	an identification of any areas to be avoided, including buffers;	No buffers required. Noise rating levels calculated and illustrated.
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	No buffers required. Noise rating levels calculated and illustrated.
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 7**
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	**Section 9** and **10**
(k)	any mitigation measures for inclusion in the EMPr;	**Section 11**
(l)	any conditions for inclusion in the environmental authorisation;	**Section 11**
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Section 11**
(n)	a reasoned opinion -	

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		**Relevant Section in Specialist study**
	whether the proposed activity, activities or portions thereof should be authorised;	**Section 11**
	regarding the acceptability of the proposed activity or activities; and	**Section 11**
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	**Section 11**
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Review of new layout.
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**Section 3.4**
(q)	any other information requested by the competent authority.	None

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APPENDICES

GLOSSARY OF ABBREVIATIONS

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EHS	Environmental Health and Safety
ENIA	Environmental Noise Impact Assessment
ENM	Environmental Noise Monitoring
ENPAT	Environmental Potential Atlas for South Africa
EPs	Equator Principles
EPFIs	Equator Principles Financial Institutions
FEL	Front-end Loader
GN	Government Notice
I&APs	Interested and Affected Parties
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
METI	Ministry of Economy, Trade, and Industry
NASA	National Aeronautical and Space Administration
NEMA	National Environmental Management Act
NCR	Noise Control Regulations
NSD	Noise-sensitive Development
PWL	Sound Power Level
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Level
SR	Significance Rating
TLB	Tip load bucker (also referred to as a back-actor or backhoe)
UTM	Universal Transverse Mercator
WHO	World Health Organization
WULA	Water Use Licence Application
WEF	Wind Farm / Wind Energy Facility
WTG	Wind Turbine Generator

GLOSSARY OF UNITS

dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)
km	kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)
^{o}C	Degrees Celsius (measurement of temperature)
µPa	Micro pascal (measurement of pressure – in air in this document)

1 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Licence Applications and EIA's), auditing of licence conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 10 years, and was involved with the following projects in the last few years:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for more than 90 different projects, including: Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Isivunguvungu (Aurecon), De Aar (Aurecon), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Kokerboom 3 (Aurecon), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee (ARCUS), Kolkies (ARCUS), San Kraal (ARCUS), Phezukomoya (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Scarlet Ibis (CESNET), Albany (CESNET), Sutherland (CSIR), Kap Vley (CSIR), Kuruman (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Perdekraal (ERM), Teekloof (Mainstream), Eskom Aberdene (SE), Dorper (SE), Spreeukloof (SE), Loperberg (SE), Penhoek Pass (SE), Amakhala Emoyeni (SE), Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE),*

	Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Namas (SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab)
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Pofadder CSP (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo)*
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm (Globeleq), Sephaku Aganang (Exigo), Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream),*
Small Noise	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church*

Impact Assessments	*(UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma Community Wind Farm Noise Simulation project (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (SE), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy), De Aar WEF (Holland), Quarterly Measurement Reports – Dangote Delmas (Exigo), Quarterly Measurement Reports – Dangote Lichtenburg (Exigo), Quarterly Measurement Reports – Mamba Cement (Exigo), Quarterly Measurement Reports – Dangote Delmas (Exigo) Quarterly Measurement Reports – Nokeng Fluorspar (Exigo), Proton Energy Limited Nigeria (ERM), Hartebeest WEF Update (Moorreesburg) (Savannah Environmental), Modderfontein WEF Opinion (Terramanzi), IPD Vredenburg WEF (IPD Power Vredenburg)*

2 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2010, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010.

____
Signature of the environmental practitioner:

Name of company:
Enviro-Acoustic Research cc

27-11-2018
____
Date:

3 INTRODUCTION

3.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was requested to review an updated layout for the proposed Rheboksfontein Wind Energy Facility (WEF).

Noise rating levels were calculated considering a potential worst-case scenario, with this report assessing the significance of the potential noise impact that the facility may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

While this is a stand-alone report, this addendum report must be read with the previous report, especially the report dated August 2010 containing details of the ambient sound levels measured in the vicinity of this WEF. Other reports include:

Report no:	**Report Title:**
ME-RF/NIA/201008-Rev 2 (June 2011)	De Jager, M. 2010: "*Noise Impact Study for Environmental Impact Assessment: Establishment of the Rheboksfontein Wind Energy Facility on various farms near Darling, Western Cape*." M2 Environmental Connections cc, Pretoria
ME-RF/ENIA/201306-Rev 1 (June 2013)	De Jager, M. 2013: "*Review of layout 2013-05-29 for Environmental Noise Impact Assessment: Rheboksfontein Wind Energy Facility*" Enviro Acoustic Research cc, Pretoria

The assessment methodology is similar as previously used in the June 2011 report, though slightly updated.

3.2 BRIEF PROJECT DESCRIPTION

Engie (the developer) proposes the establishment of a wind energy facility and associated infrastructure with a revised turbine layout (refer to **Figure 3-2**) on various farms and farm portions near the town of Darling, Western Cape. The study area is approximately 70 km^2, with the area investigated in terms of the noise impact covering approximately 132 km^2.

Environmental Authorization (EA) was granted in 2012 for the Rheboksfontein WEF. The EA allowed for up to 43 Wind Turbine Generators (WTG). The layout has again changed due to boundary buffer requirements (1.5x tip height) relating to the higher proposed hub height of the WTGs. The developer is using a hub height of 120 m with a 160 m rotor diameter.

3.3 PROPOSED WIND TURBINE

The wind energy market is fast changing and adapting to new technologies and site specific constraints. Optimising the technical specifications can add value through, for example, minimising environmental impact and maximising energy yield. As such the developer has been evaluating several turbine models, however the selection will only be finalised at a later stage once a most optimal wind turbine is identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered).

As the noise propagation modelling requires the details of a wind turbine, the developer considered a worst-case scenario to cover potential latest wind turbine types. As such the maximum sound power emission level of 108.0 dBA will be used (such as the Vestas V150 4.2 MW WTG without Serrated Trailing Edge).

3.4 COMMENTS RECEIVED FROM INTERESTED OR AFFECTED PARTIES

Condition 76 of the Rheboksfontein EA requests the review of the latest layout with condition 77 stipulating a maximum noise level of 45 dBA at receptors (as modelled). The older layout (dated 2013-05-29) is presented in **Figure 3-1**, with the latest layout depicted in **Figure 3-2**. The main changes are:

- WTG 6 is slightly closer to NSD04;
- WTG 14 was relocated closer to NSD10. This will increase the cumulative effect with up to 3 dB;
- WTGs 11 and 13 are slightly closer to NSDs 08, 09 and 10 (potential cumulative effects); and
- WTGs 22 and 30 are closer to NSDs 11 and 12 (potential cumulative effects).

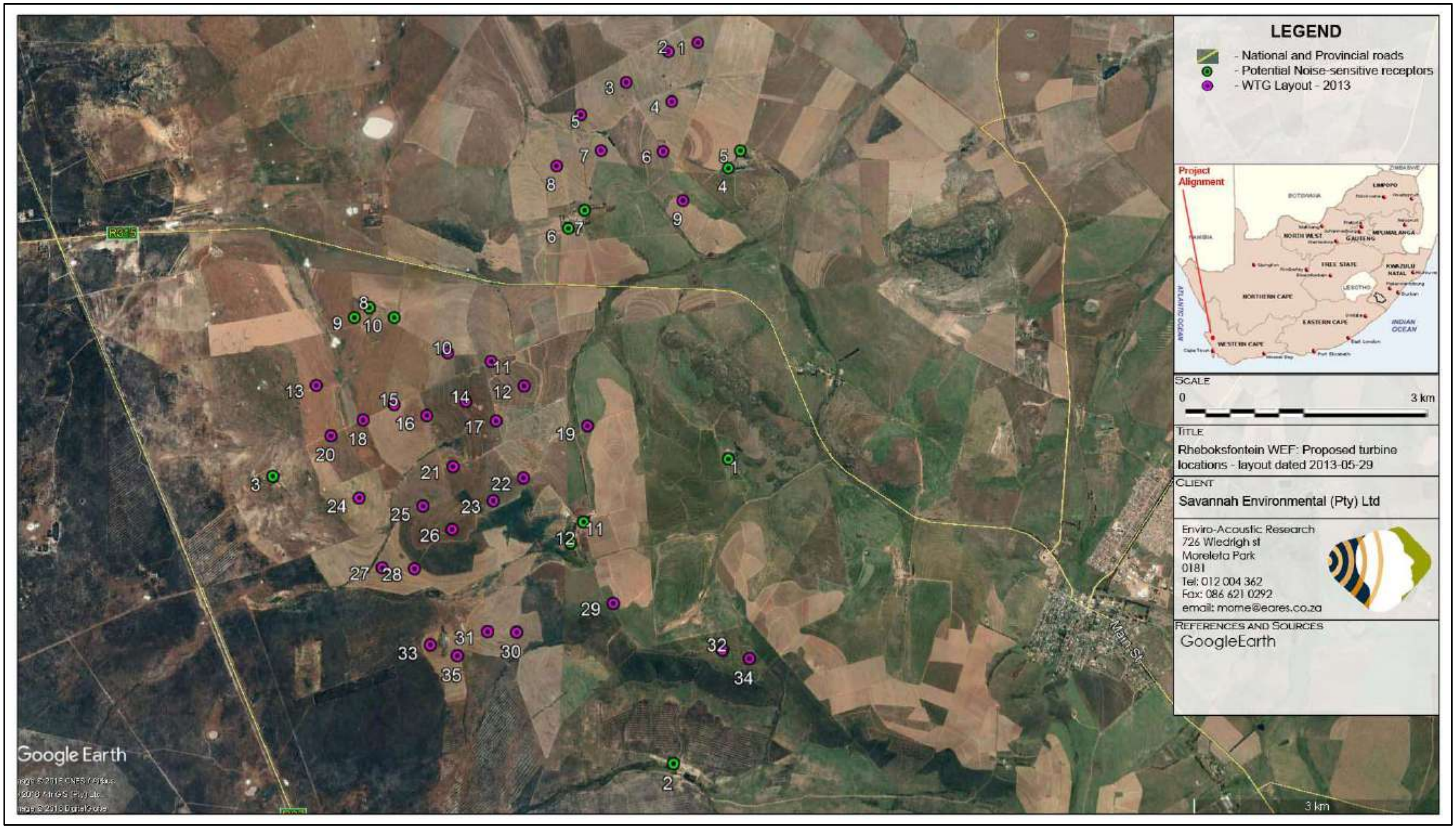

Figure 3-1: Previous proposed layout of the Rheboksfontein WEF

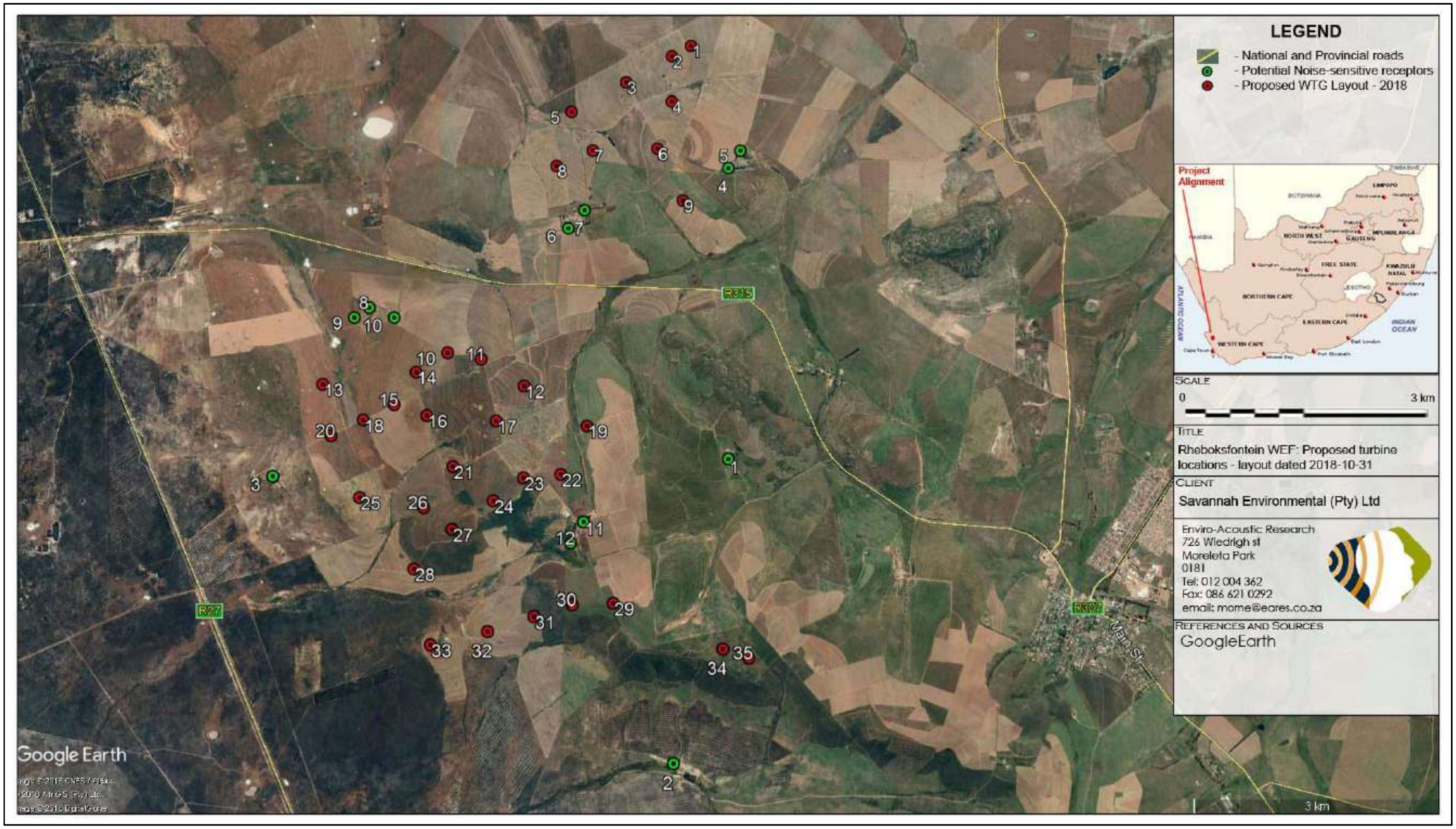

Figure 3-2: Latest proposed layout of the Rheboksfontein WEF

4 POLICIES AND THE LEGAL CONTEXT

4.1 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Minister of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. The Minister has implemented noise control regulations under the ECA, adopted in Provincial Notice 200 of 2013 by the Western Cape Provincial Authority.

4.1.1 National Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the national Noise Control Regulations (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

4.1.2 Western Cape Provincial Noise Control Regulations: PN 200 of 2013

The control of noise in the Western Cape is legislated in terms of Provincial Notice 200 of 2013.

The regulations defines:

"**ambient noise**" means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes;

"**disturbing noise**" means a noise, excluding the unamplified human voice, which—
(a) exceeds the rating level by 7 dBA;
(b) exceeds the residual noise level where the residual noise level is higher than the rating level;
(c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or
(d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103

"**noise sensitive activity**" means any activity that could be negatively impacted by noise, including residential, healthcare, educational or religious activities;

"**rating level**'' means the applicable outdoor equivalent continuous rating level indicated in Table 2 of SANS 10103;

"**residual noise**" means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes, excluding noise alleged to be causing a noise nuisance or disturbing noise;

"sound level'' means the equivalent continuous rating level as defined in SANS 10103, taking into account impulse, tone and night-time corrections;

In terms of this Provincial Notice:
2. A person may not—
(a) cause a disturbing noise; or
(b) allow a disturbing noise to be caused by any person, animal, machine, device, apparatus, vehicle, vessel or model aircraft, or any combination thereof.

Also, in terms of regulation 4:
(1) The local authority, or any other authority responsible for considering an application for a building plan approval, business license approval, planning approval or environmental authorization, may instruct the applicant to conduct and submit, as part of the application—

> *(a)* a noise impact assessment in accordance with SANS 10328 to establish whether the noise impact rating of the proposed land use or activity exceeds the appropriate rating level for a particular district as indicated in SANS 10103; or
> *(b)* where the noise level measurements cannot be determined, an assessment, to the satisfaction of the local authority, of the noise level of the proposed land use or activity.

(2) *(a)* A person may not construct, erect, upgrade, change the use of or expand any building that will house a noise-sensitive activity in a predominantly commercial or industrial area, unless he or she insulates the building sufficiently against external noise so that the sound levels inside the building will not exceed the appropriate maximum rating levels for indoor ambient noise specified in SANS 10103.

> *(b)* The owner of a building referred to in paragraph *(a)* must inform prospective tenants or buyers in writing of the extent to which the insulation measures contemplated in that paragraph will mitigate noise impact during the normal use of the building.
> *(c)* Paragraph *(a)* does not apply when the use of the building is not changed.

(3) Where the results of an assessment undertaken in terms of sub regulation (1) indicate that the applicable noise rating levels referred to in that sub regulation will likely be

exceeded, or will not be exceeded but will likely exceed the existing residual noise levels by 5 dBA or more—

(a) the applicant must provide a noise management plan, clearly specifying appropriate mitigation measures to the satisfaction of the local authority, before the application is decided; and

(b) implementation of those mitigation measures may be imposed as a condition of approval of the application.

(4) Where an applicant has not implemented the noise management plan as contemplated in sub regulation (3), the local authority may instruct the applicant in writing to—

(a) cease any activity that does not comply with that plan; or

(b) reduce the noise levels to an acceptable level to the satisfaction of the local authority.

5 ENVIRONMENTAL SOUND CHARACTER

5.1 INFLUENCE OF SEASON ON SOUND LEVELS

Natural sounds are a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises such as wind flowing through vegetation increasing as wind speed increase. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation generated noise. In addition, factors such as the season (e.g. dry or no leaves versus green leaves), the type of vegetation (e.g. grass, conifers, deciduous), the vegetation density and the total vegetation surface all determine both the sound level as well as spectral characteristics.

While the total ambient sound levels are of importance, the spectral characteristics also determines the likelihood that someone will hear external noises that may or may not be similar in spectral characteristics to that of vegetation created noise. Bolin (2006) did investigate spectral characteristics and determined the annoyance might occur at levels where noise generated by wind turbine noise exceeds natural ambient sounds with 3dB or more.

Unfortunately, current regulations and standards do not consider changing ambient sound levels due to natural events, such as can be found near the coast (from the ocean waves) or areas where wind induced noises (from vegetation) are prevalent, which is unfeasible with wind energy facilities, as these facilities will only operate when the wind is blowing. It is therefore important that the impact of wind-induced noises be considered when determining the impact of an activity such as a wind energy facility.

Ambient sound levels are significantly affected by the area where the sound measurement location (or a listener) is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and even increased wind speeds have an insignificant to massive impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings), however, are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication during the warmer spring and summer months as various species communicate in an effort to find mates, and
- Seasonal changes in weather patterns, mainly wind (also see **Sub Section 5.1.1** below).

For environmental noise weather plays an important role, the greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible. Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in **Sub-sections 5.1.1** to **5.1.3** below.

5.1.1 Effect of Wind

Wind alters sound propagation by the mechanism of refraction, that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high. Over short distances wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e. less than 5 m/s.

Wind speed frequently plays a role in increasing sound levels in natural locations. With no wind, there is little vegetation movement that could generate noises and faunal noises (normally birds and insects) dominate, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speed on sound levels depends on the vegetation type (deciduous versus connivers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes unanticipated consequences, as suitable vegetation may create suitable habitats and food sources attracting birds and insects (and the subsequent increase in faunal communication).

5.1.2 Effect of Temperature

On a typical sunny afternoon the air is the hottest near the ground surface and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, resulting in cooler temperatures near the ground. This condition, often referred to is a temperature inversion will cause sound to bend downward towards the ground and results in louder noise levels at the listener position. Like wind gradients, temperature gradients can influence sound propagation over long distances and further complicate measurements. Generally sound propagate better at lower temperatures (down to 10°C), and with everything being equal, a decrease in temperature from 32°C to 10°C could increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

5.1.3 Effect of Humidity

The effect of humidity on sound propagation is quite complex, but effectively relates how increased changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz at 20°C).

6 POTENTIAL NOISE SOURCES

6.1 CHANGES IN NOISE SOURCES: OPERATIONAL PHASE

The developer requested that the worst-case scenario be investigated, highlighting:

- A rotor diameter of 160 m;
- A hub height of 120m; and
- Considering a maximum sound power emission level of 108.0 dBA.

For the purpose of this noise assessment a potential maximum sound power emission levels of 108 dBA was used (worst-case scenario). The noise impact of a Vestas V150 4.2 MW (blades fitted with Serrated Trailing Edge) was also considered (for a mitigated option). The 2010 noise study made use of the sound power emission levels of the Vestas V90 3.0 MW WTG with the 2013 noise study using the sound power emission levels of the Vestas V112 3.0 MW WTG. The sound power emission level curves are illustrated for these wind turbines in **Figure 6-1**.

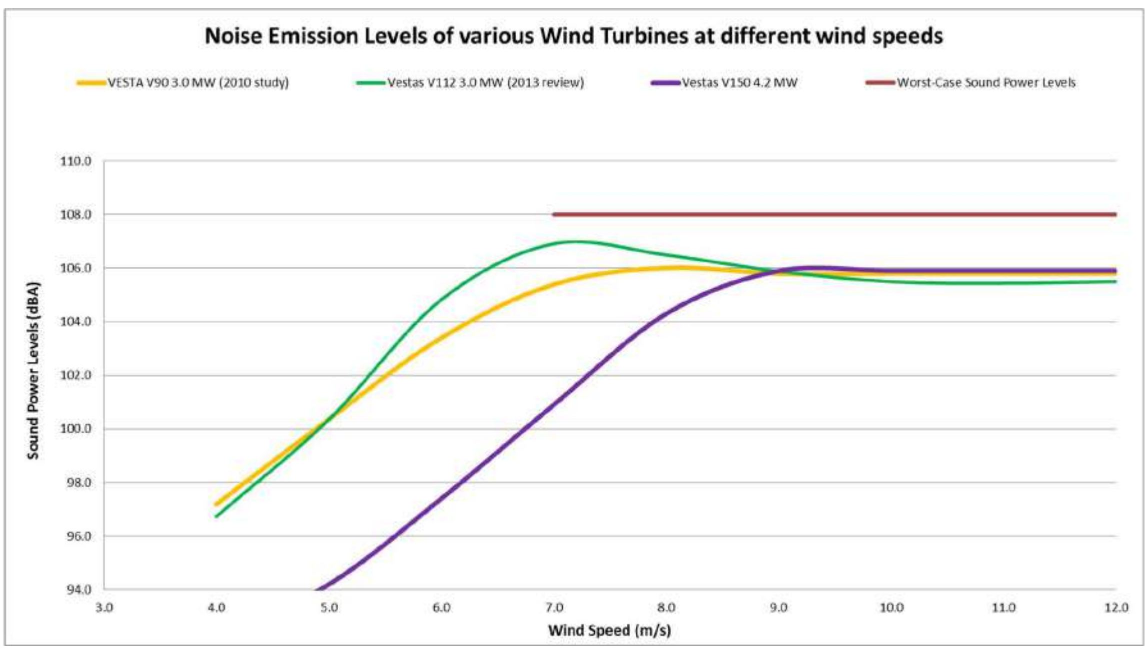

Figure 6-1: Noise Emissions Curve of a number of different wind turbines

The propagation model makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions providing a higher accuracy than models that only use the total sound power level. The octave sound power levels for various wind turbines are presented on **Figure 6-2**.

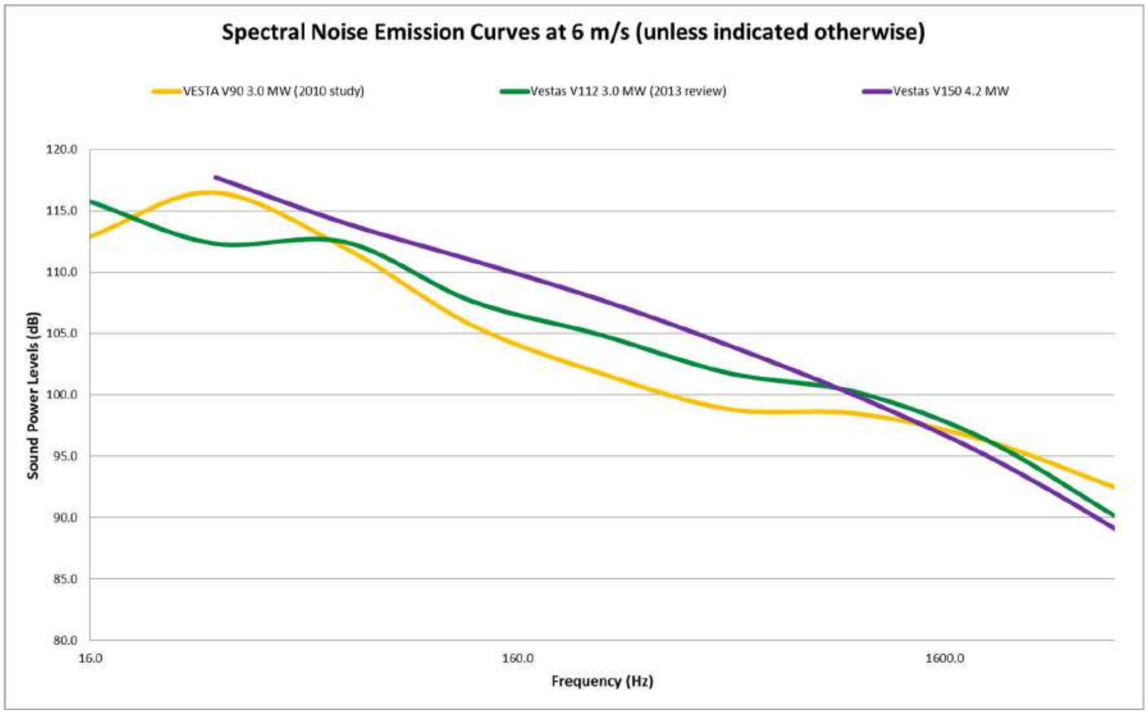

Figure 6-2: Octave sound power emissions of various wind turbines

7 ASSUMPTIONS AND LIMITATIONS

7.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

- Ambient sound levels are the cumulative effects of innumerable sounds generated from a variety of noise sources at various instances both far and near from the listener. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement, especially when at a community or house. It is assumed that the measurement locations represents ambient sound levels in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
    - the distance to the closest trees, number and type of trees as well as the height of the trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwellings, type of equipment used at dwelling (compressors, air-cons, etc.) and people in the area;
    - general maintenance condition of houses (especially during windy conditions), as well as
    - numbers and types of animals kept in the vicinity of the measurement locations.
- Determination of existing road traffic and other noise sources of significance are important (traffic counts, etc.). Traffic, however, is highly dependent on the time of day as well as general agricultural activities taking place at the time of traffic counts. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. This Study found that traffic in the area was very low, yet it cannot be assumed that is always very low;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in

the vicinity of the microphone did impact on the ambient sound levels. The site visit unfortunately coincided with a relatively windy period;

- Ambient sound levels are depended not only time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location, and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as a residential area matures.

7.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

The noise emissions into the environment from the various sources as defined were calculated for the WF, using the Sound Propagation Model described in ISO 9613-2 (operational phase) and SANS 10357[1] (construction phase).

The following was considered in the Noise Model:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout, as well as
- Acoustical characteristics of the ground. Seventy-five percent (75%) hard ground conditions were modelled considering the recommendation of a number of studies.

It is important to understand the difference between sound, or noise level and the noise rating level (also see Glossary of Terms – **Appendix A**).

Sound, or noise levels, generally refers to a sound pressure level as measured using an instrument, whereas the noise rating level refers to a calculated sound exposure level to which various corrections and adjustments was added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or

[1] SANS 10357:2004 The calculation of sound propagation by the Concave method'

noise isopleths. In this project it illustrates the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time. It is used to define potential issues of concern and not to predict a noise level at a potential noise-sensitive receptor. For this the selected sound propagation model is internationally recognized and considered adequate.

7.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds are also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor, but to calculate a noise rating level that is used to identify potential issues of concern.

7.4 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment changes depending on the load the process and equipment is subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;

- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would be likely over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify, and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Seventy-five percent (75%) hard ground conditions will be modeled that should allow slightly precautionary values.

8 METHODOLOGY: ENVIRONMENTAL NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

8.1 DETERMINING APPROPRIATE ZONE SOUND LEVELS

SANS 10103:2008 does not cater for instances when background ambient sound levels change due to the impact of external forces. Locations close (closer than 500 meters from coastline) from the sea for instance always has an ambient sound level exceeding 35 dBA, and, in cases where the sea is rather turbulent, it can easily exceed 45 dBA. Similarly, noise induced by high winds is not considered in the SANS standard.

Setting noise limits relative to the ambient sound level is relatively straightforward when the prevailing ambient sound level and source level are constant. However, wind turbines only start to operate when wind speeds exceed 3 m/s. Noise emissions therefore relates to the wind speed and similarly, the environment in which they are heard also depends upon the strength of the wind and the noise associated with its effects. It is therefore necessary to derive an ambient sound level that is indicative of the noise environment at the receiving property for different wind speeds so that the turbine noise level at any particular wind speed can be compared with the ambient sound level in the same wind conditions.

8.1.1.1 Using International Guidelines to set Noise Limits

When assessing the overall noise levels emitted by a Wind Energy Facility, it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5 m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35 m/s measured at the hub height of a wind turbine. However, ETSU-R97 (1996) proposes that noise limits only be placed up to a wind speed of 12 m/s for the following reasons:

1. Wind speeds are not often measured at wind speeds greater than 12 m/s at 10 m height;
2. Reliable measurements of background ambient sound levels and turbine noise will be difficult to make in high winds due to the effects of wind noise on the microphone and the fact that one could have to wait several months before such winds were experienced;
3. Turbine manufacturers are unlikely to be able to provide information on sound power levels at such high wind speeds for similar reasons; and
4. If a wind farm meets noise limits at wind speeds lower than 12m/s, it is most unlikely to cause any greater loss of amenity at higher wind speeds. Turbine noise levels increase only slightly as wind speeds increase; however, background

ambient sound levels increase significantly with increasing wind speeds due to the force of the wind.

Ambient sound vs. wind speed data is presented in **Figure 8-1**[2]. This is a quiet (as per the opinion of the author) location[3] where there were no apparent or observable sounds that would have impacted on the measurements, presenting the A-Weighted sound levels at an inland area. The figures clearly indicate a trend where sound levels increase if the wind speed increases. This has been found at all locations where measurements have been done for a sufficiently long enough period of time (more than 30 locations – more than 38,000 measurements).

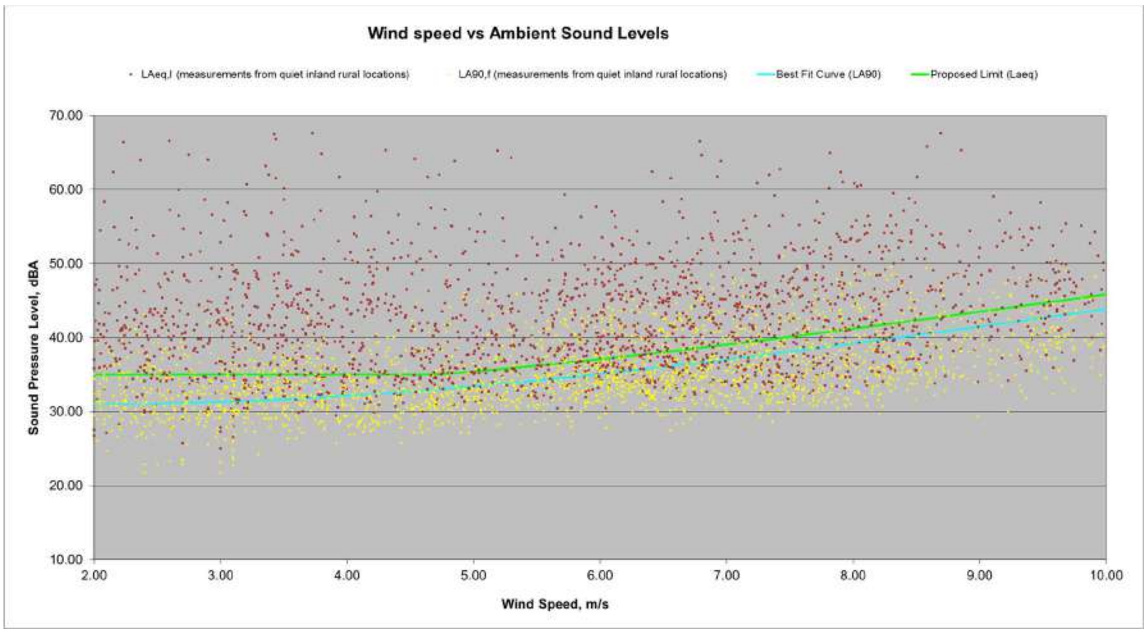

Figure 8-1: Ambient sound levels – quiet inland location (A-Weighted)

Considering this data as well as the international guidelines, noise limits starting at 40 dB that increases to more than 45 dB (as wind speeds increase) is acceptable.

In addition, project participants could be exposed to noise levels up to 45 dBA (ETSU-R97) at lower wind speeds.

[2] The sound level measuring instruments were located at a quiet location in the garden of the various houses. Data was measured in 10-minute bins and then co-ordinated with the 10 m wind speed derived from the wind mast of the developer. This wind mast normally was not close to the dwelling, at times being further than 5,000 meters from the measurement location. It is possible that the wind may be blowing at the location of the wind mast with no wind at the measurement location, resulting in low sound levels recorded.

[3] Different area where longer measurements were collected.

8.1.1.2 Using local regulations to set noise limits

Noise limits as set by the Provincial Noise Control Regulations (PN 200 of 2013 defines a "**disturbing noise**" as the noise that —

> *(a)* exceeds the rating level by 7 dBA;
>
> *(b)* exceeds the residual noise level where the residual noise level is higher than the rating level;
>
> *(c)* exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or
>
> *(d)* in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103;

Based on developmental character, much of the area is a rural noise district, night-time rating levels would be 35 dBA and a noise level exceeding 42 dBA could be a disturbing noise (therefore the noise limit). The daytime rating level is 45 dBA (52 dBA for a disturbing noise). Considering **Figure 8-1** this will be unlikely as the ambient sound levels are very high at the two measurement locations and the rating level should be higher (based on the findings of onsite sound measurements).

The Rheboksfontein WEF EA also sets a limit of 45 dBA at the houses of residents in the area.

8.2 DETERMINING THE SIGNIFICANCE OF THE NOISE IMPACT

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect will be assigned a value as defined in the third column in the tables below during the Environmental Noise Impact Assessment stage.

The impact consequence is determined by the summing the scores of Magnitude (**Table 8-1**), Duration (**Table 8-2**) and Spatial Extent (**Table 8-3**). The impact significance is determined by multiplying the Consequence result with the Probability score (**Table 8-4**).

An explanation of the impact assessment criteria is defined in the following tables.

Table 8-1: Impact Assessment Criteria - Magnitude

This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.		
Rating	**Description**	**Score**
Low	Increase in average sound pressure levels between 0 and 3 dB from the expected wind induced ambient sound level. No change in ambient sound levels discernible. Total projected noise level is less than the Zone Sound Level in wind-still conditions.	2
Low Medium	Increase in average sound pressure levels between 3 and 5 dB from the (expected) wind induced ambient sound level. The change is barely discernible, but the noise source might become audible.	4
Medium	Increase in average sound pressure levels between 5 and 7 dB from the (expected) wind induced ambient sound level. Sporadic complaints expected. Any point where the zone sound levels are exceeded during wind still conditions.	6
Severe / High	Increase in average sound pressure levels between 7 and 10 dB from the (expected) wind induced ambient sound level. Medium to widespread complaints expected.	8
Very Severe / Very High	Increase in average sound pressure levels higher than 10 dBA from the (expected) ambient sound level. Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where noise levels exceed 65 dBA at any receptor.	10

Table 8-2: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.	1
Short term	Impacts that are predicted to last only for the duration of the construction period (less than 5 years).	2
Medium term	Impacts that will continue for 5 to 20 years.	3
Long term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating (20 to 40 years).	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime (over 40 years).	5

Table 8-3: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1

Local	The impact could affect the local area (within 1,000 m from site).	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.	3
National	The impact could have an effect that expands throughout the country (South Africa).	4
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5

Table 8-4: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).	1
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25 %.	2
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50 %.	3
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined to be between 50 % to 75 %.	4
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100 %.	5

8.3 Representation of Noise Levels

Noise rating levels will be calculated in the ENIA report using the appropriate sound propagation models as defined. It is therefore important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms, **Appendix A**).

Sound or noise levels generally refers to a level as measured using an instrument, whereas the noise rating level refers to a calculated sound exposure level to which various corrections and adjustments were added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In the ENIA it will be used to illustrate the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time.

9 PROJECTED NOISE RATING LEVELS

This assessment will only consider the potential noise impact from the operational phase, as construction phase noise impacts may only be problematic if the WTGs are located closer than 500 m from a potential NSD. As there are no NSDs staying closer than 500 m from any WTG location, the significance of a construction related impact would be low. This is the same as the findings of the previous report (dated July 2011).

9.1 OPERATIONAL PHASE NOISE IMPACT

While the significance of daytime noise impacts were considered, times when a quiet environment is desired (at night for sleeping, weekends etc.) are more critical. Surrounding receptors would desire and require a quiet environment during the night-time (22:00 – 06:00) timeslot and ambient noise levels are critical. It should be noted that maintenance activities normally take place during the day, but generally involve one or two light-delivery vehicles moving around during the course of the day, an insignificant noise source. As such maintenance activities will not be considered.

This noise impact assessment will evaluate the layout presented in **Figure 3-2**, using the sound power emission characteristics presented in **Figure 6-1** and **Figure 6-2**.

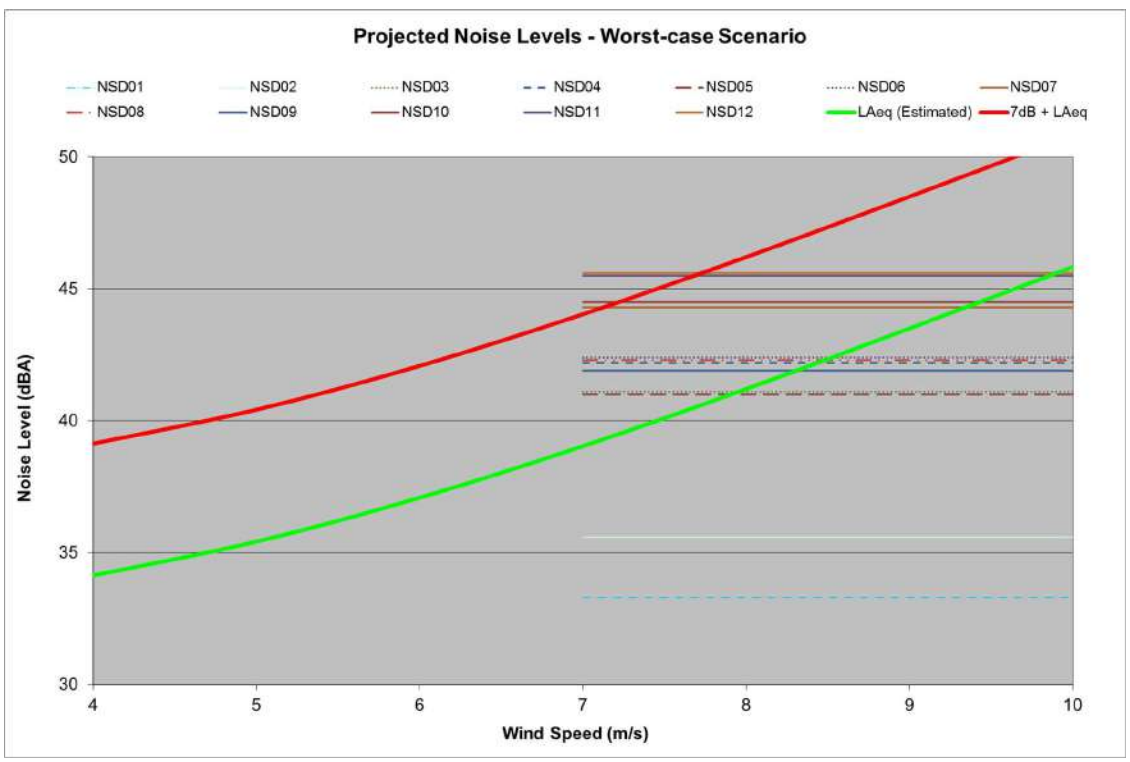

Figure 9-1: Projected noise rating levels at NSDs at different wind speeds – Worst-case Scenario

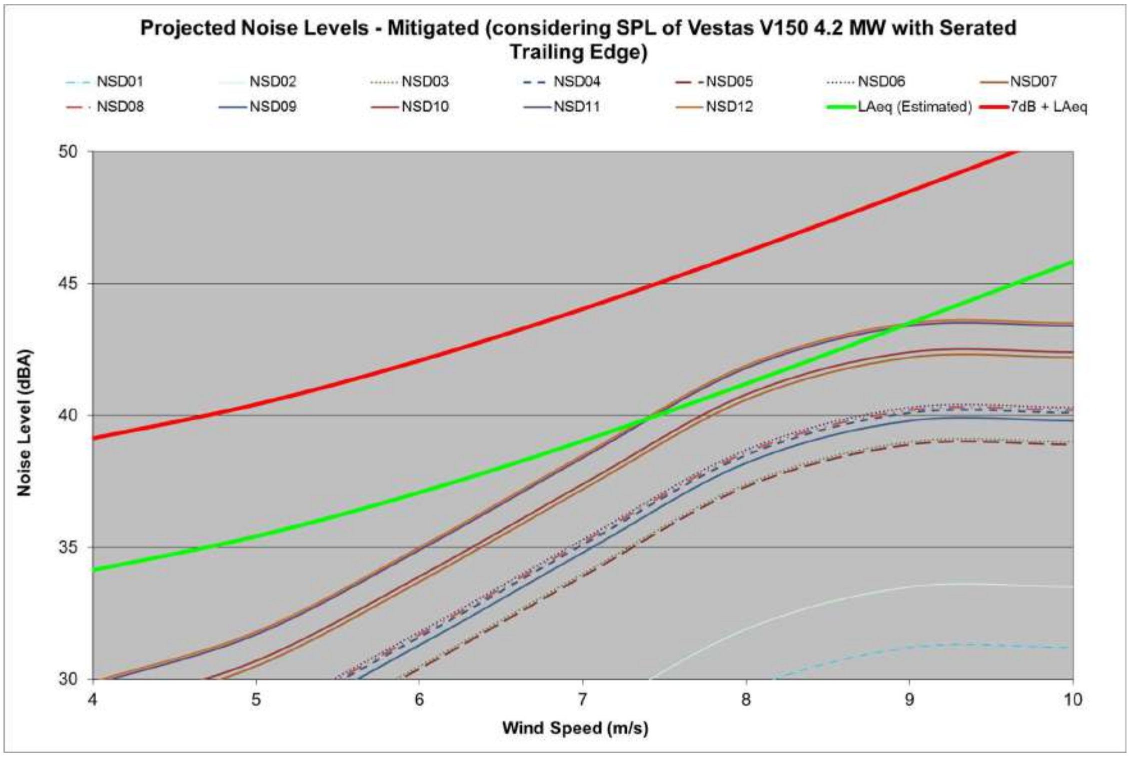

Figure 9-2: Projected noise rating levels at NSDs at different wind speeds – Mitigated Scenario

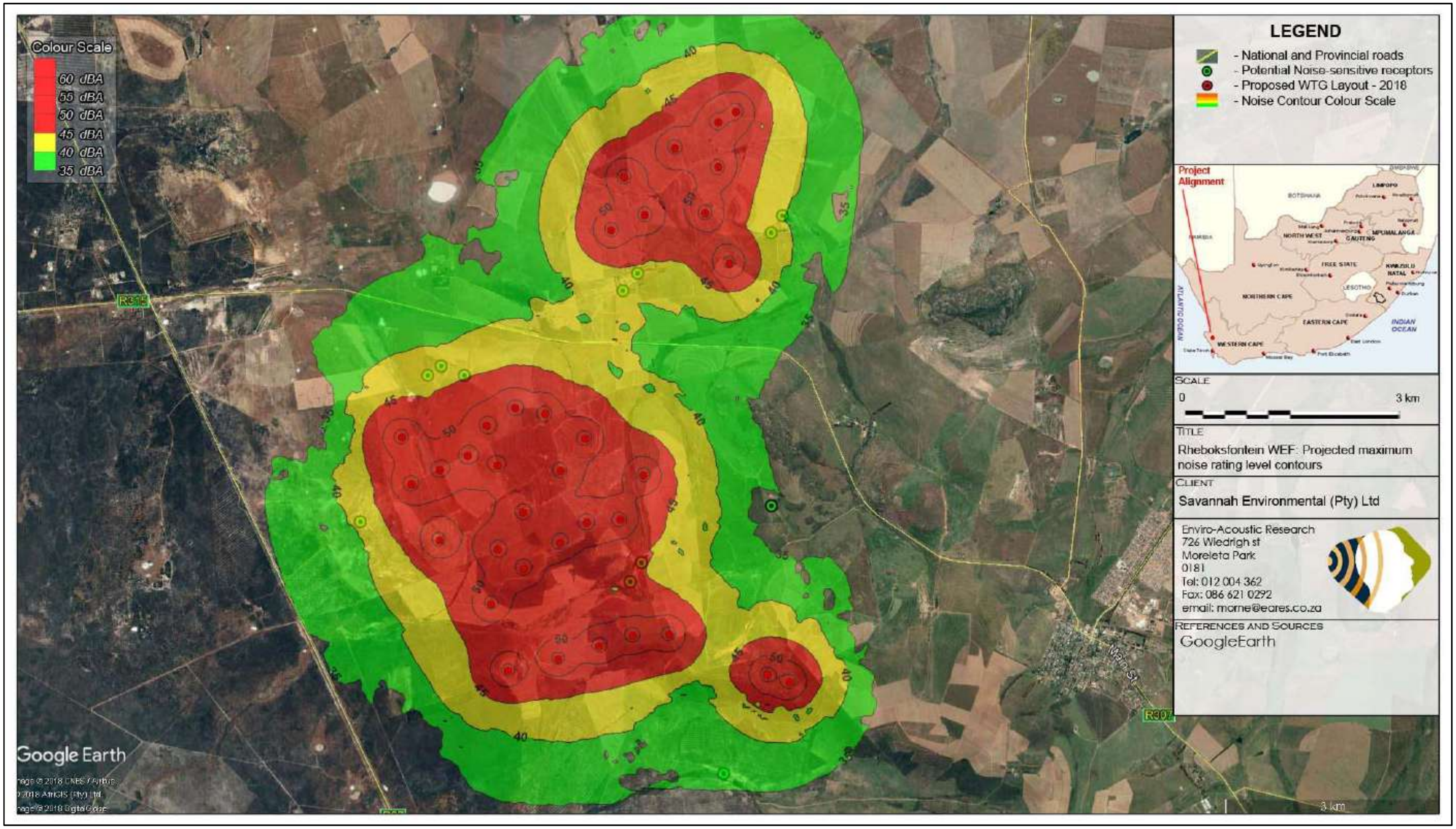

Figure 9-3: Projected conceptual night-time operational noise rating levels (worst-case scenario)

10 SIGNIFICANCE OF THE NOISE IMPACT

This assessment will only consider the potential noise impact from the operational phase, as construction phase noise impacts may only be problematic if the WTGs are located closer than 500 m from a potential NSD. As there are no NSDs staying closer than 500 m from any WTG location, the significance of construction related impact would be low. This is the same as the findings of the previous report (dated July 2011).

10.1 Operational Phase Noise Impact

The noise levels associated with the operational phase is illustrated in **Figure 9-1** (worst-case) with **Figure 9-3** depicting the noise rating level contours in isopleths (maximum sound power emission levels). The significance of the potential daytime noise impacts are presented in **Table 10-1**, with **Table 10-2** presenting the significance of the potential noise impact for the night-time period.

Table 10-1: Calculated noise rating levels and potential significance of impact

Receiver	Noise Rating Level (dBA)	Magnitude (Table 8-1)	Duration (Table 8-2)	Extent (Table 8-3)	Probability (Table 8-4)	Potential Significance
NSD01	33.3	Low	Long	Local	Improbable	Low
NSD02	35.6	Low	Long	Local	Improbable	Low
NSD03	41.1	Low	Long	Local	Improbable	Low
NSD04	42.2	Low-medium	Long	Local	Possible	Low
NSD05	41	Low	Long	Local	Improbable	Low
NSD06	42.4	Low-medium	Long	Local	Possible	Low
NSD07	44.3	Medium	Long	Local	Likely	Medium
NSD08	42.3	Low-medium	Long	Local	Possible	Low
NSD09	41.9	Low-medium	Long	Local	Improbable	Low
NSD10	44.5	Medium	Long	Local	Likely	Medium
NSD 11	45.5	Medium	Long	Local	Highly-likely	Medium
NSD 12	45.6	Medium	Long	Local	Highly-likely	Medium

Table 10-2: Impact Assessment: Night-time operation of Wind Turbines

Nature of impact: Increase in ambient sound levels that can raise the ambient sound level with more than 7 dB or night-time noise levels higher than 42 dBA. Noise levels may not exceed 45 dBA as per condition 79 of the EA.		
Description of impact: The proposed wind turbines are located further than 500m from all receptors. Cumulative effects raise the noise (rating) levels higher than 45 dBA at NSds 11 (7 WTGs within 1,500 m) and 12 (9 WTGs within 1,500 m). Mitigation is required to ensure compliance with the conditions of the EA. Noise rating levels are higher than 42 dBA at NSDs 10 and 7 and it is likely that the WTGs will be audible at night at wind speeds between 7.5 and 9 m/s.		
	Without mitigation	**With mitigation (use quieter WTG)**
Status (positive/negative)	Negative	Negative
Magnitude (Table 8-1)	Medium (6)	Low-Medium (4)
Duration (Table 8-2)	Long (4)	Long (4)
Extent (Table 8-3)	Local (2)	Local (2)
Probability (Table 8-4)	Highly-likely (4)	Possible (2)
Significance	**Medium Risk (48)**	**Low Risk (20)**
Reversibility	High	High
Loss of resources	Partly	Partly
Can impacts be mitigated?	Yes and recommended.	
Confidence in findings: High. Worst-case scenario evaluated with all wind turbines operating at a maximum sound power emission level at a relative low wind speed. Ambient sound levels considered from **Figure 8-1**.		
Mitigation: Significance of noise impact is medium for the worst-case scenario as conceptualized. Mitigation is available that will reduce the noise level below 45 dBA, and, if the correct mitigation measures are implemented, the significance of the noise impact will be reduced to low. Mitigation options will include: - Using a quieter WTG with a sound power emission level less than 107.4 dBA will ensure noise rating levels less than 45 dBA. - Using a quieter WTG with a sound power emission curve similar than the Vestas V150 4.2 MW (see Figure 6-1) will ensure noise rating levels that may not be higher than 3 dB above the residual noise level (ambient sound levels). - The development of a noise curtailment programme to reduce the sound emissions during certain times from certain WTGs. - WTG 22 and 30 may be relocated further from NSDs 11 and 12 respectively.		
Cumulative impacts: Potential of cumulative noise impact is low.		
Residual risks: Low.		

Comparing the significance of the noise impact with the findings of the 2013 report, it is noted that the significance is higher. This is likely because a worst-case scenario was evaluated, with the WTGs generating the maximum noise level even at low wind speeds as well as the relocation of two wind turbines closer to NSDs 11 and 12. The use of a WTG with a sound power emission level curve similar to the Vestas V150 4.2 MW will reduce the noise level as well as the significance of the noise impact. Such a WTG should have a maximum sound power emission level less than 107.4 dBA.

11 MITIGATION AND MANAGEMENT

11.1 MITIGATION MEASURES FOR INCLUSION IN THE EMPR

Mitigation is required due to the potential medium significance for a noise impact. This is likely because a worst-case scenario was evaluated, with the WTGs generating the maximum noise level even at low wind speeds. Monitoring is required to ensure that the appropriate mitigation measures are included and that the noise impact is reduced to a low significance. Measures to be included in the EMPr include:

1. Pre-operation ambient sound level measurements must be collected at three different locations over a period of at least 5 night-times to determine existing ambient sound levels. The data must be used to develop ambient sound levels versus wind speed curves.
2. Operational noise measurements should be collected over at least 48 hours during the operation phase (winter period) to ensure that noise levels are less than 45 dBA at the representative dwellings falling in the 40 – 45 dBA noise contour. The acoustician measuring noise levels can advise whether further measurements are required.
3. The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the location where construction activities are taking place or from an operational wind turbine.
4. The developer must select appropriate mitigation measures to ensure that the total noise levels due to the operation of the WTG are less than 45 dBA at all NSDs.

11.2 CONDITIONS FOR INCLUSION IN THE ENVIRONMENTAL AUTHORISATION

1. The potential noise impact must again be evaluated should the layout be changed and where any wind turbines are located closer than 1,000m from a confirmed NSD.
2. The developer must measure ambient sound levels prior to the construction of the WEF. This must be done over a five night-time period during the winter months to allow analysis of the data. The data must be used to develop ambient sound levels versus wind speed curves.
3. The developer must ensure that no receptor is subjected to noise levels exceeding 45 dBA at night due to the development and operation of the wind energy facility (including both the construction and operation phases). If night-time noise levels from operating WTGs exceed 45 dBA the developer must design and implement a noise curtailment programme.

4. Operational noise measurements should be collected over at least 48 hours during the operation phase (winter period) to ensure that noise levels are less than 45 dBA (considering the pre-construction ambient sound level measurements). The acoustician measuring noise levels can advise whether further measurements are required.
5. The developer must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from location where construction activities are taking place or from an operational wind turbine.

11.3 MONITORING REQUIREMENTS FOR INCLUSION IN THE EMPR OR ENVIRONMENTAL AUTHORISATION

Sound and noise measurements are required to ensure that the noise impact from the WEF is managed. The following monitoring is recommended:

1. The developer must measure ambient sound levels prior to the construction of the WEF. This must be done over a five night-time period during the winter months to allow analysis of the data. The data must be used to develop ambient sound levels versus wind speed curves. Ambient sound level measurements are recommended at the dwellings of NSDs 07, 10, 11 and 12.
2. Operational noise measurements should be collected over at least 48 hours during the operation phase (winter period) to ensure that noise levels are less than 45 dBA (considering the pre-construction ambient sound level measurements). The acoustician measuring noise levels can advise whether further measurements are required.

12 CONCLUSIONS AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the predicted noise environment due to the development of the proposed Rheboksfontein WEF in the Western Cape Province. It is based on a predictive model to estimate potential noise levels due to the various activities and to assist in the identification of potential issues of concern.

Comparing the significance of the noise impact with the findings of the 2013 report, it is noted that the significance is higher. This is likely because a worst-case scenario was evaluated, with the WTGs generating the maximum noise level even at low wind speeds as well as the relocation of two wind turbines closer to NSDs 11 and 12. The use of a WTG with a sound power emission level curve similar to the Vestas V150 4.2 MW will reduce the noise level as well as the significance of the noise impact. Such a WTG should have a maximum sound power emission level less than 107.4 dBA.

It is concluded that, for the worst-case scenario evaluated, that:

- The significance of the operational daytime noises will be low.
- The significance of the operational night-time noises may be medium.

Mitigation is available and by selecting a quieter wind turbine, the noise level will reduce which will result in a lower significance. While the noises from the WTGs may increase the ambient sound levels, the increase will be less than 7 dBA at the closest NSD and will not result in a disturbing noise impact.

Therefore, considering the findings of this assessment, the amendment to the WTG locations and specifications is not considered to be a fatal flaw. The amendment in the layout may change the findings of the original Environmental Noise Impact Assessment report (de Jager, 2013) and mitigation is of critical importance. By using a quieter WTG, the significance will be reduced to low, and the amendment in layout and WTG specifications can be authorized.

13 REFERENCES

In this report reference was made to the following documentation:

1. Acoustics, 2008: *A review of the use of different noise prediction models for wind farms and the effects of meteorology*
2. Acoustics Bulletin, 2009: *Prediction and assessment of wind turbine noise*
3. Atkinson-Palombo, C and Hoen, B. 2014: *Relationship between Wind Turbines and Residential Property Values in Massachusetts – A Joint Report of University of Connecticut and Lawrence Berkley National Laboratory.* Boston, Massachusetts
4. Bakker, RH *et al*. 2011: *Effects of wind turbine sound on health and psychological distress*. Science of the Total Environment (in press, 2012)
5. Bass JH *et al*, 1996: *Development of a wind farm noise propagation prediction model.* JH Bass, AJ Bullmore, E Sloth. Contract JOR3-CT95-0051. Renewable Energy Systems Limits, Hoare Lea & Partners Acoustics, Acoustica A/S
6. BWEA, 2005*: Low Frequency Noise and Wind Turbines – Technical Annex*
7. Chapman *et al*. 2013: *Spatio-temporal differences in the history of health and noise complaints about Australian wind farms: evidence for the psychogenic, "communicated disease" hypothesis*. Sydney School of Public Health, University of Sydney
8. Crichton *et al*. 2014: *Can expectations produce symptoms from infrasound associated with wind turbines?. Health Psychology, Vol 33(4), Apr 2014, 360-364*
9. CSIR, 2002: "*Integrated Environmental Management Information Series: Information Series 5: Impact Assessment*". Issues by the Department of Environmental Affairs and Tourism, Pretoria
10. Cummings, J. 2012: *Wind Farm Noise and Health: Lay summary of new research released in 2011*. Acoustic Ecology Institute, April 2012 (online resource: http://www.acousticecology.org/wind/winddocs/AEI_WindFarmsHealthResearch2011.pdf)
11. Cummings, J. 2009: *AEI Special Report: Wind Energy Noise Impacts*. Acoustic Ecology Institute, (online resource: http://acousticecology.org/srwind.html)
12. De Jager, M. 2010: "*Noise Impact Study for Environmental Impact Assessment: Establishment of the Rheboksfontein Wind Energy Facility on various farms near Darling, Western Cape*." M2 Environmental Connections cc, Pretoria
13. De Jager, M. 2013: "*Review of layout 2013-05-29 for Environmental Noise Impact Assessment: Rheboksfontein Wind Energy Facility*" Enviro Acoustic Research cc, Pretoria
14. DEFRA, 2003: *A Review of Published Research on Low Frequency Noise and its Effects*, Report for Defra by Dr Geoff Leventhall Assisted by Dr Peter Pelmear and Dr Stephen Benton

15. DELTA, 2008: *EFP-06 project: Low Frequency Noise from Large Wind Turbines, a procedure for evaluation of the audibility for low frequency sound and a literature study*. Danish Energy Authority
16. Duncan, E. and Kaliski, K. 2008: *Propagation Modelling Parameters for Wind Power Projects*
17. ETSU R97: 1996. '*The Assessment and Rating of Noise from Wind Farms: Working Group on Noise from Wind Turbines*'
18. Evans Tom, Cooper Jonathan, 2012: *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*. Acoustics Australia, Vol. 40, No. 1, April 2012.
19. HGC Engineering, 2006: *Wind Turbines and Infrasound*, report to the Canadian Wind Energy Association
20. HGC Engineering, 2007: *Wind Turbines and Sound*, report to the Canadian Wind Energy Association
21. HGC Engineering, 2011: *Low frequency noise and infrasound associated with wind turbine generator systems: A literature review*. Ontario Ministry of the Environment RFP No. OSS-078696.
22. ISO 9613-2: 1996. '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*'
23. Jeffery *et al*, 2013: *Adverse health effects of industrial wind turbines*, Can Fam Physician, 2013 May. 59(5): 473-475
24. Journal of Acoustical Society of America, 2009: *Response to noise from modern wind farms in the Netherlands*
25. Kaliski K & Duncan E, 2008: *Propagation modelling Parameters for Wind Power Projects.*
26. Kamperman GW & James RR, 2008: *The "How to" guide to siting wind turbines to prevent health risks from sound*
27. Knopper LD & Ollsen CA. 2011. Health effects and wind turbines: A review of the literature. Environmental Health 2011, 10:78
28. Minnesota Department of Health, 2009: *Public Health Impacts of Wind Farms*
29. Ministry of the Environment, 2008: *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*
30. Møller H, 2010: Low-frequency noise from large wind turbines. J. Acoust. Soc. Am, 129(6), June 2011, 3727 - 3744
31. Nissenbaum A, 2012: *Effects of industrial wind turbine noise on sleep and health*. Noise and Health, Vol. 14, Issue 60, p 237 – 243.
32. Noise-con, 2008: *Simple guidelines for siting wind turbines to prevent health risks*

33. Noise quest, Aviation Noise Information &Resources, 2010: http://www.noisequest.psu.edu/pmwiki.php?n=Main.HomePage
34. Norton, M.P. and Karczub, D.G.: Fundamentals of Noise and Vibration Analysis for Engineers, Second Edition, 2003
35. Oud, M. 2012:: Low-frequency noise: a biophysical phenomenon (http://www.leefmilieu.nl/sites/www3.leefmilieu.nl/files/imported/pdf_s/2012_OudM_Low-frequency%20noise_0.pdf) (unpublished webresource)
36. O'Neal, *et al*. 2011: *Low frequency noise and infrasound from wind turbines*. Noise Control Eng. J. 59 (2), March-April 2011
37. Parry G, 2008: *A review of the use of different noise prediction models for windfarms and the effect of meteorology.* Acoustics 2008, Paris.
38. Pedersen, Eja; Halmstad, Högskolan I, 2003: '*Noise annoyance from wind turbines: a review'*. Naturvårdsverket, Swedish Environmental Protection Agency, Stockholm
39. Pedersen, E. 2011: "*Health aspects associated with wind turbine noise—Results from three field studies",* Noise Control Eng. J. 59 (1), Jan-Feb 2011
40. Phillips, CV, 2011: *"Properly Interpreting the Epidemiologic Evidence About the Health Effects of Industrial Wind Turbines on Nearby Residents"*. Bulletin of Science Technology & Society 2011 31: 303 DOI: 10.1177/0270467611412554
41. Pierpont, N. 2009: *"Wind Turbine Syndrome: A Report on a Natural Experiment",* K Select Books, 2009
42. Punch, *et al*. 2010: *Wind Turbine Noise. What Audiologists should know.* Audiology Today. JulAug2010
43. SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.
44. SANS 10210:2004. 'Calculating and predicting road traffic noise'.
45. SANS 10328:2008. 'Methods for environmental noise impact assessments'.
46. SANS 10357:2004 The calculation of sound propagation by the Concave method'.
47. USEPA, 1971: *Effects of Noise on Wildlife and other animals*
48. Van den Berg, G.P., 2003. '*Effects of the wind profile at night on wind turbine sound'.* Journal of Sound and Vibration
49. Van den Berg, G.P., 2004. *'Do wind turbines produce significant low frequency sound levels?'*. 11th International Meeting on Low Frequency Noise and Vibration and its Control
50. World Health Organization, 2009: *Night Noise Guidelines for Europe*
51. World Health Organization, 1999: *Protection of the Human Environment; Guidelines for Community Noise*

APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a

	period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does

	not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} *and* L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by

	damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.

Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

End of Report

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ERM
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Attention: Ms. Amy Barclay

Dear Madam

Dear Madam

SPECIALIST STUDY: NOISE IMPACT ASSESSMENT: PROPOSED AMENDMENT – RHEBOKSFONTEIN WIND ENERGY FACILITY: CHANGE OF WIND TURBINE LAYOUT AND SPECIFICATIONS

The above-mentioned issue as well as report SE-ERWEF/ENIAR/201811-Rev 0, dated November 2018, is of relevance.

I conducted an Environmental Noise Impact Assessment (ENIA) during 2011 (report ME-RF/NIA/201008-Rev 2), doing a full review of the updated layout during November 2018. As the noise propagation modelling requires the details of a wind turbine generator (WTG), the developer requested that a worst-case scenario be evaluated to cover potential latest WTG types. The 2018 assessment therefore considered the sound power emission levels of the Vestas V150 4.2 WTG with a maximum sound power emission level of 108.0 dBA (re 1 pW). The 2018 assessment concluded that, for the worst-case scenario evaluated:

- that the significance of the operational daytime noises will be low;
- that the significance of the operational night-time noises may be medium (for the worst-case scenario as evaluated). This relates to a projected noise rating level of more than 45 dBA at two potential Noise-Sensitive Developments (NSD). This noise rating level is higher than the 45 dBA limit as set by condition 77 of the Rheboksfontein Environmental Authorization.

Mitigation is available and was proposed, recommending the use of a quieter WTG with a sound power level less than 107.4 dBA (re 1 pW) that will ensure noise levels less than 45 dBA at all NSD. While the noises from the WEF may increase the ambient sound levels, the increase will be less than 7 dBA at the closest NSD and will not result in a disturbing noise impact.

The developer of the Rheboksfontein WEF has since removed two (2) WTGs from the 2018 layout (see **Figure 1** and **2**), additionally proposing to increase the rotor diameter from 126 m to 160 m.

It should be noted that the change in WTG specifications such as the WTG hub height and rotor diameter does not relate to sound power emission levels, which depends on the model and make of a WTG. For the same model and make, a change in specifications such as hub-height and rotor diameter have an insignificant impact on sound power emission levels. Therefore, there is no advantage or disadvantage in terms of acoustics by changing the WTG specifications such as hub height as well as rotor diameter (for the same make and model of WTG).

By changing the wind turbine model and make to a WTG with a lower sound power emission levels however will have a significant advantage on acoustics (reduced noise emissions). Similarly, changing the WTG model or make to a WTG with a higher sound power emission level will increase the operational noise levels and the potential noise impact significance.

The wind energy market is fast changing and adapting to new technologies as well as site specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. As such the developer has been evaluating several WTG models, however the selection will only be finalized at a later stage once the most optimal WTG is identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered). As such the developer cannot commit to a specific wind turbine model, but it should be noted that the previous noise impact assessment did consider a worst-case scenario, using a WTG with a high noise emission level.

Therefore, considering the layout, the proposed changes and the potential noise impact, it is my opinion that:

- the change will not increase the significance of the noise impact;
- a full noise impact assessment with new modeling will not be required and the recommendations as contained in the previous document will still be valid;
- the cumulative noise impact will not change, as there are no new or proposed wind turbines (from a different WEF), located within 2,000m from identified NSDs that will cumulatively increase the noise levels;
- there are no new limitations or assumptions.

An updated noise impact assessment will not be required and the findings, mitigation measures and recommendations as contained in the previous document (report SE-ERWEF/ENIAR/201811-Rev 0) will still be valid. If the developer uses a WTG with a sound power emission level less than 107.4 dBA (re 10^{-12} watt) the significance will be low. In terms of noise, the proposed change will be acceptable.

Should you require any further details, or have any additional questions, please do not hesitate to call me on the above numbers.

Yours Faithfully,

Morné de Jager
Enviro-Acoustic Research cc

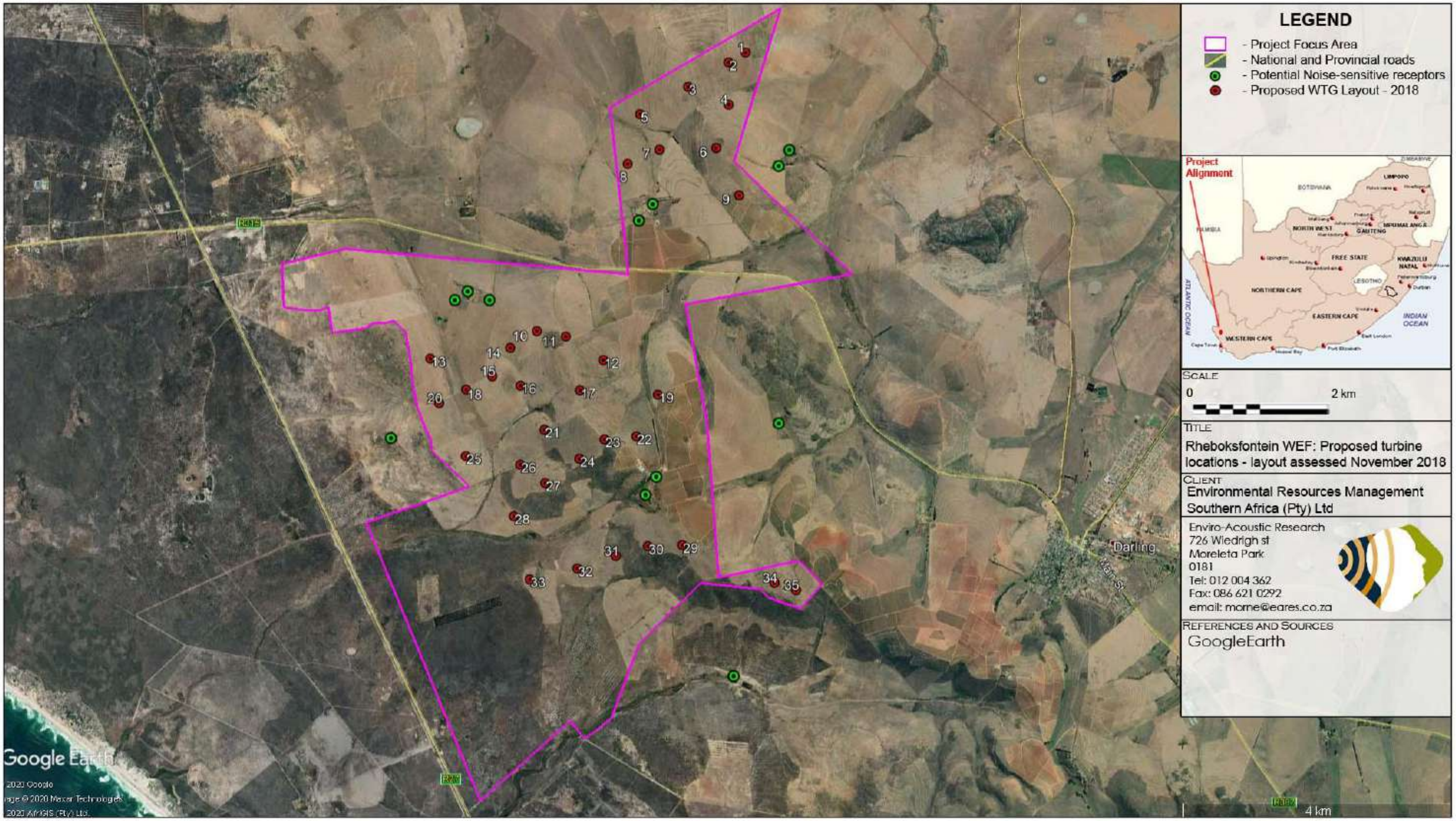

Figure 1: Layout evaluated in 2018 as well as the closest NSD locations

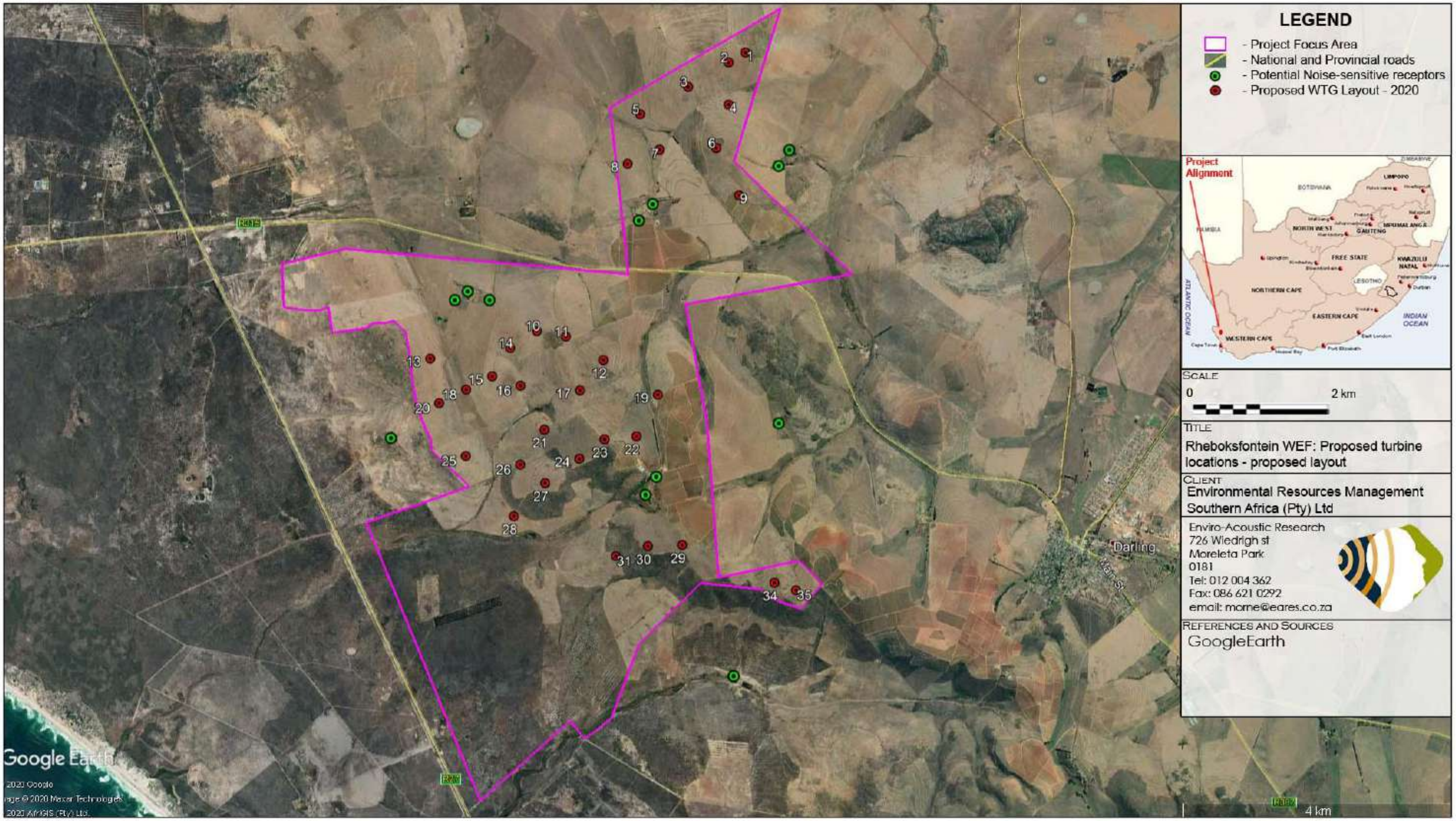

Figure 2: Proposed latest layout as well as the closest NSD locations

SOCIAL IMPACT ASSESSMENT

RHEBOKSFONTEIN WIND ENERGY FACILITY AMMENDMENT WESTERN CAPE PROVINCE

JANUARY 2021

Prepared for

ERM CONSULTING

By

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EXECUTIVE SUMMARY

INTRODUCTION AND LOCATION

ERM Consulting was appointed to manage the Basic Assessment (BA) process for an amendment for the approved Rheboksfontein Wind Energy Facility (WEF) is located ~ 3km west of the town of Darling in the Swartland Local Municipality (SLM), Western Cape Province. In terms of the proposed amendment the number of wind turbines will be reduced from the approved 35 to 33. Section 1.3 describes the proposed amendment.

Tony Barbour was been appointed to undertake a specialist Social Impact Assessment (SIA) as part of the BA process. This report contains the findings of the SIA undertaken as part of the BA process.

