GEOLOGICAL REPORT

SPECIALIST INPUT FOR THE SCOPING PHASE OF THE ENVIRONMENTAL IMPACT ASSESSMENT

PROPOSED OYSTER BAY WIND ENERGY FACILITY ON A SITE NEAR OYSTER BAY, EASTERN CAPE PROVINCE

Technical Report No: OGS2010-11-11-1

NOVEMBER 2010

PREPARED BY:

OUTENIQUA
GEOTECHNICAL SERVICES | CIVIL LABORATORIES
26 Cove St.
Knysna
T: 044 382 0502
Mirrorball St.
George
T: 044 874 3274
PO BOX 3186, GEORGE INDUSTRIA, 6536
www.outeniqualab.co.za

PREPARED FOR:

SAVANNAH ENVIRONMENTAL (PTY) LTD
PO BOX 148
SUNNINGHILL
2157

Savannah
ENVIRONMENTAL (PTY) LTD

List of abbreviations and definitions

AMSL:	Above mean sea level
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
Ma:	Million years
Quaternary:	The geological period from 2Ma to present
Study area:	The area as delineated on **Figure 1**
WEF:	Wind Energy Facility

1. INTRODUCTION

1.1. Background

Renewable Energy Systems (RES) Southern Africa is in the process of investigating the feasibility of a proposed Wind Energy Facility (WEF) on a site near Oyster Bay in the Eastern Cape Province. The proposed activity is defined as the establishment of a WEF and associated infrastructure, including the following:

- Up to 50 wind turbines of 3MW or 80 turbines of 1.8MW and concrete foundations to support them;
- Cabling between foundations;
- A substation;
- A 132/66kV power line/s linking to the transmission grid;
- Access roads;
- Workshop buildings for maintenance and control.

1.2. Terms of reference

Savannah Environmental (Pty) Ltd has been appointed by RES to undertake the EIA process for the proposed activity. As part of the Scoping Phase, specialist geological input is required in order to identify potential environmental impacts on the geology and soil within the study area, with particular focus on erosion potential. Savannah Environmental has appointed Outeniqua Geotechnical Services to conduct a specialist geological report for the Scoping Phase.

The following broad scope of work has been given:

- Carry out a desk-top study of available information pertaining to the geology, soil types and physical aspects of the study area;
- Prepare a brief report which describes the location, physical characteristics and geology of the study area and identifies potential environmental impacts on the geological environment that are likely to be associated with the proposed activity.

1.3. Limitations

Information provided in this specialist report has been based on information provided by the developer, published scientific literature and maps. The study area was not visited and no detailed geotechnical investigation (trial pits, soil testing) or verification of the existing geological mapping was conducted. The information provided in this report is deemed adequate for the Scoping Phase of the EIA process.

1.4. Authors credentials & declaration of independence

The author of this report, Iain Paton of Outeniqua Geotechnical Services cc (OGS), is an professional engineering geologist registered with the South African Council for Natural and Scientific Professions (Pr Sci Nat # 400236/07) with 12 years experience in the construction, mining and petroleum industries and a member of the South African Institute of Engineering and

Environmental Geologists (SAIEG). OGS shareholders and employees have no vested interest in the proposed activity and will not engage in conflicting activity associated with the project.

2. SITE DESCRIPTION

2.1. Location

The study area is located 5km north of Oyster Bay, on the following farms:

- Kruisfontein 681 Portions 10 and 12;
- Rebok Rant 715 Portions 1, 2, 3, 4, 5 and Remainder;
- Klein River 713 Portion 3;
- Ou Werf 738 Portions 1 and 3;
- Klippedrift 732 Portion 5.

The study area is accessed via the N2 between Port Elizabeth and Plettenberg Bay, the R102 via Humansdorp and gravel roads to Oyster Bay (see **Figure 1**). Access to site can also be from the west, mainly on gravel / dirt track roads approaching the site.

