PROPOSED ZEN WIND ENERGY FACILITY & ASSOCIATED INFRASTRUCTURE ON A SITE NEAR SARON IN THE WESTERN CAPE PROVINCE

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

Submitted as part of the
Final Environmental Impact Assessment Report for submission to DEA
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PROJECT DETAILS

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DEFINITIONS AND TERMINOLOGY

Alien species: A species that is not indigenous to the area or out of its natural distribution range.

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process, or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Ambient sound level: 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 meter was put into operation.

Assessment: The process or collecting, organising, analysing, interpreting and communicating information which is relevant.

Biological diversity: The variables among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes they belong to.

Commence: The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

Cumulative impacts: Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

Cut-in speed: The minimum wind speed at which the wind turbine will generate usable power.

Cut-out speed: The wind speed at which shut down occurs.

Department: means the Department of Environmental Affairs.

Development footprint: in respect of land, means any evidence of its physical transformation as a result of the undertaking of any activity.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation, or maintenance of an activity and are generally obvious and quantifiable.

Disturbing noise: A noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more.

'Do nothing' alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Ecosystem: A dynamic system of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

Environment: the surroundings within which humans exist and that are made up of:
The land, water and atmosphere of the earth;
Micro-organisms, plant and animal life;
Any part or combination of (i) and (ii) and the interrelationships among and between them; and
The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental assessment practitioner: An individual responsible for the planning, management and coordinating of environmental management programme or any other appropriate environmental instruments introduced by legislation.

Environmental Impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management inspector: A person designated as an environmental management inspector in terms of section 31B or 31C on the National Environmental management Act 107 of 1998.

Environmental management programme: An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Generator: The generator is what converts the turning motion of a wind turbine's blades into electricity.

Habitat: The place in which a species or ecological community occurs naturally.

Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment (Van der Linde and Feris, 2010;pg 185).

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800

Indirect impacts: Indirect or induced changes that may occur because of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place because of the activity.

Interested and affected party: 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 public.

Nacelle: The nacelle contains the generator, control equipment, gearbox, and anemometer for monitoring the wind speed and direction.

Pollution: A change in the environment caused by substances (radio-active or other waves, noise, odours, dust or heat emitted from any activity, including the storage or treatment or waste or substances.

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare."

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Rotor: The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm).

Significant impact: An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

Tower: The tower, which supports the rotor, is constructed from tubular steel. It is approximately 80 m tall. The nacelle and the rotor are attached to the top of the tower. The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. Larger wind turbines are usually mounted on towers ranging from 40 to 100 m tall. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

Waste: Any substance, whether or not that substance can be reduced re-used, recycled and recovered; that is surplus, unwanted, rejected, discarded, abandoned or disposed of which the generator has no further use for the purposes of production. Any product which must be treated and disposed of, that is identified as waste by the minister of Environmental affairs (by notice in the Gazette) and includes waste generated by the mining, medical or other sectors, but: A by-product is not considered waste, and portion of waste, once re-used, recycled and recovered, ceases to be waste (Van der Linde and Feris, 2010; pg 186).

Wind power: A measure of the energy available in the wind.

Wind speed: The rate at which air flows past a point above the earth's surface.

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PROJECT DETAILS CHAPTER 1

1.1. Overview of the Proposed Project

Zen Wind Farm (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site near Saron located within the Drakenstein Local Municipality. The site identified for consideration within an Environmental Impact Assessment (EIA) lies approximately 6 km south of Saron, in the Western Cape Province. Up to 46 wind turbines are proposed to be constructed over a broader area of approximately ~3 542 ha in extent. The proposed facility would be known as the Zen Wind Energy Facility.

The site for the proposed Zen Wind Energy Facility falls within the Drakenstein Local Municipality in the Western Cape Province. The broader area (~3 542 ha in extent) includes the following farm portions (refer to Figure 1.1):

» Portion 1 of the farm Bonne Esperance 83
» Portion 2 of the farm Bonne Esperance 83
» Portion 9 of the farm No. 88
» Remainder of Portion 4 of the farm Kleinbergrivier No.1
» Remainder of the farm Moolenaars Drift No. 85
» Remainder of Portion 1 of the farm Moolenaars Drift No. 85

Depending on the final turbine selection, the estimated total installed capacity for the proposed facility is up to 140MW and will comprise of the following infrastructure:

» The site is proposed to accommodate up to 46 wind turbines. The facility would be operated as a single facility with each turbine being up to 3MW in capacity.
» Each wind turbine is expected to consist of a concrete foundation (20m x 20m x 4m), a steel tower, a hub (up to 110 above ground level, depending on the turbine size decided upon) and three blades.
» Internal/ access roads (up to 6m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be utilised and upgraded.
» Workshop area / office for control, maintenance and storage (approximately 100m x 100m).
» An on-site substation (200 m x 200 m) to facilitate grid connection.
» A new 132 kV power line (up to 6.5 km in length) via a direct connection to the LeBonne Substation or a loop in and loop out connection to the LeBonne-Gouda power line which is located on the Farm LeBonne Esperance (adjacent to the Zen Wind Farm site). Two power line route alternatives were assessed in the EIA.

The layout of the wind energy facility is attached to Appendix A.

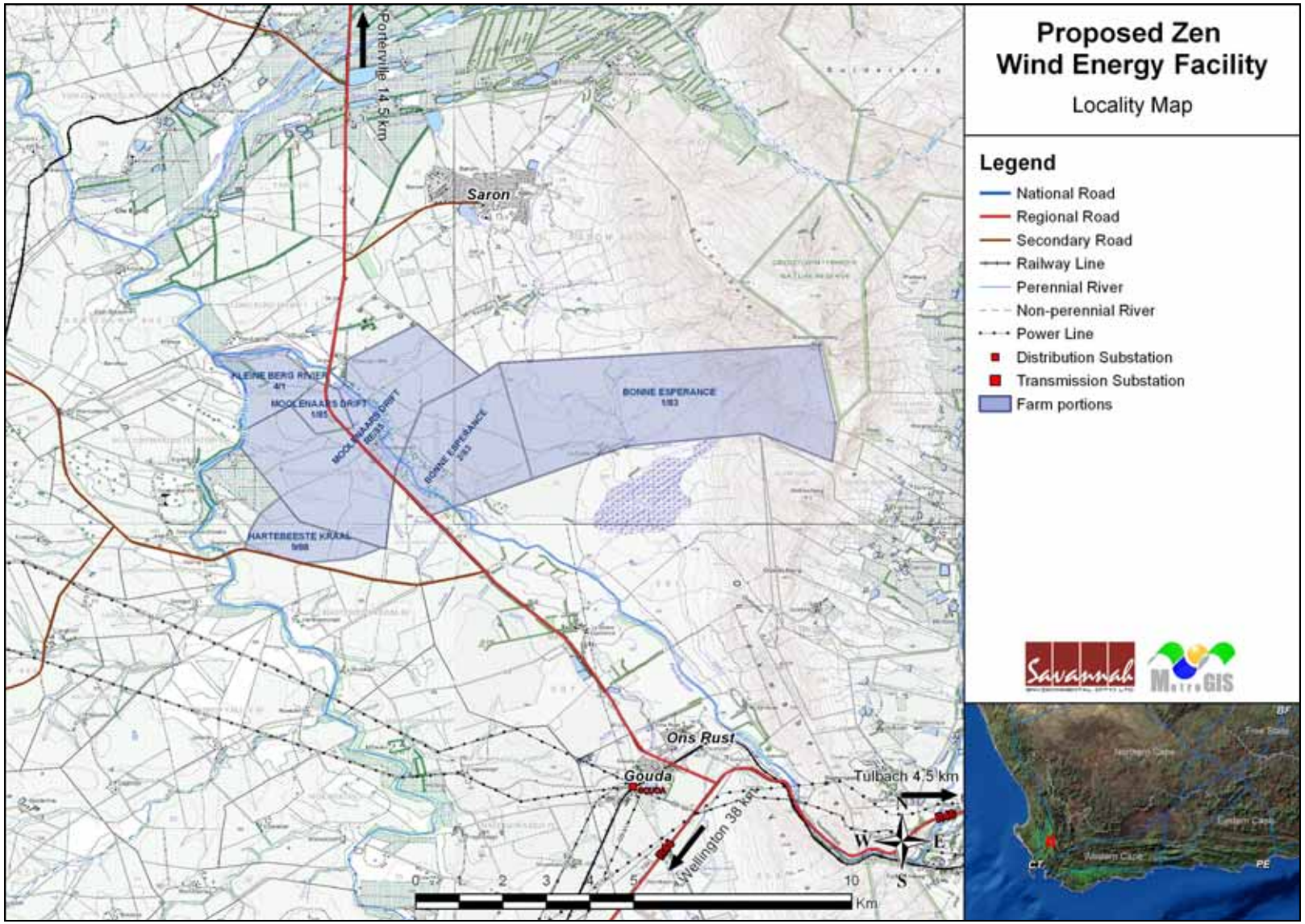


Figure 1.1: Locality Map of the Zen Wind Energy Facility

1.2. Conclusions and Recommendations of the EIA

The EMPr has been developed based on the findings of the EIA, and must be implemented to protect sensitive on-site and off-site features through controlling construction and operation activities that could have a detrimental effect on the environment, and through avoiding or minimising potential impacts.

A site of 35km^2 was considered for the facility, of which ~1.6% will be utilised for the development footprint of the proposed wind energy facility, and will be permanently transformed. Permanently affected areas include the turbine footprints and associated infrastructure, as well as the internal power line routes and the internal access roads.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by the developer. This layout includes 46 wind turbines as well as all associated infrastructure. No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However, a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact.

From the specialist investigations undertaken for the proposed Zen Wind Energy Facility development site, a number of potentially sensitive areas were identified (refer to **Figure 1.2**). The following sensitive areas/environmental features have been identified on the site and are able to be mapped:

» ***The Klein Berg River*** which bisects the site: There are no turbines located within the floodplain of the river and the Klein Berg River would not be directly impacted by the development. A buffer of 200m has been used along the Klein Berg River. An upgrade to the current farm bridge may be required for access to the site, but as this area is already disturbed, it is not likely to generate significant impact.
» ***Remnants of Swartland Alluvium Fynbos and Swartland Shale Renosterveld:*** This vegetation occurs on the eastern section of the site. These are Critically Endangered vegetation types and despite their disturbed nature, the presence of some species of conservation concern was confirmed for these areas. No turbines are located within the intact patches of remaining natural vegetation under the current layout. The access road and presumably the cable trench from Turbine 35 to Turbine 45 traverse one of these intact patches.

- The ***soils with high agricultural potential*** have been identified for the site and are shown in Figure 9.2. No infrastructure is planned in this area of high agricultural potential, as well as in current irrigated fields. This is acceptable from a soils and agricultural potential perspective. It has been agreed with the Department of Agriculture that wherever feasible that existing access routes should be utilised to minimise the need for new route establishment. The power line Route 1 would traverse centre-pivot irrigation areas on Kleinberg River and is therefore not ideal. Route 1 would require re-alignment to avoid the centre-pivot irrigation.
- ***Bats sensitive areas*** include the Berg and the Klein Berg River (and a 200m buffer has been used where no wind turbines should be constructed) as well as bat roosts sites. Roosts were observed on the site and in the broader study area. No turbines are proposed to be located in the vicinity of the bat roosts site on/within 200m of the Klein Berg River. The Saronsberg mountain range is also a bat sensitive habitat. No development of wind turbines are proposed on the elevated topography.
- ***Heritage artefacts*** (albeit of no important heritage significance) were found on the site. These include stone scatters and old buildings.
  - Figure 9.2 shows two old structures /buildings which occur on the Farm Bonne Esperance and those at Die Mond. If they require demolishing, a permit must be obtained from Heritage Western Cape. The nearest turbine is 960m from main house and 2.9km from the other historical house, and this is considered to be acceptable in terms of the current layout.
  - Early Stone Age (ESA) material is common on the site, but its density varies considerably according to location. In general, the eastern side of the farm has very few artefacts, while in the west artefacts were present throughout the area but more frequently encountered towards the north than the south. These occurrences are not really 'sites' in the typical sense, since the material is largely in secondary context having been left on the surface after erosion of the overlying deposits.
  - Two small LSA scatters were found on the banks of the Berg River in the far west of the site. Neither was dense, and the find was too dispersed to be able to distinguish any source areas.
  - No graves were observed in the study area.
- ***Noise sensitive receptors*** do occur in and around the site. NSD01, NSD02 and NSD03 are located on the Zen site and considered sensitive to noise during construction and operations of the wind turbines. Noise modelling revealed that noise from the wind turbines will be of a low significance.
- ***Visual receptors*** occur in the study area including farm homesteads and the town of Saron. The visual impacts of the wind energy facility will be of a medium- high significance.
- ***Bird Habitat and Sensitive Areas -*** The turbines are sited more than 200 m from the rivers, which is bird-sensitive habitat on the site. Birds in agricultural

land already tolerate major seasonal changes in micro-habitat and periods of major human disturbance (ploughing, harvesting etc.) so for most species displacement is unlikely to be severe. There is ample alternative habitat available so the loss caused by the footprint of the development is considered unimportant. During operation of the facility, the threat of fatalities of avifauna and bats is also considered a potentially significant impact. The main area of concern for avifauna is mortality through collisions with rotor blades. Of the bird species that may be affected, many have large populations across the Swartland and most of the others occur in the Zen area in very small numbers so that a low level of collision mortality will have no marked effect. Of the 21 identified priority species, two local resident species – Blue Crane and Spurwinged Goose - are at highest risk of mortality through collision and potentially also through displacement from breeding or foraging areas. Most of the other priority species e.g. Greater Flamingo and Martial Eagle, occur in the Zen area in far smaller or negligible numbers, and/or too infrequently, to be a source of concern. Karoo Shelduck and Egyptian geese are other species occurring in the area noted to be at higher risk of collision.

Turbine positioning should take cognisance of sensitive areas (as indicated on Figure 1.2). Should mitigation measures in the EMPr be adhered to, impacts on the identified sensitive areas can be adequately managed.

Planning of infrastructure location on the site needs to take some factors into account with respect to existing disturbance on site. Existing road infrastructure is planned to be used as far as possible for providing access to proposed turbine positions. Where no road infrastructure exists, new roads should be placed within existing disturbed areas or environmental conditions must be taken into account to ensure the minimum amount of damage is caused to natural habitats and that the risk of erosion or down-slope impacts are not increased. Road infrastructure and underground cable alignments should coincide as much as possible.

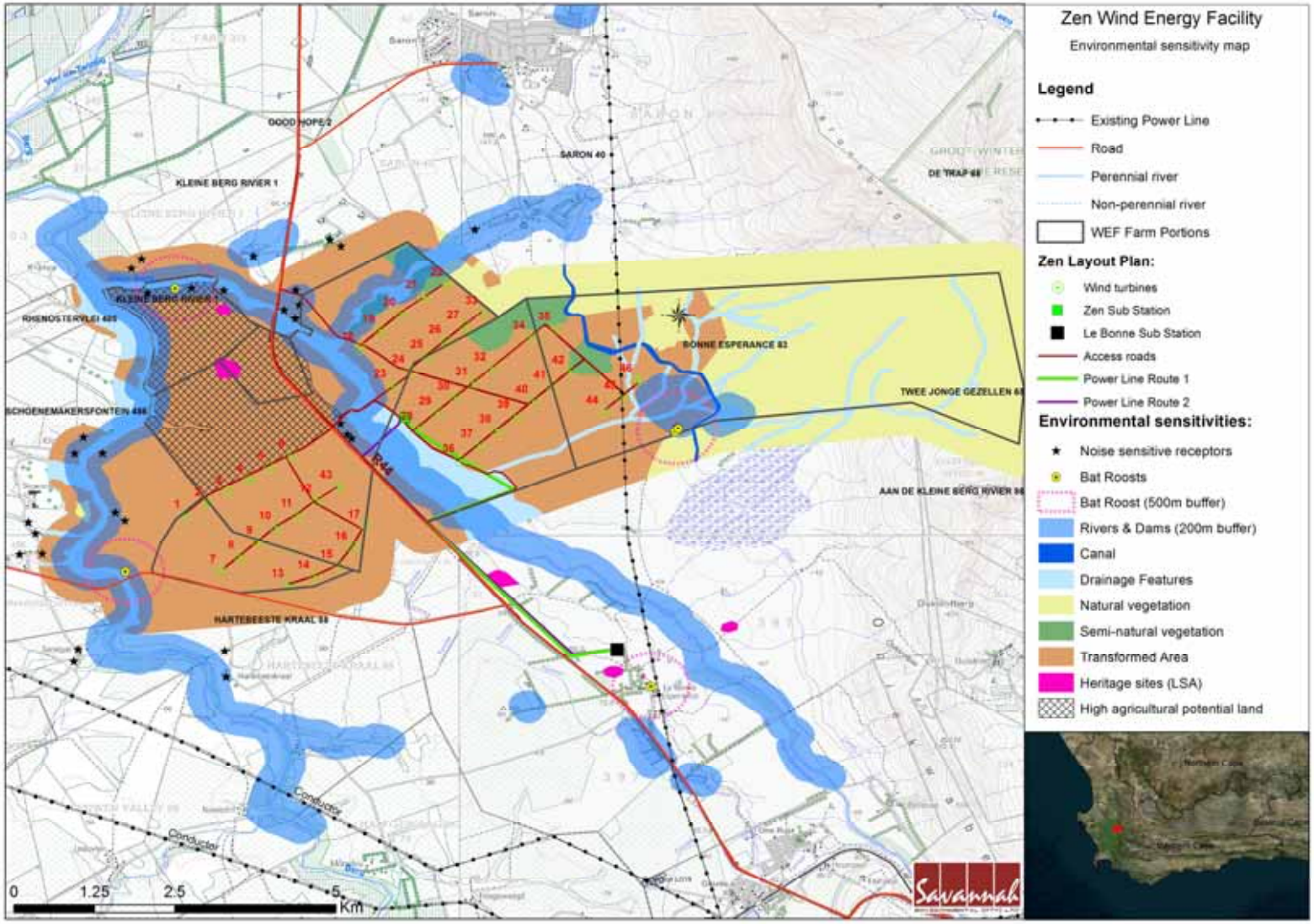


Figure 1.2: Sensitivity map for the Zen Wind Energy Facility site showing areas of environmental sensitivity

1.3. Activities and Components associated with the Facility

Table 1.1: Activities Associated with Planning, Construction, Operation and Decommissioning of the Facility

Main Activity/Project Component	Components of Activity	Details
	Planning	
Conduct technical surveys	» Negotiation for the power line servitude » Geotechnical survey by geotechnical engineer; » Site survey and confirmation of the infrastructure micro-siting footprint; » Survey of substation site; and » Survey of power line servitudes to determine tower locations.	» All surveys are to be undertaken prior to initiating construction.
	Construction	
Main Activity/Project Component	Components of Activity	Details
Conduct technical surveys	» Geotechnical survey by geotechnical engineer; » Site survey and confirmation of the infrastructure micro-siting footprint; » Survey of substation sites; and » Survey of power line servitudes to determine tower locations.	» All surveys are to be undertaken prior to initiating construction.
Establishment of access roads and/ bridge.	» Upgrade access/haul roads to the site, as required (this only refers to the main access roads leading directly to site itself). » Temporary access roads will be up to 10 m wide in some places due to turning circles that are required. » Establish internal access roads: up to 6 m wide permanent roadway within the site between the turbines for use during construction and operation phase. » Temporary track of 11 m for use during construction phase only.	» The Zen site is currently accessible from the R44. » Existing access roads will be utilised and upgraded. » A bridge to cross the Klein Berg river may have to be built. » Access roads will be constructed/upgraded in advance of any components being delivered to site, and will remain in place after completion for future access and possibly access for replacement of parts if necessary. » Existing access roads to the site will be utilised, and upgraded where required. Special haul roads may need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation. » The internal service road alignment is informed by the final micro-siting/positioning of the wind turbines (as well as specialist surveys). To accommodate the large crawler crane required for turbine assembly, a track

Main Activity/Project Component	Components of Activity	Details
		of up to 11 m in width is required to be established on the site (as advised to be required by the developer).
Undertake site preparation	» Site establishment of offices / workshop with ablutions and stores and contractors' yards. » Establishment of internal access roads (permanent and temporary roads) » Clearance of vegetation at the footprint of each turbine » Excavations for foundations	» These activities will require the stripping of topsoil, which will need to be appropriately stockpiled for use in rehabilitation.
Establishment of laydown areas on site	» Laydown areas at each turbine position for the storage of wind turbine components and accommodation of construction and crane lifting equipment. » Temporary lay down area for crane assembly.	» Each turbine needs a flat and hardened lay down area of ~2400 m2 during the construction process. » This area can be rehabilitated after construction. » The lay down area will need to accommodate the cranes required in tower/turbine assembly. Lay down and storage areas will be required to be established for the normal civil engineering construction equipment which will be required on site. A large lay down area will be required at each position where the main lifting crawler crane may be required to be erected and/or disassembled. This area would be required to be compacted and levelled to accommodate the assembly crane, which would need to access the crawler crane from all sides. » Such areas to make use of already compacted areas as far as possible, such as roadways or other laydown areas.
Construct wind turbine foundations	» Concrete foundations of approximately of up to 20 m x 20 m x 4 m depth at each turbine location (final dimensions to be defined by geotechnical survey of the site).	» Foundation holes will be mechanically excavated. » Shoring and safety barriers will be erected. » Aggregate and cement to be transported from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities. » Concrete may to be brought to site as ready-mix or batched on site if no suitable concrete suppliers are available in the vicinity. The reinforced concrete foundation will be poured and will support a mounting ring. The foundation will then be left up to a week to cure.
Transport of components and equipment to site	» Flatbed trucks will be used to transport the majority of components to site from the	» Turbine units consist of a tower comprised of 4 segments, a nacelle, and three rotor blades. Components of various specialised construction, lifting

Main Activity/Project Component	Components of Activity	Details
	nearest port (Cape Town). * Turbine units consist of a tower comprised of 4 segments, a nacelle, and three rotor blades (rotor diameter of 122 m). * Components of various specialised construction, lifting equipment and counter weights etc. are required on site (e.g. mobile assembly crane and main lift crawler crane) to erect the wind turbines. * The normal civil engineering construction equipment for the civil works (e.g. excavators, trucks, graders, compaction equipment etc.). * The components required for the establishment of the substations (including transformers) * Components required for the establishment of the power line (including towers and cabling) * Ready-mix cement trucks for turbine and substation foundations	equipment and counter weights etc. are required on site (e.g. 200 ton mobile assembly crane and a 750 ton main lift crawler crane) to erect the wind turbines. Other components include components required for the establishment of the substations (including transformers) and those required for the establishment of the power line (including towers and cabling). » The wind turbine, including tower, will be brought to site by the supplier in sections. The individual components are defined as abnormal loads in terms of the Road Traffic Act (Act No 29 of 1989) by virtue of the dimensional limitations (abnormal length of the blades) and load limitations (i.e. the nacelle). The dimensional requirements of the load during the construction phase (length/height) may require alterations to the existing road infrastructure (widening on corners, removal of traffic islands), accommodation of street furniture (electricity, street lighting, traffic signals, telephone lines etc.), and protection of road-related structures (bridges, culverts, portal culverts, retaining walls etc.) as a result of abnormal loading. The equipment will be transported to the site using appropriate National and Provincial routes, and the dedicated access/haul road to the site itself.
Erect turbines	» Large lifting crane used for lifting of large, heavy components » A crane for the assembly of the rotor	» The large lifting crane will lift the tower sections into place. » The nacelle, which contains the gearbox, generator, and yawing mechanism, will then be placed onto the top of the assembled tower. » The rotor (i.e. the blades of the turbine) will then be assembled or partially assembled on the ground. It will then be lifted to the nacelle and bolted in place. » It will take approximately 2 days to erect each turbine, although this will depend on the climatic conditions as a relatively wind-free day will be required for the installation of the rotor.
Construct substations and associated ancillary infrastructure.	» Substations and associated components; » Security fencing around high-voltage (HV) yard; and	» A temporary construction area is needed for containers, toilets, and equipment. » Permanent operational buildings are as follows:

Main Activity/Project Component	Components of Activity	Details
	» An operations and maintenance building, including a workshop building, is proposed. Some of the existing on-site buildings may be utilised where practical.	* Operations and maintenance facility, including a storage building (100m x 100m m), will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. » A laydown area for building materials and equipment associated with these buildings will also be required. » The on-site substation will be constructed with a HV yard footprint of up to 200 m x 200 m. » The substation would be constructed as follows: * Step 1: Survey of the site * Step 2: Site clearing and levelling and construction of access road to substation site * Step 3: Construction of terrace and foundations * Step 4: Assembly, erection and installation of equipment (including transformers) * Step 5: Connection of conductors to equipment * Step 6: Rehabilitation of any disturbed areas and protection of erosion sensitive areas.
Connection of the wind turbines to the on-site substations	» Wind turbines » 33 kV underground (where practical) electrical cabling connecting each turbine to the substations.	» The installation of these cables will require the excavation of trenches, approximately 1 m in depth within which these cables can then be laid. The underground cables would follow the internal access roads as far as reasonably possible.
Connect substations to power grid	» A new 132kV overhead power line feeding into the power grid at the new LeBonne Substation.	» The route for the power line will be assessed, surveyed, and pegged prior to construction. » A servitude of approximately 36 m will be required for the power line.
Commissioning of the facility	» Start up for electricity generation	» Prior to the start-up of a wind turbine, a series of checks and tests will be carried out, including both static and dynamic tests to make sure the turbine is working within appropriate limits. » Grid interconnection and unit synchronisation will be undertaken to confirm the turbine performance. Physical adjustments may be needed such as changing the pitch of the blades of the turbines.
Undertake site remediation	» Remove all construction equipment from the site. » Rehabilitation of temporarily disturbed	» On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.