APPROACH TO THE STUDY

The approach to the SIA study is based on the Western Cape Department of Environmental Affairs and Development Planning Guidelines for Social Impact Assessment (February 2007). These guidelines are based on international best practice. The key activities in the SIA process embodied in the guidelines include:

- Collection and review of baseline socio-economic data;
- Review of relevant planning and policy frameworks for the area;
- Site specific information collected during the site visit to the area and interviews with key stakeholders;
- Review of information from similar projects; and
- Identification of social issues associated with the proposed project.

SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning;
- Construction phase impacts;
- Operational phase impacts;
- Cumulative Impacts;
- Decommissioning phase impacts;
- No-development option.

FIT WITH POLICY AND PLANNING

The findings of the review indicate that renewable energy is strongly supported at a national, provincial and local level. At a national and provincial level the development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a district and local level the WCDM and SLM IDP and SDF, all support the establishment of renewable facilities. The SLM IDP also indicates that that the Rheboksfontein WEF is located in an Alternative Energy Area (Area A). The site has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs.

CONSTRUCTION PHASE
The key social issues associated with the construction phase include:

Potential positive impacts

- Creation of employment and business opportunities

The construction create approximately 120 direct employment opportunities for a period of 18 months. Approximately 25% (or 30) of opportunities will be available to skilled personnel (engineers, technicians, management and supervisory), 35% (or 42) to semi-skilled personnel (drivers, equipment operators), and 40% (or 48) to low skilled personnel (construction labourers, security staff).

Members from the local community in the area are likely to be in a position to qualify for the majority of the low skilled and a proportion of the semi-skilled employment opportunities. The majority of these employment opportunities will accrue to Historically Disadvantaged (HD) members from the SLM community. The towns that are likely to benefit are Darling, Malmesbury and Yzerfontein. The potential benefits for local communities are confirmed by the findings of the Overview of the Independent Power Producers Procurement Programme (IPPPP) undertaken by the Department of Energy, National Treasury and DBSA (March 2019). The review found that by the end of March 2019 the 64 renewable energy projects that had been successfully completed had created 31 633 job years[1] of employment, compared to the anticipated 20 689. This was 53% more than planned. The study also found that significantly more people from local communities were employed during construction than was initially planned.

The wage bill associated with the construction phase is estimated at R30 million for the 18-month construction phase (2020 Rand values). A percentage of the wage bill will therefore be spent in the local economy over the 18-month construction phase. This will create opportunities for local businesses in the area. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. This is confirmed by the experience with the other renewable projects. The potential opportunities for the local service sector are linked to accommodation, catering, cleaning, transport and security, etc. associated with the construction workers on the site.

The capital expenditure will be in the region of R 2 billion (2020 Rand values). Local procurement will create opportunities for local business in the area, specifically engineering and construction companies.

Potential negative impacts

- Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site;
- Increased risk of grass fires;
- Impact of heavy vehicles, including damage to roads, safety and dust;
- Impact on farming activities.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation were **Low Negative**. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. Given that the majority of the low and semi-skilled construction workers can be sourced from the local area the potential risk posed by construction

1 The equivalent of a full-time employment opportunity for one person for one year

workers on local family structures and social networks is regarded as low for the community as a whole. Table 1 summarises the significance of the impacts associated with the construction phase.

Table 1: Summary of impacts associated with construction phase

Impact	**Significance No Mitigation/ Enhancement**	**Significance With Mitigation/ Enhancement**
Creation of employment and business opportunities	Medium (+)	Medium (+)
Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site	Medium (-)	Low (-)
Increased fire risk	Medium (-)	Low (-)
Impact of heavy vehicles and construction activities	Medium (-)	Low (-)
Impact on farming activities	Medium (-)	Low (-)

OPERATIONAL PHASE

The key social issues associated with the operational phase include:

The key social issues affecting the operational phase include:

Potential positive impacts
- The establishment of renewable energy infrastructure.
- Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training;
- Benefits associated with the establishment of a Community Trust;
- Benefits for affected landowners.

Development of renewable energy infrastructure
The establishment of renewable energy infrastructure, such as the proposed WEF, should be viewed, firstly within the context of the South Africa's current reliance on coal powered energy to meet the majority of its energy needs, and secondly, within the context of the success of the REIPPPP.

The Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus making the greening of the electricity mix a national imperative. The Greenpeace Report (Powering the future: Renewable Energy Roll-out in South Africa, 2013), notes that within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations.

The Green Jobs study (2011) identifies a number of advantages associated with wind power as a source of renewable energy, including zero carbon dioxide (CO_2) emissions during generation and low lifecycle emissions. Greenhouse gases (GHG) associated with the construction phase are offset within a very short period of time compared with the project's lifespan. Wind power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, wind as energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The National Climate Change Response White Paper outlines the national response to the impacts of climate change, as well as the domestic contribution to international efforts to mitigate green-house gas emissions. As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The emission reductions between March 2018 and 2019 are estimated to be 10.9 million tonnes of CO^2. This represents 53% of the total projected annual emission reductions achieved with only partial operation to date. Since operation, the IPPs have generated 35 699 GWh, resulting in 36.2 Mton of CO^2 emissions being offset and saving 42.8 million kilolitres of water related to fossil fuel power generation.

The REIPPPP had therefore contributed significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability and environmental sustainability.

The establishment of renewable energy facilities, such as the proposed WEF, therefore not only address the environmental issues associated with climate change and consumption of scarce water resources, but also creates significant socio-economic opportunities and benefits, specifically for historically disadvantaged, rural communities.

Creation of employment opportunities
The operational phase will create in the region of 20 full time employment opportunities.

Community Trust
The establishment of a community benefit structure (typically, a Community Trust) also creates an opportunity to support local economic development in the area. The requirement for the project to allocate funds to socio-economic contributions (through structures such as Community Trusts) provides an opportunity to advance local community projects, which is guaranteed for a 20-year period (project lifespan). The revenue from the proposed WEF can be used to support a number of social and economic initiatives in the area, including but not limited to:

- Creation of jobs;
- Education;
- Support for and provision of basic services;
- School feeding schemes;
- Training and skills development; and
- Support for SMME's.

The 2019 IPPP Overview highlights the socio-economic development (SED) contributions associated with the 64 IPPs has to date, which have amounted to R

860.1 million. The province with the highest SED contribution has been the Northern Cape Province, followed by the Eastern Cape and Western Cape.

Enterprise development contributions committed for BW1 to BW4, 1S2 and 2S2 amount to R7.2 billion. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of March 2019 a total of R 254.3 million had already been made to the local communities located in the vicinity of the 64 operating IPPs.

The Green Jobs study (2011), found that the case for wind power is enhanced by the positive effect on rural or regional development. Wind farms located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues. In this regard the towns of as Darling and Yzerfontein are small rural towns.

The long-term duration of the contributions from the WEF also enables local municipalities and communities to undertake long term planning for the area. Experience has, however, shown that Community Trusts can be mismanaged. This issue will need to be addressed in order to maximise the potential benefits associated with the establishment of a Community Trust or other community benefit structure (entity). The REIPPP programme does however have stringent audit requirements in place to try and prevent the mismanagement of trusts.

Benefits to landowners

The income from the WEFs reduces the risks to the livelihoods of the affected landowners posed by droughts and fluctuating market prices for wheat, sheep and farming inputs, such as fuel, feed etc. The additional income from the WEF would improve economic security of farming operations, which in turn would improve job security of farm workers and benefit the local economy.

Potential negative impacts

- The visual impacts and associated impact on sense of place;
- Impact on property values; and
- Potential impact on tourism.

Visual impacts and impact on sense of place

The potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. The SLM IDP also indicated that the is located within an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs. Based on the findings of the SIA the significance was rated as **Low Negative**.

However, the owner of Alexanderfontein Farm, Mr Nicolaas Basson, indicated that turbines locations 34 and 35 impact on the views from a newly established entertainment facility on Alexanderfontein Farm. He has requested that these two turbines be relocated.

Table 2 summarises the significance of the impacts associated with the operational phase.

Table 2: Summary of impacts associated with operational phase

Impact	Significance No Mitigation/ Enhancement	Significance With Mitigation/ Enhancement
Promotion of energy projects	High (-)[2]	High (+)
Creation of employment and business opportunities	Medium (+)	Medium (+)
Establishment of Community Trust	Medium (+)	High (+)
Benefits for local affected landowners	Low (+)	Medium (+)
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on property values	Low (-)	Low (-)
Impact on tourism	Low (-)	Low (-)

CUMULATIVE IMPACTS

Cumulative impact on sense of place

There are 12 REFs or potential REFs located within a 35 km radius of the Rheboksfontein WEF site. Of these all but one has received EIA approval. However, only two, the Darling and the Umoya Energy WEF near Hopefield have been constructed to date. The potential for combined and sequential visibility is therefore high.

Based on the findings of the SIA the potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. The IDP also indicates that the site is located within an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs. Despite this the establishment of REFs will impact on the areas sense of place. It will not be possible to effectively mitigate the impact. The potential cumulative impact on the areas character and sense of place is therefore regarded as **Medium Negative**.

Cumulative impact on services

The establishment of the proposed WFF and the other renewable energy facilities in the SLM may place pressure on local services, specifically medical, education and accommodation. This pressure will be associated with the potential influx of workers to the area associated with the construction and operational phases of renewable energy projects proposed in the area, including the proposed WEF. The potential impact on local services can be mitigated by employing local community members. With effective mitigation the impact is rated as **Low Negative.**

In addition, as indicated below, this impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of renewable energy as an economic driver in the area.

Cumulative impact on local economies

In addition to the potential negative impacts, the establishment of the proposed WEF and other renewable energy projects in the area also has the potential to create a number of socio-economic opportunities for the SLM, which, in turn, will result in a positive social benefit. The positive cumulative impacts include creation of employment, skills development and training opportunities, creation of downstream

2 Assumes project is not developed

business opportunities. The Community Trusts associated with each project will also create significant socio-economic benefits. These benefits should also be viewed within the context of the limited economic opportunities in the area and the impact of the drought and decline in the fishing sector in recent years. This benefit is rated as **High Positive** with enhancement.

NO-DEVELOPMENT OPTION

The No-Development option would represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost. The no-development option also represents a lost opportunity in terms of the employment and business opportunities (construction and operational phase) associated with the proposed WEF and the benefits associated with the establishment of a Community Trust. This also represents a negative social cost.

However, at a provincial and national level, it should be noted that the proposed WEF development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Western Cape and other parts of South Africa. Foregoing the proposed establishment of WEFs would therefore not necessarily compromise the development of renewable energy facilities in the Western Cape Province and or South Africa. However, the socio-economic benefits for local communities in the SLM would be forfeited. The No-Development Option is rated as **High Negative**.

DECOMMISSIONING PHASE

Decommissioning would result in the loss of ~ 20 permanent jobs associated with the operational phase. The significance is rated a **Low Negative**.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The findings of the SIA indicate that the development of the proposed Amended Rheboksfontein WEF will create employment and business opportunities for locals during both the construction and operational phase of the project. The establishment of a Community Trust will benefit the local community. The proposed development also represents an investment in clean, energy infrastructure. Given the negative environmental and socio-economic impacts associated with a coal-based energy economy and the challenges created by climate change, this represents a significant positive social benefit for society as a whole. The findings of the SIA also indicate that the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The establishment of Community Trusts associated with renewable energy projects also have the potential to create significant benefits for local rural communities. The proposed Amended Rheboksfontein WEF is also located within area identified in the SLM IDP as an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities.

Recommendations

The establishment of the proposed Amended Rheboksfontein WEF is supported by the findings of the SIA.

<u>However, consideration should be given to relocating turbine 34 and 35 in order reduce the visual impact on the newly established entertainment facility on Alexanderfontein Farm.</u>

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Section 1.5, Annexure A,
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 1.6, Annexure B,
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1, Section 1.2, p2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.2, Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Interviews in 2020 (Annexure A)
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.2, Annexure B
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 4 Section 5,
(g) an identification of any areas to be avoided, including buffers;	Section 4
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Refer to VIA
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Section 4 Section 5
(k) any mitigation measures for inclusion in the EMPr;	Section 4
(l) any conditions for inclusion in the environmental authorisation;	Section 4 Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 5.3
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	Annexure A, lists key stakeholders interviewed
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Annexure A, lists key stakeholders interviewed
(q) any other information requested by the competent authority	N/A
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Comply with the Assessment Protocols that were published on 20

	March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed. As at September 2020, there are no sensitivity layers on the Screening Tool for Transport features. Part A has therefore not been compiled for this assessment.

ACRONYMS

DM	District Municipality
DEA&DP	Department of Environmental Affairs and Development Planning
EIA	Environmental Impact Assessment
IDP	Integrated development Plan
IPP	Independent Power Producer
kV	Kilovolts
LED	Local Economic Development
LM	Local Municipality
MW	Megawatt
REIPPPP	Renewable Energy Independent Power Producers Procurement Programme
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SLM	Swartland Local Municipality
WEF	Wind Energy Facility
WF	Wind Farm
WCDM	West Coast District Municipality

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

1.1 INTRODUCTION

ERM Consulting was appointed to manage the Basic Assessment (BA) process for an amendment for the approved Rheboksfontein Wind Energy Facility (WEF) is located ~ 3km west of the town of Darling in the Swartland Local Municipality (SLM), Western Cape Province (Figure 1.1). In terms of the proposed amendment the number of wind turbines will be reduced from the approved 35 to 33. Section 1.3 describes the proposed amendment.

Tony Barbour was appointed to undertake a specialist Social Impact Assessment (SIA) as part of the BA process. This report contains the findings of the SIA undertaken as part of the BA process.

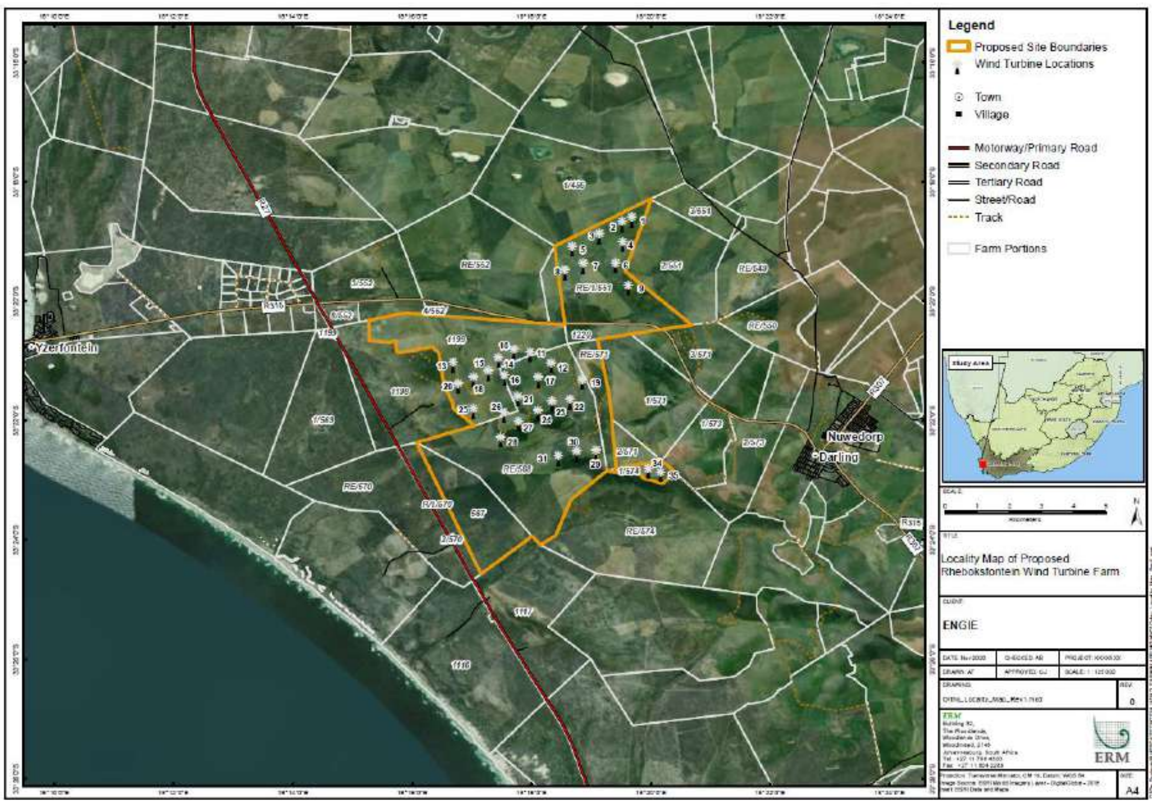

Figure 1.1: Location of Rheboksfontein WEF

1.2 TERMS OF REFERENCE AND APPROACH TO STUDY

The terms of reference for the SIA require:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed grid connection infrastructure;
- A description and assessment of the potential social issues associated with the proposed grid connection infrastructure;
- Identification of enhancement and mitigation aimed at maximising opportunities and avoiding and or reducing negative impacts.

The approach to the SIA study is based on the Western Cape Department of Environmental Affairs and Development Planning Guidelines for Social Impact Assessment (DEADP, 2007). The key activities in undertaken as part of the SIA process as embodied in the guidelines included:

- Describing and obtaining an understanding of the proposed intervention (type, scale, and location), the settlements, and communities likely to be affected by the proposed project;
- Collecting baseline data on the current social and economic environment;
- Identifying the key potential social issues associated with the proposed project;
- Site visit and semi-structured interviews with key stakeholders and affected individuals;
- Assessing and documenting the significance of social impacts associated with the proposed intervention;
- Consideration of other renewable energy projects that may pose cumulative impacts.
- Identification of enhancement and mitigation measures aimed at maximizing opportunities and avoiding and or reducing negative impacts.

The identification of potential social issues associated with proposed facility is based on observations during the project site visit, review of relevant documentation, experience with similar projects and the general area. Annexure A contains a list of the secondary information reviewed and interviews conducted. Annexure B summarises the assessment methodology used to assign significance ratings to the assessment process.

1.3 BACKGROUND AND PROJECT DESCRIPTION

An Environmental Impact Assessment (EIA) process was conducted by Savannah Environmental during 2010 and 2011. Tony Barbour was responsible for the Social Impact Assessment (SIA) undertaken as part of the EIA process (Barbour and van der Merwe, 2010). Based on the findings of the EIA the establishment of 43 wind turbines with a tower height of 80-100m and rotor blade diameter of 115 m with a generation capacity of 129 MW was approved on 2 February 2012 (DEFF Reference: 12/12/20/1582). In 2015 authorisation was granted for the amendment of the project from 43 wind turbines to 35 wind turbines with a tower height of 120m and rotor blade diameter of 126 m. The generation capacity remained 129 MW.

In terms of the Proposed Amendment Moyeng Energy are seeking to increase the capacity of the facility from 129 MW to 140 MW, the maximum capacity permitted in terms of the Department of Mineral Resources and Energy's (DMRE) Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

The proposed amendments to the Project description include:

- Increase in hub height from 120 m to 130 m.
- Increased turbine diameter from 126.m to 170 m.
- Increased maximum output capacity from 129 MW to 140 MW.
- Removal of turbine locations 32 and 33.

A wind energy facility (WEF) consists of multiple wind turbines which are used to capture the kinetic energy of the wind and generate electricity. This captured kinetic energy is used to drive a generator located within the wind turbine and the energy is subsequently converted into electrical energy. A typical wind turbine consists of four primary components (Figure 1.2).

- The **foundation unit** upon which the turbine is anchored to the ground. The area required for the concrete foundation is typically in the region of ~ 200 m^2;
- The **tower**, which is a hollow structure allowing access to the nacelle. The height of the tower is a key factor in determining the amount of electricity a turbine can generate. The tower houses the transformer which converts the electricity to the correct voltage for transmission into the grid. The transformer can also be placed in a small housing outside the tower depending on the design;
- The **nacelle** (generator/turbine housing). The nacelle houses the gearbox and generator as well as a wind sensor to identify wind direction. The nacelle turns automatically ensuring the blades always face into the wind to maximise the amount of electricity generated;
- The **rotor**, which is typically comprised of three rotor blades with a diameter varying between 100 and 200 m. The rotor blades use the latest advances in aeronautical engineering materials science to maximise efficiency. The greater the number of turns of the rotor the more electricity is produced.

The amount of energy a turbine can harness is dependent on the wind velocity and the length of the rotor blades. Wind turbines typically start generating power at wind speeds of between 10 - 15 km/hour, with speeds between 45 - 60 km/hour required for full power operation. In a situation where wind speeds are excessive, the turbine automatically shuts down to prevent damage. A turbine is designed to operate continuously, unattended and with low maintenance for more than 20 years or >120 000 hours of operation. Once operating, a WEF can be monitored and controlled remotely, with a mobile team used for maintenance, when required.

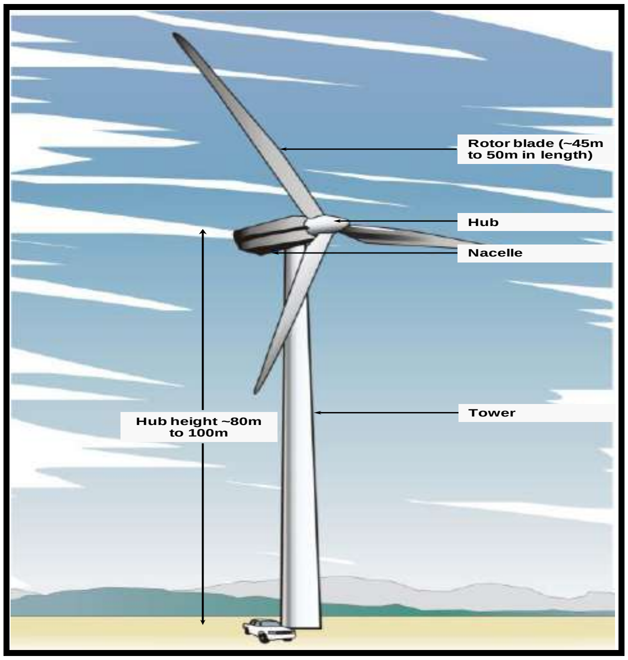

Figure 1.2: Typical example of wind turbine structure and components[3]

1.4 ASSUMPTIONS AND LIMITATIONS

1.4.1 Assumptions

Technical suitability
It is assumed that the development site represents a technically suitable site for the establishment of a wind energy facility. The site is also located in an area identified as a Renewable Energy Area by the SLM Integrated Development Plan (IDP).

Strategic importance of the project
The strategic importance of promoting renewable energy is supported by the national and provincial energy policies. However, this does not mean that site related issues can be ignored or overlooked.

Fit with planning and policy requirements
Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported. However, the study recognises the strategic importance of wind energy and the technical, spatial and land use constraints required for wind energy facilities.

As indicated above, the site is located in an area identified as a Renewable Energy Area by the SLM Integrated Development Plan (IDP).

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[3] Note the dimensions do not apply to the proposed WEF.

1.4.2 Limitations

Demographic data
Some of the information contained in some key policy and land use planning documents, such as Integrated Development Plans etc., is based on the 2011 Census. These limitations do not have a material bearing on the findings of the SIA. In addition, information from the 2016 Community Survey has been added where it is available.

1.5 SPECIALIST DETAILS

Tony Barbour, the lead author of this report is an independent specialist with 26 years' experience in the field of environmental management. In terms of SIA experience Tony Barbour has undertaken in the region of 260 SIA's and is the author of the Guidelines for Social Impact Assessments for EIA's adopted by the Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape in 2007. Annexure C contains a copy of CV for Tony Barbour.

Schalk van der Merwe, the co-author of this report, has an MPhil in Environmental Management from the University of Cape Town and has worked closely with Tony Barbour on a number of SIAs over the last sixteen years.

1.6 DECLARATION OF INDEPENDENCE

This confirms that Tony Barbour and Schalk van der Merwe, the specialist consultants responsible for undertaking the study and preparing the Draft SIA Report, are independent and do not have vested or financial interests in the proposed development being either approved or rejected. Annexure D contains a copy of signed declaration of independence.

1.7 REPORT STUCTURE

The report is divided into five sections, namely:

- Section 1: Introduction;
- Section 2: Policy and planning context;
- Section 3: Overview of study area;
- Section 4: Identification and assessment of key issues; and
- Section 5: Key Findings and recommendations.

SECTION 2: POLICY AND PLANNNIG CONTEXT

2.1 INTRODUCTION

Legislation and policy embody and reflect key societal norms, values and developmental goals. The legislative and policy context therefore plays an important role in identifying, assessing and evaluating the significance of potential social impacts associated with any given proposed development. An assessment of the "policy and planning fit[4]" of the proposed development therefore constitutes a key aspect of the Social Impact Assessment (SIA). In this regard, assessment of "planning fit" conforms to international best practice for conducting SIAs. Furthermore, it also constitutes a key reporting requirement in terms of the applicable Western Cape Department of Environmental Affairs and Development Planning's *Guidelines for Social Impact Assessment* (2007).

For the purposes of the meeting the objectives of the SIA the following national, provincial and local level policy and planning documents were reviewed, namely:

- National Energy Act (2008).
- White Paper on the Energy Policy of the Republic of South Africa (December 1998).
- White Paper on Renewable Energy (November 2003).
- Integrated Energy Plan for South Africa (2016).
- The National Development Plan (2011).
- New Growth Path Framework (2010).
- National Infrastructure Plan (2012).
- White Paper on Sustainable Energy for the Western Cape Province (2010).
- The Western Cape Provincial Strategic Plan 2014-2019 (2014).
- The Western Cape Land Use Planning Act (2014).
- The Western Cape Provincial Spatial Development Framework (2014 Revision);
- The Western Cape Climate Change Response Strategy (2014).
- The Western Cape Infrastructure Framework (2013).
- The Western Cape Green Economy Strategy Framework (2013).
- The One Cape 2040 Strategy (2012).
- The Western Cape Amended Zoning Scheme Regulations for Commercial Renewable Energy Facilities (2011).
- The Western Cape Draft Strategic Plan (2010).
- The Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape – Towards a Regional Methodology (2006).
- West Coast District Municipality Integrated Development Plan (2017-2021);
- West Coast District Municipality Spatial Development Framework (2014).
- Swartland Municipality Spatial Development Framework (2019).
- Swartland Municipality Integrated Development Plan (2017-2022).

[4] Planning fit" can simply be described as the extent to which any relevant development satisfies the core criteria of appropriateness, need, and desirability, as defined or circumscribed by the relevant applicable legislation and policy documents at a given time.

Section 2 also provides a review of the Renewable Energy Programme in South Africa and a summary of some of the key social issues associated with wind farms based on international experience. A summary of a review of international studies on the potential impacts on property values and tourism is also provided.

2.2 NATIONAL POLICY ENVIRONMENT

2.1.1 National Energy Act (Act No 34 of 2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including wind:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (…); to provide for (…) increased generation and consumption of renewable energies…" (Preamble).

2.1.2 White Paper on the Energy Policy of the Republic of South Africa

Investment in renewable energy initiatives, such as the proposed WEF, is supported by the White Paper on Energy Policy for South Africa (December1998). In this regard the document notes:

"Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential".

"Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future".

The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and ***wind*** and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented;
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and,
- Addressing constraints on the development of the renewable industry.

The White Paper also acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive and many appropriate applications exist.

The White Paper also notes that renewable energy applications have specific characteristics that need to be considered. Advantages include:

- Minimal environmental impacts in operation in comparison with traditional supply technologies; and
- Generally lower running costs, and high labour intensities.

Disadvantages include:

- Higher capital costs in some cases[5];
- Lower energy densities; and
- Lower levels of availability, depending on specific conditions, especially with sun and wind based systems.

The IRP 2010 aims to allocate 43% of new energy generation facilities in South Africa to renewables.

2.1.3 White Paper on Renewable Energy

The White Paper on Renewable Energy (November, 2003) (further referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognizes that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

The White Paper notes that while South Africa is well endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. As signatory to the Kyoto Protocol[6], Government is determined to make good the country's commitment to reducing greenhouse gas emissions. To this purpose, Government has committed itself to the development of a framework in which a national renewable energy framework can be established and operate.

South Africa is also a signatory of the Copenhagen Accord, a document that delegates at the 15th session of the Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change agreed to "take note of" at the final plenary on 18 December 2009. The accord endorses the continuation of the Kyoto Protocol and confirms that climate change is one of the greatest challenges facing the world. In terms of the accord South Africa committed itself to a reduction target of 34% compared to business as usual.

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[5] Recent studies have however shown that capital costs for wind and solar projects are more cost effective that coal and nuclear options.

[6] The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of November 2009, 187 states have signed and ratified the protocol (Wikipedia)

Apart from the reduction of greenhouse gas emissions, the promotion of renewable energy sources is aimed at ensuring energy security through the diversification of supply (in this regard, also refer to the objectives of the National Energy Act).

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels. The medium-term (10-year) target set in the White Paper is:

2.1.4 Integrated Energy Plan (2016)

The development of a National Integrated Energy Plan (IEP) was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette. The purpose of the IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development.

The IEP notes that South Africa needs to grow its energy supply to support economic expansion and in so doing, alleviate supply bottlenecks and supply-demand deficits. In addition, it is essential that all citizens are provided with clean and modern forms of energy at an affordable price. As part of the Integrated Energy Planning process, eight key objectives were identified, namely:

- Objective 1: Ensure security of supply;
- Objective 2: Minimise the cost of energy;
- Objective 3: Promote the creation of jobs and localisation;
- Objective 4: Minimise negative environmental impacts from the energy sector;
- Objective 5: Promote the conservation of water;
- Objective 6: Diversify supply sources and primary sources of energy;
- Objective 7: Promote energy efficiency in the economy; and
- Objective 8: Increase access to modern energy.

The IEP provides an assessment of current energy consumption trends within different sectors of the economy (i.e. agriculture, commerce, industry, residential and transport) and uses this information to identify future energy requirements, based on different scenarios. The scenarios are informed by different assumptions on economic development and the structure of the economy and also take into account the impact of key policies such as environmental policies, energy efficiency policies, transport policies and industrial policies, amongst others.

Based on this information the IEP then determines the optimal mix of energy sources and technologies to meet those energy needs in the most cost-effective manner for each of the scenarios. The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed. The IEP is therefore focused on determining the long-term energy pathway for South Africa, taking into account a multitude of factors which are embedded in the eight objectives.

As part of the analysis four key scenarios were developed, namely the Base Case, Environmental Awareness, Resource Constrained and Green Shoots scenarios:

- The Base Case Scenario assumes that existing policies are implemented and will continue to shape the energy sector landscape going forward. It assumes moderate economic growth in the medium to long term;
- The Environmental Awareness Scenario is characterised by more stringent emission limits and a more environmentally aware society, where a higher cost is placed on externalities caused by the supply of energy;
- The Resource Constrained Scenario in which global energy commodity prices (i.e. coal, crude oil and natural gas) are high due to limited supply;
- The Green Shoots Scenario describes an economy in which the targets for high economic growth and structural changes to the economy, as set out in the National Development Plan (NDP), are met.

The IEP notes that South Africa should continue to pursue a diversified energy mix which reduces reliance on a single or a few primary energy sources. In terms of renewable energy the document refers to wind and solar energy. The document does however appear to support solar over wind noting that solar PV and CSP with storage present excellent opportunities to diversify the electricity mix, to produce distributed generation and to provide off-grid electricity. Solar technologies also present the greatest potential for job creation and localisation. Incentive programmes and special focused programmes to promote further development in the technology, as well as solar roll-out programmes, should be pursued.

In terms of existing electricity generation capacity the IEP indicates that existing capacity starts to decline notably from 2025, with significant plant retirement occurring in 2031, 2041 and 2048. By 2050 only 20% of the current electricity generation capacity remains. As a result large investments are required in the electricity sector in order to maintain an adequate supply in support of economic growth.

By 2020, various import options become available and some new coal capacity is added along with new wind, solar and gas capacity. The mix of generation capacity technologies by 2050 is considerably more diverse than the current energy mix, across all scenarios. The main differentiating factors between the scenarios are the level of demand, constraints on emission limits and the carbon dioxide externality costs.

In all scenarios the energy mix for electricity generation becomes more diverse over the period to 2050, with coal reducing its share from about 85% in 2015 to 15–20% in 2050 (depending on the scenario). Solar, wind, nuclear, gas and electricity imports increase their share. The Environmental Awareness and Green Shoots scenarios take on higher levels of renewable energy.

An assessment of each scenario against the eight objectives with reference to renewable energy notes while all scenarios seek to ensure that costs are minimised within the constraints and parameters of each scenario, the Base Case Scenario presents the least cost followed by the Environmental Awareness, Resource Constrained and Green Shoots scenarios respectively when total energy system costs are considered.

In term of promoting job creation and localisation potential the Base Case Scenario presents the greatest job creation potential, followed by the Resource Constrained, Environmental Awareness and Green Shoots scenarios respectively. In all scenarios, approximately 85% of total jobs are localisable. For electricity generation, most jobs result from solar technologies followed by nuclear and wind, with natural gas and coal making a smaller contribution.

The Environmental Awareness Scenario, due to its stringent emission constraints, shows the lowest level of total emissions over the planning horizon. This is followed by the Green Shoots, Resource Constrained and Base Case scenarios. These trends are similar when emissions are considered cumulatively and individually by type

The IEP notes that a diversified energy mix with a reduced reliance on a single or a few primary energy sources should be pursued. In terms of renewable energy wind and solar are identified as the key options.

Wind
Wind energy should continue to play a role in the generation of electricity. Allocations to ensure the development of wind energy projects aligned with the IRP2010 should continue to be pursued.

Solar
- Solar should play a much more significant role in the electricity generation mix than it has done historically, and constitutes the greatest share of primary energy (in terms of total installed capacity) by 2050. The contribution of solar in the energy mix comprises both CSP and solar PV.
- Investments should be made to upgrade the grid in order to accommodate increasing solar and other renewable energy contributions.

With reference to the Renewable Energy Independent Power Producer (REIPP) Procurement Programme, the IEP notes:

- The REIPP Procurement Programme should be extended and new capacity should be allocated through additional bidding windows in order ensure the ongoing deployment of renewable energy technologies,;
- Experience and insights gained from the current procurement process should be used to streamline and simplify the process;
- The implementation of REIPP projects in subsequent cycles of the programme should be aligned with the spatial priorities of provincial and local government structures in the regions that are selected for implementation, in line with the Spatial Development Frameworks. This will ensure that there is long-term, sustainable infrastructure investment in the areas where REIPP projects are located. Such infrastructure includes bulk infrastructure and associated social infrastructure (e.g. education and health systems). This alignment will further assist in supporting the sustainable development objectives of provincial and local government by benefiting local communities.

The IEP indicates that Renewable Energy Development Zones (REDZs) have been identified and describe geographical areas:

- In which clusters (several projects) of wind and solar PV development will have the lowest negative impact on the environment while yielding the highest possible social and economic benefit to the country;
- That are widely agreed to have strategic importance for wind and solar PV development;
- Where the environmental and other authorisation processes have been aligned and streamlined based on scoping level pre-assessments and clear development requirements; and

- Where proactive and socialised investment can be made to provide time-efficient infrastructure access.

2.1.5 National Development Plan

The National Development Plan (NDP) contains a plan aimed at eliminating poverty and reducing inequality by 2030. The NDP identifies 9 key challenges and associated remedial plans. Managing the transition towards a low carbon national economy is identified as one of the 9 key national challenges. Expansion and acceleration of commercial renewable energy is identified as a key intervention strategy.

2.1.6 The New Growth Path Framework

Government released the New Economic Growth Path Framework on 23 November 2010. The aim of the framework is to enhance growth, employment creation and equity. The policy's principal target is to create five million jobs over the next 10 years and reflects government's commitment to prioritising employment creation in all economic policies. The framework identifies strategies that will enable South Africa to grow in a more equitable and inclusive manner while attaining South Africa's developmental agenda. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard the framework identifies investments in five key areas namely: ***energy***, transport, communication, water and housing.

The New Growth Path also identifies five other priority areas as part of the programme to create jobs, through a series of partnerships between the State and the private sector. The Green Economy is one of the five priority areas, including expansions in construction and the production of technologies for solar, wind and biofuels. In this regard clean manufacturing and environmental services are projected to create 300 000 jobs over the next decade.

2.1.7 National Infrastructure Plan

The South African Government adopted a National Infrastructure Plan in 2012. The aim of the plan is to transform the economic landscape while simultaneously creating significant numbers of new jobs and strengthen the delivery of basic services. The plan also supports the integration of African economies. In terms of the plan Government will invest R827 billion over the next three years to build new and upgrade existing infrastructure. The aim of the investments is to improve access by South Africans to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools and dams will contribute to improved economic growth.

As part of the National Infrastructure Plan, Cabinet established the Presidential Infrastructure Coordinating Committee (PICC). The Committee identified and developed 18 strategic integrated projects (SIPS). The SIPs cover social and economic infrastructure across all nine provinces (with an emphasis on lagging regions) and consist of:

- Five geographically-focussed SIPs;
- Three spatial SIPs;
- Three energy SIPs;

- Three social infrastructure SIPs;
- Two knowledge SIPs;
- One regional integration SIP;
- One water and sanitation SIP.

The three energy SIPS are SIP 8, 9 and 10.

SIP 8: Green energy in support of the South African economy
- Support sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP 2010);
- Support bio-fuel production facilities.

SIP 9: Electricity generation to support socio-economic development
- Accelerate the construction of new electricity generation capacity in accordance with the IRP 2010 to meet the needs of the economy and address historical imbalances;
- Monitor implementation of major projects such as new power stations: Medupi, Kusile and Ingula.

SIP 10: Electricity transmission and distribution for all
- Expand the transmission and distribution network to address historical imbalances, provide access to electricity for all and support economic development.
- Align the 10-year transmission plan, the services backlog, the national broadband roll-out and the freight rail line development to leverage off regulatory approvals, supply chain and project development capacity.

2.1.8 Integrated Resource Plan (2019)

The integrated resource plan (IRP) is an electricity capacity plan which aims to provide an indication of the country’s electricity demand, how this demand will be supplied and what it will cost. On 6 May 2011, the Department of Energy (DoE) released the Integrated Resource Plan 2010-2030 (IRP 2010) in respect of South Africa’s forecast energy demand for the 20-year period from 2010 to 2030. The IRP 2010 was intended to be a ‘living plan’ that would be periodically revised by the DoE. However, this was never done and resulted in an energy mix that failed to adequately meet the constantly changing supply and demand scenarios in South Africa, nor did it reflect global technological advancements in the efficient and responsible generation of energy.

On 27 August 2018, the then Minister of Energy published a draft IRP which was issued for public comment (Draft IRP). Following a lengthy public participation and consultation process the Integrated Resource Plan 2019 (IRP 2019) was gazetted by the Minister of Mineral Resources and Energy, Gwede Mantashe, on 18 October 2019, updating the energy forecast for South Africa from the current period to the year 2030. The IRP is an electricity capacity plan which aims to provide an indication of the country’s electricity demand, how this demand will be supplied and what it will cost.

Since the promulgated IRP2010, the following capacity developments have taken place. A total 6 422MW under the government led Renewable Energy Independent Power Producers Programme (RE IPP Procurement Programme) has been procured, with 3 876MW currently operational and made available to the grid. In addition, IPPs have commissioned 1 005MW from two Open Cycle Gas Turbine (OCGT) peaking plants. Under the Eskom build programme, the following capacity has been commissioned: 1 332MW of Ingula pumped storage, 1 588MW of Medupi, 800MW of Kusile and 100MW of Sere Wind Farm. In total, 18 000MW of new generation capacity has been committed to.

Provision has been made for the following new additional capacity by 2030:

- 1 500MW of coal;
- 2 500MW of hydro;
- 6 000MW of solar PV;
- 14 400MW of wind;
- 1 860MW of nuclear;
- 2 088MW for storage;
- 3 000MW of gas/diesel; and
- 4 000MW from other distributed generation, co-generation, biomass and landfill technologies.

Figure 2.1 provides a summary of the allocations and commitments between the various energy sectors.

	Coal	Coal (Decommis-sioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37,149		1 860	2,100	2 912	1 474	1 980	300	3 830	499
2019	2,155	-2,373					244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1,433	-557				114	300			
2021	1,433	-1403				300	818			
2022	711	-844			513	400 1,000	1,600			
2023	750	-555				1000	1,600			500
2024			1,860				1,600		1000	500
2025						1000	1,600			500
2026		-1,219					1,600			500
2027	750	-847					1,600		2000	500
2028		-475				1000	1,600			500
2029		-1,694			1575	1000	1,600			500
2030		-1,050		2,500		1000	1,600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33,364		1,860	4,600	5,000	8,288	17,742	600	6,380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3	17.8	0.6	1.3	

Installed Capacity
Committed/Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

- 2030 Coal Installed Capacity is less capacity decommissioned between years 2020 and 2030.
- Koeberg power station rated/installed capacity will revert to 1,926MW (original design capacity) following design life extension work.
- Other/ Distributed generation includes all generation facilities in circumstances in which the facility is operated solely to supply electricity to an end-use customer within the same property with the facility.
- Short term capacity gap is estimated at 2,000MW.

Figure 2.1: Summary of energy allocations and commitments

As indicated above, the changes from the Draft IRP capacity allocations see an increase in solar PV and wind, and a significant decrease in gas and diesel; and new inclusions include nuclear and storage.

In terms of renewable energy four bidding rounds have been completed for renewable energy projects under the RE IPP Procurement Programme. The most dominant technology in the IRP2019 is renewable energy from wind and solar PV technologies, with wind being identified as the stronger of the two technologies. There is a consistent annual allocation of 1 600MW for wind technology commencing in the year 2022 up to 2030. The solar PV allocation of 1 000MWs per year is incremental over the period up to 2030, with no allocation in the years 2024 (being the year the Koeberg nuclear extension is expected to be commissioned) and the years 2026 and 2027 (presumably since 2 000MW of gas is expected in the year 2027). The IRP 2019 states that although there are annual build limits, in the long run such limits will be reviewed to take into account demand and supply requirements.

2.3 PROVINCIAL AND LOCAL LEVEL POLICY AND PLANNING

2.3.1 White Paper on Sustainable Energy for the Western Cape

The White Paper on Sustainable Energy (2010) compliments the Climate Change Strategy and Action Plan, specifically by *inter alia* setting targets for renewable energy generation. The White Paper is currently in Final Draft form. Once approved by Provincial cabinet, it will constitute the formal Western Cape's policy document on which the Western Cape Sustainable Energy Facilitation Bill will be based. The purpose of the White Paper and the envisaged Bill is to create an enabling policy environment in the Western Cape in order to promote and facilitate energy generation from renewable sources, as well as efficient energy use technologies and initiatives. This objective forms an integrated part of the Province's overarching energy policy objectives, namely:

- To ensure medium-term energy security, sufficient in order to support economic growth;
- To reduce energy poverty;
- To increase the efficient use of energy;
- To limit the greenhouse emissions footprint (associated with the use of fossil fuels);
- To decrease reliance on finite fossil fuel resources and associated unpredictable commodity markets.

The White Paper forms part of the Provincial Government of the Western Cape's (PGWC) strategy aimed at removing a number of barriers (e.g. energy pricing, legal, institutional, low levels of investment confidence, insufficient knowledge) currently frustrating the province's energy goals by preventing the adoption and commercialization of clean energy (including electricity generation from renewable sources such as wind and solar) technologies and initiatives. The White Paper notes that, with regard to sources of renewable energy, wind and solar both represent commercially viable options in the province. The document proposes that special focus should be given to these renewable subsectors and specific associated technologies in order to achieve critical mass of installation, and therefore drive down establishment costs and ensure permanent employment opportunities.

The context, vision, identified goals and targets of the White Paper are briefly discussed below:

Context

The White Paper is rooted in an integrated set of high-level provincial policy documents, and in particular, the Western Cape Provincial Growth and Development Strategy (PGDS)[7] of 2007 and the Sustainable Development Implementation Plan (SDIP)[8]. These policy documents provide the overarching framework for the White Paper. Information contained in the internal Sustainable Energy Strategy (SES) document which was prepared in 2007, largely informed the drafting of the White Paper.

Vision

The vision underpinning the White Paper, the so-called "2014 Sustainable Energy Vision for the Western Cape" is the following:

The Western Cape has a secure supply of quality, reliable, clean and safe energy, which delivers social, economic and environmental benefits to the Province's citizens, while also addressing the climate change challenges facing the region and the eradication of energy poverty (White Paper, 15).

Goals

Six goals have been identified in order to realise to this vision. These goals are grouped under economic, environmental and social sustainability categories. These goals are listed below, and each briefly discussed:

- Goal 1: alleviate energy poverty (Social sustainability): This goal is aimed at addressing energy related under-development amongst the province's poor.
- Goal 2: Improve the health of the nation (Social sustainability): The goal is aimed at reducing health and safety risks associated with the use of fuels such as coal, paraffin and wood, as well as the generation of electricity from fossil fuels. In this regard it is noted that the use of renewable sources to generate electricity does not emit harmful substances such as smoke, or oxides of sulphur nitrogen into the atmosphere. The document notes that improving the health of the nation includes improving the health of the individual through improved indoor climate as well as the outdoor climate.
- Goal 3: Reduce harmful emissions (Environmental sustainability): The White Paper notes that improved energy efficiency and increased use of renewable energy are cost effective methods to reduce Greenhouse Gas emissions, thereby combating Climate Change. Addressing Climate Change opens the door to utilising additional finance mechanisms to reduce CO_2 emissions.
- Goal 4: Reduce negative footprints in our environment (Environmental sustainability): The White Paper notes that the use of fossil fuels has a documented negative impact on the regional and local environment. The negative impacts include, but are not limited to individual health, ground water pollution and air pollution. Any reduction in the use of fossil fuels through switching to clean(er) energy sources and more efficient energy uses is therefore desirable.
- Goal 5: Enhance energy security (Economic sustainability): The massive South African black-outs that started first in the Western Cape in early 2006 alerted the

[7] The main purpose of the PGDS is to provide a strategic framework for accelerated and shared economic growth in the Western Cape. The PGDS builds on the 12 iKapa strategies which were developed by the relevant PGWC line departments, including the Provincial Spatial Development Framework (PSDF), the Sustainable Development Implementation Plan (SDIP) and the Climate Change Response Strategy (CCRS).

[8] This plan includes programmes to encourage biodiversity, effective open-space management and the better management of settlements by ensuring the sustainability of services in respect of water, waste, energy and land. The SES and White Paper both effectively form part of SDIP.

Province to its energy vulnerability. It is essential that the Western Cape increases its resilience against external energy supply disruptions and the massive price fluctuations caused by national or international decisions with regard to energy commodities (coal, oil):

- Goal 6: Improve economic competitiveness (Economic sustainability): It has been demonstrated internationally that one of the ways to improve economic competitiveness is by improving industrial and commercial energy efficiency. Support of industrial best practice energy management as a tool to stay competitive and improve the economy is important.

Targets

The PGWC agreed to targets for electricity from renewable sources and for energy efficiency to be achieved by 2014. The purpose of the White Paper is to quantify the relevant targets, and further to provide an incremental implementation plan until 2014. In this regard, four targets have been identified. Of these, two are of direct relevance to the proposed WF:

- Target for electricity generated from renewable sources: *15% of the electricity consumed in the Western Cape will come from renewable energy sources in 2014, measured against the 2006 provincial electricity consumption* (White Paper, p21)

In this regard, the White Paper notes that in order to reach this target, it will be necessary for the PGWC to ensure that the environment to establish and generate renewable energy is such that a minimum of 15% of the electricity can be produced, and must be consumed, from renewable sources.

- Target for reducing carbon emissions: *The carbon emissions are reduced by 10% by 2014 measured against the 2000 emission levels* (p. 23).

In this regard, the White Paper notes that achieving this target largely depends on achieving the renewables target.

2.3.2 Western Cape Climate Change Response Strategy

The Western Cape Climate Change Response Strategy (WCCCRS) was adopted in February 2014. It is an update of the 2008 Western Cape Climate Change Response Strategy and Action Plan. The key difference with the 2008 Strategy is a greater emphasis on mitigation, including strategically suitable renewable energy development.

The 2014 WCCCRS was updated in accordance with the National Climate Change Response Policy (2013). It is strongly aligned with the overarching provincial objectives contained in the Western Cape Draft Strategic Plan 2009-2014 (2010), and the WCP 'Green is Smart' Strategy (2013). In line with the National Climate Change Response Policy, the Strategy takes a two-pronged approach to addressing climate change:

- **Mitigation:** Contribute to national and global efforts to significantly reduce Green House Gas (GHG) emissions and build a sustainable low carbon economy, which simultaneously addresses the need for economic growth, job creation and improving socio-economic conditions;
- **Adaptation:** Reduce climate vulnerability and develop the adaptive capacity of the Western Cape's economy, its people, its ecosystems and its critical

infrastructure in a manner that simultaneously addresses the province's socio-economic and environmental goals (WCCCRS, 2014: 21).

The Strategy will be executed through an implementation framework which will include an institutional framework for both internal and external stakeholders, with a strong emphasis on partnerships. The framework still has to be prepared. A monitoring and evaluation system is further envisaged in order to track the transition to a low carbon and climate resilient WCP. Policy aspects dealing with mitigation are of specific relevance to renewable energy generation.

Energy and emissions baseline
Based on comprehensive 2009 data for all WCP energy use sectors, the following key findings pertain to the overall WCP energy use and emissions:

- Electricity is the key fuel used in the WCP, accounting for 25% of total consumption;
- Approximately 95% of base load electricity is generated from low-grade coal and the remainder by nuclear. The vast bulk of WCP electricity is generated in the north of the country;
- In terms of emissions by sector, electricity is responsible for 55% of the total WCP emissions. According to the Strategy, this supports the case for a shift towards renewables and clean energy types;
- Transport (55%) was the greatest energy user, followed by industry (33%). Although domestic consumption accounted for only 8%, it accounted for 18% of emissions, again underscoring the emission-intensive nature of electricity generation.

Mitigation potential
According to the Strategy, the main opportunities for mitigation include energy efficiency, demand-side management, and moving towards a less-emission intensive energy mix. In the short to medium term, four areas with mitigation potential are identified, including promoting renewable energy in the form of both small-scale embedded generation as well as large scale renewable energy facilities. Together with other mitigation interventions, renewable energy generation is anticipated to result in the following socio-economic benefits:

- Reducing fuel costs to households and business;
- Improving the competitiveness of businesses;
- Job creation opportunities with the development of new economic sectors;
- Local business development;
- Improved air quality (with positive health impacts);
- Reducing the negative impact of large carbon footprints, particularly for export products; and
- Reducing stress on energy needs of the province and thereby increasing energy security.

Renewable energy as strategic focus area
Initial implementation of the Strategy will focus on select focus areas aligned with the National Climate Change Response Policy Flagship Programmes and the Western Cape Green Economy Strategy Framework. These focus areas will be reviewed every five years – i.e. the next revision is due in 2019. The renewable energy area is identified as one of nine focus areas. The Strategy document notes that renewable energy is a key area of focus for the Western Cape, and forms a fundamental

component of the drive towards the Western Cape becoming the green economy hub for Africa.

The role of the provincial government is identified as 'supporting the development of the renewable energy industry through promoting the placement of renewable energy facilities in strategic areas of the Western Cape as well as through supporting renewable energy industries'.

The document further notes that waste-to-energy opportunities are being investigated in order to facilitate large-scale rollout. Current investigation includes understanding the most appropriate technologies for waste-to-energy projects as well as developing decision support tools for municipalities to implement waste-to-energy programmes.

Priority areas identified for renewable energy development

- Development of the Renewable Energy economy in the WCP, in terms of both the appropriate placement of renewable energy as well as manufacturing opportunities;
- Development of waste-to-energy opportunities for both municipal and private sector (commercial and industrial) waste systems;
- Development of opportunities around small-scale renewable energy embedded generation activities.

2.3.3 Provincial Strategic Plan 2014-2019 (2014)

The Western Cape Provincial Strategic Plan (WCPSP) builds upon the 2009-2014 Draft Provincial Strategic Plan. The vision statement for the 2014-2019 Plan is 'a highly skilled, innovation-driven, resource-efficient, connected, high-opportunity society for all'. The five strategic goals identified for the 2014-2019 period are:

- Creating opportunities for growth and jobs;
- Improving education outcomes and opportunities for youth development;
- Increasing wellness and safety, and tackling social ills;
- Enabling a resilient, sustainable, quality and inclusive living environment; and
- Embedding good governance and integrated service delivery through partnerships and spatial alignment.

Five sets of performance indicators are identified to evaluate the implementation of strategies aimed at meeting these goals. In addition, the Plan identifies a number of 'game changers' which would help tackling provincial development issues, and result in palpable 'real' change. It envisages that action plans would be prepared by 2015/2016 for each of these identified 'game changers'. The 'game changers' are clustered around three priority areas. Key aspects of the Plan pertaining to renewable energy are discussed below.

Strategic Goal 1: Energy security as a 'game changer'

Economic growth/ job creation (Strategic Goal 1) is one of the 3 priority development areas. Achieving Energy security is identified as one of two 'game changers' for fostering this. In this regard, the Plan notes that inadequate electricity supplies over the next five years and beyond threaten to be a significant impediment to growth. A number of strategic priorities are identified to address the issue, including the development of a WCP green economy. The Plan notes that PGWC has prioritised the development of a green economy, with the further aim of establishing it as the green economy hub of Africa.

The Plan further notes that the WCP has already established itself as the national renewable energy hub. In that regard, it is home to developers which have developed more than 60% of the 64 successful projects in the first three rounds of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), as well as a wide array of firms that provide key support services for the industry (engineering and environmental consultancies, legal advisors, etc.). The WCP has also seen the majority of local manufacturing investments. Three of the 4 PV manufacturers that have been successful in supplying to the REIPPPP projects are located in Cape Town, whilst 2014 also saw major global players opening manufacturing facilities for inverters and wind turbine towers.

Future energy security priorities include scaling up renewable energy generation in the province, including embedded generation such as rooftop solar PV, and the importation of liquid natural gas as an alternative power source to support further rollout of renewable energy and low carbon fuel switching (WCPSP, 2014: p.21).

Strategic Goal 4: Reducing greenhouse emissions and improving air quality
The Plan notes that PGWC is committed to improving the resilience, sustainability, quality and inclusivity of the urban and rural settlements. The Plan further notes that while some resource conservation and management improvements have been made, the WCP resource base remains under severe pressure.

Water, energy, pollution and waste, transport and resource-use inefficiencies are leading to extensive environmental degradation, poor air quality, loss of biodiversity and agricultural resources, which result in a deterioration of social and economic conditions. These challenges are further exacerbated by population growth and climate change impacts. It is anticipated that climate change will worsen air quality, as its effects will slow air circulation around the world, resulting in an increase in the frequency and severity of disasters (e.g. fires, floods, and coastal erosion) (WCPSP, 2014: p. 35).

Strategic outcomes pursued under Goal 4 include the enhanced management and maintenance of the ecological and agricultural resource-base; sustainable and integrated urban and rural settlements; and an improved climate change response.

Four outcomes are prioritised, including reduced greenhouse gas emissions and improved air quality. In this regard, the Plan notes that, as air quality and climate change are integrally linked, activities such as reducing fossil fuel burning will address both these priorities (WCPSP, 2014: p. 36). The Plan does not discuss reduced fossil fuel burning or renewable energy in any further detail.

With regard to interventions to air quality management, the Plan refers to the Western Cape Air Quality Management Plan (WCAQMP). The WCAQMP (2010) and associated working groups focus on key interventions relating to governance and integrated management of air quality, climate change, town and regional planning and transport planning. The WCAQMP does not address renewable energy generation.

2.3.4 Western Cape Land Use Planning Act

In line with the Spatial Planning and Land Use Management Act, (Act 16 of 2013), the Western Cape Land Use Planning Act 2014 (LUPA) was adopted by PGWC in April 2014. Chapter III (which deals with spatial planning matters) sets out the minimum requirements for drafting a Provincial Spatial Development Framework (PSDF) for the WCP.

Of specific relevance, Section 4 requires a PSDF to (3) 'contain at least (*c*) provincial priorities, objectives and strategies, dealing in particular with (*iiii*) adaptation to climate change, mitigation of the impact of climate change, renewable energy production and energy conservation'. This requirement would apply to all future revisions of the PSDF. As such, it indicates PGWC's commitment to renewable energy production in order to respond to climate change.

2.3.5 Western Cape Provincial Spatial Development Framework

The 2014 Provincial Spatial Development Framework (PSDF) SDF builds on incorporates the key principles and spatial policies of the 2009 PSDF and is based on a set of 5 guiding principles, namely:

- Spatial justice;
- Sustainability and resilience;
- Spatial efficiency;
- Accessibility, and
- Quality and livability.

Under Sustainability and resilience, the PSDF notes that land development should be spatially compact, resource-frugal, compatible with cultural and scenic landscapes, and should not involve the conversion of high potential agricultural land or compromise ecosystems (p. 22). The 2004 Growth Potential Study was also revised in 2013 as part of the PSDF process[9].

Key spatial challenges are outlined in Chapter 2 of the PSDF. Energy security and climate change response are identified as key high-level future risk factors. The PSDF notes that the WCP is subject to global environmental risks such as climate change, depletion of material resources, anticipated changes to the global carbon regulatory environment, and food and water insecurity. The challenge would be to open up opportunities for inclusive economic growth, and decouple economic growth from resource consumptive activities (i.e. the development of a 'greener' economy, as outlined in the 2013 WCP Green is Smart strategy – see further below).

In this regard, the 2014 PSDF is in response to a number of associated escalating risks, including understanding the spatial implications of known risks (e.g. climate change and its economic impact and sea level rise, flooding and wind damage associated with extreme climatic events); and energy insecurity, high levels of carbon emissions, and the economic impacts of the introduction of a carbon tax (p. 27).

The WCP Spatial agenda

The spatial agenda for the WCP is set out in Chapter 2.6. This agenda is anticipated to deliver on the objectives of greater inclusivity, and growth and environmental resilience. The agenda may be summarised as three linked sub-agendas, all addressed in the PSDF:

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9 eadp-westerncape.kznsshf.gov.za/sites/default/files/news/files/2013-10-15/2013-growth-potential-study-of-towns-report_0.pdf. The 2014 PSDF is informed by three additional studies, also available at the above link.

- (1) Growing the WCP economy in partnership with the private sector, non-governmental and community based organisations;
- (2) Using infrastructure investment as a primary lever to bring about the required urban and rural spatial transitions, including transitioning to sustainable technologies, as set out in the 2013 Western Cape Infrastructure Framework (WCIF), while also maintaining existing infrastructure;
- (3.) Improving oversight of the sustainable use of the Western Cape's spatial assets. This sub-agendum is of specific relevance to climate change response and renewable energy. Its key objective is safeguarding the biodiversity networks, ecosystem services, agricultural resources, soils and water, as well as the WCP's unique cultural, scenic and coastal resources on which the tourism economy depends. In addition, it seeks to understand the spatial implications of known risks (e.g. climate change) and to introduce risk mitigation and/or adaptation measures.

Chapter 3.1 deals with the sustainable use of the WCP's assets. These are identified as Biodiversity and Ecosystem services; Water resources; Soils and Mineral resources; Resource consumption and disposal; and Landscape and scenic assets. Policies are outlined for each of these themed assets. The last two themed assets are of specific relevance with regard to renewable energy.

Resource consumption and disposal
Key challenges facing the WCP are identified as matters pertaining to waste disposal, air quality, energy, and climate change.

Energy
With regard to energy use, the PSDF notes that the Cape Metro and West Coast regions are the WCP's main energy users. It further notes that the WCP's electricity is primarily drawn from the national grid, which is dominated by coal-based power stations, and that the WCP currently has a small emergent renewable energy sector in the form of wind and solar generation facilities located in its more rural, sparsely populated areas. The PSDF also reiterates PGWC's commitment to shifting the economy towards gas[10] as transitional fuel (see WCIP below). Most of the energy discussion in the PSDF is dominated by aspects pertaining to natural gas.

With regard to renewable energy, the following policy provisions are of relevance:

- Policy R.4.6: *Pursue energy diversification and energy efficiency in order for the Western Cape to transition to a low carbon, sustainable energy future, and delink economic growth from energy use*;
- R.4.7: *Support emergent Independent Power Producers (IPPs) and sustainable energy producers (wind, solar, biomass and waste conversion initiatives) in suitable rural locations (as per recommendations of the Strategic Environmental Assessments for wind energy (DEA&DP) and renewable energy (DEA)*[11] .

Unlike the 2009 PSDF, the new PSDF does not provide any spatial provisions with regard to REF or transmission line infrastructure. Instead, such determination is envisaged in terms of the WCP WF SEA, the DEA REF SEA, municipal SDFs, etc. In

[10] The PSDF at present envisages mainly from offshore West Coast gas fields via a terminal at Saldanha. The PSDF refers to the potential exploitation of own shale reserves, but also to the environmental sensitivity involved.
[11] See notes under Regional Methodology Review below.

this regard the two policy directives contained in the 2009 PSDF that had a direct relevance for WFs are not contained in the 2014 revision, namely:

HR26 *(…) transmission lines (…) should be aligned along existing and proposed transport corridors rather than along point to point cross-country routes.* (Mandatory directive)

HR27 *Wind farms should be located where they will cause the least visual impact, taking into consideration the viability of the project.* (Guiding directive)

Climate change

Water scarcity is identified as probably the key risk associated with climate change. Essentially the same primary response objectives outlined in the 2014 Western Cape Climate Change Response Strategy (WCCCRS – see 4 below) are identified in the PSDF. These are energy efficiency, demand management and renewable energy.

Policy provisions are made with regard to climate change adaptation and mitigation. Concerning renewable energy, the following is of relevance:

- R.4.16: *Encourage and support renewable energy generation at scale*.

Landscape and scenic assets

A specialist study was undertaken into the Province's cultural and scenic landscapes. This study[12] was one of the informants of the 2014 PSDF. It established that the WCP's cultural and scenic landscapes are significant assets underpinning the tourism economy, but that these resources are being incrementally eroded and fragmented. According to the study agriculture is being reduced to 'islands', visual cluttering of the landscape by non-agricultural development is prevalent, and rural authenticity, character and scenic value are being eroded. The mountain ranges belonging to the Cape Fold Belt together with the coastline are identified as the most significant in scenic terms, and noted to underpin the WCP's tourism economy.

A number of scenic landscapes of high significance are under threat, mainly from low density urban sprawl, and require strategies to ensure their long-term protection. These include landscapes under pressure for large scale infrastructural developments such as ***wind farms***, solar energy facilities, transmission lines and shale gas development in the Central Karoo. With regard to renewable energy, the following policy provisions are of relevance:

- R.5.6: *Priority focus areas proposed for conservation or protection include -*

  - *Rural landscapes of scenic and cultural significance situated on major urban edges and under increasing development pressure, e.g. Cape Winelands;*
  - *Undeveloped coastal landscapes under major development pressure;*
  - *Landscapes under pressure for large scale infrastructural developments such as **wind farms**, solar energy facilities, transmission lines and fracking, e.g. Central Karoo; and*
  - *Vulnerable historic mountain passes and 'poorts'* .

[12] DEA&DP Winter and Oberholzer (2013). *Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape. - A Study prepared for the Western Cape Provincial Spatial Development Framework*. Draft 5. See footnote 1 above.

Renewable energy within the Spatial Economy

Chapter 3.2 deals with opportunities in the WCP spatial economy, including with regard to regional infrastructure development. Essentially the same objectives are identified as in the WCIF, including the promotion of a renewable energy sector . General project-based (EIA and specialist assessment) provisions are made for evaluating the suitability of sites proposed for bulk infrastructure (Policy E.1) .

2.3.6 Western Cape Infrastructure Framework

The Western Cape Infrastructure Framework (WCIF) (2013) was developed by the WCP Provincial Department of Transport and Public Works in terms of the Provincial Government's mandate to coordinate provincial planning under Schedule 5A of the Constitution. The objective of the WCIF is to align the planning, delivery and management of infrastructure to the strategic agenda and vision for the Province, as outlined in the 2009-2014 Draft Provincial Strategic Plan. The One Cape 2040 and 2013 Green is Smart strategy were other key informants.

The document notes that given the *status quo* of infrastructure in the province, and the changing and uncertain world facing the Western Cape over the 2-3 decades a new approach to infrastructure is needed. Namely one that satisfies current needs and backlogs, maintains the existing infrastructure, and plans proactively for a desired future outcome. The 2040 vision requires a number of transitions to shift the way in which infrastructure is provided and the type of infrastructure provided in the WCP.

The WCIF addresses new infrastructure development under five major 'systems' (themes), and outlines priorities for each. Energy is one of the 'systems' identified. The document notes that a provincial demand increase of 3% per year is anticipated for the period 2012-2040. Key priorities are in matching energy generation/ sourcing with the demand needed for WCP economic growth. Additionally, the energy focus should be on lowering the provincial carbon footprint, with an emphasis on renewable and locally generated energy.

Energy infrastructure transition

Three key transitions are identified for the WCP Energy 'system' infrastructure, namely:

- Shifting transport patterns to reduce reliance on liquid fuels;
- Promoting natural gas as a transition fuel by introducing gas processing and transport infrastructure; and
- Promoting the development of renewable energy plants in the province and associated manufacturing capacity.

2.3.7 Western Cape Green Economy Strategy Framework

The Western Cape Green Economy Strategy (2013) – 'Green is Smart' - is a framework for shifting the Western Cape economy from its current carbon intensive and resource-wasteful path within a context of high levels of poverty to one which is smarter, greener, more competitive and more equitable and inclusive. The Strategy is closely aligned with provincial development goals and the 2014 WCCCRS.

The strategy notes that two of the WCP's key economic sectors - both of national importance - agriculture and tourism, are vulnerable to climate change. At the same time, these challenges hold significant potential for opportunities linked to attracting investment, economic development, employment creation, and more resilient infrastructure and patterns of consumption. These opportunities are partly linked to the WCP's existing leadership in some fields of green technology, including knowledge services. The core objective of the Strategy is to position the WCP as the lowest carbon footprint province in South Africa, and a leading green economy hub on the African continent.

Drivers, Enablers and Priorities
The Strategy framework is made up of 5 drivers of the green economy which are market focused and principally private sector driven, and supported by 5 enablers which are either public sector driven, or the product of a collaborative effort.

The five drivers are: smart mobility, smart living and working, smart ecosystems, smart agri-processing and smart enterprise. The relevant cross-cutting enablers are: finance, rules and regulations, knowledge management, capabilities, and infrastructure.

The framework also identifies priorities that would position the WCP as a pioneer and early adopter of green economic activity. These priorities have been identified in terms of the WCP being firstly, a front-runner or pioneer and secondly, an early adopter of innovations and technologies which already exist, but are not widely adopted in South Africa. Some priorities are considered game-changers, and are singled out as 'high level priorities for green growth'.

Three such 'high level priorities for green growth' are identified, two of which are of relevance here:

- Natural Gas and Renewables: Off-shore natural gas, potential gas base-load power plants and renewable energy IPP programme, together with a greenfield gas infrastructure, will be the game-changer for the Western Cape to be the lowest carbon province in South Africa, and achieve significant manufacturing investment;
- Green Jobs: A green growth path without job growth is unsustainable. There must be early pursuit of priorities with a high rate of job growth potential – notably rehabilitation of natural assets, responsible tourism and the waste sector.

Renewable energy servicing hub
'Under the section dealing with drivers, renewable energy is discussed under 'Smart Enterprise'. The WCP's objective in terms of this driver is to establish the WCP as a globally recognised centre of green living, working, creativity, business and investment, and thereby attract investment, business and employment opportunities. Based on existing comparative advantages, three key opportunities are identified, one of which is of relevance here, namely to establish the WCP as Africa's new energy servicing hub.

In this regard, the Strategy document notes that WCP is well placed to be the most important research and servicing hub for the renewable and natural gas energy sectors in South Africa and on the African continent.

In support of this claim, it notes that the Darling Wind Energy Facility (WF) was the first operational WF in the country, and that a number of further WFs and SEFs have been approved for the province under REIPPPP. Estimated investment of REIPPPP projects in the Western Cape in the first two rounds is just under R8 billion (wind and solar). WCP professional service firms play a leading advisory role in REIPPPP projects across the country.

The WCP is further home to the country's first photovoltaic manufacturers, Tenesol/ SunPower and SolaireDirect. On the back of REIPPPP, AEG and jointly, Enertronica and Gefran have also established manufacturing facilities in the Cape, with growing interest from other companies. South Africa's first dedicated renewable training centre is being established in the Western Cape at the Cape Peninsula University of Technology (CPUT). The aim of the centre is to prepare a skilled labour pool for the new emerging renewable energies: wind, solar and biogas. The first phase will combine theoretical and practical training for wind turbine service technicians and for solar farms. In the long run, the centre will also become a development and research facility for renewable energy.

The Strategy also notes that there are important initial opportunities in the construction of new energy infrastructure. However, the real long-term benefits lie in the servicing of operational infrastructure. In this regard, it is estimated that the annual servicing and maintenance costs of WFs for instance amount to approximately 10% of the initial capital investment.

Public and market sector procurement are identified as some of the key enablers. The creation of a streamlined regulatory system – the reduction of 'red tape' – is identified as a key prerequisite for creating an enabling environment.

A leader in renewable energy research, manufacturing and servicing

Under the section dealing with enablers necessary to unlock development potential, renewable energy is discussed under "Smart Infrastructure". The Strategy document notes that existing infrastructure systems, particularly those relating to energy and transport, are carbon intensive, with high costs to the environment. Opportunities for the WCP are linked to tapping into infrastructural development funding by leveraging existing advantages.

With regard to the energy sector, the Strategy proposes that the WCP becomes an early adopter of natural gas processing and transport infrastructure, and become the hub of solar manufacture and servicing. Natural gas is identified as the key potential 'game changer' of the WCP economy, and presents the best way to transition the economy to a more fully-integrated renewables sector as major part of the WCP fuel mix in the long term. In this regard, the relative ease with which gas-fired stations could be activated makes them an ideal supplement to less predictable wind and solar sources.

CSP manufacturing and servicing centre[13]

Surprisingly, WF and Solar PV manufacture and servicing receive no specific mention, while Concentrated Solar (CSP) does. The Strategy document justly notes that while the Northern Cape Province is the best suited for CSP facilities, the WCP has strong existing research capabilities in CSP at the University of Stellenbosch (US), and the WCP's existing manufacturing sector already has the capacity to manufacture many CSP components.

Potential opportunities of commercialisation of CSP technology for local (RSA, Africa) conditions based on US research could be substantial. This subsector is identified as an important area of collaboration between the two provinces to realise the potential

[13] The revised IRP excludes CSP as an option.

benefits. The key action at this stage to initiate a WCP manufacturing and servicing centre is to lobby for support for a pilot of South African designed CSP technologies, adapted to SA conditions.

2.3.8 One Cape 2040 Strategy

The One Cape 2040 (2012) vision was developed by the Western Cape Government, the City of Cape Town (CoCT) and the Western Cape Economic Development Partnership. It was adopted as policy by CoCT Council in 2012. It is aimed at stimulating a transition towards a more inclusive and resilient WCP economy. It seeks to set a common direction to guide planning and action and to promote a common commitment and accountability to sustained long-term progress.

The 2040 Strategy does not replace any existing statutory plans. Rather, it is intended as a basic reference point and guide for all stakeholders planning for long-term economic resilience and inclusive growth.

Six key transitions are identified to define the necessary infrastructure-related shifts in the WCP. One of these 6 key transitions is an Ecological transition ('Green Cape') from an unsustainable, carbon-intensive resource use economy, to a sustainable, low carbon-footprint one. The development of renewable energy projects and natural gas are expected to significantly decrease the WCP's carbon footprint.

2.3.9 Western Cape Amended Zoning Scheme Regulations for Commercial Renewable Energy Facilities

Amendments to the Western Cape Land Use Ordinance (1985) (LUPO) were promulgated in 2011 in order to guide the development of commercial renewable energy generation facilities (REFs), mainly wind and solar[14]. The Zoning Scheme amendments are specifically intended to provide guidance with regard to land use compatibility, and applicable development restrictions and conditions, including provision for mandatory rehabilitation post construction and final decommissioning ("abandonment" in terms of the Provincial Notice[15]). The ambit of the Regulations include all REFs as well as associated ("appurtenant") infra/ structure(s) operated for commercial gain, irrespective of whether such feed into the electricity grid or not. The section below provides an overview of key points of relevance to the proposed WF.

Zoning status

- In terms of zoning status, "renewable energy structures" are designated as a consent use in the zone Agriculture I.

Land use restrictions

- Restrictions with regard to height are mainly applicable to wind energy facilities (WFs), but associated on-site buildings for all REFs are limited to a maximum of 8,5 m (ground to highest point of roof);
- Restrictions with regard to setback are only applicable to WFs.

[14] Province of the Western Cape (2011). *Provincial Gazette 6894, Friday 29 July 2011;* PN 189/2011 (pp. 1381-6).

[15] "A Renewable energy structure shall be considered *abandoned* when the structure fails to continuously operate for more than one year".

Establishment of a Rehabilitation Fund

- Prior to authorisation, the applicant ("owner") must make financial provision for the rehabilitation or management of negative environmental impacts, as well as for negative impacts associated with decommissioning or abandonment of the facility. Such provision should be in the form of a fund to be administrated by the Municipality, and should be to the satisfaction of the competent authority (i.e. Department of Energy).

Land clearing/ erosion management

- Land clearing should be limited to areas considered essential for the construction, operation and decommissioning of a REF;
- All land cleared during construction which does not form part of the REF structural footprint, must be rehabilitated in accordance with an approved rehabilitation plan;
- Soil erosion must be avoided at all costs, and any high risk areas should be rehabilitated.

Visual impact management

- Visual and environmental impacts must be taken into account, to the satisfaction of the competent authority;
- Associated structures (i.e. substations, storage facilities, control buildings, etc.) must be screened from view by indigenous vegetation, and/or located underground, or be joined and clustered to avoid adverse visual impacts. In addition, appurtenant structures must be architecturally compatible with the receiving environment;
- Lighting should be restricted to safety and operational purposes, must be appropriately screened from adjacent land units, and should also be in accordance with applicable Civil Aviation Authority requirements.

Operational management and maintenance

- REFs may not cause or give rise to any noise or pollution, deemed to be a nuisance in terms of applicable Environmental Impact Assessment (EIA) regulations or Municipal by-laws;
- The REF owner/ operator is responsible for maintaining the REF in a good condition, including with regard to painting, structural repairs, on-going rehabilitation measures (e.g. erosion), as well as the upkeep of safety and security measures.

Decommissioning management

- An REF which has reached the end of its lifespan or that has been abandoned must be removed. The owner (operator) is responsible for the removal of such structures in whole, no longer than 150 days after the date of discontinued operation, and the land must be rehabilitated to the condition it was in prior to construction of the facility;
- Decommissioning activities must include the removal of all REF structures, associated structures, as well as transmission lines; the disposal of solid and hazardous waste according to applicable waste disposal regulations; and the stabilisation and re-vegetation of the site. In order to minimise disruptive impacts on vegetation, soils, etc., the competent authority may grant approval not to remove any underground foundations or landscaping.

In conclusion, it should be noted that the relevant provisions are mandatory (compliance requirements), and would therefore have to be implemented by the proponent.

2.3.10 Western Cape Draft Strategic Plan

The 11 Strategic Objectives embodied in the Western Cape Draft Strategic Plan 2009-2014 (2010) ("Building an Open Opportunity Society for All") embody the key overarching strategic objectives identified by Provincial Government for its term in office from 2009-2014. Although the Draft Plan has been replaced by the WCPSP 2014-2019, it remains of relevance. In this regard, the objectives identified and work groups established in terms of it were some of the key informants of the 2014 WCCCRS. The 2013 WCIP is also explicitly based on the Draft Plan. Of the 11 Outcomes, the following are applicable to REF projects:

- Creating opportunities for growth and jobs (1);
- Developing integrated and sustainable human settlements (6);
- Mainstreaming sustainability and optimising resource use and efficiency (7);
- Reducing and alleviating poverty (9).