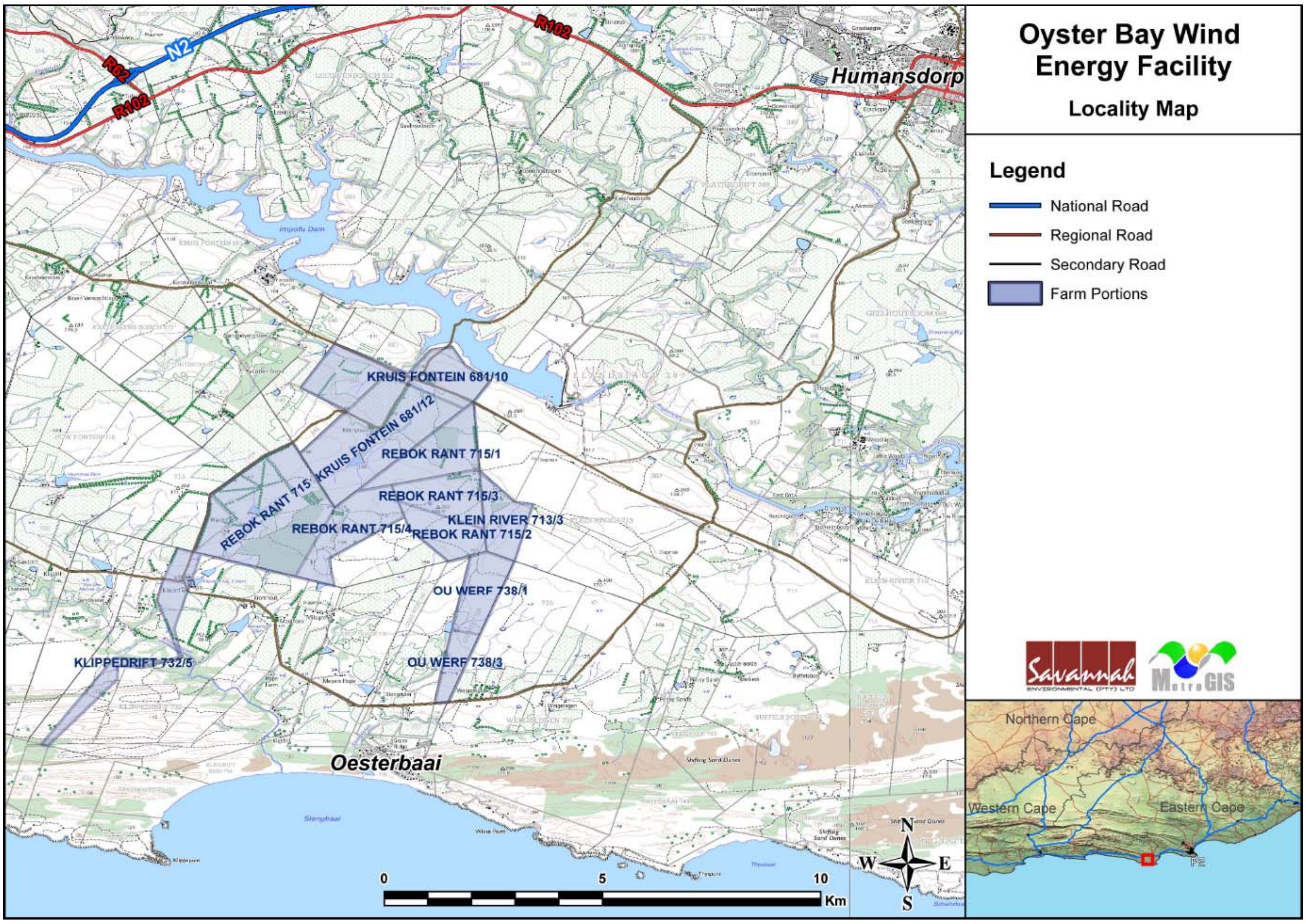

Figure 1: Locality and topography map of study area (blue shaded farm portions)

2.2. Topography, climate & vegetation cover

The study area is located on hilly terrain ranging in altitude from 60 to 190m AMSL. The majority of the study area lies between the Krom River and Klipdrif Rivers with only a small portion extending south-westwards across the Klipdrif River (See **Figure 2**).