Main Activity/Project Component	Components of Activity	Details
	areas where practical and reasonable.	
	Operation	
Operation	» Operation of the wind turbines	» Once operational, the Wind Energy Facility will be monitored. » It is anticipated that there will be full time security, maintenance and control room staff required on site. » Each turbine in the facility will be operational, except under circumstances of mechanical breakdown, extreme weather conditions, or maintenance activities.
Maintenance	Maintenance activities include: » Oil and grease – turbines; » Transformer oil – substation; and » Waste product disposal » Cleaning of turbines	» The wind turbines will be subject to periodic maintenance and inspection. » Periodic oil changes will be required and any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation. » The turbine infrastructure is expected to have a lifespan of approximately 25 - 30 years, with maintenance.
	Decommissioning	
Site preparation	» Confirming the integrity of the access to the site to accommodate required equipment and lifting cranes. » Preparation of the site (e.g. lay down areas, construction platform) » Mobilisation of construction equipment	» Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time.
Disassemble wind turbines	» A large crane will be used to disassemble the turbine and tower sections. » The turbines will be disassembled and removed.	» Turbine components would be reused, recycled, or disposed of in accordance with regulatory requirements.

PURPOSE AND OBJECTIVES OF THE EMP CHAPTER 2

An Environmental Management Programme (EMPr) is defined as "an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented or mitigated, and that the positive benefits of the projects are enhanced"[1]. The objective of this EMPr is to provide consistent information and guidance for implementing the management and monitoring measures established in the permitting process and help achieve environmental policy goals. The purpose of an EMPr is to help ensure continuous improvement of environmental performance, reducing negative impacts and enhancing positive effects during the construction and operation of the facility. An effective EMPr is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMPr provides specific environmental guidance for the construction and operation phases of a project, and is intended to manage and mitigate construction and operation activities so that unnecessary or preventable environmental impacts do not result. These impacts range from those incurred during start up (site clearing and site establishment) through those incurred during the construction activities themselves (erosion, noise, dust) to those incurred during site remediation (soil stabilisation, revegetation) and operation.

The EMPr has been developed as a set of environmental specifications (i.e. principles of environmental management for the proposed Zen Wind Energy Facility), which are appropriately contextualised to provide clear guidance in terms of the on-site implementation of these specifications (i.e. on-site contextualisation is provided through the inclusion of various monitoring and implementation tools for assisted use of the EMPr by the project implementer as well as compliance monitors). The EMPr is separated into measures dealing with the various project phases.

The EMPr has the following objectives:

» To outline mitigation measures and environmental specifications which are required to be implemented for the planning, construction, rehabilitation and operation phases of the project in order to minimise the extent of environmental impacts, and to manage environmental impacts associated with the wind energy facility.

[1] Provincial Government Western Cape, Department of Environmental Affairs and Development Planning: *Guideline for Environmental Management Plans*. 2005

- To ensure that the construction and operation phases do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- To identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- To propose mechanisms and frequency for monitoring compliance, and preventing long-term or permanent environmental degradation.
- To facilitate appropriate and proactive responses to unforeseen events or changes in project implementation that was not considered in the EIA process.

The mitigation measures identified within the EIA process are systematically addressed in the EMPr, ensuring the minimisation of adverse environmental impacts to an acceptable level.

Zen Wind Farm (Pty) Ltd must ensure that the implementation of the project complies with the requirements of all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development and the implementation of the EMPr through its integration into the contract documentation. Since this EMPr is part of the EIA process undertaken for the proposed Zen Energy Wind Facility, it is important that this document be read in conjunction with the Scoping Report (August 2012) and Final EIA Report (January 2013), as well as the Environmental Authorisation (once issued). This will contextualise the EMPr and enable a thorough understanding of its role and purpose in the integrated environmental management process. This EMPr for construction and operation activities has been compiled in accordance with Section 33 of the EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project.

This EMPr shall be binding on all the parties involved in the construction and operational phases of the project, and shall be enforceable at all levels of contract and operational management within the project. The document will be adhered to, updated as relevant throughout the project life cycle.

To achieve effective environmental management, it is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMPr. The Contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The Contractor's obligations in this regard include the following:

- Ensuring that employees have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- Ensuring that a copy of the EMPr is readily available on-site, and that all site staff are aware of the location and have access to the document. Employees will be familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the facility.
- Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended an Environmental Awareness Training course. The course must provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- Providing basic training in the identification of archaeological sites/objects, and protected flora and fauna that may be encountered on the site.
- Ensuring awareness of any other environmental matters, which are deemed necessary by the Environmental Control Officer (ECO).

The EMPr is a dynamic document, which must be updated when required. It is considered critical that this draft EMPr be updated to include site-specific information and specifications as required throughout the life-cycle of the facility. This will ensure that the project activities are planned and implemented in terms of Best Environmental Practice.

STRUCTURE OF THIS EMPR CHAPTER 3

The first two chapters provide background to the EMPr and the proposed project. The chapters which follow consider the:

» Planning and design activities
» Construction activities
» Operation activities
» Decommissioning activities

These chapters set out the procedures necessary for the developer to achieve environmental compliance. For each of the phases of implementation for the renewable energy facility project, an over-arching environmental **goal** is stated. In order to meet this goal, a number of **objectives** are listed. The management programme has been structured in table format in order to show the links between the goals for each phase and their associated objectives, activities/risk sources, mitigation actions monitoring requirements and performance indicators. A specific environmental management programme table has been established for each environmental objective. The information provided within the EMPr table for each objective is illustrated below:

OBJECTIVE: Description of the objective, which is necessary in order to meet the overall goals; these take into account the findings of the environmental impact assessment specialist studies

Project component/s	List of project components affecting the objective, i.e.: » Wind turbines » Access roads » Substations » Power lines
Potential Impact	Brief description of potential environmental impact if objective is not met
Activity/risk source	Description of activities which could impact on achieving objective
Mitigation: Target/Objective	Description of the target; include quantitative measures and/or dates of completion

Mitigation: Action/control	Responsibility	Timeframe
List specific action(s) required to meet the mitigation target/objective described above.	Who is responsible for the measures	Time periods for implementation of measures

Performance Indicator	Description of key indicator(s) that track progress/indicate the effectiveness of the management plan.
Monitoring	Mechanisms for monitoring compliance; the key monitoring actions required to check whether the objectives are being achieved, taking into consideration responsibility, frequency, methods and reporting

The objectives and EMPr tables are required to be reviewed and possibly modified whenever changes, such as the following, occur:

» Planned activities change (i.e. in terms of the components and/or layout of the facility).
» Modification to or addition to environmental objectives and targets.
» Relevant legal or other requirements are changed or introduced.
» Significant progress has been made on achieving an objective or target such that it should be re-examined to determine if it is still relevant, should be modified, etc.

3.1. Project Team

This EMPr was compiled by:

	Name	Company
EMPr Compilers:	Ravisha Ajodhapersadh	Savannah Environmental
	Karen Jodas	Savannah Environmental
Specialists:	Simon Todd	Simon Todd Consulting
	Tony Williams	African Insights
	Bárbara Monteiro and Ricardo Ramalho	Bio3
	Jayson Orton	ACO Associates
	Morne de Jager	M2 Environmental Connections CC
	Lourens du Plessis	MetroGIS
	Tony Barbour	Tony Barbour Environmental Consulting and Research
	Johan van Der Waals	Terra SoilScience
	John Almond	Natura Viva

The Savannah Environmental team have extensive knowledge and experience in environmental impact assessment and environmental management, having been involved in EIA processes for more than ten (10) years. They have managed and drafted Environmental management programmes for other power generation projects throughout South Africa, including numerous wind and solar energy facilities.

The EAPs from Savannah Environmental who are responsible for this project are:

» *Karen Jodas* - a registered Professional Natural Scientist and holds a Master of Science degree. She has 16 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development. She is currently responsible for the project management of EIAs for several renewable energy projects across the country.

» *Ravisha Ajodhapersadh*– the principle author of this report holds an Honours Bachelor of Science degree in Environmental Management and has 6 years' experience in environmental management and EIA. She is currently the responsible EAP for several renewable energy projects across the country.

MANAGEMENT PROGRAMME FOR THE WIND ENERGY FACILITY: PLANNING & DESIGN CHAPTER 4

4.1. Goal for Planning and Design

Overall Goal for Planning and Design: Undertake the planning and design phase of the Wind Energy Facility in a way that:

» Ensures that the design of the facility responds to the identified environmental constraints and opportunities.
» Ensures that adequate regard has been taken of any landowner concerns and that these are appropriately addressed through design and planning (where appropriate).
» Ensures that the best environmental options are selected for the project.
» Enables the wind energy facility construction activities to be undertaken without significant disruption to other land uses in the area.

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

4.2. Objectives

OBJECTIVE: To ensure that the design of the facility responds to the identified environmental constraints and opportunities

From the specialist investigations undertaken for the proposed Zen Wind Energy Facility development site, areas of high sensitivity were identified (refer to Figure 1.2). Regarding the micro-sting of the wind turbines and associated infrastructure, from an ecological point of view, wind turbines which are within ecologically sensitive areas and whose locations should be adjusted/ shifted.

Project component/s	Project components affecting the objective: » Wind turbines » Access roads » Substation » Power line
Potential Impact	» Design fails to respond optimally to the identified environmental considerations

Activities / risk sources	» Positioning of turbines and access roads » Positioning of substation » Alignment of power line
Mitigation: Target / Objective	» To ensure that the design of the facility responds to the identified environmental constraints and opportunities

Mitigation: Action / control	Responsibility	Timeframe
Consider design level mitigation measures recommended by the specialists, especially with respect to visual aesthetics, noise, flora, ecology, avifauna and bats as detailed within the EIA report and relevant appendices.	Engineering Design Consultant / turbine supplier Developer	Tender design, design review stage
As far as possible, access roads and cable trenches which could potentially impact on sensitive areas should be shifted in order to avoid these areas of high sensitivity (i.e. best practice is impact avoidance). Where this is not possible, alternative mitigation measures as detailed in this report must be implemented.	Engineering Design Consultant Developer	Tender design, design review stage
A walk-though survey of final infrastructure positions for the wind energy facility and associated infrastructure (including the power line) should be undertaken by a specialist ecologist, avifaunal specialist and heritage specialist prior to the commencement of construction. The EMPr for construction must be updated to include site-specific information and specifications resulting from the final walk-though surveys. This EMPr must be submitted to DEA for approval prior to the commencement of construction.	Specialists	Final design phase
A comprehensive search for protected plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure is known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate infrastructure, a permit may	Developer	Planning Phase and/ prior to construction

Mitigation: Action/control	Responsibility	Timeframe
be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species. Should TOPS species be identified during the final ecological survey, in terms of the NEM:BA a permit (a TOPS permit) will be required for any activities/ removal of TOPS listed species. Plucking, relocation, or destruction of provincially protected species will require a permit in terms of the Nature and Environmental Conservation Ordinance of 1974 and the Western Cape Nature Conservation Laws Amendment Act, 2000 (Ordinance 3 of 2000).		
Should the layout (or type of wind turbines used) change significantly during the final design, the new layout must be submitted to the Department of Environmental Affairs	Developer	Design phase
It is recommended that any revised / updated layout be remodelled/ reviewed in terms of the potential environmental impacts by an independent acoustics specialist.	Developer	Design phase
The monitoring programme already implemented to document the effect of the wind turbines on birds and bats should be continued. This should continue during construction and during operation. The monitoring protocols as required by the EIA report should be implemented.	Developer in consultation with relevant Specialist	Pre-construction, construction, operation
Use bird-friendly power line tower and conductor designs.	Developer	Design phase
Anti-collision devices such as bird flappers must be installed where power lines cross avifaunal sensitive areas (e.g. grasslands, rivers, wetlands, and dams). The input of an avifaunal specialist must be obtained for the fitting of the anti-collision devices onto specific sections of the line once the alignment has been confirmed through negotiation with the affected landowners, and the exact positions of the towers have been surveyed and pegged. Additional areas of high sensitivity along the preferred alignment must also be identified by the avifaunal specialist for the fitment of anti-collision devices. These devices must be according to Eskom's Transmission Guidelines.	Developer	Design phase

Mitigation: Action/control	Responsibility	Timeframe
Compile a comprehensive stormwater management plan for hard/compacted surfaces (e.g. substation footprints, roads) as part of the final design of the project.	Developer	Design phase
It is possible that in situ archaeological sites/remains, and human remains may be uncovered during construction. Therefore the ECO should be trained to identify heritage resources.	Relevant specialists Developer	Design phase
Make use of existing roads where possible.	Relevant specialists Developer	Design phase
Applications for all other relevant and required permits if required to be obtained by the developer must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, water use licencing for disturbance to any water courses/ drainage lines and a permit to remove heritage artefacts and/ disturbance of protected vegetation.	The developer	Planning & Design Phase

Performance Indicator	» Design meets objectives and does not degrade the environment » Design and layouts respond to the mitigation measures and recommendations in the EIA report. » Power line alignment which meets environmental objectives. » Substation site and turbine layout minimises any negative environmental impacts and maximises any benefits. » Specialists appointed to undertake required surveys
Monitoring	» Ensure that the design implemented meets the objectives and mitigation measures in the EIA report through review of the design by the Project Manager and Environmental Control Officer (ECO) prior to the commencement of construction.

OBJECTIVE: Undertake Bird and Bat Monitoring Programme during the Operational phase

A pre-construction bird and bat monitoring programme has been implemented by the Developer (in consultation with an avifauna and bat specialist) to establish population sizes and any migration routes, and to determine risk of impacts associated with the wind energy facility based on flight behaviour and patterns. This pre-construction monitoring is being undertaken in accordance with the requirements of the guidelines for bird and bat monitoring in South Africa, as well as

in line with international best practice. This monitoring should continue during construction and operation of the wind farm. This is seen as critical to furthering the understanding of avifaunal impacts and wind energy facilities on the site and in South Africa.

Project component/s	» Power line » Wind turbines
Potential Impact	» Mortality of birds due to collision with turbines and/or power line infrastructure. » Mortality of bats due to collision with turbines and/or barotrauma.
Activity/risk source	» Turbines and power line infrastructure
Mitigation: Target/Objective	» The delivery of an effective impact mitigation scheme for the facility, informed initially by influence of pre-construction monitoring on final construction plans, and refined by post-construction monitoring of actual impacts, and resulting adjustments in management practices and mitigation measures applied.

Mitigation: Action/control	Responsibility	Timeframe
Appoint advising consultant/s to undertake bird and bat monitoring during construction and operation of the wind energy facility.	Developer	Pre-construction

Performance Indicator	» Regular provision of information on the interface between the local avifauna and bats and the proposed/operating renewable energy facility » Clear and logical recommendations on why, how and when to institute mitigation measures to reduce avian and bat impacts of the development, from pre-construction to operational phase » Quantifiable reductions in avian impacts once the facility is operational
Monitoring	» 3-monthly and annual reports produced by the scientist advising the monitoring project.

OBJECTIVE: Minimise storm water runoff (guideline for stormwater management plan)

Management of storm water will be required during the construction and operational phases of the facility. A detailed storm water management plan is required to be compiled as part of the final design to ensure compliance with applicable regulations

and to prevent off-site migration of contaminated storm water or increased soil erosion. The section below provides a guideline for the management of storm water on site and will need to be supplemented with the relevant method statements during the construction and operation phases of the facility.

Project Component/s	» Storm water management components. » Any hard engineered surfaces (i.e. access roads).
Potential Impact	» Poor storm water management and alteration of the hydrological regime (i.e. drainage lines).
Activities/Risk Sources	» Construction of the facility (i.e. placement of hard engineered surfaces).
Mitigation: Target/Objective	» Appropriate management of storm water to minimise impacts on the environment.

Mitigation: Action/Control	Responsibility	Timeframe
A stormwater management plan which considers the recommendations below is to be submitted to the DEA prior to the commencement of construction.	Developer EPC contractor	Pre-construction
Ensure design aims to reduce the potential increase in surface flow velocities and the resultant impact on the localised drainage system through increased sedimentation.	Developer	Planning and design
Appropriately plan hard-engineered bank erosion protection structures to minimise erosion potential.	Developer	Planning and design
Ensure suitable handling of storm water within the site (i.e. separate clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, trapping sediments and reduce flow velocities) through appropriate design of the facility.	Developer	Construction and operation
Design measures for stormwater management needed to allow for surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows.	Developer	Planning and design

Performance Indicator	» Appropriate storm water management measures included within the facility design. » Sound water quality and quantity management during construction and operation.
Monitoring	» Devise a suitable surface water quality monitoring plan for implementation during construction and operation.

OBJECTIVE: To ensure effective communication mechanisms

On-going communication with affected and surrounding landowners is important to maintain during the construction and operational phases of the wind energy facility. Any issues and concerns raised should be addressed as far as possible in as short a timeframe as possible.

Project component/s	» wind energy facility
Potential Impact	» Impacts on affected and surrounding landowners and land uses
Activity/risk source	» Activities associated with wind energy facility construction » Activities associated with wind energy facility operation
Mitigation: Target/Objective	» Effective communication with affected and surrounding landowners » Addressing of any issues and concerns raised as far as possible in as short a timeframe as possible

Mitigation: Action/control	Responsibility	Timeframe
Compile and implement a grievance mechanism procedure for the public (as outlined in Appendix H) to be implemented during both the construction and operational phases of the facility. This procedure should include details of the contact person who will be receiving issues raised by interested and affected parties, and the process that will be followed to address issues.	Developer	Pre-construction (construction procedure) Pre-operation (operation procedure)
Develop and implement a grievance mechanism for the construction, operational and closure phases of the project for all employees, contractors, subcontractors and site personnel. This procedure should be in line with the South African Labour Law.	Developer	Pre-construction (construction procedure) Pre-operation (operation procedure)

Performance Indicator	» Effective communication procedures in place.
Monitoring	» An incident reporting system should be used to record non-conformances to the EMPr.

MANAGEMENT PROGRAMME FOR RENEWABLE ENERGY FACILITY: CONSTRUCTION CHAPTER 5

5.1. Overall Goal for Construction

Overall Goal for Construction: Undertake the construction phase of the Wind Energy Facility in a way that:

» Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
» Enables the Wind Energy Facility construction activities to be undertaken without significant disruption to other land uses in the area, in particular concerning noise impacts, traffic and road use, and effects on local residents.
» Minimises the impact on the vegetation and habitat value of the site and where possible adds to the botanical and faunal record of this area.
» Minimises the impact on the archaeological and historical value of the site and where possible adds to the archaeological record of this area.
» Minimises impacts on birds, bats and other fauna using the site.
» Establishes an environmental baseline during construction activities on the site, where possible, particularly with regard to priority bird and bat species using the site.

5.2. Institutional Arrangements: Roles and Responsibilities for the Construction Phase of the Renewable Energy Facility

As the Proponent, Zen Wind Farm (Pty) Ltd must ensure that the implementation of the proposed project complies with the requirements of all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMPr, and the implementation of the EMPr through its integration into the contract documentation.

OBJECTIVE: To establish clear reporting, communication and responsibilities in relation to environmental incident

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of the Project Manager; Site Manager; Environmental Control Officer and Contractor for the construction phase of this project are as detailed below.

The **Project Manager** will:
» Ensure of all specifications and legal constraints specifically concerning the environment are highlighted to the Contractor(s) so that they are aware of these.
» Ensure that the Developer and its Contractor(s) are made aware of all stipulations within the EMPr.

» Ensure that the EMPr is correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes.
» Be fully conversant with the Environmental Impact Assessment for the project, the EMPr, the conditions of the Environmental Authorisation (once issued), and all relevant environmental legislation.

The **Site Manager** (the Developer's On-site Representative) will:
» Be fully knowledgeable with the contents of the Environmental Impact Assessment.
» Be fully knowledgeable with the contents and conditions of the Environmental Authorisation (once issued).
» Be fully knowledgeable with the contents of the Environmental management programme.
» Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
» Have overall responsibility of the EMPr and its implementation.
» Conduct audits to ensure compliance to the EMPr.
» Ensure there is communication with the Project Manager, the Environmental Control Officer, and relevant discipline Engineers on matters concerning the environment.
» Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
» Confine activities to the demarcated construction site.

An independent **Environmental Control Officer** (ECO) must be appointed by Zen Wind Farm (Pty) Ltd prior to the commencement of any authorised activities. The ECO will be responsible for monitoring, reviewing, and verifying compliance by the Contractor with the environmental specification of the EMPr and the conditions of the Environmental Authorisation. The ECO will:

» Be fully knowledgeable with the contents with the Environmental Impact Assessment.
» Be fully knowledgeable with the contents with the conditions of the Environmental Authorisation (once issued).
» Be fully knowledgeable with the contents with the Environmental management programme.
» Be fully knowledgeable with the contents with all relevant environmental legislation, and ensure compliance with them.
» Ensure that the contents of the EMPr are communicated to the Contractor site staff and that the Site Manager and Contractor are constantly made aware of the contents through discussion.

- Keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.
- Keep and maintain a detailed incident (including spillage of bitumen, fuels, chemicals, or any other material) and complaints register on site indicating how these issues were addressed, what rehabilitation· measures were taken and what preventative measures were implemented to avoid re-occurrence of incidents/complaints.
- Keep and maintain a daily site diary.
- Keep copies of all reports submitted to DEA.
- Keep and maintain a schedule of current site activities including the monitoring of such activities.
- Obtain and keep record of all documentation including: environmental authorisation from DEA, EMPr, Site layout plan, method statement, all communication detailing changes that may have environmental implications, site inspection checklist, Environmental awareness training attendance register, Environmental incident report, environmental performance certificates (once a project has been completed) photographic records (before, during and after development), records of non- compliance and corrective action taken to remediate, permits, licenses, and authorisations such as waste disposal certificates, hazardous waste landfill site licenses etc. which are required by this facility.
- Compile a monthly monitoring report and submit to DEA.

Contractors and Service Providers: All contractors (including sub-contractors and staff) and service providers are ultimately responsible for:

- Ensuring that the activities conducted on site are compliant with all permits, Environmental Authorisations and all Local and National Legislation.
- Ensuring adherence to the environmental management specifications.
- Ensuring that Method Statements are submitted to the Site Manager (and ECO) for approval before any work is undertaken. Any lack of adherence to this will be considered as non-compliance to the specifications of the EMPr.
- Ensuring that any instructions issued by the Site Manager on the advice of the ECO are adhered to.
- Ensuring that a report is tabled at each site meeting, which will document all incidents that have occurred during the period before the site meeting.
- Ensuring that a register is kept in the site office, which lists all transgressions issued by the ECO.
- Ensuring that a register of all public complaints is maintained.
- Ensuring that all employees, including those of sub-contractors receive training before the commencement of construction in order that they can constructively contribute towards the successful implementation of the EMPr (i.e. ensure their staff are appropriately trained as to the environmental obligations).

5.3. Objectives

In order to meet the goal outlined in Section 5.1, the following objectives have been identified, together with necessary actions and monitoring requirements.

OBJECTIVE: Site establishment and securing the site

Site establishment is the first activity which is to be undertaken within the construction phase. Appropriate measures are required to be undertaken in order to minimise potential impacts on identified sensitive areas (refer to Figure 1.2).

Project component/s	» Wind turbines » Access roads » Substation » Power Line
Potential Impact	» Hazards to landowners/public » Security of materials » Substantially increased damage to natural vegetation
Activities/risk sources	» Open excavations (foundations and cable trenches) » Movement of construction vehicles in the area and on-site
Mitigation: Target/Objective	» To secure the site against unauthorised entry » To protect members of the public/landowners/residents » No loss of or damage to natural vegetation in areas outside immediate development footprint; measured monthly during duration of construction.

Mitigation: Action/control	Responsibility	Timeframe
Secure site, working areas and excavations in an appropriate manner, as agreed with the ECO.	Contractor ECO	Erection: during site establishment Maintenance: duration of contract
Where necessary to control access, fence and secure area and implement access control procedures.	Contractor	Erection: during site establishment Maintenance: duration of contract
Fence and secure Contractor's equipment camp.	Contractor	Erection: during site establishment Maintenance: duration of contract

Mitigation: Action/control	Responsibility	Timeframe
Fence off development footprints in sensitive areas in order to minimise disturbance to adjacent sensitive areas and to ensure it is clear to contractors where disturbance is permitted.	ECO	Prior to any construction activity
Minimise vegetation clearance or removal associated with site establishment activities, in line with an appropriate Plant Rescue and Protection Plan (refer to Appendix B)	Contractor	Site establishment
All development footprints for roads, buildings, underground cables, laydown areas and turbines should be appropriately fenced off and clearly marked. There is to be no disturbance outside these demarcated areas.	Contractor	Erection: during site establishment Maintenance: duration of contract
Establish the necessary ablution facilities with chemical toilets. Provide adequate sanitary facilities and ablutions for construction workers (1 toilet per every 15 workers) at appropriate locations on site.	Contractor	Erection: during site establishment Maintenance: duration of contract
Ablution or sanitary facilities should not be located within 100 m from a 1:100 year flood line including water courses, wetlands or within a horizontal distance of less than 100 m, whichever is applicable	Contractor	During site establishment, construction, maintenance
Supply adequate, contained and accessible waste collection bins and skips at site where construction is being undertaken. All work sites must be kept free of waste. No solid waste may be burned or buried on site or disposed of by any other method on site or within quarries or borrows pits. Remove stored domestic waste to the nearest registered solid waste disposal facility.	Contractor	Erection: during site establishment Maintenance: duration of contract within a particular area
Liquid waste: No liquid, including grey water, may be discharged into any water body or drainage line without purification with accordance to the Department of Water Affairs' (DWA) specifications and guidelines.	Contractor	Maintenance: duration of contract within a particular area
Ensure compliance with all national, regional and local legislation with regard to the storage, handling and disposal of hydrocarbons, chemicals, solvents and any other harmful and hazardous substances and materials. The onus is on the Contractor to identify and interpret the applicable legislation.	Contractor	During and post construction.