According to the plan to achieve the outcomes pertaining to "Mainstreaming sustainability and optimising resource use and efficiency", key measures include:

- The promotion of energy efficiency in households, commerce, industry and all provincial offices, hospitals and schools; a green building programme and a green low-cost housing programme to increase the chances of the poor against climate change impacts.
- Development of a wind energy sector and energy production from alternative sources as well as net metering supported by a small-scale feed-in tariff to encourage small-scale renewable energy production.

Proposed socio-economic interventions are underpinned by the Administration's beliefs that "economic growth constitutes the foundation of all successful development; that growth is driven primarily by private sector business operating in a market environment; and that the role of the state is (a) to create and maintain an enabling environment for business and (b) to provide demand-led, private sector-driven support for growth sectors, industries and businesses" (WC Department of the Premier; 2010: 8).

2.3.11 Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape – Towards a Regional Methodology

The document developed in 2006 remains the most recent DEA&DP publication with regard to the locational/ siting aspects of WFs. The document focuses specifically on the siting of wind energy facilities. Some of the key findings and recommendations that have a potential bearing on the study are briefly summarised below. However, it should be noted that the document does not have Guideline or Policy status.

Cumulative Impact Issues

The experience in Europe is that the very high cumulative impact of wind farms has resulted due to a policy of permitting small (wind) energy schemes in relatively close proximity to each other (only 2.5 km in Denmark). As a result the document recommends that:

- Large installations should be located extremely far apart (30 – 50km), and;
- Smaller installations should be encouraged in urban / brownfield areas.

Recommended Disturbed Landscape Focus
In addition to proposing that smaller facilities should be focused in urban/ brownfield areas, the proposed methodology further recommends focusing on existing disturbed rural landscapes, and in particular, those rural landscapes that have already been "vertically compromised" by the location, for example, of transmission lines, railway lines, and all phone towers.

Protecting Rural Landscape Values (put after "Urban Emphasis")
The document notes that in Europe in the past, a great degree of emphasis was given to quantifying views from residential locations. This policy emphasis has effectively led to commercial-scale renewable energy developments having been pushed into more "remote" rural locations. The study notes that in the South African context this policy would effectively "penalising" rural areas, and compromising wilderness and touristic visual values. As indicated above the area has been impacted upon by existing power and railway lines.

Site Specific Aesthetic Considerations
The document lists the following site-specific recommendations for turbines:

- Stick to linear, non-organic layouts;
- Placement in straight rows is preferred;
- Maintain consistency in height;
- Consistency of type across an entire facility is recommended.

In terms of REF spatial policy development the following initiatives also have a bearing on the proposed WF:

- DEA / CSIR have undertaken a Strategic Environmental Assessment (SEA) aimed at identifying strategic geographical areas best suited for the effective and efficient roll-out of large scale wind and solar PV energy projects, referred to as Renewable Energy Development Zones (REDZs). Through a process of positive and negative mapping as well as wide stakeholder consultation, eight focus areas have been identified as potentially being of national strategic importance for wind and solar PV development;
- According to DEA&DP's website, a WCP SEA for the placement of WFs is currently being undertaken. The project, headed by Paul Hardcastle, is listed as 'under development', and no documents are available yet. The project context is unclear, but it is likely linked to the national REF SEA[16].

2.3.12 Guideline for the Development on Mountains, Hills and Ridges in the Western Cape

The aim of the Guideline (2002) is to provide a decision-making framework with regard to developments which include listed activities in terms of National Environmental Management Act Regulations, and which are proposed in an environment which is characterised by mountains, hills and ridges.

The Guideline notes that mountains, hills and ridges are subject to a range of development pressures. A guiding framework is therefore needed to control development in these areas. Key reasons listed are:

[16] eadp.westerncape.gov.za/wc-sustainable-energy-projects-db/wc-strategic-environmental-assessment-placement-wind-energy (accessed 18-04-15).

- Provide catchment areas for valuable water resources;
- Often characterised by unique and sensitive ecosystems;
- Have aesthetic / scenic value; and
- Provide "wilderness" experience opportunities.

The Guideline defines a mountain, hill or ridge as "*a physical feature that is elevated above the surrounding landscape*".

The Guideline is divided into 2 sections. The second section deals with key decision-making criteria which need to be taken into account when adjudicating the suitability of developments in such areas. Key criteria which are of specific relevance to the proposed WF include:

- Development on the crest of a mountain, hill or ridge should be strongly discouraged;
- Preserve landform features through ensuring that the siting of facilities is related to environmental resilience and visual screening capabilities of the landscape;
- Adopt the precautionary principle to decision making;
- The criteria used to assess developments in these areas include, amongst others, density of the development, aesthetics, location, value in terms of "sense of place", character of adjacent land use, character of the general area, and cumulative impacts which may arise from other existing and planned developments in the area.

The proposed WF site is located in a landscape characterised by rolling hills in an agricultural setting. However, it should be noted that the Guidelines were developed in 2002 and do not take into account the locational requirements of WFs.

2.4 DISTRICT AND LOCAL LEVEL POLICY AND PLANNING

2.4.1 West Coast District Municipality Integrated Development Plan

The vision for the WCDM as set out in the WCDM Integrated Development Plan (IDP) (2017-2021) is "a quality destination of choice through an open opportunity to society". The Mission is "to ensure outstanding service delivery on the West Coast by pursuing the following objectives".

The IDP lists a number of Strategic Objectives that are relevant to the proposed development. These include:

- Ensuring environmental integrity for the West Coast;
- Pursuing economic growth and facilitation of jobs opportunities;
- Promoting social wellbeing of the community.

Strategic Objective 1: Ensuring Environmental Integrity for the West Coast
The IDP notes that the environmental integrity of the larger West Coast District is largely transformed from a natural environment to commercial farming practises. However, despite this the area is located within an area that has a high biodiversity value. The IDP also notes the potential risks posed by climate change and the need to develop and implement a climate change strategy.

Strategic Objective 2: Pursuing economic growth and the facilitation of job opportunities

The IDP highlights the importance to developing private public partnerships to support and facilitate economic development in the WCDM. Tourism is listed as a key development sector for regional and local economic development.

Strategic Objective 3: Promoting social wellbeing of the community
The section lists the key economic and social challenges and opportunities facing the area. The challenges that are relevant to the proposed development include:

- Unemployment and dependency on government grants;
- Limited employment opportunities for the youth;
- Social impact of in-migration due to current and future industrial development;

The opportunities include:

- District tourism industry and its contribution to economic development and alleviation of poverty;
- The promotion of the West Coast as a renewable energy investment destination.

The IDP includes a Climate Change Strategy. In this regard the IDP notes that the West Coast area will become a very dry area with less rainfall and less water. Of relevance to the proposed WF, the IDP Notes that the approach to addressing the challenges includes reducing greenhouse gas emissions from energy by switching to renewable energy.

2.4.2 West Coast District Municipality Spatial Development Framework

The vision of the West Coast District IDP (2012-2016) is to provide "A quality destination of choice through an open opportunity society". The spatial vision contained in WCSDF (2014) is "to Promote Sustainable Development, prioritise development in highest growth potential areas, encourage and facilitate development along the key corridors within the West Coast District".

The SDF lists three goals that underpin the West Coast District Spatial Strategy and Vision, namely:

- Goal 1: Enhance the capacity and quality of infrastructure in the areas with the highest economic growth potential, while ensuring continued provision of sustainable basic services to all residents in the District;
- Goal 2: To facilitate and create an enabling environment for employment, economic growth and tourism development, while promoting access to public amenities such as education and health facilities;
- Goal 3: Enhance and protect the key biodiversity and agricultural assets in the district and plan to minimise the human footprint on nature, while also mitigating the potential impact of nature (climate change) on the residents of the district.

The above-mentioned Goals 1, 2 and 3 are focused on the three themes identified in the Provincial Spatial Plan (2012) respectively, namely: built environment, socio-economic development and biophysical environment.

The SDF notes that the strategic locality of the WCDM within the Western Cape Province has a number of spatial planning related implications that are of relevance to the proposed development, namely:

- Existing spatial planning and policies, on a national and provincial level, identified the development potential of the West Coast District and such policies and strategies should guide planning decisions;
- The strategic location of the Saldanha Bay harbour in the district and its potential to be a key catalyst for development and economic growth in the district;
- The study area includes sensitive biodiversity areas that require conservation and responsible planning.

The SDF lists three spatial planning themes, namely:

- Theme 1: The built environment;
- Theme 2: Socio-economic environment;
- Theme 3: Biophysical environment.

Themes 2 and 3 are of specific relevance to the proposed development.

Theme 2: Socio-economic environment
The overarching goal of theme two is to facilitate and create an enabling environment for employment, economic growth and tourism development, while promoting access to public amenities such as education and health facilities.

Manufacturing and agriculture showed contraction during the economic slowdown (recession) period and are two 2 key sectors requiring revitalisation to ensure sustainable employment opportunities and economic growth in the study area. In terms of employment, agriculture was the key employment generating sector, contributing to almost 25% of employment in the West Coast District. This highlights the key role and importance of the agricultural sector.

The following policies contained in the SDF are relevant:

- *HR1* Promote infrastructure development in locations with medium, high and very high economic growth potential;
- *HR2* Invest in key economic sectors to facilitate development and employment opportunities.

A sectoral analysis and assessment of the West Coast District Economy identified the key sectors for future growth. Of relevance to the study, renewable energy is identified as a key sector. The SDF notes that "wind and solar projects can become a key sector in the study area" and that the manufacture and distribution of renewable energy components, such as wind turbines, can further promote this sector. With regard to manufacturing, although the sector has contracted since 2008 there is potential to grow, especially in the context of the Saldanha Bay IDZ, which will enhance industrial development in the area and will create more employment opportunities.

With specific reference to renewable energy the SDF states that the wind resources in the West Coast District are substantial and comparably high in relation to the rest of the country. Figure 2.2 illustrates the location of renewable energy projects in the WCDM. The Rheboksfontein WEF is indicated as number 13 on the map. The other key sectors listed that are of relevance to the study are agriculture and tourism. The SDF notes that the WCDM has a number of established agricultural production areas, such as the Swartland, Sandveld, Olifantsriver Valley citrus and wine district and the rooibos tea production area. Although reliant on natural and weather conditions, this sector has the potential to contribute more substantially to the economy, through higher productivity, advanced and environmentally sensitive methods, etc.

Tourism is also identified as a key economic sector. The strength of the tourism sector is linked to its proximity to the City of Cape Town. The area is therefore easily accessible as a breakaway destination over weekends. Of relevance to the study the area's tourism attractions are linked to natural features, scenic qualities and coastal villages.

The following policies contained in the SDF are relevant:

- *HR3* District tourism assets should be promoted and strengthened;
- *HR4* Key tourism corridors/routes should be promoted.

Theme 3: Bio-physical environment

The overarching goal outlined in the SDF is to promote conservation of Critical Biodiversity Areas by strategically implementing sustainable agricultural activities and urban development where the impact on biodiversity will be the lowest, while also mitigating the potential impact of nature (climate change) on the residents of the district.

The SDF notes that the WCDM is located within in an area that contains a wide range of conservation worthy areas, species of fauna and flora and key biodiversity areas and ecosystems. It is therefore important to ensure that these natural assets be recognised and addressed when spatial planning is considered. The key challenges identified include loss and degrading of sensitive biodiversity areas and conflict between conservation, agriculture and development needs.

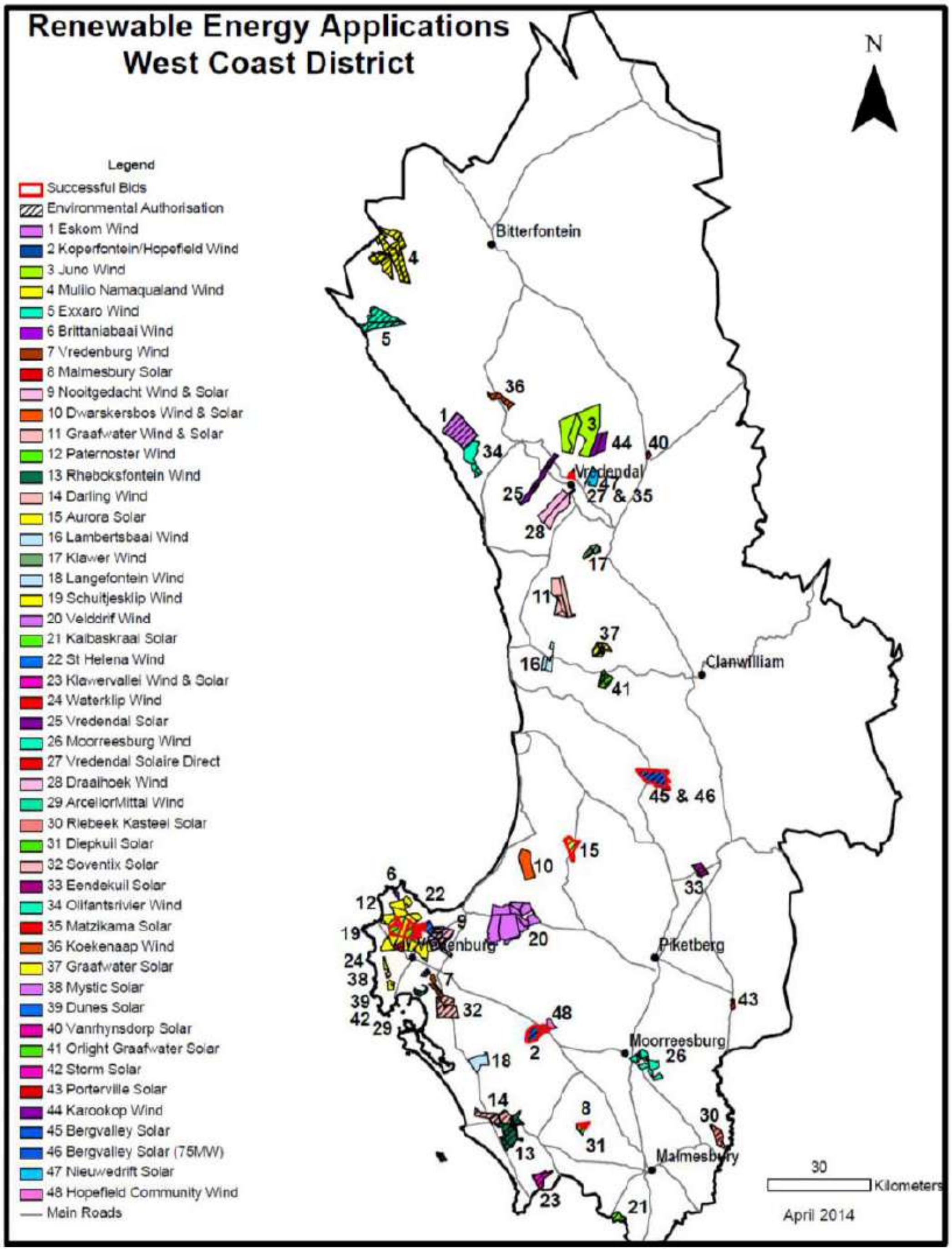

Figure 2.2: Location of potential renewable energy applications in the West Coast District Municipality Area (2014)

The SDF also highlights the potential risks posed by climate change. In this regard the Western Cape and South Africa as a whole, has been identified as potentially relatively sensitive to the impacts of climate change. The risks include increased mean annual temperatures and extended dry periods between rainfall events. Of specific relevance to the proposed development eight mitigation focus areas, including Renewable Energy, are identified to address the challenges associated with climate change. The establishment of renewable energy in the WCDM in suitable locations is therefore supported.

The proposed development of renewable energy facilities is also aligned with and supports a number of provincial and district strategic objectives. These include the creation of opportunities for growth and jobs and reduce poverty, and mainstreaming sustainability and optimising resource-use efficiency.

The following policies contained in the SDF are relevant:

- *HR1* Support and promote sustainable economic development;
- *HR2* Invest in key economic sectors for development and employment Opportunities;
- *BE16* Renewable energy sources (wind, solar, etc.) should be established to support and enhance the electricity capacity in the West Coast District.

However, the proposed development of renewable energy facilities must also take into account other key objectives, specifically those relating to tourism

- *HR3* District tourism assets should be promoted and strengthened;
- *HR4* Key tourism corridors/routes should be promoted;
- *BP9* Low density, low impact tourism development could be considered in rural areas, subject to proper assessment in terms of environmental impact, heritage and visual impact.

In this regard the SDF notes:

- *HR 27*: Wind farms should be located where they will cause the least visual impact taking into consideration the viability of the project;
- *BE 17:* Wind farms and solar farms should be located where their visual and environmental impact will be the lowest.

In terms of biodiversity the SDF makes reference to two biosphere initiatives, namely the Cape West Coast Biosphere Reserve (CWCBR) and the Greater Cederberg Biodiversity Corridor (GCBC). The Cape West Coast Biosphere Reserve (CWCBR) is an initiative by Cape Nature, established in 2000 in association with the CWCBR to facilitate sustainable development along the West Coast, through stewardship contracts/agreements with private land owners. The CWCBR stretches from Diepriver in the Cape Metropolitan Area northwards along the coastline and coastal plain towards the Bergriver north of Saldanha and Vredenburg. As indicated below, the SLM SDF indicates that the Rheboksfontein WEF is located outside the coastal plain.

2.4.3 Swartland Integrated Development Plan

The vision set out in the IDP is "Hope and a dignified life for all people". The mission statement linked to the vision is "We shape a better future by dealing accountably and sustainably with all people and the environment". The IDP sets out the five-year planning programme for the SLM. The majority of the municipal area consists of farmlands, natural areas and coastal areas. The towns and settlements in the area are Malmesbury, Moorreesburg, Darling, Yzerfontein, Riebeek West, Riebeek Kasteel, Koringberg, Ruststasie, Ongegund, Riverlands, Chatsworth, Kalbaskraal and Abbotsdale. The municipal area is divided into 12 Wards. The Rheboksfontein WEF is located in Ward 5.

The IDP identifies five strategic goals, namely:

- People - Improved quality of life for citizens;
- Economy - Inclusive economic growth;
- Environment - Quality and sustainable living environment;
- Institutions - Caring, competent and responsive institutions, organisations and business;
- Services - Sufficient, affordable and well-run services

Economy and Environment are the most relevant goals to the project.
The IDP also refers to the SDF (2017), and notes that liveable environments are linked to a number of requirements of which the following are relevant to the project:

- *Econ*omic *growth (economic) – creation of economic, social, cultural and recreational opportunities;*
- *Place Identity (natural and built) – create urban environments with unique place identity that reflect the natural and cultural context that become part of people's perception of the place; access to open space areas of high quality, scale vs. locality are used to arrange elements to create a place identity;*
- *Ecological integrity (Planet) – the continued ability of the natural and built environment to provide in, and continue to provide in all the earthly needs;*
- *Economical* Effectiveness (Prosperity) – optimising benefits through reduced costs, which include social costs.

The IDP also identifies climate change as a key risk. The IDP notes that climate change causes changes to precipitation, seasons, micro-climates and habitat stability and it is projected that the changes will impact negatively on the region and thus on the economy, natural resources and social sectors in the Swartland.

In terms of the SDF, the site is located outside the coastal corridor as identified in the Opportunities and Constraints Map. The site is also not located in any Core Conservation and or Buffer Areas (Figure 2.3). The Composite Spatial Plan for the SLM also indicates that the site is located in an Alternative Energy Zone, namely the Darling – Yzerfontein Wind Zone (Zone A). This zone has medium to high winds and is identified as having potential for wind turbines (Figure 2.4).

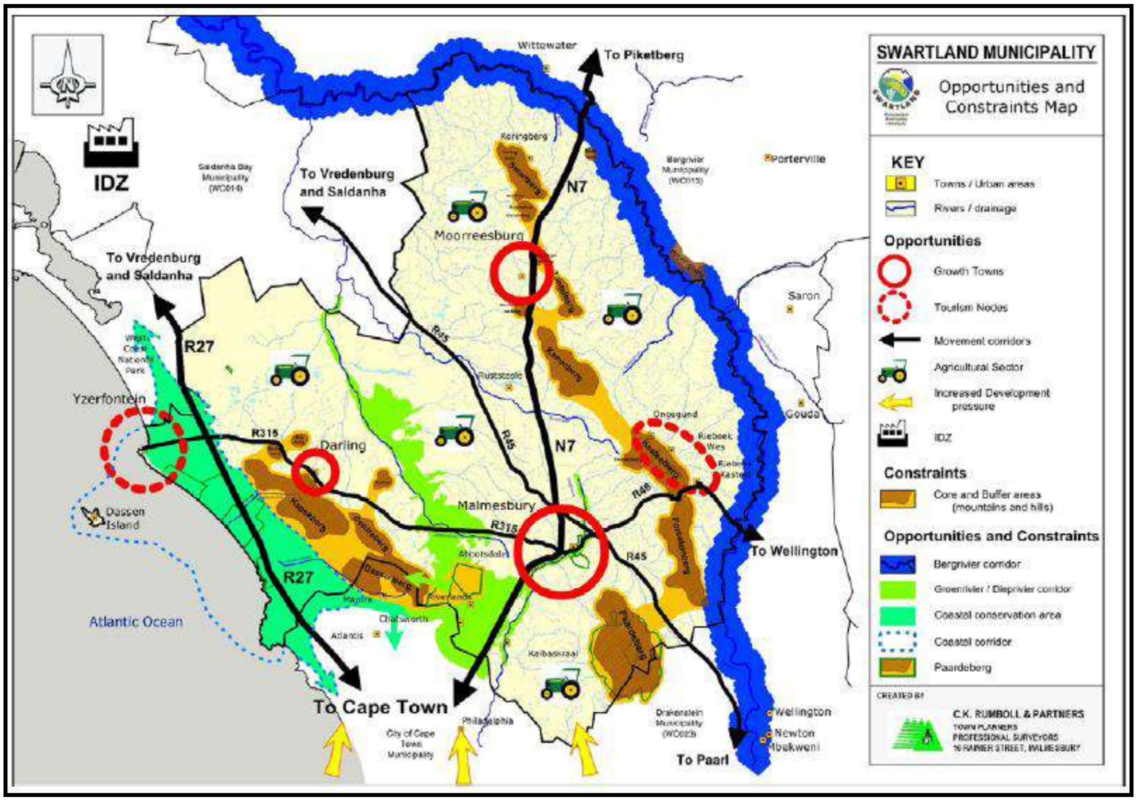

Figure 2.3: Swartland Opportunities and Constraints Map

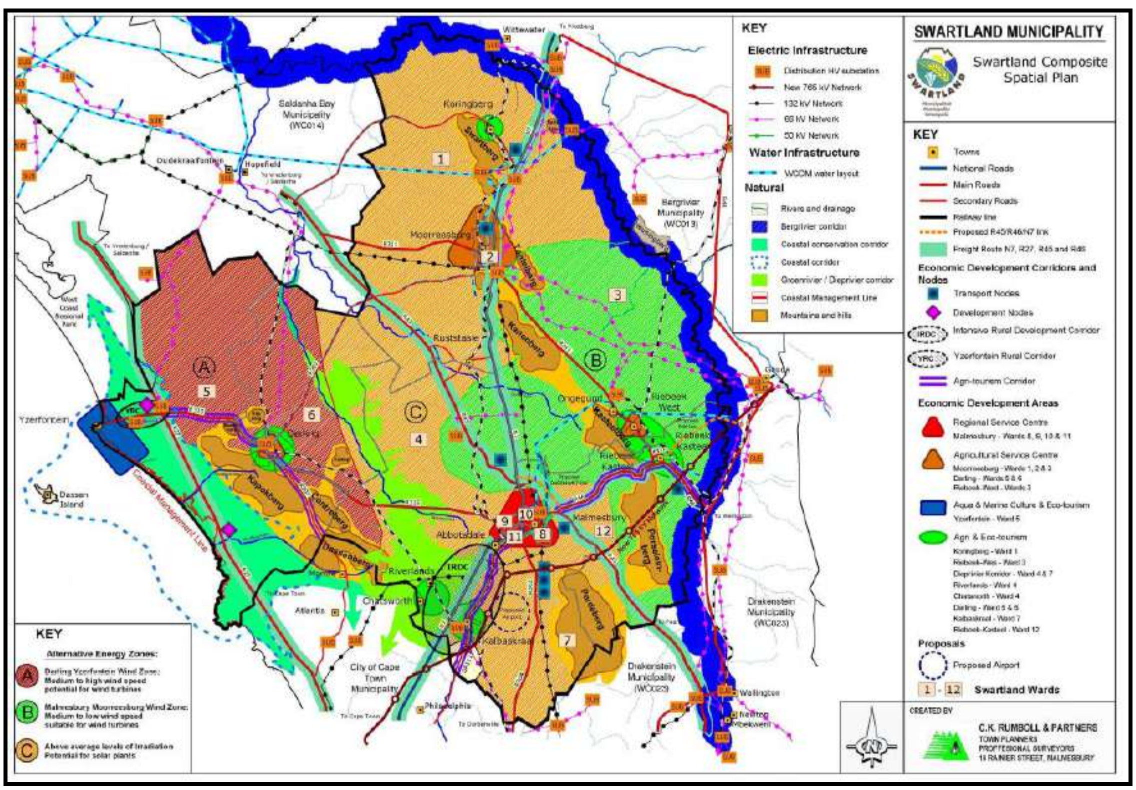

Figure 2.4: Swartland Composite Spatial Plan

As part of the IDP process area plans were developed. These plans were informed by detailed public participation processes, including workshops with Ward Committees. Areas plans were compiled for Swartland North (Moorreesburg and Koringberg), Swartland East (Riebeek West and Riebeek Kasteel), Swartland West (Darling and Yzerfontein), Swartland South (Abbotsdale, Chatsworth, Riverlands and Kalbaskraal) and Swartland Central (Malmesbury). The area plan for Swartland West (Darling and Yzerfontein) identifies renewable energy a key opportunity. The promotion of renewable energy is also identified for Ward 5 as part of supporting Goal 3, Environment.

2.4.4 Swartland Municipal SDF

The SDF (2017) is informed by a number of key policies including the Western Cape Critical Biodiversity Framework and Spatial Bioregional Planning Categories. The Western Cape Critical Biodiversity Framework (WCBF) (2010) is aimed at integrating key biodiversity information relevant to land-use planning such as Protected Areas, Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). The Bioregional Spatial Planning Categories (SPCs) are consistent with the principles of bioregional planning and UNESCO's MaB (Man and the Biosphere) Programme have their origins in the Bioregional Planning Framework for the Western Cape. The implementation of the categories is to support conservation and integration of natural areas, e.g. nature reserves can be integrated with areas where natural vegetation occur, such as agricultural areas and mountains.

All urban and rural areas within the Swartland were categorised using the SPCs, inlclding Core Conservation Areas, Buffer Areas, Agriculture, and Settlement Areas. The SPCs that are relevant to the study area are Buffer and Agriculture Areas. Buffer areas comprise of large intact portions and remnants of natural or near natural vegetation not defined as Critical Biodiversity Areas and Ecological Support Areas. There are two types of buffer areas. Buffer 1 areas contain endangered areas of biodiversity which do not justify designation as Core Areas and where limited extensive agriculture is permitted. Buffer 2 areas contain vulnerable and least threatened biodiversity areas where extensive agricultural uses are allowed. The SDF notes that the land uses identified in these areas include renewable energy projects.

A SWOT analysis of the biophysical, social and economic and built environments was undertaken as part of preparing the SDF. The strengths and opportunities identified include tourist nodes, including Yzerfontein and Darling, the natural coastal belt along the West Coast and the areas proximity to Cape Town. The threats and weaknesses include climate change, poverty and unemployment. Based on the SWOT analysis the Swartland has a strong economic corridor running North South (N7), and vibrant and growing tourism corridor running East West (R45 & R315 from the Riebeek Valley to Yzerfontein) with an agricultural and natural landscape to protect, which all pivots around Malmesbury, the heart of the Swartland.

The spatial vision emerging from the SWOT analysis of the biophysical, socio-economic and built environment (Status Quo) and the conceptual proposal is "An economically prosperous and sustainable liveable environment for all Swartland residents." To attain this vision, the overall goal or mission is to "Balance development and conservation through the strengthening and expansion of existing assets in the region". Figure 2.5 illustrates the spatial vision for the SLM as set out in the SDF.

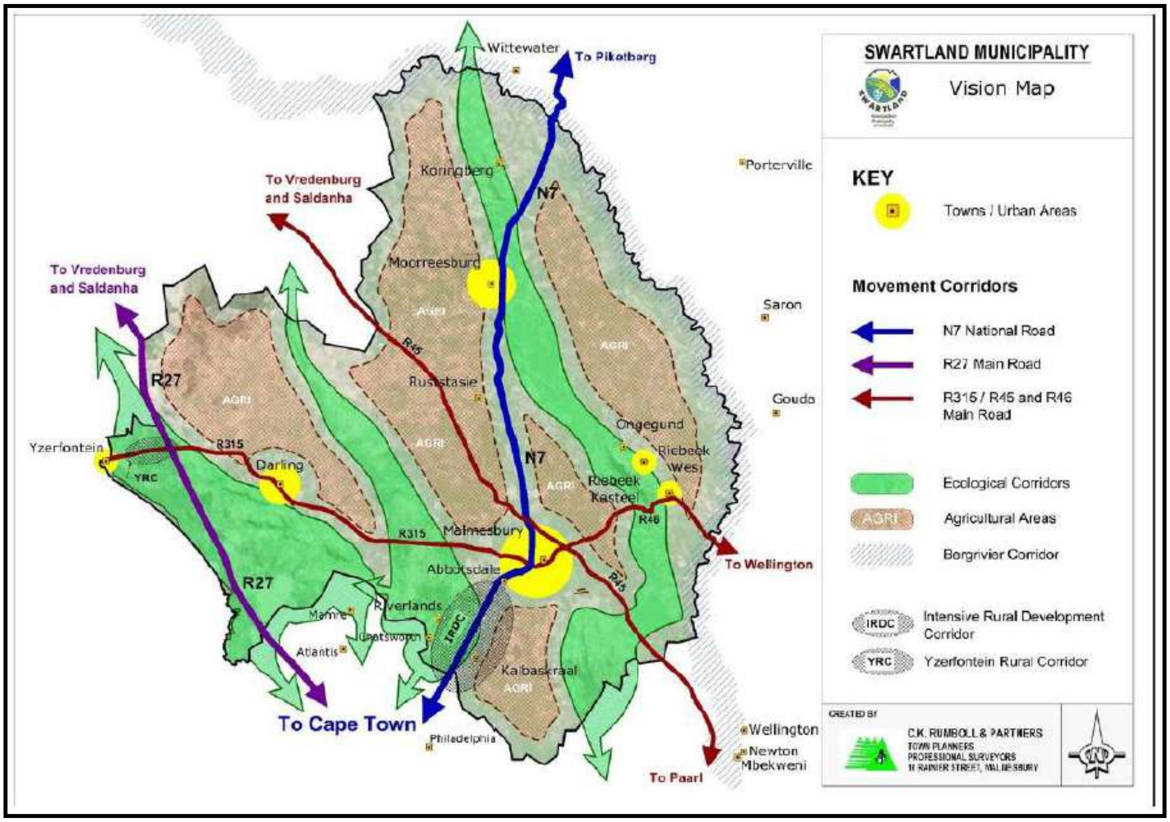

Figure 2.5: Swartland Vision Plan

The SDF also lists the spatial objectives for the SLM. These include:

- Grow economic prosperity by creating economic, social, cultural and recreational opportunities and Maximise competitive advantages and facilitate economic sector growth (including mining, agriculture, tourism, commercial and industry).
- Provide convenient and equal access to work/education facilities/housing and recreational facilities and services;
- Sustain material, physical and social well-being by creating employment opportunities to support sustainable livelihoods.
- Protect and grow place identity and cultural integrity by ensuring access to open space areas of high quality and protecting and promoting cultural and heritage resources.
- Protect ecological and agricultural integrity by recognising the natural assets within the Swartland and the role they play in the local ecosystem and economy of the region.

The SDF assess each ward in terms of the SDFs spatial objectives. The key aspects for Ward 5 are summarised below.

Objective 1: Grow economic prosperity and facilitate economic sector growth Develop an intensive rural use corridor along R315 from the R315/ R27 intersection and the town of Yzerfontein and promote node development at the intersection between the R 27 and R 315.

Objective 2: Proximate convenient and equal access
Safeguard the intersection between the R27 and the R315 by making it more visible. A tourism node could provide visible supporting services. Support the use of !Khwa ttu education centre as a social service centre for surrounding residents with the potential to use it as a facility for adult education.

Objective 3: Sustain material, physical and social wellbeing
Enhance Darling Wind Farm[17]

Objective 4: Protect and grow place identity and cultural integrity
Develop Yzerfontein as tourism node and historical coastal town. Promote the different cultural historical features of the West Coast which include !Khwa ttu San Cultural Centre and conserve and maintain kilns outside Yzerfontein.

In terms of supporting rural development, the SDF indicates that the development of alternative energy, including wind and solar, should be supported and the potential business opportunities associated with energy should be investigated.

The need to protect the Swartland's Sense of Place is identified as a key objective of the SDF. In this regard the natural environment forms the basis of various activities that include tourism, conservation, recreation and agriculture. Consideration needs to be given to - cultural landscapes, heritage areas and sites, form giving elements of scenic rural landscapes, and the relationship between the natural and cultural environment. Of relevance to the Darling WEF, development in the rural and natural areas need to:

- Exploit (develop) economic opportunities in a sustainable manner;
- Protect the sensitive natural environment and agricultural resources from inappropriate and opportunistic development;
- Create (change to) sustainable rural livelihoods.

In terms of protecting the sensitive natural environment and agricultural resources the aim of the SLM is to ensure sustainable development of its rural areas, conservation of its biological diversity to retain its environmental integrity, functionality of ecosystems and safeguarding of the rural heritage, cultural and visual aesthetics.

Under the heading, utilities, the SDF notes that utilities should be located so as to minimise the impact of bulk infrastructure, such as pylons, transmission lines and cell phone towers, on the rural landscape. However, the SDF does notes that the generation and use of alternative/renewable energy should be supported as per the energy zones identified. As indicated above, the Darling WEF is located in an Alternative Energy Zone, namely the Darling – Yzerfontein Wind Zone (Zone A).

2.5 OVERVIEW OF RENEWABLE ENERGY SECTOR IN SOUTH AFRICA

The section below provides an overview of the potential benefits associated with the renewable energy sector in South Africa. Given that South Africa supports the development of renewable energy at national level, the intention is not to provide a critical review of renewable energy. The focus is therefore on the contribution of renewable energy, specifically in terms of supporting economic development.

[17] This would in theory also apply to other renewable energy projects in Ward 5.

The following documents were reviewed:

- Independent Power Producers Procurement Programme (IPPPP): An Overview (March 2019), Department of Energy, National Treasury and DBSA;
- Green Jobs Study (2011), IDC, DBSA Ltd and TIPS;
- Powering the Future: Renewable Energy Roll-out in South Africa (2013), Greenpeace South Africa;
- WWF SA, Renewable Energy Vision 2030, South Africa, 2014
- Jacqueline M. Borel-Saladin, Ivan N. Turok, (2013). The impact of the green economy on jobs in South Africa,), South African Journal of Science, *Volume 109 |Number 9/10, September/October 2013;*
- The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town
- Market Intelligence Report: Renewable Energy (2014). Mike Mulcahy, Greencape.

2.5.1 Independent Power Producers Procurement Programme (IPPPP): An Overview

The document presents an overview of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) undertaken by the Department of Energy, National Treasury and the Development Bank of South Africa in March 2019. By the end of March 2019, the REIPPPP had made the following significant impacts:

Energy supply

By the end of March 2019, the REIPPPP had made the following significant impacts.

- 6 422MW of electricity had been procured from 112 RE Independent Power Producers (IPPs) in seven bid rounds;
- 976 MW of electricity generation capacity from 64 IPP projects has been connected to the national grid;
- 35669GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational.

In terms of renewable energy 6 422 MW of electricity had been procured from 112 RE Independent Power Producers (IPPs) in seven bid rounds to date. Of this 3 976 MW of electricity generation capacity from 64 IPP projects has been connected to the national grid. To date 35 669 GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational. Renewable energy IPPs have proved to be very reliable. Of the 64 projects that have reached COD, 62 projects have been operational for longer than a year. The energy generated over the past 12-month period for these 62 projects is 10648GWh, which is 96% of their annual energy contribution projections (P50) of 11146GWh over a 12-month delivery period. Twenty eight (28) of the 62 projects (45%) have individually exceeded their P50 projections.

Energy costs

Through the competitive bidding process, the IPPPP effectively leveraged rapid, global technology developments and price trends, buying clean energy at lower and lower rates with every bid cycle, resulting in SA getting the benefit of renewable energy at some of the lowest tariffs in the world. The estimated, average portfolio cost for all technologies under the REIPPPP has dropped consistently in every bid period to a combined average of R0.92/kWh in BW4. Indications are that prices will continue to decrease in future rounds. This compares with the industry estimates in April 2018 of R1.05/kWh for Medupi and R1.16/kWh for Kusile, i.e. R1.41/kWh and R1.60/kWh.

Investment

The document notes that the REIPPPP has attracted significant investment in the development of the REIPPs into the country. The total investment (total project costs[18]), including interest during construction, of projects under construction and projects in the process of closure is R209.7 billion (this includes total debt and equity of R209.2 billion, as well as early revenue and VAT facility of R0.5 billion).

The REIPPPP has attracted R41.8 billion in foreign investment and financing in the seven bid windows (BW1 – BW4, 1S2 and 2S2). This is almost double the inward FDI attracted into South Africa during 2015 (R22.6 billion). The document notes that the share of foreign investment and equity showed an increase in the most recent bid window (2S2), suggesting that the REIPPPP continued to generate investor confidence despite the poor economic conditions in South Africa in recent years.

South African citizen shareholding

The importance of retaining local shareholding in IPPs is key condition of the procurement requirements. The RFP notes that bidders are required to have South African Equity Participation of 40% in order to be evaluated. In terms of local equity shareholding, 52% (R31.5 billion) of the total equity shareholding (R61.0 billion) was held by South African's across BW1 to BW4, 1S2 and 2S2. This equates to substantially more than the 40% requirement. Foreign equity amounts to R29.5 billion and contributes 48% of total equity.

The REIPPPP also contributes to Broad Based Black Economic Empowerment and the creation of black industrialists. In this regard Black South Africans own, on average, 33% of projects that have reached financial close (BW1-Bw4), which is slightly above the 30% target. This includes black people in local communities that have ownership in the IPP projects that operate in or near their communities.

On average, black local communities own 9% of projects that have reached financial close. This is well above the 5% target. In addition, an average of 19% shareholding by black people in engineering, procurement and construction (EPC) contractors has been attained for the 64 projects in operation (BW1, BW2 and BW3). This is slightly below the 20% target. The target for shareholding by black people in top management has been set at 40%, with an average 65% achieved to date. The target has therefore been significantly exceeded.

Community shareholding and community trusts

The regulations require a minimum ownership of 2.5% by local communities in IPP projects as a procurement condition. This is to ensure that a substantial portion of the investments has been structured and secured as local community equity. An individual community's dividends earned will depend on the terms of each transaction corresponding with the relevant equity share. To date all shareholding for local communities have been structured through the establishment of community trusts. For projects in BW1 to BW4, 1S2 and 2S2, qualifying communities will receive R26.9 billion net income over the life of the projects (20 years). The report notes

[18] Total project costs means the total capital expenditure to be incurred up to the commercial operations date in the design, construction, development, installation, and or commissioning of the project)

that the bulk of the money will however only start flowing into the communities from 2028 due to repayment obligations in the preceding years (repayment obligations are mostly to development funding institutions). However, despite the delay this represents a significant injection of capital into mainly rural areas of South Africa.

Income to all shareholders only commences with operation of the facility. Revenue generated to date by the 64 operational IPPs amounts to R74.4 billion.

Procurement spend
In addition to the financial investments into the economy and favourable equity structures aimed at supporting BEE, the REIPPPP also targets broader economic and socio-economic investment. This is through procurement spend and local content.

The total projected procurement spend for BW1 to BW4, 1S2 and 2S2 during the construction phase was R73.1 billion, while the projected operations procurement spend over the 20 years operational life is estimated at 76.8 billion. The combined (construction and operations) procurement value is projected as R149.9 billion of which R63.1 billion has been spent to date. For construction, of the R55.7 billion already spent to date, R51.1 billion is from the 64 projects which have already been completed. These 64 projects had planned to spend R50.4 billion. The actual procurement construction costs have therefore exceeded the planned costs by 1% for completed projects.

Preferential procurement
The share of procurement that is sourced from Broad Based Black Economic Empowered (BBBEE) suppliers, Qualifying Small Enterprises (QSE), Exempted Micro Enterprises (EME) and women owned vendors are tracked against commitments and targeted percentages. The IA target requirement for BBBEE is 60% of total procurement spend. However, the actual share of procurement spend by IPPs from BBBEE suppliers for construction and operations combined is currently reported as 86%, which is significantly higher than the target of 60%, but also the 71% that had been committed by IPPs. BBBEE, as a share of procurement spend for projects in construction, is also reported as 87% with operations slightly lower at 73%. However, these figures have not been verified and the report notes that they are reported with caution.

The majority of the procurement spend to date has been for construction purposes. Of the R55.7 billion spent on procurement during construction, R48.5 billion has reportedly been procured from BBBEE suppliers, achieving 87% of total procured. Actual BBBEE spend during construction for BW1 and BW2 alone was R25.5 billion, 81% more than the 14.1 billion planned by the IPPs..

Total procurement spend by IPPs from QSE and EMEs has amounted to R19.8 billion (construction and operations) to date, which exceeds commitments by 58% and is 31% of total procurement spend to date (while the required target is 10%). QSE and EME’s procurement spend for construction is achieving 32% of total procurement to date and operations is less at 23%, however this is still well above the 10% target. QSE and EME share of construction procurement spend totals R18.1 billion, which is 3.7 times the targeted spend for construction of R4.9 billion during this procurement phase. However, procurement from women owned vendors is lagging, with only 3% of construction and 6% for operations achieved to date against a target of 5%.

Nonetheless, the fact that the REIPPPP has raised employment opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

Local Content[19]

The report notes that the REIPPP programme represents the country's most comprehensive strategy to date in achieving the transition to a greener economy. Local content minimum thresholds and targets were set higher for each subsequent bid window. The report notes that for a programme of this magnitude, with construction procurement spend alone estimated at R73.1 billion, the result is a substantial stimulus for establishing local manufacturing capacity. The local content strategy has created the required incentives for a number of international technology and component manufactures to establish local manufacturing facilities.

Actual local content spend reported for IPPs that have started construction amounts to R46.5 billion against a corresponding project value (as realised to date) of R90.3 billion. This means 52% of the project value has been locally procured, exceeding the 45% commitment from IPPs and the thresholds for BW1 – BW4 (255-45%).

For the 64 projects that have reached COD, local content spend has been R 43.1 billion of a committed R43.3 billion, which is 0.4% below the planned local spend.

Leveraging employment opportunities

To date, a total of 40 134 job years[20] have been created for South African citizens, of which 33 019 job years were in construction and 7 115 in operations. These job years should rise further past the planned target as more projects enter the construction phase. Employment opportunities across all five active bid windows are 101% of the planned number during the construction phase (i.e. 32 602 job years), with 26 projects still in construction and employing people as of March 2019. The number of employment opportunities is therefore likely to continue to grow beyond the original expectations. By the end of March 2019, 64 projects had successfully completed construction and moved into operation. These projects created 31 633 job years of employment, compared to the anticipated 20 689. This was 53% more than planned.

The report notes that employment thresholds and targets were consistently exceeded across the entire portfolio. The average share of South African citizens of total South Africa based employees for BW1 – BW4 was 89% during construction (against a target of 80%), while it was 95% during operations for BW1 – BW3 (against a target of 80%). The report notes that the construction phase offers a high number of opportunities over shorter durations, while the operations phase requires fewer people, but over an extended operating period.

In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. The expectation for local community participation was 13 058 job years. To date 18 253 job years have been realised (i.e. 140% more than initially planned), with 26 projects still in construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 22%.

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[19] Local content is expressed as a % of the total project value and not procurement or total project costs.

[20] The equivalent of a full time employment opportunity for one person for one year

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 79%, 41% and 49% of total job opportunities created by IPPs to date. However, woman and disabled people could still be significantly empowered as they represent a mere 8% and 0.5% of total jobs created to date, respectively. Nonetheless, the fact that the REIPPPP has raised employment opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

The share of black citizens employed during construction (79%) and the early stages of operations (83%) has significantly exceeded the 50% target and the 30% minimum threshold. Likewise, the share of skilled black citizens (as a percentage of skilled employees) for both construction (67%) and operations (79%) has also exceeded the 30% target and is at least 3.5 times more than the minimum threshold of 18%. The share of local community members as a share of SA-based employees was 49% and 67% for construction and operations respectively – exceeding the minimum threshold of 12% and the target of 20%.

Socio-economic development (SED) contributions
An important focus of the REIPPPP is to ensure that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. In this regard IPPs are required to contribute a percentage of projected revenues accrued over the 20-year project operational life toward SED initiatives. These contributions accrue over the 20-year project operation life and are used to invest in housing and infrastructure as well as healthcare, education and skills development.

The minimum compliance threshold for SED contributions is 1% of the revenue with 1.5% the targeted level over the 20-year project operational life. For the current portfolio of projects the average commitment level is 2.2%, which is 125% higher than the minimum threshold level. To date (across seven bid windows) a total contribution of R23.1 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.153 billion. Of the total commitment, R18.8 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

To date, with the limited number of operational IPPs (64), the SED contribution amounts to R 860.1 million. The majority of the spend has been on education and skills development (40.9%), followed by enterprise development (24.2%), social welfare (21.3%), general administration (9%) and health care (4.5%). In terms of education, the IPPs have supported 1 044 education institutions, with a total spend of R 236.7 million between 2015 and March 2018. It is estimated that these contributions have benefitted in the region of 375 737 learners.

The province with the highest SED contribution has been the Northern Cape Province, followed by the Eastern Cape and Western Cape. However, the report does note that SED contributions are concentrated in the communities in the immediate vicinity of the IPPs. As such there is a lack of equity considerations across geographical areas, i.e. some communities benefit more than others.

Enterprise development contributions

The target for IPPs to spend on enterprise development is 0.6% of revenues over the 20- year project operational life. However, for the current portfolio, IPPs have committed an average of 0.63% or 0.03% more than the target. Enterprise development contributions committed for BW1 to BW4, 1S2 and 2S2 amount to R7.2 billion. Assuming an equal distribution of revenue over the 20-year project operational life, enterprise development contributions would be R360 million per annum. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of March 2019 a total of R 254.3 million had already been made to the local communities located in the vicinity of the 64 operating IPPs.

Contribution to cleaner energy and water savings

The National Climate Change Response White Paper outlines the national response to the impacts of climate change, as well as the domestic contribution to international efforts to mitigate green-house gas emissions. As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The emission reductions between March 2018 and 2019 are estimated to be 10.9 million tonnes of CO2. This represents 53% of the total projected annual emission reductions achieved with only partial operation to date. Since operation, the IPPs have generated 35 699 GWh, resulting in 36.2 Mton of CO2 emissions being offset and saving 42.8 million kilolitres of water related to fossil fuel power generation.

The REIPPPP therefore contributes significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability and environmental sustainability.

2.5.2 Green Jobs Study

The study notes that South Africa has one of the most carbon-intensive economies in the world, therefore making the greening of the electricity mix a national imperative. Within this context the study notes that the green economy could be an extremely important trigger and lever for enhancing a country's growth potential and redirecting its development trajectory in the 21st century. The attractiveness of wind and solar technologies is not only supported by local conditions, but also by the relatively mature stage of their technological development.

The aim of the Green Jobs study was to provide information on the net direct job creation anticipated to emerge in the formal economy across a wide range of technologies/activities that may be classified as green or contributing to the greening of the economy. The study looked at the employment potential for a number of green sectors, including power generation, over three consecutive timeframes, namely, the short term (2011 – 12), medium term (2013 – 17) and long term (2018 – 25). The analysis attempts to estimate the employment potential associated with: building, construction and installation activities; operations and maintenance services; as well as the possible localisation spin-offs for the manufacturing sector as the domestic production of equipment, parts and components benefits from preferential local procurement.

It is also worth noting that the study only considered direct jobs in the formal economy. Multiplier effects were not taken into account. As a result the analysis only captures a portion of the potential employment impact of a greening economy. International studies have indicated that there are considerable backward and forward linkages through various value chains of production, as well as of indirect and induced employment effects. The employment figures can therefore be regarded as conservative.

The analysis reveals the potential of an unfolding green economy to lead to the creation of approximately 98 000 new direct jobs, on average, in the short term, almost 255 000 in the medium term and around 462 000 employment opportunities in the formal economy in the long term. The number of jobs linked to the power generation was estimated to be ~ 12 500 in the short term, 57 500 in the medium term and 130 000 in the long term. Power generation jobs therefore account for 28% of the employment opportunities created in the long term. However, the report notes that the contribution made by a progressively expanding green energy generation segment increases from 14% of the total in the short term, or just over 13 500 jobs, to more than 28% in the long term (166 400) (Table 2.1). The study also found that energy generation is expected to become an increasingly important contributor to green job creation over time, as projects are constructed or commissioned. The international wind power industry employed almost half a million workers worldwide in 2009 – a figure that is expected to grow to over a million in five years from now, according to forecasts by the Global Wind Energy Council.

Table 2.1: Net direct employment potential estimated for the four broad types of activity and their respective segments in the long term, and an indication of the roll-out over the three timeframes

Broad green economy category		Segment	Technology/product	Total net direct employment potential in the long-term	Net direct manufacturing employment potential in the long-term	Total net direct employment potential (ST, MT, LT)	Net direct manufacturing employment potential (ST, MT, LT)
ENERGY GENERATION	Renewable (non-fuel) electricity	Wind power	Onshore wind power Offshore wind power	5 156	2 105	VL, L, M	L, M, H
		Solar power	Concentrated solar power	3 014	608	N, VL, M	N, VL, M
			Photovoltaic power	13 541	8 463	M, H, H	H, VH, VH
		Marine power	Marine power	197	0	N, N, VL	N, N, N
		Hydro power	Large hydro power	272	111	VL, VL, VL	VL, M, VL
			Micro-/small-hydro power	100	0	VL, VL, VL	N, N, N
	Fuel-based renewable electricity	Waste-to-energy	Landfills	1 178	180	VL, VL, L	VL, VL, L
			Biomass combustion	37 270	154	VL, H, VH	VL, VL, L
			Anaerobic digestion	1 429	591	VL, VL, L	VL, L, M
			Pyrolysis/Gasification	4 348	2 663	VL, L, M	VL, H, H
			Co-generation	10 789	1 050	L, M, H	M, H, H
	Liquid fuel	Bio-fuels	Bio-ethanol Bio-diesel	52 729	6 641	M, H, VH	L, H, VH
ENERGY GENERATION SUB-TOTAL				**130 023**	**22 566**		
ENERGY & RESOURCE EFFICIENCY		Green buildings	Insulation, lighting, windows	7 340	838	L, M, M	L, M, M
			Solar water heaters	17 621	1 225	L, H, H	L, M, H
			Rain water harvesting	1 275	181	VL, VL, L	VL, VL, L
		Transportation	Bus Rapid Transport	41 641	350	VH, VH, VH	H, M, L
		Industrial	Energy efficient motors	-566	4	VL, VL, VL	VL, VL, VL
			Mechanical insulation	666	89	VL, VL, VL	VL, VL, VL
ENERGY & RESOURCE EFFICIENCY SUB-TOTAL				**67 977**	**2 686**		
EMMISIONS AND POLLUTION MITIGATION		Pollution control	Air pollution control	900	166	N, VL, VL	N, L, L
			Electrical vehicles	11 428	10 642	VL, L, H	N, H, VH
			Clean stoves	2 783	973	VL, VL, L	VL, L, M
			Acid mine water treatment	361	0	VL, VL, VL	N, N, N
		Carbon Capture and Storage		251	0	N, VL, VL	N, N, N
		Recycling		15 918	9 016	M, H, H	H, VH, VH
EMMISIONS AND POLLUTION MITIGATION SUB-TOTAL				**31 641**	**20 797**		
NATURAL RESOURCE MANAGEMENT		Biodiversity conservation & eco-system restoration		121 553	0	H, VH, VH	N, N, N
		Soil & land management		111 373	0	VH, VH, VH	N, N, N
NATURAL RESOURCE MANAGEMENT SUB-TOTAL				**232 926**	**0**		
TOTAL				**462 567**	**46 049**		

Notes:

- VH = very high (total employment potential > 20 000 direct jobs; manufacturing employment potential > 3 000 direct jobs);
- H = high (total employment potential > 8 000 but < 20 000; manufacturing employment potential > 1 000 but < 3 000);
- M = medium (total employment potential > 3 000 but < 8 000; manufacturing employment potential > 500 but < 1 000);
- L = low (total employment potential > 1 000 but < 3 000; manufacturing employment potential > 150 but < 500);
- VL = very low (total employment potential > 0 but < 1 000; manufacturing employment potential > 0 but < 150);
- N = negligible/none (total employment potential = 0; manufacturing employment potential = 0).

Of relevance the study also notes that the largest gains are likely to be associated with operations and maintenance (O&M) activities, particularly those involved in the various natural resource management initiatives. In this regard, operations and maintenance employment linked to renewable energy generation plants will also be substantial in the longer term. The employment growth momentum related to building, construction and installation activities peaks in the medium term, largely propelled by mass transportation infrastructure, stabilising thereafter as green building methods become progressively entrenched.

In addition, as projects related to a greening economy are progressively commissioned, the potential for local manufacturing also become increasingly viable. Employment gains in manufacturing are also expected to be relatively more stable than construction activities, since the sector should continue exhibiting growth potential as new and replacement components are produced, as additional markets are penetrated and as new green technologies are introduced. Manufacturing segments with high employment potential in the long term would include suppliers of components for wind farms. The study does note that a shortage of skills in certain professional fields pertinent to wind power generation presents a challenge that must be overcome.

The study also found that South Africa is in a position to leverage upon some of its existing manufacturing capacities in order to produce components and parts for various sections of wind turbines, especially those industries involved in the production of steel and metal products, as well as the boat building and electrical industries. Local manufacturing capacity can be promoted through engagement with established global manufacturers. The study does however note that critical mass would have to be developed in order to obtain economies of scale.

The study found that there was also significant potential for local involvement in the wind sector (Table 2.2). Local companies can also exploit market opportunities in other African countries with higher wind power potential. This would create additional opportunities for improving economies of scale and enhancing the local industry's chances to succeed.

Table 2.2: Potential contribution capacity of local industries

Industry	Product/services	Share in turbine cost[30]	Local capacity
Manufacturing:	**Production of**:		
Structural steel, cast iron, metal and cement products	Towers, frames, hubs	34%	High
Boat-, airplane-, glass fibre composites	Rotor blades, nacelle, other plastic and fibre glass products	26%	High
High-technology parts and machinery	Gearbox parts, shafts, bearings	18%	Low
Electrical and electronic equipment	Generators, transformers and other electrical components	15%	Medium
Metal products	Pitch, yaw and break systems, and other parts	7%	Medium
Construction and civil engineering	**Foundation laying, tower erection, housing**	-	High
Electricity distribution	**Grid connection**	-	High
Electricity generation	**Operations and maintenance**	-	High
Logistics	**Transportation of very large components**	-	Medium

The study also identifies a number of advantages associated with wind power as a source of renewable energy with a large 'technical' generation potential. In this regard wind energy does not emit carbon dioxide (CO_2) in generating electricity and is associated with exceptionally low lifecycle emissions. The construction period for a wind farm is much shorter than that of conventional power stations, while an income stream may in certain instances be provided to local communities through employment and land rental. The study also notes that the greenhouse gases (GHG) associated with the construction phase are offset within a very short period of time compared with the project's lifespan. Wind power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, wind as an energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

Of relevance, the study also notes that the case for wind power is enhanced by the positive effect on rural or regional development. Wind farms located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues. In Denmark, one of the world's most advanced countries with respect to wind power generation, a significant portion of wind turbines are owned by local communities. A major drawback for wind energy is that, due to the natural variation in wind power on a daily and/or seasonal basis, back-up base-load generation capacity is imperative to provide stability to the energy supply. Furthermore, as with other renewable energy sources, wind power has relied on incentive measures throughout the world for its development, although its relative competitiveness has been improving continuously.

2.5.3 Powering the Future: Renewable Energy Roll-out in South Africa

The study notes that South Africa has higher CO_2 emissions per GDPppp (2002 figures) from energy and cement production than China or the USA (Letete, T et al). Energy accounts for 83% of the total GHG emissions (excluding land use, land use change and forestry) with fuel combustion in the energy industry accounting for 65% of the energy emissions of South Africa (DEA, 2011).

Within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations. Eskom uses an estimated 10 000 litres of water per second due to its dependency on coal (Greenpeace, 2012).

The report notes that the concerns relating to whether South Africa can afford renewable energy arise out of the perception that renewable energy (RE) is expensive while fossil and nuclear technologies are cheap. The premise also ignores life cycle costing of the technologies which is favourable to renewable technologies where the sources of fuel are free or cheap.

In terms of costs, onshore wind energy costs are expected to drop by 12% since 2011 due to lower cost equipment and gains in output efficiency. The report refers to Bloomberg New Energy Finance, which noted that the average wind farm could reach grid parity by 2016. In Australia, unsubsidised renewable energy is now cheaper than electricity from new-build coal- and gas-fired power stations. A BNEF study indicated that electricity can be supplied from a new wind farm at a cost of R747.32/MWh (AUS$80), compared to R1 335.82/MWh (AUS$143) from a new coal plant or R1 083.06 /MWh (AUS$116) from a new base-load gas plant, including the cost of emissions under the Australian government's carbon pricing scheme. Based on this the chief executive of Bloomberg New Energy Finance, Michael Liebreich, noted that "The fact that wind power is now cheaper than coal and gas in a country with some of the world's best fossil fuel resources showing that clean energy is a game changer which promises to turn the economics of power systems on its head," (Paton, 2013).

Within the South African context, a presentation by the South African Wind Energy Association (SAWEA) at the NERSA hearings in February 2013 indicated that in the second round of (REIPPPP) the bidding price for wind was 89c/kWh. The estimates for nominal new Eskom coal power range from NERSA's 97c/kWh to Standard Bank's estimate that Kusile will cost R1.38/kWh in 2019. In addition to being more expensive, coal-fired power stations have fewer job creation possibilities than RE, carry future expenses due to climate change impacts, and have health expense issues due to pollution.

The Greenpeace study notes that it is not only local manufacturers and rural farmers that benefit from RE, but large scale renewable utilities as well. The report notes that the Lake Turkana Wind Power Project (LTWP), which has a capacity of 310MW and consists of 365 turbines of 850kW, is the largest wind farm in Sub-Saharan Africa. The project is equivalent to 20% of the current installed capacity in Kenya and is the largest single private investment in Kenya's history (LTWP, 2012). At the proposed 9.9 US cents per kWh it will be the cheapest electricity in Kenya (Kernan, 2012). Wind energy therefore creates significant opportunities for investment and the production of affordable energy without the significant environmental and socio-economic impacts associated with coal and nuclear energy options.

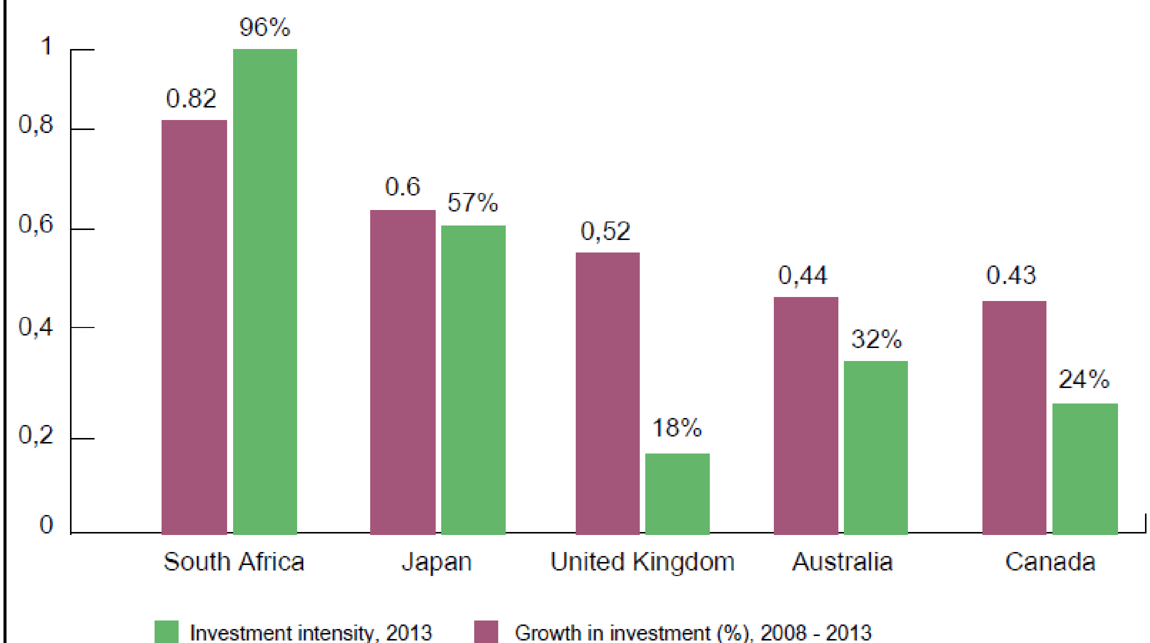
2.5.4 WWF SA, Renewable Energy Vision 2030

In its vision the WWF motivated for a more ambitious plan, suggesting that the IRP should provide for an 11-19% share of electricity capacity by 2030, depending on the country's growth rate over the next fifteen years. The vision is to increase renewable energy at the expense of new coal-fired and nuclear capacity. The report notes that in addition to the obvious environmental benefits of this scenario, it will enable South Africa to add flexibility to energy supply capacity on an on-demand basis.

The report notes that Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) introduced in 2011, has by all accounts been very successful in quickly and efficiently delivering clean energy to the grid. Increasingly competitive bidding rounds have led to substantial price reductions. In this regard the study indicates that in three years, wind and solar PV have reached pricing parity with supply from new coal-fired power stations from a levelised cost of electricity (LCOE) perspective.

In bidding window 3 of August 2013, the average tariffs bid for wind and solar PV were R0,66/kWh and R0.88/kWh respectively, well below the recent estimates of R1.05/kWh for supply from the coal-fired Medupi and Kusile power stations (Papapetrou 2014). In 2013, the average levelised cost of electricity supplied to the grid was R0.82/kWh (Donnelly 2014), so wind-generated power has already achieved pricing parity with the grid.

The report also notes that the REIPPPP has several contracting rounds for new renewables supply. A robust procurement process, extension of a 20-year sovereign guarantee on the power purchase agreement (PPA) and, especially, ideal solar power conditions, have driven the investment case for RE in South Africa. In this regard South Africa has been identified as one of the worlds' leading clean energy investment destinations (Figure 2.6).



Source: *Pew (2014)*
Notes: *Investment intensity is defined as clean energy investment per dollar of GDP.*

Figure 2.6: South Africa leads as a clean energy investment destination

The study also found that there were a number of opportunities to further reduce the cost of wind energy, specifically cost reductions for turbines. Towers, constructed mostly from steel, comprise 25% of the cost of wind turbines. The increasing distribution of manufacturers, greater competition and the use of more lightweight materials support cost reductions. In addition, since towers can, and are manufactured locally, they will be less sensitive to the weakening Rand. The study estimates a potential cost reduction of 15-20% by 2030. Rotor blades comprise 20% of the cost of wind turbines. On-going improvements in reducing weight through the use of carbon fibre and other lightweight materials will support a reduction of 10-20% by 2020. Gearbox costs and the costs of other components may be reduced by 10-15% by 2020, owing to manufacturing efficiencies.

With regard to local economic development, the REIPPPP sets out various local economic development requirements with stipulated minimum threshold and aspirational targeted levels, which each bidder must comply with. Based on the Broad-Based Black Economic Empowerment Codes, this requirement comprises the following components which make up a scorecard:

- Ownership by black people and local communities;
- Job creation;
- Local content;
- Management control;
- Preferential procurement;
- Enterprise development; and
- Socio-economic development.

The final award is based on a combined evaluation in which price determines 70% of the ranking and performance on the local economic development scorecard the remaining 30%. This gives non-price criteria a much heavier weighting than they would normally enjoy under Government's preferential procurement policy.

Job creation, local content and preferential procurement accounted for the bulk of possible points on the scorecard in REIPPPP Round 3. Consequently, a requirement to source goods and services locally is considered to be the central driver of project costs associated with local economic development. In terms of local content, the definition of local content is quite broad, being the value of sales less the costs associated with imports. However, through successive bidding rounds, the definition has become subject to more detailed definition, with an expanding list of exclusions and increased targeting in terms of key components identified by the Department of Trade and Industry for local manufacturing. This has benefitted local manufacturers and suppliers.

The WWF study considers a low and high growth renewable energy scenario. The capital requirements for the low growth scenario are estimated at R474 billion over the period 2014-2030 (2014 Rand value), rising to R1.084 trillion in the high-growth scenario, in which 35 GW of capacity is built. Each annual round of purchasing 2 200 MW of RE capacity would cost approximately R77 billion in 2014 Rand value terms. In relative economic terms, this equates to 2% of the GDP per annum or approximately one quarter of Government's planned annual investment in infrastructure over the medium term. In the low economic growth scenario, which is arguably the more realistic one, the average annual new liability over the period is approximately R40 billion.

The study also points out that infrastructure spend is more beneficial than other government expenditure due to the infrastructure multiplier effect. This refers to the beneficial impact of infrastructure on economic growth in both the short term, resulting from expansion in aggregate demand, as well as in the longer term (six to eight years) due to enhanced productive capacity in the economy. A recent USA study on highway expenditure revealed the infrastructure multiplier to be a factor of two on average, and greater during economic downturns (Leduc & Wilson 2013). This means that one dollar spent on infrastructure raises GDP by two dollars. If the same were to hold true, as similar analysis suggests it would (Kumo 2012, Ngandu et al 2010), this indicates that the construction of renewable energy plants could be a valuable economic growth driver at a time when fears of recession abound.

The report concludes that the WWF is optimistic that South Africa can achieve a much more promising clean energy future than current plans allow for. With an excellent solar resource and several very good wind-producing pockets, the country is an ideal candidate for a renewable energy revolution.

The report indicates that the levelised cost of producing renewable energy already competes favourably with the three main alternatives, namely coal, gas and nuclear. In addition, renewable energy would contribute to a more climate-resilient future and insulate South Africa from dependence on expensive and unreliable fuel sources priced in dollars. Critical from a planning perspective, the report notes that renewable energy can also provide added flexibly on an 'as needed' basis, as electricity demand grows. This is vital in a highly uncertain environment.

2.5.5 The impact of the green economy on jobs in South Africa

The paper notes that greening the economy is particularly important in South Africa for two basic reasons: (1) the exceptional level of unemployment that the country is experiencing and (2) the high carbon impact of the economy.

In terms of employment, the paper refers to the IDC *Green Jobs R*eport (2011). In summary, the short-term (next 2 years) estimate of total net employment potential is 98 000 jobs, and the long-term (next 8 years) employment potential is 462 567 jobs. 16 Natural resource management is predicted to lead to the greatest number of these at 232 926 long-term jobs. Green energy generation is estimated to produce 130 023 long-term jobs, with energy and resource efficiency measures adding another 67 977 long-term jobs.

The paper notes that the Green Jobs Report was prepared by 17 primary researchers from three prominent organisations, namely the IDC, the Development Bank of South Africa, and Trade and Industrial Policy Strategies. Many role players from other organisations were also consulted, including the World Wide Fund for Nature, the Green Building Council, the Economic Development Department and private companies involved in green industries.

Despite questions surrounding the employment estimates contained in the Green Jobs Report, green economic activity does appear to generate more local jobs than fossil-fuel-based industries. Some of the estimates also indicate the potential for significant employment. The paper concludes that the figures represent a promising starting point that warrants further research and policy involvement in greening the economy in South Africa.

2.5.6 The potential for local community benefits from wind farms in South Africa

In her thesis, Tait[21] notes that the distributed nature of renewable energy generation can induce a more geographically dispersed pattern of development. As a result RE sites can be highly suited to rural locations with otherwise poor potential to attract local inward investment therefore enabling to target particularly vulnerable areas.

In her conclusion, Tait notes that the thesis has found positive evidence for the establishment of community benefit schemes in the wind sector in South Africa. The BBBEE requirements for developers as set out in the DoE's IPPPP for renewables is the primary driver for such schemes. The procurement programme, in keeping with the objective of maximising the economic development potential from this new sector, includes a specific focus on local communities in which wind farms are located.

The procurement programme, typical of all Government tendering processes, includes a BBBEE scorecard on which wind projects are evaluated. However the renewables scorecard appears to play an important part in a renewed focus on the broad-based Aspects of the legislation, as enforced by a recent national review of the BBBEE Act. In this regard the renewables scorecard includes specifications for local communities in respect of broad-based ownership schemes, socio--economic development and enterprise development contributions. This approach to legislating

[21] The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town

social responsibilities of business in all sectors definitely has a South African flavour, borne out of the political history of the country and the imperatives for social transformation laid out in the constitution.

While Tait notes that it is still early days for the development of this sector and one cannot determine the impact that such benefit schemes may have, it is clear though that targeted development expenditure will be directed to multiple rural communities and there seems to be a strong potential to deliver socio-economic benefits.

2.5.7 Market Intelligence Report: Renewable Energy

A study undertaken by Greencape in 2014 found that the bidding programme is placing increasing pressure on developers to include locally manufactured 'key components'. In the wind sector the key components that are being focussed on are wind turbine blades and towers. The increasing local content requirements are leading to increasing interest in setting up manufacturing in the country, specifically in the Western Cape. In this regard a number of renewable energy related companies have established operations in the Atlantis Special Economic Zone (SEZ) which is located within 50 km of the proposed WEF site.

2.6 IMPACT OF WIND FARMS ON TOURISM

A review of international literature in the impact of wind farms was undertaken as part of the SIA. Three articles were reviewed, namely[22]:

- Atchison, (April, 2012). Tourism Impact of Wind Farms: Submitted to Renewables Inquiry Scottish Government. University of Edinburgh
- Glasgow Caledonian University (2008). The economic impacts of wind farms on Scottish tourism. A report prepared for the Scottish Government
- Regeneris Consulting (2014). Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector

The most comprehensive appears to be a review undertaken by Professor Cara Aitchison from the University of Edinburgh in 2012 which formed part Renewable Energy Inquiry by Scottish Government. The research by Aitchison found that previous research from other areas of the UK has demonstrated that wind farms are very unlikely to have any adverse impact on tourist numbers (volume), tourist expenditure (value) or tourism experience (satisfaction) (Glasgow Caledonian University, 2008; University of the West of England, 2004). In addition, to date, there is no evidence to demonstrate that any wind farm development in the UK or overseas has resulted in any adverse impact on tourism. In conclusion, the findings from both primary and secondary research relating to the actual and potential tourism impact of wind farms indicate that there will be neither an overall decline in the number of tourists visiting an area nor any overall financial loss in tourism-related earnings as a result of a wind farm development. The study by the Glasgow Caledonian University (2008) found that only a negligible fraction of tourists will change their decision whether to return to Scotland as a whole because they have seen a wind farm during their visit.

The study also found that 51.0% of respondents indicated that they thought wind farms could be tourist attractions. In this regard the visitor centre at the Whitelee Wind Farm in east Ayrshire Scotland run by ScottishPower Renewables has become

[22] Annexure E contains a more detailed review of the documents

one of the most popular ‘eco-attractions’ in Scotland, receiving 200 000 visitors since it opened in 2009.

2.7 IMPACT ON WIND FARMS ON PROPERTY VALUES

The literature review undertaken as part of the SIA does not constitute a property evaluation study and merely seeks to comment on the potential impact of wind farms on property values based on the findings of studies undertaken overseas[23]. The literature reviewed was based on an attempt by the authors of the SIA to identify what appear to be “scientifically” based studies that have been undertaken by reputable institutions. In this regard it is apparent that there are a number of articles available on the internet relating to the impact of wind farms on property values that lack scientific vigour. The literature review also sought to identify research undertaken since 2010. The literature review does not represent an exhaustive review.

In total five articles were identified and reviewed namely:

- Stephen Gibbons (April, 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre, SERC Discussion Paper 159;
- Review of the Impact of Wind Farms on Property Values, Urbis Pty Ltd (2016): Commissioned by the Office of Environment and Heritage, NSW, Australia;
- Yasin Sunak and Reinhard Madlener (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing. School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University. Model Working Paper No. 3/2012;
- Martin D. Heintzelman and Carrie M. Tuttle (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University;
- Ben Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory.

Three of the articles indicate that wind farms have the potential to impact on property values, while two indicate that the impacts are negligible and or non-existent.

In terms of the proposed project the most relevant study is the Urbis study (2016). The authors of the study found that appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values.

[23] Annexure F contains a more detailed review of the documents

SECTION 3: OVERVIEW OF THE STUDY AREA

3.1 INTRODUCTION

Section 3 provides an overview of:

- The administrative context.
- The socio-economic context.
- The demographic context.
- The study area and surrounding land-uses.

3.1 ADMINISTRATIVE CONTEXT

The project site is located within Swartland Local Municipality (WC015), one of 5 Local Municipalities (LMs) comprising the West Coast District Municipality (WCDM) (Figure 3.1). The Swartland LM is the most populous of the WCDMs LMs and has its administrative seat in Malmesbury. After Malmesbury (population 25 176) and Moorreesburg (12 877), Darling (10 420) is the largest settlement in the Swartland LM. The site is located within Ward 5 within the SLM.

Figure 3.1: Location of Swartland Local Municipality within the Western Cape Province (Source: Wikipedia)

3.2 ECONOMIC OVERVIEW

The SLM contributed R5.18 billion (or 27%) of the District's total R19.16 billion gross domestic product per region (GDPR) at the end of 2015. GDP growth averaged 3.7% per annum over the period 2005-2015. This is marginally above the District average of 3.4%. Average annual growth of 2.8% in the post-recessionary period (2010-2015) nevertheless came in marginally below the long-term trend and the District average of 2.8%.

In terms of employment, the SLM employed 25.8% of the District's labour force in 2015, and employment growth remained fairly stagnant, averaging 1.2% per annum since 2005 which was on par with the overall district employment growth rate of 1.1% per annum. Employment growth has nevertheless picked up significantly in the post-recessionary period averaging 2.8% per annum (which is on par with the District's rate of 2.7% over the same period). The SLM has experienced significant job losses prior to and during the recession, but these jobs have been recovered and approximately 5 927 (net) additional jobs have been created since 2005. The majority (40.6%) of the formally employed workforce Swartland operate within the low-skill sector, which has stagnated at 0% per annum on average since 2005. Most of the job losses experienced during the recession were in the Agriculture, forestry and fishing sector. The semi-skilled sector employed 27% of the Swartland's workforce, and grew by 0.7% per annum on average since 2005. The informal sector (which employs 20.9% of the area's workforce) experienced robust growth of 7.1% per annum over the past decade and absorbed most of the job losses from the low and semi-skilled sectors. The skilled sector employed only 11.4% of the workforce and grew at a moderate rate of 1.6% per annum since 2005.

The majority of the Swartland's formally employed individuals (54%) in 2015 were low skilled, compared to 31.8% semi-skilled and 14.2% skilled. Skilled formal employees have been increasing positively (2.2%) between 2004 and 2015, while the semi- and low skilled formal employees have been increasing by only 0.9% and 0.8% respectively between 2004 and 2015.

The main contributing sectors to the Swartland's GDP and employment in 2015 are listed in Table 3.