The Köppen-Geiger Climate Map indicates that this area falls within the marine temperate climatic region of South Africa which is characterised by frontal weather, leading to changeable, often overcast and moderate conditions. Seasonal variation in temperatures is generally mild, but snow can occur at high altitudes on the mountain ranges to the north of the study area. Midday temperatures typically range between 15 and 25°C and mean annual precipitation between 1900 and 1973 is 686mm.[2] The Weinert Climatic N-number[7] for the area, which is approximately 2, indicates that the climate is semi-humid and chemical weathering processes is dominant.

The indigenous vegetation on the site has been highly altered for agricultural purposes and presently consists of croplands and grazing.

Figure 2: Aerial photo of the study area (black lines) with 20m contours (white)

2.3. Geology & soil types

The majority of the study area is underlain by Table Mountain Group rocks of the Cape Supergroup (Ordovician to Silurian age ~ 500-395Ma) which are unconformably overlain in the southwest portion of the study area by Nanaga Formation aeolian sands and aeolianite of Tertiary-Quaternary age (<65Ma)[9]. The geological sequence of the Table Mountain Group exposed in the study area consists of the basal Peninsula Formation quartzites, successively overlain by Cederberg Formation shales, Goudini Formation sandstone, Skurweberg Formation quartzites, and Baviaanskloof Formation sandstones.

The Table Mountain Group rocks are folded along a northwest-southeast trending anticline which plunges southeast, thus exposing a mirror image sequence of formations on either side of the axial plane. The rocks dip between 35 and 80°. This folding is a result of compressional deformation during the Permo-Triassic collision of the Pan-African and African plates. Subsequent tensional forces during the Jurassic-Cretaceous breakup of Gondwana produced significant normal faulting in the Cape Supergroup, producing several large half-grabens into which Cretaceous sediments were deposited (i.e. Uitenhage Group). There are no significant geological faults in the immediate vicinity of the study area and the region is considered to be seismically stable.

Hard quartzite rock outcrops and gravelly soils are likely to occur in areas underlain by Peninsula and Skurweberg Formations. Slightly softer sandstone with clayey, sandy and gravelly soil overburden are expected in areas underlain by Goudini and Baviaanskloof Formations. Relatively soft shale and clayey and gravelly soil is expected in minor areas underlain by Cederberg Formation. The Nanaga Formation, which occurs in the far southwest portion of the study area (across the Klipdrif River), consists of unconsolidated to semi-consolidated sands of several meters thick.