Mitigation: Action/control	Responsibility	Timeframe
Keep a record of all hazardous substances stored on site for submission to the ECO and follow the hazardous substance monitoring program.	Contractor	Construction.
An open space management plan must be implemented during the construction of the facility (refer to Appendix C).	Contractor	Pre-Construction
Water required for construction purposes to be sourced from legitimate sources such as the local municipality. If water to be abstracted from ground or surface water resources the relevant permit must be obtained from DWA.	Contractor	Pre-Construction

Performance Indicator	» Minimum vegetation clearance associated with site establishment activities. » No unnecessary environmental impacts associated with site established. » Site is secure and there is no unauthorised entry. » No members of the public/ landowners injured as a result of construction activities.
Monitoring	» An incident reporting system will be used to record non-conformances to the EMPr » ECO to monitor all construction areas on a continuous basis until all construction is completed; immediate report backs to site manager in terms of non-conformances recorded.

OBJECTIVE: Limit disturbance of vegetation and loss of protected flora during construction

Project component/s	» Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	» Loss of indigenous natural vegetation due to construction activities
Activity/risk source	» Site preparation and earthworks » Construction-related traffic » Foundations or plant equipment installation » Mobile construction equipment » Power line construction activities » Dumping or damage by construction equipment outside of demarcated construction areas.
Mitigation: Target/Objective	» Minimal loss of natural vegetation

Mitigation: Action/control	Responsibility	Timeframe
The plant rescue and protection plan should be implemented (see Appendix B).	Developer Contractor	Construction
The construction impacts must be contained to the footprint of the infrastructure.	Developer Contractor	Construction
Internal access roads and underground cables should be aligned as far as possible along existing linear disturbances.	Developer Contractor	Construction
Unnecessary impacts on surrounding natural vegetation must be avoided.	Developer Contractor	Construction
Rehabilitate any disturbed areas as soon as possible after construction is completed in an area in order to stabilise landscapes.	Developer Contractor	Construction

Performance Indicator	» No loss of natural vegetation within areas deemed as sensitive. » No impact on vegetation outside of demarcated construction areas.
Monitoring	» None

OBJECTIVE: Limit disturbance and impact on the Kleinberg River and drainage lines on the site

The major drainage feature which occurs within the site is Klein Berg River which bisects the site, more or less parallel to the R44. Historically the Klein Berg River would have contained a lot of riparian vegetation as well as an extensive associated floodplain. Today, this area has been very heavily impacted by agriculture and little of the original vegetation still exists. The banks of the river are dominated by alien woody species, mainly *Eucalyptus camaldulensis*, *Acacia saligna* and *Sesbania punicea*. Along the banks and side channels, species such as *Bolboschoenus maritimus*, *Cotula turbinata*, *Cotula coronopifolia*, *Persicaria attenuata* subsp. *attenuata* and *Rumex crispus* were observed. Outside of the main channel itself, the floodplain consists of sandy flats and hummocks dominated by *Cynodon dactylon* and various shrubs and forbs such as *Wiborgia fusca* subsp. *fusca*, *Eriocephalus africanus* var. *africanus*, *Galenia africana*, *Leysera gnaphalodes*, *Lobelia erinus* and *Monopsis simplex*. Alien species were also common or dominant in this area and included *Bromus diandrus*, *Echium plantageum*, *Lolium rigidum*, *Polypogon monspeliensis*, *Erodium cicutarium*, *Hordeum murinum* and *Hypochaeris radicata*. Despite the obvious degradation of the area, the river and floodplain are considered sensitive on account of the ecological role and function provided by the riverine corridor. This area was identified as sensitive during the EIA and the development footprint largely avoids impact to this area, with the only infrastructure elements within this area being the access roads and power line infrastructure. There are no turbines located within the floodplain of the river and the Klein Berg River would not be directly impacted by the development. However, an upgrade to the current farm bridge is required for access to the site.

Away from the Klein Berg River, there are a number of small dams on the property which are used for livestock watering and a newly built larger dam which is presumably for irrigation purposes. The dams are fringed by *Cynodon dactylon* with sedges and forbs such as *Bolboschoenus maritimus*, with occasional larger species such as *Typha capensis* and *Pseudoschoenus inanis*. The inflows of the dams have developed into small wetlands with species such as *Pennisetum macrourum* and *Micranthus alopecuroides* present.

The minor drainage lines within the site have been heavily impacted and most have been canalized or are incised as a result of erosion, internal access roads to the wind turbines may impact on drainage lines. There is little vegetation within the eroded channels themselves, but some remnants of the original flanking vegetation persist and includes species such as *Salvia africana-caerulea*, *Athanasia trifurcata*, *Dicerothamnus rhinocerotis*, *Berkheya rigida*, *Senecio pubigerus*, *Relhania fruticosa* and *Conyza scabrida* as well as the usual complement of alien annual grasses. Due

to the habitat these areas provide as well as their ecological role in flow regulation, these areas should be disturbed as little as possible.

Project component/s	» Any infrastructure or activity that will result in disturbance to drainage lines
Potential Impact	» Damage to drainage lines by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation). The focus should be on the functioning of the watercourse as a natural system.
Activity/risk source	» Site preparation and earthworks » Construction-related traffic » Foundations or plant equipment installation » Mobile construction equipment » Power line construction activities » Dumping or damage by construction equipment outside of demarcated construction areas.
Mitigation: Target/Objective	» No unauthorised changes or damage to drainage lines or watercourses within project area.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that power line towers are constructed at least 32 m from the drainage lines (i.e. span the drainage lines)	Developer, Contractor, ECO	Construction, Operation
The construction impacts must be contained to the footprint of the infrastructure.	Developer, Contractor, ECO	Construction, Operation
Rehabilitate any disturbed areas as soon as possible after construction is completed in an area.	Developer, Contractor, ECO	Construction, Operation
Develop and implement an appropriate stormwater management plan for all infrastructure.	Developer, Contractor, ECO	Construction, Operation
Infrastructure (including culverts and/or bridges) should not be placed within drainage line channels but should span them completely.	Developer, Contractor, ECO	Construction, Operation
Make use of existing access roads. If extra tracks are needed to conduct any activities on site, ensure that they are not in contravention of any environmental legislation or the EMPr.	Developer, Contractor, ECO	Construction, Operation
Stabilise banks using erosion control (gabions baskets, geotextile material / reno mattresses/hessian etc.) prior to any construction work in the vicinity on the Klein Berg River	Developer, Contractor, ECO	Construction

Performance Indicator	» No unauthorised impacts on water quality, water quantity, drainage lines/vegetation, natural status of watercourses
Monitoring	» Habitat loss in watercourses should be monitored before and after construction.

	» The presence and development of erosion features downstream of any construction through drainage lines must be monitored.

OBJECTIVE: Control alien invasive plants

The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodline of water courses and wetlands.

A wide variety of alien species are already present at the site and so further disturbance would serve to exacerbate these problems. Within areas that have not been ploughed for some time, diversity is significantly higher than the cultivated areas, but a large proportion of the species present on the site are alien species such as *Bromus tectorum*, *Bromus japonicus*, E*chium plantagineum* and *Hypochaeris radicata*. *Eucalyptus camaldulensis*, *Acacia saligna* and *Sesbania punicea*. Along the banks and side channels, species such as *Bolboschoenus maritimus*, *Cotula turbinata*, *Cotula coronopifolia*, *Persicaria attenuata* subsp. *attenuata* and *Rumex crispus* were observed along the Klein Berg River.

On-going alien and invasive plant monitoring and removal should be undertaken on all areas of natural vegetation within the project lease area on an annual basis. The section below provides a guideline for the Invasive Plant Management Plan and should be implemented together with consideration of the principles contained in the Department of Water Affairs: Working for Water Programme (refer to Appendix D).

Project component/s	» Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	» Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species
Activity/risk source	» Construction activities
Mitigation: Target/Objective	» No alien plants within project control area

Mitigation: Action/control	Responsibility	Timeframe
Avoid creating conditions in which alien plants may become established: a. keep disturbance of indigenous vegetation to a minimum b. rehabilitate disturbed areas as quickly as possible c. do not import soil from areas with alien plants	Contractor ECO	Construction
Establish an on-going monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act)	Contractor ECO	Construction
Immediately control any alien plants that become established using registered control methods	Contractor ECO	Construction
Cleared alien vegetation must not be dumped on adjacent intact vegetation during clearing but should be temporarily stored in a demarcated area	Contractor ECO	Construction
Removal of alien invasive species or other vegetation and follow-up procedures must be in accordance with the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) ..	Contractor ECO	Construction
Larger woody species such as *Acacia saligna* should be managed, especially along the floodplain of the Klein Berg River.	Contractor ECO	Construction

Performance Indicator	» For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	» On-going monitoring of area by environmental control officer during construction » On-going monitoring of area by environmental manager during operation » Annual audit of project area and immediate surroundings by qualified botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency depends on legal compliance framework.

OBJECTIVE: Limit disturbance of vegetation and loss of faunal habitat during construction

Game farming does occur on the site. Free-ranging species observed during the site visit includes Steenbok, Common Duiker, Vlei Rat, Cape Grey Mongoose, Cape Porcupine, African Mole Rat, Cape Mole Rat and Cape Gerbil. Three species of conservation concern potentially occur at the site, i.e. the White-tailed Mouse (Endangered), Leopard (Near Threatened) and the Honey Badger (SA RDB Endangered). Very few reptiles were observed at the site and the only species observed was the Angulate Tortoise.

Project component/s	» All activities which require or result in the clearing of or impact to vegetation
Potential Impact	» Loss of faunal habitat and impacts on resident listed and non-listed species
Activity/risk source	» Site preparation and earthworks » Construction-related traffic » Foundations or plant equipment installation » Mobile construction equipment » Power line construction activities
Mitigation: Target/Objective	» Minimal impact on terrestrial environment. » Reduced impact and disturbance of terrestrial fauna

Mitigation: Action/control	Responsibility	Timeframe
Demarcate important or sensitive areas as no-go areas.	Specialist, ECO	Pre-construction
Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.	Specialist, ECO	Construction
The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site.	Specialist, ECO	Construction
Prior to construction, the game that is farmed on the site should be moved to a separate came outside of the construction footprint for the wind energy facility.	ECO Contractor Landowner	Construction

Performance Indicator	» Walk-through report identifying sensitive areas. » Adjustments to final layout to avoid these areas
Monitoring	» Monitor alien plant abundance an annual basis. » Document re-vegetation actions taken and their success » Document erosion problems and the control measures implemented.

OBJECTIVE: A Wind Energy Facility that is sustainable in terms of its impacts on birds and bats

The potential interactions between birds and the proposed facility are: disturbance of birds during construction and maintenance; habitat destruction during construction and maintenance of the facility and associated infrastructure; displacement of birds from the site, or from flying over the site; collision of birds with turbine blades during operation; and collision and electrocution of birds on associated electrical infrastructure.

Bats have been found to be particularly vulnerable to being killed by wind turbines. It has long been a mystery why they should be so badly affected since bat echo-location allows them to detect moving objects very well. A recent study in America has found that the primary cause for mortality is a combination of direct strikes and barotrauma (bats are killed when suddenly passing through a low air pressure region surrounding the turbine blade tips causing low pressure damage the bat's lungs).

A pre-construction bird and bat monitoring programme was undertaken on site, in accordance with the South African best practice guidelines currently available. Areas of potential significance have been identified through this study, and bird and bat species occurring on the site have been recorded. Appropriate management measures are required to be implemented to ensure this impact is minimised as far as possible.

Project component/s	» Wind turbines » Access roads » Substation linking the facility to the electricity grid » Underground cabling » Power lines
Potential Impact	» Disturbance to or loss of birds and bats as a result of collision with the turbine blades » Disturbance to or loss of birds as a result of collision with the overhead power lines » Electrocution on power line and substation
Activity/risk source	» Results of pre-construction monitoring not integrated into the final layout and/or the mitigation scheme » Lack of clear communication between the scientist analysing the monitoring data and the client » Misinterpretation of either monitoring data
Mitigation: Target/Objective	» No significant impacts on identified bird or bat species of concern. » The delivery of an effective impact mitigation scheme for the

	facility, informed initially by influence of pre-construction monitoring on final construction plans, and refined by post-construction monitoring of actual impacts, and resulting adjustments in management practices and mitigation measures applied

Mitigation: Action / control	Responsibility	Timeframe
Ensure construction EMPr is applied, with particular reference to minimising the temporary and permanent development footprint, and the extent and duration of noise and movement disturbance, and ensuring that stipulations re sensitive areas and times are adhered to.	Environmental Control Officer	During construction
Conduct bird and bat monitoring during the construction and operational phases	Advising avifauna consultant	Construction and Operational
Refine post-construction monitoring protocol in terms of results from pre-construction.	Advising avifauna consultant	As soon as possible / practical after construction completed
Bird diverters must be installed on the new power line.	Contractor	Construction

Performance Indicator	» Regular provision of information on the interface between the local avifauna and bats and the proposed/operating Wind Energy Facility » Clear and logical recommendations on why, how and when to institute mitigation measures to reduce avian/bat impacts of the development, from pre-construction to operational phase » Quantifiable reductions in avian/bat impacts once the facility is operational
Monitoring	» Map extent of suitable habitats for priority species before construction. » Identify project components that infringe on habitat and or longevity of species of concern. » After construction, record any disturbance to habitat in terms of extent and potential effects on remaining habitat. » 3-monthly and annual reports produced by the scientist advising the monitoring project

OBJECTIVE: To avoid and or minimise the potential risk of increased veld fires during the construction phase

Uncontrolled, unplanned fires will not serve their desired purpose and may serve to place the vegetation in the study area and the people at risk of veld fires.

Project component/s	Construction and establishment activities associated with the wind energy facility and associated infrastructure
Potential Impact	Veld fires can pose a personal safety risk to local farmers and communities, and their homes, livestock and farm infrastructure, such as gates and fences.
Activities/risk sources	The presence of construction workers and their activities on the site can increase the risk of veld fires.
Mitigation: Target/Objective	To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that open fires on the site for cooking or heating are not allowed except in designated areas.	Contractor	Duration of construction
Provide adequate fire fighting equipment onsite.	Contractor	Duration of construction
Provide fire-fighting training to selected construction staff.	Contractor	Duration of construction
Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to infrastructure etc., for losses associated with fires resulting from negligence or non-compliance.	Contractor	As required

Performance Indicator	» Designated areas for fires identified on site at the outset of the construction phase. » Fire fighting equipment and training provided before the construction phase commences. » Compensation claims settled within 1 month of claim being verified by Community Monitoring Forum.
Monitoring	» Zen Wind Farm (Pty) Ltdand or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Minimise soil degradation and erosion (Erosion management Plan)

The natural geological profile including bedrock and soil cover must be preserved as far as possible to minimise unforeseen impacts on the surrounding environment.

A set of strict mitigation measures are required to be implemented in order to effectively limit the impact on the geological environment. The proposed disturbance areas - where construction activity is likely to occur - are the focus of the mitigation measures laid out below.

Management of erosion will be required during the construction phase of the facility. An erosion management plan is required to ensure compliance with applicable regulations and to prevent increased soil erosion and sedimentation of the downstream environment. The section below provides a guideline for the management of erosion on site and will need to be supplemented with the principles for erosion management contained in the Erosion Management Plan included in Appendix E.

Project component/s	» Wind turbines » Access roads » Substation linking the facility to the electricity grid » Underground cabling » Power line
Potential Impact	» Soil and rock removal » Soil mixing, wetting, stockpiling, compaction » Soil pollution » Accelerated soil erosion » Increased deposition of soil into drainage systems » Increased run-off over the site » Dust pollution
Activities/risk sources	» Construction activity – earthworks & transportation across site » Machinery, chemicals and human waste – soil pollutants » Rainfall - water erosion of disturbed areas » Wind erosion of disturbed areas
Mitigation: Target/Objective	» To minimise size of construction disturbance areas » To minimise destructive activity within disturbance areas & prevent unnecessary activity outside of disturbance areas » To minimise soil degradation (removal, excavation, mixing, wetting, compaction, pollution, erosion, etc.) » To minimise deposition of soil into drainage lines » To minimise the loss of topsoil » To minimise dust pollution

Mitigation: Action/control	Responsibility	Timeframe
Blasting a(if required0 must be undertaken in line with the relevant blasting and construction regulations of South Africa	Contractor	Construction

Mitigation: Action/control	Responsibility	Timeframe
Identify areas of high erosion risk (drainage lines/watercourses). Only special works to be undertaken in these areas to be authorised by ECO and Engineer's representative (ER).	ECO/ER/Contractor	Before and during construction
Identify disturbance areas for general construction work and restrict construction activity to these areas.	ECO/ER/Contractor	Before and during construction
Prevent unnecessary destructive activity within disturbance areas (prevent over-excavations and double handling)	ECO/ER/Contractor	Before and during construction
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary degradation of soil. Special attention to be given to roads that cross drainage lines and roads on steep slopes (to prevent unnecessary cutting and filling operations).	ECO/ER/Contractor	Before and during construction
Dust control on construction site: Wetting or covering of cleared areas.	Contractor	During construction
Minimise removal of vegetation which aids soil stability.	ECO/Contractor	During construction
Rehabilitate disturbance areas as soon as an area is vacated.	Contractor	During and after construction
Soil conservation: Stockpile topsoil for re-use in rehabilitation phase. Protect stockpile from erosion. As per the Erosion Management Plan in Appendix E.	Contractor	Before and during construction
Erosion control measures: Run-off control and attenuation on slopes (sand bags, logs), silt fences, stormwater channels and catch-pits, shade nets, soil binding, geofabrics, hydroseeding or mulching over cleared areas.	Contractor/ECO	Erection: Before construction Maintenance: Duration of contract
Where access roads cross natural drainage lines, culverts must be designed to allow free flow. Regular maintenance must be carried out.	ECO/ER/Contractor	Before construction and maintenance over duration of contract
Control depth of excavations and stability of cut faces/sidewalls.	ECO/ER/Contractor	Before construction and maintenance over duration of contract
A Stormwater Management Plan to be implemented	ECO/ER	Before and

Mitigation: Action/control	Responsibility	Timeframe
during, construction of the facility.		during construction
Develop and implement an erosion management system for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this system is to prevent and reduce risk of any potential erosion.	ECO/ER/Contractor	Before construction and maintenance over duration of contract
Foundations and trenches must be backfilled with originally excavated materials as and where possible. Excess excavation materials must be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.	Before and during construction	During construction
Determine the best ways to utilise waste rock material from excavations, preferably as part of road construction or erosion control, where necessary to avoid having to stockpile such materials	ECO/ER/Contractor	Before and during construction

Performance Indicator	» Only authorised activity outside disturbance areas » No activity in no-go areas » Acceptable level of activity within disturbance areas, as determined by ECO » Acceptable level of soil erosion around site, as determined by ECO » Acceptable level of increased siltation in drainage lines, as determined by ECO » Acceptable level of soil degradation, as determined by ECO » Acceptable state of excavations, as determined by ER & ECO
Monitoring	» Fortnightly inspections of the site » Fortnightly inspections of sediment control devices » Fortnightly inspections of surroundings, including drainage lines » Immediate reporting of ineffective sediment control systems » An incident reporting system will record non-conformances

OBJECTIVE: Maximise local employment and business opportunities associated with the construction phase

Employment opportunities could be created during the construction phase although limited. The unemployment rate in the study area is quite high and there are therefore various individuals in the area in search of employment. As indicated it is foreseen that it would be possible to make use of local labour for sections of the construction activities. Opportunities for SMMEs to be considered for some of the

construction activities also exist. Employment of locals and the involvement of local SMMEs would enhance the social benefits associated with the project, even if the opportunities are only temporary. The procurement of local goods could furthermore result in positive economic spin-offs.

Project component/s	Construction and establishment activities associated with the establishment of the facility and associated infrastructure such as the power line and substations.
Potential Impact	The opportunities and benefits associated with the creation of local employment and business should be maximised.
Activities/risk sources	» Contractors who make use of their own labour thereby reducing the employment and business opportunities for locals. » The inflow of various specialists from outside the study area and even abroad » Sourcing of individuals outside the municipal area
Mitigation: Target/Objective	The project proponent should aim to employ a maximum number of the low-skilled to semi-skilled workers from the local area where possible. This should also be stipulated in the tender documentation and contractors should adhere to this guideline. Inputs from the Ubuntu Local Municipality in this regard would be critical.

Mitigation: Action/control	Responsibility	Timeframe
Employment of local community members (e.g. source labour from within the municipal area) should be undertaken where possible.	Project proponent, Drakenstein Local Municipality & Contractor	Construction
A broad-based approach should be followed to identify and involve relevant organisations which could assist the main contractor and project proponent in identifying people whose skills may correspond with the job specifications	Project proponent, Drakenstein Local Municipality & Contractor	Construction
An equitable process should be promoted whereby locals and previously disadvantaged individuals (women) are taken into account.	Drakenstein Local Municipality & Project proponent	Construction
Create conditions that are conducive for the involvement of entrepreneurs, small businesses, and SMMEs during the construction process.	Drakenstein Local Municipality, Project proponent & Contractor	Construction
Tender documentation should contain guidelines for the involvement of labour, entrepreneurs, businesses and SMMEs from the local sector.	Project proponent & Contractor	Construction
A local labour desk should be set-up (if not already established) in the beneficiary communities to co-ordinate the process of involving local labour.	Drakenstein Local Municipality & Contractor	Construction
Communication efforts concerning job creation	Project proponent	Construction

Mitigation: Action/control	Responsibility	Timeframe
opportunities should refrain from creating unrealistic expectations.		

Performance Indicator	» Job opportunities, especially of low to semi-skilled positions, are primarily awarded to members of local communities. » Locals and previously disadvantaged individuals (women) are taken into account during the hiring process. » SMMEs are awarded with contracts during the construction phase. » Labour, entrepreneurs, businesses and SMMEs from the local sector are awarded with jobs, based on requirements in the Tender Documentation. » The involvement of local labour is promoted. » Reports are not made from members of the local communities regarding unrealistic employment opportunities.
Monitoring	» Project proponent and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Address economic inequities within the study area and enhance capacity building and skills training

Due to the high unemployed figures in the study area, it is also clear that there would be various unemployed persons in search of employment, even if they can only secure temporary positions. For the lower level skilled positions, outsiders would thus definitely not have to be sourced. Even though all that would be employed might not have the necessary applicable skills, this issue could be addressed through proper focused skills training and capacity building initiatives after locals have been sourced, but prior to construction activities starting.

Project component/s	Availability of required skills in the local communities
Potential Impact	The opportunities and benefits associated with the creation of local employment and business could be maximised as it is anticipated that sufficient locals would have the necessary skills to be employed.
Activity/risk source	Unavailability of locals with the required skills resulting in locals not being employed and labour be sourced from outside the Drakenstein Local Municipality area. Higher skilled positions might even be sourced internationally
Mitigation: Target/Objective	Project proponent, in discussions with the Drakenstein Local Municipality, should aim to employ a maximum number of the low-skilled workers from the local area where possible. Should the necessary skills not be readily available, skills training and capacity building should be undertaken

Mitigation: Action/control	Responsibility	Timeframe
A broad-based approach should be followed to identify and involve relevant organisations in identifying people whose skills may correspond with the job specifications.	Project proponent and Drakenstein Local Municipality	Construction
In cases for the semi-skilled jobs, where the relevant skills do not exist, training should be provided to willing local community members to enable them to fill the positions.	Project proponent and Contractor	Construction
Capacity building and skills development should include on-site training and tailor made individual packages to further each individual.	Project proponent and Contractor	Construction
Capacity building initiatives could link in with existing capacity building and skills training initiatives of the Drakenstein Local Municipality and/or other initiatives of contractors.	Project proponent and Drakenstein Local Municipality	Construction

Performance Indicator	» A skills development plan is developed » Job opportunities, especially of lower skilled positions, are primarily awarded to members of local communities. » Skills training and capacity building initiatives are developed and implemented » Local SMMEs and/or entrepreneurs should be awarded the opportunity to become involved in the tender process.
Monitoring	» Project proponent and or appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: To minimise traffic related impacts (Traffic Management Plan)

Access to the farms under investigation can be obtained from the R44 to Saron. The imported wind turbines would be transported via sea to South Africa (to the Port in Cape Town) where after they would be transported along the national, secondary and local access roads to the actual site. Due to the size of the wind turbines and the abnormal size of the vehicles that would be required, some of the secondary and local roads would have to be upgraded prior to the delivery of the turbines, which would include widening of corners and/or bridges. Abnormal vehicles would have the most detrimental impact on the local roads' surface and capacity. Additional construction vehicles that would make use of the national, secondary and local roads to access the construction site(s) would include cranes, trucks, excavators, graders and those heavy vehicles transporting the materials and equipment required for especially the wind component of the proposed facility.

Project component/s	Traffic related impacts on existing road infrastructure and property owners situated along the routes to be travelled and those surrounding the construction site, as well as possible impact on local road users.
Potential Impact	Impact of abnormal sized vehicles and general heavy construction vehicles on road surfaces, and possible increased risk in accidents involving people and animals
Activities/risk sources	Construction vehicle movement Speeding on local roads Degradation of local road conditions
Mitigation: Target/Objective	Minimise the impact of the increase in abnormal and heavy vehicles on existing infrastructure, property owners, animals and road users.