Table 3.1: SLM Economic Sectors

Sector	GDP	Employment
Manufacturing	22.5%	10.5%
Agriculture, forestry and fishing	18.7%	32.2%
Wholesale and retail trade, catering and accommodation	16.9%	20.0%
General Government	11.3%	11.4%
Finance, insurance, real estate and business services	10.0%	8.0%

3.2 DEMOGRAPHIC OVERVIEW OF STUDY AREA

The population of the SLM was 133 762 (2016 Household Community Survey). In terms of age, 34.5% of the population was between the age of 0 and 19, 62.3% between the age of 20 and 69 and the remaining 3.2% over the age of 70. The majority of the population was Coloured (65.1%), followed by Whites (18.6%) and Black Africans (15.7%)(2016 Survey). The dominant language within the Municipality was Afrikaans (78.1%), followed by isiXhosa (12.3%) and English (5.1%)(2016 Survey).

There were 39 137 households in the SLM, approximately 33% of the total number of households (109 471) in the West Coast District Municipality (WCDM). Approximately 4% of the households were classified as informal dwellings. The majority of families in the SLM therefore live in formal houses.

At a local level the population in Ward 5 was 7 916. The majority were Coloured (63%), followed by Whites (26.6%) and Black African's (7.9%). The main language was Afrikaans (80.8), followed by English (11.4%) and isiXhosa (4.5%). There were 2 523 households in Ward 5, less than 10% of the total number of households (109 471) in the West Coast District Municipality (WCDM). Only 0.5% of the households were classified as informal dwellings. The majority of families in Ward 5 therefore live in formal houses.

Dependency ratio

The dependency ratio in the both the WCDM and SLM decreased from 51.4 to 45.9 and 51.6 to 44.7 respectively. The age dependency ratio is the ratio of dependents, people younger than 15 or older than 64, to the working age population, those ages being 15-64. The increase represents a positive socio-economic improvement and reflects a decreasing number of people dependent on the economically active 15-64 age group. This decrease is linked to the increase in the percentage of economically active people in both the WCDM and SLM. The dependency ratio in the SLM is lower than the provincial ratio of 45.0, while the ratios of the WCDM and the SLM are both lower than the national figure of 52.7.

Employment

The official unemployment rate in both the WCDM and SLM also increased for the ten year period between 2001 and 2011. In the WCDM the rate increased from 13.8% to 14.6%. In the SLM the rate increased from 10.2% to 12.7%. Youth unemployment in SLM also increased over the same period, from 13.6% to 17.9%. However, the unemployment and youth unemployment rates in the WCDM and SLM are lower than the provincial figures of 21.6% and 29.0% respectively. The current unemployment rates are likely to be higher given the recent drought and job losses associated with the decline in the role of the fishing sector and the subsequent loss of employment opportunities in this sector.

Household income

Based on the data from the 2016 data, 10.6 % of the households in the SLM have no formal income, 1.7% earn up to R 4 800, 2.6% earn between R 5 000 and R 10 000 per annum, 13.5% between R 10 000 and R 20 000 per annum and 21.5% between R 20 000 and R 40 000 per annum. The poverty income datum for households is linked to the number of household members (Western Cape Provincial Treasury, 2012a - "Definitions"). According to this yardstick, the average poor South African household (5.1 people) requires R1 6371/ month just to subsist, and R3 162/ month to meet the most basic of food and other needs. The City of Cape Town uses a figure of R3 500.00 per month. Based on this measure 50% of the households in the SLMs in 2016 lived close to or below the poverty line. The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the district and local municipality.

At a local ward level, 10.4 % of the households in Ward 5 have no formal income, 0.3% earn up to R 4 800, 0.9% earn between R 5 000 and R 10 000 per annum, 10.4% between R 10 000 and R 20 000 per annum and 15.9% between R 20 000 and R 40 000 per annum. Approximately 38% of the households in Ward 5 lived close to or below the poverty line.

Education

The education levels in both the WCDM and SLM improved between 2001 and 2011, with the percentage of the population over 20 years of age with no schooling in the WCDM decreasing from 9.5 1% to 5.4%. For the SLM the decrease was from 10.5% to 6.0%. The percentage of the population over the age of 20 with matric also increased in both the WCDM and SLM, from 19.1% to 23.7% in the WCDM and 19.7% to 24.2% in the SLM. The matric pass level in the SLM and WCDM were however both lower than the provincial average of 28.1%.

The figures from the 2016 Community Survey indicate that the percentage of the population over 20 years of age with matric in both the WCDM and SLM has increased to 31.0% and 34.3% respectively. However, they still remain lower than the provincial average of 35.2%.

3.3 MUNICIPAL SERVICE LEVELS

As indicated in Table 3.2, the provision of and access to municipal services as measured in terms of flush toilets, weekly refuse removal, piped water and electricity, increased in both the WCDM and SLM for the period 2001 to 2011. As indicated in Table 3.1 there have been significant improvements in the number of households with access to piped water inside their dwellings in both the WCDM and SLM. These improvements also contribute significantly to the overall improvement in the quality of life of the residents of the WCDM and SLM. The lower rates in the SLM compared to the WCDM reflects the rural nature of the SLM.

Table 3.1: Overview of access to basic services in the WCDM and SLM

	WCDM		SLM	
	2001	**2011**	**2001**	**2011**
% households with access to flush toilet	80.8	85.6	73.8	77.3
% households with weekly municipal refuse removal	69.4	76.5	70.8	76.1
% households with piped water inside dwelling	69.1	78.7	72.2	80.6
% households which uses electricity for lighting	88.1	94.4	91.0	97.8

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

The 2016 figures for Ward 5 indicate that 69.8% of households had piped water inside their dwelling, 89.3% had flush toilets and 64.3% had their waste removed on a weekly basis.

3.3 SITE AND SURROUNDING LAND USES

The Rheboksfontein WEF site is located in a rural, farming area approximately 3 km west of the town of Darling and 8 km east of the coastal town of Yzerfontein (Figure 3.2).

Figure 3.2: Location of proposed Rheboksfontein WEF site (pink outline) in relation to urban areas (blue outlines), the Jakobuskraal smallholding area (yellow), registered conservation areas (green fill), and existing Eskom lines.

The main access roads in the area are the R27 and R 315. The R27 (West Coast Road) is located to the west of the site and serves as the main link between Cape Town and the West Coast settlements south of the Berg River (Photograph 3.1). The R27 runs in a south-north direction and terminates at Velddrif near the Berg River mouth in the north. It provides access to the settlements of Melkbosstrand, Atlantis, Yzerfontein, Darling, Langebaan, Saldanha, Hopefield, Vredenburg, Paternoster and St Helena Bay.

Photograph 3.1: Intersection of R27 and R315

The R315 bisects the northern section of the WEFR site and runs in an west-east alignment, linking Yzerfontein in the west and Darling and Malmesbury in the east. The R315 intersects with the R27 approximately 1.4 km to the west of the WEF site.

The site and adjacent properties are accessed directly from either R315 or R27 via private access roads. The access roads onto the Rheboksfontein WEF site properties all provide access to these properties only. They not provide access to any neighbouring properties.

The existing Darling WEF is located on the farm Windhoek directly to the north-north west of the Rheboksfontein WEF site and the R315. Two Eskom 132 kV lines traverse the Wildschutsvlei portion of the Rheboksfontein site. The lines link the Eskom Aurora substation west of Hopefield with the Dassenberg substation at Atlantis (Photograph 3.2). Two 66 kV lines are also located in the vicinity of the site, namely one to the west and one to the east of the site. The lines feed into the Yzerfontein and Darling substations, respectively.

Photograph 3.2: 132 kV lines traversing the R 315 on Widschutsvlei Farm

In terms of land uses, the Rheboksfontein WEF site is located in a rural area on the western periphery of the Swartland agricultural region in an area known as the Darling Hills. The Darling Hills are a series of low rolling are located to the west of Darling. The R27, which roughly demarcates the transition from the Darling Hills to the coastal plan, also demarcates the transition to more sandy and lower productivity Sandveld soils. As a result, most of the properties located adjacent to the east of the R27 are used for intensive commercial farming, while those to the west are typically used for non-farming purposes such as residential or conservation.

The farming operations in the Swartland are typically mixed, including cropping and livestock components. The Swartland is traditionally known as the 'bread-basket of the Cape' and is a key producer of wheat (Photograph 3.3). This is traditionally complimented with sheep and cattle farming (Photograph 3.4). Darling is a key producer of dairy products. Many operations also plant fodder crops, primarily for own use. In recent years, a number of vineyards and olive plantations have been established in the Darling area. The Darling Hills terroir is especially favourable for the cultivation of cultivars which benefit from the cooling effects of the nearby Atlantic. The farms located to the north and east of the site are all used for intensive mixed agriculture. All the farms are inhabited, with the owners and workers typically living on the farms. The large farming operations also create significant permanent employment opportunities.

Photograph 3.3: Recently harvested wheat fields along the R315

Photograph 3.4: Cattle grazing on along the R315

The sense of place can be described as a patchwork of intensively cultivated fields set in a rolling landscape, dotted by grazing livestock and farm dwellings. The farm dwellings are typically set back from the road R 315 and R 27 and the yards are planted with trees.

The properties located on the sandy coastal plain directly along the R27 and to the west thereof, support limited agriculture. Established and emerging land uses directly around the R27/ R315 intersection are largely focused on passing traffic and visitors to the area. These include conservation tourism (Khwa ttu San Heritage Centre), farm stalls and delis (West Coast Farm Stall; Beulah's Farm Deli), and a new BP fuel station complex currently proposed to the south of the West Coast Farm Stall.

The main settlements in the study area are Darling and the coastal town of Yzerfontein. There is also the Jakobuskraal Smallholdings area located to the west of the intersection between the R27 and R315. The town of Darling is located approximately 3 km to the east of the eastern boundary of the WEF site. The town was founded in 1853. The older part of town is laid out in a grid-pattern around the Dutch Reformed Church. Over the last 20 years or so, the town has gained a reputation as popular destination for artists and people wanting to get away from the hustle and bustle of city life. Despite this the town has managed to retain a small-town atmosphere. The town reflects the legacy of Apartheid planning, with the historical, 'White' part of town located to the south of the Cape Town – Hopefield railway line, and the newer, 'Coloured' Nuwedorp and the industrial part of town located to the north of the railway line. Views from the town towards the west and south-west are onto the Darling Hills.

The town continues to function as an agricultural service centre for the well-established and productive agricultural sector in its hinterland. The tourism sector has developed significantly over the last 20 years or so.

The town of Yzerfontein is located approximately 7 km to the west of the western boundary of the WEF site. While Yzerfontein town was already established 1930s, the bulk of the development took place in the mid-1990s. Yzerfontein boasts one of the longest sandy beaches in the world (Sixteen Mile beach) and has a small proclaimed fishing harbour. As a tourist destination the town benefits from its proximity to Cape Town and the Cape Winelands. As a result, there are a large number of B&Bs and self-catering facilities. There is no low-income area associated with Yzerfontein. Labourers serving the settlement typically live in Darling.

The Jakobskraal Small holding area is located to the west of the R27-R315 intersection, approximately 1.4 km to the west of the WEF site. Jakobuskraal consists of approximately 39 smallholdings of varying sizes (viz. 10-48 ha). The bulk of subdivisions only occurred from 1995 onwards. A number of properties are still undeveloped. All the smallholdings are accessed directly from the R315. Those located to the north of the road are accessed via two north-south aligned private communal roads off the R315. Both are access controlled.

Jakobuskraal is mainly used for rural residential purposes, but also includes a tunnel farming operation, an upmarket self-stay accommodation facility (Jakobuskraal), and two restaurants located on the R315, namely the West Coast Farm Stall and Yzervark Bistro). many of which have been invaded by alien trees. The area immediately around the R27/ R315 intersection has a more peri-rural sense of place, currently anchored by the West Coast Farm Stall complex.

Tourism in the area is strongly associated with the spring flower season (August-October), the December holidays and Easter weekend. However, the proximity of both Yzerfontein and Darling to Cape Town and the Cape Winelands ensures a regular tourist flow throughout the year. Established attractions in the vicinity of the site include the West Coast National Park, the !Khwa ttu San Cultural Centre, the Tinie Versveld Wildflower Reserve, and attractions in and around Darling such as the Ormonde winery on the outskirts of the town and the historic Groote Post Farm to the south. Well-established and popular annual arts festivals include the Darling Voorkamerfees and the Rocking the Daisies Festival. Two historic lime kilns, the only two still in existence from a time when all building cement in the Cape was produced from burning seashells for lime, are located along the R315 near the outskirts of Yzerfontein.

3.4 WEF SITE PROPERTIES

The Rheboksfontein WEF site consists of 6 cadastral units belonging to two owners (Table 3.1). Ownership has remained unchanged since the SIA was undertaken in 2010 (Barbour and van der Merwe, 2010).

Table 3.1: Properties constituting the Rheboksfontein WEF site

OWNER	PROPERTY	SIZE (ha)	LAND USE	INHABITED
Kirsten, Mr Jorrie	Groot Berg 1199	854	Mixed wheat/ sheep farming Sand mining	Yes
Basson, Mr Theo	Nieuwe Plaats 567	445	Veld	No
	Plat Klip 1220	181	Vineyard Wheat Cellar	No
	Plat Klip 551/1/RE	723	Vineyard Wheat Staff housing and farm buildings	Yes
	Rheboks Fontein 568/RE	1449	Vineyard Wheat Dairy	Yes
	Witte Klip 574/1	57	Wheat	No

Grootberg

Grootberg Farm (1199) is located to the south of the R315 in the north-western portion of the site. The property is owned by Mr Jorrie Kirsten, who is retired and lives in Yzerfontein. The farm is farmed by his son, Mr Frikkie Kirsten, who lives on the property. The farmyard complex is located approximately 1.2 km north-west of the nearest proposed turbine (Photograph 3.5). Most of the 854-ha property consists of arable land, supporting mixed farming activities comprising of cattle, sheep and wheat cropping. A small portion of the property is also used for sand mining (Photograph 3.6). The farming operations provide permanent employment to 12 workers, seven of whom residing on the property, and the balance in Darling.

Photograph 3.5: Farmhouse and outbuildings on Grootberg.

Photograph 3.6: Sand mine on Grootberg to the south of the R315, viewed from the access road to Windhoek.

Rheboksfontein and Wildschutsvlei

The balance of the site properties are owned by Mr Theo Basson. The properties form part of what is referred to as Wildschutsvlei (Plat Klip 551/ 1/RE; Plat Klip 1220 and Rheboksfontein (Rheboksfontein 568/RE; Witte Klip 574/1; Nieuwe Plaats 567) farms. The properties are essentially farmed as one unit. Key farming operations include vineyards, dairy and beef cattle, small stock and cereal cropping. The vineyards are located both on Rheboksfontein and Wildschutsvlei. A production cellar is located on Wildschutsvlei (Photograph 3.7), but the tasting centre is located at the Ormonde winery on the southern outskirts of Darling, approximately 3 m from the WEF site. The dairy is located on Rheboksfontein near the homestead.

Photograph 3.7: Ormonde production cellar and vineyard on portion of Platklip 1220 located to the south of the R315

Farmsteads and associated outbuildings are located on Wildschutsvlei and Rheboksfontein (Photograph 3.7). Mr Basson resides on Rheboksfontein 568/RE. The farming operation provides permanent employment for around 240 people and an additional 60 opportunities associated with harvesting and pruning. Four clusters of staff and worker housing are located on Wildschutsvlei (551/1/RE) and Rheboksfontein (568/RE). The nearest residential receptors on both properties are located 600-700 m from the nearest proposed turbine locations (in both instances, to the south of the buildings).

Photograph 3.8: Farmhouse and outbuildings on Wildschutsvlei

3.5 ADJACENT PROPERTIES

The Rheboksfontein WEF site borders onto 14 cadastral units belonging to 11 different owners (Table 3.2; Figure 3.3). Land uses on the relevant properties have remained essentially unchanged from 2010 (Barbour and van der Merwe, 2010). Only two properties, namely Doornfontein and Vyge Vallei, have new owners. On both properties pre-existing land uses have remained essentially unchanged, albeit expanded.

Properties located to the north and east of the site are primarily used for agricultural purposes, while those to the south of the site are used for conservation and wildlife tourism, and those to the west for a mix of non-agricultural uses. The relevant properties are briefly discussed.

Drooge Valley 456/1 (Droeëvlei) located to the north of the site is owned by Mr Basie Basson. The bulk of the farm is used for cereal cropping in a mixed farming operation which also includes a dairy component. Mr Basson and his labour force reside on the property. The property is currently traversed (north to south) by an existing 132 kV Eskom corridor. The property forms part of the approved Slangkop WEF (see below). The nearest proposed Rheboksfontein WEF turbine is located ~2.2 km south of the nearest dwelling on the property.

Table 3.2: Site-adjacent properties (clockwise from N):

OWNER	PROPERTY	SIZE(ha)	LAND USE	
Basson, Mr Basie	Drooge Valley 456/1	1177	Wheat; Dairy	Yes
Steyn, Mr Gawie	Plat Klip 551/2	622	Mixed farming	Yes
	Plat Klip 551/3	187	Mixed farming	No
Steyn, Mr Gert	Bonte Berg 571/3	385	Mixed farming	Yes
Basson, Mr Nicholaas	Alexander Fontein 573/1	511	Vineyard; Wheat Olive Tasting Centre	Yes
	Bonte Berg 571/1	634	Olives; Vineyard; Wheat	Yes
	Bonte Berg 571/2	93	Mixed farming	No
Fourie, Mr Ryan	Witte Klip 574/RE	1187	Doornfontein Wildlife Estate Tourism accommodation	Yes
Duckitt Family	Nieuwe Plaats 1117	818	Rondeberg PNR Number of owner houses	Yes
Mather, Mr Irshaad	Vyge Valley 570/1/RE	151	Vygekraal Farm Stall complex Tourist accommodation	Yes
Meerkat NPO	Groot Water 1198	776	Khwa/Ttu San cultural centre Conservation tourism	Yes
Smit, Mr Paul	Slang Kop 552/3	500	Sheep; fodder cropping Darling WEF; Sand mining, 4x4 trails, Rented accommodation	Yes
SANBI	Slang Kop 552/4	21	Tienie Versfeld Wildflower Reserve	No
Bosch, Mr Alfred; Duscher, Mr Stephan	Slang Kop 552/RE	1115	Rented out for mixed farming	Yes

Figure 3.3: Rheboksfontein WEF site (outlined in pink) in relation to adjacent properties (white outlines). Also indicated are urban areas (blue outlines), existing Eskom lines (orange lines) and registered conservation areas (green fill).

Plat Klip 551/ 2 and 551/3 (Platklip) located to the north-east of the site and is owned by Mr Gawie Steyn. The farming operations consist of mixed cereal cropping and livestock farming. Mr Steyn resides on the property. The nearest proposed turbine is located ~1 km west the nearest dwelling on the property.

Bonte Berg 571/3 (Wolwefontein) is located to the east of the site. The farm is owned by Mr Gert Steyn, who is retired and lives in Yzerfontein. The farming operation is managed by his son, Mr Steyn Junior, who resides on the farm. The farming operations consist of mixed cereal cropping and livestock farming. The nearest proposed turbine is located 2.8 km west of the nearest dwelling on the property.

Alexanderfontein Farm is owned by Mr Nicolaas Basson. The property consists of 3 contiguous properties, measuring 1237 ha in total (Figure 3.4). The property straddles the Darling-Yzerfontein road. An existing 132 kV line corridor is located across the property. The sense of place is of rolling hills and vales covered in a patchwork of veld, wheat fields, vineyards and olive groves dotted by well-preserved/ well-maintained historic and new buildings.

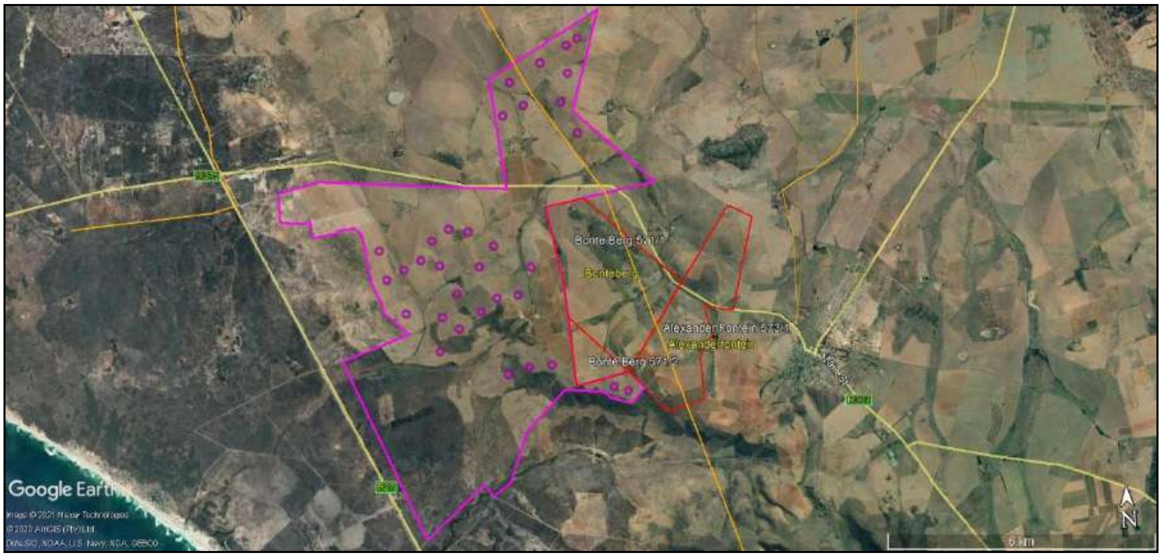


Figure 3.4: Location of Mr Nicolaas Basson's properties (red outlines) in relation to WEF site (pink outline), proposed turbines (pink circles) and existing 132 kV corridor (orange).

Large farmsteads complexes are located on Alexanderfontein 573/1 and Bonteberg 571/1. Mr Basson grew up on Alexanderfontein, and currently lives in the historic farmstead with his family. A large new olive processing facility and tasting centre is located on Alexanderfontein 573/1, near the farmstead (Photograph 3.9). The dwellings on Bonteberg are inhabited by management staff. Labourers' housing is in a small village on Bonte Berg 571/2 just north of the Darling-Yzerfontein Road.

Photograph 3.9: Farmhouse (background) and new olive tasting centre on Alexanderfontein

The farming operation was historically a typical Swartland mixed farming operation, with dairy farming forming the main component. The first quality cultivar vineyard plantings in the Darling area were made on Alexanderfontein in 1975 by the owner's father. Limited historic plantings have since been significantly expanded. Olives were established around 1990.

The composition of the operation has significantly shifted since the 2010 SIA was conducted. The operation remains a mixed operation, but the dairy herd has been phased out, and the owner now exclusively focuses on dairy processing at a facility in Dartling (Darling Creamery), a separate business entity to the farming operation. The current Alexanderfontein Farm operation derives roughly 70% of its income from the production of wine grapes, 15% from wheat, 10% livestock and 5% olive products (oil, table olives). The vineyard operation provides roughly 100 permanent positions.

The vineyard operation consists of around 200 ha of established blocks on Alexanderfontein and Bonteberg (571/1). The Darling Hills area benefits from cooling by Atlantic breezes and is considered a prime growing area for cultivars such as Sauvignon blanc, Chenin blanc, Pinot noire and Pinotage. Most of the current planting is of Sauvignon blanc. The primary focus is on growing quality grapes on contract for various wine makers. Blocks (and annual harvests) are currently grown under contract for Spier, KWV and some other prominent cellars. Negotiating contracts and prices/ tonne often take place on site. This typically involves wine makers and frequently overseas wine buying agents visiting the vineyards of origin for authentication. The operation competes with producers in countries like Chile and Australia and depends on the 'edge' provided by the fynbos setting and Cape heritage. Setting, presentation and perception are key elements in the appeal of the vineyards to buyers, and consequently the prices fixed for each harvest.

A management program for around 400 ha of small parcels of veld is currently followed, mainly with the aim of reversing historic Renosterbos encroachment, thus clearing up space for the previously suppressed geophytes to flower. The change in habitat over recent years is said to have resulted in more diverse and more abundant bird life on the property. The various historic farm buildings on Alexanderfontein and Bonteberg are also managed according to a management plan ensuring regular scheduled maintenance.

A substantial entertainment facility was built in 2019-2020 specifically to entertain wine makers and wine buyers. The facility is located on an elevated portion of Alexanderfontein at the edge of the vineyards, fronting west and carefully chosen for its views across veld on Doornfontein game farm (Fourie) and Rondeberg PNR (Duckitt), with the Atlantic visible in the distance (Photograph 3.10). No major industrial infrastructure is currently located within the primary West fronting viewshed. The facility has been built of stone to blend in. It espouses Alexanderfontein's branding/ presentation emphasis on the fynbos treasure house of the Darling area (Basson, pers. comm).

Photograph 3.10: New entertainment facility on Alexanderfontein seen from the north-west, veld on Doornfontein game farm in the background

Witte Klip 551/ RE (Doornfontein) located to the south-east of the site has changed owners since 2010. The property is currently owned by the Fourie family and is used for wildlife farming and tourism. The previous farming activities were beef cattle and game farming and the breeding of exotic wildlife. The current owners use the property for residential purposes, game farming, and game tourism (Doornfontein Game Estate). Game-viewing areas and tourist accommodation facilities are located in the southern portion of the property, the portion furthest away from site. The nearest proposed turbine is located 1.5 km north-east of the nearest dwelling on the property.

Nieuwe Plaats 1117 located to the south-west of the site and is owned by the Duckitt family. A number of family members reside on different parts of the 818-ha property. The property is a registered as a Private Nature Reserve (PNR) and land uses are largely associated with conservation. In as far as could be established, no tourism facilities are located on the property, and the property is not open to the public. The property is accessed from the R27 via a gravel road which runs via Doornfontein and Lanner Hill to Darling. The nearest proposed turbine is located 2.7 km north of the nearest dwelling on the property.

Vyge Valley 570/RE is owned by a number of owners, one of whom resides on and manages the property, namely Mr Irshaad Mather. The property is located to the west of the site, on a relatively narrow strip of 151 ha sandwiched between the site and the R27. The current owners acquired the property around 2014. They have extended the lease of the pre-existing Vyge Valley Fam Stall and developed further facilities adjacent to the farm stall (Photograph 3.11). These include two restaurants and a fuel station. Traveller accommodation facilities have also been established. The remainder of the property is not farmed. The nearest proposed turbine is located 3.4 km east of the Vyge Valley boundary, and 3.4-3.7 km of the mixed-use node.

Photograph 3.11: Vyge Valley farm stall, Roosterkoek restaurant and Puma filling station on Vyge Valley

Grootwater 1198 (!Khwa ttu), is located to the west of the site. The 776-ha property straddles the R27, with the largest portion located to the east of the road. The property was bought in 1999 by the Swiss anthropologist Irene Staehelin to host a San Culture and Education Centre. The property is run by a Non-Profit Company, jointly directed by the Ubuntu Foundation Switzerland and representatives of the San. The farm is held in perpetuity by the Meerkat Non-Profit Company for the sole use of the !Khwa ttu project, and may only be used for the purpose of hosting a San Culture and Education Centre.

!Khwa ttu provides 40 permanent training-linked employment opportunities to 40 Kalahari San people. Training fields include life skills, entrepreneurship, tourism, health, community development and gender issues. A further 10 internships are provided. An associated objective is to educate the public with regard to the San heritage and way of life. The project also aims at promoting the long-term financial sustainability of San development in southern Africa. Khwa ttu currently provides a number of tourism facilities.

These include a restaurant, accommodation for 26 people, an indigenous nursery and a large new San Cultural interpretation centre housed in 3 buildings (Photograph 3.12). The centre is the only one of its kind in the world and was opened in late 2018. Tourism activities include guided game drives and walking and cycling trails. Pre-Covid, Khwa ttu was visited by 20 000 tourists a year, of which an estimated 25% were overseas tourists. Accommodation occupancy is largely associated with weekends throughout the year.

Photograph 3.12: The restaurant complex on !Khwa ttu, viewed from the back.

A boma is located on a granite outcrop located approximately 1.2 km north-east of the built cluster. The boma faces south, towards Table Mountain. Turbines from the existing Darling WEF are only visible from a relatively small portion of !Khwa ttu, and not at all from the built-up cluster and boma. Turbines on the Rheboksfontein WEF are essentially proposed >500 m to the east of !Kwa Ttu boundary. These turbines will not impact on the key views to the south and west (Atlantic Ocean).

Slangkop 552/3 (Windhoek) is located to the north of the Grootberg portion of the site. Most of the property is located to the north of the R315. The Darling WEF, which was commissioned in 2008 as South Africa's first commercial WEF, is located in the north-east portion of the property. The property is located in the transition zone to less arable Sandveld land, and currently supports limited agriculture (sheep, fodder cropping). The owner, Mr Paul Smit, resides on the property. The operation provides permanent tenured employment for two households. A small portion of the property near the R315 has been leased out for sand mining since 1990 (Photograph 3.13).

Two tourist accommodation cottages are located approximately 200 m north of the R315. Each self-catering cottage provides accommodation for 4 guests. Camping facilities for an additional 40 people (10 stands) are also provided. A 4x4 trail is located adjacent to the R315 and is used by guests or for events. The nearest proposed turbine is located 3.5 km south of the nearest dwelling on the property.

Photograph 3.13: Entrance to sand mine on Windhoek; the farmstead complex and Darling WEF turbines are visible in the background.

The Tinie Versveld Wildflower Reserve (21 ha) is located on Slang Kop 552/4, to the south of the R315 (Photograph 3.14). It is one of three publicly accessible sites showcasing Darling's spring floral displays. The Darling area is internationally renowned for its seasonal displays of rare geophytes. These three small reserves (the other two are located to the east of Darling) conserve a small section of the area which has been largely transformed by farming. The Tinie Versveld is owned by the National Botanical Society of South Africa (SANBI) and managed by the Darling Wildflower Society. The nearest proposed turbine location is 1.5 km.

Photograph 3.14: Entrance to the Tinie Versfeld Wildflower Reserve along the R315.

Slangkop 552/RE (Slangkop), the portion on which the historic early-19th century Slangkop werf is located, is located to the west of Windhoek Farm. This is the most visually exposed of the inhabited farms in the area. The nearest existing Darling WEF turbine is located approximately 110 m to the west of Slangkop's western boundary, and 2.6 km north-west of the farmstead (Photograph 3.15). The Darling WEF turbines are clearly visible from most of the property.

Photograph 3.15: Historic farmstead on Slangkop, turbines on the adjacent Darling WEF visible in the background

Slangkop is owned by Messrs Alfred Bosch and Stephan Duscher. Mr Bosch is retired and lives on Slangkop. Mr Duscher is based in Germany. The property is 1115 ha in extent, and largely consists of high-potential arable land. The property is currently rented out for mixed farming activities to Mr Nico Laubscher based on the nearby Klipvlei farm. All labour and tenure are associated with Klipvlei, i.e. no workers reside on Slangkop. Slangkop was originally intended to accommodate the Darling WEF when the project was initially conceived during the 1990s. Slangkop forms part of the Slangkop WEF approved in 2014. No development has taken place yet. The nearest proposed turbine is located 2.2 km south-east of Slangkop farm dwelling.

3.6 POTENTIAL IMPACT ON ADJACENT PROPERTIES AND RECEPTORS

The current proposal for the Rhebboksfontein WEF involves the reduction in turbines from 35 (2015) to 33. The initial authorisation (2012) was for 48 turbines, while 80 were initially proposed (2010). The 33 turbines are in the same position as the locations identified in 2015. However, the process of reducing the number of turbines from 48 to 33 has resulted in the removal of turbines that were identified to be more visible intrusive. In addition, the proposed hub height increase from the 120 m approved in 2015 to 130 m is relatively small. None of the interviews raised issues or concerns with regard to either proposed turbine locations or visual/ sense of place impacts related to the proposed height increase.

In terms of the potential impact on sensitive receptors, the manager of !Kwa tuu indicated that the proposed layout does not affect key views to the south (Table mountain) and west (Atlantic coast). While the establishment of the proposed WEF may potentially detract from the San-orientated setting, it is considered unlikely to have any significant impact on visitor flows to !Kwa Tuu (Daiber, pers. comm). The owners of Doornfontein Wildlife Estate to the south of the site indicated that the turbines would be located sufficiently distant from their game viewing area, and, as such were unlikely to impact on operations (Fourie, pers. comm). Representatives from Darling Tourism indicated that the proposed WEF was unlikely to impact on visitors to the Tienie Versfeld Wild Flower Reserve (Burger, pers. comm). The Vyge Valley and the West Coast Farmstall complexes primarily rely on passing traffic along the R27, and visitor flows are unlikely to be affected by the wind turbines.

These findings are consistent with the findings of the SIA conducted earlier this year with regard to the proposed extension of the Darling WEF (Barbour and van der Merwe, 2020), namely that the existing turbines were generally not considered intrusive, but rather seen as a landmark, and that the generation of green energy in the Darling area is generally supported by all relevant stakeholders (Barbour and van der Merwe, 2020).

3.7 LOCATION OF OTHER RENEWABLE ENERGY FACILITIES

The DEFF's Renewable Energy Applications database (August 2020) indicates that 12 Renewable Energy Projects (REFs) are located within a 35 km radius of the Rheboksfontein WEF site (Figure 3.5). The majority projects are WEFs, with a few smaller solar projects. Only two REFs are currently operational, namely the Darling WEF located adjacent to the site, and the Umoyo WEF located south-east of Hopefield. A number of proposals and authorisations have been abandoned. A brief overview of REFs is provided below.

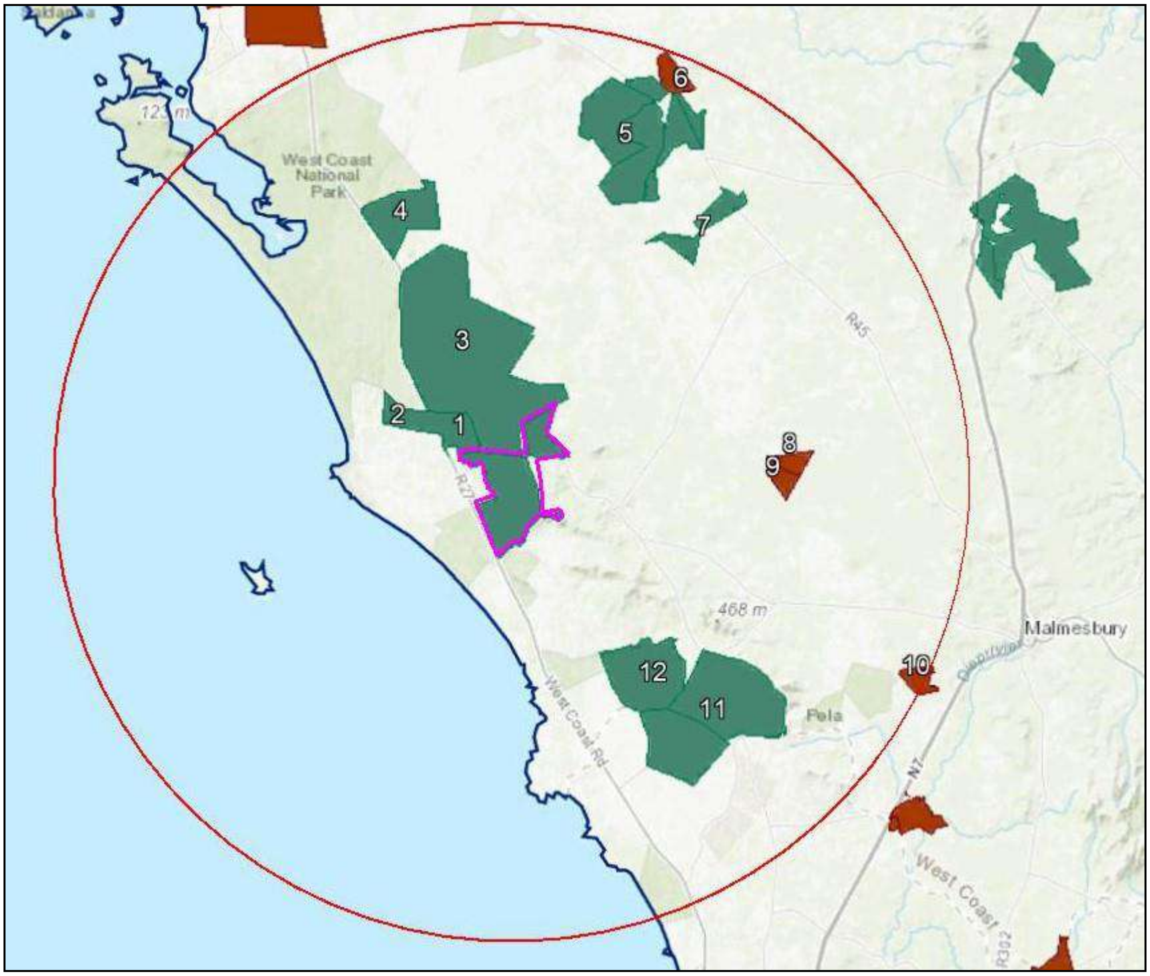


Figure 3.5: Renewable energy facilities within 35 km radius (red circle) of the Rheboksfontein WEF site (pink outline) (Source: DEA[24]).

The Darling Wind Farm (1) located on Windhoek farm adjacent to the north-west of the site is the oldest commercial WEF in South Africa, and the first to produce power in terms of government's IPP programme. Construction started early in 2007. Construction spend was around R70 million. Fourteen direct employment opportunities were created per MW of installed capacity. An additional 30 indirect opportunities were created by construction activities. The WEF started commercial operation on 1 May 2008.[25] The facility currently provides dedicated permanent employment to 2 persons. No staff reside on-site.

The current facility consists of 4 identical turbines with a total capacity of 5.2 MW (1.3 MW each). The hub height is 50 m, i.e. almost 3 times less than ones proposed for the Rheboksfontein WEF (130 m), and the rotor diameter (62 m) substantially

[24] Base image and information in this section based on the DEFF's renewable energy online viewer: https://portal.environment.gov.za/portal/apps/webappviewer/index.html?id=1c45081a7f65490c9ce58fad88e3b9e3

[25] http://darlingwindfarm.com/index.html

smaller (vs. 170 m)[26]. The turbines are clearly visible from portions of the R27, R315 and many adjacent properties.

As the oldest commercially operational WEF, it was an early media source for imagery illustrating renewable energy in South Africa. The use of stock images and footage has since made the facility recognizable to many South Africans. It continues to be the WEF located in closest proximity to Cape Town and is therefore attractive to the film and advertising industries for hosting shoots. Proximity to the R27 and R315 also exposes the WEF to many people, and the turbines have become a landmark. Both Mr Smit (owner of Windhoek) and the Darling Tourism Office have indicated that they regularly receive requests from tourists wishing to visit the facility. A proposal to enlarge the existing facility by 4 turbines (165 m hub heights) was submitted earlier in 2020.

The 20-21 MW Kerriefontein and Darling WEF (2) was an earlier proposed extension of the Darling WEF on Windhoek and some adjacent properties. The 2010 application called for an additional 14 turbines. The EIA application was approved in 2011. Approval has since lapsed.[27]

The Slangkop WEF (3) (capacity unknown) was approved on a number of contiguous properties to the west and north of the Rheboksfontein site in 2014. The project's bidding status in terms of the IPP programme is unclear. No infrastructure has been developed yet.

The application for the 50 MW Langefontein WEF (4) proposed near the Langebaan Lagoon in 2010 has since been withdrawn.

The Umoya Energy WEF (3), more commonly referred to as the Hopefield WEF, is also located along the R45 south-east of Hopefield. The WEF was constructed in 2013 and has an installed capacity of 66.6 MW. The WEF consists of 37 x 1.8 MW Vestas V100 turbines located on both sides of the R45. The turbines have a hub height of 85 m. Umoya's core CSI education programme provides financial support for 3 local schools as well as a scholarship programme open to applicants within a 50 km radius. Umoya's Hopefield Home Improvement Project saw the training of 18 local artisans over a two-year period, and the awarding of 3-year contracts to 3 of the trainees as part of its Entrepreneurship Incubation Programme.[28]

The proposed Hopefield Community Solar PV (6) project directly to the east of Umoya appears to be dormant. A BAR was submitted in 2014, but no approval has been obtained yet.

The application for the WEF proposed in 2011 on the farm Karbonadieskraal (7) has since been withdrawn.

The Eenboom SEF (5), a 5MW Solar PV facility located between Darling and Malmesbury was approved around 2010. The project's bidding status in terms of the IPP programme is unclear. No infrastructure has been developed yet. The Diepkuil SEF (6), a 9.5 MW Solar PV facility located adjacent to the east of the proposed Eenboom SEF, was approved around 2011, and an amended application around

[26] https://www.thewindpower.net/windfarm_en_4098_darling.php
[27] http://www.sandrarippon.co.za/kerriefontein.php
[28] https://umoyaenergy.co.za/community/#more-10

2015. The project's bidding status in terms of the IPP programme is unclear. No infrastructure has been developed yet.

The 19 MW Tygerfontein Solar PV (10) facility south-west of Malmesbury was approved in 2012. The project's bidding status in terms of the IPP programme is unclear. No infrastructure has been developed yet.

It is unclear when the 56 MW Groene Kloof WEF (11) located near Mamre was initially approved in 2012. Amendment applications were approved around 2015 and 2018. The project's bidding status in terms of the IPP programme is unclear. No infrastructure has been developed yet. The same information also pertains to the proposed Clover Valley WEF (12) located adjacent to the Groene Kloof WEF (proposed capacity unknown).

SECTION 4: ASSESSMENT OF SOCIAL ISSUES

4.1 INTRODUCTION

Section 4 provides an assessment of the key social issues identified during the study. The identification of key issues was based on:

- Review of project related information;
- Interviews with key interested and affected parties;
- Experience/ familiarity of the authors with the area and local conditions;
- Experience with similar projects.

The assessment section is divided into the following sections:

- Assessment of compatibility with relevant policy and planning context ("planning fit";
- Assessment of social issues associated with the construction phase;
- Assessment of social issues associated with the operational phase;
- Assessment of social issues associated with the decommissioning phase.
- Assessment of the "no development" alternative;
- Assessment of cumulative impacts.

4.2 ASSESSMENT OF POLICY AND PLANNING FIT

The findings of the review indicate that renewable energy is strongly supported at a national, provincial and local level. At a national and provincial level the development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a district and local level the WCDM and SLM IDP and SDF, all support the establishment of renewable facilities. The SLM IDP also indicates that that the Rheboksfontein WEF is located in an Alternative Energy Area (Area A). The site has therefore been identified as suitable for the establishment of energy facilities, including WEFs.

4.3 CONSTRUCTION PHASE SOCIAL IMPACTS

The key social issues associated with the construction phase include:

Potential positive impacts
- Creation of employment and business opportunities.

Potential negative impacts
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site;
- Increased risk of grass fires associated with construction related activities;
- Noise, dust, waste and safety impacts of construction related activities and vehicles.

4.3.1 Creation of local employment and business opportunities

Based on the information from similar WEF projects the capital expenditure will be in the region of R 2 billion (2020 Rand Values) and create approximately 120 direct employment opportunities for a period of 18 months. Approximately 25% (or 30) of opportunities will be available to skilled personnel (engineers, technicians, management and supervisory), 35% (or 42) to semi-skilled personnel (drivers, equipment operators), and 40% (or 48) to low skilled personnel (construction labourers, security staff).

Members from the local community in the area are likely to be in a position to qualify for the majority of the low skilled and a proportion of the semi-skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members from the SLM community. The towns that are likely to benefit are Darling, Malmesbury and Yzerfontein. The creation of potential employment opportunities, even temporary employment, will represent a localised social benefit.

The wage bill associated with the construction phase is estimated at R30 million for the 18-month construction phase (2020 Rand values). A percentage of the wage bill will therefore be spent in the local economy over the 18-month construction phase. This will create opportunities for local businesses in the area. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. This is confirmed by the experience with the other renewable projects. The potential opportunities for the local service sector are linked to accommodation, catering, cleaning, transport and security, etc. associated with the construction workers on the site.

Given the location of the site, the majority of suitably qualified and experienced companies that can provide key services, such as construction and engineering companies, are likely to be based in Cape Town and the Cape Town Metropolitan area. A number of renewable energy related companies have become established in the Atlantis Special Economic Zone (SEZ), which is located ~ 30 km to the south of the WEF site.

The potential benefits for local communities are confirmed by the findings of the Overview of the Independent Power Producers Procurement Programme (IPPPP) undertaken by the Department of Energy, National Treasury and DBSA (March 2019). The study found that to date, a total of 40 134 job years[29] have been created for South African citizens, of which 33 019 job years were in construction and 7 115 in operations. These job years should rise further past the planned target as more projects enter the construction phase. Employment opportunities across all five active bid windows are 101% of the planned number during the construction phase (i.e. 32 602 job years), with 26 projects still in construction and employing people as of March 2019. The number of employment opportunities is therefore likely to continue to grow beyond the original expectations. By the end of March 2019, 64 projects had successfully completed construction and moved into operation. These projects created 31 633 job years of employment, compared to the anticipated 20 689. This was 53% more than planned.

[29] The equivalent of a full time employment opportunity for one person for one year

The report notes that employment thresholds and targets were consistently exceeded across the entire portfolio. The average share of South African citizens of total South Africa based employees for BW1 – BW4 was 89% during construction (against a target of 80%), while it was 95% during operations for BW1 – BW3 (against a target of 80%). In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. The expectation for local community participation was 13 058 job years. To date 18 253 job years have been realised (i.e. 140% more than initially planned), with 26 projects still in construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 22%.

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 79%, 41% and 49% of total job opportunities created by IPPs to date. The study also found that the share of black citizens employed during construction (79%) had significantly exceeding the 50% target. Likewise, the share of skilled black citizens (as a percentage of skilled employees) for both construction (67%) and operations (79%) has also exceeding the 30% target and is at least 3.5 times more than the minimum threshold of 18%. The study also found that the share of local community members as a share of SA-based employees was 49% and 67% for construction and operations respectively – exceeding the minimum threshold of 12% and more than 2.5 times more than the target of 20%.

Table 4.1: Impact assessment of employment and business creation opportunities during the construction phase

Nature: Creation of employment and business opportunities during the construction phase		
	Without Mitigation	**With Enhancement**
Extent	Local – Regional (3)	Local – Regional (4)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	Medium (44)	Medium (56)
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: Opportunity to up-grade and improve skills levels in the area.		
Residual impacts: Improved pool of skills and experience in the local area.		

Assessment of No Go option
There is no impact, as the current status quo will be maintained.

Recommended enhancement measures
In order to enhance local employment and business opportunities associated with the construction phase the following measures should be implemented.

Employment

- Where reasonable and practical the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. Due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area;
- Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria;
- Before the construction phase commences the proponent should meet with representatives from the SLM to establish the existence of a skills database for the area. If such as database exists it should be made available to the contractors appointed for the construction phase;
- The local authorities, relevant community representatives and local farmers should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project;
- Where feasible a training and skills development programmes for local workers should be initiated prior to the initiation of the construction phase;
- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Business

- The proponent should liaise with the SLM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors. These companies should be notified of the tender process and invited to bid for project-related work;
- Where possible, the proponent should assist local BBBEE companies to complete and submit the required tender forms and associated information.
- The SLM, in conjunction with the local business sector and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.

4.3.2 Impact of construction workers on local communities

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour of male construction workers, including:

- An increase in alcohol and drug use;
- An increase in crime levels;
- The loss of girlfriends and or wives to construction workers;
- An increase in teenage and unwanted pregnancies;
- An increase in prostitution;
- An increase in sexually transmitted diseases (STDs).

The project will provide approximately 120 direct employment opportunities for a period of 18 months. As indicated above, the direct employment opportunities for members from the local Darling community is likely to be limited to low skilled opportunities, which account for approximately 48 jobs. Given the proximity of the site to the City of Cape Town and large towns in the Swartland (Malmesbury) and Boland (Paarl, Wellington), it is likely that contractors from the areas would be appointed. Experience has shown that the potential social impacts associated with construction workers are typically associated with low-skilled workers and not the more skilled workers. However, given the relative proximity of the site to the Cape Town and other large towns in the Swartland and Boland, it would be relatively easy to transport workers to and from site on a daily basis. Some skilled and semi-skilled personnel may be accommodated in nearby towns such as Darling or Yzerfontein. In this regard Moyeng Energy has indicated that construction workers will be transported onto and off site on a daily basis. Exposure to farm workers and their families is therefore expected to be minimal. The potential risk posed by construction workers on local communities is therefore not likely to represent a significant social issue. Employing local community members for the low skilled jobs will also assist to effectively mitigate the potential risks associated with construction workers in the area.

Table 4.2: Assessment of impact of the presence of construction workers in the area on local communities

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short term for community as a whole (2)	Short term for community as a whole (2)
Magnitude	Moderate for the community as a whole (6)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	Medium for the community as a whole (30)	Low for the community as a whole (21)
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	
Mitigation: See below		
Cumulative impacts: Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.		
Residual impacts: See cumulative impacts.		

Assessment of No Go option
There is no impact as the current status quo would be maintained.

Recommended mitigation measures
The potential risks associated with construction workers can be effectively mitigated. The detailed mitigation measures should be outlined in the Environmental Management Plan (EMP) for the Construction Phase. Aspects that should be covered include.

- Where possible the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories;
- The proponent should consider the need for establishing a Monitoring Forum (MF) in order to monitor the construction phase and the implementation of the recommended mitigation measures. The MF should be established before the construction phase commences, and should include key stakeholders, including representatives from the SLM, farmers and the contractor(s). The MF should also be briefed on the potential risks to the local community and farm workers associated with construction workers;
- The proponent and the contractor(s) should, in consultation with representatives from the MF, develop a code of conduct for the construction phase. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be dismissed. All dismissals must comply with the South African labour legislation;
- The proponent and contractor (s) should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;
- The contractor should provide transport to and from the site on a daily basis for low and semi-skilled construction workers. This will enable the contractor to effectively manage and monitor the movement of construction workers on and off the site;
- Where necessary, the contractors should make the necessary arrangements to enable low and semi-skilled workers from outside the area to return home over weekends and/ or on a regular basis. This would reduce the risk posed to local family structures and social networks;
- It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

4.3.3 Influx of job seekers

Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the manner in which they conduct themselves can impact on the local community.

Experience from other projects has also shown that the families of job seekers may accompany individual job seekers or follow them at a later date. In many cases the families of the job seekers that become "economically stranded" and the construction workers that decided to stay in the area, subsequently moved to the area. The influx of job seekers to the area and their families can also place pressure on the existing services in the area, specifically low-income housing. In addition to the pressure on local services the influx of construction workers and job seekers can also result in competition for scarce employment opportunities. Further secondary impacts included increase in crime levels, especially property crime, as a result of the increased number of unemployed people. These impacts can result in increased tensions and conflicts between local residents and job seekers from outside the area.

These issues are similar to the concerns associated with the presence of construction workers and are discussed in Section 4.3.2. However, in some instances the potential impact on the community may be greater given that they are unlikely to have accommodation and may decide to stay on in the area. In addition, they will not have a reliable source of income. The risk of crime associated with the influx of job seekers may therefore be greater. However, the potential for economically motivated in-migration and subsequent labour stranding in the area linked to the proposed project is likely to be low. This is due to the location of the site and the relatively small size of the project (140MW), the limited employment opportunities (~120) and short duration of the construction phase (18 months). There are also limited economic opportunities in area, specifically Yzerfontein and Darling. The risks associated with job seekers being attracted to and staying on in the area will therefore be low.

Table 4.3: Assessment of impact of job seekers on local communities associated with the construction phase

Nature: Potential impacts on family structures, social networks and community services associated with the influx of job seekers		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Permanent (5) (For job seekers that stay on the town)	Permanent (5) (For job seekers that stay on the town)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	Low (27)	Low (24)
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	
Mitigation: See below		
Cumulative impacts: Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.		
Residual impacts: See cumulative impacts.		

Assessment of No Go option
There is no impact as the current status quo would be maintained.

Recommended mitigation measures
It is not possible to prevent job seekers from coming to the area in search of a job. However, as indicated above, due to the location of the site the potential influx of job seekers to the area as a result of the proposed WEF will be low. In addition:

- The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities.

4.3.4 Risk to safety, livestock, farm infrastructure and farming operations

The presence on and movement of construction workers on and off the site may pose a potential safety threat to local famer's and farm workers in the vicinity of the site threat. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged or stock theft linked either directly or indirectly to the presence of farm workers on the site. The local farmers in the area interviewed indicated that the presence of construction workers on the site increased the exposure of their farming operations and livestock to the outside world, which, in turn, increased the potential risk of stock theft and crime.

The proposed WEF site and adjacent area is primarily used for mixed commercial farming and conservation. All the properties affected by the proposed Rheboksfontein site farm sheep, which are vulnerable to stock theft. Sheep theft is currently problematic in the study area. The local farmers interviewed did, however, indicate that the potential risks (safety, livestock and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction on the site workers during the construction phase. Moyeng Energy has indicated that construction workers will not be housed on-site

Table 4.4: Assessment of risk to safety, livestock, infrastructure and farming operations

Nature: Potential risk to safety of scholars, farmers and farm workers, livestock and damage to farm infrastructure associated with the presence of construction workers on site		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Medium (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium (33)	Low (24)
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses and damage to farm infrastructure etc.	Yes, compensation paid for stock losses and damage to farm infrastructure etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: See below		
Cumulative impacts: No**,** provided losses are compensated for.		
Residual impacts: See cumulative impacts.		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
Key mitigation measures include:

- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase proven to be associated with the construction activities for the WEF will be compensated for. The agreement should be signed before the construction phase commences;
- Contractors appointed by the proponent should provide daily transport for workers to and from the site. This would reduce the potential risk of trespassing on the remainder of the farm and adjacent properties;
- The proponent should consider the option of establishing a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. This committee should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site;
- The proponent should hold contractors liable for compensating farmers in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below);

- The Environmental Management Programme (EMP) should outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested;
- Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.
- Contractors appointed by the proponent must ensure that construction workers who are found guilty of trespassing, stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation;
- The housing of construction workers on the site should be limited to security personnel.

4.3.5 Increased fire risk

The presence of construction workers and construction-related activities on the site poses an increased fire risk, which could, in turn, pose a threat grazing and livestock. The potential fire risk of grass fires is highest towards the end of the dry summer months (November-March). This period also coincides with dry, windy conditions in the area. The local fynbos vegetation is fire prone, especially over the hot, dry summer months. In addition, a number of properties are infested with alien vegetation (*Acacia* spp.), specifically some of the properties located to the west of the R27. The risk of veld fires therefore exists.

Table 4.5: Assessment of impact of increased risk of fires

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires		
	Without Mitigation	**With Mitigation**
Extent	Local (4)	Local (2)
Duration	Short term (2)	short term (2)
Magnitude	Moderate due to reliance on agriculture for maintaining livelihoods (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium (36)	Low (24)
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and crop losses etc.	Yes, compensation paid for stock and crop losses etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: See below		
Cumulative impacts: No, provided losses are compensated for.		
Residual impacts: See cumulative impacts.		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The mitigation measures include:

- The proponent should enter into an agreement with the local farmers in the area whereby losses associated with fires that can be proven to be associated with the construction activities for the WF will be compensated for. The agreement should be signed before the construction phase commences;
- Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas;
- No smoking should be permitted on site, except in designated areas;
- Contractor should ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the higher-risk dry, windy summer months;
- Contractor to provide adequate fire-fighting equipment on-site;
- Contractor to provide fire-fighting training to selected construction staff;
- No construction staff, with the exception of security staff, to be accommodated on site over night;

As per the conditions of the Code of Conduct, in the event of a fire proven to be caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire-fighting costs borne by farmers and local authorities.

4.3.6 Impacts associated with construction vehicles

The movement of heavy construction vehicles during the construction phase has the potential to damage local farm roads and create dust and safety impacts for other road users in the area and also impact on farming activities. The movement of construction traffic on the site should be limited to the relevant access road(s) and construction site.

The project components are likely to be transported to the site via the R27, which is an important tourist route between Cape Town and the West Coast. The transport of components to the site therefore has the potential to impact on other road users travelling along the R27, including tourists. Measures will need to be taken to ensure that the potential impact on motorist using the R27 is minimised. The potential impacts on tourists and locals can be effectively mitigated by restricting construction traffic movements to weekdays, and, where possible, limiting activities during over holiday periods, specifically Christmas and Easter holiday periods and other long weekends. The movement of heavy construction vehicles will also damage internal farm roads and other unsurfaced public roads that may be used to access the site. The damage will need to be repaired after the completion of the construction phase.

Experience from other projects also indicates that the transportation of construction workers to and from the site can result in the generation of waste along the route (packaging and bottles etc. thrown out of windows etc.)

Table 4.6: **Assessment of the impacts associated with construction vehicles**

Nature: Potential noise, dust and safety impacts associated with movement of construction related traffic to and from the site		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short Term (2)	Short Term (2)
Magnitude	Medium (6)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	Medium (30)	Low (15)
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: See below		
Cumulative impacts: If damage to local farm roads is not repaired then this will affect the farming activities in the area and result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were not responsible for the damage. Dust impacts to vineyards could also impact on future contracts.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option

There is no impact as it maintains the current status quo.

Recommended mitigation measures

The potential impacts associated with heavy vehicles can be effectively mitigated. The mitigation measures include:

- As far as possible, the transport of components to the site along the R27 should be planned to avoid weekends and holiday periods;
- The contractor should inform local farmers and representatives from the SLM and the Tourism representatives of dates and times when abnormal loads will be undertaken;
- The contractor must ensure that damage caused by construction related traffic to the gravel public roads and local, internal farm roads is repaired on a regular basis throughout the construction phase. The costs associated with the repair must be borne by the contractor;
- Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis[30], adhering to speed limits and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers;
- All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits;

[30] Treated effluent (non-potable) water should be used for wetting of roads and construction areas

- The Contractor should ensure that workers are informed that no waste can be thrown out of the windows while being transported to and from the site. Workers who throw waste out windows should be fined;
- The Contractor should be required to collect waste along access roads on a weekly basis;
- Waste generated during the construction phase should be transported to the local permitted landfill site.
- EMP measures (and penalties) should be implemented to ensure farm gates are closed at all times;
- EMP measures (and penalties) should be implemented to ensure speed limits are adhered to at all times.

4.3.7 Impacts on productive farmland due to construction activities

Activities such as the establishment of access roads, the movement of heavy vehicles, the establishment of lay-down areas and foundations for the wind turbines, as well as the establishment of substations and power lines will potentially damage topsoil and vegetation. As indicated above, all the affected landowners indicated that the movement should be limited to the access road(s) and construction site. The construction footprint should be minimized to mitigate the damage to the natural veld and disturbed areas should be rehabilitated upon completion of the construction phase.

Table 4.7: **Assessment of impact on farmland due to construction related activities**

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the WEF and power lines will damage farmlands and result in a loss of farmlands for grazing.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long term-permanent if disturbed areas are not effectively rehabilitated (5)	Short term if damaged areas are rehabilitated (2)
Magnitude	Medium (6)	Minor (2)
Probability	Probable (3)	Highly Probable (4)
Significance	Medium (36)	Low (20)
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable loss of resources?	Yes, loss of farmland. However, disturbed areas can be rehabilitated	Yes, loss of farmland. However, disturbed areas can be rehabilitated
Can impact be mitigated?	Yes, however, loss of farmland cannot be avoided	
Mitigation: See below		
Cumulative impacts: Overall loss of farmland could affect the livelihoods of the affected farmers, their families, and the workers on the farms and their families. However, disturbed areas can be rehabilitated.		

Residual impacts: See cumulative impacts.

Assessment of No-Go option

There would be no impact as the current status quo is maintained.

Recommended mitigation measures

With mitigation, the potential impacts on farming activities and livelihoods as a result of damage to and loss of farmland are assessed to be of low significance due to the relatively small portions of arable land likely to be affected. Impacts may be further reduced by the implementation of the following mitigation measures:

- The location of wind turbines, access roads, laydown areas etc. should be informed by the findings of the soil and vegetation study. In this regard areas of sensitive vegetation soils should be avoided;
- The footprint areas for the establishment of individual wind turbines should be clearly demarcated prior to commencement of construction activities. All construction related activities should be confined to the demarcated area and minimised where possible;
- An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase;
- All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. The rehabilitation plan should be informed by input from the soil scientist and discussed with the local farmer;
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed;
- The implementation of the Rehabilitation Programme should be monitored by the ECO;
- All workers should receive training/ briefing on the reasons for and importance of not driving in undesignated areas;
- EMP measures (and penalties) should be implemented to strictly limit all vehicle traffic to designated roads and construction areas. Under no circumstances should vehicles be allowed to drive into the veld;
- Disturbance footprints should be reduced to the minimum.
- Compensation should be paid by the developer to farmers that suffer a permanent loss of land due to the establishment of the WEF. Compensation should be based on accepted land values for the area.

4.4 OPERATIONAL PHASE SOCIAL IMPACTS

The key social issues associated with the operational phase include:

Potential positive impacts
- Establishment of renewable energy infrastructure.
- Creation of employment and business opportunities.
- Benefits associated with the establishment of a Community Trust.
- Benefits for affected landowners.

Potential negative impacts
- The visual impacts and associated impact on sense of place.
- Impact on property values and operations.
- Impact on tourism.

4.4.1 Development of renewable energy infrastructure

The establishment of renewable energy infrastructure, such as the proposed WEFs, should be viewed, firstly within the context of the South Africa's current reliance on coal powered energy to meet the majority of its energy needs, and secondly, within the context of the success of the REIPPPP.

Impact of a coal powered economy

The Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus making the greening of the electricity mix a national imperative. Within this context the study notes that the green economy could be an extremely important trigger and lever for enhancing a country's growth potential and redirecting its development trajectory in the 21st century. The study also identifies a number of advantages associated with wind power as a source of renewable energy with a large 'technical' generation potential. In this regard wind energy does not emit carbon dioxide (CO_2) in generating electricity and is associated with exceptionally low lifecycle emissions. The construction period for a wind farm is much shorter than that of conventional power stations, while an income stream may in certain instances be provided to local communities through employment and land rental. The study also notes that the greenhouse gases (GHG) associated with the construction phase are offset within a very short period of time compared with the project's lifespan. Wind power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, wind as energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The Greenpeace Report (powering the future: Renewable Energy Roll-out in South Africa, 2013), notes that within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations. Eskom uses an estimated 10 000 litres of water per second due to its dependency on coal (Greenpeace, 2012).

The National Climate Change Response White Paper outlines the national response to the impacts of climate change, as well as the domestic contribution to international efforts to mitigate green-house gas emissions. As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The emission reductions between March 2018 and 2019 are estimated to be 10.9 million tonnes of CO2. This represents 53% of the total projected annual emission reductions achieved with only partial operation to date. Since operation, the IPPs have generated 35 699 GWh, resulting in 36.2 Mton of CO2 emissions being offset and saving 42.8 million kilolitres of water related to fossil fuel power generation.

The REIPPPP therefore contributes significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability and environmental sustainability.

Benefits associated with REIPPPP

The overview of the IPPPP (March 2019) indicates that the REIPPPP has attracted R41.8 billion in foreign investment and financing in the seven bid windows (BW1 – BW4, 1S2 and 2S2). This is more than double the inward FDI attracted into South Africa during 2015 (R22.6 billion). In terms of local equity shareholding, 52% (R31.5 billion) of the total equity shareholding (R61.0 billion) was held by South African's across BW1 to BW4, 1S2 and 2S2. This equates to substantially more than the 40% requirement. Foreign equity amounts to R 29.5 billion and contributes 48% to total equity. As far as Broad Based Black Economic Empowerment is concerned, Black South Africans own, on average, 33% of projects that have reached financial close, which is slightly above the 30% target.

The total projected procurement spend for BW1 to BW4, 1S2 and 2S2 during the construction phase was R73.1 billion, while the projected operations procurement spend over the 20 years operational life is estimated at 76.8 billion. The combined (construction and operations) procurement value is projected as R149.9 billion of which R63.1 billion has been spent to date. For construction, of the R55.7 billion already spent to date, R51.1 billion is from the 64 projects which have already been completed. These 64 projects had planned to spend R50.4 billion.

The report notes that for a programme of this magnitude, with construction procurement spend alone estimated at R73.1 billion, the result is a substantial stimulus for establishing local manufacturing capacity. The report also notes that the strategy has prompted several technology and component manufacturers to establish local manufacturing facilities. The report also notes that this will improve with greater certainty relating to subsequent bid windows and further determinations will continue to build on these successes.

In terms of employment, to date, a total of 40 134 job years[31] have been created for South African citizens, of which 33 019 were in construction and 7 115 in operations. Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 79%, 41% and 49% of total job opportunities created by IPPs to date. These job years should rise further past the planned target as more projects enter the construction phase. The REIPPPP has also ensured that black people in local communities have ownership in the IPP projects that operate in or nearby their vicinities. On average, black local communities own 9% of projects that have reached financial close. This is well above the 5% target. In addition, an average of 19% shareholding by black people in engineering, procurement and construction (EPC) contractors has been attained for the 64 projects in operation (BW1, BW2 and BW3). This is slightly below the 20% target.

The socio-economic development (SED) contributions associated with eh 64 operational IPPs have to date amounted to R 860.1 million. The majority of the spend has been on education and skills development (40.9%), followed by enterprise development (24.2%), social welfare (21.3%), general administration (9%) and health care (4.5%). In terms of education, the IPPs have supported 1 044 education institutions, with a total spend of R 236.7 million between 2015 and March 2018. It is estimated that these contributions have benefitted in the region of 375 737 learners.

[31] The equivalent of a full time employment opportunity for one person for one year

The WWF (2014) study also notes that the REIPPPP requirement of 30% allocated to the local economic development has ensured that non-price criteria linked to socio-economic upliftment have a much heavier weighting than they would normally enjoy under Government's preferential procurement policy (WWF, 2014). The establishment of renewable energy facilities, such as the proposed WEF, therefore not only address the environmental issues associated with climate change and consumption of scarce water resources, but also creates significant socio-economic opportunities and benefits, specifically for historically disadvantaged, rural communities.

Table 4.8: Implementation of clean, renewable energy infrastructure

Nature: Development of infrastructure to generate clean, renewable energy		
	Without Mitigation	**With Mitigation**
Extent	Local, Regional and National (4)	Local, Regional and National (5)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Highly Probable (4)	Definite (5)
Significance	High (64)	High (85)
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	Reduced CO_2 emissions and impact on climate change
Can impact be mitigated?	Yes	
Enhancement: See below		
Cumulative impacts: Overall reduction in CO_2 emission, reduction in water consumption for energy generation, contribution to establishing an economically viable commercial renewables generation sector in the Western Cape and South Africa.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. This would represent a negative opportunity cost.

Recommended mitigation measures

Should the project be approved the proponent should:

- Implement a skills development and training programme aimed at maximizing the number of employment opportunities for local community members;
- Maximise opportunities for local content, procurement and community shareholding;
- Consider establishing a visitor centre. The findings of the SIA indicate that there are frequent requests by visitors to visit the existing Darling Wind Farm. The

literature review found that visitor centers in Scotland have attracted large numbers of visitors to wind farms.

4.4.2 Creation of employment and business opportunities and support for local economic development

Based on information from other wind projects the establishment of a 140 MW WF would create ~ 20 employment opportunities over a 20-year period. Of this total ~70 % will be low and semi-skilled and 30% skilled. The annual wage bill for the operational phase would be ~ R 3 million. The majority of employment opportunities associated with the operational phase is likely to benefit HD members from the local community. It will also be possible to increase the number of local employment opportunities through the implementation of a skills development and training programme linked to the operational phase. Such a programme would support the strategic goals of promoting employment and skills development contained in the NKLM and NDM. The operational phase will also require regular maintenance which will also create employment opportunities.

A percentage of the monthly wage bill earned by permanent staff will be spent in the regional and local economy. This will benefit local businesses in the relevant towns. The benefits to the local economy will extend over the anticipated 20-year operational lifespan of the project.

The local hospitality industry is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc.) who are involved in the company and the project but who are not linked to the day-to-day operations.

Procurement during the operational phase will also create opportunities for the local economy and businesses. In this regard the overview of the IPPPP (March 2019) notes that the operational phase procurement spend over the 20 year for BW1 to BW4, 1S2 and 2S2 will be in the region of R 73.1 billion. The combined (construction and operations) procurement value is projected as R149.9 billion of which R63.1 billion has been spent to date. For construction, of the R55.7 billion already spent to date, R51.1 billion is from the 64 projects which have already been completed. These 64 projects had planned to spend R50.4 billion. The actual procurement construction costs have therefore exceeded the planned costs by 1% for completed projects.

The Green Jobs study (2011) also found that energy generation is expected to become an increasingly important contributor to green job creation over time, as projects are constructed or commissioned. The study notes that largest gains are likely to be associated with operations and maintenance (O&M) activities. In this regard, operations and maintenance employment linked to renewable energy generation plants will also be substantial in the longer term.

The establishment of WFs, such as the proposed WEF, also supports the development of a green energy manufacturing sector in South Africa. The Green Jobs study (2011) found that South Africa is in a position to leverage upon some of its existing manufacturing capacities in order to produce components and parts for various sections of wind turbines. The study does however note that critical mass would have to be developed in order to obtain economies of scale. The establishment of WEFs, such as the proposed WEF, would therefore contribute to achieving this critical mass.

Table 4.9: Impact assessment of employment and business creation opportunities

Nature: Creation of employment and business opportunities associated with the operational phase		
	Without Mitigation	**With Enhancement**
Extent	Local and Regional (1)	Local and Regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Definite (5)
Significance	Low (27)	Medium (50)
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	No	No
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended enhancement measures
The enhancement measures listed to enhance local employment and business opportunities during the construction phase, also apply to the operational phase. In addition:

- The proponent should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project;
- The proponent, in consultation with the SLM, should investigate the options for the establishment of a Community Development Trust (see below).

4.4.3 Benefits associated with the establishment of a Community Trust

An important focus of the REIPPPP is to ensure that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. In this regard IPPs are required to contribute a percentage of projected revenues accrued over the 20-year project operational life toward socio-economic development (SED) initiatives. These contributions are linked to Community Trusts and accrue over the 20-year project operation life and are used to invest in housing and infrastructure as well as healthcare, education and skills development.

Community Trusts provide an opportunity to generate a steady revenue stream that is guaranteed for a 20-year period. This revenue can be used to fund development initiatives in the area and support the local community. The long-term duration of the revenue stream also allows local municipalities and communities to undertake long term planning for the area. The revenue from the proposed WEF plant can be used to support a number of social and economic initiatives in the area, including:

- Creation of jobs;
- Education;
- Support for and provision of basic services;
- School feeding schemes;
- Training and skills development;
- Support for SMME's.

Socio-economic development (SED) contributions

Socio-economic development (SED) contributions represent an important focus of the REIPPPP and is aimed at ensuring that e that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. In this regard IPPs are required to contribute a percentage of projected revenues accrued over the 20-year project operational life toward SED initiatives. These contributions accrue over the 20-year project operation life and are used to invest in housing and infrastructure as well as healthcare, education and skills development.

The SED contributions associated with the 64 IPPs has to date amounted to R 860.1 million. The majority of the spend has been on education and skills development (40.9%), followed by enterprise development (24.2%), social welfare (21.3%), general administration (9%) and health care (4.5%). In terms of education, the IPPs have supported 1 044 education institutions, with a total spend of R 236.7 million between 2015 and March 2018. It is estimated that these contributions have benefitted in the region of 375 737 learners.

The province with the highest SED contribution has been the Northern Cape Province, followed by the Eastern Cape and Western Cape.

Enterprise development contributions

The target for IPPs to spend on enterprise development is 0.6% of revenues over the 20- year project operational life. Enterprise development contributions committed for BW1 to BW4, 1S2 and 2S2 amount to R7.2 billion. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of March 2019 a total of R 254.3 million had already been made to the local communities located in the vicinity of the 64 operating IPPs.

The Green Jobs study (2011), found that the case for wind power is enhanced by the positive effect on rural or regional development. Wind farms located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues. The findings of the thesis by Tait (2012) also note that the distributed nature of renewable energy generation can induce a more geographically dispersed pattern of development. As a result renewable energy sites can be highly suited to rural locations with otherwise poor potential to attract local inward investment thus able to target particularly vulnerable areas. In her conclusion Tait notes that thesis found positive evidence for the establishment of community benefit schemes in the wind sector in South Africa. The BBBEE requirements for developers as set out in the DoE's IPPPP for renewables was the primary driver for such schemes. The procurement programme, in keeping with the objective of maximising the economic development potential from this new sector, includes a specific focus on local communities in which wind farms are located.

Based on the findings of the review it is clear that the establishment of Community Trusts associated with renewable energy projects create significant benefits for local rural communities. In addition to the benefits for local communities, the establishment of a WF has a limited impact on the current agricultural land uses that underpin the local economic activities in the area and consumes negligible volumes of water during the operational phase. Based on the findings of the review it is clear that the establishment of Community Trusts associated with renewable energy projects have the potential to create significant benefits for local rural communities. However, Community Trusts can also be mismanaged. This is an issue that will need to be addressed when setting up the trust.

Table 4.10: Assessment of benefits associated with establishment of community trust

Nature: Establishment of a community trust funded by revenue generated from the sale of energy. The revenue can be used to fund local community development		
	Without Mitigation	**With Enhancement**[32]
Extent	Local and Regional (2)	Local and Regional (3)
Duration	Long term (4)	Long term (4)
Intensity	Low (4)	Moderate (6)
Likelihood	Probable (3)	Definite (5)
Significance	Medium (30)	High (65)
Status	Positive	Positive
Reversibility	Yes	Yes
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: Promotion of social and economic development and improvement in the overall well-being of the community		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo. However, the potential opportunity costs in terms of the supporting the social and economic development in the area would be lost.

Recommended enhancement measures
In order to maximise the benefits and minimise the potential for corruption and misappropriation of funds the following measures should be implemented:

[32] Enhancement assumes effective management of the community trust

- The SLM should be consulted as to the structure and identification of potential trustees to sit on the Trust. The key departments in the SLM that should be consulted include the Municipal Managers Office, IDP Manager and LED Manager;
- Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community;
- Strict financial management controls, including annual audits, should be instituted to manage the funds generated for the Community Trust from the WEF.

4.4.4 Generate income for affected landowners

The proponent has entered into rental agreements with the affected landowners for the use of the land for the establishment of the proposed WEF. In terms of the rental agreement the affected landowner(s) will be paid an annual amount dependent upon the number of wind turbines located on the property. Based on the findings of the SIA the area is prone to droughts and farming operations can be challenging. Any additional source of income therefore represents a significant benefit for the affected landowner(s). The additional income reduces the risks to their livelihoods posed by droughts and fluctuating market prices for livestock and farming inputs, such as fuel, feed etc. The additional income from the WEF would improve economic security of farming operations, which in turn would improve job security of farm workers and benefit the local economy.

Table 4.11: Assessment of benefits associated with income generated for affected farmer(s)

Nature: The generation of additional income represents a significant benefit for the local affected farmer(s) and reduces the risks to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as feed etc. (+)		
	Without Mitigation	**With Enhancement**[33]
Extent	Local (1)	Local (3)
Duration	Long term (4)	Long term (4)
Intensity	Low (4)	Moderate (6)
Likelihood	Probable (3)	Definite (5)
Significance	Low (27)	Medium (53)
Status	Positive	Positive
Reversibility	Yes	Yes
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: Support for local agricultural sector and farming		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

[33] Enhancement assumes effective management of the community trust

Recommended enhancement measures
Implement agreements with affected landowners.

4.4.5 Impact on sense of place and rural character of the landscape

The potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. A number of interviewees also indicated that the existing Darling WEF has become well known landmark in in the area. In this regard the owner of the Darling WEF and Darling Tourism Office routinely receive requests from tourists to visit the Darling WEF facility. Due to its proximity to Cape Town the WEF is also frequently used for film shoots and commercials.