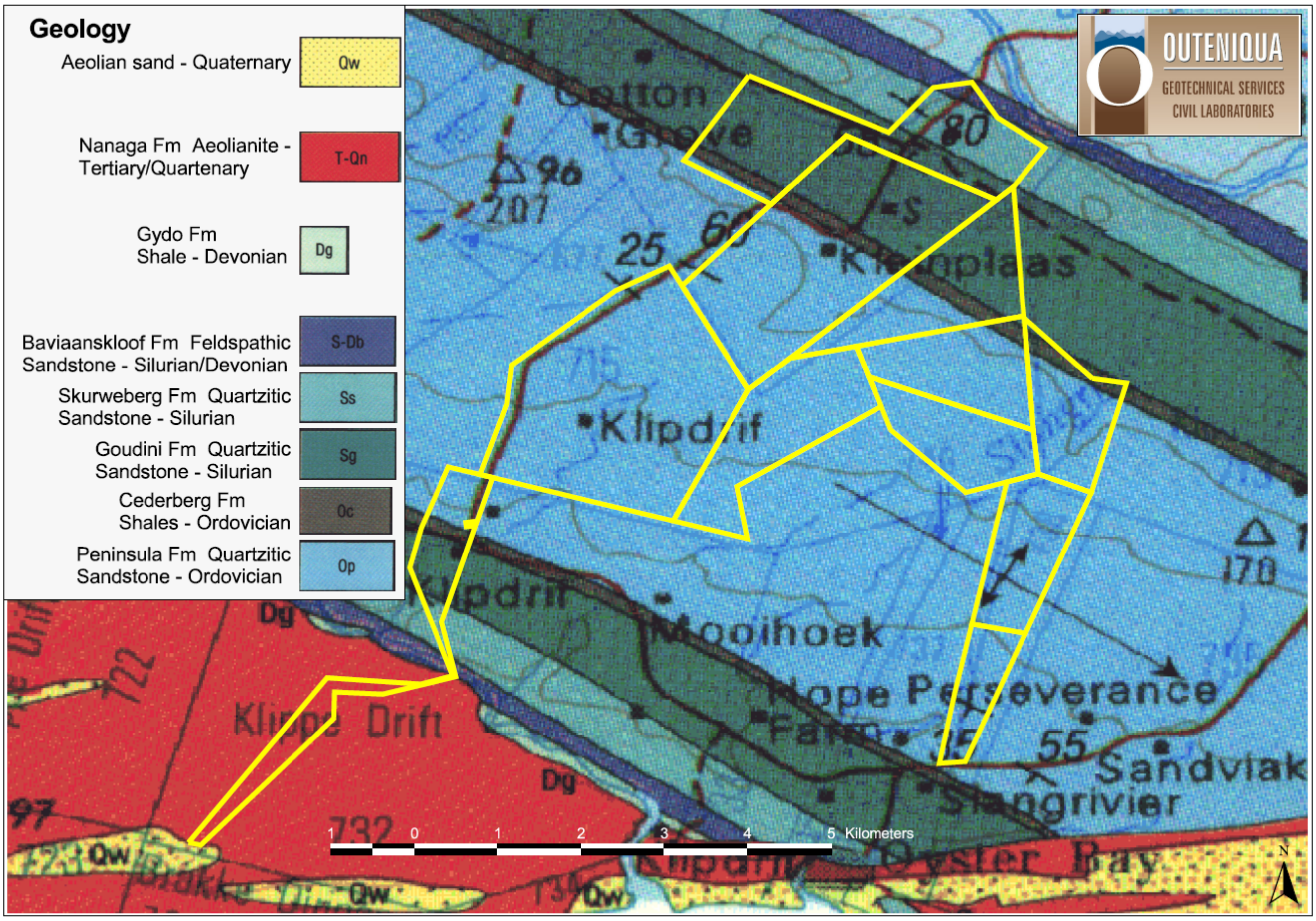

Figure 3: Geology of the study area.

2.4. Hydrology

The study area drains into tributaries of the Klipdrif and Krom Rivers. Rainfall infiltration rates are likely to be low due to the presence of rock outcrops, shallow rock or low permeability soils and a significant percentage of rainfall will end up as surface run-off. The presence of well-defined drainage lines are an indication of significant surface drainage. The amount of surface run-off has implications for water erosion potential.

3. GEOLOGICAL SCOPING ASSESSMENT

The proposed activity may have certain impacts on the geological environment, and this needs to be assessed as an integral part of the broader EIA study. The geological environment includes the parent rock and the soil overburden. Important or prominent geological features (geosites) that contribute to the aesthetic scenery or geological interest in the area, such as fossil sites, prominent rock outcrops or features, must also be considered in the impact study. Geological features, such as caves, addits, middens, worship rocks, etc. which are important from historical, cultural, archaeological or religious heritage standpoint are not covered in this report as they are covered in the Heritage Impact Assessment. Geohydrological assessments also do not form part of this study.

3.1. Geo-sites

There are no known important or interesting geological phenomena that need to be addressed.

3.2. Rock degradation

Small scale road cuttings into rock are anticipated due to the hilly terrain but there are no large-scale or deep excavations such as quarries planned and thus there are no significant negative impacts associated with rock degradation.