Mitigation: Action/control	Responsibility	Timeframe
The contractor's plans, procedures and schedules, as well as the anticipated intrusion impacts should be clarified with affected parties prior to the construction phase.	Developer and Environmental Control Officer	Pre-Construction
All regulations and legislation pertaining to the use of provincial and local roads by abnormal vehicles to transport the wind turbines should be noted and adhered to.	Developer, Contractor and relevant government departments (national and provincial)	Pre-construction Construction
Speeding of construction vehicles should be avoided at all costs.	Contractor & Environmental Control Officer	Construction
Strict vehicle safety standards should be implemented and monitored.	Contractor & Environmental Control Officer	Construction
Property owners of the surrounding farms should at all times have proper access to their properties.	Contractor & Environmental Control Officer	Construction
The local gravel access roads frequently used by construction vehicles should regularly be graded by the project proponent to limit the degradation of the road surface.	Developer	Construction
Signage must be used for public road safety along the R44 during the transport and construction phases.	Developer	Construction

Performance Indicator	» Vehicles keeping to the speed limits. » Vehicles are in good working order and safety standards are implemented. » Local residents and road users are aware of vehicle movements

	and schedules. » Property owners have access to their properties at all times. » No traffic related accidents are experienced. » Local road conditions and road surfaces are up to standard. » Complaints of residents are not received (e.g. with regards to the speeding of heavy vehicles).
Monitoring	» Zen Wind Farm (Pty) Ltd and/or appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: To minimise the potential impact on safety and security

An inflow of workers could, as a worst case scenario and irrespective of the size of the workforce, pose some security risks. Criminals could also use the opportunity due to "outsiders" being in the area to undertake their criminal activities. The actual safety of construction workers is also of concern due to the large equipment used and the size of the turbines to be erected. Further health and safety issues associated with the actual construction site include unauthorised entry to the site and construction areas, the usage of large cranes on site, the risks associated with the storage of equipment and material on site, as well as the increased risk of accidents due to the increased movement of construction vehicles on the local roads.

Other concerns relate to littering, unwanted behaviour of construction workers, transmission of Sexually Transmitted Diseases (STDs), environmental pollution, an increase risk in fires and so forth. Although such perceptions cannot be substantiated or be changed it should be sensitively dealt with. It is thus clear that even though the construction phase when these impacts could occur is only of a very short to short duration, the effects of the impacts could remain in the medium term.

Project component/s	Inflow of workers could result in increased safety and security risks.
Potential Impact	Outside workers are involved in criminal activities and/or fires occur.
Activities/risk sources	» Safety of individuals and animals are at risk » Theft of livestock » Theft of construction material » On-site accidents » Spread of sexually transmitted diseases » Littering and environmental pollution
Mitigation: Target/Objective	Employment of local labour should be maximised and strict security measures should be implemented at the construction site.

Mitigation: Action/control	Responsibility	Timeframe
Employing local community members could minimise the potential for criminal activity or perceived perception of an increase in criminal activity due to the presence of an outside workforce.	Contractor	Pre-Construction
Screening of workers that apply for work could be useful to lessen perceived negative perceptions about the outside workforce.	Contractor	Pre-Construction
Construction workers should be easily identifiable by wearing uniforms and even identity tags.	Contractor	Construction
Local community members and property owners should be informed of the presence of the outside workforce, the construction schedule and movement of workers.	Project proponent	Construction
Care should be taken to avoid conflict between the local communities and the "outside" workforce.	Project proponent and Contractor	Pre-Construction and Construction
Property owners, their workers, as well as local communities should be motivated to be involved in crime prevention and by reporting crimes.	Project proponent Local communities	All phases of project
The construction site should be fenced and access to the area controlled.	Project proponent and Contractor	All phases of project
Security personnel should be aware of the possibility of animal theft and poaching and should be able to identify possible criminal elements and/or criminal activities in this regard.	Project proponent and Contractor	Construction
Procedures and measures to prevent, and in worst cases, attend to fires should be developed in consultation with the surrounding property owners and Drakenstein Local Municipality.	Project proponent Drakenstein Local Municipality, Local communities	Pre-Construction and when required

Performance Indicator	» No criminal activities and theft of livestock attributed to workforce are reported. » No fires occur. » No on-site accidents occur. » No long term increase in the prevalence of STDs.
Monitoring	» Project proponent, and appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: To minimise the potential impact on the daily living and movement patterns and farming activities

The farm under investigation is currently used for crop production and grazing. During the construction phase some negative impacts on the resource use on the farm are anticipated due to the extent of the construction activities. Alternative grazing areas would have to be found for the livestock currently grazing on the areas to be used for the wind turbines. Game should also be moved outside of the construction areas. Farming activities could furthermore be negatively impacted on by general intrusions and noise associated with the construction activities such as the increase in vehicular movement and possible blasting noise.

Some intrusion impacts due to the construction activities and vehicular movements (noise and dust) on the surrounding property owners could be experienced, but it is not anticipated that their farming activities would be negatively affected during the construction phase, except if construction workers and/or jobseekers would enter these properties and in the event that stock thefts occur.

Project component/s	Construction activities could impact on the farming activities undertaken on the farms under investigation, as well as impact on the activities and daily living and movement patterns of the surrounding farms
Potential Impact	» Loss of resource use » Dust and noise pollution » General intrusion
Activities/risk sources	» Possible loss of income should sheep farming not continue » Increased risk of accidents due to increase in vehicle movement » Possible degradation of local roads » Dust and noise pollution negatively affecting farming activities
Mitigation: Target/Objective	Limit any negative impacts on the farming activities and on the surrounding property owners' daily living and movement patterns

Mitigation: Action/control	Responsibility	Timeframe
Additional access roads at the construction sites should be kept to a minimum. Access roads and entrances to the site should be carefully planned to limit any intrusion on the neighbouring property owners and road users	Contractor	Construction
Noise and dust pollution should be limited . Gravel roads could be sprayed with water to limit dust creation if economically feasible and	Contractor	Construction

Mitigation: Action/control	Responsibility	Timeframe
reasonable from an environmental perspective (water scarce area)		
Surrounding property owners should be notified if and when blasting would occur	Project proponent and Contractor	Construction
Construction vehicles should adhere to the speed limits and should be inspected to ensure that these are in good working order and not overloaded	Project proponent and Contractor	Construction
The movement of abnormal loads should be communicated to the property owners in the study area and the necessary permits and authorisations should be obtained from the relevant government departments	Project proponent Local communities	Construction
Source general construction material and goods locally where available to limit transportation of these over long distances	Project proponent and Contractor	Construction
The property owners affected should put pro-active measures in place to find alternative grazing areas for the sheep currently grazing on the affected areas	Project proponent	Construction
Local labourers should be used during the construction phase to limit the inflow of outsiders to the area	Project proponent Drakenstein Local Municipality	Construction

Performance Indicator	» No loss of resource use and no loss of income » No noise and dust pollution » Limited intrusions on surrounding property owners » Limited or no reports from property owners regarding problems with construction activities and workforce » No degradation of local roads
Monitoring	» Project proponent, and appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: Noise control

Projected noise levels during construction of the Wind Energy Facility were modelled using the methods as proposed by SANS 10357:2004. The resulting future noise projections indicated that the construction activities, as modelled for the worst case scenario, would comply with the Noise Control Regulations (GN R154) as well as the acceptable day rating levels as per the SANS 10103:2008 guidelines.

Various construction activities will be taking place during the development of the facility and may pose a noise risk to them. While this study investigated likely and

significant noisy activities, it did not evaluate all potential activities that could result in a noise impact. These activities could include temporary or short-term activities where small equipment is used (such as the digging of trenches to lay underground power-lines).

Project component/s	Construction of infrastructure, including but not limited to: turbine system (foundation, tower, nacelle, and rotor), substation(s), access roads and electrical power cabling.
Potential Impact	» Increased noise levels at potentially sensitive receptors » Potentially changing the acceptable land use capability
Activity/risk source	» Any construction activities taking place within 500 m from potentially sensitive receptors
Mitigation: Target/Objective	» Ensure equivalent A-weighted noise levels below 45 dBA at potentially sensitive receptors. » Ensure that maximum noise levels at potentially sensitive receptors be less than 65 dBA. » Prevent the generation of disturbing or nuisance noises » Ensure acceptable noise levels at surrounding stakeholders and potentially sensitive receptors. » Ensuring compliance with the Noise Control Regulations

Mitigation: Action/control	Responsibility	Timeframe
Establish a line of communication and notify all stakeholders and potentially sensitive receptors of the means of registering any issues, complaints or comments.	ECO	All phases of project
Notify potentially sensitive receptors about work to take place at least 2 days before the activity in the vicinity (within 500 m) of the potentially sensitive receptors is to start. Following information to be presented in writing: » Description of activity to take place » Estimated duration of activity » Working hours » Contact details of responsible party	Contractor, ECO	Duration of construction; At least 2 days, but not more than 5 days before activity is to commence
Ensure that all equipment is maintained and fitted with the required noise abatement equipment.	ECO	Weekly inspection
When any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured	Acoustical Consultant / Approved Noise Inspection Authority	Within 7 days after complaint was registered
The construction crew must abide by the local by-laws regarding noise.	Contractor, ECO	Duration of construction

Mitigation: Action/control	Responsibility	Timeframe
		phase
Where possible construction work should be undertaken during normal working hours (06H00 – 22H00), from Monday to Saturday; If agreements can be reached (in writing) with the all the surrounding (within a 1,000 distance) potentially sensitive receptors, these working hours can be extended	Contractor	As required
All noisy construction operations should only occur during daylight hours in areas located close to noise sensitive receptors.	Contractor, ECO	Duration of construction phase

Performance Indicator	» Equivalent A-weighted noise levels below 45 dBA at potentially sensitive receptors (8 hours). » Ensure that maximum noise levels at potentially sensitive receptors are less than 65 dBA. » No noise complaints are registered
Monitoring	» Quarterly noise monitoring by an Acoustic Consultant or Approved Noise Inspection Authority. » Noise monitoring to be conducted downwind from all noisy activities or at potentially sensitive receptors when work is taking place within 1 000 meters from a potentially sensitive receptor. » Monitoring to take place every time that a noise complaint is registered.

OBJECTIVE: Management of dust and emissions to air

During the construction phase, limited gaseous or particulate emissions are anticipated from exhaust emissions from construction vehicles and equipment on-site, as well as vehicle entrained dust from the movement of vehicles on the main and internal access roads.

Project component/s	Construction and establishment activities associated with the wind energy facility and associated infrastructure.
Potential Impact	» Dust and particulates from vehicle movement to and on-site, foundation excavation, road construction activities, road maintenance activities, temporary stockpiles, and vegetation clearing affecting the surrounding residents and visibility. » Release of minor amounts of air pollutants (for example NO_2, CO and SO_2) from vehicles and construction equipment.
Activities/risk sources	» Clearing of vegetation and topsoil » Excavation, grading, scraping

	» Transport of materials, equipment and components on internal access roads » Re-entrainment of deposited dust by vehicle movements » Wind erosion from topsoil and spoil stockpiles and unsealed roads and surfaces » Fuel burning vehicle engines
Mitigation: Target/Objective	» To ensure emissions from all vehicles are minimised, where possible, for the duration of the construction phase » To minimise nuisance to the community from dust emissions and to comply with workplace health and safety requirements for the duration of the construction phase

Mitigation: Action/control	Responsibility	Timeframe
Roads must be maintained to a manner that will ensure that dust from road or vehicle sources is not visibly excessive. Ensure that damage to roads is repaired on completion of construction phase.	Contractor	Site establishment; duration of construction
Appropriate dust suppressant must be applied on all exposed areas and stockpiles as required to minimise/control airborne dust.	Contractor	Duration of contract
Haul vehicles moving outside the construction site carrying material that can be wind-blown must be covered with tarpaulins.	Contractor	Duration of contract
Speed of construction vehicles must be restricted, as defined by the ECO.	Contractor	Duration of contract
Disturbed areas must be re-vegetated as soon as practicable once construction is completed in an area.	Contractor	At completion of construction phase
Construction vehicles and equipment must be maintained in a road-worthy condition at all times.	Contractor	Duration of contract
If monitoring results or complaints indicate inadequate performance against the criteria indicated, then the source of the problem must be identified, and existing procedures or equipment modified to ensure the problem is rectified.	Contractor	Duration of contract

Performance Indicator	» No complaints from affected residents or community regarding dust or vehicle emissions associated with construction activties. » Dust suppression measures on roads implemented for all areas that require such measures during the construction phase commences. » Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed. » Road worthy certificates in place for all heavy vehicles at outset of construction phase and up-dated on a monthly basis.

Monitoring	» Monitoring must be undertaken to ensure emissions are not exceeding the prescribed levels via the following methods: * Visual daily inspections of dust generation by construction activities throughout the construction phase. * Immediate reporting by personnel of any potential or actual issues with nuisance dust or emissions to the Project Manager. * A complaints register must be maintained, in which any complaints from residents/the community will be logged. Complaints will be investigated and, where appropriate, acted upon. * An incident reporting system must be used to record non-conformances to the EMP.

OBJECTIVE: Management of impacts of the proposed facility on heritage resources and archaeological material

The main cause of impacts to archaeological and fossil material during construction activities is physical disturbance of the material itself and its context. The heritage and scientific potential of an archaeological site is highly dependent on its geological and spatial context. This means that even though, for example a deep excavation may expose archaeological artefacts, the artefacts are relatively meaningless once removed from the area in which they were found. Large-scale excavations for foundations will damage archaeological sites, as will road construction activities. Archaeological mitigation must take place prior to the start of construction.

If at any stage during the construction phase any semblance of a fossil is observed, it would be vital to stop the work immediately and report this occurrence to SAHRA and / or a professional palaeontologist as soon as possible so that appropriate mitigation measures can be implemented. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

In the unlikely event that any concentrations of archaeological/fossil material or human remains are uncovered during further development of the site, all work must immediately cease and be should reported to the South African Heritage Resources Agency so that systematic and professional investigation/excavations can be undertaken. Sufficient time should be allowed to remove/collect such material.

Construction managers/foremen should be informed before the start of construction on the possible types of heritage sites and cultural material they may encounter and the correct procedures to follow when they encounter sites. It is suggested that one

person be trained to be on site and report to the site manager when possible sites are encountered.

Project component/s	» Wind turbines » Access roads » Underground cabling » Substation » Power line » Associated infrastructure
Potential Impact	» Irreplaceable loss of the archaeological heritage and fossil material
Activity/risk source	» Site preparation and earthworks » Foundations or plant equipment installation » Mobile construction equipment movement on site » Power line construction activities
Mitigation: Target/Objective	» To ensure that any heritage objects found on site are treated appropriately and in accordance with the relevant legislation

Mitigation: Action/control	Responsibility	Timeframe
Train ECO and construction personnel regarding identification of heritage sites	Archaeologist	Pre-construction
Report exposed human remains to Heritage Western Cape and SAHRA to guide on removal process for heritage artefacts.	HWC, SAHRA, heritage consultant authority/archaeologist / ECO	Pre-construction
If at any stage during the construction phase any semblance of a fossil were to be observed, it would be vital to recover the fossil and report the occurrence to a heritage specialist.	Developer/ Contractor/ Appointed professional archaeologist/s in consultation with palaeontology Specialist/ ECO	Construction
If a heritage object is found any activities in that area must be stopped immediately, and appropriate specialists must be brought in to assess the site (photographs and GPS points must be recorded), the administering authority (Heritage Western Cape) of the item/site must be notified, and must undertake due/required processes. Where required the necessary and relevant permits must be obtained.	Developer/ Contractor/ appointed professional archaeologist/ ECO	Construction
Monitoring vegetation clearing and construction activities	Developer/Contractor/ appointed relevant professional archaeologist/ ECO	Construction

Performance Indicator	» Zero disturbance outside of designated work areas » All heritage/fossil material located are dealt with as per the legislative guidelines » A record is kept of all instances of accidental disturbance of heritage/fossil material, as well as post construction review of impacts on landscape context. » Compliance with the recommendations in the heritage report and Heritage Western Cape's Record of Decision (RoD) » Site visit, assessment report and recommendations to Heritage Western Cape in terms of archaeology and palaeontology
Monitoring	» Supervision of all clearing and earthworks by ECO and/or archaeologist throughout construction phase

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Zen Wind Facility

The duration of the construction phase of the facility is dependent on the number of turbines being constructed, and is estimated at 2-3 days per turbine depending on local conditions. During the construction period, there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and landowners in the area.

In this environment, dust from construction work is also likely to represent a significant visual impact.

Project component/s	» Wind turbines » Ancillary infrastructure (i.e. substation, power line, access roads, underground cables, etc.)
Potential Impact	» Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing.
Activity/risk source	» The viewing of the above mentioned by observers on or near the site.
Mitigation: Target/Objective	» Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.

Mitigation: Action/control	Responsibility	Timeframe
Plan the placement of lay-down areas and temporary construction camps in order to minimise vegetation clearing.	Developer, Contractor	Construction
Restrict the activities and movement of construction	Developer,	Construction

Mitigation: Action/control	Responsibility	Timeframe
workers and vehicles to the immediate construction site and existing access roads.	Contractor	
Ensure that rubble, litter and disused construction materials are managed and removed regularly.	Developer, Contractor	Construction
Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way.	Developer, Contractor	Construction
Reduce and control construction dust through the use of approved dust suppression techniques.	Developer, Contractor	Construction
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Developer, Contractor	Construction
Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.	Developer, Contractor	Construction

Performance Indicator	» Vegetation cover on and in the vicinity of the site is intact with no evidence of degradation or erosion.
Monitoring	» Monitoring of vegetation clearing during construction. » Monitoring of rehabilitated areas post construction.

OBJECTIVE: Traffic management and transportation of equipment and materials to site

The construction phase of the project will be the most significant in terms of generating traffic impacts; resulting from the transport of equipment (including turbine components) and materials and construction crews to the site and the return of the vehicles after delivery of materials. Potential impacts associated with transportation and access relate to works within the site boundary (i.e. the Wind Energy Facility and ancillary infrastructure) and external works outside the site boundary.

Project component/s	» Wind turbines » Substations » Power line
Potential Impact	» Traffic congestion, particularly on narrow roads or on road passes where overtaking is not permitted » Risk of accidents » Deterioration of road pavement conditions (i.e. both surfaced and gravel road) due to abnormal loads
Activity/risk	» Transportation of project components to site

source	
Mitigation: Target/Objective	» To minimise impact of traffic associated with the construction of the facility on local traffic » To minimise potential for negative interaction between pedestrians or sensitive users and traffic associated with the facility construction

Mitigation: Action/control	Responsibility	Timeframe
Developer and implement a transportation/traffic management plan.	Contractor, Transportation contractor)	Duration of contract
All relevant permits for abnormal loads must be applied for from the relevant authority.	Contractor, Transportation contractor)	Duration of contract
A designated access (or accesses) to the proposed site must be created to ensure safe entry and exit.	Contractor	Duration of contract
Appropriate road management strategies must be implemented on external and internal roads with all employees and contractors required to abide by standard road and safety procedures.	Contractor, Transportation contractor)	Duration of contract
Any traffic delays because of construction traffic must be co-ordinated with the appropriate authorities.	Contractor	Duration of contract
Signage must be established at appropriate points warning of turning traffic and the construction site (all signage to be in accordance with prescribed standards).	Contractor	Duration of contract
Appropriate maintenance of all vehicles must be ensured.	Contractor	Duration of contract
All vehicles travelling on public roads must adhere to the specified speed limits and all drivers must be in possession of an appropriate valid driver's license.	Contractor	Duration of contract
Keep hard road surfaces as narrow as possible.	Contractor	Duration of contract
Utilise construction warning signage.	Contractor	Duration of contract

Performance Indicator	» No avoidable traffic incidents involving construction personnel » Appropriate signage in place » No complaints resulting from traffic congestion, delays or driver negligence associated with construction of the Wind Energy Facility
Monitoring	» Visual monitoring of dust produced by traffic movement » Visual monitoring of traffic control measures to ensure they are effective

	» A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMP

OBJECTIVE: Appropriate handling and storage of chemicals, hazardous substances and waste

The construction phase of the Wind Energy Facility will involve the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents. The main wastes expected to be generated by the construction of the facility will include general solid waste, hazardous waste and liquid waste. A guideline for integrated management of construction waste is included as Appendix G of this EMPr.

Project component/s	» Storage and handling of chemicals, hazardous substances and waste
Potential Impact	» Release of contaminated water from contact with spilled chemicals » Generation of contaminated wastes from used chemical containers » Inefficient use of resources resulting in excessive waste generation » Pollution of the surrounding environment through inappropriate waste management practices » Litter or contamination of the site or water through poor waste management practices » Pollution of water and soil resources
Activity/risk source	» Wind turbine construction activities » Power line construction activities » Substation construction activities » Packaging and other construction wastes » Hydrocarbon use and storage » Spoil material from excavation, earthworks and site preparation
Mitigation: Target/Objective	» To ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons » To ensure that the storage and maintenance of machinery on-site does not cause pollution of the environment or harm to persons » To comply with waste management guidelines developed by contractor

	» To minimise production of waste » To ensure appropriate waste handling, storage and disposal » To avoid environmental harm from waste disposal

Mitigation: Action/control	Responsibility	Timeframe
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Contractor	Duration of contract
Corrective action must be undertaken immediately if a complaint is made, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing preventive measures.	Contractor	Duration of contract
In the event of a major spill or leak of contaminants, the relevant administering authority must be immediately notified as per the notification of emergencies/incidents.	Contractor	Duration of contract
Spilled cement must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	Contractor	Duration of contract
Soil contaminated/ polluted because of a major spill must be removed from the site and disposed of at a licensed hazardous waste disposal facility. Soils contaminated/ polluted through minor spills can be treated on site provided they are contained and have not penetrated the soil surface.	Contractor	Duration of contract
Routine servicing and maintenance of vehicles must not take place on-site outside of designated areas (except for emergencies or large cranes which cannot be moved off-site). If repairs of vehicles must take place on site, an appropriate drip tray must be used to contain any fuel or oils.	Contractor	Duration of contract
All stored fuels to be maintained within a bunded area and on a sealed surface.	Contractor	Duration of contract
Fuel storage areas must be inspected regularly to ensure bund stability, integrity, and function.	Contractor ECO	Duration of contract
Construction machinery must be stored in an appropriately sealed area.	Contractor	Duration of contract
Oily water from bunds at the substations must be removed from site by licensed contractors.	Contractor	Duration of contract
The storage of flammable and combustible liquids such as oils will be in designated areas which are appropriately bunded, and stored in compliance with MSDS files.	Contractor	Duration of contract
Any storage and disposal permits/approvals which may	Contractor	Duration of

Mitigation: Action/control	Responsibility	Timeframe
be required must be obtained, and the conditions attached to such permits and approvals will be compiled with.		contract
Transport of all hazardous substances must be in accordance with the relevant legislation and regulations.	Contractor	Duration of contract
Construction contractors must provide specific detailed waste management plans to deal with all waste streams.	Contractor	Pre-construction
Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap), and contaminated waste. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control.	Contractor	Duration of contract
Where possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection, separation, and storage of waste streams (such as wood, metals, general refuse etc.).	Contractor	Duration of contract
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Contractor	Duration of contract
No waste may be buried or burnt on site	Contractor	Duration of contract
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	Contractor	Duration of contract
Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Contractor	Duration of contract
Documentation (waste manifest) must be maintained detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.	Contractor	Duration of contract
An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit he possibility of oil and other toxic liquids from entering the soil or storm water systems.	Contractor	Duration of contract
Dispose of all solid waste collected at an appropriately registered waste disposal site. The disposal of waste shall be in accordance with all relevant legislation. Under no circumstances may waste be burnt on site.	Contractor	Duration of contract

Mitigation: Action/control	Responsibility	Timeframe
Where a registered waste site is not available close to the construction site, provide a method statement with regard to waste management.	Contractor	Pre-construction
Upon the completion of construction, the area must be cleared of potentially polluting materials.	Contractor	Completion of construction

Performance Indicator	» No chemical spills outside of designated storage areas » No water or soil contamination by spills » No complaints received regarding waste on site or indiscriminate dumping » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately » Provision of all appropriate waste manifests for all waste streams
Monitoring	» Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase » A complaints register must be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » Observation and supervision of waste management practices throughout construction phase » Waste collection to be monitored on a regular basis » Waste documentation completed » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMPr

OBJECTIVE: Effective management of concrete batching plants (if required)

A considerable amount of concrete is required during the construction of a wind energy facility. In this regard there could be a need to establish a batching plant within the site. Batching plants are facilities/installations that combine various ingredients to form concrete. Some of these inputs include sand, water, aggregate (rocks, gravel, etc.), fly ash, potash, and cement.

Turbid and highly alkaline wastewater, dust emissions and noise are the key potential impacts associated with concrete batching plants. Concrete batching plants, cement, sand and aggregates can produce dust. Potential pollutants in batching plant wastewater and stormwater include cement, sand, aggregates, chemical additive mixtures, fuels and lubricants.