The manager of !Kwa Tuu, Mr Daiber, indicated that the key views from the facility area to the west (Atlantic) and south (Table Mountain) and not towards the WEF site. The context is not pristine, and while the addition of industrial infrastructure is not ideal, it is unlikely to significantly affect visitor flows to !Kwa tuu (Daiber, pers. comm). Mr Fourie from the Doornfontein Wildlife Estate indicate that the turbines are located sufficiently distant not to have any potentially adverse impact on the operation (Fourie, pers. comm). The representative for the Tienie Versfled Wild Flower Reserve indicated that the nearest turbine would be located 1.5 km from the reserve and was unlikely to impact on visitor numbers (Burger, pers. comm). Mr Duckitt from the Rondeburg Private Nature Reserve indicated that the none of the turbine locations are considered intrusively close to Rondeberg PNR and associated residential uses (Duckitt, pers. comm).

The owner of Alexanderfontein Farm, Mr Nicolaas Basson, indicated that he prepared to live with the WEF, providing that 2 specific problematic wind turbine locations are either located or the turbines are removed. The relevant two turbines (locations 34 and 35, Figure 4.1) are located within in 1.2 km and 900 m respectively of the newly established entertainment facility (See Section 3.5) and impact on the views from the facility.

Figure 4.1: Location of new entertainment facility in relation to turbines 34 and 35 deemed unacceptability intrusive by Mr Basson. The facility was built

None of the other landowners in the area interviewed raised issues or concerns with regard to turbine locations or increased hub heights and rotor diameters. This is largely linked to the facts that the hub height (+10 m) and rotor diameter (+38 m) increases are relatively small and that turbines located in potentially sensitive areas have been removed, reducing the number of turbines from 80 in 2010 to 48 in 2012 to 35 in 2015 to 33 in 2020.

The Rheboksfontein WEF is also located within an Alternative Energy Area (Area A). Based on the findings of the SIA the significance is rated as **Low Negative**. <u>However, as indicated above, turbine 34 and 35 should be relocated.</u>

Table 4.12: Assessment of visual impact on sense of place

Impact pathway: Construction activities		
Nature: Visual impact associated with the proposed solar facility and the potential impact on the area's rural sense of place.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (4)	Highly Probable (4)
Significance	Medium (32)	Low (28)
Status	Negative	Negative
Reversibility	Yes, solar facility can be removed.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: See below		
Cumulative impacts: Potential impact on current rural sense of place		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
- The recommendations contained in the VIA should be implemented;
- <u>Recommended that the applicants meet with the affected landowners to discuss the possibility relocating wind turbines that have the highest potential visual impact. As indicated above, turbine 34 and 35 should be relocated.</u>

4.4.6 Potential impact on property values

As indicated in Section 2.5, a literature review was undertaken as part of the SIA. It should be noted that the review does not constitute a property evaluation study and merely seeks to comment on the potential impact of wind farms on property values based on the findings of studies undertaken overseas. The assessment rating is based on the findings of the review.

In total five articles were identified and reviewed namely:

- Stephen Gibbons (April, 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre, SERC Discussion Paper 159;
- Review of the Impact of Wind Farms on Property Values, Urbis Pty Ltd (2016): Commissioned by the Office of Environment and Heritage, NSW, Australia;
- Yasin Sunak and Reinhard Madlener (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing. School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University. Model Working Paper No. 3/2012;
- Martin D. Heintzelman and Carrie M. Tuttle (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University;
- Ben Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory.

The literature reviewed was based on an attempt by the authors of the SIA to identify what appear to be "academically and or scientifically" based studies that have been undertaken by reputable institutions post 2010. However, the literature review does not represent an exhaustive review. The key findings of the literature review are summarised below.

Stephen Gibbons (April, 2014)

The overall findings of the study indicate that wind farms reduce house prices in postcodes where the turbines are visible, and reduce prices relative to postcodes close to wind farms where the wind farms are not visible. The overall finding is that "averaging over wind farms of all sizes, this price reduction is around 5-6% within 2km, falling to less than 2% between 2 and 4km, and less than 1% by 14km which is at the limit of likely visibility". The study notes that small wind farms have no impact beyond 4km, whereas the largest wind farms (20+ turbines) reduce prices by 12% within 2km, and reduce prices by small amounts right out to 14km (by around 1.5%).

Martin D. Heintzelman and Carrie M. Tuttle (March, 2011)

The findings of the study indicate that nearby wind facilities significantly reduce property values. In this regard, based on the repeat sales model, the construction of turbines within 0.5 miles (0.8 km) of the property resulted in a 10.87%-17.77% decline in sales price depending on the initial distance to the nearest turbine and the particular specification. At a distance of 1 mile (1.6km) (about 20% of the sample), the decline in value was between 7.73% and 14.87%. The study notes that from a policy perspective, these results indicate that there is a need to compensate local homeowners/communities for allowing wind development within their borders.

The paper concludes that the results of the study appear to indicate that proximity to wind turbines does have a negative and significant impact on property values. Importantly, the best and most consistent measure of these effects appears to be the simple, continuous, proximity measure, the (inverse distance) to the nearest turbine.

Ben Hoen, et al (August 2013)
The study was based on data from more than 50 000 home sales among 27 counties in nine states of the USA. The homes were located within 10 miles of 67 different wind facilities, and 1 198 sales were within 1 mile (1.6 km) (331 of which were within a half mile (0.8km)) of a turbine. The findings of the study indicated that across all model specifications, there was no statistical evidence that home prices near wind turbines were affected in either the post-construction or post-announcement/pre-construction periods. Therefore, if effects do exist, either the average impacts are relatively small (within the margin of error in the models) and/or sporadic (impacting only a small subset of homes). In addition, the sample size and analytical methods enabled the study to bracket the size of effects that would be detected, if those effects were present at all.

Based on the results, the study found that it is *highly unlikely* that the actual average effect for homes that sold in the sample areas within 1 mile of an existing turbine is larger than +/-4.9%. In other words, the average value of these homes could be as much as 4.9% higher than it would have been without the presence of wind turbines, as much as 4.9% lower, the same (i.e., zero effect), or anywhere in between. Similarly, it is highly unlikely that the average actual effect for homes sold in the sample area within a half mile of an existing turbine is larger than +/-9.0%. In other words, the average value of these homes could be as much as 9% higher than it would have been without the presence of wind turbines, as much as 9% lower, the same (i.e., zero effect), or anywhere in between. The study notes that, regardless of these potential maximum effects, the core results of the study consistently show no sizable statistically significant impact of wind turbines on nearby property values.

Urbis Pty Ltd (2016)
Based on the outcome of the study the authors were of the opinion that wind farms may not significantly impact rural properties used for agricultural purposes. However, the study found that there is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas. In conclusion, the authors of the Urbis study found:

- Appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values;
- There is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas.

Based on the findings of the literature review the potential impact of WEFs on rural property values is likely to be low. This was confirmed by the feedback from the local landowners interviewed, none of whom raised concerns about the potential impact on property values.

Table 4.13: Assessment of potential impact on property values and operations

Nature: Potential impact of the WEF on property values		
	Without Mitigation	**With Enhancement / Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	Low (24)	Low (24)
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: The proposed WEF is one of a number of WEFs proposed in the area. However, site is located in an Alternative Energy Area (Area A) and has therefore been identified as suitable for WEFs.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
- The recommendations contained in the VIA should be implemented;
- Recommended that the applicants meet with the affected landowners to discuss the possibility relocating wind turbines that have the highest potential visual impact.

4.4.7 Potential impact on tourism

A review of international literature in the impact of wind farms was undertaken as part of the SIA (Section 2.6). The key findings are summarised below. Three articles were reviewed, namely:

- Atchison, (April, 2012). Tourism Impact of Wind Farms: Submitted to Renewables Inquiry Scottish Government. University of Edinburgh
- Glasgow Caledonian University (2008). The economic impacts of wind farms on Scottish tourism. A report prepared for the Scottish Government
- Regeneris Consulting (2014). Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector

The research by Aitchison (2012) found that that previous research from other areas of the UK has demonstrated that wind farms are very unlikely to have any adverse impact on tourist numbers (volume), tourist expenditure (value) or tourism experience (satisfaction) (Glasgow Caledonian University, 2008; University of the

West of England, 2004). In addition, to date, there is no evidence to demonstrate that any wind farm development in the UK or overseas has resulted in any adverse impact on tourism. In conclusion, the findings from both primary and secondary research relating to the actual and potential tourism impact of wind farms indicate that there will be neither an overall decline in the number of tourists visiting an area nor any overall financial loss in tourism-related earnings as a result of a wind farm development.

In addition, all of the studies that have sought to predict impact have demonstrated that any negative impact of wind farms on tourism will be more than outweighed by the increase in tourists that are attracted by wind farms, by the increase in employment brought about by the development of wind farms and/or by the continuing growth of tourism. The study by the Glasgow Caledonian University (2008) found that only a negligible fraction of tourists will change their decision whether to return to Scotland as a whole because they have seen a wind farm during their visit. The study also found that 51.0% of respondents indicated that they thought wind farms could be tourist attractions. In this regard the visitor centre at the Whitelee Wind Farm in east Ayrshire Scotland run by ScottishPower Renewables has become one of the most popular ‘eco-attractions’ in Scotland, receiving 200 000 visitors since it opened in 2009.

The study by Regeneris Consulting (2014) found that there was no evidence that wind farms would deter tourists from traveling along designated visitor or tourists routes. The study indicated that small minorities of visitors would be encouraged, whilst others would be discouraged. Overall, however, there was no evidence to suggest that there would be any significant change in visitor numbers using these routes to reach destination elsewhere.

Based on the findings of the literature review there is limited evidence to suggest that the proposed WEF would impact on the tourism in the SLM at a local and regional level. The findings also indicate that wind farms do not impact on tourist routes. Also, as indicated above, a number of interviewees indicated that the existing WEF has become well known landmark and the owner of the Darling WEF and the Darling Tourism Office routinely receive requests from tourists to visit the facility. The director of !Khwa tuu also indicated that the increased visibility associated with the larger wind turbines was unlikely to deter potential visitors.

Based on the findings of the SIA the significance is rated as **Low Negative**.

Table 4.14: Impact on tourism in the region

Nature: Potential impact of the WEF on local tourism		
	Without Mitigation	**With Enhancement / Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	Low (24) (Applies to both – and +)	Low (24) (Applies to both – and +)
Status	Negative (Potential to distract from the tourist experience of the area) Positive (Potential to attract people to the area)	Negative (Potential to distract from the tourist experience of the area) Positive (Potential to attract people to the area)
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impact be enhanced?	Yes	
Enhancement: See below		
Cumulative impacts: The proposed WEF is one of a number of WEFs proposed in the area.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures

- The recommendations contained in the VIA should be implemented.

4.5 ASSESSMENT OF DECOMMISSIONING PHASE

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 years post commissioning[34]. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning. The number of people employed during the operational phase will be in the region of 4. Given the low number of people employed during the operational phase the decommissioning of the facility will not

[34] There is also a possibility that the existing wind turbines may be replaced with new, more efficient turbines at the end of the first 20 year contract period. This would create additional employment opportunities and also ensure that the existing operational phase jobs are maintained.

have a significant negative social impact on the local community. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme.

The decommissioning phase will also create employment opportunities. This will represent a positive impact. These jobs will, however, be temporary.

Table 4.15: Impacts associated with decommissioning

Nature: Social impacts associated with retrenchment including loss of jobs, and source of income		
	Without Mitigation	**With Mitigation**
Extent	Local and regional (2)	Local and regional (1)
Duration	Medium Term (2)	Very Short Term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Medium (40)	Low (24)
Status	Negative	Negative
Reversibility	Yes, assumes retrenchment packages are paid to all affected employees	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: See below		
Cumulative impacts: Loss of jobs and associated loss of income etc. can impact on the local economy and other businesses. However, decommissioning can also create short term, temporary employment opportunities associated with dismantling etc.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The following mitigation measures are recommended:

- The proponent should ensure that retrenchment packages are provided for all staff retrenched when the WEF is decommissioned.
- All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning;
- The proponent should investigate the option of establishing an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 20-year operational life of the facility. The rationale for the establishment of a Rehabilitation Trust Fund is linked to the experiences with the mining sector in South Africa and failure of many mining companies to allocate sufficient funds during the operational phase to cover the costs of rehabilitation

and closure. Alternatively, the funds from the sale of the WEF as scrap metal should be allocated to the rehabilitation of the site.

4.6 CUMULATIVE IMPACT ON SENSE OF PLACE

The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. The key concerns in terms of cumulative impacts are linked to visual impacts and the impact on rural, undeveloped landscapes.

The Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. The relevant issues raised by the Scottish Natural Heritage Report include:

- Combined visibility (whether two or more wind farms will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
- The visual compatibility of different wind farms in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010). Research on wind farms undertaken by Warren and Birnie (2009) also highlights the visual and cumulative impacts on landscape character. The paper notes that given that aesthetic perceptions are a key determinant of people's attitudes, and that these perceptions are subjective, deeply felt and diametrically contrasting, it is not hard to understand why the arguments become so heated. Because landscapes are often an important part of people's sense of place, identity and heritage, perceived threats to familiar vistas have been fiercely resisted for centuries. The paper also identifies two factors that important in shaping people's perceptions of wind farms' landscape impacts. The first of these is the cumulative impact of increasing numbers of wind farms (Campbell, 2008). The research found that if people regard a region as having 'enough' wind farms already, then they may oppose new proposals. The second factor is the cultural context. This relates to people's perception and relationship with the landscape. In the South African context, the majority of South Africans have a strong connection with and affinity for the large, undisturbed open spaces that are characteristic of the South African landscape.

There are 12 Renewable Energy Projects (REFs) located within a 35 km radius of the Rheboksfontein WEF site (See Figure 3.3). The majority projects are WEFs, with a few smaller solar projects. Only two REFs are currently operational, namely the Darling WEF located adjacent to the site, and the Umoyo WEF located south-east of Hopefield. The potential for combined and sequential visibility is therefore high.

However, as indicated above, potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. The IDP also indicates that the site is located within an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs. However, despite this the establishment of the proposed WEF and other REFs will result in a change in the areas current sense of place and character. This impact will not be possible to mitigate effectively and the significance is regarded as **Medium Negative**.

Table 4.16: Cumulative impacts on sense of place and the landscape

Impact pathway: Operational activities		
Nature: Visual impacts associated with the establishment of more than one WEF and the potential impact on the area's rural sense of place and character of the landscape.		
	Without Mitigation	**With Mitigation**
Extent	Local and regional (2)	Local and regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium (30)	Medium (30)
Status	Negative	Negative
Reversibility	Yes. Wind energy plant components and other infrastructure can be removed.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Enhancement: See below		
Cumulative impacts: Impact on other activities whose existence is linked to rural sense of place and character of the area, such as tourism. However, site is located within Alternative Energy Area (A) and has therefore been identified as suitable for WEFs.		
Residual impacts: See cumulative impacts		

Assessment of No-Go option

There is no impact as it maintains the current status quo.

Recommended mitigation measures

The recommendations contained in the VIA should be implemented.

4.7 CUMULATIVE IMPACT ON LOCAL SERVICES AND ACCOMMODATION

The establishment of the proposed WEF and the other renewable energy facilities in the SLM may place pressure on local services, specifically medical, education and accommodation. This pressure will be associated with the influx of workers to the area associated with the construction and operational phases of renewable energy projects proposed in the area, including the proposed WEF. The potential impact on local services can be mitigated by employing local community members. The presence of non-local workers during both the construction and operation phase may also place pressure on property prices and rentals. As a result, local residents, such as government officials, municipal workers, school teachers, and the police, may no longer be able to buy or afford to rent accommodation in the local towns. The inflationary impact on rentals has been confirmed from experience with other renewable energy projects in South Africa.

However, as indicated below, the potential impacts should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of renewable energy as an economic driver in the area. These benefits will create opportunities for investment in the SLM, including the opportunity to up-grade and expand existing services and the construction of new houses. In this regard the establishment of a renewable energy will create an opportunity for economic development in the area. The Community Trusts associated with each project will also generate revenue that can be used by the SLM to invest in up-grading local services where required. In should also be noted that it is the function of national, provincial and local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of development renewable energy projects should therefore be addressed in the Integrated Development Planning process undertaken by the SLM.

Table 4.17: Cumulative impacts on local services

Nature: The establishment of a number of renewable energy facilities in the SLM will place pressure on local services, specifically medical, education and accommodation		
	Without Mitigation	**With Mitigation[35]**
Extent	Local and regional (3)	Local and regional (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Medium (52)	Low (28)
Status	Negative	Negative
Reversibility	Yes. Wind energy plant components and other infrastructure can be removed.	
Irreplaceable loss of	No	No

[35] The mitigation measures are linked to initiatives undertaken by Provincial and Local Government to address the additional demand for services and accommodation etc. created by the establishment of development renewable energy projects in the SLM.

resources?		
Can impact be mitigated?	Yes	
Enhancement: See below		
Cumulative impacts: Negative impact on the local services		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo.

Recommended mitigation measures
The Western Cape Provincial Government, in consultation with the SLM and the proponents involved in the development renewable energy projects in the area should consider establishing a Development Forum to co-ordinate and manage the development and operation of renewable energy projects in the area, with the specific aim of mitigating potential negative impacts and enhancing opportunities. This would include identifying key needs, including capacity of existing services, accommodation and housing and the implementation of an accredited training and skills development programmes aimed at maximising the opportunities for local workers to be employed during the construction and operational phases of the various proposed projects. These issues should be addressed in the Integrated Development Planning process undertaken by the SLM.

4.8 CUMULATIVE IMPACT ON LOCAL ECONOMY

In addition to the potential negative impacts, the establishment of the proposed WEF and other renewable energy facilities in the area has the potential to result in significant positive cumulative socio-economic opportunities for the region, which, in turn, will result in a positive social benefit. As indicated above, there are a number of renewable energy projects proposed in the study area. The positive cumulative impacts include creation of employment, skills development and training opportunities, and downstream business opportunities. The Community Trusts associated with each project will also create significant socio-economic benefits.

As indicated above the review of the REIPPPP (March 2019) indicates that R 860.1 million has been generated by socio-economic development contribution associated with the current 64 operational IPPs. This has been spent on education and skills development (40.9%), followed by enterprise development (24.2%), social welfare (21.3%), general administration (9%) and health care (4.5%). In terms of education, the IPPs have supported 1 044 education institutions, with a total spend of R 236.7 million between 2015 and March 2018. It is estimated that these contributions have benefitted in the region of 375 737 learners. In addition, enterprise development contributions committed for BW1 to BW4, 1S2 and 2S2 amount to R7.2 billion. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of March 2019 a total of R 254.3 million had already been made to the local communities located in the vicinity of the 64 operating IPPs. The potential cumulative benefits for the local and regional economy are therefore significant and are associated with both the construction and operational phase of renewable energy projects and extend over a period of 20-25 years.

Table 4.18: Cumulative impacts on local economy

Nature: The establishment of a number of solar energy facilities in the SLM will create employment, skills development and training opportunities, creation of downstream business opportunities.		
	Without Mitigation	**With Mitigation**
Extent	Local and regional (3)	Local and regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Highly Probable (4)	Definite (5)
Significance	Medium (44)	High (70)
Status	Positive	Positive
Reversibility	Yes. Wind energy plant components and other infrastructure can be removed.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Enhancement: See below		
Cumulative impacts: Positive impact on the local and regional economy through the creation of downstream opportunities and wage spend in the local economy		
Residual impacts: See cumulative impacts		

Assessment of No-Go option
There is no impact as it maintains the current status quo. This would represent a lost socio-economic opportunity for the SLM.

Recommended mitigation measures
The proposed establishment of suitably sited renewable energy facilities within the SLM should be supported.

4.9 ASSESSMENT OF NO-DEVELOPMENT OPTION

As indicated above, South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result, South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions. The No-Development option would represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a significant negative social cost. However, at a provincial and national level, it should be noted that the proposed WEF development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Western Cape and other parts of South Africa. Foregoing the proposed establishment of WEFs would therefore not necessarily compromise the development of renewable energy facilities in the Western Cape Province and or South Africa. However, the socio-economic benefits for local communities in the SLM would be forfeited. Given that there is an existing WEF facility on the site, the No-Development Option would represent a significant lost opportunity for the area and is not supported by the findings of the SIA.

Table 4.19: Assessment of no-development option

Nature: The no-development option would result in the lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy		
	Without Mitigation	**With Mitigation**[36]
Extent	Local-International (4)	Local-International (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Moderate (56)	Moderate (56)
Status	Negative	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	N/A	N/A
Can impact be mitigated?	Yes	
Enhancement: See below		
Cumulative impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.		
Residual impacts: See cumulative impacts		

Recommended enhancement measures

The proposed establishment of suitably sited renewable energy facilities within the SLM should be supported.

[36] Assumes establishment of a Community Trust

SECTION 5: KEY FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

Section 5 lists the key findings of the study and recommendations. These findings are based on:

- A review of key planning and policy documents pertaining to the area;
- Semi-structured interviews with interested and affected parties;
- A review of social and economic issues associated with similar developments;
- A review of selected specialist studies undertaken as part of the EIA;
- A review of relevant literature on social and economic impacts;
- The experience of the authors with other wind energy projects in South Africa

5.2 SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning;
- Construction phase impacts;
- Operational phase impacts;
- Cumulative Impacts;
- Decommissioning phase impacts;
- No-development option.

5.2.1 Policy and planning issues

The findings of the review indicate that renewable energy is strongly supported at a national, provincial and local level. At a national and provincial level the development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all make reference to renewable energy. At a district and local level the WCDM and SLM IDP and SDF, all support the establishment of renewable facilities. The SLM IDP also indicates that that the Rheboksfontein WEF is located in an Alternative Energy Area (A). The site has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs.

5.2.2 Construction phase impacts

The key social issues associated with the construction phase include:

Potential positive impacts

- Creation of employment and business opportunities

The construction create approximately 120 direct employment opportunities for a period of 18 months. Approximately 25% (or 30) of opportunities will be available to skilled personnel (engineers, technicians, management and supervisory), 35% (or 42) to semi-skilled personnel (drivers, equipment operators), and 40% (or 48) to low skilled personnel (construction labourers, security staff).

Members from the local community in the area are likely to be in a position to qualify for the majority of the low skilled and a proportion of the semi-skilled employment opportunities. The majority of these employment opportunities will accrue to Historically Disadvantaged (HD) members from the SLM community. The towns that are likely to benefit are Darling, Malmesbury and Yzerfontein. The potential benefits for local communities are confirmed by the findings of the Overview of the Independent Power Producers Procurement Programme (IPPPP) undertaken by the Department of Energy, National Treasury and DBSA (March 2019). The review found that by the end of March 2019 the 64 renewable energy projects that had been successfully completed had created 31 633 job years[37] of employment, compared to the anticipated 20 689. This was 53% more than planned. The study also found that significantly more people from local communities were employed during construction than was initially planned.

The wage bill associated with the construction phase is estimated at R30 million for the 18-month construction phase (2020 Rand values). A percentage of the wage bill will therefore be spent in the local economy over the 18-month construction phase. This will create opportunities for local businesses in the area. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. This is confirmed by the experience with the other renewable projects. The potential opportunities for the local service sector are linked to accommodation, catering, cleaning, transport and security, etc. associated with the construction workers on the site.

The capital expenditure will be in the region of R 2 billion (2020 Rand values). Local procurement will create opportunities for local business in the area, specifically engineering and construction companies.

Potential negative impacts

- Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site;
- Increased risk of grass fires;
- Impact of heavy vehicles, including damage to roads, safety and dust;
- Impact on farming activities.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation were **Low Negative**. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. Given that the majority of the low and semi-skilled construction workers can be sourced from the local area the potential risk posed by construction workers on local family structures and social networks is regarded as low for the community as a whole. Table 5.1 summarises the significance of the impacts associated with the construction phase.

[37] The equivalent of a full-time employment opportunity for one person for one year

Table 5.1: Summary of impacts associated with construction phase

Impact	Significance No Mitigation/ Enhancement	Significance With Mitigation/ Enhancement
Creation of employment and business opportunities	Medium (+)	Medium (+)
Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site	Medium (-)	Low (-)
Increased fire risk	Medium (-)	Low (-)
Impact of heavy vehicles and construction activities	Medium (-)	Low (-)
Impact on farming activities	Medium (-)	Low (-)

5.2.3 Operational phase

The key social issues affecting the operational phase include:

Potential positive impacts

- The establishment of renewable energy infrastructure.
- Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training;
- Benefits associated with the establishment of a Community Trust;
- Benefits for affected landowners.

Development of renewable energy infrastructure

The establishment of renewable energy infrastructure, such as the proposed WEF, should be viewed, firstly within the context of the South Africa's current reliance on coal powered energy to meet the majority of its energy needs, and secondly, within the context of the success of the REIPPPP.

The Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus making the greening of the electricity mix a national imperative. The Greenpeace Report (Powering the future: Renewable Energy Roll-out in South Africa, 2013), notes that within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations.

The Green Jobs study (2011) identifies a number of advantages associated with wind power as a source of renewable energy, including zero carbon dioxide (CO_2) emissions during generation and low lifecycle emissions. Greenhouse gases (GHG) associated with the construction phase are offset within a very short period of time compared with the project's lifespan. Wind power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, wind as energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The National Climate Change Response White Paper outlines the national response to the impacts of climate change, as well as the domestic contribution to international efforts to mitigate green-house gas emissions. As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The emission reductions between March 2018 and 2019 are estimated to be 10.9 million tonnes of CO^2. This represents 53% of the total projected annual emission reductions achieved with only partial operation to date. Since operation, the IPPs have generated 35 699 GWh, resulting in 36.2 Mton of CO^2 emissions being offset and saving 42.8 million kilolitres of water related to fossil fuel power generation.

The REIPPPP had therefore contributed significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability and environmental sustainability.

The establishment of renewable energy facilities, such as the proposed WEF, therefore not only address the environmental issues associated with climate change and consumption of scarce water resources, but also creates significant socio-economic opportunities and benefits, specifically for historically disadvantaged, rural communities.

Creation of employment and business opportunities
The operational phase will create in the region of 20 full time employment opportunities.

Community Trust
The establishment of a community benefit structure (typically, a Community Trust) also creates an opportunity to support local economic development in the area. The requirement for the project to allocate funds to socio-economic contributions (through structures such as Community Trusts) provides an opportunity to advance local community projects, which is guaranteed for a 20-year period (project lifespan). The revenue from the proposed WEF can be used to support a number of social and economic initiatives in the area, including but not limited to:

- Creation of jobs;
- Education;
- Support for and provision of basic services;
- School feeding schemes;
- Training and skills development; and
- Support for SMME's.

The 2019 IPPP Overview highlights the socio-economic development (SED) contributions associated with the 64 IPPs has to date, which have amounted to R 860.1 million. The province with the highest SED contribution has been the Northern Cape Province, followed by the Eastern Cape and Western Cape.

Enterprise development contributions committed for BW1 to BW4, 1S2 and 2S2 amount to R7.2 billion. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of March 2019 a total of R 254.3 million had already been made to the local communities located in the vicinity of the 64 operating IPPs.

The Green Jobs study (2011), found that the case for wind power is enhanced by the positive effect on rural or regional development. Wind farms located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues. In this regard the towns of as Darling and Yzerfontein are small rural towns.

The long-term duration of the contributions from the WEF also enables local municipalities and communities to undertake long term planning for the area. Experience has, however, shown that Community Trusts can be mismanaged. This issue will need to be addressed in order to maximise the potential benefits associated with the establishment of a Community Trust or other community benefit structure (entity). The REIPPP programme does however have stringent audit requirements in place to try and prevent the mismanagement of trusts.

Benefits to landowners

The income from the WEFs reduces the risks to the livelihoods of the affected landowners posed by droughts and fluctuating market prices for wheat, sheep and farming inputs, such as fuel, feed etc. The additional income from the WEF would improve economic security of farming operations, which in turn would improve job security of farm workers and benefit the local economy.

Potential negative impacts

- The visual impacts and associated impact on sense of place;
- Impact on property values; and
- Potential impact on tourism.

Visual impacts and impact on sense of place

The potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. The SLM IDP also indicated that the is located within an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs. Based on the findings of the SIA the significance was rated as **Low Negative**.

However, the owner of Alexanderfontein Farm, Mr Nicolaas Basson, indicated that turbines locations 34 and 35 impact on the views from a newly established entertainment facility on Alexanderfontein Farm. He has requested that these two turbines be relocated.

Table 5.2 summarises the significance of the impacts associated with the operational phase.

Table 5.2: Summary of impacts associated with operational phase

Impact	Significance No Mitigation/ Enhancement	Significance With Mitigation/ Enhancement
Promotion of energy projects	High (-)[38]	High (+)
Creation of employment and business opportunities	Medium (+)	Medium (+)
Establishment of Community Trust	Medium (+)	High (+)
Benefits for local affected landowners	Low (+)	Medium (+)
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on property values	Low (-)	Low (-)
Impact on tourism	Low (-)	Low (-)

5.2.4 Assessment of cumulative impacts

Cumulative impact on sense of place

There are 12 REFs or potential REFs located within a 35 km radius of the Rheboksfontein WEF site. Of these all but one has received EIA approval. However, only two, the Darling and the Umoya Energy WEF near Hopefield have been constructed to date. The potential for combined and sequential visibility is therefore high.

Based on the findings of the SIA the potential visual impact on the areas sense of place and rural character was not raised as a concern by local landowners and tourism representatives interviewed. The IDP also indicates that the site is located within an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities, including WEFs. Despite this the establishment of REFs will impact on the areas sense of place. It will not be possible to effectively mitigate the impact. The potential cumulative impact on the areas character and sense of place is therefore regarded as **Medium Negative**.

Cumulative impact on services

The establishment of the proposed WFF and the other renewable energy facilities in the SLM may place pressure on local services, specifically medical, education and accommodation. This pressure will be associated with the potential influx of workers to the area associated with the construction and operational phases of renewable energy projects proposed in the area, including the proposed WEF. The potential impact on local services can be mitigated by employing local community members. With effective mitigation the impact is rated as **Low Negative.**

In addition, as indicated below, this impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of renewable energy as an economic driver in the area.

Cumulative impact on local economies

In addition to the potential negative impacts, the establishment of the proposed WEF and other renewable energy projects in the area also has the potential to create a number of socio-economic opportunities for the SLM, which, in turn, will result in a positive social benefit. The positive cumulative impacts include creation of employment, skills development and training opportunities, creation of downstream business opportunities. The Community Trusts associated with each project will also create significant socio-economic benefits. These benefits should also be viewed

[38] Assumes project is not developed

within the context of the limited economic opportunities in the area and the impact of the drought and decline in the fishing sector in recent years. This benefit is rated as **High Positive** with enhancement.

5.2.5 Assessment of no-development option

The No-Development option would represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost. The no-development option also represents a lost opportunity in terms of the employment and business opportunities (construction and operational phase) associated with the proposed WEF and the benefits associated with the establishment of a Community Trust. This also represents a negative social cost.

However, at a provincial and national level, it should be noted that the proposed WEF development is not unique. In this regard, a significant number of other renewable energy developments are currently proposed in the Western Cape and other parts of South Africa. Foregoing the proposed establishment of WEFs would therefore not necessarily compromise the development of renewable energy facilities in the Western Cape Province and or South Africa. However, the socio-economic benefits for local communities in the SLM would be forfeited. The No-Development Option is rated as **High Negative**.

5.2.6 Decommissioning phase

Decommissioning would result in the loss of ~ 4 permanent jobs associated with the operational phase. The significance is therefore rated a **Low Negative**.

5.3 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The findings of the SIA indicate that the development of the proposed Amended Rheboksfontein WEF will create employment and business opportunities for locals during both the construction and operational phase of the project. The establishment of a Community Trust will benefit the local community. The proposed development also represents an investment in clean, energy infrastructure. Given the negative environmental and socio-economic impacts associated with a coal-based energy economy and the challenges created by climate change, this represents a significant positive social benefit for society as a whole. The findings of the SIA also indicate that the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The establishment of Community Trusts associated with renewable energy projects also have the potential to create significant benefits for local rural communities. The proposed Amended Rheboksfontein WEF is also located within area identified in the SLM IDP as an Alternative Energy Area (Area A). The area has therefore been identified as suitable for the establishment of renewable energy facilities.

Recommendation

The establishment of the proposed Amended Rheboksfontein WEF is supported by the findings of the SIA.

However, consideration should be given to relocating turbine 34 and 35 in order reduce the visual impact on the newly established entertainment facility on Alexanderfontein Farm.

ANNEXURE A

INTERVIEWS

- Basson, Mr Theo (2020-11-19). Rheboksfontein and Wildschutsvlei Farms.
- Basson, Mr Nicolaas (2020-01-19). Owner Alexanderfontein 573/1 and Bonteberg 571/1 and 571/2.
- Burger, Mr David (telephonic 2020-11-20). Darling Tourism Association Chairperson.
- Daiber, Mr Michael (telephonic 2020-11-18). !Khwa ttu San Cultural Centre (1198).
- Duckitt, Mr Mark (telephonic 2020-11-13; 2020-11-17; e-mail 2020-11-18). Rondeberg Private Nature Reserve.
- Fourie, Ms. Amanda (telephonic 2020-11-18). Doornfontein Farm.
- Kirsten, Mr Jorrie (telephonic 2020-11-13). Grootberg Farm.
- Le Roux, Ms. Dianne (telephonic 2020-11-17). Manager Darling Tourism Office.
- Mather, Mr Irshaad (2020-11-19). Vyge Vallei Farm.
- Smit, Mr Paul (telephonic 2020-11-17)). Windhoek Farm.
- Steyn, Mr Gert (telephonic 2020-11-13; e-mail 2020-11-16). Wolwefontein Farm.

The following stakeholders were notified of the SIA and invited to comment

- Basson, Mr Nicholaas (telephonic 2020-11-17; e-mail 2020-11-17). Alexanderfontein and Bonteberg Farms.
- Bosch, Mr Alfred (e-mail 2020-11-15). Slangkop Farm.
- Rangasamy Cllr. Michael (telephonic 2020-11-13; e-mail 2020-11-15). Swartland Municipality Ward 5 Councilor.
- Steyn, Mr Gawie (e-mail 2020-11-15). Platteklip Farm.

REFERENCES

- Barbour, T and van der Merwe, S (2020). Social Impact Assessment for Darling 1B and Darling 2 Wind Energy Facilities and Grid Connection and Associated Infrastructure, Darling. Prepared for Arcus Consultancy Services South Africa.
- Barbour, T and van der Merwe, S (2011). Addendum to Social Impact Assessment for Rheboksfontein Energy Facility (near Darling). Prepared for Savannah Environmental.
- Barbour, T and van der Merwe, S (2010). Social Impact Assessment for Rheboksfontein Wind Energy Facility (near Darling) – Draft Report. Prepared for Savannah Environmental.
- National Energy Act (2008);
- White Paper on the Energy Policy of the Republic of South Africa (December 1998);
- White Paper on Renewable Energy (November 2003);
- Integrated Energy Plan for South Africa (2016));
- The National Development Plan (2011);
- New Growth Path Framework (2010);
- National Infrastructure Plan (2012);
- White Paper on Sustainable Energy for the Western Cape Province (2010);
- The Western Cape Provincial Strategic Plan 2014-2019 (2014);
- The Western Cape Land Use Planning Act, 2014;

- The Western Cape Provincial Spatial Development Framework (2014 Revision);
- The Western Cape Climate Change Response Strategy (2014);
- The Western Cape Infrastructure Framework (2013);
- The Western Cape Green Economy Strategy Framework (2013);
- The One Cape 2040 Strategy (2012);
- The Western Cape Amended Zoning Scheme Regulations for Commercial Renewable Energy Facilities (2011);
- The Western Cape Draft Strategic Plan (2010);
- The Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape – Towards a Regional Methodology (2006);
- West Coast District Municipality Integrated Development Plan (2017-2021);
- West Coast District Municipality Spatial Development Framework (2014);
- Swartland Municipality Spatial Development Framework (2019);
- Swartland Municipality Integrated Development Plan (2017-2022).

LITERATURE REVIEW

- Aitken, M., McDonald, S. & Strachan, P. (2008) 'Locating 'power' in wind power planning processes: the (not so) influential role of local objectors', *Journal of Environmental Planning and Management* 51(6), pp. 777–799;
- Atchison, (April, 2012). Tourism Impact of Wind Farms: Submitted to Renewables Inquiry Scottish Government. University of Edinburgh
- Australian Environment Protection and Heritage Council (EPHC), *National Wind Farm Development Guidelines* DRAFT - July 2010;
- Australian Health and Medical Research Council. *Literature review of health impacts of wind farms* (July 2010).
- Braunholtz, S. (2003) Public Attitudes to Windfarms: A Survey of Local Residents in Scotland (Edinburgh:MORI Scotland for Scottish Executive Social Research);
- Campbell, L. (2008) Onshore windfarms landscape visual and cumulative impacts – the SNH approach, in: C. A. Galbraith & J. M. Baxter (Eds) Energy and the Natural Heritage, pp. 195–203 (Edinburgh: TSO Scotland).
- Gibbons, S. (April, 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre, SERC Discussion Paper 159;
- Gipe, P. (1995) Wind Energy Comes of Age (New York: John Wiley).
- Krohn, S. & Damborg, S. (1999) On public attitudes towards wind power, Renewable Energy, 16(1–4), pp. 954–960.
- Meyer, N. I. (2007) Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain, European Environment, 17(5), pp. 347–362.
- National Infrastructure Plan (2012);
- New Growth Path Framework (2010);
- NFO System Three (2002) Investigation into the Potential Impact of Windfarms on Tourism in Scotland (Edinburgh: VisitScotland);
- Nielsen, F. B. (2002) A formula for success in Denmark, in: M. J. Pasqualetti, P. Gipe & R. W. Righter (Eds) Wind Power in View: Energy Landscapes in a Crowded World, pp. 115–132 (San Diego, CA: Academic Press).
- Glasgow Caledonian University (2008). The economic impacts of wind farms on Scottish tourism. A report prepared for the Scottish Government
- Green Jobs Study (2011), IDC, DBSA Ltd and TIPS;
- Heintzelman, MD and Tuttle CM, (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University;
- Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory.
- Independent Power Producers Procurement Programme (IPPPP): An Overview (30 September 2016), Department of Energy, National Treasury and DBSA;
- Jacqueline M. Borel-Saladin, Ivan N. Turok, (2013). The impact of the green economy on jobs in South Africa,), South African Journal of Science, *Volume 109 |Number 9/10, September/October 2013;*
- Market Intelligence Report: Renewable Energy (2014). Mike Mulcahy, Greencape.

- Meyer, N. I. (2007) Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain, European Environment, 17(5), pp. 347–362.
- National Infrastructure Plan (2012);
- New Growth Path Framework (2010);
- NFO System Three (2002) Investigation into the Potential Impact of Windfarms on Tourism in Scotland (Edinburgh: VisitScotland);

- Nielsen, F. B. (2002) A formula for success in Denmark, in: M. J. Pasqualetti, P. Gipe & R. W. Righter (Eds) Wind Power in View: Energy Landscapes in a Crowded World, pp. 115–132 (San Diego, CA: Academic Press).
- Pasqualetti,M. J., Gipe, P. & Righter, R. W. (2002) A landscape of power, in:M. J. Pasqualetti, P. Gipe & R. W. Righter (Eds) Wind Power in View: Energy Landscapes in a Crowded World, pp. 3–16 (San Diego, CA: Academic Press).
- Powering the Future: Renewable Energy Roll-out in South Africa (2013), Greenpeace South Africa;
- Redlinger, R. Y., Andersen, P. D. & Morthorst, P. E. (2002) Wind Energy in the 21st Century: Economics, Policy, Technology and the Changing Electricity Industry (Basingstoke: Palgrave).
- Regeneris Consulting (2014). Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector
- Redlinger, R. Y., Andersen, P. D. & Morthorst, P. E. (2002) Wind Energy in the 21st Century: Economics, Policy, Technology and the Changing Electricity Industry (Basingstoke: Palgrave).
- Republic of South Africa (2003). *White Paper on Renewable Energy.*
- StatsSA (2012). *Census 2011 Municipal Fact Sheet*
- Szarka, J. (2007) Wind Power in Europe: Politics, Business and Society (Basingstoke: Palgrave Macmillan).
- Sunak, Y and Madlener, R (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing. School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University. Model Working Paper No. 3/2012;
- The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master’s Thesis, Energy Research Centre University of Cape Town;
- Urbis Pty Ltd, (2016). Review of the Impact of Wind Farms on Property Values. Commissioned by the Office of Environment and Heritage, NSW, Australia;
- Warren, Charles R. and Birnie, Richard V.(2009) *'Re-powering Scotland: Wind Farms and the 'Energy or Environment?*' Debate', Scottish Geographical Journal, 125: 2, 97 — 126;
- Wolsink, M. (2007a) Planning of renewables schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation, Energy Policy, 35(5), pp. 2692–2704;
- Wolsink, M. (2007b) Wind power implementation: the nature of public attitudes: equity and fairness instead of ‘backyard motives’, Renewable and Sustainable Energy Reviews, 11(6), pp. 1188–1207.

ANNEXURE B

ANNEXURE B

METHODOLOGY FOR THE ASSESSMENT OF POTENTIAL IMPACTS

Direct, indirect and cumulative impacts of the above issues, as well as all other issues identified will be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, where it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score between 1 and 5 will be assigned as appropriate (with a score of 1 being low and a score of 5 being high).
- The **duration**, where it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5.
- The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - 0 is small and will have no effect on the environment;
  - 2 is minor and will not result in an impact on processes;
  - 4 is low and will cause a slight impact on processes;
  - 6 is moderate and will result in processes continuing but in a modified way;
  - 8 is high (processes are altered to the extent that they temporarily cease); and
  - 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
  - Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
  - Assigned a score of 2 is improbable (some possibility, but low likelihood);
  - Assigned a score of 3 is probable (distinct possibility);
  - Assigned a score of 4 is highly probable (most likely); and
  - Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- The **status**, which will be described as either positive, negative or neutral.
- The *degree* to which the impact can be *reversed*.
- The *degree* to which the impact may cause *irreplaceable loss of resources*.
- The *degree* to which the impact can be *mitigated.*

The **significance** is determined by combining the criteria in the following formula:

S=(E+D+M)P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

ANNEXURE C: CV

Tony Barbour
ENVIRONMENTAL CONSULTING AND RESEARCH

10 Firs Avenue, Claremont, 7708, South Africa
(Tel) 27-21-761 2355 - (Fax) 27-21-761 2355 - (Cell) 082 600 8266
(E-Mail) tbarbour@telkomsa.net

Tony Barbour's experience as an environmental consultant includes working for ten years as a consultant in the private sector followed by four years at the University of Cape Town's Environmental Evaluation Unit. He has worked as an independent consultant since 2004, with a key focus on Social Impact Assessment. His other areas of interest include Strategic Environmental Assessment and review work.

EDUCATION

- BSc (Geology and Economics) Rhodes (1984);
- B Economics (Honours) Rhodes (1985);
- MSc (Environmental Science), University of Cape Town (1992)

EMPLOYMENT RECORD

- Independent Consultant: November 2004 – current;
- University of Cape Town: August 1996-October 2004**:** Environmental Evaluation Unit (EEU), University of Cape Town. Senior Environmental Consultant and Researcher;
- Private sector: 1991-August 2000: 1991-1996**:** Ninham Shand Consulting (Now Aurecon, Cape Town). Senior Environmental Scientist; 1996-August 2000: Steffen, Robertson and Kirsten (SRK Consulting) – Associate Director, Manager Environmental Section, SRK Cape Town.

LECTURING

- University of Cape Town: Resource Economics; SEA and EIA (1991-2004);
- University of Cape Town: Social Impact Assessment (2004-current);
- Cape Technikon: Resource Economics and Waste Management (1994-1998);
- Peninsula Technikon: Resource Economics and Waste Management (1996-1998).

RELEVANT EXPERIENCE AND EXPERTISE

Tony Barbour has undertaken in the region of 200 SIA's, including SIA's for infrastructure projects, dams, pipelines, and roads. All of the SIAs include interacting with and liaising with affected communities. In addition he is the author of the Guidelines for undertaking SIA's as part of the EIA process commissioned by the Western Cape Provincial Environmental Authorities in 2007. These guidelines have been used throughout South Africa.

Tony was also the project manager for a study commissioned in 2005 by the then South African Department of Water Affairs and Forestry for the development of a Social Assessment and Development Framework. The aim of the framework was to enable the Department of Water Affairs and Forestry to identify, assess and manage social impacts associated with large infrastructure projects, such as dams. The study also included the development of guidelines for Social Impact Assessment, Conflict Management, Relocation and Resettlement and Monitoring and Evaluation.

Countries with work experience include South Africa, Namibia, Angola, Botswana, Zambia, Lesotho, Swaziland, Ghana, Mozambique, Mauritius, Kenya, Ethiopia, Oman, South Sudan and Sudan.

ANNEXURE D: DECLARATION

The specialist declaration of independence in terms of the Regulations_

I, ~~Tony Barbour~~ ______________________, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Tony Barbour Environmental Consulting and Research

Name of company (if applicable):

2 December 2020

Date:

ANNEXURE E

IMPACT ON TOURISM: LITERATURE REVIEW

The potential impact on tourism was raised a key concern by a number of interested and affected parties during the Scoping Process and SIA. The literature review undertaken as part of the SIA seeks to comment on the potential impact of wind farms on tourism based on the findings of studies undertaken overseas, specifically in the United Kingdom. The most comprehensive appears to be a review undertaken by Professor Cara Aitchison from the University of Edinburgh in 2012 which formed part Renewable Energy Inquiry by Scottish Government.

Professor Atchison, (April, 2012). Tourism Impact of Wind Farms: Submitted to Renewables Inquiry Scottish Government. University of Edinburgh

The paper notes that tourism plays an increasingly important role in contributing to rural regeneration in the UK. New forms of rural tourism associated with landscape, culture and active recreation are increasingly important to rural tourism economies. Activities related to natural history and birdlife, cultural heritage and historic gardens, local food and drink and a range of active outdoor pursuits, including walking and mountain biking, are increasingly promoted as policy priorities through which wider agendas of sustainable development can be addressed.

However, the prevalence of high wind speeds in these same coastal and upland areas means that they are also the preferred destinations for wind farm developments. In spite of this proximate and apparent inter-relationship between wind farms and tourism it is only recently that research examining tourists' attitudes towards the location of wind farms in or near areas that they visit for holiday and/or leisure has been conducted in any depth (UWE, 2004, British Wind Energy Association 2006; Glasgow Caledonian University, 2008; MORI Scotland, 2002; Starling, 2006).

The paper notes that although tourism research relating to wind farm developments is limited compared with that on policy, landscape, ecology and noise it is increasingly evident that there is an emerging consensus within the research examining the actual and potential impact of wind farms on tourism. The clear consensus is that there has been no measurable economic impact, either positively or negatively, of wind farms on tourism. Similarly, there is consensus among researchers of studies that have sought to predict the potential economic impact of wind farms on tourism. Here again, there is no evidence to support the assertion that wind farms are likely to have a negative economic impact on tourism. In addition, all of the studies that have sought to predict impact have demonstrated that any negative impact of wind farms on tourism will be more than outweighed by the increase in tourists that are attracted by wind farms, by the increase in employment brought about by the development of wind farms and/or by the continuing growth of tourism.

However, despite these findings some local authorities, business owners and residents in rural areas that fall within Strategic Search Areas for wind farm developments continue to voice opposition to such developments, increasingly citing negative impact on tourism as a reason to reject planning applications.

The aim of the submission by Professor Aitchison was to clarify the evidence relating to tourism impacts of wind farms so that remaining opposition to development is based on *fact* rather than unfounded, but nonetheless understandable, *fear*.

The research undertaken by Aitchison indicates that two major academic studies of the impact of wind farms on tourism have been conducted in the UK: the University of the West of England's (UWE)(Aitchison, 2004) study titled *The Potential Impact of Fullabrook Wind Farm Proposal, North Devon: Evidence Gathering of the Impact of Wind Farms on Visitor Numbers and Tourist Experience* and Glasgow Caledonian University's (GCU) study *The Economic Impact of Wind Farms on Scottish Tourism* (2008).

Both of these studies address many of the shortcomings of earlier research in relation to weaknesses in the use of survey methods, sampling, interpretation and extrapolation of data associated with other studied. Aitchison also indicates that both university studies meet the criteria of 'originality, significance and rigour' set out in the UK Government's Research Excellence Framework which is designed to identify high quality research in UK universities (Higher Education Funding Councils, 2011). The two studies therefore arguably provide the most reliable knowledge base from which to draw conclusions about the impact of wind farms on tourism. The paper also notes that the research methodology, analysis and presentation of the UWE study findings relating to the tourism impact of wind farms were fully accepted by the Inspector in his report and were seen as a model of good practice in research design, implementation and analysis (The Planning Inspectorate, 2007).

The UWE study was designed to provide evidence of the potential impact of the proposed wind farm development on both visitor numbers and tourist expenditure. The findings of the study revealed overwhelming support for renewable energy in general and the proposed wind farm in particular. The findings demonstrated that the construction of Fullabrook wind farm would not have a detrimental impact on visitor numbers, tourist experience or tourist expenditure in the area of North Devon.

The findings from the study demonstrated that the potential impact of a wind farm in North Devon on day visitor and tourist numbers would be as follows:

- A total of 86.7% (n=170) respondents stated that the presence of a wind farm would neither encourage nor discourage them from visiting;
- A further 7.2% (n=14) of those surveyed said that a wind farm would either marginally encourage or strongly encourage them to visit the area;
- A further 6.1% (n=12) said that the presence of a wind farm would either marginally discourage or strongly discourage them from visiting.

The findings of the study indicated that the potential impact of wind farms on the tourist experience was:

- The majority of respondents (58.2%, n=114) thought that wind farms have 'no overall impact' on the visitor or tourist experience;
- A total of 18.4% (n=36) of those questioned thought that wind farms have a positive impact on the visitor or tourist experience;
- A total of 14.8% (n=29) thought that wind farms have a negative impact on the visitor or tourist experience.

The findings of the research therefore contradicted the argument that tourists would inevitably view the turbines as having a detrimental impact on the attractiveness of the landscape and would therefore be put off visiting North Devon as suggested by North Devon Marketing Bureau on behalf of North Devon District Council (2004). The findings from the UWE study in North Devon broadly accord with those of the other major academic study of the impact of wind farms on tourism; that conducted by Glasgow Caledonian University (GCU) in 2008 into *The Economic Impact of Wind Farms on Scottish Tourism*. The GCU study found that only a negligible fraction of tourists will change their decision whether to return to Scotland as a whole because they have seen a wind farm during their visit' (Glasgow Caledonian University 2008).

The study also found that 51.0% of respondents indicated that they thought wind farms could be tourist attractions. In this regard the *Investigation into the Potential Impact of Wind Farms on Tourism in Wales*, by the Wales Tourist Board in 2003 found that 68% of those questioned would be interested in attending a visitor centre at a wind farm, while the visitor centre at the Whitelee Wind Farm in east Ayrshire has become one of the most popular 'eco-attractions' in Scotland. The visitor centre run by ScottishPower Renewables has received 200 000 visitors since it opened in 2009 and an estimated 50 000 more have used the 90km of access tracks at the project site for recreational purposes. The popularity of the wind farm as a visitor attraction for schools and families and outdoor sports enthusiasts has completely surpassed the expectations of the developers.

Aitchison notes that the UWE and GCU studies are consistent in their conclusion that the development of wind farms will not result in a reduction in tourist numbers, tourist experience or tourism revenue. Given the similarity between North Devon, Mid-Wales and Scotland in tourism landscapes, visitor attractions and tourists themselves, it is possible that the planned and sustainable development of wind farms in Scotland, will induce no overall financial loss in tourism-related earnings. In fact, as indicated in the UWE research, it is possible that the planned and sustainable development of wind farms in Scotland could result in a small increase in visitor numbers and tourist-related expenditure. This is most likely to be the case where renewable energy projects are developed in tandem with the development of visitor attractions.

The paper by Aitchison also indicates that previous research from other areas of the UK has demonstrated that wind farms are very unlikely to have any adverse impact on tourist numbers (volume), tourist expenditure (value) or tourism experience (satisfaction) (Glasgow Caledonian University, 2008; University of the West of England, 2004). Moreover, to date, there is no evidence to demonstrate that any wind farm development in the UK or overseas has resulted in any adverse impact on tourism. In conclusion, the findings from both primary and secondary research relating to the actual and potential tourism impact of wind farms indicate that there will be neither an overall decline in the number of tourists visiting an area nor any overall financial loss in tourism-related earnings as a result of a wind farm development.

Glasgow Caledonian University (2008). The economic impacts of wind farms on Scottish tourism. A report prepared for the Scottish Government

The report notes that Scottish tourism depends heavily on the country's landscape, with 92% of visitors stating that scenery was important in their choice of Scotland as a holiday destination, the natural environment being important to 89% of visitors (Tourism Attitudes Survey 2005). As part of the general policy to create a more successful country, with increasing sustainable economic growth, the Tourism sector has agreed a target of 50% revenue growth in the ten years to 2015. As in South

Africa, tourism is therefore regarded as a key sector. Likewise, the natural environment is identified as a key tourist asset.

As part of the study some 40 studies in the UK and Ireland were reviewed. In addition, to ensure that international experiences were considered the review also examined reports from Denmark, Norway, the US, Australia, Sweden and Germany. The findings of the review can be summarised as follows:

- There is often strong hostility to developments at the planning stage on the grounds of the scenic impact and the perceived knock on effect on tourism. However developments in the most sensitive locations do not appear to have been given approval so that where negative impacts on tourism might have been a real outcome there is, in practice, little evidence of a negative effect;
- There is a loss of value to a significant number of individuals but there are also some who believe that wind turbines enhance the scene;
- An established wind farm can be a tourist attraction in the same way as a hydro-electric power station. This of course is only true whilst a visit remains a novel occurrence;
- In Denmark, a majority of tourists regard wind turbines as a positive feature of the landscape;
- Over time hostility to wind farms lessens and they become an accepted even valued part of the scenery. Those closest seem to like them most;
- Overall there is no evidence to suggest a serious negative **economic** impact of wind farms on tourists.

The study also included an intercept survey which focused on tourists most of whom had had a recent experience of a wind farm. The aim was primarily to identify if the experience had altered the likelihood of a return to Scotland. The findings of the survey indicated that vast majority (99%) of those who had seen a wind farm suggested that the experience would not have any affect. Indeed there were as many tourists for whom the experience increased the likelihood of return as decreased. Surprisingly there was no difference between those who has a close and extensive experience and those who had a minimal experience. Those who had not seen a farm were more likely to state a decrease in the likelihood of return, which was even stronger when all tourists were faced with a potential extension of the relevant wind farm. However even then this only related to a small minority of tourists.

The study concludes that the "Overall the finding of the research is that if the tourism and renewable industries work together to ensure that suitably sized wind farms are sensitively sited, whilst at the same time affording parts of Scotland protection from development, then the impacts on anticipated growth paths are expected to be so small that there is no reason to believe that Scottish Government targets for both sectors are incompatible' (Glasgow Caledonian University).

Regeneris Consulting, (2014). Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector

The key findings of the study indicate that visitor responses and reactions to wind farms are subjective and depend on the individual's own judgements and interpretation of the relative value of wind farms and their aesthetics. In this regard a key factor is the reaction of individual tourists to the impact of wind farms in the landscape. This is potentially very important to the performance of tourism in many parts of Wales, where surveys have shown that beautiful and unspoiled countryside is an important reason for the visit and a key contributor to visitor enjoyment.

However, the study notes that previous studies have shown that while individuals vary widely in their reaction to wind farms, a clear majority do not react negatively to them in the landscape and will not change their destination choice on account of the presence of wind farms. In this regard there are a number of factors which could influence people's perceptions of wind farms. These are likely to include their views on renewable energy and the effectiveness of wind farms as a means of energy production. The research suggests that these wider perceptions play a role in how tourists weigh up the positive and negative aspects of wind farm development.

In this regard the study notes that based on current evidence of visitor responses and reactions, and the balance of public support for wind energy over time, there is little to suggest that the planned increase in onshore wind production would result in significant changes in visitor numbers, even in those areas where there may be multiple wind farm developments.

However, the study does indicate that there is also a potential danger that the increased rate of development in some parts of Wales could change the value judgements made by some visitors if they feel a point is reached when wind farms become too dominant a presence on Welsh landscapes. This could alter their perceptions of the relative merits of wind turbines and in turn change their visitor behaviour. The study indicates that while this is acknowledged as a potential risk, risk also needs to be considered in light of the fact that wind farms will become a more common sight in the UK and Europe in general. This increased familiarity with turbines could mean that many visitors become more tolerant of turbines as a feature of rural landscapes, and their visiting behaviour may change little as a result.

Likewise, it is also important to recognise that the wider perceptions that influence visitor reactions are not set in stone. They are likely to be influenced by a wide set of factors related to climate change and energy production over the next ten years, including changes in energy prices and views on the relative merits of wind energy compared to alternatives, such as fracking or other forms of renewable energy.

While most of the evidence points toward limited impacts on tourism from wind farms, there are examples of certain locations which are, on balance, more sensitive to wind farm development. This is on account of their landscapes, types of visitor, limited product diversity and proximity to wind farms. This is particularly the case where the key visitor markets are older people visiting for the tranquillity, remoteness and natural scenery offered in some parts of Wales.

However, the study also notes that in these more sensitive locations, the findings of the study indicate that the potential negative effect on visitor numbers may still be low overall, but in some circumstances could be moderate. The greatest concern exists amongst areas and businesses closest to wind farms and appealing to visitor markets most sensitive to changes in landscape quality. The case studies did highlight some businesses reporting negative reaction from visitors and also holding back investment on account of the uncertain impact, although a majority were not affected negatively at all.

The study also found that there was no evidence that wind farms would deter tourists from traveling along designated visitor or tourists routes. The study indicated that small minorities of visitors would be encouraged, whilst others would be discouraged. Overall, however, there was no evidence to suggest that there would be any significant change in visitor numbers using these routes to reach destination elsewhere.

ANNEXURE F

IMPACT ON PROPERTY VALUES: LITERATURE REVIEW

The potential impact on property values was raised as a concern by a number of interested and affected parties interviewed during the SIA, specifically owners of game farms located to the east of the site. The literature review undertaken as part of the SIA does not constitute a property evaluation study, but merely seeks to comment on the potential impact of wind farms on property values based on the findings of studies undertaken overseas.

The literature reviewed was based on an attempt by the authors of the SIA to identify what appear to be "scientifically" based studies that have been undertaken by reputable institutions. In this regard it is apparent that there are a number of articles available on the internet relating to the impact of wind farms on property values that lack scientific vigour. The literature review also sought to identify research undertaken since 2010. The literature review does not represent an exhaustive review.

In total five articles were identified and reviewed namely:

- Stephen Gibbons (April, 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre, SERC Discussion Paper 159;
- Review of the Impact of Wind Farms on Property Values, Urbis Pty Ltd (2016): Commissioned by the Office of Environment and Heritage, NSW, Australia;
- Yasin Sunak and Reinhard Madlener (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing. School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University. Model Working Paper No. 3/2012;
- Martin D. Heintzelman and Carrie M. Tuttle (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University;
- Ben Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory.

Three of the articles indicate that wind farms have the potential to impact on property values, while two indicate that the impacts are negligible and or non-existent.

Stephen Gibbons (April, 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre

The paper notes that there has been a rapid expansion of wind farm developments in the UK, like other areas in Europe and parts of the US, since the mid-1990s. While renewable energy technology clearly provides potential global environmental benefits in terms of reduced CO_2 emissions and slower depletion of natural energy resources, like most power generation and transmission infrastructure, the plant, access services and transmission equipment associated with renewable electricity generation may involve environmental costs. This is particularly so in the case of wind turbine developments, where the sites that are optimal in terms of energy efficiency are typically in rural, coastal and wilderness locations that offer many natural environmental amenities. These natural amenities include the aesthetic appeal of landscape, outdoor recreational opportunities and the existence values of wilderness habitats. The visual impacts of these 'wind farms' may be especially important because they are often on high ground with extensive visibility. As a result there has been significant opposition from local residents and other stakeholders with interests in environmental preservation. This opposition suggests that the environmental costs may be important. It is interesting to note that similar trends have also started to emerge in South Africa.

Gibbons states that the paper provides quantitative evidence on the local benefits and costs of wind farm developments in England and Wales, focussing on the effects of wind turbine visibility, and the implied cost in terms of loss of visual landscape amenities. The approach is based on "hedonic" pricing which uses housing costs to reveal local preferences for views of wind farms. This is feasible, because wind farms are increasingly encroaching on rural, semi-rural and even urban residential areas in terms of their proximity and visibility, so the context provides a large sample of housing sales that potentially affected (at the time of writing, around 1.8% of residential postcodes are within 4 km of operational or proposed wind farm developments). The paper notes that the study offers a significant advance over previous studies in the US and UK, which have mostly been based on relatively small samples of housing transactions and cross-sectional price comparisons. Estimation in this current work is based on quasi experimental, difference-in-difference based research designs that compare price changes occurring in postcodes where wind farms become visible, with postcodes in appropriate comparator groups. These comparator groups include: places where wind farms became visible in the past, or where they will become visible in the future and places close to where wind farms became operational but where the turbines are hidden by the terrain. The postcode fixed effects design implies that the analysis is based on repeat sales of the same, or similar housing units within postcode groups (typically 17 houses grouped together).

The study also notes that there have been several previous attempts to quantify impacts on house prices in the US, including the study in the US by Hoen et al (2013), which attempts a difference-in-difference comparison for wind farms, but using cross-sectional comparisons between houses at different distances from the turbines. The conclusions of the Hoen et al study was there is 'no statistical evidence that home values near turbines were affected' by wind turbines. Gibbons does however note that the Hoen et al study (2013) uses fairly sparse data on 61 wind farms across nine US states. While the sample contains over 50 000 transactions, very few of transactions are in areas near the wind farms. In this regard on 1 198 (2%) transactions were reported within 1 mile of current or future turbines and only 300 post.

The study undertaken by Gibbons has nearly 38 000 quarterly, postcode-specific housing price observations over 12 years, each representing one or more housing transactions within 2km of wind farms (about 1.25 miles). Turbines are potentially visible for 36 000 (94.7%) of these. The study therefore notes that there is a much greater chance than in previous work of detecting price effects if these are indeed present. The overall finding is that operational wind farm developments reduce prices in locations where the turbines are visible, relative to where they are not visible, and that the effects are causal. This price reduction is around 5-6% on average for housing with a visible wind farm within 2km, falling to under 2% between 2-4km, and to near zero between 8-14km, which is at the limit of likely visibility. Evidence from comparisons with places close to wind farms, but where wind farms are less visible suggests that the price reductions are directly attributable to turbine visibility. As might be expected, large visible wind farms have much bigger impacts that extend over a wider area.

The conclusion of the study notes that the fairly crowded geographical setting, with numerous wind farms developed within sight of residential property, provides a unique opportunity to examine the visual impacts of wind farms through hedonic property value methods. In undertaking the study comparisons were made between house price changes occurring in areas where nearby wind farms become operational and visible, with the price changes occurring where nearby wind farms become operational but are hidden from view. The overall findings of the study indicate that wind farms reduce house prices in postcodes where the turbines are visible, and reduce prices relative to postcodes close to wind farms where the wind farms are not visible. The overall finding is that "averaging over wind farms of all sizes, this price reduction is around 5-6% within 2km, falling to less than 2% between 2 and 4km, and less than 1% by 14km which is at the limit of likely visibility". The study notes that small wind farms have no impact beyond 4km, whereas the largest wind farms (20+ turbines) reduce prices by 12% within 2km, and reduce prices by small amounts right out to 14km (by around 1.5%).

The study also found that there are small (~2%) increases in neighbouring prices where the wind farms are not visible, although these are only statistically significant in the 4-8km band. The paper also notes that the findings are in line with existing literature that suggests that other tall power infrastructure has negative impacts on prices (e.g. high voltage power lines, Sims and Dent 2005).

Urbis Pty Ltd (2016). Review of the Impact of Wind Farms on Property Values, Commissioned by the Office of Environment and Heritage, NSW, Australia

The purpose of the study was to analyse the impact of wind farm development on the value of surrounding properties in NSW. A 2009 study commissioned by the NSW Valuer-General's Office to address concerns in the community that wind farms have a detrimental impact on property values found that there was no conclusive evidence available at the time to indicate a universal fall in the value of properties surrounding wind farm developments. The follow up study undertaken by Urbis was commissioned by Office of Environment and Heritage (OEH), New South Wales (NSW), Australia. The Australian experience is regarded as highly relative to South Africa given the similarities between the two countries both in terms of the development of the wind energy sector and the rural landscapes and properties affected.

In terms of potential limitations the study does note that in most cases there were a limited number of transactions over the 15-year period from 2000 to 2015. This paper does note that this is typical of rural and rural residential areas that have a relatively low population density and larger individual properties. The study notes that the limited data availability precluded a broad based statistical analysis (e.g. multiple regression or Monte Carlo analysis) to establish any trends in value change as a result of proximity to wind farm infrastructure.

The study sought to determine what sample size is required to undertake an analysis of sales data within a 2 kilometre radius of a wind farm. Adopting a confidence level of 95%, a minimum sample of 97 transactions would be required to arrive at a result accurate within 10%. This increases to a sample size of 385 transactions to arrive at a result accurate within 5%.

The wind farms reviewed in the study experienced far fewer than 100 sales transactions, ranging from 9 to 44 sales within a 2 kilometre radius over the past 15 years (between 2000 and 2015). Based on this there was insufficient data to undertake a traditional statistical analysis that would produce a result with a sufficient degree of confidence. As a result the study adopted a same property repeat sale approach to test value change of properties within 2 km of wind farms relative to the comparable property market within each relevant Local Government Area.

The study notes that Australia had 1 866 wind turbines spread across 71 wind farms at the end of 2014. Approximately 82% of these wind turbines were located in wind farms with more than 50 MW installed capacity with the remaining 18% installed in smaller wind farms under 50 MW. The majority of wind farms in South Africa also tend to be over 50 MW. Of relevance to the current project, the majority of Australia's wind resources are concentrated in its south-western, southern and south-eastern regions, typically closer to the coast or in elevated exposed areas. The study notes that while wind farms are broadly viewed as a sustainable source of energy the level of acceptance begins to fall away the closer respondents reside to the development. In this regard a survey found that 81% of the respondents supported the development of wind farms within NSW. This dropped to 73% for one within their local region and 59% for one 1–2 km from their residence.

The findings of the survey clearly illustrate that proximity to the development impacts the level of acceptance of wind farms. The concerns typically raised regarding wind farms located within 1-2 kilometres of their homes included noise (61%), negative visual impact (38%) and health (23%). A study undertaken in the UK by Bond et al (2013) found that the five most frequently cited reasons for objection to wind farms were; visual eyesore (22.9%); effect on wildlife (11.4%); turbine noise (11.4%); construction traffic (6.8%) and industrialisation of the countryside (6.4%).

Apart from surveying residents, another way of exploring community perceptions about wind farms is to analyse data from property sales. A range of quantitative evaluation techniques such as hedonic price can identify differences between wind farm affected and non-affected transactions. Put simply, transactions are analysed based on specific characteristics such as proximity to wind farms or other non-amenities. This comes in the form of a 'hedonic analysis', which is effectively a multivariate regression analysis of the impact of 'quality' on the price of a commodity.

The study notes that research has shown that public perception of negative non-physical property attributes such as views, noise and odour can impact the value of residential property. However, accurately identifying the impact of a dis-amenity, be it wind farms or other impacts, is a challenging exercise that requires a large sample size of property transactions covering a number of years, with data that include a measure of the dis-amenity (e.g. distance from wind farm development, degree of visual impact) to establish statistically significant results (Bond et al. 2013).

The study undertaken by Urbis (2016) includes a review of relevant literature, and refers to research undertaken by Hoen (2009 & 2013), noting that Hoen found no statistical evidence that home values near wind turbines were affected in the post-construction or post-announcement/ pre-construction periods. Hoen (2009 & 2013) also concluded that if there was an effect, it is possible that the impact is sporadic, affecting only particular types of homes or in markets where consumer preferences were ill-disposed to wind farms. However, other studies found mixed results. Research by Heintzelman and Tuttle (2012) found that when testing across three different US counties, that in some instances there was a negative relationship between proximity to wind turbines and property values; however, it was not consistent and there was no identifiable factor driving the difference. The authors of the report note that the lack of consistency between the results may point to a qualitative factor associated with the wind farm itself, or a difference in consumer preferences between counties when it comes to co-location with wind farms. This would make it difficult to draw conclusive implications about compensating all landholders in close proximity to wind farms.

Research undertaken by Sunak and Madlener (2014) in Germany found that the asking prices for properties whose view was strongly affected by the construction of wind turbines decreased by 10–17%, while properties with a minor or marginal view experienced no price effect. The impact of visual amenity is complex however, with the angle of view, distance and size of the wind farm all playing a part in the potential negative impact on a property's amenity.

The 2009 NSW Valuer-General's assessment of the impact of wind farms on property values did not conduct a hedonic analysis like many of the international studies because:

- The sample of comparable sales transactions was limited;
- Wind farm development occurred on rural land, with low population density;
- There was significant variation in property characteristics (view from the dwelling, lot size, improvements, etc.) and the level of visual impact;
- The complex array of factors that impact property prices was difficult to capture.

The Urbis study notes that similar limitations also impacted the study undertaken in 2016. This was despite the time that has passed and the increase in the number of wind farms between the 2009 study and 2016. The 2009 NSW Valuer-General's assessment of the impact of wind farms on property values reviewed 45 property transactions within eight study areas. Of these only five were identified as potentially being adversely affected by their view of a wind farm: a small impact was observed for one township property, and potential impacts were observed on four out of 13 lifestyle properties. There were no observed impacts on the 12 rural properties analysed.

The 2009 study found that properties in rural/agricultural areas appeared to be the least affected by wind farm development, with no reductions found near any of the eight wind farms investigated. The only properties where a possible effect was observed were lifestyle properties in Victoria within 500 metres of a wind farm, some of which were found to have lower than expected land values. Generally, the 2009 NSW Valuer-General's assessment of the impact of wind farms on property values found that the separation distance identified in NSW appears to be sufficient to ameliorate any dis-amenity associated with the presence of wind farm development. Ultimately the 2009 NSW Valuer-General's assessment of the impact of wind farms on property values found that the wind farms that had been developed up to that time had not negatively affected property values in the majority of cases. For the minority of transactions that showed a fall in value, other factors may have been involved.

The literature review of Australian and international studies on the impact of wind farms on property values revealed that the majority of published reports conclude that there is no impact or a limited definable impact of wind farms on property values. Those studies which identified a negative impact are based in the northern hemisphere and are associated with countries with higher population densities and a greater number of traditional residential and lifestyle properties affected by wind farms. This is generally contrary to the Australian experience, with most wind farms being located in low population density environments that derive the majority of their value from productive farming purposes.

The key conclusions of the study note that there is insufficient sales data to provide a definitive answer to the question of whether wind farm development in NSW impacts on surrounding land values utilising statistically robust quantitative analysis techniques. The study was therefore based on the best available data and traditional valuation sales analysis techniques to compare the change in values around wind farms over time and qualitative information from a review of the international literature on the impact of wind farms on property values.

Based on the outcome of these research techniques, the opinion of the authors was that that wind farms may not significantly impact rural properties used for agricultural purposes. However, the study found that there is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas.

Based on the available literature and the sales evidence analysed around wind farms in Australia, the study notes that "in our professional opinion, there are some factors that may be more likely to negatively influence property values around wind farms. Whilst evidence to support these effects in the present Australian context is somewhat limited, the following factors are worthy of consideration":

- Proximity to residential dwellings – Issues surrounding noise, shadow flicker and close visual impacts are likely to be exacerbated if wind turbines are located close to residential dwellings, and therefore any such perceived diminution of residential amenity has the potential to influence property values;
- Proximity to higher density populations – The location of wind farms near areas of higher population density could be expected to result, in absolute terms if nothing else, in an increase in perceived and actual impacts on a larger number of residential use properties**;**
- Uncertainty – Community concern around the development of a local wind farm and its potential impacts may increase the amount of time required to sell a property, as potential buyers defer their decision until specific details of the proposed wind farm are known. (note that historic data that allows comprehensive analysis of time-on-market impacts is limited; however, the available evidence does not indicate that an increase in the time required to sell a property near a wind farm has corresponded to a loss in value.)

It is clear that the properties located around wind farms (particularly in NSW) are predominantly rural or rural residential in nature. There are very few smaller residential properties (such as those in towns) that are within close proximity of a wind turbine. For rural properties used for primary production, there is no direct loss of productivity resulting from wind farms. Therefore they are unlikely to negatively impact the value of such properties.

The types of locations chosen to date for wind farms in NSW have differed from many chosen for wind farms in the USA and Europe. Overseas countries with relatively high population densities have situated wind farms close to small urban centres or villages more often. This could account for a small number of overseas studies finding a property value reduction associated with the development of a wind farm; however, most studies undertaken in the northern hemisphere have essentially supported the notion that wind farms have a limited impact on property values. The findings from the northern hemisphere studies that have identified a negative impact are also more likely to be associated with a greater number of traditional residential and lifestyle properties affected by wind farms.

In conclusion, the authors of the Urbis study indicated that the review of case studies in NSW and Victoria did not identify any conclusive trends that would indicate that wind farms have negatively impacted on property values. A property resale analysis indicated that all of the properties examined as part of the study demonstrated capital growth that was aligned with the broader property market of the time. As such, the circumstances of wind farms in NSW and the differences between those circumstances and those in other countries where similar studies have been conducted, have led the study to reach the following conclusions:

- Appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values;
- There is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas.

Yasin Sunak and Reinhard Madlener (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing Model, FCN Working Paper No. 3/2012

The paper notes that the extensively promoted expansion of renewable energy technologies is mostly justified by referring to the advantages and benign attributes associated with them. In the case of wind power, these attributes are, e.g., a "green" and CO_2-free energy generation without fuel costs as well as reasonable land consumption (Ackermann and Söder, 2002; Manwell, et al., 2009, pp.443-447; BWE, 2012). However, the paper notes that there are also negative impacts associated with wind farms, including changes to landscapes and vistas. The negative externalities associated with wind farm sites have led to public concerns relating to the impact on the environment and landscape. The authors indicate that at the time of preparing the paper there were, to their knowledge, only four peer-reviewed papers on the topic of impacts on property values., namely, Sims and Dent, 2007; Sims et al., 2008; Laposa and Mueller, 2010; Heintzelman and Tuttle, 2011.

Sims and Dent (2007) investigated the impact of a wind farm near Cornwall, UK, on house prices, using a hedonic pricing approach and comparative sales analysis. Applying straightforward OLS regression, they found some correlation between the distance to a wind farm and property values. Due to data limitations, the overall model results had a fairly weak explanatory power. Sims et al. (2008) modelled the impact of wind farm proximity to houses for a region near Cornwall, UK. There was some evidence to suggest that noise and flicker effects as well as visibility may influence property value in a wind farm's vicinity. The hedonic analysis, in which standard OLS regression techniques were used, showed no significant impacts caused by the wind farm.

Laposa and Müller (2010) examined the impact of wind farm project announcements on property values for northern Colorado, US. Including observations before and after the announcement of the wind farm project, they applied a hedonic pricing model using standard OLS regression. The results obtained indicate a significant impact of the project announcement at the 10% level. However, they conclude that this impact is likely more attributable to the beginning of the national housing crisis rather than the announcement itself. Heintzelman and Tuttle (2011) study exploring the impacts of new wind facilities on property values in northern New York, US found that nearby wind facilities can significantly reduce property values. Decreasing the distance to the wind farm to one mile indicated a property price devaluation of between 7.73% and 14.87%. In addition, they controlled for omitted variables and endogeneity biases by applying a repeat-sales analysis.