3.3. Soil degradation

Soil degradation is the removal, alteration or damage to soil and soil-forming processes which can be due to natural processes, such as erosion, or human influence during construction activity. The preservation of the natural soil is important to maintain environmental *status quo*.

Potential negative impacts relating to soil degradation are anticipated for the proposed activity. Such impacts include excavation, displacement or importation of soil, stockpiling, mixing, wetting, compaction and pollution of soil, soil erosion and sedimentation of watercourses and storage dams.

Soil erosion is the process of the lowering of the natural ground level by wind or water and may occur as a result of, *inter alia*, chemical processes and/or physical transport on the land surface[1]. Erosion sensitivity is the likelihood that erosion will occur when soils are exposed to water (and/or wind) during or as a result of land-disturbing activities. Erosion sensitivity is higher in areas underlain by thick accumulations of unconsolidated, fine-grained soils of low-plasticity occur, such as colluvium or topsoil and Quaternary sand deposits such as the Nanaga Formation (see **Figure 3**). Erosion sensitivity is higher on steep slopes or at the base of steep slopes where hydraulic energy of run-off is higher. The Erosion Index for South Africa[1] indicates that the site is located within an area that is ranked between 11 and 15 on a scale from 1 (highest potential) to 19 (lowest). This means that the erosion sensitivity is moderate to low. This indication is primarily based on terrain and geology.

No severe water erosion features are mapped on the 1:50 000 topography maps or are visible on the aerial photographs. However, moderate levels of erosion can be expected along drainage lines.

It is estimated that 90% of the study area is underlain by soils with a low to moderate sensitivity to erosion. **Table 1** provides a summary of the expected erosion sensitivity of the different facets of the study area. A more detailed site investigation (to be undertaken during the EIA phase of the project) will provide more accurate information which will facilitate the identification of areas where severe erosion has taken place or is likely to take place.

Erosion sensitivity level	Land facet, terrain unit or geological formation	Comments
High	Drainage lines	No go areas apart from road crossings
Moderate-high	Nanaga Formation	Special mitigating measures apply
Low-moderate	Rest of study area	Normal mitigating measures apply

Table 1: Erosion sensitivity

3.4. Preliminary assessment of potential impacts

The proposed activity will involve earthworks for foundations for structures (turbines, substations, workshops, etc.), access roads and underground services for electrical cabling.

The most important issues are the direct impacts of soil degradation and specifically, soil erosion from the area of activity.

The main direct potential impacts are identified and tabulated in **Table 2** below.

Impact:	Nature:	Extent:
Soil removal	Removal of soil due to excavations for foundations, underground services and access roads	Local
Soil alteration	Alteration of soil texture, density, structure and chemistry due to soil loosening, mixing, wetting, stockpiling and compaction	Local
Soil pollution	Pollution of *in situ* soil due to spillage of hazardous substances such as fuel, oil and cement	Local
Soil erosion	Loss of soil by water or wind erosion	Local

Table 2: Main direct impacts

Indirect potential impacts include increased deposition downstream (siltation) or downwind (dust) caused by accelerated water or wind erosion from the site.

The main indirect potential impacts are identified and tabulated in **Table 3** below.

Impact:	Nature:	Extent:
Siltation downstream/ dust downwind	Alteration of soil processes due to abnormal siltation arising from accelerated erosion	Regional

Table 3: Main indirect impacts

Other impacts may come to light as the study proceeds into the EIA phase.

The potential significance of the impacts that have been identified is likely to be low to moderate due to the localised extent of the activity within the study area and the low to moderate erosion potential. The limited scale of earthworks also generally points towards a short critical period where soils are loosened and exposed to erosion, and this can be managed successfully.

The vicinity of the study area is largely undeveloped and the impacts that this proposed development will contribute to the overall cumulative impact on soil degradation is considered to be low.

More in-depth analysis of these impacts should be carried with a site reconnaissance for the EIA phase of the project.