Project component/s	» Batching plant and associated activities
Potential Impact	» Dust emissions » Release of contaminated water » Generation of contaminated wastes from used chemical containers » Inefficient use of resources resulting in excessive waste generation
Activity/risk source	» Operation of the batching plant » Packaging and other construction wastes » Hydrocarbon use and storage » Spoil material from excavation, earthworks and site preparation
Mitigation: Target/Objective	» To ensure that the operation of the batching plant does not cause pollution to the environment or harm to persons

Mitigation: Action/control	Responsibility	Timeframe
Where possible concrete batching plants should be sited such that impacts on the environment or the amenity of the local community from noise, odour or polluting emissions are minimised.	Contractor	Construction phase
The provision of natural or artificial wind barriers such as trees, fences and landforms may help control the emission of dust from the plant.	Contractor	Construction phase
Where there is a regular movement of vehicles. Access and exit routes for heavy transport vehicles should be planned to minimise noise and dust impacts on the environment.	Contractor	Construction phase
The concrete batching plant site should demonstrate good maintenance practices.	Contractor	Construction phase
The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in a sheltered position to minimise the effects of the wind.	Contractor	Construction phase
Aggregate material should be delivered in a damp condition, and water sprays or a dust suppression agent should be correctly applied to reduce dust emissions and reduce water usage.	Contractor	Construction phase
Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point. Belt cleaning devices at the conveyor head may also assist to reduce spillage.	Contractor	Construction phase
The site should be designed and constructed such that clean stormwater, including roof runoff, is	Contractor	Construction phase

Mitigation: Action/control	Responsibility	Timeframe
diverted away from contaminated areas and directed to the stormwater discharge system.		
Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with applicable legislation	Contractor	Construction phase
Contaminated stormwater and process wastewater should be captured and recycled where possible. A wastewater collection and recycling system should be designed to collect contaminated water.	Contractor	Construction phase
Process wastewater and contaminated stormwater collected from the entire site should be diverted to a settling pond, or series of ponds, such that the water can be reused in the concrete batching process. The settling pond or series of ponds should be lined with an impervious liner capable of containing all contaminants found within the water they are designed to collect	Contractor	Construction phase
Areas where spills of oils and chemicals may occur should be equipped with easily accessible spill control kits to assist in prompt and effective spill control	Contractor	Construction phase
Ensure that all practicable steps are taken to minimise the adverse effect that noise emissions. This responsibility includes not only the noise emitted from the plant and equipment but also associated noise sources, such as radios, loudspeakers and alarms	Contractor	Construction phase
Where possible, waste concrete should be used for construction purposes at the batching plant or project site.	Contractor	Construction phase
The batching plant should be monitored by the ECO to ensure that the plant is operating according to its environmental objectives and within legislative requirements.	ECO	Construction phase

Performance Indicator	» No complaints on dust » No water or soil contamination by chemical spills » No complaints received regarding waste on site or indiscriminate dumping
Monitoring	» Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » A complaints register will be maintained, in which any complaints

	from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMPr » Zen Wind Farm (Pty) Ltdor appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase

OBJECTIVE: Ensure disciplined conduct of on-site contractors and workers

In order to minimise impacts on the surrounding environment, Contractors must be required to adopt a certain Code of Conduct and commit to restricting construction activities to areas within the development footprint. Contractors and their sub-contractors must be familiar with the conditions of the Environmental Authorisation (once issued), the EIA Report, and this EMPr, as well as the requirements of all relevant environmental legislation.

Project component/s	» Wind turbines » Access roads » Substation » Power line
Potential Impact	» Pollution/contamination of the environment » Disturbance to the environment
Activity/risk source	» Contractors are not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment
Mitigation: Target/Objective	» To ensure appropriate management of actions by on-site personnel in order to minimise impacts to the surrounding environment

Mitigation: Action/control	Responsibility	Timeframe
The terms of this EMPr and the Environmental Authorisation (once issued) must be included in all tender documentation and Contractors contracts.	Developer	Tender process
An ECO must be permanently on site throughout the road construction, cable laying, and turbine foundation excavation periods.	Developer	Duration of construction
Contractors must use chemical toilets/ablution facilities situated at designated areas of the site; no ablution will be permitted outside the designated area. These facilities must be regularly cleaned, sanitised, emptied and serviced by the appropriate contractors. Sewage must be disposed of at an	Contractor (and sub-contractor/s)	Duration of contract

Mitigation: Action/control	Responsibility	Timeframe
approved wastewater treatment site and may under no circumstances be dumped in the bush or buried.		
Cooking/meals must take place in a designated area; no firewood or kindling may be gathered from the site or surrounds.	Contractor (and sub-contractor/s)	Duration of contract
All litter must be deposited in a clearly marked, closed, animal-proof disposal bin in the construction area; particular attention needs to be paid to food waste.	Contractor (and sub-contractor/s)	Duration of contract
No one other than the ECO or personnel authorised by the ECO must disturb flora or fauna outside of the demarcated construction area/s.	Contractor (and sub-contractor/s)	Duration of contract
Contractors appointed by Zen Wind Farm (Pty) Ltdmust 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.	Contractor (and sub-contractor/s)	Construction
On completion of the construction phase all construction workers must be transported back to their place of origin within two days of their contract ending. The costs of transportation must be borne by the contractor	Contractor (and sub-contractor/s)	Construction

Performance Indicator	» Compliance with specified conditions of Environmental Authorisation, EIA report and EMPr » No complaints regarding contractor behaviour or habits » Code of Conduct implemented before commencement of construction phase. » Briefing session with construction workers held at outset of construction phase
Monitoring	» Observation and supervision of Contractor practices throughout construction phase. » A complaints register must be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMPr

5.4. Detailing Method Statements

OBJECTIVE: To ensure all construction activities/practices/procedures are undertaken with the appropriate level of environmental awareness to minimise environmental risk, in line with the specifications of the EMPr

The environmental specifications are required to be underpinned by a series of Method Statements, within which the Contractors and Service Providers are required to outline how any identified environmental risks will practically be mitigated and managed for the duration of the contract, and how specifications within this EMPr will be met. That is, the Contractor will be required to describe how specified requirements will be achieved through the submission of written Method Statements to the Site Manager (and ECO).

A Method Statement is defined as "a written submission by the Contractor in response to the environmental specification or a request by the Site Manager, setting out the plant, materials, labour and method the Contractor proposes using to conduct an activity, in such detail that the Site Manager is able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications". The Method Statement must cover applicable details with regard to:

» Construction procedures, from site preparation to completion.
» Site access
» Materials and equipment to be used
» Getting the equipment to and from site
» How the equipment/material will be moved while on-site
» How and where material will be stored
» The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur
» Timing and location of activities
» Compliance/non-compliance with the Specifications, and
» Any other information deemed necessary by the Site Manager.

Specific areas to be addressed in the method statement: pre, during and post construction include:

» Site establishment (which explains all activities from induction training to offloading, construction sequence for site establishment and the different

amenities and to be established etc. Including a site camp plan indicating all of these).

- » Preparation of the site (i.e. Clearing vegetation, compacting soils and removing existing infrastructure and waste).
- » Soil management/stockpiling and erosion control.
- » Excavations and backfilling procedure.
- » Stipulate norms and standards for water supply and usage (i.e.: comply strictly to licence and legislation requirements and restrictions)
- » Stipulate the storm water management procedures recommended in the storm water management method statement.
- » Ablution facilities (placement, maintenance, management and servicing)
- » Solid Waste Management:
  - * Description of the waste storage facilities (on site and accumulative).
  - * Placement of waste stored (on site and accumulative).
  - * Management and collection of waste process.
  - * Recycle, re-use and removal process and procedure.
- » Liquid waste management:
  - * The design, establish, maintain and operate suitable pollution control facilities necessary to prevent discharge of water containing polluting matter or visible suspended materials into rivers, streams or existing drainage systems.
  - * Should grey water (i.e. water from basins, showers, baths, kitchen sinks etc.) need to be disposed of, link into an existing facilities where possible. Where no facilities are available, grey water runoff must be controlled to ensure there is no seepage into wetlands or natural watercourses.
- » Dust and noise pollution
  - * Describe necessary measures to ensure that noise from construction activities is maintained within lawfully acceptable levels (construction activities generating output levels of 85 dB(A) near human settlement, are to be confined to working hours (08h00 - 17h00) Mondays to Fridays).
  - * Procedure to control dust at all times on the site, access roads, borrow pits and spoil sites (dust control shall be sufficient so as not to have significant impacts in terms of the biophysical and social environments). These impacts include visual pollution, decreased safety due to reduced visibility, negative effects on human health and the ecology due to dust particle accumulation.
- » Hazardous substance storage (Ensure compliance with all national, regional and local legislation with regard to the storage of oils, fuels, lubricants, solvents, wood treatments, bitumen, cement, pesticides and any other harmful and hazardous substances and materials. South African National Standards apply).
  - * Lists of all potentially hazardous substances to be used.
  - * Appropriate handling, storage and disposal procedures.

    - Prevention protocol of accidental contamination of soil at storage and handling areas.
    - All storage areas, (ie: for harmful substances appropriately bunded with a suitable collection point for accidental spills must be implemented and drip trays underneath dispensing mechanisms including leaking engines/ machinery).
- Fire prevention and management measures on site.
- Fauna and flora protection process on and off site (ie removal to reintroduction or replanting, if necessary).
    - Rehabilitation and re-vegetation process.
- Incident and accident reporting protocol.
- General administration
- Designate access road and the protocol on while roads are in use.
- Requirements on gate control protocols.

The Contractor may not commence the activity covered by the Method Statement until it has been approved by the Site Manager, except in the case of emergency activities and then only with the consent of the Site Manager. Approval of the Method Statement will not absolve the Contractor from their obligations or responsibilities in terms of their contract.

Failure to submit a method statement may result in suspension of the activity concerned until such time as a method statement has been submitted and approved. The ECO should monitor the construction activities to ensure that these are undertaken in accordance with the approved Method Statement.

5.5. Awareness and Competence: Construction Phase of the Wind Energy Facility

OBJECTIVE: To ensure all construction personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm

To achieve effective environmental management, it is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMPr. The Contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The Contractors obligations in this regard include the following:

- Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- Ensuring that a copy of the EMPr is readily available on-site, and that all site staff are aware of the location and have access to the document. Employees will be familiar with the requirements of the EMPr and the environmental specifications as they apply to the construction of the facility.
- Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended an Environmental Awareness Training course. The course must provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- Basic training in the identification of archaeological sites/objects, paleontological sites, and protected flora and fauna that may be encountered on the site.
- Awareness of any other environmental matters, which are deemed necessary by the ECO.
- Ensuring that appropriate communication tools are used to outline the environmental “do’s” and “don’ts” (as per the environmental awareness training course) to employees.
- Records must be kept of those that have completed the relevant training.
- Refresher sessions must be held to ensure the contractor’s staff are aware of their environmental obligations.

Therefore, prior to the commencement of construction activities on site and before any person commences with work on site thereafter, adequate environmental awareness and responsibility are to be appropriately presented to all staff present onsite, clearly describing their obligations towards environmental controls and methodologies in terms of this EMPr. This training and awareness will be achieved in the following ways:

5.5.1. Environmental Awareness Training

Environmental Awareness Training must take the form of an on-site talk and demonstration by the EO or responsible personnel before the commencement of site establishment and construction on site. The education/awareness programme should be aimed at all levels of management and construction workers within the contractor team. A record of attendance of this training must be maintained by the EO or responsible on site.

5.5.2. Induction Training

Environmental induction training must be presented to all persons who are to work on the site – be it for short or long durations; Contractor’s or Engineer’s staff; administrative or site staff; sub-contractors or visitors to site.

This induction training should include discussing the developer's environmental policy and values, the function of the EMPr and Contract Specifications and the importance and reasons for compliance to these. The induction training must highlight overall do's and don'ts on site and clarify the repercussions of not complying with these. The non-conformance reporting system must be explained during the induction as well. Opportunity for questions and clarifications must form part of this training. A record of attendance of this training must be maintained by the SHE Officer on site.

5.5.3. Toolbox Talks

Toolbox talks should be held on a scheduled and regular basis (at least twice a month) where foremen, environmental and safety representatives of different components of the Works and sub-consultants hold talks relating to environmental practices and safety awareness on site. These talks should also include discussions on possible common incidents occurring on site and the prevention of reoccurrence thereof. Records of attendance and the awareness talk subject must be kept on file.

5.6. Monitoring Programme: Construction Phase of the Wind Energy Facility

OBJECTIVE: To monitor the performance of the control strategies employed against environmental objectives and standards

A monitoring programme must be in place not only to ensure conformance with the EMPr, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are, or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly dictated, Zen Wind Farm (Pty) Ltdwill determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Project Manager will ensure that the monitoring is conducted and reported.

The aim of the monitoring and auditing process would be to routinely monitor the implementation of the specified environmental specifications, in order to:

» Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications
» Ensure adequate and appropriate interventions to address non-compliance

- Ensure adequate and appropriate interventions to address environmental degradation
- Provide a mechanism for the lodging and resolution of public complaints
- Ensure appropriate and adequate record keeping related to environmental compliance
- Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site
- Aid communication and feedback to authorities and stakeholders.

The ECO will ensure compliance with the EMPr, and to conduct monitoring activities. The ECO must have the appropriate experience and qualifications to undertake the necessary tasks. The ECO will report any non-compliance or where corrective action is necessary to the Site Manager and/or any other monitoring body stipulated by the regulating authorities.

The following reports will be applicable:

5.6.1. Non-Conformance Reports

All supervisory staff including Foremen, Resident Engineers, and the ECO must be provided the means to be able to submit non-conformance reports to the Site Manager. Non-conformance reports will describe, in detail, the cause, nature and effects of any environmental non-conformance by the Contractor. Records of penalties imposed may be required by the relevant authority within 48 (forty eight) hours.

The non-conformance report will be updated on completion of the corrective measures indicated on the finding sheet. The report must indicate that the remediation measures have been implemented timeously and that the non-conformance can be closed-out to the satisfaction of the Site Manager and ECO.

5.6.2. Monitoring Reports

A monitoring report will be compiled by the ECO on a monthly basis and must be submitted to DEA for their records. This report should include details of the activities undertaken in the reporting period, any non-conformances or incidents recorded, corrective action required, and details of those non-conformances or incidents which have been closed out.

5.6.3. Final Audit Report

A final environmental audit report must be compiled by an independent auditor and be submitted to DEA upon completion of the construction and rehabilitation activities (within 30 days of completion of the construction phase (i.e.: within 30 days of site handover) and within 30 days of completion of rehabilitation activities. This report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions and the requirements of the EMPr.

MANAGEMENT PROGRAMME FOR WIND ENERGY FACILITY: REHABILITATION OF DISTURBED AREAS CHAPTER 6

6.1. Overall Goal for the Rehabilitation of Disturbed Areas

Overall Goal for the Rehabilitation of Disturbed Areas: Undertake the rehabilitation measures in a way that:

» Ensures rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed

6.2. Objectives

In order to meet this goal, the following objective, actions and monitoring requirements are relevant:

OBJECTIVE: To ensure appropriate rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed

Areas requiring rehabilitation will include all areas disturbed during the construction phase and that are not required for regular maintenance operations. Rehabilitation should be undertaken in an area as soon as possible after the completion of construction activities within that area.

The main areas requiring rehabilitation will be the laydown areas adjacent to the turbines, the crane tracks alongside the permanent access roads, any cable routings where these fall outside the above-mentioned areas, and disturbed areas around the substations and maintenance building, and disturbed areas associated with the power line tower foundations, substation sites and access roads.

Project component/s	» Wind Energy Facility (including laydown areas) » Power line servitude and associated service roads » Substation site and associated access road » Access roads not required for operation and maintenance
Potential Impact	» Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention.
Activity/risk	» Temporary laydown areas

source	» Temporary access roads/tracks » Other disturbed areas/footprints
Mitigation: Target/Objective	» To ensure and encourage site rehabilitation of disturbed areas » To ensure that the site is appropriately rehabilitated following the execution of the works, such that residual environmental impacts (including erosion) are remediated or curtailed

Mitigation: Action/control	Responsibility	Timeframe
All temporary facilities, equipment, and waste materials must be removed from site as soon as practically possible after construction is complete.	Contractor	Following execution of works
All areas are to be cleared of rubble and construction waste ruminants. This includes the removal of excess materials, which includes excavation and disposal of concrete and concrete wash water, and all the waste related thereto.	Contractor	Following the excavation of works.
All soil contaminated by hydrocarbons is to be excavated to the depth of contaminant penetration, removed and transported to an appropriate registered landfill site.	Contractor	Completion of construction activities in an area
All temporary fencing and danger tape must be removed once the construction phase has been completed.	Contractor	Completion of construction activities in an area
Necessary drainage works and anti-erosion measures must be installed, where required, to minimise loss of topsoil and control erosion.	Contractor	Completion of construction activities in an area
The topography of the area must be restored, as far as possible, to the natural state of the area.	Contractor	Completion of construction activities in an area
Drainage lines affected by construction are to be rehabilitated to the approximate original profile. I f rehabilitation of the drainage line is not possible the profile is to be agreed upon by the ECO and Principal Agent/Engineer.	Contractor	Completion of construction activities in an area
All compacted disturbed areas are to be tilled, following the landscapes contours to a depth of 150 mm before replacement of topsoil (except where otherwise specified in the EMPr).	Contractor	Completion of construction activities in an area
Topsoil is to be re-placed consistent with the surrounding natural environment and remain un compacted.	Contractor	Completion of construction activities in an area.

Mitigation: Action/control	Responsibility	Timeframe
All areas of disturbed soil must be reclaimed using only indigenous grass and shrubs. Reclamation activities should be undertaken as early as possible on disturbed areas.	Contractor	Completion of construction activities in an area
No exotic plants may be used for rehabilitation purposes; only indigenous plants from the area may be utilised (preferably within 50km radius of the site). No chemical based fertilizers and compost may be used.	Contractor	Completion of construction activities in an area
Topsoil stored for longer than 6 months, must be vegetated. In cases like this, the biological viability of topsoil stockpiles shall be tested before placement during rehabilitation and where necessary amelioration such as microbial supplementation may be required.	Contractor	Completion of construction activities in an area
Replacement of soil types must be done so as to match the baseline soil profile as closely as possible.	Contractor	Completion of construction activities in an area
The seed mix for use in rehabilitation must be an approved mix of indigenous grass species common to the area.	Contractor	Prior to the start of rehabilitation
Seeding operations must coincide with rainfall events or as part of a managed watering schedule	Contractor	Completion of construction activities in an area

Performance Indicator	» All portions of site, including construction equipment camp and working areas, cleared of equipment and temporary facilities » Topsoil replaced on all areas and stabilised » Disturbed areas rehabilitated and acceptable plant cover achieved on rehabilitated sites » Completed site free of erosion and alien invasive plants
Monitoring	» On-going inspection of rehabilitated areas in order to determine effectiveness of rehabilitation measures implemented. » On-going alien plant monitoring and removal should be undertaken on an annual basis for the life of facility. » Botanist to monitor rehabilitation every two years after first sowing.

MANAGEMENT PROGRAMME FOR WIND ENERGY FACILITY: OPERATION CHAPTER 7

7.1. Overall Goal for Operation

Overall Goal for Operation: To ensure that the operation of the Wind Energy Facility does not have unforeseen impacts on the environment and to ensure that all impacts are monitored and the necessary corrective action taken in all cases. In order to address this goal, it is necessary to operate the Wind Energy Facility in a way that:

» Ensures that operation activities are properly managed in respect of environmental aspects and impacts.
» Enables the Wind Energy Facility operation activities to be undertaken without significant disruption to other land uses in the area, in particular with regard to noise impacts, farming practices, traffic and road use, and effects on local residents.
» Minimises impacts on birds and other fauna using the site.
» Monitors and evaluates the impacts of the Wind Energy Facility on birds and bats that frequent the area, in particular monitoring of bird and bat strikes, bird nesting and bat roosting activities and water bird uses of the water bodies on the site.
» Monitors the actual noise impacts of the Wind Energy Facility.
» Establishes an environmental baseline for Wind Energy Facility sites in South Africa, particularly with regard to priority bird species using the site.

7.2. Objectives

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

OBJECTIVE: Limit impacts on bats

Bats have been found to be particularly vulnerable to being killed by wind turbines. It has long been a mystery why they should be so badly affected since bat echo-location allows them to detect moving objects very well. A recent study in America has found that the primary cause for mortality is a combination of direct strikes and barotrauma (bats are killed when suddenly passing through a low air pressure

region surrounding the turbine blade tips causing low pressure damage the bat's lungs).

Bats are most vulnerable when leaving and returning to their roosts, usually at sunset and sunrise. This is also the time of the day (usually) when there is the least wind. The bat monitoring programme implemented prior to the commencement of construction will identify whether threatened / near threatened species occur on site or not and when they are most active. The most vulnerable species are those that are already classified as threatened species, including those classified as critically endangered, endangered or vulnerable.

By considering the results from the bat surveys and the species recorded, selected sensitive areas for bats, including the mountain area, the river and water bodies, and roosts must be safe guarded. It is important to safeguard the Roodesandberge mountain range, where recorded individuals of the *Molossidae* family were recorded nearby, possibly roosting in the crevices.

Project component/s	» Wind turbines
Potential Impact	Loss of individuals of the near threatened bat species
Activity/risk source	Operation
Mitigation: Target/Objective	Limited bat mortalities within project control area

Mitigation: Action/control	Responsibility	Timeframe
A bat monitoring program in the operational phase should be implemented in order to determine the actual impacts of the wind energy facility on the bat community.	Developer in consultation with specialist	Operation
Minimal lighting for the wind farm to be used.	Developer	Operation
Utilization of red lights in the turbines, instead of white, in order to minimize insect attraction and bat foraging behaviours near the turbines.	Developer	Operation
Intensify the opportunity for foraging in areas where turbines are not located.	Developer	Operation
Land management practices beneath the turbines should ideally not attract bat species vulnerable to collision (e.g. open air-foragers or clutter-edge foragers).	Developer	Operation
Cereal plantations should be limited in the surrounding of the wind turbines to reduce the suitability of the areas for bat foragers.	Developer	Operation

Performance Indicator	Number of individual mortalities from collision with wind turbines
Monitoring	» Determine densities of bat species within the area before and after construction » Document patterns of bat movement in the vicinity » Record bat mortalities and, as far as possible, the circumstances surrounding collisions. Standard protocols should be used when undertaking such surveys

OBJECTIVE: Limit impacts on birds

Impacts on birds during the operation of the wind energy facility include collisions with turbines, and collisions with and electrocutions by the power line.

Project component/s	» Wind turbines » Power line
Potential Impact	» Loss of individuals of the near threatened bird species » Disturbance to or loss of birds as a result of collision with the turbine blades and » Electrocution on power lines and substations
Activity/risk source	» Operation of wind turbines » Disturbance to or loss of birds as a result of collision with the overhead power line
Mitigation: Target/Objective	Limited bird mortalities within project control area

Mitigation: Action/control	Responsibility	Timeframe
On-going bird monitoring during operation.	Developer in consultation with specialist	Operation
Ensuring that all new power lines are marked with bird flight diverters from origin to destination (with marker and fitting standards as per the industry standard)	Developer Environmental Manager	Construction - operation
Bird diverter devices spaced at 1 m intervals along the line (as the flight line is narrow) where it crosses any rivers. The devices used must have nocturnal illumination	Developer Environmental Manager	Construction - operation
Review monitoring report on the full year of post-construction monitoring, and integrate findings into operational EMPr and broader mitigation scheme	Advising scientist, monitoring agency and radar specialist (if applicable), in negotiation with the	1 year post-construction

	client	
Conduct operational phase bird monitoring	Developer in consultation with specialist	Operation

Performance Indicator	Number of individual mortalities from collision with wind turbines
Monitoring	» Determine densities of bird species within the area before and after construction » Document patterns of bird movement in the vicinity » Record bird mortalities and, as far as possible, the circumstances surrounding collisions. Standard protocols should be used when undertaking such surveys

OBJECTIVE: Protection of vegetation

Project component/s	» Wind turbines » Access roads » Substation linking the facility to the electricity grid » Underground cabling » Power line
Potential Impact	» Disturbance of vegetation outside of areas affected by wind energy facility components
Activity/risk source	» Maintenance of wind energy facility and associated infrastructure
Mitigation: Target/Objective	» Minimisation of impacts on vegetation in the area surrounding the wind energy facility infrastructure

Mitigation: Action/control	Responsibility	Timeframe
Limit maintenance activities to facility footprint.	Developer	Operational Life of the Facility
Only utilise existing roads.	Developer	Operational Life of the Facility
Alien invasive management to be implemented during operation of the facility. The management strategy must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and' removal of alien species is undertaken.	Developer	Operational Life of the Facility
Use erosion control measures, should erosion arise during the operational life of the facility.	Developer	Operational Life of the

Mitigation: Action/control	Responsibility	Timeframe
		Facility

Performance Indicator	» Minimal impacts on vegetation outside of facility footprint
Monitoring	» On-going monitoring of area by environmental manager. » Annual audit of project area and immediate surroundings by qualified botanist. » If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. » The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area and used in optimising the control programme. » The environmental manager should be responsible for driving this process. » Reporting frequency depends on legal compliance framework..

OBJECTIVE: Appropriate handling and management of hazardous substances and waste

The operation of the Wind Energy Facility will involve the generation of limited waste products. The main wastes expected to be generated by the operation activities includes general solid waste, hazardous waste and liquid waste.