The aim of the study by Sunak and Madlener was to investigate the impacts of wind farms on the surrounding area through property values, by means of a geographically-weighted hedonic pricing model. The main focus of the study was to assess the potential visual impacts associated with wind farms. A wind farm near the cities of Rheine and Neuenkirchen in the federal state of North Rhine-Westphalia (Germany), constructed in 2002, was chosen for conducting a pilot application of the model developed for the study. In 2000, the federal district administration announced the construction of a wind farm consisting of nine turbines, which were built in July 2002. The nine turbines, each with a capacity of 1.5 MW, have hub heights of 100 meters and rotor sizes of 77 meters. The areas of northern North Rhine-Westphalia is very flat with an average altitude only varying between 30 and 90 m above sea level. The wind farm therefore substantially influences the landscape.

The study focused on property sales within an area of 119 km^2 in the north of the federal state of North Rhine-Westphalia, including parts of the city of Rheine and the city of Neuenkirchen. Both cities, at least two districts in the case of Rheine (Mesum and Hauenhorst), are in the immediate proximity of the wind farm site. This northern region of North Rhine-Westphalia can be defined as a semi-urban region mainly characterized by medium- and small-sized towns. In 2011, a population of 26 900 lived within a radius of about 5.5 km around the site. The area is therefore more densely populated that the study area.

The distance of the wind turbines from affected properties ranged from 945 m to 5.5 km. To measure the visibility of the wind farm site, the study calculated viewsheds for each property. A precise measurement of the view crucially depends on capturing all features in the landscape that are visible from the observer's point of view. The view of a certain feature in the landscape might be hindered by heights, slopes, vegetation, or buildings. In order to calculate viewsheds as precisely as possible, a digital surface model was applied with an accuracy of one meter. The digital surface model included height level information of the terrain, the vegetation, and buildings. The study also looked at aural impacts (noise) of wind turbines. The research indicated that increases of the dB-level above the average ambient noise level in urban or semi-urban regions are only measureable within the immediate vicinity of a turbine of about 350 m (Hau, 2006; Rogers et al., 2006; Harrison, 2011). The shortest distance to a property is 945 m. As such aural impacts were not considered by the study.

Three different global model specifications were applied. The first two models included 452 properties that were sold after the construction of the wind farm. The findings of the study indicated that proximity to wind farms negatively affects property prices within the first two kilometres. The approach also enabled the study to investigate the impact of the wind farm project announcement and construction by means of dummy variables. The findings of the study indicate that there was no evidence for an announcement effect. Alternatively, the construction of the wind farm is negatively related to the property price. The study concludes that "it seems obvious to deduce that wind farm presence is significantly influencing the surrounding property prices".

Martin D. Heintzelman and Carrie M. Tuttle (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University

The study area where the research was undertaken was New York State, which is a leader in wind power development in the US. In 1999, New York had 0 MW of installed wind capacity, but by 2009 had 14 existing facilities with a combined capacity of nearly 1300 MW, ranking it in the top 10 of states in terms of installed capacity. The paper notes that when discussing wind power development it is important to understand the costs that such development might impose. Unlike traditional energy sources, where external/environmental costs are spread over a large geographic area through the transport of pollutants, the costs of wind development are largely, but not exclusively, borne by local residents. Only local residents are likely to be negatively affected by any health impacts, and are the people who would be most impacted by aesthetic damages, either visual or audible. These impacts are likely to be capitalized into property values and, as a consequence, property values are likely to be a reasonable measuring stick of the imposed external costs of wind development.

The paper, although dated (2011), indicates that the literature assessing impact on property values is limited. The study looked at data on 11 369 arms-length residential and agricultural property transactions between 2000 and 2009 in Clinton, Franklin, and Lewis Counties in Northern New York to explore the effects of relatively new wind facilities. The findings of the study indicate that nearby wind facilities do impact on property values. In this regard, based on the repeat sales model, the construction of turbines within 0.5 miles (0.8 km) of the property resulted in a 10.87%-17.77% decline in sales price depending on the initial distance to the nearest turbine and the particular specification. At a distance of 1 mile (1.6km) (about 20% of the sample), the decline in value was between 7.73% and 14.87%. The study notes that from a policy perspective, these results indicate that there is a need to compensate local homeowners/communities for allowing wind development within their borders.

The paper concludes that the results of the study appear to indicate that proximity to wind turbines does have a negative and significant impact on property values. Importantly, the best and most consistent measure of these effects appears to be the simple, continuous, proximity measure, the (inverse distance) to the nearest turbine.

This study does not say anything about the societal benefits from wind power and should not be interpreted as saying that wind development should be stopped. However, when comparing the environmental benefits of wind power one must not only include the take into account the costs to developers, but also the external costs to property owners located close to new wind facilities. In this regard the study notes that property values are an important component of any cost-benefit analysis and should be accounted for as new projects are proposed and go through the approval process.

Ben Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory

The paper notes that previous research on the effects of wind energy facilities on surrounding home values has been limited by small samples of relevant home-sale data and the inability to account adequately for confounding home-value factors and spatial dependence in the data. The authors note that this study helps fill those gaps by collecting data from more than 50 000 home sales among 27 counties in nine states of the USA. The homes were located within 10 miles of 67 different wind facilities, and 1 198 sales were within 1 mile (1.6 km) (331 of which were within a half mile (0.8km)) of a turbine. This total represents 2 % of the total survey and, as indicated above, has been raised an issue by commentators.

The approach was aimed at answering the following questions:

- Did homes that sold prior to the wind facilities' announcement (PA)—and located within a short distance (e.g., within a half mile) from where the turbines were eventually located—sell at lower prices than homes located farther away?
- Did homes that sold after the wind facilities' announcement but before construction (PAPC)—and located within a short distance (e.g., within a half mile)—sell at lower prices than homes located farther away?
- Did homes that sold after the wind facilities' construction (PC)—and located within a short distance (e.g., within a half mile)—sell at lower prices than homes located farther away?
- For question 3 above, if no statistically identifiable effects are found, what is the likely maximum effect possible given the margins of error around the estimates?

In order to answer these questions the hedonic pricing model (Rosen, 1974; Freeman, 1979) was used. The paper notes this approach allows one to disentangle and control for the potentially competing influences of home, site, neighbourhood, and market characteristics on property values, and to uniquely determine how home values near announced or operating facilities are affected.

The summary of the key findings notes that previous published and academic research on this topic has tended to indicate that wind facilities, after they have been constructed, produce little or no effect on home values. At the same time, some evidence has emerged indicating potential home-value effects occurring after a wind facility has been announced but before construction. The paper indicates that previous studies, however, have been limited by their relatively small sample sizes, particularly in relation to the important population of homes located very close to wind turbines, and have sometimes treated the variable for distance to wind turbines in a problematic fashion.

This study by Hoen seeks to fill this gap by collecting a very large data sample and analyzing it with methods that account for confounding factors and spatial dependence. AsWe collected data from more than 50,000 home sales among 27 counties in nine states. These homes were within 10 miles of 67 different then-current or existing wind facilities, with 1,198 sales that were within 1 mile of a turbine—many more than were collected by previous research efforts. The data span the periods well before announcement of the wind facilities to well after their construction.

The findings of the study indicated that across all model specifications, there was no statistical evidence that home prices near wind turbines were affected in either the post-construction or post-announcement/pre-construction periods. Therefore, if effects do exist, either the average impacts are relatively small (within the margin of error in the models) and/or sporadic (impacting only a small subset of homes). In addition, the sample size and analytical methods enabled the study to bracket the size of effects that would be detected, if those effects were present at all.

Based on the results, the study found that it is *highly unlikely* that the actual average effect for homes that sold in the sample areas within 1 mile (1.6km) of an existing turbine is larger than +/-4.9%. In other words, the average value of these homes could be as much as 4.9% higher than it would have been without the presence of wind turbines, as much as 4.9% lower, the same (i.e., zero effect), or anywhere in between. Similarly, it is highly unlikely that the average actual effect for homes sold in the sample area within a half mile of an existing turbine is larger than +/-9.0%. In other words, the average value of these homes could be as much as 9% higher than it would have been without the presence of wind turbines, as much as 9% lower, the same (i.e., zero effect), or anywhere in between. The study notes that, regardless of these potential maximum effects, the core results of the study consistently show no sizable statistically significant impact of wind turbines on nearby property values.

Rheboksfontein Wind Energy Facility

Terrestrial Ecology Verification Assessment of Turbine Positions

26 November 2020

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The business of sustainability

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Rheboksfontein Wind Energy Facility

Terrestrial Ecology Verification Assessment of Turbine Positions

Declaration

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I, Marianne Strohbach, declare that -

- I act as the independent specialist;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Marianne Strohbach
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Executive Summary

ENGIE Africa (hereafter referred to as ENGIE) is planning to develop a Wind Energy Facility (WEF) to be called Rheboksfontein WEF (hereafter the Project or WEF), to add capacity to the national electricity grid. Rheboksfontein WEF will be located approximately 3 km west of Darling and 10 km east of Yzerfontein, within the Western Cape Province. The original EIA Report and associated specialist studies were submitted to the relevant Authorities in 2011, and the proposed WEF was subsequently authorised on 2 February 2012 (EA Reference: 12/12/20/1582).

ENGIE intends to increase the proposed wind turbine sizes and reduce the number of turbines to optimise the efficiency of the WEF. The proposed amendments may be construed as a change in the scope of the EA and may result in changes in the associated impacts. This report focuses on a review of data on terrestrial fauna and flora as previously determined as part of the original EIA and the online screening tool (based on data from SANBI), coupled with a site verification survey. Insights gleaned have been used for a re-evaluation of the potential impacts of the updated *turbine locations* on terrestrial biodiversity, in order to avoid or minimise potential negative impact(s) of the turbines on such biodiversity

The Project area falls within the Sand Fynbos and Granite Renosterveld types and Swartland Biodiversity Sector Plan Area, which is part of the Fynbos Biodiversity Hotspot in South Africa. Sand Fynbos is represented within the study area in the form of **Hopefield Sand Fynbos** which is listed as a **Vulnerable Ecosystem.** The type of Granite Renosterveld that historically covered large extents of the study area is referred to as **Swartland Granite Renosterveld,** which is listed as **Critically Endangered** due to most of it being converted to cultivated lands. The area falls is considered a winter-rainfall area, where the peak flowering season usually occurs between August and early October. Hence the verification survey was timed to coincide with this period.

The habitats that could be confirmed within the study area are summarised below, also indicating the approximate area that may be impacted during construction and operation of the turbines:

Habitat and notes	PS 6 classification	Site Ecological Importance	Area/ha Present	Area/ha Impacted
Swartberg Granite Renosterveld	Natural	Very High	155,5	0
Fragmented Swartberg Granite Renosterveld	Modified	Medium	83,7	0
Hopefield Sand Fynbos	Modified	High	838,2	0
Wetlands and Riparian Areas	Modified	Medium	134,1	0
Alien Tree Patches	Modified	Low	23,7	0
Cultivated and Transformed Areas	Modified	Very Low	2553,2	± 2 to 20
Total Area Investigated			**3788,4**	**± 2 to 20**

From a faunal perspective, a few threatened species of herpetofauna and Lepidoptera have been either historically found or modelled to have a potential to occur within the wider areas. On and within close proximity of the turbines localities however, no suitable habitat or the presence of species could be confirmed.

Data and research on negative impacts of wind turbine operation on terrestrial wildlife is limited. Potentially, terrestrial animals can be affected by temporary factors associated with the construction of wind turbines e.g. destruction of habitat, vibration and noise effects, higher direct mortality on wind farm roads, and an increase in human activity within the area. In most cases, however, the operation of wind farms was found to have no *significant* effects on ground-dwelling animals, and negative impacts on Lepidoptera by wind energy facilities could not yet be verified.

From an ecological perspective, all sites where turbines will be constructed have a low ecological value, as they are already under cultivation, and often are already subject to a high presence of alien invasive forbs. Where under cultivation, planted crops are growing at such density that movement through crops before harvest is limited and habitats are rather marginal for indigenous fauna. This may change to some degree after cereals are harvested, but still these habitats remain a seasonal forage resource only, not a more permanent source of shelter.

There will thus be no direct impact on indigenous flora, and negative impacts on indigenous terrestrial fauna is expected to be minor and short-lived (during construction or maintenance only), or negligible.

After construction, if cultivation in the immediate vicinity of turbines will be replaced by grazing or reestablishment of indigenous, this could actually improve habitat conditions relative to the current state for small fauna, neutralising potential negative effects created by low but continuous disturbances such as noise emitted by the operation of the turbines or the occupation of area by turbine foundations.

There is thus no (terrestrial) ecological justification that would prevent the construction and operation of the Rheboksfontein Wind Energy Facilities turbines at the currently selected locations.

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Acronyms and Abbreviations

Name	Description
ADU	Animal Demography Unit, with the Virtual Museum at FitzPatrick Institute of African Ornithology, Department of Biological Sciences, University of Cape Town
AIS	Alien Invasive Species
BAP	Biodiversity Action Plan
BODATSA	Botanical Database of Southern Africa
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
DEA	Department of Environmental Affairs
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ERM	Environmental Resources Management
ESA	Ecological Support Area
GN	Gazetted Government Notice
GPS	Global Positioning System
IBAT	International Biodiversity Assessment Tool
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Act: Biodiversity Act
NFA	National Forest Act
PAOA	Project Area of Assessment, the boundary of the area assessed, which should preferably be slightly larger than the PAOI
PAOI	Project Area of Influence, the boundary of the project and surrounding environment that may potentially be influenced by activities of the project
PS6	IFC Performance Standard 6
SANBI	South African National Biodiversity Institute
SCC	Species of conservation concern, i.e. data deficient, Near-Threatened or threatened species (IUCN, 2020) or national protected species
WEF	Wind Energy Facility

1. INTRODUCTION

1.1 Background

ENGIE Africa (hereafter referred to as ENGIE) is planning to develop a Wind Energy Facility (WEF) to be called Rheboksfontein WEF (hereafter the Project or WEF), to add capacity to the national electricity grid. Rheboksfontein WEF will be located approximately 3 km west of Darling and 10 km east of Yzerfontein, within the Western Cape Province. The original EIA Report and associated specialist studies were submitted to the relevant Authorities in 2011, and the proposed WEF was subsequently authorised on 2 February 2012 (EA Reference: 12/12/20/1582).

Since completion of the original specialist studies on terrestrial fauna and flora, and obtaining the initial Environmental Authorisation (EA), technologies have advanced, and hence ENGIE intends to increase the proposed wind turbine sizes and reduce the number of turbines to optimise the efficiency of the WEF. The proposed amendments may be construed as a change in the scope of the EA and may result in changes in the associated impacts, thus requiring an amendment application in terms of Part 2 of Chapter 5 of the EIA Regulations 2014 (as amended). It must be noted that the layout of all associated infrastructure, which includes the access road- and cabling network, grid connection, temporary laydown areas and other infrastructure, is assumed to remain as approved under the existing EA (EA Reference: 12/12/20/1582), and was not included in this assessment.

This report focuses on a review of data on terrestrial fauna and flora as previously determined as part of the original EIA and the online screening tool (based on data from SANBI), coupled with a site verification survey. Insights gleaned have been used for a re-evaluation of the potential impacts of the updated *turbine locations* on terrestrial biodiversity, in order to avoid or minimise potential negative impact(s) of the turbines on such biodiversity.

1.2 Project Components

The amendment of the project includes:

- Increased turbine hub height from 120 m to 130 m, which will enable a reduction of the overall number of turbines, but increase the generation output from 129 MW to 140 MW;
- Increased rotor diameter from 126 m to 170 m;
- Removal of turbine locations 32 and 33 (and their access roads and cabling networks);
- Removal of restriction of steel tower; and
- An associated increase of the size of the permanent turbine foundation from 15x15 m to 25x25 m

In addition, the WEF will have the following already authorised components:

- A network of access roads (6 m wide) to the project area, and connecting all turbine locations with associated infrastructure
- A network of underground cabling connecting all turbines with the on-site substation, cabling networks will run alongside the road network
- A grid connection connecting the on-site substation with the national electricity grid
- Temporary infrastructure/areas consisting of:
    - Hard stands at turbine locations to accommodate heavy machinery
    - Construction laydown area
- Permanent associated infrastructure consisting of:
- On-site substation with control-room and power evacuation power lines

1.3 Objectives of the Terrestrial Ecology Verification Study

The overall objectives of this assignment are to provide specialist input for the Part 2 Environmental Authorisation (EA) amendment in terms of the Environmental Impact Assessment (EIA) Regulations, Listing Notice 2, GNR 326 of the National Environmental Management Act, (NEMA), as amended for the proposed amendments to the infrastructure design at the authorised Rheboksfontein WEF in the Western Cape.

The original Terrestrial Faunal Assessment was undertaken during 2010 (Hoare, 2010), and updated 2011 (Hoare, 2011). Likewise, detailed botanical studies were carried out by Helme (2010). The review had the following objectives:

- A review of available botanical and faunal data, and likely presence and habitat requirements of species of conservation concern (SCC) historically recorded in or modelled to potentially occur in the area;
- Site verification visit for the confirmation of the validity and mapping of terrestrial biodiversity and other biodiversity-related themes at the local scale, based on existing mapping and description of habitats;
- This would also include a verification of the landuse and environmental sensitivity as currently delineated by the national web-based environmental screening tool (and BGIS) as well as regional Biodiversity Sector Plans (BSP), specifically the Swartland BSP (2017);
- Identify and delineate highly sensitive habitats within the PAOA, including priority areas for avoidance, mitigation, rehabilitation and monitoring;
- Verify the potential presence of Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) habitats or species of conservation concern (SCC) and potential suitable habitat for these species;
- A re-assessment of all impacts related to the proposed turbine positions;
- Provision of measures to ensure avoidance, management and mitigation of any impacts associated with the turbines; and
- Recommendations for biodiversity management actions to be included in the EMPr.

This report deals with the following taxonomic groups:

- Flora
- Terrestrial Mammals
- Herpetofauna
- Lepidoptera

1.4 Study Area

The site that has been identified for the establishment of the facility is located 3 km west of Darling within the Western Cape Province (Figure 1-1). The area originally considered for development of the proposed facility and associated infrastructure, is as follows (also indicating on which portions the revised layout will be):

- Remaining extent of Farm 568 Rheboksfontein;
- Farm 567 Nieuwe Plaats (no turbines on this land);
- Remaining extent of Farm 571 Bonteberg (no turbines on this land);
- Portion 1 of Farm 574 Doornfontein;
- Portion 1 of Farm 551 Plat Klip;
- Farm 1199 Groot Berg; and
- Portion 2 of Farm 552 Slang Kop (no turbines on this land).

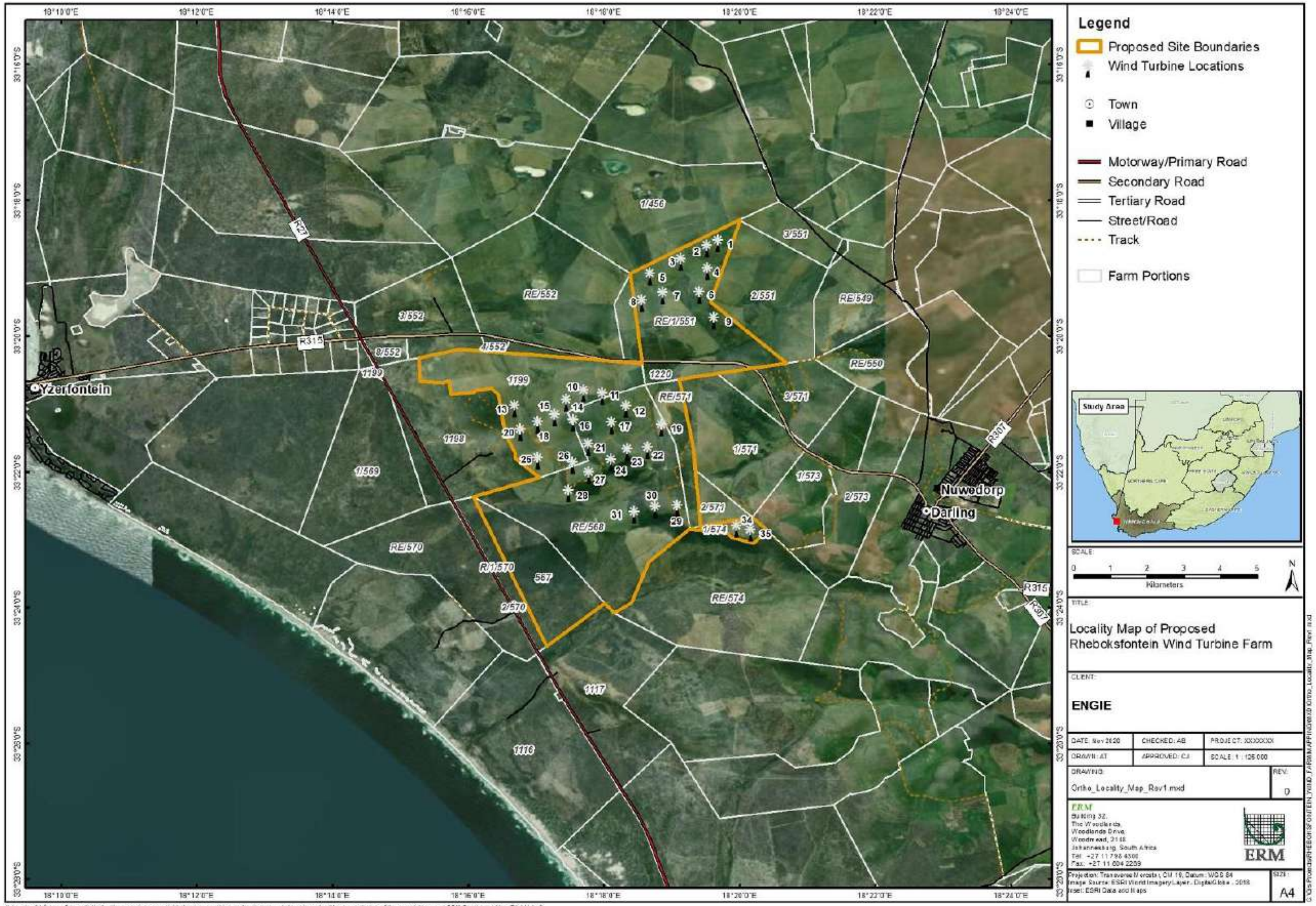

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Figure 1-1: Locality of Study Area

Two conservation areas border the study area - the small Tienie Versfeld Wildflower Reserve in the northwest, and Rondeberg Private Nature Reserve in the south. The former is managed by SANBI (South African National Biodiversity Institute) and the latter is privately owned and managed. Both reserves are regarded amongst the most important botanical conservation areas in the West Coast area, with exceptionally high numbers of threatened plant species recorded from both reserves. Additional protected and key biodiversity areas nearby include the Darling Renoster- and Darling Veldblomme Reserves, West Coast National Park, and private nature reserves such as Jakkalsfontein, Buffelsfontein, pela, Grotto Bay and Riverlands.

1.4.1 Climate and Landuse

Darling lies only 134 m above sea level, and its climate is classified as warm and temperate. Rainfall is predominantly in winter, averaging about 420 mm per annum in Darling, and decreasing slightly towards the coast. Accordingly, the peak flowering season usually occurs between August and September, depending on the onset of the rains in April/May. According to local farmers, 2020 had been a very good rainfall year – and rains persisted longer than usual, with good rains still experienced in September.The long-term monthly average temperatures and rainfall is shown in Figure 1-2. In addition to rainfall, precipitation is also received from frequent mist, which occurs predominantly over winter.

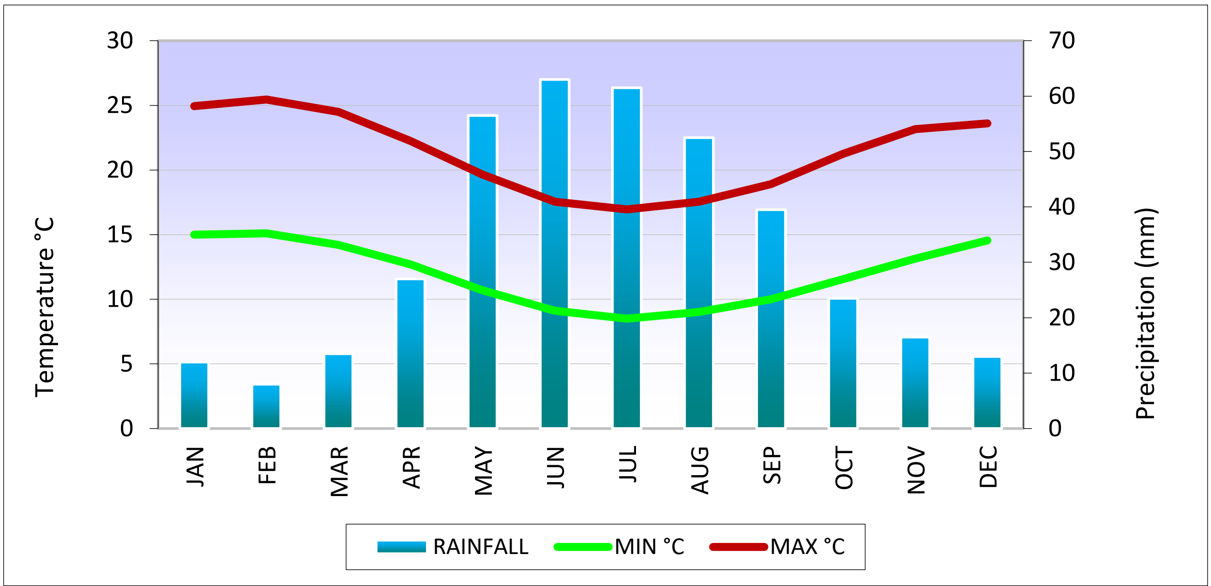

Figure 1-2: Climate averages for the study area.

The Darling agricultural area has long been one of the major dairy-producing regions of the Western Cape, with more recent shifts in agriculture to cereals, wine grapes, canola, forage and olive-groves, the latter on a smaller scale only. It is generally only the rockier and very steep areas that remained as natural vegetation. Some of the areas on lower-lying and less steep land portions were ‘strip-cultivated’ in the past: a wide strip of natural vegetation was cleared and replaced by forage grasses or annual crops. In addition, remaining natural vegetation was often subjected to continuous intense grazing, causing a shift in species composition. Subsequently, large extents of especially lower-lying areas towards the coast have been gradually invaded by exotic *Acacia* species. Smaller fragments of remaining natural vegetation have also degraded immensely over the years due to fragmentation and the ‘edge effect’ (explained in Section 6). In these small areas, there may still be a variable presence of geophytes, larger shrubs and low trees, but in general the low microphyllous shrub layer (the ‘characteristic’ component of Fynbos) as well as indigenous forbs have been significantly reduced, mostly outcompeted by ruderal weeds and forage grasses.

Currently, landowners are opting to abandon strip-cultivation and grazing of any larger extents of remaining natural vegetation, allowing these remnants to gradually revert back to their more typical/ original vegetation state. Instead, forage is planted on completely modified areas as part of the annual crop-rotation management, and livestock (cattle and sheep) are allowed to graze on fields where forage or annual crops have been harvested. This in itself is a positive conservation effort, and may also in future increase tourism potential as potential new additions to the Darling Wildflower Reserves, if the public could get access to such areas via some of the roads constructed for the WEF.

1.5 Project Area of Assessment

For purposes of this assessment, the biological Study Area (Project Area of Assessment- PAOA) was based on the potential Area of Influence of the WEF as far as flora, terrestrial mammals, herpetofauna and Lepidoptera is concerned. More specifically, a review of available literature (e.g. Helldin, 2012) was conducted to see what the direct and indirect effects of the anticipated long-term operation and maintenance may have on the most sensitive species present within or possibly frequenting the WEF land portions. As such, and after consideration of the Screening Tool Assessment (below), it was decided to limit the PAOA to the land portions on which the turbines of the WEF would be built, as illustrated in Figure 1-1: Locality of Study Area.

1.6 Department of Environmental Affairs Screening Tool and Desktop

The newly developed Governmental Screening Tool[1], in combination with spatial data available from SANBI Biodiversity GIS (BGIS[2]) was used to generate an overview of potential sensitivities within the Project Area and immediate surroundings. The identity of potential sensitive species was then verified directly with a SANBI representative. Further, the Virtual Museum of the Animal Demographic Unit (ADU[3]) of the University of Cape Town was queried for observations on the target species groups as recorded from 2000 onwards. The quarter degree grids used were: 3318 AD, - BC, - CB, and –DA.

Data obtained above was then compared to the following existing specialist studies:

- Hoare, 2010: Faunal Report for the Rheboksfontein WEF
- Helme, 2010: Vegetation Report for the Rheboksfontein WEF
- Hoare 2011: Faunal and Wetland Study for the Rheboksfontein WEF
- Helme, 2011: Addendum to the Rheboksfontein WEF Vegetation IA

According to the screening tool report generated (20/05/2020 at 10:59:40), the following relevant sensitivities have been identified for the study area:

- Combined animal sensitivity was high, mainly due to the likely presence of sensitive avifauna (Class Aves). For animal sensitivity excluding Aves, sensitivity is medium only, indicating a possible presence of sensitive Lepidoptera and Herpetofauna.
- Combined plant species sensitivity was high with the likely and/or confirmed presence of several sensitive species in remaining natural areas.
- Further, regarding the combined terrestrial biodiversity (more information in Section 4.1), sensitivity was regarded as Very High.

1.7 Limitations

- It is assumed that all third party information acquired is correct (e.g. GIS data and scope of work);
- Due to the nature of most biophysical studies, it is not possible to cover every square metre of a given PAOA. Due to factors such as thick vegetation stands and seasonality/climatic conditions influence of species' presence, it is conceivable that small individual species may have been overlooked during site investigations, which was compensated by an extensive review of available data and additional data supplied by the South African National Biodiversity Institute (SANBI).

[1] https://screening.environment.gov.za/screeningtool
[2] http://bgis.sanbi.org/MapViewer
[3] http://vmus.adu.org.za/

2. LEGISLATION AND STANDARDS

This study has been conducted in accordance with the following legislation:

2.1 Provincial

- Draft Western Cape Biodiversity Bill, 2019 (not yet promulgated, used as a guideline – if promulgated, will repeal all below provincial legislation)
- Sea Shore Act, 1935 (21 of 1935)
- Nature Conservation Ordinance, 1974 (19 of 1974)
- Nature Reserves Validation Ordinance, 1982 (23 of 1982)
- Western Cape Nature and Environmental Conservation Ordinance Amendment Act, 1999 (8 of 1999)
- Western Cape Conservation Laws Amendment Act, 2000 (3 of 2000)
- Western Cape Biosphere Reserves Act, 2011 (6 of 2011)

2.2 National

- National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
- National Environmental Management Act: Biodiversity Act / NEMBA (Act No. 10 of 2004) and amendments, with particular reference to protected (TOPS Regulations 2007), Procedures and criteria for reporting on environmental themes (GN 9, 320 of 2020 and 648 of 2019) and alien invasive species (A&IS regulations, updated September 2020)
- National list of ecosystems that are threatened and in need of protection (Government Notice 1002 of 2011)
- National Forest Act 1998 / NFA (No 84 of 1998)
- Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

2.3 International Standards

- The International Finance Corporation (IFC) Performance Standard (PS) 6 and associated Guidance Note 6, with special reference to:
  - Extent of modified and/or natural habitat (as per IFC PS6 para. 11 and 13)
  - Occurrence or likely occurrence of critical habitat values, if any (as per IFC PS6 para. 16), or protected areas or international recognized areas (PS6 para. 20)
- Equator Principles 4 (July 2020)
- The World Bank Group Environmental, Health and Safety (EHS) Guidelines

3. METHODS

Detailed assessments of terrestrial fauna and flora have been conducted before. In addition, landowners will only allow the development of the WEF under strict conditions, of which the most important one relating to this report is that no remaining natural area (regardless its ecological state), be physically impacted on. Hence, only a verification of existing studies was undertaken (in line with a compliance statement), but results of the previous studies were wholly incorporated this report. The primary aim of this study was to gain insights as to the current state of remaining natural vegetation/habitats and the likelihood of such being directly or indirectly impacted by the WEF. The field study did not include a detailed assessment (i.e. localities) of the presence of species of conservation concern (SCCs), but looked at the *possibilities* of the presence of such species within the temporary and permanent footprint (direct impact) or immediate surroundings (20 m of) to the footprint (indirect or cumulative impact). The proposed updated layout was then compared to such localities where a pre-construction search-and-rescue operation can be undertaken.

Apart from desktop studies as indicated in Section 1.6 a field verification visit was undertaken from 29 September to 2 October 2020.

3.1 Flora

Existing reports on flora were verified by a 4-day random meander transect through the different natural and semi-natural vegetated areas of the Project site, focusing on the general ecological state of the vegetation, habitat types and protected and/or threatened species (i.e. Species of Conservation Concern, SCCs).

3.2 Fauna

In the light of specialist studies having been conducted previously, the site verification visit primarily focused on the availability and current state of habitats. For Lepidoptera in particular, natural vegetation was investigated for the presence of specific species used by SCC during the larval phase.

As indicated by desktop studies, there was a perceived low sensitivity/presence of terrestrial fauna (and medium based on screening records prior to 2002 or species distribution models), hence the faunal survey only involved opportunistic day-time observations (in parallel to the vegetation survey). From this, confirmed presence or the probability of occurrence (POO) for species was determined. Assigning a POO for a species takes into account the sum of the circumstantial evidence gathered. Criteria used to derive the probability of occurrence are listed below, and were evaluated on site, complemented by local interviews (such as Theo Basson from Rheboksfontein, and staff from the nearby !Khwa ttu Heritage Centre).

POO for a particular species was evaluated as High, Medium or Low based on the following criteria:

- Degree of habitat disturbance/transformation - disturbance such as agricultural clearings, road networks and *changes* in natural vegetation structure (also due to invasion of alien species) influences the likelihood of a species being found in a particular habitat;
- Vegetation community suitability - this took into account the presence of particular plant species for forage, refugia and nesting sites;
- Structural (vegetation and substrate) suitability - a combination of soil texture, presence and type of rock (if any) and structural characteristics of the vegetation e.g. canopy height, density, leaf litter potential etc.;
- Connectivity with other important habitats - dispersal ability of fauna between different habitat types can depend on the interconnectedness of these habitats and therefore influences their POO; and
- Anecdotal evidence: interviews, sunrise investigations of nearby road kills, and existing data such as ADU records

3.2.1 Mammals

Available data as indicated above and selected literature was used in the desktop component of the study. Key sources for identification of mammal species are:

- Apps (2000);
- Monadjem et al. (2015); and
- Stuart & Stuart (2013) to aid with identification of tracks and signs.

3.2.2 Herpetofauna

All available data and recent publications providing information on distribution ranges and/or conservation status of southern African herpetofauna will be utilized to adjust predictions of occurrence in the Project Area. The key references used for each taxonomic group were as follows:

- Amphibian identification and geographic distribution: Field Guide to the Frogs & other Amphibians of Africa (Channing & Rödel, 2019);
- Reptile and amphibian conservation status: IUCN (2019); and
- SANBI verification of sensitive species indicated in the screening tool.

3.2.3 Lepidoptera

Data evaluated included the ADU records, SANBI records on this species group (verified from the screening tool), as well as:

- Field Guide to Butterflies of South Africa (Woodhall, 2005)

3.3 Impact Receptors

To evaluate potential impacts from the proposed development, it is essential to appropriately define the potential impact receptors in relation to specific habitats, species, group of species and it/ their use of/ reliance on a particular habitat. SCCs and ecosystem functionality and -services should be some of the main factors (but not the only) influencing the description of habitat and/or vegetation units (as general habitat for other taxa investigated) as receptors to potential impacts. The receptor therefore includes both the habitat/vegetation unit (often referred to as vegetation association or -community) and the important species (floristic and faunal) reliant on it for a particular purpose (breeding, refugia, foraging etc.). Therefore, when evaluating Site Ecological Importance (SEI; see below) for the receptor and describing potential impacts from the proposed development, the species or group of species of concern have been specifically taken into account. Further, the applicability of current Biodiversity Sector Plan status, as delineated for the study area by the screening tool and BGIS, are evaluated as part of the SEI.

Where possible, the impact receptors must be defined spatially and mapped appropriately. In cases where mapping cannot easily be performed (e.g. specific trees used as nesting sites), the general area containing these receptors should be mapped.

3.4 Habitat Sensitivity by Evaluation of Site Ecological Importance (SEI)[4]

In order to spatially identify the different areas of importance for a species for a proposed development site and to facilitate transparent and comparable reporting of the potential impacts of development, a standardised metric for identifying site-based ecological importance for species, in relation to a proposed project with a specific footprint and suite of anticipated activities, is implemented.

[4] Extracted wholly from South African National Biodiversity Institute (SANBI). 2020. Draft Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 1.0.

3.4.1 Method for the determination of Site Ecological Importance (SEI)

SEI is considered to be a function of the Biodiversity Importance (BI) of the receptor (e.g. species of conservation concern, the vegetation/fauna community or habitat type present on the site and its resilience to impacts (Receptor Resilience) as follows:

$$SEI = BI + RR$$

BI in turn is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows:

$$BI = CI + FI$$

Conservation Importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN (2016)).

Conservation Importance is defined here as:

> *The importance of a site for supporting biodiversity features of conservation concern present e.g. populations of IUCN Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes*.

These criteria are defined as follows:

- IUCN Threatened and Near-Threatened Species (CR, EN, VU & NT) refers to either the global or national assessments of the risk of extinction as evaluated by a dedicated panel of species specialists according to the criteria of the International Union for The Conservation of Nature (www.iucnredlist.org). Where the global and national assessments differ for the same taxon, the most recent evaluation of status should be used in calculating SEI. It is important to note that the specialist is required to have a firm understanding of the IUCN Red List Categories and Criteria (IUCN 2012) in order to appropriately apply these for the evaluation of SEI. This criterion can be assessed using confirmed occurrences of species or the suitability of the habitat to support these species;
- Rare species are those included on the country-specific Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat.
- Range-restricted species – the presence of terrestrial flora, vertebrate and invertebrate fauna with a global population extent of occurrence (EOO) of 10 000 km^2 or less;
- Globally significant populations of congregatory species – a roughly estimated proportion (%) of the global population of a fauna species that congregate for breeding / feeding / hibernation / other reasons;
- Significant areas of threatened vegetation types – this is a function of both the area (size) being considered in relation to the total extent of that vegetation type (i.e. proportion) and how threatened (CR, EN, VU) the vegetation types are; and
- Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

As a minimum requirement, CI needs to be determined for each identified habitat within the project footprint but best practice recommendation is that it should be determined for all habitats within the entire Project Area of Assessment (PAOA), using the ratings as in Table 3-1.

Table 3-1: Conservation Importance Ratings

Conservation Importance	Fulfilling Criteria
Very High	■ Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare or Critically Rare species that have a global Extent of Occurrence of < 10 km^2 ■ Any area of natural habitat of a CR ecosystem type or large area (> 0.1 % of the total ecosystem type extent) of natural habitat of EN ecosystem type ■ Globally significant populations of congregatory species (>10% of global population)
High	■ Confirmed or highly likely occurrence of CR, EN, VU species that have a global Extent of Occurrence of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. ■ Small area (>0.01% but < 0.1 % of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1 %) of natural habitat of VU ecosystem type. ■ Presence of Rare species. ■ Globally significant populations of congregatory species (>1% but <10% of global population).
Medium	■ Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under a criterion only and which have > 10 locations or > 10 000 mature individuals. ■ Any area of natural habitat of threatened ecosystem type with status of VU ■ Presence of range-restricted species ■ > 50 % of receptor contains natural habitat with potential to support SCC
Low	■ No confirmed or highly likely populations of Species of Conservation Concern ■ No confirmed or highly likely populations of range-restricted species ■ < 50 % of receptor contains natural habitat with limited potential to support SCC
Very Low	■ No confirmed and highly unlikely populations of SCC ■ No confirmed and highly unlikely populations of range-restricted species ■ No natural habitat remaining

Functional Integrity (FI) of the receptor (e.g. the vegetation/fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions. Simply stated, FI is:

> *a measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*

These criteria can be defined as:

- Connectivity to other natural areas - connectivity, which can also be measured conversely as the degree of habitat fragmentation, refers to how connected habitat patches are to each other, which has a significant influence on numerous ecological process, such as migration and dispersal opportunities of biota and therefore genetic exchange between populations. Connectivity to other similar habitats becomes more important as the remaining intact and functional area of a habitat decreases, mainly because population sizes decrease and are therefore at greater risk from ecological perturbations and inbreeding effects. The degree of connectivity between habitat patches varies greatly with the dispersal ability of the taxon or taxon group (e.g. fossorial reptiles) in question;

- Degree of current persistent negative ecological impacts - persistent negative impacts such as uncontrolled spread of alien and invasive flora effectively decreases both the remaining intact area and ecosystem functioning of a particular habitat; and
- Remaining intact and functional area – the proportion of the receptor that supports natural habitat with intact ecological processes - small areas are less likely to withstand ecological degradation compared to large areas and are therefore better able to maintain structure and function allowing for intact ecological processes.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table 3-2), and will require justification by the specialist.

Table 3-2: Functional Integrity Ratings

Functional Integrity	Fulfilling Criteria
Very High	■ Very large (>100 ha) intact area for any conservation status of ecosystem type or >5 ha for CR ecosystem types ■ High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches ■ No or minimal current negative ecological impacts with no signs of major past disturbance (e.g. ploughing)
High	■ Large (>20 ha but <100 ha) intact area for any conservation status of ecosystem type or >10 ha for EN ecosystem types ■ Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches ■ Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential
Medium	■ Medium (>5 ha but <20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types ■ Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches ■ Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance; moderate rehabilitation potential
Low	■ Small (>1 ha but <5 ha) area ■ Almost no habitat connectivity but migrations still possible across some transformed or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. ■ Several minor and major current negative ecological impacts
Very Low	■ Very small (<1 ha) area ■ No habitat connectivity except for flying species or flora with wind-dispersed seeds. ■ Several major current negative ecological impacts

As Biodiversity Importance (BI) is a function of Conservation Importance (CI) and the Functional Integrity (FI) of a receptor, BI can be derived from a simple matrix of CI and FI as follows:

Biodiversity Importance		Conservation Importance				
		Very High	High	Medium	Low	Very Low
Functional Integrity	Very High	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

Receptor Resilience (RR) needs to be evaluated by the specialist and justification for each evaluation must be provided in the report.

Receptor Resilience (RR) is defined as:

> *the intrinsic capacity of the receptor to resist major damage from disturbance and / or to recover to its original state with limited or no human intervention.*

The fulfilling criteria to evaluate RR is based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (Table 3-3), and will require justification by the specialist. The specialist needs to bear in mind that resilience will often be linked to a particular disturbance or impact, or even time of year, and needs to be described in relation to these factors. As an example, large birds of prey have different levels of resilience to noise disturbance depending on whether they are breeding or not; these species would have low resilience to noise disturbance such as construction of a road adjacent to a nest site during the breeding season but a higher resilience to lodge construction in an area with limited breeding habitat outside of the breeding season.

Table 3-3: Receptor Resilience Rating

Resilience	Fulfilling Criteria
Very High	■ Habitat that can recover rapidly (~ less than 5 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed
High	■ Habitat that can recover relatively quickly (~ 5-10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed
Medium	■ Will recover slowly (~more than 10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed

Resilience	Fulfilling Criteria
Low	■ Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~less than 50 % of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed
Very Low	■ Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed

After the evaluation of both Biodiversity Importance and Receptor Resilience as described above, it is possible to evaluate Site Ecological Importance (SEI) from the final matrix as follows:

Site Ecological Importance		Biodiversity Importance				
		Very High	High	Medium	Low	Very Low
Receptor Resilience	Very Low	Very High	Very High	High	Medium	Low
	Low	Very High	Very High	High	Medium	Very Low
	Medium	Very High	High	Medium	Low	Very Low
	High	High	Medium	Low	Very Low	Very Low
	Very High	Medium	Low	Very Low	Very Low	Very Low

4. RESULTS

4.1 Historical Vegetation and Regional Conservation Planning

The Project area falls within the Sand Fynbos and Granite Renosterveld types and Swartland Biodiversity Sector Plan Area, which is part of the Fynbos Biodiversity Hotspot in South Africa.

Sand Fynbos is almost entirely coastal, occurring on sands of marine and aeolian origin, as found along large extents of the West- and South Coast. Vegetation structure and species dominance is mostly influenced by the depth and seasonal variability of the water table. Within the western extent of the PAOA, the specific Sand Fynbos present is referred to as **Hopefield Sand Fynbos** in the 'Vegetation Types of South Africa' (Mucina and Rutherford 2006, delineation revised by SANBI 2018 as shown in Figure 4-1), which is listed as a **Vulnerable Ecosystem**.

Hopefield Sand Fynbos occurs on relatively dep acid sands of the coastal sand fields and localised inland dune fields between Rondeberg in the south and Langebaan-Aurora area in the north. About 80% of the remaining vegetation in the original study area is of this type. Some 41% of this vegetation type has been lost, with a conservation target of 30%, which at present has not been achieved. The main areas of protection are within the Hopefield and Jakkalsfontein Nature Reserves and West Coast National Park (Mucina and Rutherford, 2006).

Granite Renosterveld has very strong affinities to Granite Fynbos. A typical component of the vegetation is a very prominent geophyte (bulb) diversity and a strong forest-thicket element, the latter most conspicuous on rocky outcrops and fire-safe habitats. Specific to the PAOA, the type of Granite Renosterveld is referred to as **Swartland Granite Renosterveld** (Mucina and Rutherford 2006, delineation revised by SANBI 2018 as shown in Figure 4-1).

Swartland Granite Renosterveld has been very heavily impacted by agriculture within the region where it occurs (Darling to Malmesbury) and today less than 20% of its original extent remains (Rouget et al., 2004). The vegetation type is regarded as a **Critically Endangered**, with an unachievable national conservation target of 26%, and only 1% conserved (e.g. in the Paarl Mountain Nature Reserve, Pella Research Site and Tienie Versveld Flower Reserve). Intact examples of this vegetation type are typically home to a high number of rare and threatened plant species, many of which are endemic (restricted) or near endemic to the vegetation type.

Although not mapped at the scale of the South African Vegetation Types, it can be expected that at least historically, vegetation along larger rivers and floodplains was covered by **Swartland Alluvium Renosterveld**, which is found in narrow belts along in the Darling, Moorreesburg, Malmesbury and Klipheuwel areas. A conspicuous feature of these wetlands/riparian areas is a conspicuous seasonal cover of *Zantedeschia aethiopica* and *Ornithogalum thyrsoides*, together with dense stands of grasses, restios and Renosterbos shrubland.

In general, the different vegetation types occur in intricately linked mosaics, with ecotones (transition from one to the other) mostly difficult to distinguish, especially due to past (and present) high disturbance levels.

The Western Cape/Swartland Biodiversity Sector Plan of 2017 (Figure 4-2) delineated most of the vegetation as Modified Area, with small sections as Critical Biodiversity and Ecological Support Area.

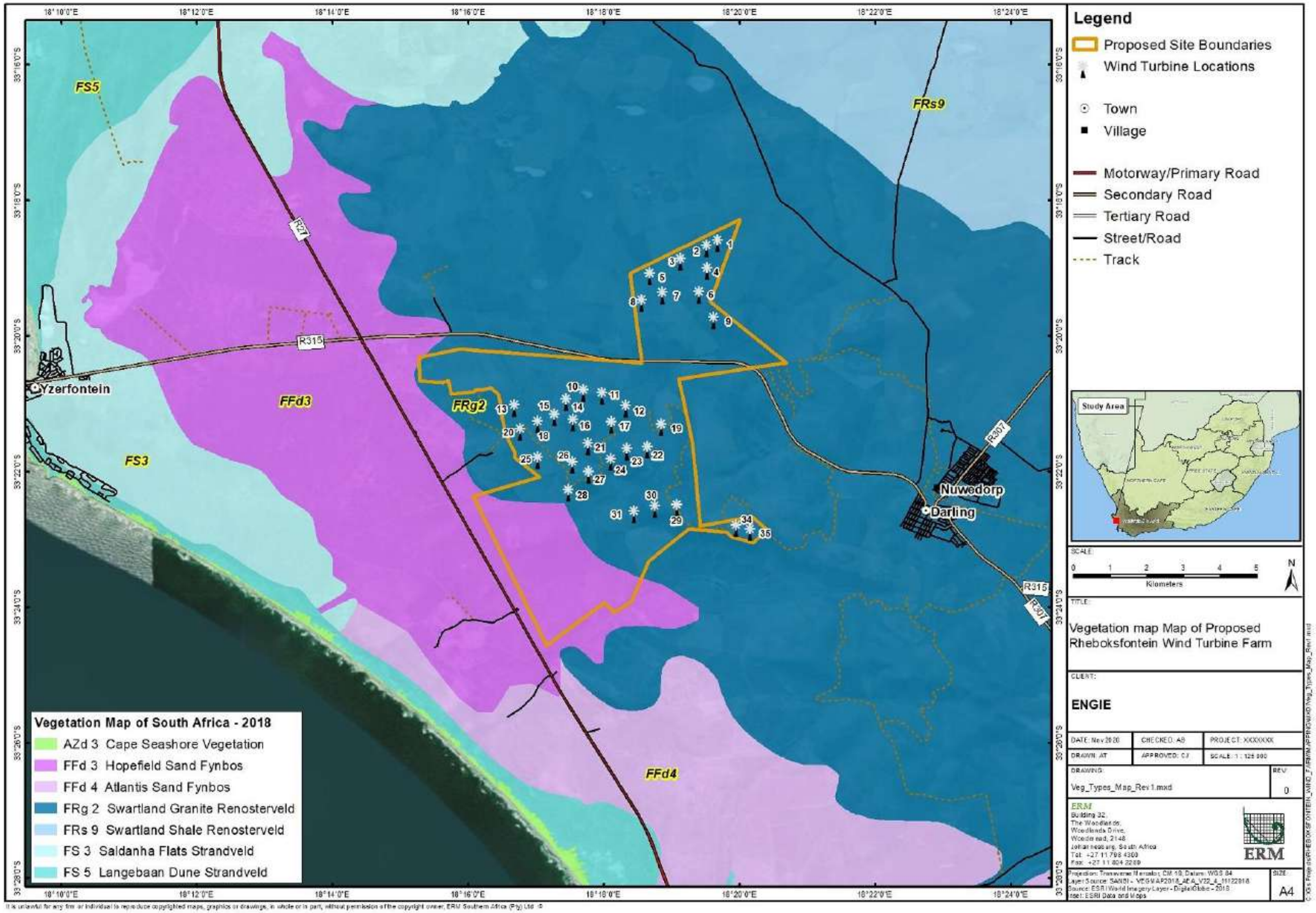

Figure 4-1: Vegetation Types historically on and around the Project Area

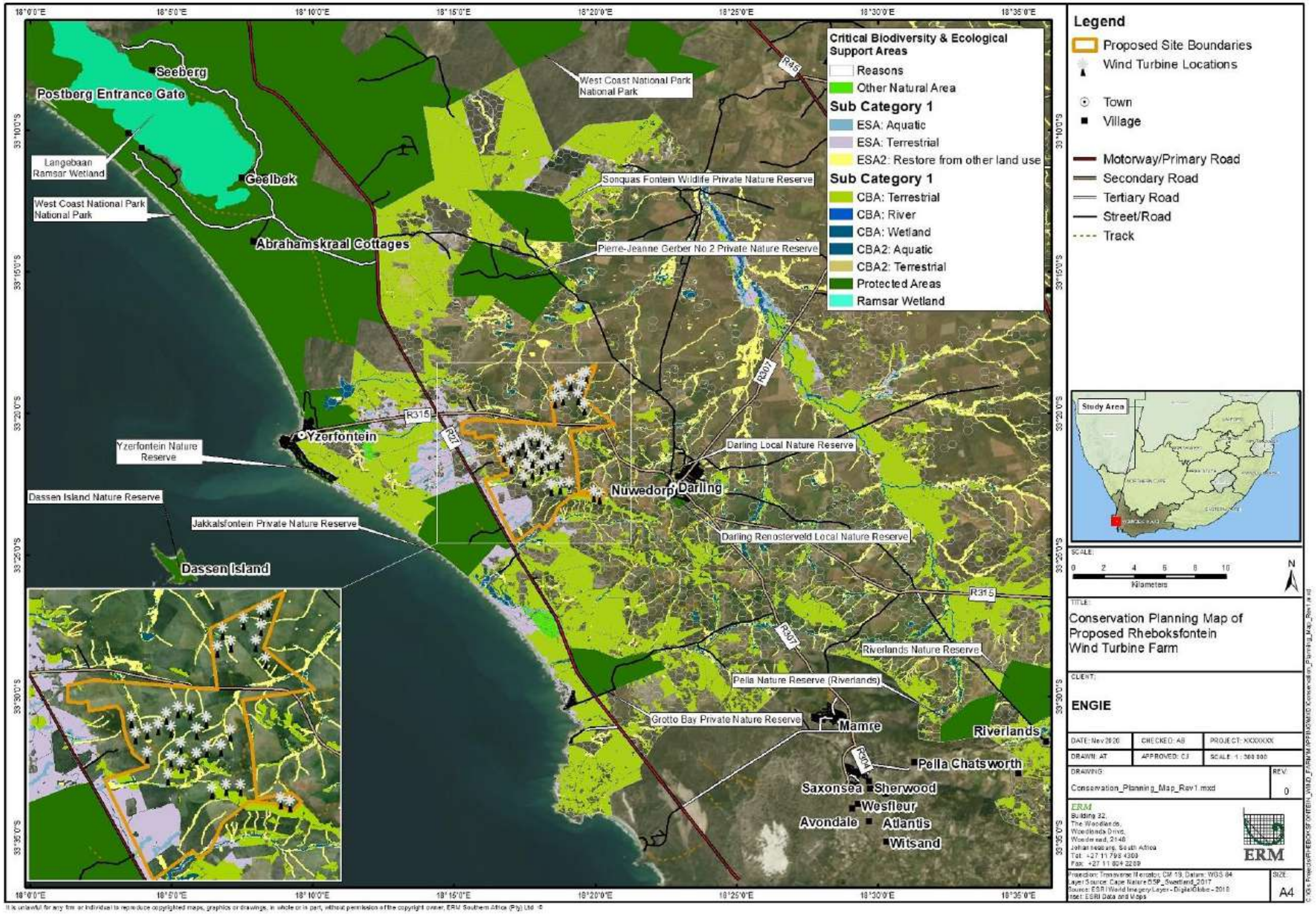

Figure 4-2: Biodiversity Sector Plan delineations on and around the Project Area.

4.2 Vegetation Habitats

The field survey could verify that remaining natural vegetation is Swartberg Granite Renosterveld in the higher-lying areas (mostly central and eastern study area), of which smaller fragments and edges or larger patches are highly degraded, and thus have reduced ecological value. In the lower-lying areas towards the western periphery of the PAOA is Hopefield Sand Fynbos, which overall is very disturbed due to past strip cultivation as well as invasion by mostly *Acacia cyclops*. Floodplains and riparian areas in general are no longer natural, often subject to deep erosion and/or invasion of alien plants, but some still have some of the characteristic species of the Swartland Alluvium Renosterveld (north-eastern extent of the study area). Some of the land-owners have their own programs to either spare natural and semi-natural vegetation from direct impacts such as grazing, or allow previous strip-cultivation and vegetation in larger floodplain/river areas gradually revert back to natural vegetation, aiding this process by removing alien invasive trees.

Modified areas, as potential habitat, include all cultivated lands. The approximate delineations are shown in Figure 4-9 and Figure 4-10 at the end of this subsection.

Table 4-1: Habitats Identified

Habitat and notes	PS 6 classification	Site Ecological Importance	Area
Swartberg Granite Renosterveld	Natural	Very High	155,5
Fragmented Swartberg Granite Renosterveld	Modified	Medium	83,7
Hopefield Sand Fynbos	Modified	High	838,2
Wetlands and Riparian Areas	Modified	Medium	134,1
Alien Tree Patches	Modified	Low	23,7
Cultivated and Transformed Areas	Modified	Very Low	2553,2
Total Area Investigated			**3788,4**

4.2.1 Swartberg Granite Renosterveld

Swartberg Granite Renosterveld is found mostly on steeper slopes, moderate footslopes and undulating plains, and consist of a mosaic of grasslands/herblands interspersed with a medium-dense, microphyllous shrubland, the latter dominated by Renosterbos. Groups of small trees and tall shrubs are associated with heuweltjies and rocky outcrops. In many cases, only these rocky outcrops have been spared from cultivation and although they still frequently have a conspicuous cover of the small tree/tall shrub as well as geophytic component, they are almost entirely invaded by self-germinating cereal crops, as well as alien grasses and –forbs.

Larger intact extents of this vegetation within the study area was in the past subjected to very high grazing levels, and are still subject to changes in species composition due to an absolute control/absence of fires (that would occur naturally every 10-15 years). Nevertheless, according to local farmers, the significant reduction of grazing pressure (now only by small indigenous antelope such as Duiker and Klipspringer) has seen a gradual improvement in the condition of natural species diversity. Further, disturbed areas originally dominated by *Galenia africana* have seen a reduction in this pioneer shrub and a gradual increase in indigenous Fynbos species.

In its more natural state (Figure 4-3), Swartberg Granite Renosterveld would be characterised by the following species (species indicated in green are still common; (d) indicates historically dominant species):

Important Taxa:

Tall Shrubs: *Euclea racemosa* subsp. *racemosa* (d), *Olea europaea* subsp. *africana* (d), *Putterlickia pyracantha* (d), *Searsia laevigata* (d), *Aspalathus acuminata* subsp. *acuminata*, *Chrysanthemoides monilifera*, *Diospyros glabra*, *Dodonaea viscosa* var. *angustifolia*, *Myrsine africana*, *Passerina corymbosa*, *Searsia angustifolia*, *S. crenata*, *S. tomentosa*, *S. undulata*, *Wiborgia obcordata*.

Low Shrubs: *Anthospermum aethiopicum* (d), *Elytropappus rhinocerotis* (d), *Eriocephalus africanus* var. *africanus* (d), *Felicia filifolia* subsp. *filifolia* (d), *Maytenus oleoides* (d), *Salvia lanceolata* (d), *Anthospermum galioides* subsp. *galioides*, *Aspalathus hispida*, *Asparagus rubicundus*, *Athanasia trifurcata*, *Chironia baccifera*, *Erica paniculata*, *Galenia africana*, *Gnidia squarrosa*, *Helichrysum cymosum*, *H. dasyanthum*, *H. revolutum*, *H. teretifolium*, *Hermannia alnifolia*, *H. hyssopifolia, H. prismatocarpa, Leucadendron lanigerum* var. *lanigerum*, *Lobostemon argenteus, L. fruticosus*, *Nenax hirta* subsp. *hirta*, *Oftia africana*, *Phylica thunbergiana*, *Searsia dissecta*, *S. rosmarinifolia*, *Salvia africana-caerulea*, *Stoebe cinerea*.

Succulent Shrub: *Lampranthus sociorum*.

Woody Climbers: *Cissampelos capensis*, *Microloma sagittatum*.

Herbs: *Helichrysum crispum* (d), *Annesorhiza macrocarpa*, *Cotula turbinata, Hebenstretia paarlensis, Lichtensteinia obscura, Stachys aethiopica*.

Geophytic Herbs: *Mohria caffrorum* (d), *Chlorophytum undulatum*, *Geissorhiza monanthos*, *Moraea papilionacea, Oxalis obtusa, O. pes-caprae, O. purpurea, Pelargonium longifolium, Romulea eximia, R. rosea, Sparaxis parviflora, Watsonia borbonica* subsp. *borbonica*.

Succulent Herb: *Crassula capensis*.

Herbaceous Climber: *Cynanchum africanum*.

Grasses and Restios: *Ehrharta calycina* (d), *E. villosa* var. *villosa* (d), *Ischyrolepis gaudichaudiana* (d), *Cymbopogon marginatus*, *Ehrharta longiflora*, *E. ottonis, E. thunbergii, Ischyrolepis capensis, Thamnochortus bachmannii, Themeda triandra, Tribolium uniolae*.

Figure 4-3: Swartberg Granite Renosterveld within the PAOA.

Due to the significant difference in habitat diversity, possibly functionality and rehabilitation potential, this vegetation type has been mapped as Swartberg Granite Renosterveld (larger extents, although they are not pristine) and Fragmented Swartberg Granite Renosterveld (Figure 4-4). The latter usually have a high presence of alien weeds such as *Brassica tournefortii*, *Lupinus* species, *Trifolium campestre, Fumaria muralis*, *Avena fatua, Bromus diandrus* and *Hordeum*-, *Lolium*- and *Vulpia*-species.

Figure 4-4: Fragmented Swartberg Granite Renosterveld within the PAOA

Note the typical element of these fragments being a significant cover of rock plates or boulders.

4.2.2 Hopefield Sand Fynbos

Vegetation is a moderately tall, sclerophyllous (with short needle-like leaves) shrubland with a dense herbaceous layer of leafless hemicryptophytes (plants with growth points on the soil surface). Vegetation is dominated by mostly asteraceous and restioid fynbos, although proteoid fynbos is extensive and ericaceous fynbos, the latter of low diversity, can occur in seeps and along watercourses.

Large extents of this vegetation within the study area is severely degraded due to past high grazing levels, partial conversion to grasslands, partial conversion by strip-cultivation (and now allowed to regenerate naturally), changes in species composition due to an absolute control of fires (that would occur naturally every 10-15 years), as well as a high level of invasion by the alien shrub *Acacia cyclops*, as well as several alien invasive species.

In its more natural state, Hopefield Sand Fynbos (Figure 4-5) would be characterised by the following species (species indicated in green are still common; (d) indicates historically dominant species):

<u>Important Taxa:</u>

Tall Shrubs: *Leucadendron foedum* (d), *Leucospermum rodolentum* (d), *Leucadendron pubescens*, *Putterlickia pyracantha*.

Low Shrubs: *Diosma hirsuta* (d), *Phylica cephalantha* (d), *Anaxeton asperum*, *Anthospermum spathulatum* subsp. *spathulatum*, *Aspalathus lotoides* subsp. *lagopus*, *A. ternata*, *Erica mammosa*, *E. plumosa*, *Leucadendron cinereum*, *L. salignum*, *Leucospermum* *hypophyllocarpodendron* subsp. *canaliculatum*, *Metalasia capitata*, *Pharnaceum lanatum*, *Phylica harveyi*, *Serruria decipiens*, *S. fasciflora*, *Trichocephalus stipularis*.

Succulent Shrubs: *Euphorbia muirii*

Herbs: *Helichrysum tinctum*, *Indigofera procumbens*, *Knowltonia vesicatoria*.

Geophytic Herbs: *Geissorhiza purpurascens*, *Lachenalia reflexa*, *Romulea obscura*.

Grasses and Restios: *Cannomois parviflora* (d), *Cynodon dactylon* (d), *Ehrharta villosa* var. *villosa* (d), *Elegia tectorum* (d), *Staberoha cernua* (d), *Thamnochortus erectus* (d), *T. punctatus* (d), *Willdenowia incurvata* (d), *Elegia verreauxii*.

Additional common species observed, which most likely are the result of past disturbances, include a wide-spread dominance of *Galenia africana*, coupled with frequent stands of *Tetragonia fruticosa*, *Asparagus capensis*, *Berkheya rigida, Dimorphotheca pluvialis, Eriocephalus-, Ursinia-* and *Arctotis* species.

Figure 4-5: View of Hopefield Sand Fynbos in the area.

Note Diosma hirsuta in the foreground, and past strip-cultivation in the background. The photo was taken on the neighbouring !Khwa ttu Heritage Centre, as it enabled a better view of the former strip-cultivation.

4.2.3 Riparian Areas

The study area crosses several smaller watersheds, draining to the north-west, north-east and south-west. Drainage lines start either as insignificant seepages mostly modified by cultivation, or as shallow depressions/incisions between undulating landscapes. Such smaller drainage lines are prone to erosion if runoff from cultivated areas is not well managed or roads are not optimally aligned to contours. In the lower-lying areas, the riparian width increases as smaller drainages flow together. Vegetation along the riparian areas is very variable, depending on the width and longevity of moisture levels within. Smaller drainages are usually covered with grasses (Figure 4-6 top) – many either invasive weeds or originating from planted cereals or pastures (e.g. *Pennisetum clandestinum*) – and annual forbs, whilst the restio- and low shrub component increases in wider, lower-lying rivers (Figure 4-6 bottom).

Geophytes are rather common in riparian areas, dominated mostly by *Ornithogalum thyrsoides* and *Zantedeschia aethiopica*. Large extents of especially the lower-lying riparian areas still have patches of alien invasive trees on or near the banks, mostly consisting of *Eucalyptus* and *Acacia* species. On occasion, small man-made impoundments or natural seasonal pans can be found, of which the vegetation is typically dominated by restios.

Figure 4-6: Closer look at riparian areas.

Low shrubs are mostly of the species *Eriocephalus africanus* var. *africanus* and Galenia africana, whilst the annual (non-grass) forb layer is often dominated by *Arctotis* species*, Berkheya rigida, Ursinia anthemoides, Senecio* species and *Dimorphotheca pluvialis.* Overall the riparian vegetation in the riparian areas has been degraded to such extent that it is no longer natural.

4.2.4 Alien Tree Patches

Throughout the study area, variable stands of large alien invasive trees have been observed, assumed to have been planted at some stage either as wind-break or for other reasons (this does not include alien invasive *Acacia cyclops* that have invaded larger lower-lying areas towards the western periphery of the study area). Species either consist mostly of *Eucalyptus*-, *Pinus*- or *Acacia* species. Many of the smaller patches of trees (Figure 4-7) are within or close to riparian areas.

Figure 4-7: Groups of large alien trees in the study area.

4.2.5 Cultivated Areas

From a floristic perspective, these areas are of low value. Many of these areas are subject to annual chemical treatment to combat both pathogens and invasive weeds. Crops vary from perennial wine grapes with regularly cleared soil around (Figure 4-8 top), to annual cereals, forage grasses and canola crops (possibly also others) planted in rotation (Figure 4-8 bottom). Many of the annual species do establish randomly on the edges of riparian areas or remaining natural areas. After harvesting, livestock are allowed to graze on the remaining cut plants, and it is aimed to minimise tilling and disturb soil only just before and for planting new crops.

From a faunal perspective, it can be expected that cultivated areas will be frequented by the more opportunistic species such as gerbils and other rodents, but due to the density of annual crops, this will most likely be more towards the slightly more open edges of fields. Here they may also attract smaller predators, which would be able to move readily along tracks and berms between cultivated areas.

Figure 4-8: Different views of modified areas.

The distribution of the different habitat types is shown in Figure 4-9 and Figure 4-10.

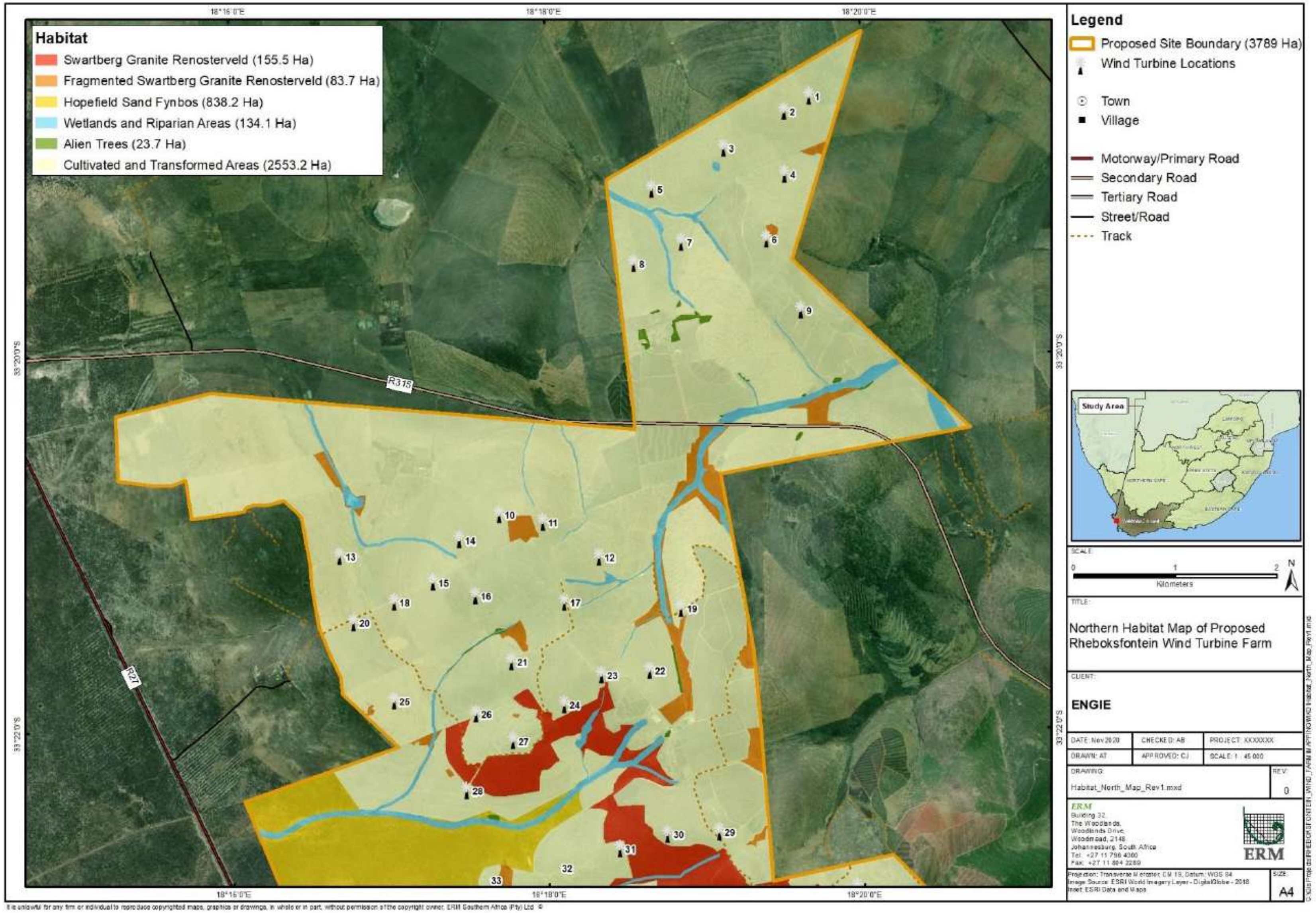

Figure 4-9: Habitats identified across the Project Area (North).

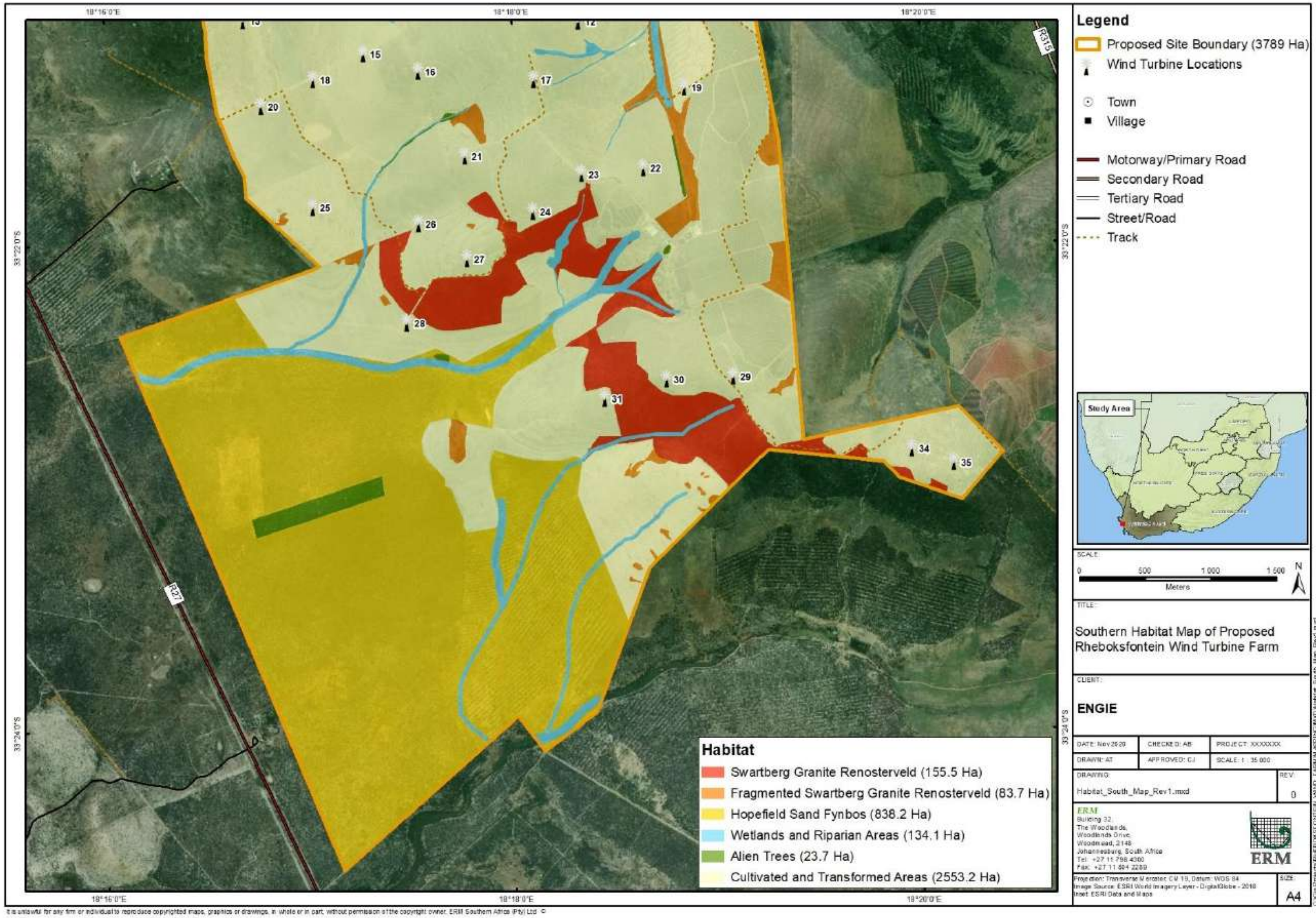

Figure 4-10: Habitats identified across the Project Area (South)

4.3 Plant Species of Conservation Concern

Following plant species of conservation concern have been historically observed within and in close proximity to the project area:

Species	Conservation Status	Notes on Presence
Screening tool: Possibility of being present based on species distribution models		
Aspalathus lotoides subsp. lotoides	VU	Possible, if then in habitat outside envisaged footprint
Diosma dichotoma	EN	Unlikely, if then in habitat outside envisaged footprint
Erica bolusiae var. bolusiae	CR	Unlikely, if then in habitat outside envisaged footprint
Ixia curta	EN	Small possibility, if then in habitat outside envisaged footprint
Lampranthus debilis	EN	Unlikely, if then in habitat outside envisaged footprint
Lampranthus sociorum	EN	Possible, if then in habitat outside envisaged footprint
Leucospermum tomentosum	VU	Possible, if then in habitat outside envisaged footprint
Oxalis stictocheila	EN	Small possibility, if then in habitat outside envisaged footprint
Pauridia canaliculata	EN	Unlikely, if then in habitat outside envisaged footprint
Ruschia diversifolia	VU	Possible, if then in habitat outside envisaged footprint
Sensitive species 588	EN	Observed on western periphery of study area, far beyond extent of footprint, thus not impacted
Serruria decipiens	NT	Observed, but well outside envisaged footprint
Sparaxis parviflora	VU	Unlikely, if then in habitat outside envisaged footprint
Xiphotheca reflexa	EN	Unlikely, if then in habitat outside envisaged footprint
Protected species observed		
Haemanthus cf pubescens	LC	Observed in fragmented areas, but well outside envisaged footprint
Microloma sagittatum	LC	Observed in fragmented areas, but well outside envisaged footprint
Berzelia abrotanoides	LC	Observed, but well outside envisaged footprint
Babiana species		Observed, but well outside envisaged footprint
Ferraria crispa	LC	Observed, but well outside envisaged footprint
Gladiolus spp	LC	Observed, but well outside envisaged footprint
Morea spp	LC	Observed, but well outside envisaged footprint
Watsonia meriana	LC	Observed, but well outside envisaged footprint
Aizoaceae – *Ruschia*, *Carpobrotus*, *Mesembryanthemum*, *Drosanthemum* species and others		Many RSA endemics, outside envisaged footprint

Some of these species are depicted in Figure 4-11 below.