3.5. Mitigation of impacts

Construction activity will have negative impacts on the natural soil profile but this is generally restricted to the construction site footprint located within the boundary of the study area (only a portion of the study area will be utilised) and the activity within this footprint (the disturbance area) can be regulated to mitigate the impacts successfully. The following mitigation measures should be considered for the framework for the Environmental Management Plan (EMP):

- Construction activities should be kept to restricted areas and activities should be kept to a minimum as far as possible (limit unnecessary earthworks, double handling, etc.);
- Excavation processes should be monitored to prevent over-excavation and the correct placement of soil in controlled stockpiles (slope stability must be ensured);
- Rehabilitation of disturbed areas should be undertaken as soon as possible and properly monitored;
- Correct use of hazardous substances should be controlled;
- The wetting of soil and the discharge of construction grey water across natural soil should be controlled;
- Erosion control measures (e.g.: silt fences, sand bags, flow attenuation devices, etc.) should be installed where necessary and maintained;
- Where significant pedestrian and / or vehicular traffic is predicted during construction, such areas should be surfaced with a temporary gravel wearing course to reduce erosion of the *in situ* soil and to prevent dust;
- The handling of natural construction materials, such as filling soil and gravels will require dust management, particularly near sensitive areas;

- Rehabilitation will involve the replacement of suitable and adequate topsoil and the encouragement of indigenous local vegetation to stabilise the soil.

4. PLAN OF STUDY FOR EIA

The following methodology will be adopted for the EIA phase study:

- Conduct a site visit to confirm the physical and geological information used in this report and to collect visual information pertaining to the soil types and their geotechnical engineering properties;
- Assess the present state of erosion, identify critical areas in terms of erosion;
- Prepare a specialist report detailing the environmental issues and potential impacts pertaining to soil degradation and erosion;
- Assess the potential direct and indirect impacts using a weighting system that assigns a value to the categories (extent, duration, magnitude, probability) and arrives at a total which depicts the significance of the particular impact;
- Assess the contribution of the proposed activity in the cumulative impact of the development in the area;
- Comparatively assess any feasible alternatives (if any);
- Provide mitigating measures to input into the Environmental Management Programme (EMP).

5. CONCLUSIONS

The scoping level study has identified the geology of the site and expected soil types. The degradation of the natural soil, and specifically soil erosion, are the main environmental impacts that the proposed activity may have on the geological environment. The erodibility potential is considered to be low-moderate over most of the study area but high erosion sensitivity is anticipated along natural drainage lines where hydraulic energy is increased Moderate to high erosion sensitivity is anticipated in areas underlain by Nanaga Formation, which occurs on portion 5 of Farm Klippedrift 732. The implementation of effective mitigating measures can reduce the overall impact level to an acceptable level.

A visual assessment of the study area should be undertaken in the EIA phase to provide more accurate sensitivity mapping. Simultaneously, a basic geotechnical engineering assessment of the site should also be undertaken in the EIA phase to determine the constraints on the development which may affect the positioning of the infrastructure.

6. REFERENCES AND BIBLIOGRAPHY

1. National Department of Environmental Affairs (www.environment.gov.za).
2. South African Weather Service website (www.weathersa.co.za).
3. Department of Water Affairs website (www.dwaf.gov.za).
4. Brink, A.B.A. (1979) Engineering Geology of South Africa (Series 1-4). Building Publications, Pretoria.

5. Identification of Problematic Soils in Southern Africa (2007). Technical notes for civil and structural engineers. Published by the Department of Public Works.
6. Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria.
7. Wienert, H. H. (1980). The Natural Road Construction Materials of Southern Africa. H&R Academia Publ., Pretoria, 298pp.
8. SACS (1980). Stratigraphy of South Africa. Handbook 8, Geological Survey, Department of Mineral and Energy Affairs, Government Printer, 690pp.
9. 1:250 000 Geological map 3324 Port Elizabeth (1990). Council for Geoscience, Pretoria.