Project component/s	» Wind turbines » Substation » Power line
Potential Impact	» Inefficient use of resources resulting in excessive waste generation » Litter or contamination of the site or water through poor waste management practices
Activity/risk source	» Generators and gearbox - turbines » Transformers and switchgear - substation » Fuel and oil storage » Maintenance building
Mitigation: Target/Objective	» To comply with waste management guidelines » To minimise production of waste » To ensure appropriate waste disposal » To avoid environmental harm from waste disposal

Mitigation: Action/control	Responsibility	Timeframe
Hazardous substances must be stored in sealed containers within a clearly demarcated designated area.	Developer	Operation
Storage areas for hazardous substances must be appropriately sealed and bunded.	Developer	Operation
All structures and/or components replaced during maintenance activities must be appropriately disposed of at an appropriately licensed waste disposal site or sold to a recycling merchant for recycling.	Developer	Operation
Care must be taken to ensure that spillage of oils and other hazardous substances are limited during maintenance. Handling of these materials should take place within an appropriately sealed and bunded area. Should any accidental spillage take place, it will be cleaned up according to specified standards regarding bioremediation.	Developer	Operation, maintenance
Waste handling, collection, and disposal operations must be managed and controlled by a waste management contractor.	Developer /waste management contractor	Operation
Used oils and chemicals: » Appropriate disposal must be arranged with a licensed facility in consultation with the administering authority. » Waste must be stored and handled according to the relevant legislation and regulations.	Developer	Operation
It must be ensured that volumes of any hazardous waste stored on site do not exceed 30m^3. Should this volume be exceeded, a waste license will be required to be obtained.	Developer	Operation
General waste must be recycled where possible or disposed of at an appropriately licensed landfill.	Developer	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	Developer	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Developer	Operation

Performance Indicator	» No complaints received regarding waste on site or indiscriminate dumping » Internal site audits identifying that waste segregation recycling and reuse is occurring appropriately » Provision of all appropriate waste manifests

	» No contamination of soil or water
Monitoring	» Waste collection must be monitored on a regular basis· » Waste documentation must be completed and available for inspection on request » An incidents/complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon » Regular reports on exact quantities of all waste streams exiting the site must be compiled by the waste management contractor and monitored by the SHE Representative. All appropriate waste disposal certificates accompany the monthly reports.

OBJECTIVE: Noise control

The resulting future noise projections indicated that the operation of the facility would comply with the Noise Control Regulations (GN R154) as well as the guidelines as proposed by SANS 10103:2008 during periods when the wind speeds are less than 6 m/s. The significance of this noise impact was determined to be low. Mitigation measures, however, are proposed to ensure that the potential noise impacts and risks be optimally minimised.

The following measures are recommended to define the performance of the developer in mitigating the projected impacts and reducing the significance of the noise impact.

Project Component(s)	Wind turbines
Potential Impact	» Increased noise levels at potentially sensitive receptors » Changing ambient sound levels could change the acceptable land use capability » Disturbing character of sound
Activity/Risk source	» Simultaneous operation of a number of turbines
Mitigation Target/Objective	» Ensure that the change in ambient sound levels as experienced by potentially sensitive receptors is less than 5 dBA » Prevent the generation of nuisance noises » Ensure acceptable noise levels at surrounding stakeholders and potentially sensitive receptors

Mitigation: Action/control	Responsibility	Timeframe
Design and implement a noise monitoring programme.	Acoustical Consultant / Approved Noise	Before operational

Mitigation: Action/control	Responsibility	Timeframe
	Inspection Authority	phase commence
Quarterly noise measurements to be undertaken for the first year of operation of the facility.	Acoustical Consultant / Approved Noise Inspection Authority	Operational phase: quarterly
Add additional noise monitoring points at any complainants that registered a noise complaint relating to the operation of the wind energy facility	Acoustical Consultant / Approved Noise Inspection Authority	With quarterly monitoring

Performance Indicator	» Ensure that the change in ambient sound levels as experienced by potentially sensitive receptors is less than 7 dBA.
Monitoring	» Quarterly noise monitoring by an Acoustic Consultant or Approved Noise Inspection Authority for the first year of operation. Monitoring should take place over a 24 hour period in 10 minute bins, with the results co-ordinated with the 10 m wind speed. Noise monitoring programme to be developed and implemented at the start of operation.

OBJECTIVE: Maximise local employment and business opportunities associated with the operation phase

The establishment of the wind energy facility will create ~7 permanent and ~9 temporary employment opportunities. The operational phase is expected to extend over a period of 20 years. The employment opportunities are therefore limited. Therefore, long-term direct job opportunities for locals exist, although limited. However, in an area with such high unemployment figures, these limited opportunities should still be seen as a positive impact on the quality of life of those benefiting from the employment.

Some local procurement of goods, materials and services could occur which would result in positive economic spin-offs. These opportunities for local service providers to render services to the facility could include maintenance of the guardhouse, gardening at the guardhouse, cleaning services, security services and maintenance or replacement of general equipment.

Project component/s	Operation and maintenance of the facility
Potential Impact	The opportunities and benefits associated with the creation of local employment and business should be maximised
Activities/risk	Locals are not employed where the local skills exist

sources	Local procurement is not undertaken if possible Local businesses are not supported
Mitigation: Target/Objective	Maximise the appointment of local employees

Mitigation: Action/control	Responsibility	Timeframe
Contractors should capacitate locals where practical	Project proponent Contractor	Pre-operation and Operation
The project proponent should consider training and capacity building programmes to lessen the skills disparity	Project proponent	Operation
The skill requirements should be communicated to the local community leaders and community based organisations	Project proponent	Operation
Make use of local recruitment agencies or other relevant community based organisations to obtain a list of jobseekers	Project proponent	Operation
An equitable process whereby minorities and previously disadvantaged individuals (women) are taken into account should be implemented.	Project proponent	Operation
Local sourcing of materials and general services to assist in providing more economic and employment opportunities for the local people	Project proponent	Operation

Performance Indicator	» An employee list should be drawn up indicating the percentage of locals employed. » A Skills Development Plan should be developed. This plan should concentrate on the transfer of skills to employees to increase their capacity and to equip them with alternative skills should they wish to be employed elsewhere. » For each employee a career path should be developed to put mechanisms in place which allows employees to progress from lower skilled working levels to higher skilled and possibly management levels. » Local procurement is undertaken
Monitoring	» Project proponent should be able to demonstrate that the above indicators are implemented.

OBJECTIVE: Assist with social development and enhance capacity building and skills development within the local communities

An important positive role that the project proponent could fulfil as part of their social responsibility towards the local communities is to assist in addressing community development needs. The project applicant is therefore accountable to optimise the productive potential of those employed at the proposed facility's operation through capacity building and skills training, whether these individuals are temporary or permanent employees.

One of the aims of the project could be to revitalise the area in terms of job creation and infrastructure development, in other words it would focus on broad based empowerment.

Project component/s	Capacity building and skills training undertaken during the operational phase.
Potential Impact	» Positive contribution to the capacity of individuals involved with the project, and equipping them with transferable skills » Contribution towards local development initiatives
Activity/risk source	» No social responsibility from project proponent » No contribution towards local development initiatives » Inefficient training or lack of capacity building and skills training
Mitigation: Target/Objective	» Capacity building and skills training should be continuously undertaken during the operational phase of the project » Positive social responsibility initiatives

Mitigation: Action/control	Responsibility	Timeframe
Involvement in upliftment programmes could be done according to the needs identified as part of the IDP of the Drakenstein Local Municipality	Project proponent and Drakenstein Local Municipality	Operation
Capacity building and skills training should form part of the social development support provided to local communities.	Project proponent and Drakenstein Local Municipality	Operation
Individual tailor made training programmes for full time employees should be embarked upon in association with accredited training facilities to ensure long term benefits to those involved.	Project proponent	Operation
In cases for the middle to lower skilled jobs, where the relevant skills do not exist, training should be provided to willing local community members to enable them to fill the positions.	Project proponent Drakenstein Local Municipality	Operation
The Skills Development Levy should be established once the project is commissioned to ensure that the benefits of the implementation thereof reach the local communities from the start of the project.	Project proponent Drakenstein Local Municipality	Operation

Mitigation: Action/control	Responsibility	Timeframe
The project applicant should create conditions that are conducive for the involvement of entrepreneurs, small businesses and SMME's during the operational phase for rendering ancillary services to the proposed facility.	Project proponent	Operation

Performance Indicator	» A Skills Development Plan should be developed. This plan should concentrate on the transfer of skills to employees to increase their capacity and to equip them with alternative skills should they wish to be employed elsewhere. » For each employee a career path should be developed to put mechanisms in place which allows employees to progress from lower skilled working levels to higher skilled and possibly management levels. » Local development initiatives should be supported
Monitoring	» Project proponent should be able to demonstrate that the above indicators are implemented.

OBJECTIVE: Minimise the potential impact on farming activities and on the surrounding landowners

Once operational, the impact on the daily living and movement patterns of neighbouring residents is expected to be minimal and intermittent (e.g. the increase in traffic to and from site, possible dust creation of vehicle movement on gravel roads on site and possible increase in criminal activities). A limited number of workers would be on site on a daily basis with subsequent minimal social impacts in this regard.

The only land that would be sterilised would be the areas actually used for the turbine structures, access roads, fire breaks and associated buildings and sub-station buildings. Agriculture could thus continue on the sections of land between the turbines. It is not anticipated that any activities undertaken as part of the operation and maintenance of the facility would negatively impact on the surrounding property owners' daily living patterns. They would thus be able to continue their farming practices without interference from the wind energy. An increase in noise is however seen as a concern.

Project component/s	» Possible negative impacts of activities undertaken on site on the activities of surrounding property owners » Impact on farming activities on site
Potential Impact	» Possible limited intrusion impact on surrounding land owners » Possible phasing out of sheep farming

Activity / risk source	» Increase in traffic to and from site could impact on daily living and movement patterns of surrounding residents.
Mitigation: Target / Objective	» Effective management of the facility » Mitigation of intrusion impacts on property owners » Mitigation of impact on farming activities » Limit noise impacts

Mitigation: Action / control	Responsibility	Timeframe
Effective management of the facility to avoid any environmental pollution focusing on water, waste and sanitation infrastructure and services, and limiting any increase in noise levels	Project proponent	Operation
Vehicle movement to and from the site should be minimised	Project proponent Employees	Operation
Local roads should be maintained to keep the road surface up to standard	Project proponent	Operation
Reduce any negative impacts on farming activities by keeping fencing within the site to a minimum and designing fencing to maximise efficiency of stock movements	Project proponent	Operation
Limit the development on new access roads on site as far as possible	Project proponent and Contractors	Operation
The engineering design of the turbines should thus ensure the least noise as possible	Project proponent and Contractors	Operation

Performance Indicator	» No environmental pollution occur (waste, water and sanitation related) » Limited noise pollution » No intrusion on private properties and on the activities undertaken on the surrounding properties » Continuation of farming activities » No noise increase
Monitoring	» Project proponent should be able to demonstrate that facility is well managed without environmental pollution and that the above requirements have been met

OBJECTIVE: Minimisation of visual impacts

The primary visual impact, namely that of the wind turbines is not possible to mitigate. The functional design of the structures cannot be changed in order to reduce visual impacts. However, the sympathetic placement of the turbines with respect to the topography may ameliorate the magnitude of the impact somewhat.

The functional design of the structures and the dimensions of the facility cannot be changed in order to reduce visual impacts. Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's Marking of Obstacles expressly states, "Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The potential for mitigation is therefore low or non-existent. Due to the nature of the area within which the facility is planned, there are only a few potentially sensitive receptors.

Other impacts include impacts associated with lighting of substations, and the aircraft warning lights mounted on top of the hub of the wind turbines. The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

Project component/s	» Wind turbines » Substation » Power line and service roads for power line servitudes
Potential Impact	» Visual impact of facility degradation and vegetation rehabilitation failure.
Activity/risk source	» The viewing of the above mentioned by observers on or near the site.
Mitigation: Target/Objective	» Well maintained and neat facility » To minimise potential for visual impact » To ensure that the facility complies with Civil Aviation Authority requirements for turbine visibility to aircraft » Minimise contrast with surrounding environment and visibility of the turbines to humans » The containment of light emitted from the substations in order to eliminate the risk of additional night-time visual impacts.

Mitigation: Action/control	Responsibility	Timeframe
Maintain the general appearance of the facility in an aesthetically pleasing way.	Developer	Operation, Maintenance
Monitor rehabilitated areas, and implement remedial action as and when required.	Developer	Operation, Maintenance
Aviation warning lights must be mounted on turbine hub or such measures required by the Civil Aviation Authority. Indications are that the facility may not be required to fit a light to each turbine, but rather place	Developer	Erection, maintenance

Mitigation: Action/control	Responsibility	Timeframe
synchronous flashing lights on the turbines representing the outer perimeter of the facility.		
The turbines will be painted a pale, matt, non-reflective colour (i.e. off white, as specified) and it will be ensured that the specified paint colour is complied with before erection of the turbines.	Contractor	Erection of turbines
Ensure that proper planning is undertaken regarding the placement of lighting structures for the substations and that light fixtures only illuminate areas inside the substation site.	Developer	Construction, operation, maintenance
A lighting engineer must be consulted to assist in the planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass.	Developer	Erection, maintenance
Maintain the general appearance of the facility in an aesthetically pleasing way.	Developer	Operation, maintenance
Undertake regular maintenance of light fixtures.	Developer	Operation, maintenance
Limit access to the Wind Energy Facility site, power line and substation to along existing access roads.	Developer	Operation, maintenance
Avoid the unnecessary removal of vegetation within the power line servitudes and limit access to the servitudes (during both construction and operational phases) along existing access roads.	Developer	Operation, maintenance
Mitigation of lighting impacts includes the pro-active design, planning, and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for both the turbines and the ancillary infrastructure will go far to contain rather than spread the light. Additional measures include the following: * Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself); * Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights; * Making use of minimum lumen or wattage in fixtures; * Making use of down-lighters, or shielded fixtures; * Making use of Low Pressure Sodium lighting or other types of low impact lighting. * Making use of motion detectors on security lighting. This will allow the site to remain in	Developer/ lighting engineer	Operation, maintenance

Mitigation: Action/control	Responsibility	Timeframe
relative darkness, until lighting is required for security or maintenance purposes.		

Performance Indicator	» Well maintained and neat facility with intact vegetation on and in the vicinity of the facility. » Minimised visual intrusion on surrounding areas » Appropriate visibility of infrastructure to aircraft » The effective containment of the light to the substation site.
Monitoring	» Monitoring of rehabilitated areas. » Ensure that aviation warning lights or other measures are installed before construction is completed » Ensure that Aviation warning lights or other measures are functional at all times » The monitoring of the condition and functioning of the light fixtures during the operational phase of the project.

MANAGEMENT PROGRAMME FOR WIND ENERGY FACILITY: DECOMMISSIONING CHAPTER 8

The turbine infrastructure which will be utilised for the proposed Wind Energy Facility is expected to have a lifespan of 25 to 30 years (with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time.

8.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required abnormal load equipment and lifting cranes, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment.

8.2 Disassemble and Replace Existing Components

The wind (turbine and tower sections) of the proposed facility will be disassembled once it reaches the end of its economic lifespan. A large crane would be required for disassembling the turbine and tower sections. Once disassembled, the components will be reused, recycled, or disposed of in accordance with regulatory requirements. If deemed necessary, the disassembled components would be replaced with more appropriate technology/infrastructure available at that time.

OBJECTIVE: To avoid and or minimise the potential impacts associated with the decommissioning phase.

Project component/s	» Decommissioning phase of the Wind Energy Facility.
Potential Impact	» Decommissioning will result in job losses, which in turn can result in a number of social impacts, such as reduced quality of life, stress, depression etc. However, the number of people affected (~20) is relatively small. Decommissioning is also similar to the construction phase in that it will also create temporary employment opportunities.
Activity/risk	» Decommissioning of the Wind Energy Facility.

source	
Mitigation: Target/Objective	» To avoid and or minimise the potential social impacts associated with decommissioning phase of the Renewable Energy Facility.

Mitigation: Action/control	Responsibility	Timeframe
The developer should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the facility is decommissioned Retrenchments should comply with South African Labour legislation of the day.	Developer	Decommissioning
The developer should investigate the option of relocating employees to other renewable energy facilities when the Zen Wind Farm is decommissioned (if feasible).	Developer	Decommissioning
The developer should establish 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 25 - 30 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.	Developer	Decommissioning
Rehabilitation should start immediately after decommissioning is completed.	Developer	Straight after Decommissioning
All excavations must be rehabilitated with soil and topsoil, which should not contain invasive plant species (in compliance with the CARA, as amended), to the satisfaction of the ECO.	Developer ECO	Decommissioning
Re-vegetation specifications to be developed.	Developer	Decommissioning
All building materials must be removed from the site. All compacted surfaces must be ripped and re-vegetated as per the re-vegetation specifications.	Developer	Decommissioning
The most suitable seed mix for disturbed areas to be used in rehabilitation would include indigenous species.	Developer	Decommissioning
Rehabilitation to be conducted in a progressive manner (i.e. once decommissioning in an area has been completed the area will be rehabilitated). The rehabilitation of the area with indigenous vegetation must coincide with the rainfall events and all alien	Developer	Decommissioning

Mitigation: Action/control	Responsibility	Timeframe
invasive vegetation shall be removed.		
Rehabilitation measures for the site are to include the following: » Re-contouring Subsoil stockpiles should be used to re-contour construction affected areas. The Contractor shall restore the profile, soil condition and landform to as close as possible state to the pre-construction state. » Scarification and ripping All areas where rehabilitation interventions are required shall be cross-ripped before topsoil placement. Topsoil and fertile soil shall be uniformly scarified to allow for vegetation growth » Fertilising The Contractor shall be required to perform soil analysis tests on the top 75mm of prepared surface prior to re-vegetation/seeding to determine the required fertiliser levels for permanent cover. » Seed acquisition The Contractor shall purchase seed from a South African National Seed Organisation (SANSOR) accredited dealer. Seed used for rehabilitation shall not be older than one season. Purchased seed must be of the correct species and of known origin, dried and packed, conforming to all legal requirements for seed.	Developer Contractor	Decommissioning
The Contractor shall schedule works for placing of topsoil once all infrastructure has been successfully decommissioned. Seeding can then take place after the first rains of the season and should be concluded by one month before the end of the growing season.	Contractor	Decommissioning
The seed mix for use in rehabilitation must be an approved mix of indigenous grass species common to the area.	Contractor	Decommissioning
The Contractor shall maintain rehabilitated areas free of weeds and invader plants until the end of the Defects Notification Period applicable to rehabilitation. Control of weeds and invader plants must be done in accordance with the specifications stipulated in the CARA.	Contractor	Decommissioning
The Contractor shall be responsible for the	Contractor	Decommissioning

Mitigation: Action/control	Responsibility	Timeframe
prevention of erosion in areas impacted upon by their activities. All erosion repairs must be implemented at the first signs thereof and no erosion shall be allowed to develop on a large scale.		
If required, at the time of decommissioning, the developer must submit a method statement to the DWA / DEA to manage and rehabilitate the work in any wetlands. Wetlands shall be rehabilitated immediately after decommissioning has been completed as these are sensitive habitats and disturbance must be kept to a minimum. The beds of the wetlands shall be restored to a similar state, in terms of the soil profile, as well as physical and chemical properties as established in the pre-construction survey.	Contractor	Decommissioning
All recyclable rubble and solid waste (e.g. scrap metal, cables, bottles, cans, and plastic residues) shall be collected and disposed of through a registered recycling company. Waste manifests will be kept by the Contractor and shown to the ECO on request. All non-recyclable rubble and solid waste shall be collected and disposed of at an approved waste disposal site. Waste manifests will be shown to the ECO on request.	Contractor	Decommissioning

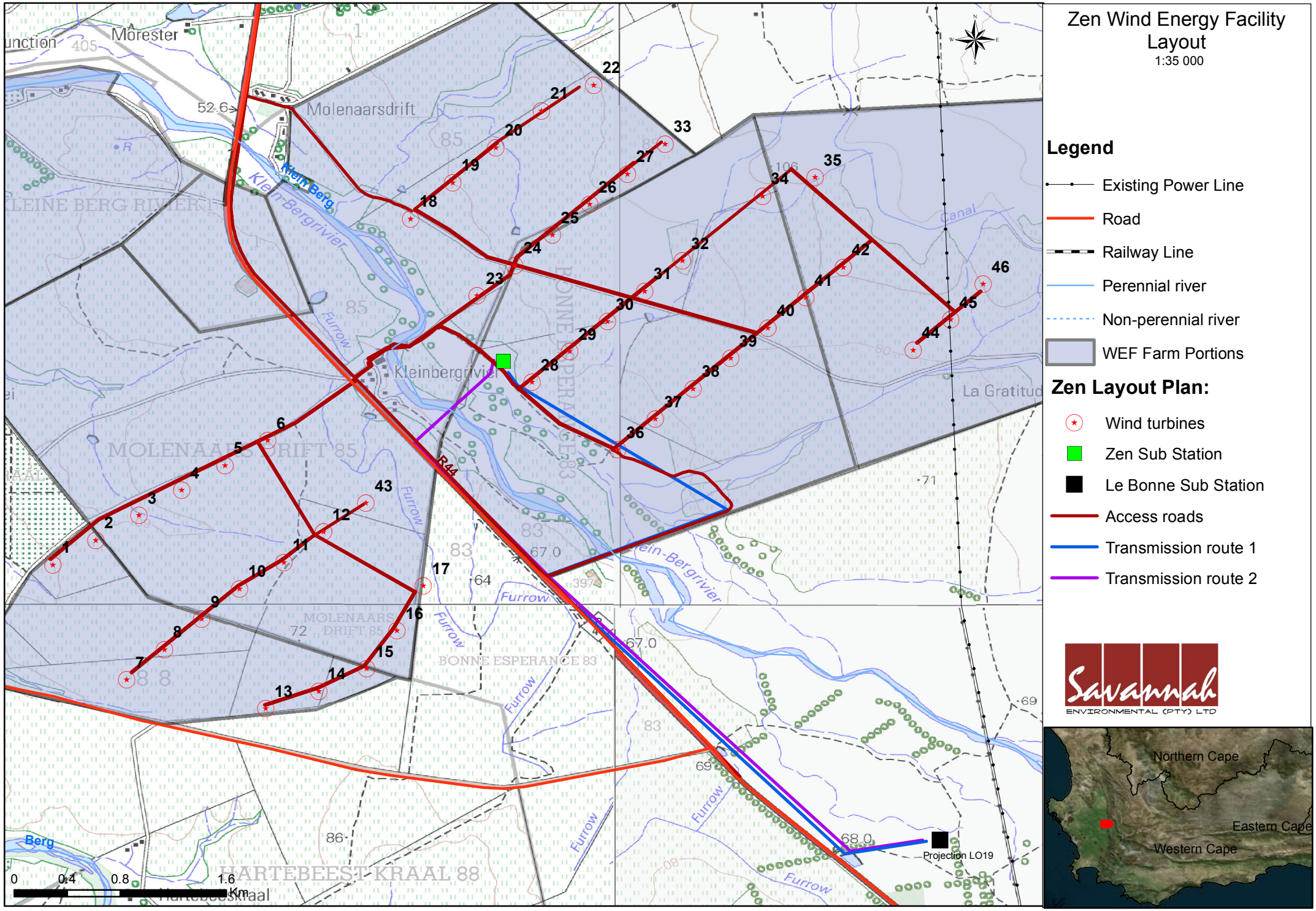
Performance Indicator	South African Labour legislation at the relevant time
Monitoring	» Retrenchments should comply with South African Labour legislation of the day » ECO to monitor rehabilitation

FINALISATION OF THE EMPR CHAPTER 9

The EMPr is a dynamic document, which must be updated to include any additional specifications as and when required. It is considered critical that this draft EMPr be updated to include site-specific information and specifications following the final walk-through survey by specialists of the power line, and development site. This will ensure that the construction and operation activities are planned and implemented considering sensitive environmental features.

Appendix A:

Layout Plan


Zen Wind Energy Facility Layout
1:35 000
Legend
Existing Power Line
Road
Railway Line
Perennial river
Non-perennial river
WEF Farm Portions
Zen Layout Plan:
Wind turbines
Zen Sub Station
Le Bonne Sub Station
Access roads
Transmission route 1
Transmission route 2
Savannah
ENVIRONMENTAL (PTY) LTD
Northern Cape
Eastern Cape
Western Cape
Projection LO19
Morester
Molenaarsdrift
Kleinbergrivier
Klein Berg
Furrow
R44
0 0.4 0.8 1.6 Km

Appendix B:

Plant Rescue and Protection, and Rehabilitation Plan

METHODS FOR PLANT RESCUE AND HABITAT REHABILITATION

List of Abbreviations

CARA: Conservation of Agricultural Resources Act 43 of 1983
DEA: Department of Environmental Affairs
EA: Environmental Authorisation
ECO: Environmental Control Officer
EMP: Environmental Management Plan
NEMA: National Environmental Management Act 107 of 1998
LFA: Landscape Functional Analysis (Tongway and Hindley 2004)
IAP: Invasive Alien Plant

List of Definitions:

Accelerated soil erosion: Soil erosion induced by human activities.

Acceptable cover: An acceptable cover shall mean that not less than 75% (in an area with rainfall above 400 mm per annum), or 40% (in regions receiving less than 400 mm rain per annum), of the area planted or hydroseeded shall be covered with grass and that there shall be no bare patches of more than 500 mm in maximum dimension.

Alien: originating from another country or continent and originally different environment, commonly used to describe plants that are not indigenous to South Africa and have become problematic (spreading rapidly, threatening existing biodiversity).

Allelopathic components: one or more biochemical compound produced by a plant and released through leaf litter or roots that suppresses the growth, survival, and reproduction of other surrounding vegetation.

Bare soil: Un-vegetated soil surface, unaltered by humans.

Compacted soil surface: A soil surface that has been hardened by an outside source, causing the soil to be more compacted than the surrounding area.

Container plants: Container plants include all vegetation which are bought or supplied in acceptable containers from nurseries or vegetation lifted out of their natural position and placed in containers.

Desirable end state: the future condition or target on which the rehabilitation is designed and that will serve later as a basis for rehabilitation success evaluation. This can be based on a reference site or modelled according to available information on historic vegetation.