Figure 4-11: Some of the Plant Species of Conservation Concern observed.

Top from Left to Right: Haemanthus cf. pubescens and Microloma sagittatum

Bottom: Ferraria crispa.

4.4 Fauna

Online data searched was limited to the quarter degree grids of 3318AD, 3318BC, 3318CB, 3318DA, looking at recordings since the year 2000 (this still having some overlap with historic sightings before 2002 as used in the screening tool).

4.4.1 Herpetofauna

Herpetofauna are secretive, and robust lists require intensive field surveys over numerous seasons. Reptiles have adapted to a wide variety of natural habitats with their occurrence largely related to broad scale micro-habitats including terrestrial and aquatic habitats (Alexander & Marais, 2007). Southern Africa has a high diversity of reptile species, and some species are extremely sensitive to habitat destruction, fragmentation and modification, as well as anthropogenic disturbance and degradation of habitats.

It is predicted that significant alterations to the original reptilian composition have already occurred to some degree within the project area due to the extensive anthropogenic disturbances within and surrounding these habitats.

The ADU database and screening tool list 12 Amphibian[5] and 39 Reptile[6] species, of which the SCC's and observed species are listed below:

Name	Common name	Status	Likelihood of Presence and Notes
Amphibians			
Breviceps gibbosus	Cape Rain Frog	VU	Medium to High: burrowing frog of renosterveld fynbos. It also occurs in disturbed habitats, such as pine plantations and gardens, and there is ongoing decline in its habitat over much of its range. It breeds by development occurring directly in subterranean nests, and is not associated with water-bodies.
Cacosternum capense	Cape Caco	NT (2017)	Low to Medium: It lives in undulating low-lying areas with poorly drained loamy to clay soils, although it is known from *some* shallow sandy habitats. The dominant vegetation in which it historically occurred was Renosterveld Fynbos. Observed in disturbed agricultural land. It breeds in shallow natural pools of water (vleis) and depressions in flat low-lying areas.
Cacosternum platys	Flat Caco	NT (2017)	Low to Medium: It is a species of fynbos, and in the dry season individuals have been found aestivating under stones or logs and among the roots of dead reed-like plants in dried-up watercourses. It typically breeds in seasonally inundated fynbos.
Reptiles			
Agama hispida	Spiny Ground Agama	LC (SARCA 2014)	Observed in rocky areas
Bradypodion pumilum	Cape Dwarf Chameleon	VU (SARCA 2014)	Low: This species is generally absent from agricultural landscapes
Pachydactylus geitje	Ocellated Gecko	LC (SARCA 2014)	Observed in rocky areas
Psammophis leightoni	Cape Sand Snake	LC (IUCN 2020), narrow endemic	Possible: Found in sand fynbos and strandveld habitats throughout its range
Scelotes kasneri	Kasner's Dwarf Burrowing Skink	NT (SARCA 2014), narrow endemic	Low: Occurs in coastal dunes, often under stones or other debris or in association with the roots of plants, chiefly below 300 m
Scelotes montispectus	Bloubergstrand Dwarf Burrowing Skink	NT (SARCA 2014), narrow endemic	Unlikely: Inhabits sparsely vegetated coastal dunes near sea level
Naja nivea	Cape Cobra	LC (SARCA 2014)	According to farm staff frequently observed near homesteads
Chersina angulata	Angulate Tortoise	LC (SARCA 2014)	Observed in lower-lying areas of the western extent of the PAOA.

[5] FitzPatrick Institute of African Ornithology (2020). FrogMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=FrogMAP on 2020-06-01

[6] FitzPatrick Institute of African Ornithology (2020). ReptileMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=ReptileMAP on 2020-06-01

Name	Common name	Status	Likelihood of Presence and Notes
			Angulate Tortoises are known to occur in great densities with up to 34 individuals counted in one ha. This tortoise can eat large quantities of plants, resulting in their scats being full of undamaged seeds. As such, they are ideal seed dispersers, and they defecate inside bushes, giving seeds a better chance of germination and survival (IUCN, 2020).
Trachylepis capensis	Cape Skink	LC (SARCA 2014)	Observed in rocky areas
Sensitive Species 15	Sensitive Species 15	VU (SARCA 2014)	Unlikely: Occurs mainly in *coastal fynbos associated with limestone geology*. Shelters under limestone rock slabs between dense shrubs on coastal plains. Found in two disjunct coastal regions on the West- and South Coast.

Additional species potentially frequenting the area are indicated in Appendix A.

4.4.2 Mammals

According to MammalMap (Animal Demographic Unit) a total of 29 species have been recorded within the investigated quarter degree squares (QDS) since 2000, of which the larger antelopes are restricted to protected areas. As with reptiles, many of the smaller mammal species are either secretive and not readily observed, or sensitive to an avoiding anthropogenic disturbance. SCC's and observed species are listed below:

Name	Common name	Status	Likelihood of Presence and Notes
Cryptomys hottentotus	Southern African Mole-rat	LC	Typical mole-heaps most likely of this species observed in degraded Hopefield Sand Fynbos close to cultivated forage areas. It occurs in a wide range of substrates from friable sandy loams to exfoliated schists and sandy soils; they tend to avoid stony soils. They are often located within human modified environments, such as lawns, golf courses and gardens. The species is subterranean.
Lepus saxatilis	Scrub Hare	LC	Observed on edge of riparian vegetation, droppings around natural vegetation
Mellivora capensis	Honey Badger	LC	Observed on occasion *as reported by farm staff*
Poecilogale albinucha	African Striped Weasel	NT	Unlikely to Low: It is mainly found in savanna associations, although this species probably has a wide habitat tolerance and has been recorded from lowland rainforest, semi-desert grassland, fynbos and pine plantations.
Rhabdomys pumilio	Striped Mouse	LC	Likely predated observation (Figure 4-12): Widely distributed in South Africa with a wide habitat tolerance, from desert fringe to high-rainfall mountain areas, but does require the presence of grass.
Mus minutoides	Southern African Pygmy Mouse	Least Concern	Observed predated (Figure 4-12): wide distribution from fynbos habitats, savanna, grassland, rocky habitats, vlei and riverine associations, recently burnt grassland and suburban areas.

Figure 4-12: Some of the smallest mammals observed.

Left: Rhabdomys pumilio and Right: Mus minutoides as preyed on outside the more open western extent of the PAOA (!Khwa ttu Heritage Centre).

Further species that may potentially frequent the area are listed in Appendix A.

Data and research on negative impacts of wind turbine operation on terrestrial wildlife is limited, as most research work has focused on studies relating to avifauna. Potentially, terrestrial animals can be affected by temporary factors associated with the construction of wind turbines e.g. destruction of habitat, vibration and noise effects, higher direct mortality on wind farm roads, and an increase in human activity within the area (Helldin et al., 2012). In most cases, however, the operation of wind farms was found to have no *significant* effects on ground-dwelling animals, but cases of avoidance of wind farm areas by large or medium-sized mammals during construction and operation has been reported (Helldin et al., 2012; Łopucki & Mróz, 2016). In the case of small mammals that occupy smaller spaces, e.g. rodents and shrews), some species may be more prone to show physiological stresses if and where they are permanently exposed to potential effects of turbines such as noise, vibration, and electromagnetic disturbances (Łopucki et al., 2017; 2018). However, despite the apparent increased stress levels in some small species, no significant differences in species numbers or social structure could be found between populations in close proximity and away from wind turbines (Łopucki & Mróz, 2016).

4.4.3 Lepidoptera

According to LepiMap and the screening tool, at least 64 butterfly species could occur in the PAOI. SCC's are listed below, but none of these species, including their host plants, were observed during the September 2020 site visit.

Name	Common name	Status	Likelihood of Presence and Notes
Aloeides egerides	Red Hill Russet	VU (SABCA 2013)	Occurs in sandy, coastal fynbos, with flight period generally from October to April, host plants unknown. Known from Red Hill (Simon's Town) to Mamre area, Piketberg.
Trimenia wallengrenii wallengrenii	Swartland silver-spotted copper	CR (SABCA 2013)	Unlikely, possibly extinct. Historically found near the summits and on the western slopes of low hills in renosterveld vegetation at an altitude of 350 m to 450 m. This taxon has not been seen for 14 years at its last two known locations,

Name	Common name	Status	Likelihood of Presence and Notes
			despite regular surveys. It was once quite widespread in the Western Cape Province, from Stellenbosch to Darling.
Torynesis mintha piquetbergensis	Mintha Widow	VU	Unlikely: Endemic to the Western Cape Province in South Africa, this taxon is found on hills in and around Moorreesburg, Koringberg and Piketberg. Along rocky hillsides where its host plant (*Merxmuellera* species) grows in Swartland Shale Renosterveld, Piketberg Sandstone Fynbos and Boland Granite Fynbos
Sensitive Species 5	Sensitive Species 5	CR	A highly restricted endemic to the Western Cape, used to occur from Melkbosstrand to the Mamre area and also at Philadelphia, now only known from 2 localities well outside the PAOA. Larvae are dependent on specific ant species, which are equally restricted, and have not been reported in or around the study area to date.
Sensitive Species 7	Sensitive Species 7	CR	Unlikely: A range-restricted endemic from the Western Cape Province in South Africa, so far only found on the southern slopes to the peaks of one small mountain well outside the PAOA. Some host plants present in larger areas of remaining Renosterveld, but could not be confirmed within 100 m of any turbine location.

A review by Grealey and Stephenson (2007) concluded that there is no evidence to suggest that butterfly mortality is a concern at commissioned wind farm sites as a result of collisions with turbines, and hence impacts of the proposed turbines on the above species is considered negligible.

4.5 Alien Invasive Species

In general, the occurrence of alien and invasive species within the study area is very low. However, past and current landuse and related disturbances have made the open areas within the entire study area prone to invasion by undesirable alien plant species. The latter often happens unintentionally through wind- or bird-distributed seed, or seeds distributed by the movement of soils and materials contaminated with seeds of such plants, or movement of machinery. In addition, species such as Mesquite had been planted as part of the initial Aggeneys settlement, from where seed may gradually spread. It is recommended that these species are controlled on an ongoing basis.

The following regulations of NEMBA (2014; 2016; 2020) need to be adhered to before, during and after any development:

- Not allowed: Spreading or allowing the spread of any specimen of a listed invasive species, which implicates that species must be destroyed so that seedbanks are not further amplified.

Explanation of classes of listed alien invasive species according to Government Notice R598 and 1020, Chapters 2 and 3, are as follows:

- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.

- Category 2: Alien Invasive species that may only be allowed to persist if the land-owner has a relevant permit to retain such species. Without a permit, such species are to be controlled 9as for Category 1b) and with a permit, such species are not allowed to spread outside the permitted area.
- Category 3: Invasive species that may be exempted from eradication as specified in the species regulations. Any Category 3 plants in riparian zones are automatically re-classified as category 1b, and must be controlled.

The following listed alien invasive species have been observed within the project area:

Species	Vernacular Name	Category
Acacia cyclops	Red Eye / Rooikrans	1b
Acacia longifolia	Long-leaved wattle	1b
Echium plantagineum	Patterson's curse	1b
Eucalyptus cf. camaldulensis	Red River Gum	1b
Flaveria bidentis	Smelter's-bush	1b
Malvastrum coromandelianum	Prickly Malvastrum	1b
Pinus sp	Pine trees (plantation)	2

4.6 Site Ecological Importance Evaluations

Swartberg Granite Renosterveld

Evaluation of Site Ecological Importance: Swartberg Granite Renosterveld

Notes on abiotic environment: areas with sandy soils of highly variable depth, rock plates or rock boulders generally present, slopes gentle to moderately steep

Notes on existing disturbances and severity thereof:

Historically subjected to high grazing intensities, which have been removed for at least 10 years to allow natural vegetation to regenerate. Edge vegetation still dominated to a large extent by alien grasses and/or *Galenia africana*. Natural fire regime actively prevented.

Conservation Importance rating: Very High

Reasoning: Any area of natural habitat of a CR ecosystem type

Functional Integrity rating: High

Reasoning: >20 ha but <100 ha relatively intact area of any conservation status, limited connectivity to ecological corridors and/or other functional natural still available, constant and permanent anthropogenic disturbances on edges

Biodiversity Importance: High

Receptor Resilience rating: Low

Reasoning: Will recover slowly (~more than 15 years) to restore > 50 % of the original species composition and functionality of the receptor if the disturbance or impact has been removed, *if patches of natural habitat remain in close proximity*; some of the species are likely to remain and/or return after construction has been completed or if areas are rehabilitated

Site Ecological Importance: Very High

Implications for mitigation (for the entire WEF):

1. No turbine positions are located within this habitat.
2. Land-owners have indicated a strict requirement for the avoidance of these remnants of primary vegetation by the development footprint, which must be upheld by the developer.

Evaluation of Site Ecological Importance: Swartberg Granite Renosterveld

3. The above would also imply that erosion off temporary and permanent infrastructure is adequately monitored and remedied at all times to reduce potential increased disturbances at the edges of these habitats.
4. The creation of access roads (upgrading of existing tracks) and temporary hard-stand areas for the Project create an opportunity to increase the tourism potential of some of the larger areas of primary vegetation. This is wholly supported by land-owners, and it should be investigated by the developers if temporary hardstand areas around turbines 31 and/or 24 can be retained as parking areas, from which day-hiking trails can be created to these areas, and if it would be permissible to allow public access along maintenance roads
5. As far as practical and possible, initiatives by land-owners to improve the condition of primary vegetation by removal of alien invasive plants should be supported.

Fragmented Swartberg Granite Renosterveld

Evaluation of Site Ecological Importance: Fragmented Swartberg Granite Renosterveld

Notes on abiotic environment: areas dominated by rock plates or rock boulders with either no or only pockets of mostly shallow sandy soils

Notes on existing disturbances and severity thereof:

- Habitat patches are in general rather small (mostly less than 1 ha in extent), surrounded by cultivated areas
- Edges and/or the entire patch are extensively invaded by alien grasses and forbs – either ruderal or invasive species, or self-seeding annual crops
- Natural fire regime actively prevented

Conservation Importance rating: Medium

Reasoning: > 50 % of receptor contains natural habitat with potential to support SCC

Functional Integrity rating: Low

Reasoning: Almost no habitat connectivity except stepping-stone functionality, migrations hence still possible across some transformed or degraded natural habitat, small areas of usually less than 1 ha, but do have moderate rehabilitation potential on those limited areas. Despite high disturbance levels, still provide some refuge to rupicolous species.

Biodiversity Importance: Low

Receptor Resilience rating: Low

Reasoning: Will recover slowly (~more than 15 years) to restore > 50 % of the original species composition and functionality of the receptor if the disturbance or impact has been removed, *if patches of natural habitat remain in close proximity*; some of the species are likely to remain and/or return after construction has been completed or if areas are rehabilitated

Site Ecological Importance: Medium

Implications for mitigation (for the entire WEF):

1. No turbine positions are located within this habitat.
2. Avoid patches that are more than 50 m in diameter.
3. As far as practical and possible, initiatives by land-owners to improve the condition of primary vegetation by removal of alien invasive plants should be supported.

Hopefield Sand Fynbos

Evaluation of Site Ecological Importance: Hopefield Sand Fynbos

Notes on abiotic environment: flat to gently undulating plains with deep grey to red-brown sands

Notes on existing disturbances and severity thereof:

- All areas historically subjected to high intensity grazing, whilst some areas were strip-cultivated
  - Grazing has been largely removed by present land-owners for the past 5+ years
- Invasion of alien *Acacia* species, mostly *Acacia cyclops*, extensive
- Invasion by alien grasses and forbs wide-spread

Conservation Importance rating: Medium

Reasoning: Natural habitat of a VU ecosystem and large extents of modified habitat in variable states of self-regeneration; > 50 % of receptor contains natural habitat with potential to support SCC and few SCCs could be confirmed

Functional Integrity rating: High

Reasoning: > 20 ha for VU ecosystem type, although not all of it is intact, it has been allowed to naturally regenerate, and will be allowed to continue to do so; good habitat connectivity with functional ecological corridors still exists

Biodiversity Importance: Medium

Receptor Resilience: Low

Reasoning: Will recover slowly (~more than 15 years) to restore > 50 % of the original species composition and functionality of the receptor if the disturbance or impact has been removed, *if patches of natural habitat remain in close proximity*; indigenous species are likely to remain and/or return after construction has been completed or if areas are rehabilitated.

Site Ecological Importance: High

Implications for mitigation (for the entire WEF):

1. No turbine positions are located within this habitat.
2. Assist with the alien invasive control program, most importantly to eliminate *Acacia cyclops* from the project area, preferably around as well, due to its very high flammability, which could pose a high risk to the project as such

Riparian Areas

Evaluation of Site Ecological Importance: Riparian Areas

Notes on abiotic environment: generally sandy substrate, channels narrow and moderately incised on steeper slopes, shallow to somewhat eroded on flatter areas. Highly susceptible to erosion.

Notes on existing disturbances and severity thereof:

- Edges extensively invaded by alien grasses and forbs, on occasion by stands of alien trees
- Gully erosion mostly present, especially where riparian area is bare or only covered with annual grasses and forbs

Conservation Importance rating: Medium

Reasoning: > 50 % of receptor contains natural habitat with potential to support SCC

Functional Integrity rating: Medium

Reasoning: the habitat itself provides a narrow but functional ecological corridor, providing connectivity with lower-lying but more intact and/or functional habitats

Biodiversity Importance: Medium

Evaluation of Site Ecological Importance: Riparian Areas

Receptor Resilience: Medium

Reasoning: Will recover slowly (~more than 10 years) to restore > 70 % of the original species composition and functionality of the receptor if the disturbance or impact has been removed, *if patches of natural habitat remain in close proximity*; indigenous species are likely to remain and/or return after construction has been completed or if areas are rehabilitated, will retain its ecological corridor function despite the presence of the envisaged development.

Site Ecological Importance: Medium

Implications for mitigation (for the entire WEF):

1. No turbine positions are located within this habitat.
2. Design crossings as a ford or 'drif', i.e. river crossings built at the level of the river bed. They can be made of natural materials (natural bed and bank material maintained) or they can be reinforced with artificial material (bed and/ or banks). Fords need to be wide enough to cater for occasional (seasonal) higher levels of water (i.e. span across the floodplain where present as well).
3. Ensure that reno-mattrasses are installed on the down-stream side of the ford to avoid cut-back erosion of the channel.
4. Where, from an engineering perspective, a ford will not be feasible (e.g. wider stretches of river in lower-lying areas), river-crossing design should aim for a single-span structure, or a minimal number of in-stream supports. Abutments must be placed outside the riparian zone, and the use of culverts or any structure that could potentially concentrate flow of water will not be permissible.
5. Ensure all river crossings are wide enough to cater for all types of traffic using such structures, are perpendicular to channels and are not within depositional- or meander bend stretches of channels.
6. Where there are signs of risk of erosion, re-inforce banks with reno-mattresses and further stabilise with the planting of perennial cyperoid (sedges and restios) or other indigenous vegetation.

Alien Tree Patches

Evaluation of Site Ecological Importance: Alien Tree Patches

Notes on abiotic environment: generally sandy soils, landscapes variable

Notes on existing disturbances and severity thereof:

The alien trees as such pose a disturbance, but smaller dense patches that have been planted may provide shelter to a number of faunal species. However, litter from such trees has also contributed to a gradual change in soil chemistry and natural light, which limits the establishment of natural vegetation below it.

Conservation Importance rating: Low

Reasoning: no or only highly disturbed and fragmented natural habitat, with limited potential to support SCC

Functional Integrity rating: Low

Reasoning: There is connectivity for fauna to surrounding habitat, especially riparian areas, but the habitat quality of the faunal habitat relates mostly to shelter only, not other resources. In terms of plants, the alien tree patches rather form ecological barriers due to the influence of shading and leaf litter on the ability of indigenous flora to (re-)establish in such areas.

Biodiversity Importance: Low

Receptor Resilience rating: Medium

Reasoning: May be able to recover to >70% of its original diversity after 10 years, but only with active intervention and removal of all ecological barriers, including the complete removal of the trees.

Site Ecological Importance: Low

Implications for mitigation (for the entire WEF):

1. No turbine positions are located within this habitat.

Evaluation of Site Ecological Importance: Alien Tree Patches

2. As far as practical and possible, initiatives by land-owners to improve the condition of primary vegetation by removal of alien invasive plants should be supported.

Cultivated Areas

Evaluation of Site Ecological Importance: Cultivated Areas

Notes on abiotic environment: gently flat to moderately undulating to areas, mostly with deep grey to reddish sandy soils

Notes on existing disturbances and severity thereof:

Continuous cultivation by wine grapes or annual cereals rotated with legumes and canola. Prior to sowing, soils are treated with herbicides to suppress weeds where no-till practices are not sufficient to suppress such. After harvesting, livestock is allowed to graze on remaining plant material.

Conservation Importance rating: Very Low

Reasoning: No natural habitat remaining

Functional Integrity rating: Low

Reasoning: Faunal movement (and seed dispersal by wind) still possible across transformed areas or patches of natural/semi-natural habitat between cultivated areas, especially grapevines. Faunal movement between annual crops may be limited during the growing season due to the high planting density of such crops which impedes movement and vision. Low rehabilitation potential due to long-term absence of indigenous soil seed banks.

Biodiversity Importance: Very Low

Receptor Resilience rating: Low:

Habitat is unlikely to be able to recover fully after a relatively long period: > 15 years required to < 50 % of the original species composition and functionality and only with intensive management and intervention (such as planting or seeding of indigenous species) as habitats are completely modified. Bare areas susceptible to accelerated erosion.

Site Ecological Importance: Very Low

Implications for mitigation (for the entire WEF):

1. All turbine positions will be within modified areas.
2. The bulk of the development will be placed on these modified areas, which is supported from an ecological perspective.
3. Protect all excavations to ensure no access to terrestrial fauna. During construction, inspect all excavations daily for the presence of fauna.
4. Ensure adequate storm water control off all sealed surfaces to minimise the risk of accelerated erosion, especially along access roads.
5. During construction and operational maintenance, ensure there are methods in place to allow the rapid clean-up of any unforeseen hydrocarbon spill.
6. After construction, ensure no rock piles or similar artificial niches remain within the turbine areas, which as such may attract small mammals who may use them as shelter, which again would lure raptors (such as owls) due to the increased prey-base close to the turbines (Schuster et.al, 2015)

The Site Ecological Importance delineations in relation to the turbine positions is shown in Figure 4-13 and Figure 4-14.

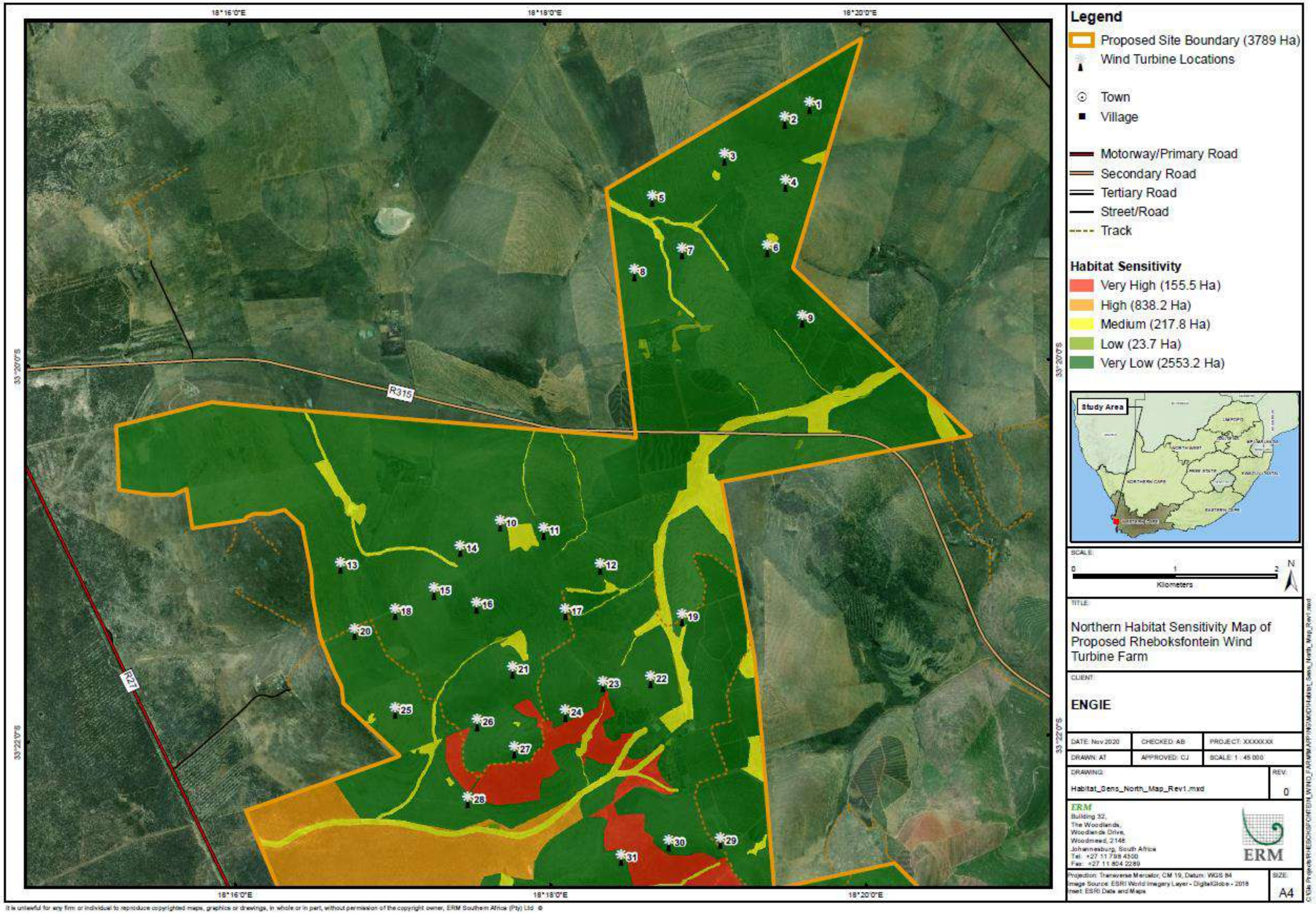

Figure 4-13: Site Ecological Importance of the northern extent of the study area.

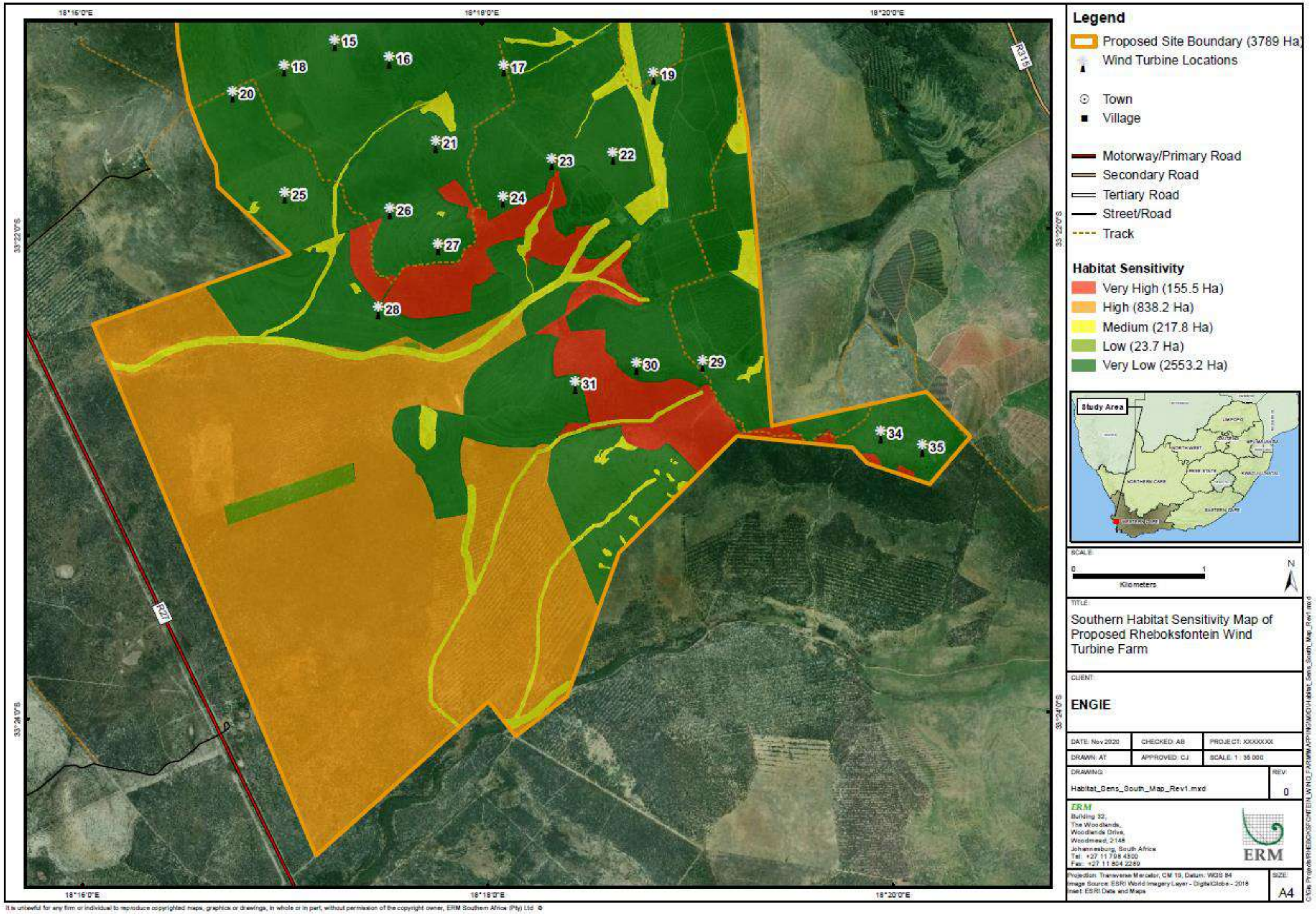

Figure 4-14: Site Ecological Importance of the southern extent of the study area.

5. IMPACT/ RISK ASSESSMENT

Any anthropogenic activity, whether historic, current, or proposed, carried out within a natural or semi-natural ecosystem will have an impact on the immediate and surrounding environment, usually in a negative way. As required for any sustainable development and according to, it was necessary to determine and assess the significance of any potential impacts of the construction of the proposed new pipeline and related activities, and to provide a description of available mitigation measures required to limit or reduce the perceived negative impacts on the natural environment.

Mining and its related activities can have the following types of impacts:

- *Direct impacts* are those impacts directly linked to the project (e.g. clearing of vegetation, removal of topsoil and soil seed banks for extraction of ore, contamination of water bodies, dust from blasting, etc.). These can be temporary or remain as residual impacts.
- *Indirect impacts* are those impacts resulting from the project that may occur beyond or downstream of the boundaries of the project site and/or after the project activity has ceased (e.g. migration of pollutants from dump sites, sealing of surrounding topsoil by dust particles, altered runoff patterns).
- *Induced impacts* are impacts that are not directly attributable to the project, but are anticipated to occur because of the presence of the project (e.g. impacts of associated industries, establishment of residential settlements and increased waste streams, increased pressure on biodiversity such as illegal collection of plant material).
- *Cumulative impacts* are those impacts from the project combined with the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity or natural resources

Very often, indirect and induced, and to some degree cumulative impacts are difficult to assess beforehand (hence uncertainties) and will only manifest if mitigation measures are not implemented or not sufficient. Many of the above impacts are not only a result of the direct impact on a particular species, but rather due to what is known as the '*Edge Effect'*, which can be explained as follows: Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of natural patches, influences of neighbouring environments become apparent; this then is the '*edge effect'*. Patch edges may be subjected to degradation due factors such as increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other negative agents. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat to survive in the long term. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman and Milder, 2005).

5.1 Impact Assessment Criteria

Potential impacts of the proposed activity on the environment were assessed according to pre-determined criteria (listed in Appendix C) to estimate their significance pre-mitigation. The most practical and necessary mitigation measures were then listed, with the residual impact significance evaluated thereafter, assuming that the proposed mitigation/management measures will be implemented to the full extent possible. In essence, impacts on the biodiversity are determined according to the magnitude of the impact, which includes the following typical characteristics of an impact:

- Extent
- Duration
- Scale
- Frequency
- Likelihood (only used for unplanned events)

The above is then evaluated against the sensitivity of the receiving environment (see Sections 3.3 and 4.6) to the impact and its characteristics (details in Appendix C). Possible outcomes of the evaluation process to determine the impact significance is summarised in Table 5-1 below.

Table 5-1: Impact Significances

Evaluation of Impact Significance		**Site Ecological Importance**		
		Very Low - Low	**Medium**	**High – Very High**
Magnitude of Impact	**Negative Impacts**			
	Negligible	Negligible	Negligible	Minor
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Critical
	Positive Impacts			
	Positive	Minor	Moderate	High

5.2 Area of Influence for Biodiversity Impacts

Considering the data reviewed, potential species and habitats affected and findings from the site verification visit, the area of influence has been determined as being restricted to the Project footprint, with a reach of at most 500 m beyond the project footprint. For ease of assessment, this has been extended to include all land portions on which infrastructure will be located. This basically excludes Farm 567 Nieuwe Plaats from being directly or indirectly affected in terms of flora or terrestrial fauna by the development of the WEF. A summary of anticipated impacts on flora and terrestrial fauna by the development of the WEF are summarised in Table 5-2, and elaborated further in Section 5.2.1.

Table 5-2: The approximate scale of areas that most likely will be affected by the proposed Turbines

Activity	Habitats Included	Site Ecological Importance	Area
Habitat Modification and impacts on Indigenous Species *Construction and Operational Phase*	Cultivated Areas	Very Low	± 2 to 20 ha
Impacts related to alien invasive species *Construction and Operational Phase*	Cultivated Areas	Very Low	± 20 ha

5.2.1 Explanatory Notes and Uncertainties considered for the Impact/ Risk Assessment

Species limitations:

It is often difficult to identify what exactly limits the distribution of a species. Factors that have been identified as playing a major role, either on their own or together, are habitat limitation and dispersal limitation (Münzbergova & Herben 2005). Rare taxa often have specialised habitat requirements and are thus restricted to rare environmental conditions, of which rock outcrops and narrow water channels are typical (Keith 1998). A restricted availability of a habitat may also reduce the dispersal capability of a species. Lower reproductive effort of a species, on the other hand, is a common trait in species with a long life span and strong competitive ability, but this may also imply that such species need specific environmental conditions such as suitable habitat and a number of successive favourable seasons to be able to establish a new cohort of plants of re-colonize a rehabilitated area (Ehrlén & Groenendael 1998).

Within a community or plant association, the species composition is often as or more important than the species number in affecting ecosystem processes. Changes in species compositions can occur indirectly by an altered resource supply due to anthropogenic influence e.g. change of moisture flows. Although a reduction in the number of species may initially have small effects, even minor losses may indicate that the capacity of the ecosystem to adjust to a changing environment is being lost (Chapin et al. 2000, Hooper et al. 2005). Species are allocated an official conservation status to prevent their further decline due to identified threats (Keith 1998). Protected or red-data species, as well as endemic species, apart from their conservation status, are a first indicator of the health of an ecosystem. They will most probably be the first to show a sudden decline should their environment be changed beyond a specific threshold, e.g. by excessive dust pollution.

Niches and Habitats:

Many species have specific niche requirements that consist of a unique set of environmental conditions (e.g. vegetation structure, rocks, substrate), creating optimal habitat. The reliance of flora on specific abiotic conditions and/or the presence of nurse plants, of for fauna on species-specific plant resources indicates the interconnected nature between faunal and botanical diversity, as plant communities often contribute significantly to the physical structure of the faunal habitat (Burnett et al., 1998; Mecenero et al., 2013). These “micro-habitats” are further shaped by a combination of topography, land use, available food sources and other intrinsic factors. Landscapes composed of spatially heterogeneous abiotic conditions results in a greater diversity of potential niches for faunal species.

Several studies have shown that the vegetation units contributing the most to regional species diversity cover the smallest areas because these species are concentrated on and some also limited to particular habitats (Chong & Stohlgren 2007, Keith 1998). Very often such diverse vegetation is found within rocky outcrops in and around the study area. These outcrops increase the heterogeneity of the existing habitat by providing a variation in biophysical characteristics that includes variable soil resources (influencing vegetation patterns), hydrological conditions as well as specific micro-climatic conditions (Samways & Hatton, 2000; Fitzsimons & Michael, 2016). These smaller habitats often support high levels of species diversity and elevated levels of endemism (Fitzsimons & Michael, 2016). Furthermore, species utilising these habitats may have developed specific body structures and ways of movement for taking refuge in crevices/fissures and moving efficiently within such habitats. The diversity and size of a landscape unit also influences ecosystem services – species on the edges of a habitat are more vulnerable to environmental stresses, and the more a habitat is fragmented, the higher this stressful edge effect becomes, in addition to habitat loss. Habitat loss and/or fragmentation can thus have disproportionately large effects on ecosystem services (Díaz et al. 2005).

5.3 Impact/Risk Assessment

5.3.1 Assumptions

- All infrastructure layouts associated with the turbines and overall WEF will remain as already approved, except where such will be removed due to the removal of turbines 32 and 33 from the development, and impacts of such do not need to be re-assessed or verified
  - This also implies that no access routes, cabling routes or other temporary or permanent infrastructure will be within habitats of Very High or High SEI, and access and cabling routes follow existing farm tracks and contours as requested by land-owners
  - General mitigation measures indicated in the Site Ecological Importance determinations are already part of the approved WEF Environmental Management Programme (EMPr) and will be fully implemented
- The developer will work with land-owners on optimising the tourism potential of remaining natural vegetation, as well as the control of alien and invasive species
- The developer will fully implement erosion control and unforeseen spill mitigation measures as part of the overall EMPr

5.3.2 Habitat Modification and Impacts on Indigenous Species during Construction

Construction of the turbines will not impact on any indigenous flora, but may reduce habitat for some fauna, or have the potential to alter their movement between more suitable habitats used for shelter and/or breeding.

Impact Characteristics

Summary	Construction
Project Aspect/Activity	All activities related to the construction of the turbine foundations and turbines: ■ Clearing of vegetation on cultivated areas ■ Excavation works, deposition of materials, landscaping and compaction of soil. ■ Interim storage of excavated soils and subsurface materials. ■ Machinery and vehicle movement on or to site. ■ Unforeseen spillages of hydrocarbons or other pollutants. ■ Landscaping after completion of construction
Impact Type	Direct Negative during construction due to: ■ Direct destruction of vegetation cover and associated faunal habitats, but noting that these habitats are marginal rather than optimal for fauna. ■ Compaction and potential unforeseen pollution of topsoils by possible hydrocarbon spills and unauthorised/uncontrolled off-road driving, especially with heavy machinery. ■ Potential avoidance of area by fauna due to high disturbance and noise levels ■ Potential direct loss of individuals due to collisions, or being crushed if sheltering in unseen burrows, or falling into excavations ■ Possible degradation of adjacent natural habitats due to indirect and induced impacts, resulting in a decline of habitat quality and/or increased invasion by alien plant species.
Sensitive Receptors Affected	• Cultivated Area – very low site ecological importance, no sensitive plant species, marginal habitat for fauna

Rating of Impacts Before Mitigation

Characteristic	Designation	Summary of Reasoning
Extent	Local	The impacts of turbine construction will not extend beyond the cadastral boundaries of the development, and most likely will be restricted to the turbine sites only
Duration	Short-term	Impacts will be reduced after completion of construction
Scale	Between 3 and 10 ha	Taking into account the physical turbine foundation and immediate surroundings necessary for doing the construction
Frequency	Once off	Construction is expected to be completed within 24 months, possibly shorter
Likelihood	Definite	Habitat reduction will occur through planned activities
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low		
Irreplaceability: none.		
Significance Rating Before Mitigation: MINOR		

Possible Indirect Impacts:

- Possible degradation of more sensitive habitats within adjacent or downstream habitats, due accidental leaching or deposition of pollutants, avoidance of area due to high disturbance levels, or distribution of reproductive material of invasive species.

Possible Induced Impacts:

- Avoidance of area due to high disturbance levels.
- Temporary avoidance of more suitable natural habitats in closer proximity to the construction area

Most Likely Cumulative Impacts:

- Possible further spread and establishment of alien invasive species.

Mitigation Measures

Avoid and Minimise:

- In general, minimise clearing and avoid any spill-over of operations into any surrounding or adjacent area with more sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).
- Avoid loss of fauna by inspecting the area prior to groundworks, and ensuring that all excavations are adequately fenced off to block access to large(r) fauna, e.g. hares or guinea fowl
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas.
- Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to such areas, these being designated access roads, maintenance roads, turning points and parking areas.
  - No off-road driving beyond designated areas may be allowed.
- Design and create berms to stop runoff from temporary stockpile during/after a periodic high rainfall event to enter directly into existing washes.
  - Ensure foundation and excavations are protected from heavy rainfall – if such dams up into excavated turbine foundations, ensure that water is not polluted before pumping it out, preferably not directly into the environment. If the latter cannot be avoided, ensure that pumped-out water is dissipated in a way that will avoid any erosion.

Reduce:

- Keep the clearing of vegetation to a minimum.
- Ensure top soils are first removed and stored separately for rehabilitation purposes.
- Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur.
- Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
  - Install adequate drainage structures to ensure that water flows are never concentrated or blocked in any way.

- If filling material is to be used, this should be sourced from areas *free* of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials.
  - Should there be surface material with potential seed-banks of alien invasive species, such material can be used to fill the lowest areas of excavations, ensuring it will be covered at least 50 cm deep with other subsurface substrate to prevent any of the alien invasive seed to actually germinate.
- Ensure that staff are aware that no fauna may be snared or in any way hunted, and strictly implement compliance
- Ensure there are staff members adequately trained in handling fauna should such occur within a construction area from which they cannot exit on own accord.

Rehabilitate:

- To aid a more rapid revegetation of construction areas, excavations should be backfilled as soon as possible, all stockpiles must be, as far as possible, obliterated and/or landscaped to merge into the surroundings.
- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during and after construction.
  - Re-vegetation of disturbed/modified areas will be done using indigenous shrubs and grasses only, unless otherwise requested by landowners. The selection of species used for rehabilitation may not include any species that are not suitable to the receiving environment (i.e. may become invasive), and also no species that are indicative of habitat degradation, such as species declared as Encroaching (by CARA) or Increaser II or –III grasses.
  - Special attention will be paid to ensuring that topography is reconstructed as far as practical.

Residual Impacts: Habitat Modification and Impacts on Indigenous Species

Habitat loss, albeit limited, will still occur as a residual impact but could be reduced with effective mitigation as discussed above.

Pre- and Post-Mitigation Significance

Construction Phase			
Characteristic	**Pre-Mitigation**	**Post Mitigation**	**Type**
Extent	Local	Site-specific	Negative
Duration	Long Term	Short-Term	Negative
Scale	up to 10 ha	± 2 ha	Negative
Impact Magnitude	Medium	Small	Negative
Significance Rating	**MINOR**	**NEGLIGIBLE**	Negative

5.3.3 Habitat Modification and Impacts on Indigenous Species during Operation

Operation of the turbines will not directly impact on any indigenous flora, but may alter habitat conditions for some fauna, or have the potential to alter their movement between more suitable habitats used for shelter and/or breeding. Further, no impacts on Lepidoptera are expected, hence anticipated impacts relate mostly to terrestrial fauna.

Impact Characteristics

Summary	Operation
Project Aspect/Activity	All activities related to the operation of the turbines: ■ Rehabilitation of disturbed areas around the turbines ■ Alien plant control around the turbines. ■ Machinery or vehicle movement to or near the turbines for routine maintenance. ■ Noise created by the turbines.
Impact Type	Direct Negative during operation due to: ■ Noise-induced stressors to ground-dwelling fauna that may keep these habitats in a marginal state for fauna - This could, however, also prevent an influx of less desirable opportunistic rodents which in turn may attract raptors. ■ Potential unforeseen pollution of topsoils by possible hydrocarbon spills during routine maintenance. ■ Potential avoidance of area by fauna due to disturbance levels ■ Possible degradation of adjacent natural habitats due to an increased invasion by alien plant species (see under separately discussed impacts).
Sensitive Receptors Affected	■ Cultivated Area – very low site ecological importance, no sensitive plant species, marginal habitat for fauna at present

Rating of Impacts Before Mitigation

Characteristic	Designation	Summary of Reasoning
Extent	Local	The impacts of turbine operation will not extend beyond the cadastral boundaries of the development, and most likely will be restricted to the turbine sites only, at most within a radius of 100 m of the turbine
Duration	Long-term	Impacts will likely after decommissioning
Scale	Between 10 and 20 ha	Taking into account the physical turbine foundation and immediate surroundings in which effects of turbine operations can be noticed
Frequency	Continuous	Effect will remain until decommissioning
Likelihood	Likely	Habitat alteration will occur through planned activities, but the actual severity of impact on faunal species are expected to be very low to insignificant
Impact Magnitude: Low		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: Low		
Irreplaceability: none.		
Significance Rating Before Mitigation: NEGLIGIBLE		

Possible Indirect Impacts:

- Possible minor changes to microclimatic conditions due to alteration of airflows by sweeping rotors.

Possible Induced Impacts:

- Avoidance of area due to consistent disturbance levels.

Most Likely Cumulative Impacts:

- None envisaged as the area is already regularly disturbed by cultivation.
- Positive impacts may be experienced where previously cultivated areas may be vegetated with grazing or indigenous vegetation, thereby increasing habitat conditions for fauna.

Mitigation Measures

Avoid and Minimise:

- In general, avoid any spill-over of operations into any surrounding or adjacent area with more sensitive vegetation or any adjacent or nearby riparian habitats (except the clearing of alien invasive species).
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas.
- Delineate all permissible areas so that all movement of vehicles and heavy machinery can be restricted to such areas, these being designated access roads, maintenance roads, turning points and parking areas.
  - No off-road driving beyond designated areas may be allowed.
- Manage occasional high volumes of runoff from sealed surfaces to avoid accelerated erosion.

Reduce:

- Parking and operational areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur.
- Prevent the establishment of alien invasive plants
- Ensure the area around turbines is managed in line with current land-uses:
  - If there will be an exclusion zone in which no cultivation should take place, ensure such areas are either vegetated with suitable indigenous vegetation or grazing that can suppress the establishment of alien invasive plants
  - The above will expand natural habitat, especially where turbines are in closer proximity to patches of natural vegetation, and will thus also improve habitat conditions for ground-dwelling fauna.

Rehabilitate:

- Inspect areas around turbines regularly for signs of accelerated erosion and mitigate as soon as such is detected.
- Monitor the establishment of vegetation around turbines, and intervene if such re-vegetation tends to be dominated by undesirable species.

Residual Impacts: Habitat Modification and Impacts on Indigenous Species

Habitat modification after construction is expected to occur, especially if a radius around the turbine will no longer be subject to cultivation but rather be converted to grazing or secondary indigenous vegetation. Such modification of habitat from the present state will be positive overall, and may also be positive to indigenous species, or at least neutralise potential negative operational impacts.

Pre- and Post-Mitigation Significance

Construction Phase			
Characteristic	**Pre-Mitigation**	**Post Mitigation**	**Type**
Extent	Local	Site-specific	Negative
Duration	Long Term	Long-Term	Neutral to Positive
Scale	> 20 ha	up to 20 ha	Neutral to Positive
Impact Magnitude	Low	Small	Neutral to Positive
Significance Rating	**NEGLIGIBLE**	**NEGLIGIBLE**	Neutral to Positive

5.3.4 Impacts related to Alien Invasive Vegetation

Physical disturbance to any environment always presents a window of opportunity for the establishment of alien invasive species, especially if regenerative material of such species is already present in close proximity or along major transport routes, as will be in the case of the turbine locations. Introduction of such species is almost always accidental, and it will require an ongoing program to control such plants to prevent a build-up of large seedbanks and populations that become large enough to start negatively affecting rehabilitation efforts as well as remaining natural habitats.

Impact Characteristics

Summary	**Construction and Operation**
Project Aspect/Activity	■ Existing stands of alien invasive species on and around the study area that act as source of reproductive material. ■ Existing soil seed banks of alien invasive species due to continued persistence. ■ Extensive or repeated disturbance of indigenous vegetation and/or topsoil, which creates a window of opportunity for the establishment of alien invasive species. ■ Transport of reproductive materials of alien invasive species by movement of personnel, machinery or other agents from infested areas to non-infested areas. ■ Soil of areas with high presence of alien invasive species being used for rehabilitation or being transported to areas with non-invaded indigenous vegetation.
Impact Type	Direct and Indirect Negative during all phases due to: ■ Possible continued distribution and increased establishment of alien invasive species, also in surrounding areas. ■ Possible increased displacement of indigenous vegetation by alien invasive species. ■ Possible reduction of suitable habitat for species of conservation concern due to degradation of such habitats caused by the negative impacts of alien invasive species on natural resources as well as indigenous species themselves. ■ Possible influx of opportunistic species, especially rodents due to (seasonal) increase in food resources from invasive grains, which may again attract raptors that may then be subject to collision with blades. ■ Possible continued distribution and increased establishment of alien invasive species, also in surrounding areas. ■ Possible continued degradation of ecosystem functionality.

Impact Characteristics

Summary	Construction and Operation
Sensitive Receptors Affected	■ Currently, there is a high presence of alien invasive species already due to continued cultivation. As part of the cultivation regime, much emphasis is placed on the annual suppression of these species by large-scale application of herbicides by sprayer plane. This may no longer be possible once the turbines are operational, creating opportunities for such undesirable species to become established en masse in close proximity to the turbines. From there they can spread even more to nearby sensitive areas, of which riparian areas (washes) will be most at risk of invasion and further associated degradation.

Rating of Impacts Before Mitigation

Characteristic	Designation	Summary of Reasoning
Extent	Local	Although a full assessment of alien plants was within the scope of the study, it could be confirmed that there is a wide-spread presence of alien invasive species.
Duration	Long-Term to Permanent	It is expected that where such species occur, soil seed banks have already built up that will facilitate ongoing re-establishment that may worsen the infestation if not addressed
Scale	Full assessment of alien distribution was not part of the study, and should be done as part of an alien species control plan	
Frequency	Continuous	It is expected that where such species occur, soil seed banks have already built up that will facilitate ongoing re-establishment that may worsen the infestation if not addressed
Likelihood	Highly possible	Degradation of more sensitive habitats due to infestation with alien invasive species is likely if such species are not continually controlled
Impact Magnitude: Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor: currently Low, but may affect habitats of Medium-High to High Sensitivity if not addressed		
Irreplaceability: Alien invasive species should be eradicated		
Significance Rating Before Mitigation: MODERATE		

Induced Impacts:

- Possible increased cost and time required to achieve annual rehabilitation goals.
- Possible further reduction of ecological health of rehabilitated and surrounding areas.

Cumulative Impacts:

- If mitigation measures are not strictly implemented:
- Possible increased modification and degradation of natural and unique habitats and continued loss of species unique to the area and affected ecosystems, increasing the impact of existing surrounding anthropogenic activities.
- Possible continued and unabated spread and establishment of alien invasive species.

Mitigation Measures

Unfortunately, alien invasive species are widespread throughout southern Africa. The study area is no exception, with a high presence of annual and perennial alien invasive species. Mitigation will thus focus on keeping the level of alien invasive plants as low as possible, whilst also acting pro-actively to prevent infestations by any additional species or in new areas.

Avoid and Minimise:

- Wheels of large machinery should be checked prior to entering the site and cleared of seed or any other plant material (especially of species with spiny or bur-like seeds) to reduce the introduction and spread of alien invasive plants. All such plant material removed must be burnt in a controlled area or otherwise destroyed.
- If filling material is to be used, this should be sourced from areas free of invasive species, and alien plant control measures are to be applied to all areas used for sourcing fill materials.

Reduce:

- Conduct a detailed Alien Invasive Survey, and if possible also along approximately 20 -50 km of all major access routes leading to the site (along which heavy machinery is expected to be coming in). From this:
  - Create and implement a suitable Alien Management Control Plan, which is also aligned to control plans by the land-owners
  - Destruction of regenerative material of cleared alien species by burning in a protected area is encouraged.
  - Be aware of alien species that may be newly introduced to the area and act immediately to eradicate such once detected – focus especially on the early eradication of Patterson's Purse.

Rehabilitate:

- Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible and progressively during all phases of construction, during operation and after decommissioning. This will be according to a Rehabilitation Plan that needs to be compiled and will include the following:
  - Re-vegetation measures of disturbed/modified areas using indigenous shrubs, forbs and grasses only – unless requested otherwise (i.e. crops) by the landowner. The selection of species used for rehabilitation may not include any species that are not suitable to the receiving environment (i.e. are known to be weeds or invasive), and also no species that are indicative of habitat degradation, such as species declared as Encroaching or Increaser II or –III grasses.

Residual Impacts related to Alien Invasive Species

Any physical disturbance and movement of man and machinery always present opportunities for alien invasive plants to become established. Currently this can be controlled, but will require a permanent ongoing effort to ensure that alien invasive species do not become a major problem to manage.

Pre- and Post-Mitigation Significance

All Phases			
Characteristic	**Pre-Mitigation**	**Post Mitigation**	**Type**
Extent	Regional	Local	Negative
Duration	Permanent	Mid- to Long-term	Negative

Scale	> 20 ha	< 2 ha	Negative
Impact Magnitude	Medium	Small to Negligible	Negative
Significance Rating	**MODERATE**	**MINOR TO NEGLIGIBLE**	Negative Pre-mitigation Neutral Post-mitigation

5.4 Limitations of the Ecological Impact Assessment

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence collected during rapid field surveys, combined with collective experience and professional opinion. The available evidence may be limited, potentially leading to over-simplification of ecological systems and responses, and contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill and Arnold, 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments, but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill and Arnold, 2012).

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of mining. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill and Arnold, 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments, as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category (i.e. protected species) because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill and Arnold, 2012).

6. MONITORING REQUIREMENTS

- Monitor excavated areas on a daily basis to remove any fauna that may have become trapped
- Ensure drivers of vehicles and machinery are on the look-out for slower-moving fauna such as tortoises that may cross access roads to move such out of the way
- Monitor the establishment of alien invasive species on disturbed areas and eradicate timeously before flowering/production of reproductive material
- Ensure signs of accelerated erosions, such as conspicuous sheet-wash, rills or gullies are detected early and mitigated as soon as detected
- Ensure re-vegetation of construction areas around turbines actually achieves rehabilitation goals and does not allow the establishment of alien invasive species
- It is recommended that a faunal observation register is maintained to establish, over time, if and which terrestrial faunal species utilise the space within 100 m around the turbines. If a significant influx of undesirable and/or opportunistic small mammals such as rodents or gerbils are recorded, this should be addressed as it may attract raptor, which will then be subject to collision with the rotor blades.

7. CONCLUSION

From an ecological perspective, all sites where turbines will be constructed have a low ecological value, as they are already under cultivation, and often are already subject to a high presence of alien invasive forbs. Where under cultivation, planted crops are growing at such density that movement through crops before harvest is limited and habitats are rather marginal for indigenous fauna. This may change to some degree after cereals are harvested, but still these habitats remain a seasonal forage resource only, not a more permanent source of shelter.

There will thus be no direct impact on indigenous flora, and negative impacts on indigenous terrestrial fauna is expected to be minor and short-lived (during construction or maintenance only), or negligible.

After construction, if cultivation in the immediate vicinity of turbines will be replaced by grazing or reestablishment of indigenous, this could actually improve habitat conditions relative to the current state for small fauna, neutralising potential negative effects created by low but continuous disturbances such as noise emitted by the operation of the turbines or the occupation of area by turbine foundations.

8. BIBLIOGRAPHY AND ADDITIONAL LITERATURE

Alexander, G. & Marais, J. (2007). A Guide to the Reptiles of Southern Africa. Struik Nature, Cape Town, South Africa

Apps, P. (Ed). (2000). Smither's Mammals of Southern Africa. A field guide. Random House Struik, Cape Town, RSA.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J & de Villiers, M.S. (eds). (2014). Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. South African Biodiversity Institute, Pretoria

Bromilow, C. (2010). Problem plants and alien weeds of South Africa. Briza Publications, Pretoria, RSA.

Burnett, M.R., August, P.V., Brown, J.H. & Killingbeck, K.T. (1998). The influence of geomorphological heterogeneity on biodiversity. A patch-scale perspective. Conservation Biology 12: 363-370

Department of Environmental Affairs (2011). National Environmental Management: Biodiversity Act, 2004: National list of ecosystems that are threatened and in need of protection, Government Gazette Number 34809, Notice 1002, 9 December 2011, Pretoria: DEA.

Department of Environmental Affairs and Tourism (2007). NEMBA 2004 (Act No. 10 of 2004): Critically Endangered, Endangered, Vulnerable and Protected Species, Regulation No. 151, Government Gazette No. 29657, 23 February 2007, Pretoria: DEAT.

Fitzsimons, J.A. & Michael, D.R. (2016). Rocky outcrops: A hard road in the conservation of critical habitats. Biological Conservation 211: 36-44

Grealey, J. & Stephenson, D. (2007). Effects of Wind Turbine Operation on Butterflies. North American Windpower, Vol. 4, No. 1.

Helldin, J.O., Jung, J., Neumann, W., Olsson, M., Skarin, A., Widemo, F. (2012). The impacts of wind power on terrestrial mammals. A synthesis. Edited by Swedish Environmental Protection Agency, (Report 6510). Stockholm, Sweden.

Helme, N. (2010). Specialist ecological study on the potential impacts of the proposed Rheboksfontein Wind Energy Facility Project, Darling, Western Cape. Report prepared for and submitted to Savannah Environmental (Pty) Ltd, 48 pp.

Henderson, L. (2001). Alien weeds and invasive plants: A complete guide to declared weeds and invaders in South Africa. Agricultural Research Council, Paarl Printer, Cape Town

Hill, D. and R. Arnold (2012). Building the evidence base for ecological impact assessment and mitigation, Journal of Applied Ecology 49(1): 6-9.

Hoare, D. (2010). Environmental Impact Report: Specialist ecological study on the potential impacts of the proposed Rheboksfontein Wind Energy Facility Project, Darling, Western Cape. Report prepared for and submitted to Savannah Environmental (Pty) Ltd, 43 pp.

Hoare, D. (2011). Environmental Impact Report: Specialist faunal and wetland study on the potential impacts of the proposed Rheboksfontein Wind Energy Facility Project, Darling, Western Cape. Report prepared for and submitted to Savannah Environmental (Pty) Ltd, 43 pp.

Kremen, C. (2005). Managing ecosystem services: what do we need to know about their ecology? Ecology Letters 8: 468-479

Łopucki, R., & Mróz, I. (2016). An assessment of non-volant terrestrial vertebrates' response to wind farms – a study of small mammals. *Environmental monitoring and assessment*, *188* (2), 122. https://doi.org/10.1007/s10661-016-5095-8

Łopucki, R., Klich, D., & Gielarek, S. (2017). Do terrestrial animals avoid areas close to turbines in functioning wind farms in agricultural landscapes? *Environmental monitoring and assessment*, *189*(7), 343. https://doi.org/10.1007/s10661-017-6018-z

Łopucki, R., Klich, D., Ścibior, A., Gołębiowska, D. & Perzanowski, K. (2018). Living in habitats affected by wind turbines may result in an increase in corticosterone levels in ground dwelling animals. Ecological Indicators 84 (2018) 165–171. http://dx.doi.org/10.1016/j.ecolind.2017.08.052

Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger. M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds) (2013). Conservation assessment of butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas. Johannesburg & Cape Town: Saftronics (Pty.) Ltd. & Animal Demography Unit. 676 pp

Monadjem, A., Taylor, P., Denys, C. and Cotterill, F. (2015). Rodents of sub-Saharan Africa. A biogeographic and taxonomic synthesis. Walter de Gruyter GmbH, Berlin, Germany.

Mucina, L. and Rutherford, M.C. (Eds.) (2006). The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria

Perlman, D.L. and Milder, J.C. (2005). Practical ecology for planners, developers and citizens. Island Press, Washington

Pustkowiak, S., Banaszak-Cibicka, W., Mielczarek, Ł. E., Tryjanowski, P., & Skórka, P. (2018). The association of windmills with conservation of pollinating insects and wild plants in homogeneous farmland of western Poland. *Environmental science and pollution research international*, *25* (7), 6273–6284. https://doi.org/10.1007/s11356-017-0864-7

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. and Manyama, P.A. (Eds.). (2009). Red list of South African plants 2009. Strelitzia 25: 1-668. Updated Online: http://redlist.sanbi.org/

Samways, M. & Hatton, M. (2000). Palmnut Post 3: 9-11

SANBI. (2016a). Lexicon of Biodiversity Planning in South Africa. Beta Version, June 2016. South African National Biodiversity Institute, Pretoria. 72 pp.

SANBI. (2016b). Botanical Database of Southern Africa (BODATSA) [dataset]. http://newposa.sanbi.org/

SANBI. (2017). Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. First Edition (Beta Version), June 2017. Compiled by Driver, A., Holness, S. & Daniels, F. South African National Biodiversity Institute, Pretoria.

Stuart, C. & Stuart, T. (2015). Stuart's Field Guide to Mammals of Southern Africa (5th eds), Cape Town: Struik Nature

Digital References

CJB (Conservatoire et Jardin botaniques de la Ville de Genève) (2017): AFRICAN PLANT DATABASE: http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php

SANBI databases:

Red List of South African Plants: http://redlist.sanbi.org/

Plants of Southern Africa: http://newposa.sanbi.org/sanbi/Explore

BGIS: http://bgis.sanbi.org/SpatialDataset

Climate:

https://en.climate-data.org/africa/south-africa/western-cape/darling-23410/

APPENDIX A FAUNAL SPECIES HISTORICALLY RECORDED WITH A POTENTIAL OF FREQUENTING THE PAOA

Family	Scientific name	Common name	Red list category
AMPHIBIA			
Brevicepitidae	*Breviceps gibbosus*	Cape Rain Frog	Vulnerable
Brevicepitidae	*Breviceps namaquensis*	Namaqua Rain Frog	Least Concern
Brevicepitidae	*Breviceps rosei*	Sand Rain Frog	Least Concern
Bufonidae	*Vandijkophrynus angusticeps*	Sand Toad	Least Concern
Pipidae	*Xenopus laevis*	Common Platanna	Least Concern
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog	Least Concern
Pyxicephalidae	*Cacosternum aggestum*	Klipheuwel Caco	Least Concern
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern
Pyxicephalidae	*Cacosternum capense*	Cape Caco	Near Threatened
Pyxicephalidae	*Cacosternum platys*	Flat Caco	Near Threatened
Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog	Least Concern
Pyxicephalidae	*Tomopterna delalandii*	Cape Sand Frog	Least Concern
REPTILIA			
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern
Agamidae	*Agama hispida*	Spiny Ground Agama	Least Concern
Chamaeleonidae	*Bradypodion occidentale*	Western Dwarf Chameleon	Least Concern
Chamaeleonidae	*Bradypodion pumilum*	Cape Dwarf Chameleon	Vulnerable
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern
Colubridae	*Dispholidus typus typus*	Boomslang	Least Concern
Cordylidae	*Cordylus cordylus*	Cape Girdled Lizard	Least Concern
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	Least Concern
Elapidae	*Aspidelaps lubricus lubricus*	Coral Shield Cobra	Least Concern
Elapidae	*Naja nivea*	Cape Cobra	Least Concern
Gekkonidae	*Afrogecko porphyreus*	Marbled Leaf-toed Gecko	Least Concern
Gekkonidae	*Goggia lineata*	Northern Striped Pygmy Gecko	Least Concern
Gekkonidae	*Pachydactylus austeni*	Austen's Gecko	Least Concern
Gekkonidae	*Pachydactylus geitje*	Ocellated Gecko	Least Concern
Gekkonidae	*Pachydactylus mariquensis*	Marico Gecko	Least Concern
Lacertidae	*Meroles knoxii*	Knox's Desert Lizard	Least Concern
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern
Lamprophiidae	*Duberria lutrix lutrix*	South African Slug-eater	Least Concern

Family	Scientific name	Common name	Red list category
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	Least Concern
Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	Least Concern
Lamprophiidae	*Lycodonomorphus rufulus*	Brown Water Snake	Least Concern
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis leightoni*	Cape Sand Snake	LC (IUCN 2020), narrow endemic
Lamprophiidae	*Psammophis notostictus*	Karoo Sand Snake	Least Concern
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	Least Concern
Lamprophiidae	*Pseudaspis cana*	Mole Snake	Least Concern
Scincidae	*Acontias meleagris*	Cape Legless Skink	Least Concern
Scincidae	*Scelotes bipes*	Silvery Dwarf Burrowing Skink	Least Concern
Scincidae	*Trachylepis capensis*	Cape Skink	Least Concern
Scincidae	*Trachylepis variegata*	Variegated Skink	Least Concern
Scincidae	*Typhlosaurus caecus*	Southern Blind Legless Skink	Least Concern
Testudinidae	*Chersina angulata*	Angulate Tortoise	Least Concern
Testudinidae	*Homopus areolatus*	Parrot-beaked Tortoise	Least Concern
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern
MAMMALS			
Bathyergidae	*Bathyergus suillus*	Cape Dune Mole-rat	Least Concern
Bathyergidae	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern
Canidae	*Otocyon megalotis*	Bat-eared Fox	Least Concern
Canidae	*Vulpes chama*	Cape Fox	Least Concern
Chrysochloridae	*Chrysochloris asiatica*	Cape Golden Mole	Least Concern
Felidae	*Caracal caracal*	Caracal	Least Concern
Felidae	*Felis silvestris*	Wildcat	Least Concern
Herpestidae	*Atilax paludinosus*	Marsh Mongoose	Least Concern
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	Least Concern
Herpestidae	*Herpestes ichneumon*	Egyptian Mongoose	Least Concern
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern
Muridae	*Mus minutoides*	Southern African Pygmy Mouse	Least Concern

Family	Scientific name	Common name	Red list category
Muridae	*Otomys unisulcatus*	Karoo Bush Rat	Least Concern
Muridae	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern

APPENDIX B IMPACT ASSESSMENT METHODOLOGY

The impact assessment stage comprises a number of steps that collectively assess the manner in which the Project will interact with elements of the physical, biological, cultural or human environment to produce impacts to resources/receptors. The steps involved in the impact assessment stage are described in greater detail below.

Impact Assessment Methodology

Definition of Key Terminology

- **Project** - The features and activities that are a necessary part of the Project Developer's development plans without which the Project cannot proceed. The Project is also the collection of features and activities for which authorisation is being sought.
- **Project Site -** The (future) primary operational area for the Project activities.
- **Project Footprint** - The area that may reasonably be expected to be directly affected by Project activities, across all phases. The Project Footprint includes land used on a temporary basis such as construction lay down areas, materials yards, borrow pits or construction haul roads, as well as disturbed areas in transport corridors, both public and private.
- **Area of Influence:** The area where impacts could reasonably be expected.
- **Study Area:** The area that needs to be studied in order to adequately understand and describe the baseline likely to be affected by the Project. At a minimum, the Study Area will encompass the Project Footprint and the Area of Influence, and in some cases it may extend farther to further establish the context for the Baseline.

Impact Types and Definitions

An impact is any change to a resource or receptor brought about by the presence of a Project component or by the execution of a Project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the Project could affect the biological, physical and socio-economic environment.

Impacts are described according to their nature or type, as summarised below:

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	An impact that results from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	An impact that results from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Induced impact	An impact that results from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
Cumulative impact	An impact that acts together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

Assessing Significance

Impacts are described in terms of 'significance'. Significance is a function of the **magnitude** of the impact and the **sensitivity/vulnerability/importance of resource/receptor**.

Determining Impact Magnitude

Impact magnitude (sometimes termed severity) is a function of the **type, extent, duration, scale** and **frequency** of the impact. These characteristics apply to both planned and unplanned events/ impacts and are briefly described below.

Impact Characteristics Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the type of impact in relationship to the Project (in terms of cause and effect)	■ Direct ■ Indirect ■ Induced
Extent	The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc).	■ Local - impacts that affect an area in a radius of 20km around the development site. ■ Regional - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem. ■ International - impacts that cross national borders, affect nationally important environmental resources or affect an area that is nationally important/or have macro-economic consequences.
Duration	The time period over which a resource / receptor is affected.	■ Temporary - impacts are predicted to be of short duration and intermittent/occasional. ■ Short-term - impacts that are predicted to last only for the duration of the construction period. ■ Long-term - impacts that will continue for the life of the Project, but ceases when the Project stops operating. ■ Permanent - impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc)	■ [no fixed designations; intended to be a numerical value or a qualitative description of "intensity"]
Frequency	A measure of the constancy or periodicity of the impact.	■ [no fixed designations; intended to be a numerical value or a qualitative description]

An additional characteristic that pertains to mostly unplanned events is likelihood. The likelihood of an unplanned event occurring is designated using a qualitative scale, as described below.

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

The overall magnitude of an impact is a combination of the above characteristics. The universal magnitude designations are:

- Negligible;
- Small;
- Medium; and
- Large.

Determining sensitivity/vulnerability/importance of resource/receptor

There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered when characterising sensitivity/ vulnerability/ importance, such as legal protection, government policy, stakeholder views and economic value.

As for the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis. The sensitivity/vulnerability/importance designations used herein for all resources/receptors are:

- Low;
- Medium; and
- High.

Below is an illustrative example of the sensitivity/vulnerability/importance of the resource/receptor.

Designation	**Receiving environment**	
	Biophysical environment	**Socio-economic environment**
Low	The impact affects the environment in such a way that natural functions and processes are not affected.	People/communities are able to adapt with relative ease and maintain pre-impact livelihoods.
Medium	Where the affected environment is altered but natural functions and processes continue, albeit in a modified way.	People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.
High	Where natural functions or processes are altered to the extent that they will temporarily or permanently cease.	Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.

Determining Impact Significance

As earlier stated above, Impact Significance is a function of the magnitude of the impact and the sensitivity/vulnerability/importance of resource/receptor. Impact significance can be Negligible, Minor, Moderate or Major (as determined in Table 5-1 above).

A brief description of the different categories of Impact Significance is given below.

Significance definitions	
Negligible significance	An impact of negligible significance (or an insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.

Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects, there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors such as employment, in coming to a decision on the Project.

Note*: It is important to note that the positive impacts are not rated, merely stated. It is considered sufficient for the purpose of the Impact Assessment to indicate that the Project is expected to result in a positive impact, without characterising the exact degree of positive change likely to occur. However, positive impacts are presented quantitatively where possible*

Mitigation of Impacts

Once the significance of a given impact has been characterised using the above mentioned methodologies, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

It is important to have a solid basis for recommending mitigation measures. The role of any given ESIA is to help develop a consentable project, and to help clients meet their business objectives in a responsible manner. Impact assessment is about identifying the aspects of a project that need to be managed, and demonstrating how these have been appropriately dealt with. As key influencers in the decision making process, the role of the impact assessment is not to stop development or propose every possible mitigation or compensatory measure imaginable, but rather to make balanced judgements as to what is warranted, informed by a high quality evidence base.

Additional mitigation measures should not be declared for impacts rated as not significant, unless the associated activity is related to conformance with an 'end of pipe' applicable requirement. Further, it is important to note that it is not an absolute necessity that all impacts be mitigated to a not significant level; rather the objective is to mitigate impacts to an as low as reasonably possible (ALARP) level.

As previously mentioned, embedded controls (i.e., physical or procedural controls that are planned as part of the project design and are not added in response to an impact significance assignment), are considered as part of the project (prior to entering the impact assessment stage of the impact assessment process).

Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

Dealing with Uncertainty

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty. Uncertainty stemming from on-going development of the Project design is inevitable, and the environment is typically variable from season to season and year to year. Where such uncertainties are material to ESIA findings, they will be clearly stated and conservatively approached ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques such as hydrodynamic modelling to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation.

Cumulative Impacts/Effects

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects.

The approach for assessing cumulative impacts is influenced by the availability of information about the impact of the other activity, and whether or not it already exists or is only proposed. Cumulative impacts of the Project are identified and briefly described in a qualitative manner in the context of other existing or planned development Projects.

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PROPOSED RHEBOKSFONTEIN WIND ENERGY FACILITY, WESTERN CAPE PROVINCE

AMENDMENT: COMPARATIVE VIEWSHED ANALYSIS AND VISUAL ASSESSMENT

Produced for:

Moyeng Energy (Pty) Ltd

On behalf of:

Savannah Environmental (Pty) Ltd
1st Floor, Block 2, 5 Woodlands Drive Office Park,
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- November 2018 -

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MAPS

Lourens du Plessis (t/a LOGIS), a specialist in visual assessments and Geographical Information Systems, undertook the comparative viewshed analysis and visual assessment for the proposed amendment to the turbine specifications for the Rheboksfontein Wind Energy Facility (WEF). Lourens, then director of MetroGIS (Pty) Ltd, did the Visual Impact Assessment for the original Rheboksfontein WEF (submission date 2011) and the subsequent Visual Assessment for the Motivation for Amendment of Environmental Authorisation (2014).

Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His expertise is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

Lourens is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments.

Savannah Environmental (Pty) Ltd appointed Lourens du Plessis as an independent specialist consultant to undertake the visual assessment for the proposed amendment to the Rheboksfontein WEF. He will not benefit from the outcome of the project decision-making.

1. INTRODUCTION

Moyeng Energy (Pty) Ltd is proposing the following amendments to the authorised Rheboksfontein Wind Energy Facility (WEF).

The intended amendment includes:

- The increase of the wind turbine rotor diameter from 126m (as assessed during the EIA phase of the project) to a maximum of 160m diameter (an increase of 34m);
- Update the layout as required;
- Extend the validity period by an additional two years.

The number of wind turbines (35), the hub-height (120m above ground level) and the generating capacity of the facility (140MW) remain unchanged.

The primary relevance of this proposed increase in dimensions, from a visual impact perspective, is that the total maximum vertical dimension (height) of the wind turbine increases from approximately **183m** (120m hub-height + 63m blade length) to **200m** (120m hub-height + 80m blade length) above ground level. This translates to a total **17m** maximum increase in height per wind turbine.

2. SCOPE OF WORK

The scope of work includes a comparative viewshed analysis and identification of potential sensitive visual receptors that may be influenced by the increase in dimensions of the wind turbines. This is done in order to determine:

- If there are any additional visual receptors that may be negatively influenced by the amendment;

- Whether the increase in dimensions would significantly aggravate the potential visual impact on identified receptors (identified during the EIA phase);
- If additional impact mitigation measures are relevant; and
- To suggest amendments or additions to the Environmental Management Programme (EMPr) (if applicable).