Ecological rehabilitation: The process of assisting the recovery of a degraded or damaged ecosystem in a trajectory that renders the ecosystem fully functional, stable, and able to develop further, but not necessarily returning to the original historic state.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed, in a trajectory that ultimately returns the ecosystem to its natural successional stage.

Ecosystem: The combination of biota within a given area, together with a suitable environment that sustains the biota and the interactions between biota. It can have a spatial unit of any size, but shows some degree homogeneity as far as structure, function and species composition is concerned. Small-scale ecosystems typically link up to larger scale ecosystems and all contribute to the ecosystem function and services at the landscape-scale.

Environmental Management Plan: an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction and operation, and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced.

Establishment of grass: All procedures necessary to produce an acceptable cover of grass on an area.

Establishment Period: The Establishment Period is defined as the period beginning from the actual planting or placing of vegetation until three months thereafter, unless otherwise specified or unless grass cover is unacceptable or unless plants have not taken.

Extinction debt: is a concept that describes the future extinction of species due to events in the past. Extinction debt occurs because of time delays between impacts on a species, such as destruction of habitat or reduction of population size, and the species' ultimate disappearance.

Geophytic: resprouting during the growing season from an underground storage organ such as bulbs, corms, tubers or rhizomes, and dying back completely during unfavourable seasons.

Hydroseeding: To apply seed in a slurry with water (plus other materials to enhance growth) by means of a spraying device.

Indigenous: refers to a plant or animal that occurs naturally in the place in which it is currently found.

Invasive plant: a kind of plant which has under section 2 (3) of CARA been declared an invader plant, and includes the seed of such plant and any vegetative part of such plant which reproduces itself asexually.

Landscape: Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

Nursery conditions: These are the necessary conditions to maintain healthy growth of rescued and/or container plants. This includes protection of such plants against wind, frost, direct sunlight, pests, rodents, diseases, and drought. It also includes the provision of suitable water, fertilizer and any other measures required to maintain the container plants.

Period of Maintaining: The Period of Maintaining is defined as the period following directly after the Establishment Period until the end of the Period

of Maintenance for the whole Contract as defined in the General Conditions of Contract, unless otherwise specified.

Revegetation: The process of establishing a vegetative cover on exposed soils, regardless of species composition or structure, as long as the species are non-invasive and their presence will not impede the gradual process of ecological rehabilitation or –restoration.

Soil Erosion: is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and or physical transport on the land surface**.**

Scarifying: To roughen the surface of soil as a preparation for seeding or topsoil addition.

Trimming: To neatly round off the levels of existing or previously shaped earthworks to blend in with the levels of other earthworks, constructed works, or natural landforms.

Transformation: The conversion of an ecosystem to a different ecosystem or land use type.

Topsoil: uppermost layer of soil, in natural vegetation maximally 30 cm, in cultivated landscapes the total depth of cultivation, containing the layer with humus, seeds and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

Weed: a plant that grows where it is not wanted, and can therefore be an indigenous or alien species. An unwanted plant growing in a garden is just called a weed, but the 198 listed IAPs are called “declared weeds and invaders”.

1. Purpose

The Plant Rescue and Revegetation Management Plan addresses the need to mitigate all impacts leading to disturbed vegetation, loss of species and/or agricultural potential, disturbed soil surfaces, and generally bare soils prone to erosion and further degradation on the proposed development site. The plan overlaps to some degree with the Storm Water and Erosion Management Plan, and for successful rehabilitation, it is imperative that this plan is at all times used in conjunction with other EMPs mentioned.

The objective of the plan is therefore to provide:

» Protocols for the removal, temporary storage and replanting of plant species of conservation concern
» Protocols for the rehabilitation of vegetative cover across the project area
» Tools for planning the rehabilitation work and responding to unforeseen events
» Guidelines on implementation and post-implementation tasks
» Criteria for evaluating rehabilitation success
» A summary of items to be included in the rehabilitation budget to ensure that there is sufficient allocation of resources on the project budget so that the scale of EMP-related activities is consistent with the significance of project impacts

2. Scope

This document is a plant rescue, rehabilitation, and revegetation plan that provides a guideline to be applied by all contractors on the development site. This plan, as part of the project EMP, is a legally binding document that must be implemented to fullfil the requirements of relevant legislation. However, the management plan is an evolving guideline that needs to be updated or adapted as progress is made with the rehabilitation and revegetation of the project area, and successes and failures of procedures identified.

The objective of rescuing plants, rehabilitation and revegetation on the project area is:

» Preventing the loss of species either directly or through future extinction and minimising impacts of development on population dynamics of species of conservation concern.
» Preserving the natural configuration of habitats as part of ecosystems, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist.
» Preserving or re-creating the structural integrity of natural plant communities.
» Actively aid the improvement of indigenous biodiversity according to a desirable end state according to a previously recorded reference state. This reference

state, if healthy, will be dynamic and able to recover after occasional disturbances without returning to a degraded state.

» Improving the ecosystem function of natural landscapes and their associated vegetation.

3. Legislation and Standards

Relevant legislation:

» Conservation of Agricultural Resources Act 43 of 1983
» Environmental Conservation Act 73 of 1989
» National Forestry Act 84 of 1998
» National Environmental Management Act 107 of 1998
» The Nature and Environmental Conservation Ordinance, 1974 (Ordinance 19 of 1974)
» The Western Cape Nature Conservation Laws Amendment Act, 2000 (Ordinance 3 of 2000)

4. Effect of clearing alien vegetation

Invasive and Alien Plants (IAPs) gradually displace and suppress indigenous and/or herbaceous vegetation as their stands become bigger and denser. In addition, they use more water, hence desiccate the soil more, and may alter chemical properties of the soil – partially through secondary compounds released from their litter, partially from compounds released from roots. These altered soils suppress the germination and establishment of herbaceous species, leading to bare soil underneath dense IAP canopies.

After clearing dense stands of invasive shrubs, soil surfaces are thus generally bare with topsoil exposed to erosion and often already somewhat capped and eroded.

5. Effect of removing individuals of species of conservation concern

Species of conservation concern are declining either due to overexploitation or because their range of occupancy is limited and further infringed on by development. Most plant populations require a certain minimum number of individuals within a population or metapopulation to allow for sufficient genetic transfer between individuals. This prevents genetic erosion and hence weakening of the ability of individuals to persist in their environments. Similarly, where the distance between metapopulations is significantly increased due to fragmentation and the resultant loss of some populations, populations may suffer genetic decline due to restricted movement of pollen. Pollinators or other species that depend on a particular plant species for a specific microhabitat or food source may be equally affected because of the reduction of available resources. Therefore the aim of plant rescue actions are always to maintain as many individuals of a plant population in as close proximity to

the original habitat as possible to minimise loss of individuals and fragmentation of populations to prevent the creation of future extinction debts of the development.

6. General: Plant rescue and protection

Successful plant rescue can only be achieved if:

» Species can be removed from their original habitat with minimal damage to the plant, especially the roots.
» All plants removed are safely stored and treated according to their specific requirements prior to being transplanted again.
» They are relocated into a suitable habitat and protected from further damage and all disturbances to aid their re-establishment.
» Timing of planting activities is planned with the onset of the growing season.
» Steps are taken where necessary to aid the initial establishment of vegetation, including occasional watering.

6.1. Time of planting

» All planting shall be carried out as far as is practicable during the period most likely to produce beneficial results (i.e. during the peak growing season), but as soon as possible after completion of a section of earthworks.
» Drainage line rehabilitation preparation must be done during autumn, and planting of appropriate species in these areas should commence during early spring after the first rains.

7. General: IAP removal

Removal of invasive plants should at all time follow the specifications and guidelines of the Working for Water Programme (refer also to invasive plant management plan).

Information can be obtained from the relevant website:
http://www.dwaf.gov.za/wfw

Detailed information on clearing methods is available on the above websites “Alien Invasive Plants” menu (clearing methods, operational standards and species-specific treatment methods).

8. General: Rehabilitation and re-vegetation

Successful rehabilitation can only be achieved with:
» A long-term commitment
» Practical, adaptive management
» Viable goals of desired outcomes

Prior to vegetation rehabilitation, all stakeholders involved should be consulted to determine:

» What the rehabilitation is ultimately aiming for– rehabilitation of cropping/grazing lands or rehabilitation of indigenous vegetation, after soil erosion and storm water management is in place and IAPs have been cleared?
» A clear definition of incompatible and compatible vegetation on and in the immediate surroundings of the development must be defined and maintained as such. No tree or shrubs shall be allowed to grow to a height in excess of the horizontal distance of that tree or shrub from the nearest newly developed structure or to grow in such a manner as to endanger the development or its operation
» Who will take long-term ownership and hence responsibility for the rehabilitation and its subsequent monitoring and management? Continued monitoring of vegetation establishment and composition, as well as erosion detection will have to be coupled with continued follow-up maintenance of rehabilitation and erosion control from commencement of activity up to the decommissioning phase.

The ultimate objective for rehabilitation should focus on the stabilisation of soil erosion, retaining agricultural potential of transformed areas and /or the establishment of a dense and protective plant cover and the maintenance of habitats to enable vegetation to persist and flourish on rehabilitated areas indefinitely, ultimately relying only on environmental resources.

8.1. Map and create management areas

The entire project area must be mapped and divided into management areas indicating:

» Current land cover
  - Roads and residential
  - Areas with IAPs, subdivided further in sparse or dense infestations where applicable
  - Transformed areas
  - Untransformed indigenous vegetation

For every one of the management areas, the project proponent, in consultation with the land users, will have to decide what intervention will be necessary, desirable, and feasible to enable the development of the project and long-term sustainable maintenance of infrastructure. Thus for every management area there must be an operational outline on:

» what will happen there
» what needs to be mitigated – including storm water- and erosion management
» which management units need priority intervention/mitigation

» how will this mitigation / intervention be done (method statements) including schedule of work
» realistic and desirable end states including list of species that should be established to initiate rehabilitation after initial revegetation
» approximate timeframes
» monitoring protocol to evaluate success or failures of interventions
  - establish permanently marked transects and monitor with fixed-point photography
» who will be responsible for doing what
» how will different actions be integrated to achieve and maintain or improve the desirable end state of the environment of that management unit

Special attention will have to be given to drainage zones, as these not only have very active morphodynamics, but are also distributers of seeds – both indigenous and of IAPs. Thus clearing a downstream invasion of aliens to enable maintenance of the development will be futile if the upstream IAPs are not cleared or at least aggressively controlled.

8.2. Setting realistic rehabilitation goals

Rehabilitation efforts typically aim at improving ecosystem function that consists of a series of processes, which can in the end be evaluated against a desired outcome or reference state of the vegetation and environment.

Attainable goals of rehabilitation on the project area should be possible and viable for at least the following:

» Stabilisation of soils
» Stabilisation of riparian areas
» Storm water reduction through management and wetland integrity
» Clearing of IAPs
  - The degree to which IAPs can be cleared from the project area needs to be determined according to desirability, available project funding, personnel and project requirements
» Restoring and/or rehabilitating vegetative cover on non-transformed areas to obtain an acceptable vegetation cover that can be maintained or persists on its own indefinitely

8.3. Remove or ameliorate the cause of degradation

This will include:

» Physical rehabilitation of topsoil where it has been removed.
» Topsoil on areas that have not been cultivated are considered as the upper 20 - 30 cm only. These contain the most important nutrients, micro flora and –fauna essential for nutrient cycling processes. Topsoils are also an important source of seeds.

» Subsoils and overburden substrata lack the above elements and will first have to be used for physical rehabilitation of landscapes as and where necessary, and then overlain with topsoils
» Stabilisation of topsoils and prevention of erosion – refer to the Erosion management pan
» Removal of all invasive vegetation – refer to the Invasive Management Plan
    - Where it is desirable to use brush or logs of the cleared vegetation for soil stabilisation, such material must be free of regenerative material – e.g. seeds or root suckers

8.4. Initial revegetation

Immediately after clearing of vegetation, the soil surface must be inspected for signs of erosion and stabilised as soon as possible. After completion of construction, such erosion stabilisation should preferably be with a cover of vegetation. A dense initial grass or other perennial cover will be desirable. The appropriate seed mix should be determined in consultation with an ecologist familiar with the area. The aim of the first vegetation cover is to form a protective, relatively dense indigenous layer to slow runoff, increase moisture infiltration into the soil, and gradually change the soil nutrient status in order for it to be more favourable for other desirable indigenous vegetation to become established.

8.5. Plant Search and Rescue

Prior to construction, once all the areas where topsoil will be removed or areas will be transformed have been demarcated, the ECO and contractor will be responsible to remove all bulbous species from the topsoil, as well as succulents and small indigenous shrubs that can be transplanted. These are to be kept in a raised, protected position in a designated area until they can be replanted again as part of the rehabilitation process. Further details are listed in the operation standards.

8.6. Natural seed banks and improvement of plant structural and compositional diversity

It is expected that soil seed banks of indigenous vegetation will be present to initiate initial vegetation cover, but may not be sufficient to establish an acceptable cover of desirable species. After deciding which indigenous species should be re-introduced, seed should be ideally collected from site or an environmentally-matched site nearby.

Seed collection may be done throughout the year as seed ripens, but can also be restricted to summer, when a large amount of the perennial seed should have ripened. Seeds should be stored in paper or canvas bags dusted with insecticide, and sown at the onset of the rainy season.

Alternatively, slower-growing perennials may be raised from seed or cuttings in a nursery and then transplanted once established. It will be beneficial to investigate if community members would be able to create and maintain such a nursery, or if there are nurseries in the area, that raise indigenous flora from the area.

The final vegetation cover should resemble the original (non-encroached) vegetation composition and structure as far as practicable possible or permissible within each management unit.

For drainage areas:

» First restore drainage line morphology following the guidelines of the Erosion management plan – without that ecological recovery cannot be initiated
» Determine if natural seed sources may be present further upstream
» If such upstream seed sources are still present, rehabilitation of riparian vegetation after soil erosion management will most likely occur naturally, PROVIDED that follow-up monitoring of the establishment of vegetation is carried out, and all invasive species eradicated as they emerge. This can only be achieved with a long-term commitment (> 5 years minimum)
» Should no upstream seed resources be available, suitable species (as determined in consultation with an ecologist) should be sown or planted.

8.7. Monitoring and follow-up action

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any new degradation of ecosystems affected by the development, and remedy these as soon as detected.

During the construction phase, the ECO and contractor will be responsible for initiating and maintaining a suitable monitoring system. Once the development is operational, the project proponent will have to identify a suitable entity that will be able to take over and maintain the monitoring cycle and initiate adaptive management as soon as it is required. Monitoring personnel must be adequately trained.

The following are the minimum criteria that should be monitored:
» Composition and density of replanted vegetation, distinguishing between species introduced for initial revegetation only and species that are part of the pre-determined desirable end state
» Associated nature and stability of surface soils
  - It is recommended that permanent transects are marked and surveyed annually according to the LFA technique (Tongway and Hindley 2004), adapted to integrate both surface soil characteristics and the vegetation to be monitored
» Re-emergence of IAPs

  - If noted, remedial action must be taken immediately according to Working for Water specifications
- Nature and dynamics of riparian zones
  - Stability of riparian vegetation
  - Any form of bank erosion, slumping or undercutting
  - Stability of channel form and width of streams – if this increases, it shows that vegetation on plains and/or riparian areas and upper drainage lines are not yet in a stable enough state to be fully functional in reducing excess runoff and the ecosystem overall is losing valuable resources

8.8. Timeframes and duration

- Rehabilitation will occur during construction, as areas for the re-application of topsoil and revegetation become available or where revegetation can be initiated after clearing of invasives or to stabilise erosion.
- The initial revegetation period post construction is estimated to be over a period of 6 (minimum) to 12 months (maximum), or a time period specified by the Horticultural Landscape Contractor, particularly if planting of trees and shrubs occurs.
- The rehabilitation phase (including post seeding maintenance) should be at least 12 months (depending on time of seeding and rainfall) to ensure establishment of an acceptable plant cover is achieved (excluding invasive plant species or weeds).
- If the plants have not established and the acceptable plant cover is not achieved within the specified maintenance period, maintenance of these areas shall continue until at acceptable plant cover is achieved (excluding alien plant species or weeds).
- Additional seeding or planting may be necessary to achieve acceptable plant cover. Hydroseeding may have to be considered as an option in this case.
- Any plants that die, during the maintenance period, shall be replaced by the Horticultural Landscape Contractor (at the Horticultural Landscape Contractor's cost if it was due to insufficient maintenance).
- Succession of natural plant species should be encouraged
- Monitoring of rehabilitation success and follow-up adaptive management, together with clearing of emerging invasives shall be carried on until the decommissioning phase has been completed.

9. Conclusion

The Plant Rescue and Revegetation Management Plan is a document to assist the contractor, the developer, and the ECO with guidelines on how to plan and implement the required work, and understand the concepts behind successful rehabilitation. This plan will have to be implemented in conjunction with erosion-, storm water- and IAP management plans. The exact details of the rehabilitation plan will depend on the determined extent of rehabilitation that will have to be undertaken, available funding, and desirable end state of the vegetation after rehabilitation.

10. References and further reading

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A. APPENDIX: RECOMMENDED OPERATIONAL STANDARDS

OBJECTIVE: Revegetate and Rehabilitate disturbed areas

The Contractor must take all reasonable measures to ensure that plant species of conservation concern are rescued and survive indefinitely. Landscaped topsoils as well as areas cleared of IAPs must be adequately rehabilitated and /or revegetated to ensure that the ecosystems affected by the development regain and/or retain their functionality indefinitely.

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any new degradation of ecosystems affected by the development and remedy these as soon as detected.

Mitigation measures relating to the vegetative cover as part of a healthy ecosystem must be implemented in order to effectively limit and gradually reverse the impact on the environment. The focus of the mitigation measures laid out below relate to project-related disturbances. Where such disturbances are exacerbated by farming-related disturbances or vice versa, mitigation measures must be carried out in consultation with the land-user responsible.

Project component/s	Project components affecting the objective: » Turbines » Access roads and cabling between and to turbine units » Power line » Sealed surfaces (e.g. roofs, concrete surfaces, compacted road surfaces, paved roads / areas) » Substation » All other infrastructure
Potential Impact	» Loss of suitable substrate for a stable vegetation cover » De-stabilisation and/or alteration of substrate and hence degradation of vegetation cover, significant change in species composition or loss of agricultural potential » Loss of suitable habitat for flora and fauna » Leaky ecosystem due to loss of nutrients and moisture from the system, leading to a less resilient vegetation cover and loss of ecosystem function and -services » Degradation and/or loss of riparian areas and wetlands on and beyond the project boundaries » A loss of indigenous vegetation cover and possibly endangered species » Disturbance of fauna species
Activities/risk sources	» Rainfall and wind erosion of disturbed areas » Excavation, stockpiling and compaction of soil » Existing IAPs as well as clearing thereof » Concentrated discharge of water from construction activity or new

	infrastructure » Storm water run-off from sealed, altered or bare surfaces » Mobile construction equipment movement on site » Cabling and access roads construction activities » Power line construction activities » River/stream/drainage line road crossings » Roadside drainage ditches » Project related infrastructure » Premature abandonment of follow-up monitoring and adaptive management of rehabilitation
Mitigation: Target / Objective	» To minimise loss of plant species of conservation concern » To minimise unfavourable runoff conditions and loss of resources from the ecosystems » To minimise erosion of soil from site during and after construction » To minimise and mitigate unfavourable alteration to drainage lines, especially incision » To minimise damage to indigenous vegetation during and after construction » No accelerated overland flow related surface erosion as a result of project infrastructure » No reduction in the surface area or general nature and functionality of wetlands (drainage lines and other wetland areas) as a result of the establishment of infrastructure on the project areas and beyond its boundaries » A clear reduction of IAPs on the project area and replacement thereof by indigenous vegetation according to a pre-determined desirable end state

Mitigation: Action / control	**Responsibility**	**Timeframe**
Planning		
Classify the entire project area into management units according to current land cover and state of the environment and map accordingly	Developer / Contractor	Prior to construction
For each management unit » establish what interventions will be necessary relating to IAPs, soil erosion management, topsoil handling, landscape rehabilitation and revegetation » where rehabilitation and revegetation will be necessary, decide on the desired end state of vegetation for that management unit and create a list of species to be established on specific sites » outline the management of construction activities, including topsoils, excavated materials and felled biomass in a manner that will optimise the rehabilitation goals as fast and as effective as possible for that management unit	Developer / Contractor in collaboration with ECO and land-users	Prior to construction
Plant Rescue and indigenous plant materials		
All harvested plant materials shall be labelled with » Genus as minimum, species if known » Habitat from which materials were collected	ECO	Prior to construction

Mitigation: Action / control	Responsibility	Timeframe
Indigenous plant materials for re-vegetation: » All plant material shall be obtained from the search-and-rescue operation on the site prior to clearing or from local nurseries or reputable seed providers » Indigenous materials shall only be removed from their habitat with the necessary permits whenever applicable » Each plant removed shall be handled, packed and stored in a manner suitable for that species » Removed plants shall be protected from windburn or other damage during transportation » No plants or plants with exposed roots shall be subjected to excessive exposure to drying winds and sun, or subjected to water logging » All plants shall be kept free from plant diseases and pests and protected from rodents or other damaging agents » All indigenous plants that have been removed prior to clearing shall be returned to conditions resembling their original habitat as close as practically possible	Contractor in collaboration with ECO	Before, during and after construction
Seed stocks for rehabilitation » Seed can be used for cultivation of desirable species for revegetation » Seed shall be utilised for direct sowing or hydroseeding » Seed collected from the site must be dried and stored in a suitable facility under cool (7-10˚C), dry, insect free conditions until required for cultivation or seeding. Only viable, ripe seed shall be used » Seed harvested shall be insect- and pathogen free » Seed harvested shall not contain materials of any invasive species » Prior to clearing, seed should be collected from the site on a regular basis as species start to seed to maximise the amount of fully developed seed secured » From sites that will be cleared, 100% of all seeds available may be collected » From sites adjacent to the development, 25% of seeds can be collected for rehabilitation	Contractor and ECO	Before, during and after construction
Site-specific nursery » On-site nursery facilities shall be erected for the holding of rescued plant material and the propagation of appropriate species for re-vegetation » Where nursery facilities can only cater for rescued plants, a suitable (local) nursery shall be identified that will be willing to receive seeds collected and propagate the necessary species for later revegetation » Soil or other propagation media, were used, shall be weed- and pathogen free » Argentine ants shall be controlled at all times » The area where plants are stored shall be kept free of	Contractor, ECO to control	Prior to construction

Mitigation: Action / control	Responsibility	Timeframe
weeds » Plants stored in the designated area shall be protected from rodents, excessive sun and wind, and inspected regularly until being planted for pathogens and pests, and then treated accordingly » The nursery shall be adequately secured to prevent loss or theft of species		
Protected flora » Ensure that no indigenous protected flora is removed from its original habitat in the project area without legal documents from the relevant authorities	ECO	Before, during and after construction
Topsoil		
Avoid » Management units that will not be developed or selected elements – trees, rocky outcrops on site shall be maintained in situ and demarcated clearly to prevent any disturbance during construction » These units will be considered as NO-GO areas during construction	Contractor and ECO	Before, during and immediately after construction
Invasives » Remove all invasive shrubs as per the Working for Water specifications	Contractor, ECO to control	Before, during and after construction
Mulch » all trees felled shall be debranched and the logs used in controlling erosion from re-landscaped topsoils and/or adding surface roughness and organic matter to topsoils to be rehabilitated » all cut branches from trees, as well as all shrubs cleared from the construction site shall be shredded to mulch, either by a chipper or by hand to sticks no longer than 10 cm » preparation of mulch shall be done at source » mulched material shall be free of seed-bearing invasive plant material » the mulch shall be suitably stored – bagged if necessary - and will be used in rehabilitation and soil erosion management on the site » should additional mulch be used for rehabilitation, this should be obtained from invasive shrubs of areas not cleared » mulch shall be stored for as short a period as possible	Contractor, ECO to control	Before, during and immediately after construction
Storage of topsoil and subsoil: » topsoils constitute the upper 20 – 30 cm of soil only, lower layers of soil are regarded as subsoil » stockpiling of topsoils and subsoils shall only be done on previously transformed areas, and be kept at least 50 m from any remaining natural vegetation » care shall be taken during stockpiling to prevent the	Contractor, ECO to control	During and immediately after construction

Mitigation: Action / control	Responsibility	Timeframe
mixing of topsoil with subsoil and/or any other material » topsoils shall be stored in heaps no higher than 100 cm, and shall be re-applied as soon as possible » care shall be exercised during stockpiling of topsoils to prevent compaction thereof » topsoils shall be adequately protected from erosion by preventing concentration of surface water and scouring of slopes » erosion of topsoils has to be contained and repaired as soon as it occurs, before large scale erosion and loss of topsoil develops » any logs obtained during clearing operations can be used in continuous rows to curtail erosion where necessary. Geojute (geotextile) shall be used additionally if the logs are not sufficient to remedy any erosion – for details refer to the erosion management plan » where topsoils need to be stored longer than 6 months, such stockpiles shall be revegetated, even if this has to include re-seeding to achieve an acceptable cover of vegetation		
Boulders and rocks » where removed during clearing, should be stored separately and used in the rehabilitation program » boulders and rocks must be partially buried within the topsoil layer wherever practical to provide greater soil-holding stability and reduce water erosion » placement of rocks and boulders shall mimic the natural occurrence of rocks and boulders in the area	Contractor, ECO to control	During and after construction
Rehabilitation of surface		
Prior to the application of topsoil » subsoil shall be shaped and trimmed to blend in with the surrounding landscape or used for erosion mitigation measures » ground surface or shaped subsoil shall be ripped or scarified with a mechanical ripper or by hand to a depth of 15 – 20 cm, » compacted soil shall be ripped to a depth greater than 25 cm and the trimmed by hand to prevent re-compacting the soil » any rubbish, concrete remnants, steel remnants or other objects introduced to the site during the construction process shall be cleared before ripping, or shaping and trimming of any landscapes to be rehabilitated takes place » shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscapes	Contractor, ECO to control	During and after construction