3. METHODOLOGY

The visual assessment includes a comparative viewshed analysis in order to determine the visual exposure (visibility) of the original (authorised) turbine dimensions compared to the potential (additional) exposure of the increased (proposed) turbine dimensions. The viewshed analysis focuses on a radius of 5km from the proposed wind turbine layout and potential visual receptors located within this zone. The original VIA report determined that receptors, where visible, within this zone may experience a ***high*** visual impact of the proposed infrastructure. Should this review of the change in dimensions of the wind turbine structures indicate that there may be a significant increase in the visual impact within this zone, as determined during the VIA, the study area may need to be increased to accommodate areas that were rated as ***moderate*** as well (i.e. beyond a 5km radius and up to a 20km radius from the structures).

Potential sensitive visual receptors include observers residing at homesteads (farm residences and dwellings) within the study area, and observers travelling along the arterial and secondary roads traversing near or over the proposed development site.

4. RESULTS

A visibility analysis was undertaken from each of the wind turbine positions (35 in total) at an offset of 183m (maximum blade tip height) above ground level. The result of this analysis represents the potential total visual exposure of the original turbine dimensions (indicated in green). The viewshed analysis was repeated at an offset of 200m to indicate the visual exposure of the increased turbine dimensions (shown in red) and revised wind turbine layout. The results of the visibility analyses and both the original wind turbine layout and the revised turbine layouts are displayed on **Map 1** below.

It is clear that the approximately 8.5% increase in turbine dimensions, would have a relatively small influence on the overall visual exposure, due to the already tall turbine structures previously approved and the elevated positions of the turbines on hills within the landscape. The micro siting of the wind turbine positions (revised turbine layout) within the proposed development site is similarly not expected to influence the area of potential visual exposure.

The surface area (within the study area) of the original turbine exposure is $464km^2$, compared to the $468km^2$ of the increased dimensions of the wind turbine exposure. This is an increase of $4km^2$, or alternatively, an increase of less than 1% (0.8%) in potential visual exposure.

There are no additional sensitive visual receptors located within the area of increased visual exposure.

Potential sensitive visual receptors within a 5km radius (identified during the EIA phase) include:

- Rheboksfontein*

- Grootberg*
- Wildschutsvlei*
- Grootwater
- Tienie Versveld Wildflower Reserve
- Slangkop
- Windhoek
- Droëvlei
- Burgerspan
- Klipvlei
- Brakrivier
- Kraalbosdam
- Platteklip
- Klipberg
- Wolwefontein
- Alexanderfontein
- Bonteberg
- Darling
- Nuwedorp
- The Towers
- Doornfontein
- Jakkalsfontein
- Uitkoms
- Observers travelling along the R25 and R315 arterial roads, and secondary roads

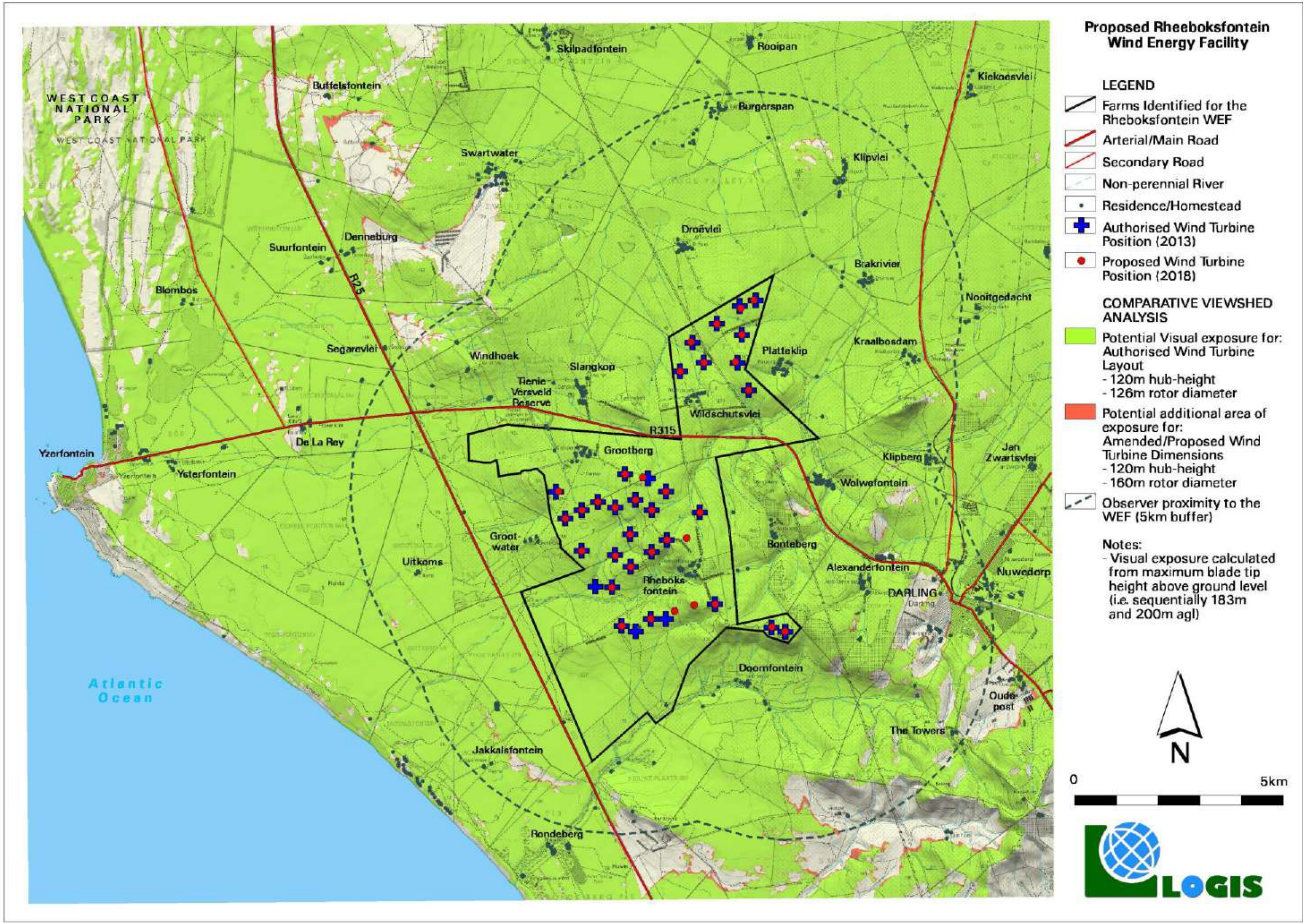
*Note: The homesteads marked * are located on the farms earmarked for the development, assuming their approval of the WEF development.*

Where homesteads are derelict or deserted, the visual impact will be non-existent, until such time as it is inhabited again.

The increased area of visual exposure does not include any additional exposure to major roads within the study area.

It is expected that the wind turbine structures, both the original dimensions and the proposed increased dimensions would be equally visible and noticeable from both the roads and homesteads identified above, therefore signifying a negligible change to the potential visual impact.

In consideration of the proposed amendments, there is no (zero) change to the significance rating compared with the original EIA visual impact assessment report.



Map 1: Comparative Viewshed Analysis – Rheboksfontein Wind Energy Facility.

5. CONCLUSION/RECOMMENDATIONS

The proposed increase in the dimensions of the wind turbine structures and the revised turbine layout are **not expected to significantly alter** the influence of the WEF on *areas of higher viewer incidence* (observers traveling along arterial or major secondary roads within the region) or *potential sensitive visual receptors* (residents of homesteads and visitors in close proximity to the WEF).

The proposed increase in dimensions are consequently **not expected to significantly influence** the anticipated visual impact, as stated in the original VIA report (i.e. the visual impact is expected to occur regardless of the amendment). This statement relates specifically to the assessment of the visual impact within a 5km radius of the wind turbine structures (potentially ***high*** significance), but also generally apply to potentially ***moderate*** to ***low*** visual impacts at distances of up to 20km from the structures.

From a visual perspective, the proposed changes will therefore require no (zero) changes to the significance rating within the original visual impact assessment report that was used to inform the approved EIA. In addition to this, no new mitigation measures are required.

It is suggested that the proposed amendment to the turbine dimensions and layout be supported, subject to the conditions and recommendations as stipulated in the original Environmental Authorisation, and according to the Environmental Management Programme and suggested mitigation measures, as provided in the original Visual Impact Assessment report.

6. REFERENCES

MetroGIS (Pty) Ltd, 2010. *Proposed Rheboksfontein Wind Energy Facility – Visual Impact Assessment Report.*

Savannah Environmental (Pty) Ltd, 2014. *Establishment of the Proposed Rheboksfontein Wind Energy Facility and Associated Infrastructure, Western Cape Province. DEA ref: 12/12/20/1582. Motivation for the Amendment of Environmental Authorisation.*

FINAL

Visual Impact Assessment

RHEBOKSFONTEIN WIND ENERGY FACILITY PROPOSED AMENDMENTS

WESTERN CAPE

Newtown Landscape Architects

23 November 2020

VISUAL IMPACT ASSESMENT OF THE PROPOSED RHEBOKSFONTEIN WIND ENERGY FACILITY

PROPOSED AMENDMENTS

WESTERN CAPE

Submitted to:

ERM

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Prepared by:

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Report Status:	*FINAL*
Date Issued:	23 November 2020
Prepared By:	Graham Young PrLArch, FILASA
Reviewed By:	Graham Young PrLArch, FILASA

Signed:

Reference: Rheboksfontein Wind Energy Facility - Amendment, VIA

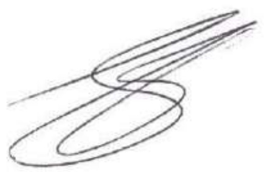
EXPERTISE OF SPECIALIST

Name:	Graham A Young
Qualification:	BL (Toronto) ML (Pretoria)
Professional Registration:	South African Council for the Landscape Architectural Profession (SACLAP) Reg. No. 87001 Fellow Institute of Landscape Architects of South Africa (FILASA)
Experience in Years:	40 years
Experience	Graham Young is a registered landscape architect with interest and experience in landscape architecture, urban design, and environmental planning. He holds degree in landscape architecture from the Universities of Toronto (BL) and Pretoria (ML). He has carried out visual impact assessments in Canada and throughout Africa, where he has spent most of his working life. He has served as President of the Institute of Landscape Architects of South Africa (ILASA) and as Vice President of the Board of Control for Landscape Architects. He is a Fellow of the ILASA and a professionally registered landscape architect in South Africa (SACLAP). He is Secretary General for the International Federation of Landscape Architect, Africa Region (IFLA Africa). He runs his own practice, Graham A Young Landscape Architect (GYLA). A specialty is Visual Impact Assessments for which he has been cited with an Institute of Landscape Architects of South Africa (ILASA), Merit Award (1999). Aspects of this work also include landscape characterization studies, end-use studies for quarries and computer modelling and visualization. He has completed over 300 specialist reports for projects and conducted several VIA reviews. He has served as a specialist witness in legal cases involving visual impact issues. Mr Young helped develop the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* (Oberholzer 2005) and produced a research document for Eskom, *The Visual Impacts of Power Lines* (2009). In 2011 he produced '*Guidelines for involving visual and aesthetic specialists'* for the Aapravasi Ghat Trust Fund Technical Committee, who manage a World Heritage Site in Mauritius, along with the *Visual Impact Assessment Training Module Guideline Document* for the same client.

DECLARATION OF INDEPENDENCE

I, Graham Young, declare that –

- I am contracted as the Visual Impact Assessment Specialist for the Rheboksfontein Wind Energy Facility, Amendment.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998), 2014 Environmental Impact Assessment Regulations (as amended on 7 April 2017), and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations, and all other applicable legislation.
- I will consider, to the extent possible, the matters listed in Regulation 13.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 16 (1)(b)(iii).



Graham A. Young FILASA PrLArch Reg. No. 87001

20 November 2020

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1. INTRODUCTION

1.1 Project Overview and Background

Newtown Landscape Architects (NLA) was commissioned by ERM, Cape Town to carry out a Visual Impact Assessment (VIA) of the proposed amendments to the approved Rheboksfontein Wind Energy Facility. The original wind energy facility was given Environmental Authorisation (EA) on 02 February 2012. An application for amendment to the original EA was granted on 28 May 2015 (DEA Reference: 12/12/20/1582/AM2), allowing Moyeng Energy (PTY) Ltd (Moyeng Energy) to construct 35 wind turbines with a total generating capacity of 129MW. Moyeng Energy now wishes to apply for a further amendment to the existing EA, in terms of Regulation 31 and 32 of the 2014 National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations, and is proposing to increase the generating capacity of the facility to 140MW.

1.2 Project site

The project site is located approximately 8km (to the centre of the site) west of the Darling, Western Cape. The R315 passes through the northern section of the site and connects Darling to Yzerfontein. The R27 is adjacent to the western site boundary and connects Cape Town to Langebaan, Saldanha, and Vredenburg. Yzerfontein lies approximately 12km west of the site and Langebaan is approximately 37km to the northwest of the site.

1.3 Scope of Study

The main aim of the study is to ensure that the visual consequences of the proposed Amendments are understood. The report provides specialist input to assess the changes of the proposed amendments in the context of the approved project (EA) and the former VIA[1] and is to be read in conjunction with it. This report therefore does not repeat information that remains relevant to the current amendment VIA, specifically the baseline and sensitivity data.

1.4 Assumption, Uncertainties, and Limitations

The following assumptions limitations have been made in the study:

- The description of project components is limited to what has been supplied to the author before the date of completion of this report.
- The former 2010 VIA comprehensively described the baseline information such as a description of the site and surrounding area. The description of the landscape characteristics and receptor sensitivities remains unchanged. The emphasis of this VIA is thus placed on the impact assessment of the proposed amendments vs the approved layout and turbine design.
- The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. We have interpolated these down to 1m intervals to get better accuracy. However, these types of viewshed investigations can be limited in their accuracy due to their inability to incorporate vegetation and structure information. However, for comparative reasons, this method is adequate.

[1] MetroGIS (Pty) Ltd. September 2010, *Proposed Rheboksfontein wind Energy Facility Visual Impact Assessment.* Unpublished Report. La Montagne.

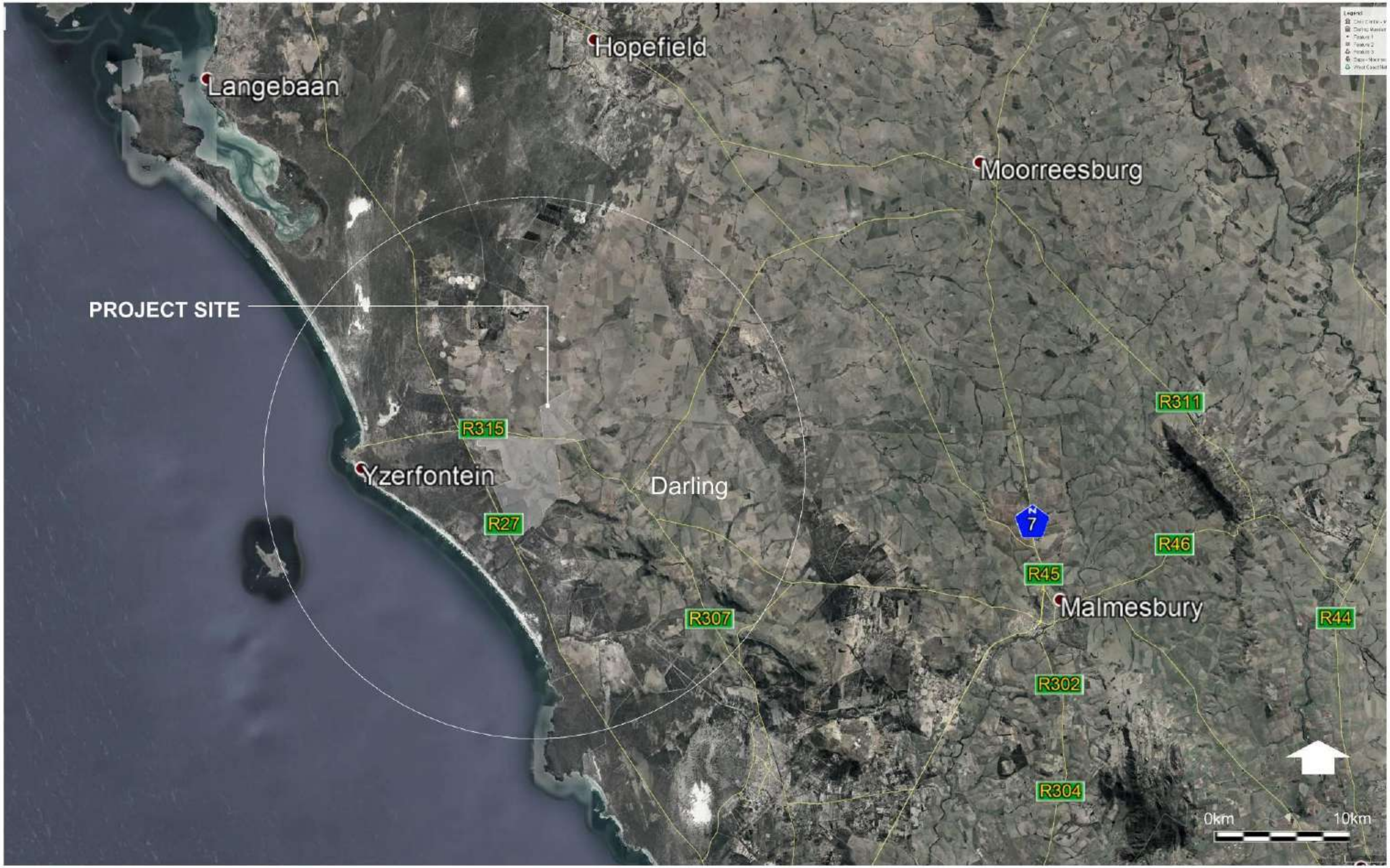


Figure 1: LOCALITY - Rheboksfontein Wind Energy Amendment Project

2. APPROACH AND METHODOLOGY

2.1 Approach

The assessment of likely effects on a landscape resource and visual amenity is complex since it is determined through a combination of quantitative and qualitative evaluations. When assessing the visual impact, the worst-case scenario is considered. The visual impact is assessed as one of the interrelated effects on people i.e. the viewers and the impact of an introduced object into a view or scene.

In this assessment, the focus was on the potential visual impact of the components of the proposed amendment option, versus the approved 2015 project, and their potential impact within the local landscape and sensitive receptor context.

2.2 Methodology

A GIS was used to calculate two viewsheds for the project and the following method was used:

- The visibility of the components that received EA (2015) was first determined using a computer-generated viewshed analysis.
- A second viewshed was generated based on the visibility of the components of the proposed changes to the 2015 project.
- A comparative analysis of the two viewsheds was undertaken to determine the increase or otherwise of the amendment proposal's visibility.
- The magnitude of the impact of the amendment proposal was undertaken and compared against the approved option to determine the significance of the impact of the proposed amendment.

3. PROJECT DESCRIPTION

3.1 Proposed Amendments

Moyeng Energy intends to amend the 2015 EA by increasing the rotor diameter and hub height of each of the turbines, which would allow for fewer turbines to be used. The intended amendments include:

- The increase in rotor diameter to form 126m to 170m
- The increase in the hub height from 120m to 130m
- The increase in the total maximum height of each turbine from 183m to 215m; and
- Small layout changes, which include the removal of two turbines.

Figure 2-1 illustrates the approved layout, Figure 2-2 the amended layout, and 2-3, which indicates the differences between the two layouts. The most significant change between the two options is the reduction from 35 to 33 turbines, along with the increased dimensions as stated above and illustrated in Figure 3 of the amended proposal.

The assessment in the following section focuses on these changes, primarily through a comparative analysis of the two viewsheds, visual exposure and visual intrusion, as well as the identification of potential sensitive visual receptors that may be influenced by the increase in design dimensions of the wind turbines. This determines:

- Whether there are additional visual receptors who may be affected by the amendment; and
- Whether the increase in design specifications will result in a significant increase in visual impact on sensitive receptors identified in the EIA (MetroGIS 2010 and subsequent EA and which remain unchanged from the original VIA).

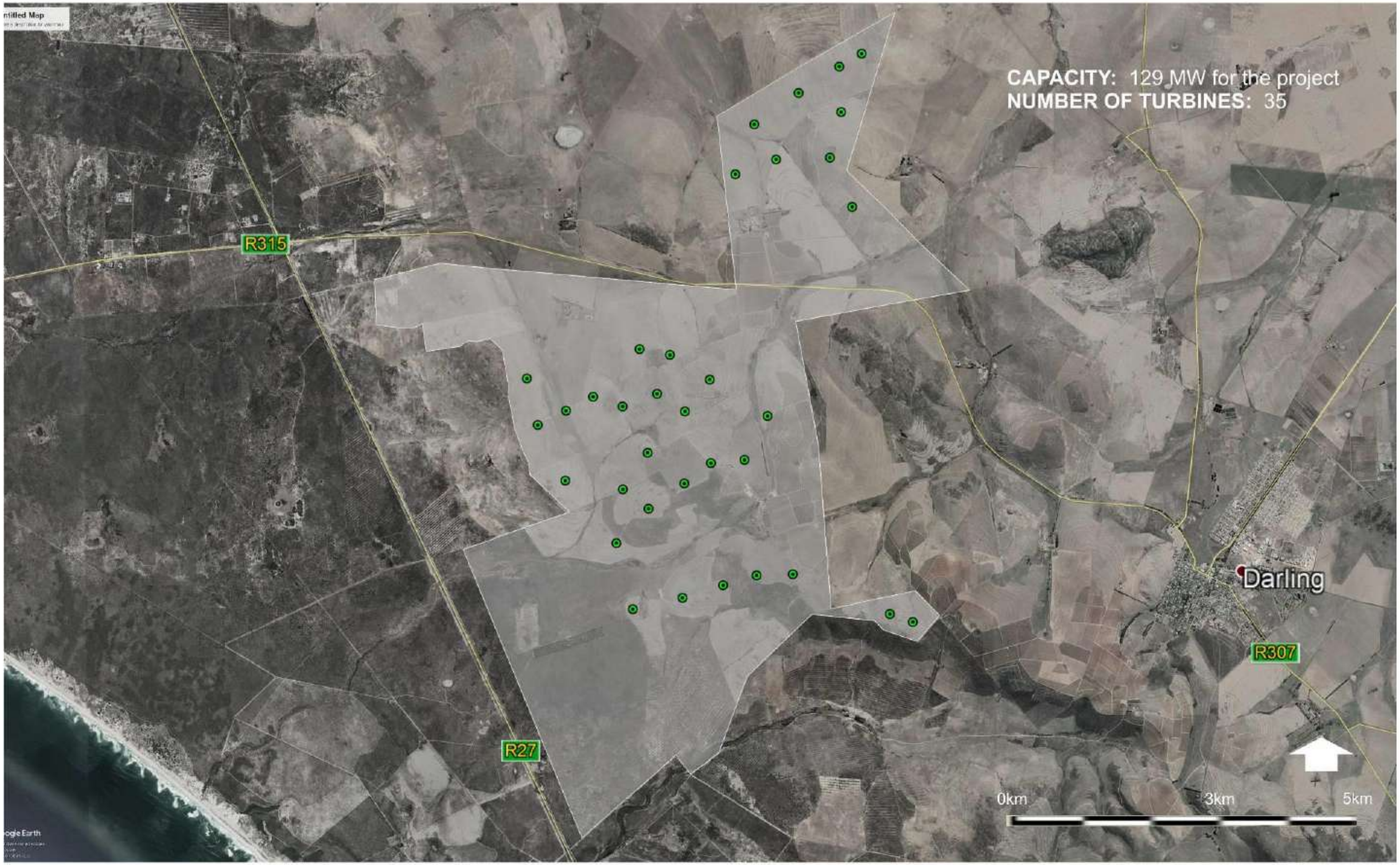


Figure 2-1: LAYOUT - Approved

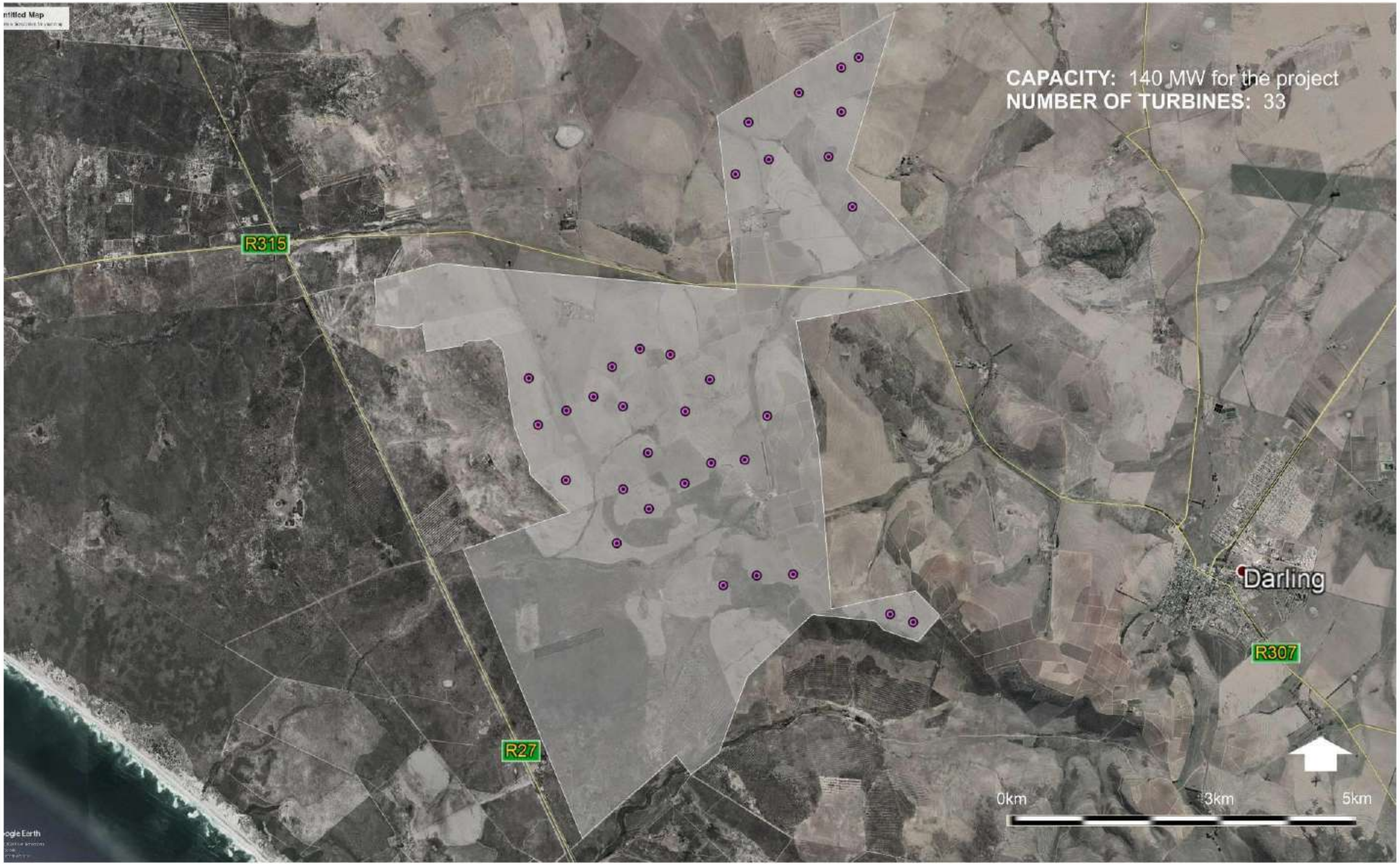


Figure 2-2: LAYOUT - Amendment Proposal

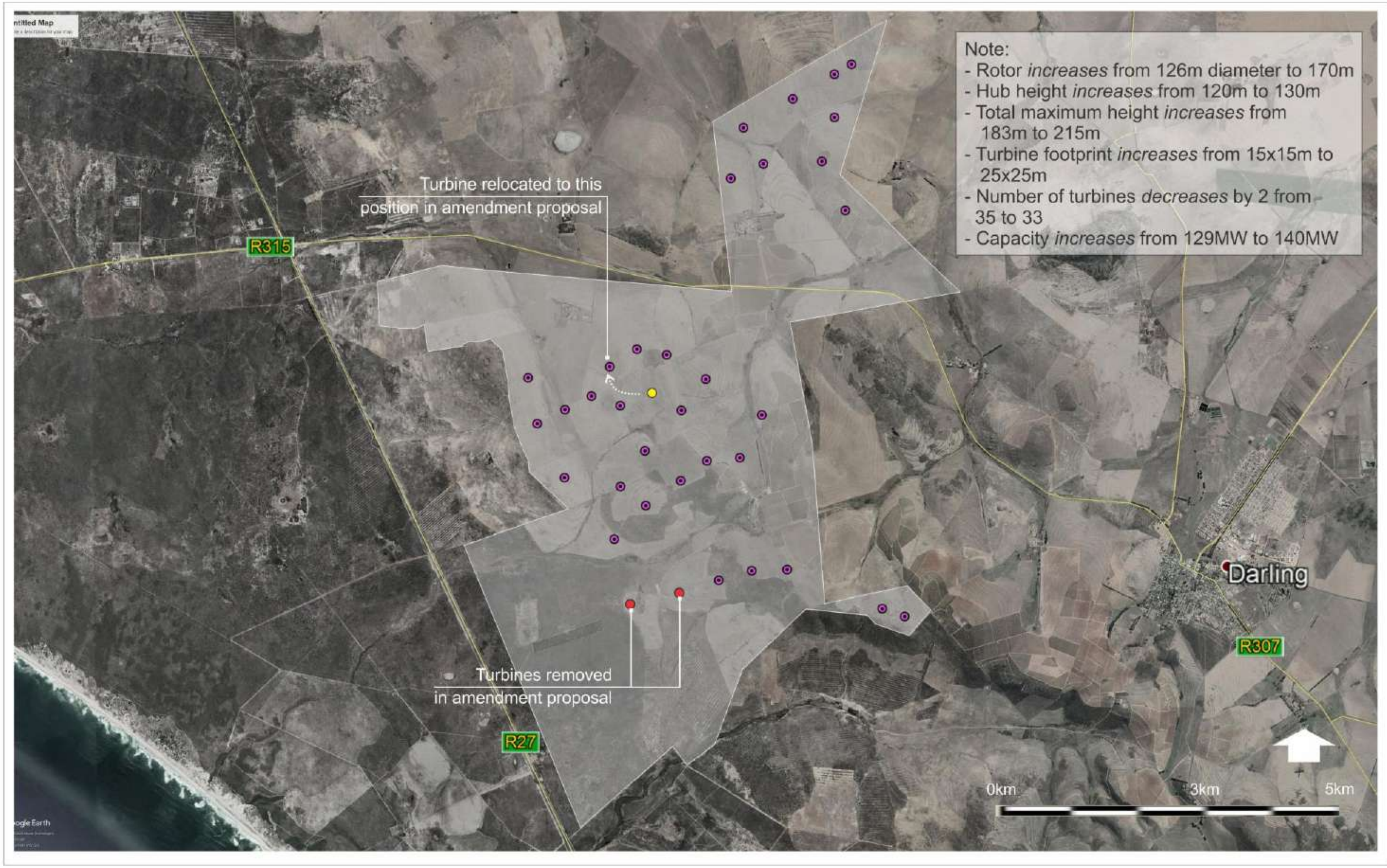


Figure 2-3: LAYOUT - Difference between Approved and Amendment Proposal

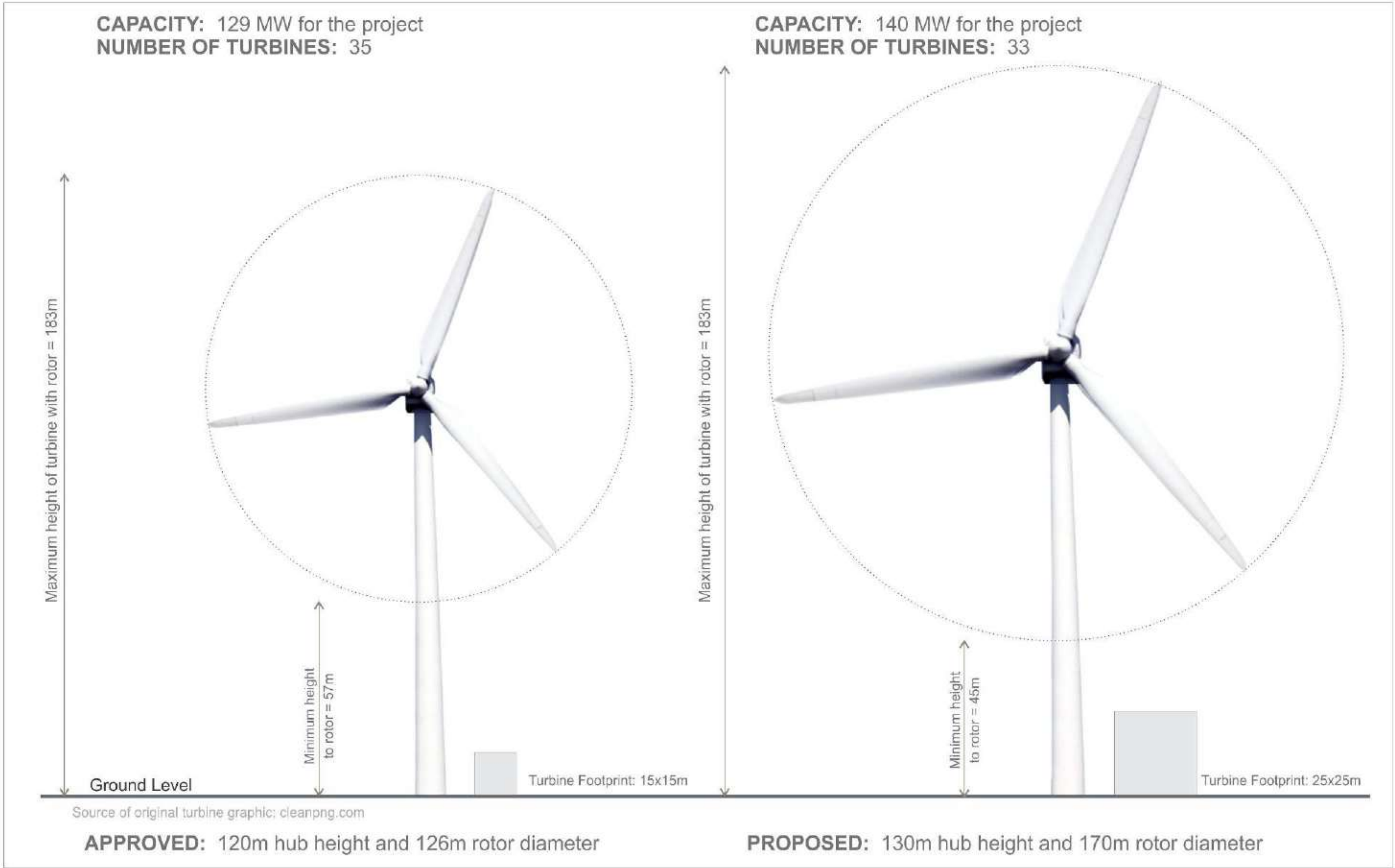


Figure 3: COMPARISON OF TURBINE SIZES_Rheboksfontein Amendment

4. ASSESSMENT OF PROPOSED CHANGES

Visual impacts will likely be caused by the proposed amendment to varying degrees. The *magnitude* of visual impact is determined using visibility, visual intrusion, visual exposure, and viewer sensitivity criteria. When the *magnitude* of impact is qualified with spatial, duration, and probability criteria the significance of the impact can be predicted (refer to Appendix C). The impact of the amendment proposal will then be compared with the approved project components to determine if a significant change can be expected.

4.1 Sensitive Viewers and Locations

Two main areas of concern were identified in the original VIA and which remain unchanged:

- The first area includes the town of Darling and several homesteads/farms (mainly to the north and west of Darling within an approximate radius of 4 to 5km of the proposed development site).
- The second area includes a 200m buffer zone along the main West Coast Road (R27), and other arterial roads (i.e. the R311 and R45) (Metro GIS 2010:12).

In addition to these areas, potentially sensitive visual receptors (other than farmsteads on whose property the development will take place) within a 5km radius (identified during the original EIA phase and listed in the unpublished report by LOGIS[†]) include:

- Grootwater
- Tienie Versveld Wildflower Reserve
- Slangkop
- Windhoek
- Droëvlei
- Burgerspan
- Klipvlei
- Brakrivier
- Kraalbosdam
- Platteklip
- Klipberg
- Wolwefontein
- Alexanderfontein
- Bonteberg
- Darling
- Nuwedorp
- The Towers
- Doornfontein
- Jakkalsfontein
- Uitkoms
- Observers traveling along the R25 and R315 arterial roads, and secondary roads.

[†] LOGIS. November 2018. *Proposed Rheboksfontein Wind Energy Facility, Western Cape Province Amendment: Comparative Viewshed Analysis and Visual Assessment.* Unpublished Report. La Montagne.

4.2 Comparative Analysis – Approved vs Amendment Proposal

The 'zone of potential influence' for the viewshed assessment was established at 20,0km around the project site. Over 20,0km, the impact of the turbines would have diminished as they will recede into the background, and/or views to the site would be screened by topographic features. Offsets equivalent to the maximum heights of the approved turbines (183m) and the proposed amended turbines (215m) were used to generate the viewsheds and determine whether the increased visibility of the larger turbines would significantly increase the visual envelope (visibility) of the amendment project.

4.2.1 Visibility

A viewshed analysis defines the areas, which contain all possible observation sites from which the development would be visible. It follows that the more visible a project is, its potential for visual impact increases. Two viewsheds were calculated, one for each of the approved, and amendment options.

The viewshed analyses in Figures 4-1 and 4-2 illustrate the potential visibility of the approved layout and size of turbines versus the proposed amendment option respectively. The viewsheds were overlaid in Figure 4-3 to establish the spatial extend of increased visibility (shown in pink) of the proposed design and layout over the approved option. The visual envelope of the amended option is 1516,10km^{2}., which equates to an increase in visibility of 0,716% over the approved project.

The increase in visibility occurs mainly to the northwest and southeast of the project site and at distances of greater than 5km (i.e. in middle to the background of views) and therefore most of the sensitive viewing locations listed above would not be impacted upon by the amended project. It is, however, clear from this calculation that the slight change in layout, the removal of two turbines, and the increase in turbine dimensions, would have a minor influence on the overall visibility of the project. Increased visibility is therefore not an issue.

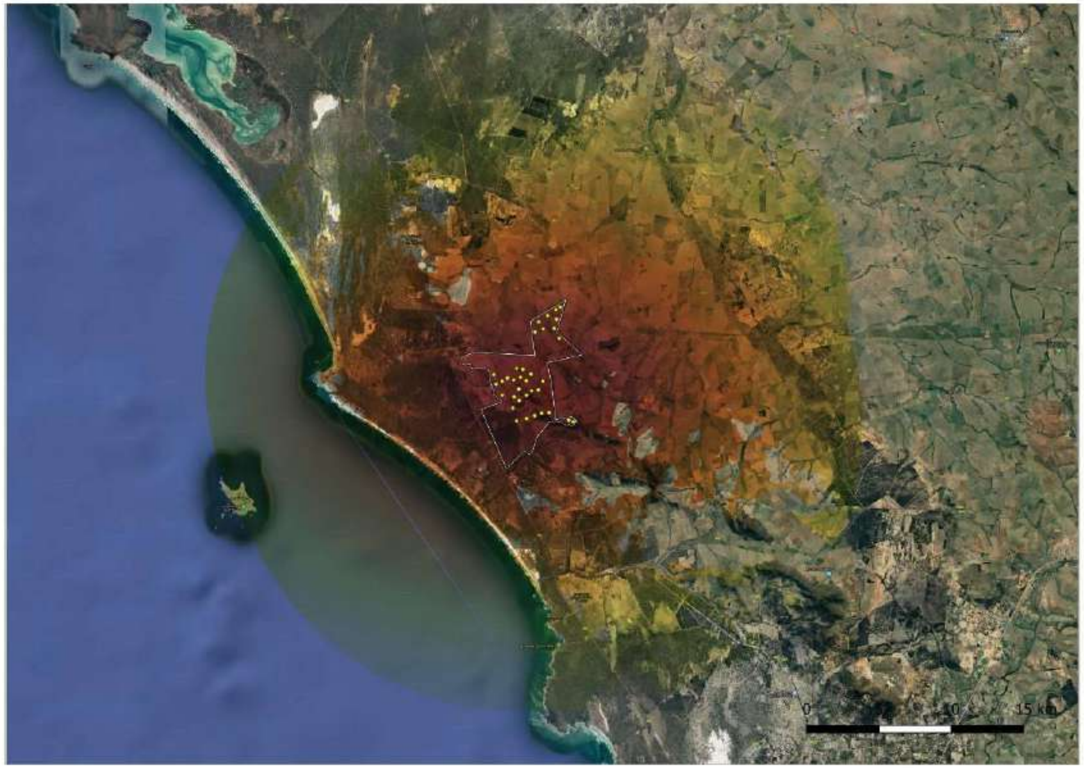
4.2.2 Visual Exposure and Visual Intrusion

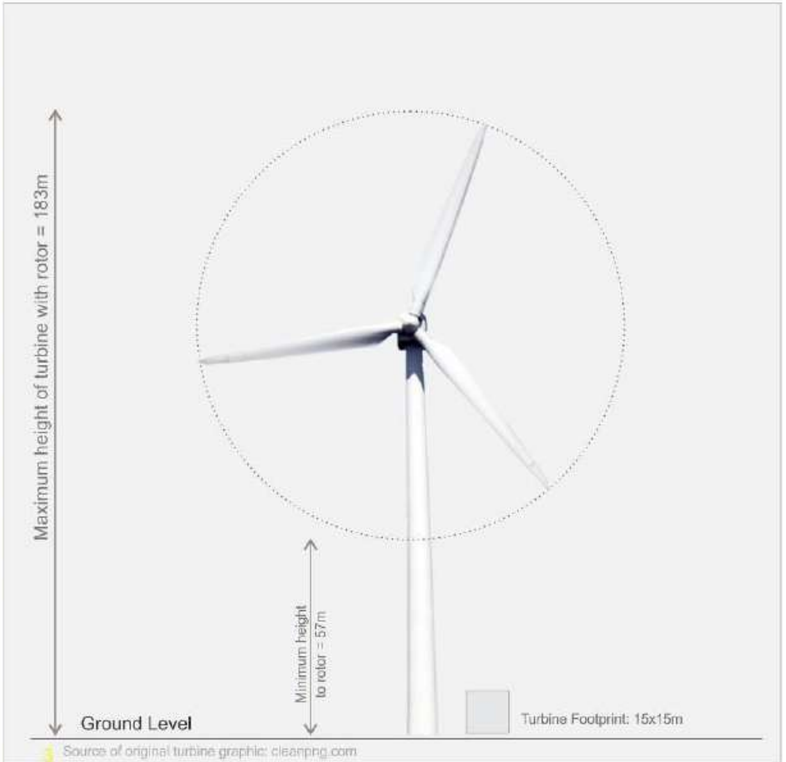
Visual exposure is determined by qualifying the visibility with a distance rating to indicate the degree of intrusion and visual acuity (see also Appendix A which illustrates this effect). Distance from a viewer to a viewed object or area of the landscape influences how visual changes are perceived in the landscape and the degree of contrast between an object and its surroundings. In general, visual impacts are greater when objects are seen at close range i.e. in foreground views up to 1,0km, and recedes rapidly beyond this distance as indicated in the charts in Figures 4-1 to 4-3. Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit with or disrupt/enhance the ecological and cultural aesthetic of the landscape as a whole?

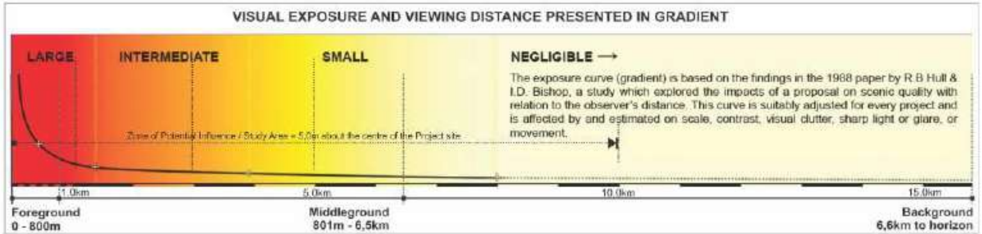
Visual exposure would be higher for the proposed amendment turbines from locations for which the turbines are visible as illustrated in the scaled elevations that approximate a view from a variety of distances from the viewer (refer to Figure 5). i.e. the turbines would not be closer to receptors, however, the proposed turbines would appear larger in the view frame relative to the approved turbines as indicated in Figures 3 and 5.

Receptors would experience this change in the middle ground and background of views along the R315 road (i.e. the closest turbine for be over 1km away) resulting in moderate exposure. For all other sensitive receptor locations, they would appear in background views i.e. over 5km from the viewer. The result is *low* visual exposure and intrusion for the amendment proposal versus the approved project.

Research also indicates that although visual exposure would increase with the ‘decrease in the number of turbines by about 40% and the increase of installed capacity of 20% will not add to the comparative impact in general’ (Möller, B. 2006:1).







Note:
The viewshed analyses are presented first for each of the options, and then as a comparative analysis between the visibility of the Approved Option (i.e. 35 wind turbines at a maximum height of 183m) and the visibility of the Proposed Options (i.e. 33 wind turbines at a maximum height of 215m).

SPECIFICATIONS:

Capacity: 129 MW for the project

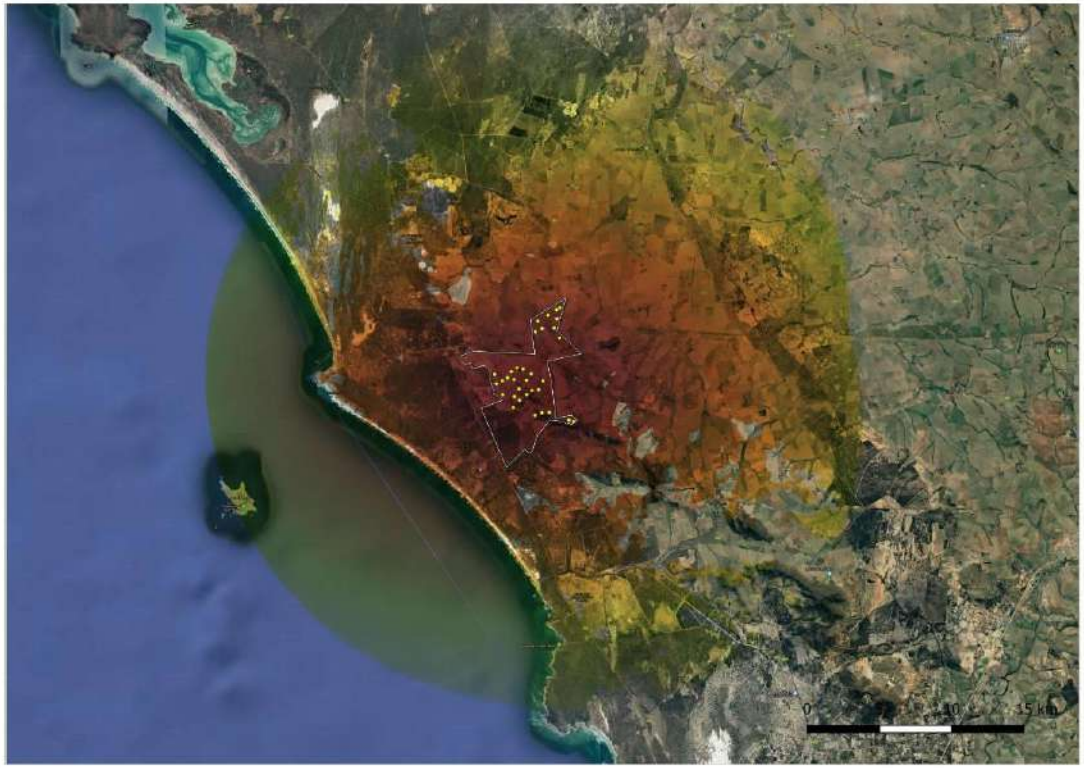
Number of Turbines: 35

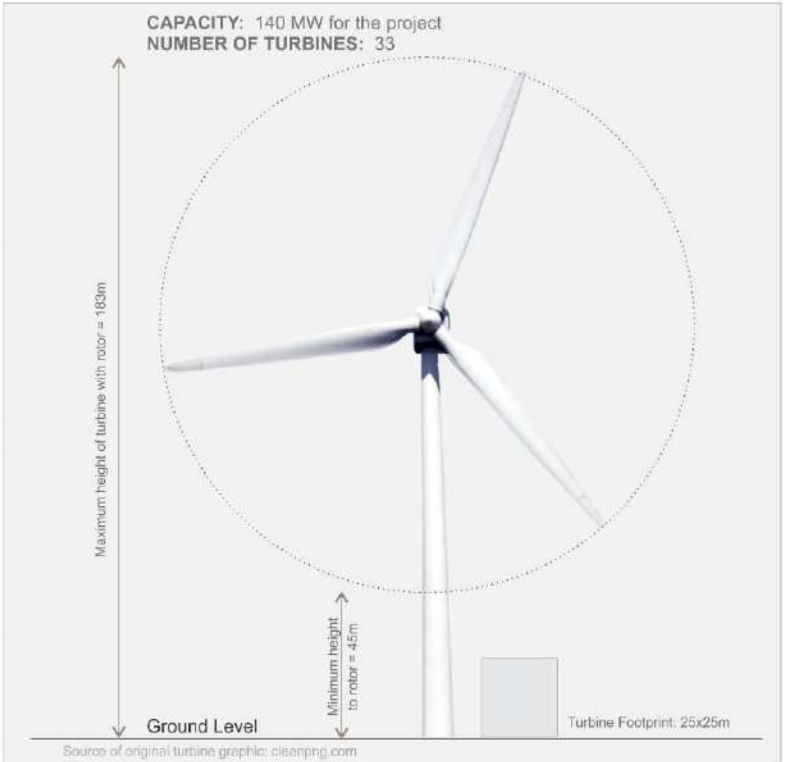
Hub Height: 120m

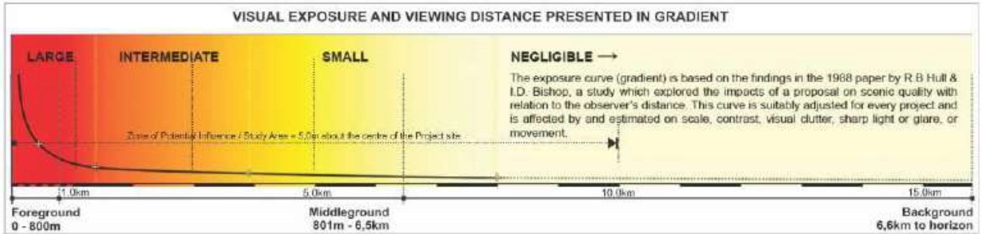
Rotor Diameter: 126m

Maximum Height: 183m

Figure 4-1: VIEWSHED ANALYSIS - APPROVED OPTION







Note:
The viewshed analyses are presented first for each of the options, and then as a comparative analysis between the visibility of the Approved Option (i.e. 35 wind turbines at a maximum height of 183m) and the visibility of the Proposed Options (i.e. 33 wind turbines at a maximum height of 215m).

SPECIFICATIONS:

Capacity: 140 MW for the project

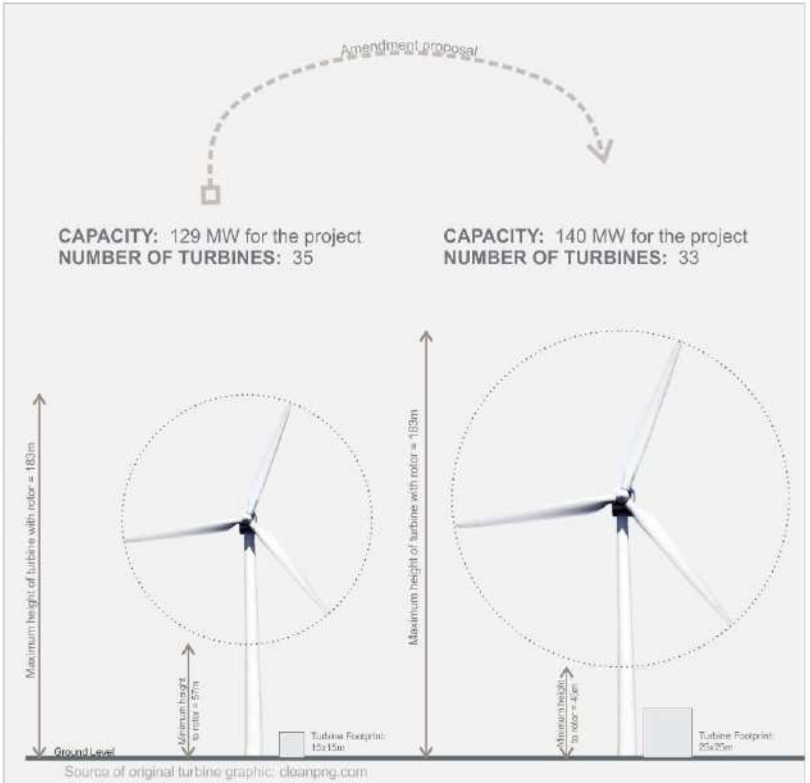
Number of Turbines: 33

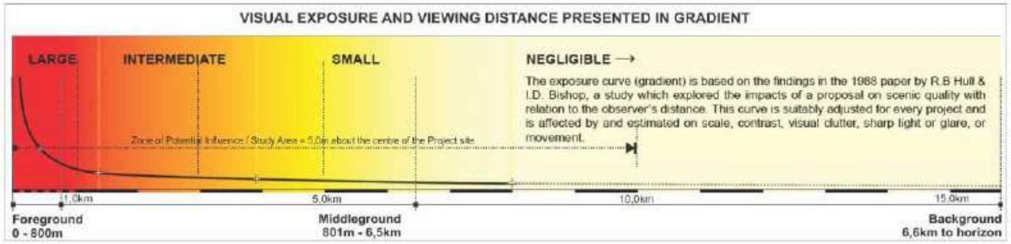
Hub Height: 130m

Rotor Diameter: 170m

Maximum Height: 215m

Figure 4-2: VIEWSHED ANALYSIS - AMENDMENT OPTION





Note:

The viewshed analyses are presented first for each of the options, and then as a comparative analysis between the visibility of the Approved Option (i.e. 35 wind turbines at a maximum height of 183m) and the visibility of the Proposed Options (i.e. 33 wind turbines at a maximum height of 215m).

NOTES:

Two turbines (no. 32 anad 33), in south west corner, have been eliminated, and turbine no. 14 has been moved north west of its original position. Refer also to Figure 3.

All other locations remain the same or have moved slightly (i.e. no more that 100m from the original approved location).

Pink areas = increased visibility

Figure 4-3: VIEWSHED ANALYSIS - COMPARATIVE ANALYSIS

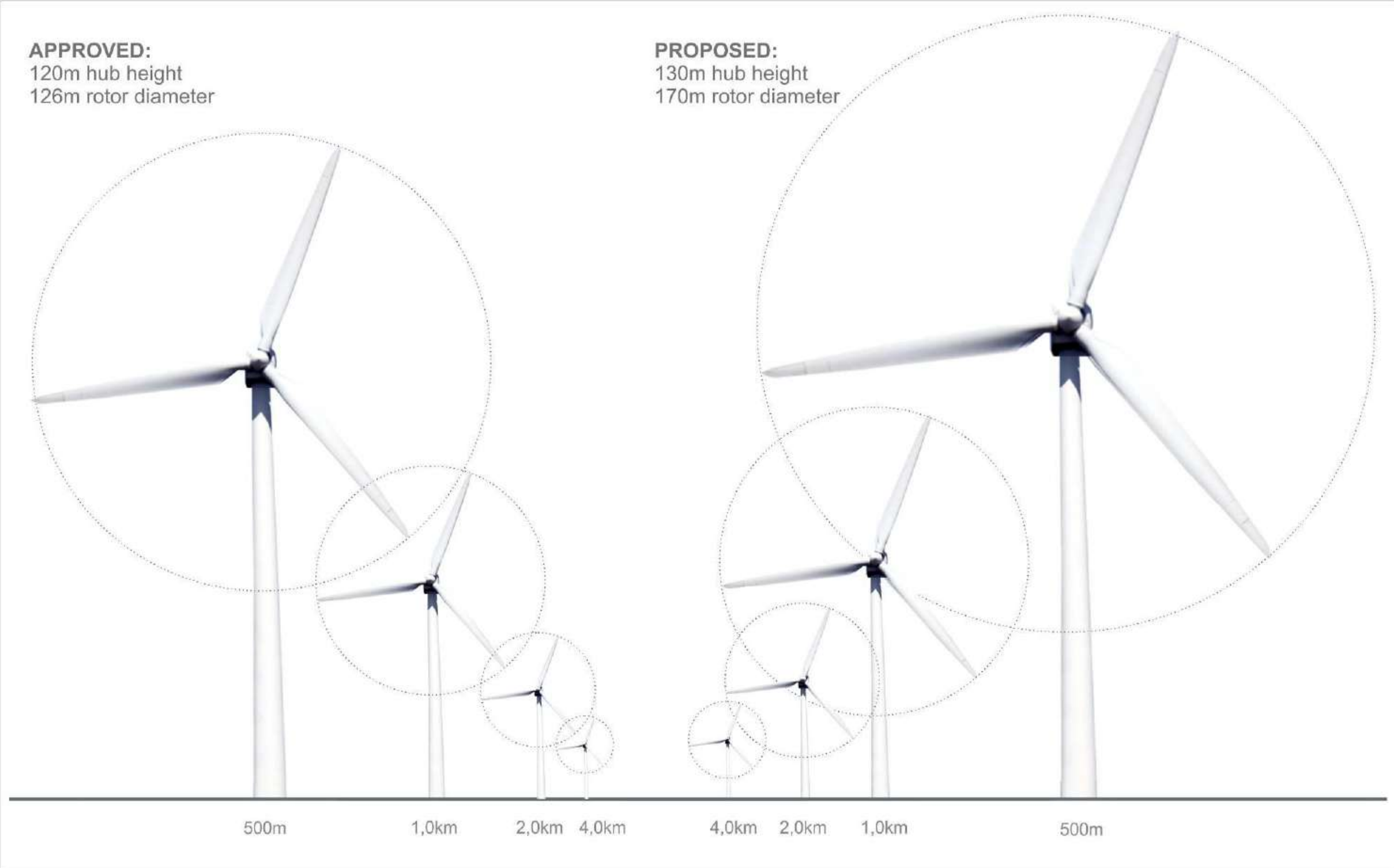


Figure 5: COMPARISON OF TURBINE SIZES_Visual Exposure

4.3 Magnitude of Impact

Referring to discussions in Section 4.2 and using the criteria listed in Appendix B, the *magnitude* of visual impact, of the amended proposal when compared with the approved project turbines and layout, is rated in Table 1 below. In synthesizing the criteria a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgment (LI-IEMA 2013).

According to the results tabulated below in Table 1, the magnitude of visual impact and the changes in landscape characteristics and receptor sensitivities, of the amended wind energy infrastructure, will be *low* relative to the approved project (baseline).

Table 1: *Magnitude* of impact of the proposed amendments versus the approved project

High	**Moderate**	**Low** For the Amended Project	**Negligible**
A major loss of or alteration to key elements/features/ characteristics of the baseline in the immediate vicinity of the site. i.e. Pre-development landscape or view and/or introduction of elements considered to be uncharacteristic when set within the attributes of the receiving landscape. **High scenic quality impacts would result.**	A partial loss of or alteration to key elements/features/ characteristics of the baseline. i.e. Pre-development landscape or view and/or introduction of elements that may be prominent but may not necessarily be substantially problematic when set within the attributes of the receiving landscape. **Moderate scenic quality impacts would result**	A minor loss of or alteration to key elements/features/ characteristics of the baseline. i.e. Pre-development landscape or view and/or introduction of elements that may not be problematic when set within the attributes of the receiving landscape. **Low scenic quality impacts would result.**	A very minor loss or alteration to key elements/features/characteristics of the baseline. i.e. Pre-development landscape or view and/or introduction of elements that is not problematic with the surrounding landscape – approximating the 'no change' situation. **Negligible scenic quality impacts would result.**

5. CONCLUSION

The Rheboksfontein wind energy facility was issued with Environmental Authorisation (EA) on 02 February 2012. An application for amendment to the EA was granted on 28 May 2015 (DEA Reference: 12/12/20/1582/AM2), allowing Moyeng Energy (PTY) Ltd (Moyeng Energy) to construct 35 wind turbines with a total generating capacity of 129MW. Moyeng Energy now wishes to apply for a further amendment that would increase the generating capacity of the facility to 140MW, resulting in the removal of two turbines but an increase in hub height and rotor diameter of the remaining 33 turbines.

The proposed amendments would slightly increase the visibility of the project and its visual exposure. These changes, however, would have a minor negative effect when compared to the approved facility. A *low* magnitude and significance of change in the visual characteristics of the study area is predicted[3]. Mitigation measures as per the original VIA report must be upheld.

Author's Opinion

It is concluded that the potential losses of scenic resources are not sufficiently significant to prevent authorization of the proposed amendments to the project. It is therefore the opinion of the author that all aspects of the amended Project, from a potential visual impact perspective, should be approved provided that the mitigation/management measures contained in the original 2010 VIA report, are effectively implemented, managed, and monitored in the long term.

***** NLA *****

[3] i.e. A Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Sporadic complaints could be expected.

Amir, S. & Gidalizon, E. 1990. Expert-based method for the evaluation of visual absorption capacity of the landscape. *Journal of Environmental Management.* Vol. 30, Issue 3: 251 – 263.

Crawford, D., 1994. Using remotely sensed data in landscape visual quality assessment. *Landscape and Urban Planning.* 30: 71-81

Landscape Institute – Institute of Environmental Management and Assessment (LI-IEMA), 2013. *Guidelines for Landscape & Visual Impact Assessment*. 3rd Edition, Routledge, London.

MetroGIS (Pty) Ltd. September 2010, *Proposed Rheboksfontein wind Energy Facility Visual Impact Assessment.* Unpublished Report. La Montagne.

Möller, B. Changing wind-power landscapes: regional assessment of visual impact on land use and population in Northern Jutland, Denmark. *Applied Energy.* Vol 83, Issue 5, 2006 (sourced from: http://www.sciencedirect.com/scinece/article/pii/S0306261905000565)

Oberholzer, B., 2005. Guideline for involving visual & aesthetic specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

A visual impact study analysis addresses the importance of the inherent aesthetics of the landscape, the public value of viewing the natural landscape, and the contrast or change in the landscape from the project.

For some topics, such as water or air quality, it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. The assessment of likely effects on a landscape resource and on visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations. (The Landscape Institute with the Institute of Environmental Management and Assessment (2002).

Landscape impact assessment includes a combination of objective and subjective judgements, and it is therefore important that a structured and consistent approach is used. It is necessary to differentiate between judgements that involve a degree of subjective opinion (as in the assessment of landscape value) from those that are normally more objective and quantifiable (as in the determination of magnitude of change). Judgement should always be based on training and experience and be supported by clear evidence and reasoned argument. Accordingly, suitably qualified and experienced landscape professionals carry out landscape and visual impact assessments (The Landscape Institute with the Institute of Environmental Management and Assessment (2002),

Landscape and visual assessments are separate, although linked, procedures. The landscape baseline, its analysis and the assessment of landscape effects all contribute to the baseline for visual assessment studies. The assessment of the potential effect on the landscape is carried our as an effect on an environmental resource, i.e. the landscape. Visual effects are assessed as one of the interrelated effects on population.

Landscape Impact

Landscape impacts derive from changes in the physical landscape, which may give rise to changes in its character and from effects to the scenic values of the landscape. This may in turn affect the perceived value ascribed to the landscape. The description and analysis of effects on a landscape resource relies on the adOption of certain basic principles about the positive (or beneficial) and negative (or adverse) effects of change in the landscape. Due to the inherently dynamic nature of the landscape, change arising from a development may not necessarily be significant (Institute of Environmental Assessment & The Landscape Institute (2002)).

Visual Impact

Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the area.

To assess the magnitude of visual impact four main factors are considered.

Visual Intrusion:	The nature of intrusion or contrast (physical characteristics) of a project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use.
Visibility:	The area/points from which project components will be visible.
Visual exposure:	Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion.
Sensitivity:	Sensitivity of visual receptors to the proposed development

Visual Intrusion / contrast

Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit into the ecological and cultural aesthetic of the landscape as a whole? Or conversely what is its contrast with the receiving environment. Combining landform / vegetation contrast with structure contrast derives overall visual intrusion/contrast levels of high, moderate, and low.

Landform / vegetation contrast is the change in vegetation cover and patterns that would result from construction activities. Landform contrast is the change in landforms, exposure of soils, potential for erosion scars, slumping, and other physical disturbances that would be noticed as uncharacteristic in the natural landscape. Structure contrast examines the compatibility of the proposed development with other structures in the landscape and the existing natural landscape. Structure contrast is typically strongest where there are no other structures (e.g., buildings, existing utilities) in the landscape setting.

Photographic panoramas from key viewpoints before and after development are presented to illustrate the nature and change (contrast) to the landscape created by the proposed development. A computer simulation technique is employed to superimpose a graphic of the development onto the panorama. The extent to which the component fits or contrasts with the landscape setting can then be assessed using the following criteria.

- Does the physical development concept have a negative, positive, or neutral effect on the quality of the landscape?
- Does the development enhance or contrast with the patterns or elements that define the structure of the landscape?
- Does the design of the project enhance and promote cultural continuity, or does it disrupt it?

The consequence of the intrusion / contrast can then be measured in terms of the sensitivity of the affected landscape and visual resource given the criteria listed below. For instance, within an industrial area, a new sewage treatment works may have an insignificant landscape and visual impact; whereas in a *valued* landscape it might be considered to be an intrusive element. (Institute of Environmental Assessment & The landscape Institute (1996)).

Visual Intrusion

High	Moderate	Low	Positive
If the project: - Has a substantial negative effect on the visual quality of the landscape. - Contrasts dramatically with the patterns or elements that define the structure of the landscape. - Contrasts dramatically with land use, settlement, or enclosure patterns. - Is unable to be 'absorbed' into the landscape.	If the project: - Has a moderate negative effect on the visual quality of the landscape. - Contrasts moderately with the patterns or elements that define the structure of the landscape. - Is partially compatible with land use, settlement, or enclosure patterns. - Is partially 'absorbed' into the landscape.	If the project: - Has a minimal effect on the visual quality of the landscape. - Contrasts minimally with the patterns or elements that define the structure of the landscape. - Is mostly compatible with land use, settlement, or enclosure patterns. - Is 'absorbed' into the landscape.	If the project: - Has a beneficial effect on the visual quality of the landscape. - Enhances the patterns or elements that define the structure of the landscape. - Is compatible with land use, settlement, or enclosure patterns.

Result	*Result*	*Result*	*Result*
Notable change in landscape characteristics over an extensive area and/or intensive change over a localized area resulting in major changes in key views.	Moderate change in landscape characteristics over localized area resulting in a moderate change to key views.	Imperceptible change resulting in a minor change to key views.	Positive change in key views.

Visual intrusion also diminishes with scenes of higher complexity, as distance increases, the object becomes less of a focal point (more visual distraction), and the observer's attention is diverted by the complexity of the scene (Hull and Bishop (1988)).

Visibility

A viewshed analysis was carried out to define areas, which contain all possible observation sites from which the development would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1.8m above ground level. Topographic data was captured for the site and its environs at 10 m contour intervals to create the Digital Terrain Model (DTM). The DTM includes features such as vegetation, rivers, roads and nearby urban areas. These features were 'draped' over the topographic data to complete the model used to generate the viewshed analysis. It should be noted that viewshed analyses are not absolute indicators of the level of significance (magnitude) of the impact in the view, but merely a statement of the fact of potential visibility. The visibility of a development and its contribution to visual impact is predicted using the criteria listed below:

Visibility

High	Moderate	Low
Visual Receptors If the development is visible from over half the zone of potential influence, and/or views are mostly unobstructed and/or the majority of viewers are affected.	*Visual Receptors* If the development is visible from less than half the zone of potential influence, and/or views are partially obstructed and or many viewers are affected	*Visual Receptors* If the development is visible from less than a quarter of the zone of potential influence, and/or views are mostly obstructed and/or few viewers are affected.

Visual Exposure

Visual exposure relates directly to the distance of the view. It is a criterion used to account for the limiting effect of increased distance on visual impact. The impact of an object in the foreground (0 – 800m) is greater than the impact of that same object in the middle ground (800m – 5.0 km) which, in turn is greater than the impact of the object in the background (greater than 5.0 km) of a particular scene.

Distance from a viewer to a viewed object or area of the landscape influences how visual changes are perceived in the landscape. Generally, changes in form, line, colour, and texture in the landscape become less perceptible with increasing distance.

Areas seen from 0 to 800m are considered foreground; foliage and fine textural details of vegetation are normally perceptible within this zone.

Areas seen from 800m to 5.0km are considered middle ground; vegetation appears as outlines or patterns.

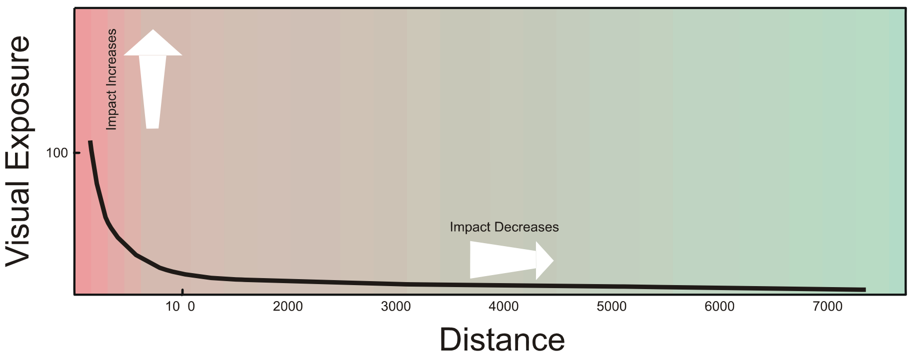
Depending on topography and vegetation, middle ground is sometimes considered to be up to 8.0km.

Areas seen from 5.0km to 8.0km and sometimes up to 16km and beyond are considered background. Landforms become the most dominant element at these distances.

Seldom seen areas are those portions of the landscape that, due to topographic relief or vegetation, are screened from the viewpoint or are beyond 16km from the viewpoint. Landforms become the most dominant element at these distances.

The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. Thus, the visual impact at 1000 m would be 25% of the impact as viewed from 500 m. At 2000 m it would be 10% of the impact at 500 m. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (e.g.: Hull and Bishop (1988)) and is used as an important criteria for the study. This principle is illustrated in the Figures below.

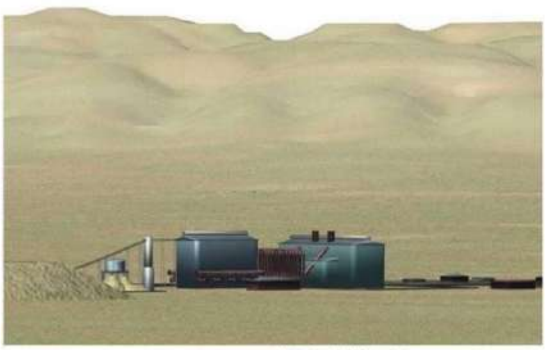
Effect of Distance on Visual Exposure




View from 10 000 metres


View from 5 000 metres


View from 3 000 metres


View from 1 000 metres

Sensitivity of Visual Receptors

When visual intrusion, visibility and visual exposure are incorporated, and qualified by sensitivity criteria (visual receptors) the magnitude of the impact of the development can be determined.

The sensitivity of visual receptors and views will be depended on:

- The location and context of the viewpoint.
- The expectations and occupation or activity of the receptor.
- The importance of the view (which may be determined with respect to is popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art).

The most sensitive receptors may include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape.
- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community.
- Occupiers of residential properties with views affected by the development.
- These would all be high

Other receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value).
- People travelling through or past the affected landscape in cars, on trains or other transport routes.
- People at their place of work.

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

In this process more weight is usually given to changes in the view or visual amenity which are greater in scale, and visible over a wide area. In assessing the effect on views, consideration should be given to the effectiveness of mitigation measures, particularly where planting is proposed for screening purposes (Institute of Environmental Assessment & The Landscape Institute (1996).

Sensitivity of Visual Receptors

High	Moderate	Low
Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape.	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value).	The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view (i.e. office and industrial areas).
Communities where the development results in changes in the landscape setting or valued views enjoyed by the community.	People travelling through or past the affected landscape in cars, on trains or other transport routes.	
Occupiers of residential properties		Roads going through urban and industrial areas

with views affected by the development.

Intensity of the Visual Impact

Potential visual impacts are determined by analysing how the physical change in the landscape, resulting from the introduction of a project, are viewed and perceived from sensitive viewpoints. Impacts to views are the highest when viewers are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the change. Visual impacts occur when changes in the landscape are noticeable to viewers looking at the landscape from their homes or from parks, and conservation areas, highways and travel routes, and important cultural features and historic sites, especially in foreground views.

The magnitude of impact is assessed through a synthesis of visual intrusion, visibility, visual exposure and viewer sensitivity criteria. Once the magnitude of impact has been established this value is further qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact.

For instance, the fact that visual intrusion and exposure diminishes significantly with distance does not necessarily imply that the relatively small impact that exists at greater distances is unimportant. The level of impact that people consider acceptable may be dependent upon the purpose they have in viewing the landscape. A particular development may be unacceptable to a hiker seeking a natural experience, or a household whose view is impaired, but may be barely noticed by a golfer concentrating on his game or a commuter trying to get to work on time (Ittleson *et al.,* 1974).

In synthesising these criteria a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement. (Institute of Environmental Assessment and The landscape Institute (1996)).

Intensity (Magnitude) of Visual Impact

High	Moderate	Low	Negligible
Total loss of or major alteration to key elements/features/characteristics of the baseline.	Partial loss of or alteration to key elements/features/characteristics of the baseline.	Minor loss of or alteration to key elements/features/characteristics of the baseline.	Very minor loss or alteration to key elements/features/characteristics of the baseline.
I.e. Pre-development landscape or view and/or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that may be prominent but may not necessarily be substantially uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view an/or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that are not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.

High scenic quality impacts would result.	Moderate scenic quality impacts would result	Low scenic quality impacts would result.	Negligible scenic quality impacts would result.

Cumulative effects

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility (visibility) of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The landscape Institute (1996)).

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Graham is a registered landscape architect with interest and experience in landscape architecture, urban design, and environmental planning. He holds a degree in landscape architecture from the University of Toronto and has practiced in Canada and Africa, where he has spent most of his working life. He has served as President of the Institute of Landscape Architects of South Africa (ILASA) and as Vice President of the Board of Control for Landscape Architects.

During his 30 years plus career he has received numerous ILASA and other industry awards. He has published widely on landscape architectural issues and has had projects published both locally and internationally in, scientific and design journals and books. He was a being a founding member of Newtown Landscape Architects and is also a senior lecturer, teaching landscape architecture and urban design at post and undergraduate levels, at the University of Pretoria. He has been a visiting studio critic at the University of Witwatersrand and University of Cape Town and in 2011 was invited to the University of Rhode Island, USA as their Distinguished International Scholar for that year. Recently, Graham resigned from NLA and now practices as a Sole Proprietor.

A niche specialty of his is Visual Impact Assessment for which he was cited with an ILASA Merit Award in 1999. He has completed over 250 specialist reports for projects in South Africa, Canada and other African countries. He was on the panel that developed the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* (2005) and produced a research document for Eskom, *The Visual Impacts of Power Lines* (2009). In 2011, he produced '*Guidelines for involving visual and aesthetic specialists'* for the Aapravasi Ghat Trust Fund Technical Committee (they manage a World Heritage Site) along with the *Visual Impact Assessment Training Module Guideline Document.*

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