Mitigation: Action / control	Responsibility	Timeframe
Application of topsoil » topsoils shall be spread evenly over the ripped or trimmed surface, if possible not deeper than the topsoil originally removed » the final prepared surface shall not be smooth but furrowed to follow the natural contours of the land » the final prepared surface shall be free of any pollution or any kind of contamination » care shall be taken to prevent the compaction of topsoil » where applicable, the final prepared surface will also contain scattered rocks and/or logs to mimic the natural condition of the original habitat or area and to aid in soil stabilisation and erosion control	Contractor, ECO to control	During and after construction
Soil stabilisation » mulch from brush shall be applied by hand to achieve a layer of uniform thickness » mulch shall be rotovated into the upper 10 cm layer of soil o this operation shall not be attempted if the wind strength is such as to remove the mulch before it can be incorporated into the topsoil » in very rocky areas a layer of mulch shall be applied prior to adding the topsoil » measures shall be taken to protect all areas susceptible to erosion by installing temporary and permanent drainage work as soon as possible o where natural water flow-paths can be identified, subsurface drains or suitable surface drains and chutes need to be installed » additional measures shall be taken to prevent surface water from being concentrated in streams and from scouring slopes, banks or other areas o if mulch is limited, available mulch, together with harvested seeds, should be concentrated in these hollows to promote rapid re-vegetation in them » runnels or erosion channels developing shall be back-filled and restored to a proper condition o such measures shall be effected immediately before erosion develops at a large scale » where erosion cannot be remedied with available mulch, logs or rocks, geojute shall be used to curtail erosion	Contractor, ECO to control	During and after construction
Borrow-pits » shall be shaped to have undulating, low-gradient slopes and surfaces that are rough and irregular, suitable for trapping sediments and facilitation of plant growth » upon completion of rehabilitation these reshaped and revegetated areas shall blend into the natural terrain	Contractor, ECO to control	After construction

Mitigation: Action / control	Responsibility	Timeframe
Revegetation		
Recreate a non-invasive, acceptable vegetation cover that will facilitate the establishment of desirable and/or indigenous species » revegetation of the final prepared area is expected to occur spontaneously to some degree where topsoils could be re-applied within 6 months » revegetation will be done according to an approved planting/landscaping plan according to the management units initially delineated and their respective desirable end states and permissible vegetation	Contractor, ECO to control	Successively during construction, as construction of individual components is completed, then followed up until desired end state is reached
Re-seeding » revegetation can be increased where necessary by hand- seeding indigenous species o previously collected and stored seeds shall be sown evenly over the designated areas, and be covered by means of rakes or other hand tools » re-seeding shall occur at the recommended time to take advantage of the growing season » in the absence of sufficient follow-up rains after seeds started germinating, watering of the new vegetation cover until it is established shall become necessary to avoid loss of this vegetative cover and the associated seedbank » where, after initial re-seeding, the no acceptable vegetation cover has established within 12 months, hydroseeding should be considered as an option for follow-up revegetation work » sowing rates of seeds used during hydro-seeding should be obtained from the relevant supplier and in accordance with the existing environment	Contractor, ECO to control	Successively during construction, as construction of individual components is completed, then followed up until desired end state is reached
Planting of species » species to be planted include all rescued species » the size of planting holes shall be sufficiently large to ensure that the entire root system is well covered with topsoil » soil around the roots of container plants shall not be disturbed » bulbous plants shall be planted in groups or as features in selected areas » before placement of larger plant specimens into prepared holes, the holes shall be watered if not sufficiently moist » during transplanting care shall be taken to limit or	Contractor, ECO to control	Successively during construction, as construction of individual components is completed, then followed up until desired end state is

Mitigation: Action/control	Responsibility	Timeframe
prevent damage to roots » plants should be watered immediately after transplanting to help bind soil particles to the roots (or soil-ball around rooted plants) and so facilitate the new growth and functioning of roots		reached
Traffic on revegetated areas » designated tracks shall be created for pedestrian of vehicle traffic where necessary » Disturbance of vegetation and topsoil must be kept to a practical minimum, no unauthorised off road driving will be allowed » All livestock shall be excluded from revegetated areas	Contractor	Before, during and after construction
Establishment » The establishment and new growth of revegetated and replanted species shall be closely monitored » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created	Contractor	Successively during construction, as construction of individual components is completed, then followed up until desired end state is reached
Monitoring and follow-up treatments		
Monitor success of rehabilitation and revegetation and take remedial actions as needed according to the respective plan » Erosion shall be monitored at all times and measures taken as soon as detected » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created	ECO during construction, suitable designated person/institution after that	During and after construction, during operational and decommis-sioning phase
Weeding » It can be anticipated that invasive species and weeds will germinate on rehabilitated soils o These need to be hand-pulled before they are fully established and/or reaching a mature stage where they can regenerate o Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications		

Performance Indicator	» No activity in identified no-go areas » Acceptable level of activity within disturbance areas, as

	determined by ECO » Natural configuration of habitats as part of ecosystems or cultivated land is retained or recreated, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist » The structural integrity and diversity of natural plant communities is recreated or maintained » Indigenous biodiversity continually improves according to the pre-determined desirable end state o This end state, if healthy, will be dynamic and able to recover by itself after occasional natural disturbances without returning to a degraded state » Ecosystem function of natural landscapes and their associated vegetation is improved or maintained
Monitoring	» Fortnightly inspections of the site by ECO during construction » An incident reporting system must record non-conformances to the EMP. » Quarterly inspections and monitoring of the site by the ECO or personnel designated to the rehabilitation process until 80% of the desired plant species have become established o These inspections should be according to the monitoring protocol set out in the rehabilitation plan » Thereafter annual inspections according to the minimal monitoring protocol

B. APPENDIX: CHECKLIST OF ACTIONS FOR REHABILITATION PLANNING

Conceptual Planning	» Identify rehabilitation site locations and its boundaries » Identify ownership of rehabilitation program » Describe improvements that are anticipated following rehabilitation » Identify the kind of ecosystem to be rehabilitated at each site » Identify rehabilitation goals and desirable end state » Identify physical site conditions in need of repair » Identify stressors in need of regulation or re-initiation to maintain the integrity of the ecosystem, such as aliens, erosion, fire-regime » Identify the list and kinds of interventions of abiotic and biotic interventions that are and will be needed » Identify landscape restrictions and whether or not its integrity is dependent on a functioning ecosystem outside the project area » Determine project funding and sources » Identify labour sources and equipment needs » Identify biotic resource needs and sources, e.g. suitable topsoil, seeds » Identify any permit requirements or other legal issues » Determine project duration » Outline adaptable strategies for long-term protection and management
Preliminary Tasks	» Appoint a rehabilitation practitioner who is in charge of all the technical aspects of rehabilitation » Appoint a restoration team and train where necessary to ensure effective implementation » Prepare a budget to accommodate the completion of preliminary tasks » Document existing site conditions, also describing biota » Conduct pre-project monitoring as needed, including soil chemistry, that may affect the success of the rehabilitation program » Establish a reference site or past reference that represents the desired end state of the site » Gather information on key species to be re-introduced » Conduct investigations as needed to assess the effectiveness of restoration methods and strategies used in similar habitats up to date » Decide if rehabilitation goals are realistic or need modification » Prepare a list of objectives that need to be reached to achieve restoration goals » Ensure liaison with affected stakeholders, especially as far as rehabilitation goals are concerned » Investigate available accedes and infrastructure needed to facilitate implementation of rehabilitation
Implementation phase	» Describe the interventions that will be implemented to attain each set objective » Acknowledge potential for passive restoration where viable » Prepare performance standards and monitoring protocols to measure the attainment of each objective » Schedule tasks needed to fulfil each objective

	» Obtain equipment, supplies and biotic resources as needed » Prepare an appropriate budget
Implementation tasks	» Mark boundaries and work areas » Install permanent monitoring fixtures » Implement restoration tasks
Post-implementation tasks	» Protect the rehabilitation site against initial disturbance, including herbivores » Perform post-implementation maintenance, especially continued monitoring and eradication of emerging IAPs » Monitor site at least once per year, using the LFA technique, and identify needs for adaptive management
Evaluation	» Assess monitoring data to determine whether performance standards are met and rehabilitation objectives reached and maintained » Conduct an ecological evaluation of the newly completed rehabilitation

C. APPENDIX: TRANSPLANTING GUIDELINES FOR PLANTS WITH UNDERGROUND STORAGE ORGANS

Many of the plants in harsh environments have underground storage organs from which they resprout every year after sufficient rains, flower and then die back soon after fruiting and remain dormant, out of sight until the next growing season. All species of the families Amaryllidaceae, Iridaceae, Orchidaceae are protected provincially, nationally and/or internationally, as are many species of other monocot species.

Root system: underground storage organs are variable in size, but usually between 15 and 40 cm deep in the soil

Transplanting: success of transplanting is usually very high IF handled correctly

Rescue 101: Plants should be lifted and transplanted after flowering and fruiting, preferably as the leaves start to die back. For lifting, loosen the soil or wedge apart rocks working from a circle of about 20 cm away from the base of the plant, working inwards but not closer than about 5 cm of the plant with a sharp narrow object such as a koevoet. Once the soil is loosened, gently feel by hand where the bulb, corm, or other storage organ is, and wedge out by hand, taking care not to damage it. Remove loose soil, gently cleanse off most of remaining soil, or rinse off the storage organ. Group these according to species and label clearly, keep records of labels to include name if that is known, or a brief description or photo, also the average depth of the organs when they were removed, and the habitat they were removed from. Spread these plants so that the storage organ can dry completely, and then loosely pack into newspaper or paper bag and then store in a shaded, dry position for maximally 3 months. Transplant into soil that is as similar as possible to the original habitat, TAKING CARE that the growing point of the organ points to the top, else the plant will die. Make sure the storage organs are positioned according to the records kept about original depth of the storage organ.

Aftercare: Firm down soil around the base of the plant once it is in a new position. Allow plant to resprout naturally after sufficient rains, do not water. As these plants may not be visible for a while, clearly demarcate the area where these have been planted to avoid disturbing and potentially destroying them later on.

Appendix C:

Open Space Management Plan

OPEN SPACE MANAGEMENT PLAN

OVERALL OBJECTIVE

The purpose of the Open Space Management Plan is to provide a framework for the integrated management of the natural and semi-natural areas within the Wind Energy Facility.

PROBLEM OUTLINE

The Zen Wind Farm facility consists of wind turbines distributed over approximately 3 542 ha. As the actually footprint of the facility is approximately 31 ha, the majority of the property will remain undeveloped. The construction and presence of the facility within the site, will however pose several novel threats to the area that should be managed in order to promote the maintenance of biodiversity within the site and to ensure that the facility operates in a biodiversity compatible manner and does not have a long-term negative impact on the local environment.

RELATION TO OTHER SUBPLANS

Given that the goal of the Open Space Management plan is to ensure the biodiversity compatible management of the facility, it cannot be considered independently of the other environmental management subplans at the site. In particular the Erosion Management plan and Alien Invasive Management plan should be closely aligned with the Open Space Management plan.

OPEN SPACE MANAGEMENT SUBPLAN

The following elements are considered part of the Open Space Management Subplan

Access Control:

- Access to the facility should be strictly controlled.
- All visitors and contractors should be required to sign-in.
- Signage at the entrance should indicate that disturbance to fauna and flora is strictly prohibited.

Prohibited Activities:

The following activities should not be permitted by anyone except the landowner or his representatives:

- No fires within the site.
- No hunting, collecting or disturbance of fauna and flora, except where required for the safe operation of the facility and only by the Environmental Officer on duty and with the appropriate permits and landowner permission.
- No driving off of demarcated roads.
- No interfering with livestock.

Fire Risk Management:

Although fires are not a regular occurrence at the site, particularly within the higher-lying areas with a high grass cover, fires may occasionally occur under the right circumstances. Ignition risk sources in the area include the following:

- Lightning strikes
- The railway line which runs through the facility
- Personnel within the facility
- Infrastructure such as transmission lines

The National Veld and Forest Fires Act places responsibility on the landowner to ensure that the appropriate equipment as well as trained personnel are available to combat fires. Therefore, the management of the facility should ensure that they have suitable equipment as well as trained personnel available to assist in the event of fire.

Firebreaks

Extensive firebreaks are not recommended as a fire-risk management strategy at the site. The site is very large compared to the extent of the infrastructure and the maintenance of firebreaks would impose a large management burden on the operation of the facility. In addition, the risk of fires is not distributed equally across the site and within many of the lowlands of the site, there is not sufficient biomass to carry fires and the risk of fires within these areas is very low. Rather targeted risk management should be implemented around vulnerable or sensitive elements of the facility such as substations or other high-risk components. Within such areas, the extent over which management action needs to be applied is relatively limited and it is recommended that firebreaks are created by mowing and that burning to create firebreaks is not used as this in itself poses a risk of runaway fires. Where such firebreaks need to be built such as around substations, a strip of vegetation 5-10 m wide can be cleared manually and maintained relatively free of vegetation through manual clearing on an annual basis. However if alien species colonise these areas, more regular clearing should be implemented.

Grazing Management

The development of the wind energy facility will not prevent the site from being used for its current landuse of extensive livestock production. Extensive livestock grazing is compatible with biodiversity maintenance provided that it is implemented according to the basic principles of sustainable grazing management. While the majority of these are beyond the scope of the current plan, the following basic principles should be adhered to:

- A grazing management plan for the site should be developed in cooperation with Agricultural Extension services.
- The stocking rate applied should be within the recommended limits as identified by the Department of Agriculture.
- Livestock should be rotated through the different paddocks at the site in a manner which allows for the growth and recovery of the vegetation between grazing events.

- Precautions should be taken to ensure that the development of the site does not increase the risk of stock theft within the facility. These include access control as previously described, as well as security patrols.

Alien Plant Control

Alien invasive plants should be controlled according to the Alien Invasive Management Plan.

Erosion Management

The facility should be inspected every 6 months for erosion problems or more frequently in the event of exceptional rainfall events. All erosion problems should be rectified according to the Erosion Management Subplan.

Integrated Management

The management of the facility should meet with the landowner and other relevant local managers to review the management of the facility on a regular basis. Records of such meetings should be maintained including decisions and management outcomes resulting from such meetings.

Appendix D:

Alien Invasive Management Plan

ALIEN INVASIVE PLANT MANAGEMENT PLAN

OVERALL OBJECTIVE

Manage alien and invasive plant species during the construction and operation of the Wind Energy Facility, through the implementation of an alien invasive species management and control programme.

PROBLEM OUTLINE

Alien plants replace indigenous vegetation leading to severe loss of biodiversity and change in landscape function. Potential consequences include loss of biodiversity, loss of grazing resources, increased fire risk, increased erosion, loss of wetland function, impacts on drainage lines, increased water use etc.

In addition, the Conservation of Agricultural Resources Act (Act 43 of 1983), as amended in 2001, requires that land users clear *Declared Weeds* from their properties and prevent the spread of *Declared Invader Plants* on their properties. A list of declared weeds and invader plants is attached.

Table 3 of CARA (the Conservation of Agricultural Resources Act) lists all declared weeds and invader plants. Alien plants are divided into 3 categories based on their risk as an invader.

- Category 1 - These plants must be removed and controlled by all land users. They may no longer be planted or propagated and all trade in these species is prohibited.
- Category 2 – These plants pose a threat to the environment but nevertheless have commercial value. These species are only allowed to occur in demarcated areas and a land user must obtain a water use license as these plants consume large quantities of water.
- Category 3 – These plants have the potential of becoming invasive but are considered to have ornamental value. Existing plants do not have to be removed but no new plantings may occur and the plants may not be sold.

The following guide is a useful starting point for the identification of alien species:

Bromilow, C. 2010. *Problem Plants and Alien Weeds of South Africa*. Briza, Pretoria.

SPECIFIC MANAGEMENT OBJECTIVES:

- Ensure alien plants do not become dominant in parts or the whole landscape
- Initiate and implement a monitoring and eradication programme for alien and invasive species
- Control alien and invasive species dispersal & encroachment
- Promote the natural reestablishment and planting of indigenous species

VULNERABLE ECOSYSTEMS AND HABITATS

Certain habitats and environments are more vulnerable to alien plant invasion and are likely to bear the brunt of alien plant invasion problems at the site. In addition, construction activities and changes in water distribution at the site following construction are also likely to increase and alter the vulnerability of the site to alien plant invasion.

Areas at the site which are likely to require specific attention include the following

- Wetlands, drainage lines and other mesic areas
- Cleared and disturbed areas such as road verges, crane pads and construction footprints etc.
- Construction camps and lay-down areas which are cleared or are active for an extended period

Wetlands, drainage lines and other mesic areas

There are a relatively large number of drainage lines at the site as well as a number of natural and artificial wetlands. Disturbance within these areas often results in alien plant invasion on account of the greater water and nutrient availability in this habitat. Although there are no turbines within such areas, numerous road crossings will be required. The disturbance footprint within such areas should be minimized and these areas should be checked for alien species more often than the surrounding landscape.

Cleared and disturbed areas

Cleared and disturbed areas are clearly vulnerable to invasion on account of the lack of existing plant cover to resist invasion as well as the disturbance which created during construction which promotes the germination and establishment of alien plant species.

Construction camps and laydown areas

Construction camps and lay down areas are either cleared of vegetation or prolonged activities in these areas result in negative impact on indigenous vegetation. In addition, repeated vehicle and human activity in these areas usually results in the import of alien plant seed on clothes, dirty vehicles or with construction machinery and materials.

GENERAL CLEARING & GUIDING PRINCIPLES

- Alien control programs are long-term management projects and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area. Alien problems at the site should be identified during preconstruction surveys of the development footprint. This may occur simultaneously to other required searches and surveys. The clearing plan should then form part of the preconstruction reporting requirements for the site.

- The plan should include a map showing the alien density & indicating dominant alien species in each area.
- Lighter infested areas should be cleared first to prevent the build-up of seed banks.
- Dense mature stands of woody species where present should be left for last, as they probably will not increase in density or pose a greater threat than they are at the moment.
- Collective management and planning with neighbours may be required as seeds of aliens are easily dispersed across boundaries by wind or water courses.
- All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.

CLEARING METHODS

- Different species require different clearing methods such as manual, chemical or biological or a combination of both.
- However care should be taken that the clearing method (s) used does not encourage further invasion. As such, regardless of the method (s) used, disturbance to the soil should be kept to a minimum. Fire is not a natural phenomenon at the site and fire should not be used as a clearing method or vegetation management approach at the site.
- The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. http://www.dwaf.gov.za/wfw/Control/

USE OF HERBICIDES FOR ALIEN CONTROL

Although it is usually preferable to use manual clearing methods where possible, such methods may create additional disturbance which stimulates alien invasion and may also be ineffective for many woody species which re-sprout. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by observing the following:

- Area contamination must be minimised by careful, accurate application with a minimum amount of herbicide to achieve good control.
- Specific care must be taken to prevent contamination of any water bodies. This includes: due care in storage, application, cleaning of equipment and disposal of containers, product and spray mixtures.
- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed of in a suitable site.
- To avoid damage to indigenous or other desirable vegetation, products used should have least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighboring vegetation.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.

For all herbicide applications, the following guidelines should be followed:

Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation.

ALIEN PLANT MANAGEMENT PLAN

CONSTRUCTION PHASE ACTIVITIES

The following management actions are aimed at reducing soil disturbance during the construction phase of the development, as well as reducing the likelihood that alien species will be brought onto site or otherwise encouraged.

Action	Frequency
The ECO is to provide permission prior to any vegetation being cleared for development.	Daily
Clearing of vegetation must be undertaken as the work front progresses – mass clearing is not allowed unless the entire cleared area is to be rehabilitated immediately.	Weekly
Should re-vegetation not possible immediately, the cleared areas must be protected with packed brush, or appropriately battered with fascine work. Alternatively, jute (Soil Saver) may be pegged over the soil to stabilise it.	Weekly
Cleared areas that have become invaded can be sprayed with appropriate herbicides provided that these are such that break down on contact with the soil. Residual herbicides should not be used.	Weekly
Although organic matter is frequently used to encourage regrowth of vegetation on cleared areas, no foreign material for this purpose should be brought onto site. Brush from cleared areas should be used as much as possible. Arid soils are usually very low in organic matter and the use of manure or other soil amendments is likely to encourage invasion.	Weekly
Clearing of vegetation should not be allowed within 50m of any wetland or pan, 80m of any wooded area, within 1:100 year floodlines, in conservation servitude areas or on slopes steeper than 1:3, unless permission is granted by the ECO for specifically allowed construction activities in these areas.	Weekly
Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.) Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
Alien vegetation regrowth must be controlled throughout the entire site during the construction period.	Monthly
The alien plant removal and control method guidelines should adhere to best-practice for the species involved. Such information can be obtained from the DWAF Working for Water website.	Monthly
Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.	Daily
Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.	Monthly

Drainage lines and other sensitive areas should remain demarcated with appropriate fencing or hazard tape while construction activities within the area are underway. These areas are no-go areas (this must be explained to all workers) that must be excluded from all development activities.	Daily

MONITORING – CONSTRUCTION PHASE

The following monitoring actions should be implemented during the construction phase of the development.

Monitoring Action	Indictor	Timeframe
Document alien species present at the site	List of alien species	Preconstruction
Document alien plant distribution	Alien plant distribution map	3 Monthly
Document & record alien control measures implemented	Record of clearing activities	3 Monthly
Review & evaluation of control success rate	Decline in documented alien abundance over time	Biannually

OPERATIONAL PHASE ACTIVITIES

The following management actions are aimed at reducing the abundance of alien species within the site and maintaining non-invaded areas clear of aliens.

Action	Frequency
Surveys for alien species should be conducted regularly. Every 3 months for the first two years after construction and biannually thereafter. All aliens identified should be cleared.	Every 3 months for 2 years and biannually thereafter
Re-vegetation with indigenous, locally occurring species should take place in areas where natural vegetation is slow to recover or where repeated invasion has taken place.	Biannually, but re-vegetation should take place at the start of the rainy season.
Areas of natural vegetation that need to be maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected, such as using a weed-eater to mow above the soil level.	When necessary
No alien species should be cultivated on-site. If vegetation is required for esthetic purposes, then non-invasive, water-wise locally-occurring species should be used.	When necessary

MONITORING – OPERATIONAL PHASE

The following monitoring and evaluation actions should take place during the operational phase of the development.

Monitoring Action	Indictor	Timeframe
Document alien species distribution and abundance over time at the site	Alien plant distribution map	Biannually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate. A decline in alien distribution and cover over time at the site	Quarterly
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Biannually

DECOMMISSIONING PHASE ACTIVITIES

The following management actions are aimed at preventing the invasion, by alien plant species, of the re-vegetated areas created during the decommissioning phase. Re-vegetation of the disturbed site is aimed at approximating as near as possible the natural vegetative conditions prevailing prior to operation.

Action	Frequency
All damaged areas shall be rehabilitated if the infrastructure is removed and the facility is decommissioned.	Once off
All natural areas must be rehabilitated with species indigenous to the area. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction.	Once off, with annual follow up re-vegetation where required.
Maintain alien plant monitoring and removal programme for 3 years after rehabilitation.	Biannually

MONITORING – DECOMMISSIONING PHASE

The following monitoring and evaluation actions should take place during the decommissioning phase of the development.

Monitoring Action	Indictor	Timeframe

Monitor newly disturbed areas where infrastructure has been removed to detect and quantify any aliens that may become established for 3 years after decommissioning and rehabilitation.	Alien plant surveys and distribution map	Biannually until such time as the natural vegetation has recovered sufficiently to resist invasion.
Monitor re-vegetated areas to detect and quantify any aliens that may become established for 3 years after decommissioning and rehabilitation.	Alien plant surveys and distribution map	Biannually for 3 years
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate. A decline in alien distribution and cover over time at the site	Annually for 3 years

REFERENCES:

AGIS (2006) Weeds and Invasive Plants Atlas (www.agis.agric.za/wip)

Appendix E:

Erosion Management Plan

PRINCIPLES FOR EROSION MANAGEMENT

1. Purpose

An Erosion Management Plan addresses the management and mitigation of significant impacts relating to soil erosion. The objective of the plan is to provide:

» A general framework for erosion management, which enables the contractor to identify areas where erosion can be accelerated from their action.
» An outline of general methods to monitor, manage and rehabilitate erosion in ensuring that all erosion caused by this development is addresses.

2. Legislation and Standards

Soil conservation pertaining to erosion has been a topic within legislation form the 1930's till today in South Africa. Internationally, standards have been set by the International Finance Corporation and the World Bank to address soil erosion in construction and decommissioning of areas. Therefore this document will ensure that the developer meets the South African legislative requirements and the IFC standards with regards to monitoring, managing and rehabilitating soil erosion on the Cookhouse wind energy facility site.

Relevant legislation:

» Conservation of Agricultural Resources Act No 43 of 1983
» Environmental Conservation Act No 73 of 1989
» National Forestry Act No 84 of 1998
» National Environmental Management Act No 107 of 1998
» The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.

3. Areas with a high soil erodability potential

The following areas are generally associated with high soil erodibility potential:

» Any areas without vegetation cover
» Excavated areas
» Steep areas
» Areas where the soil has been degraded already
» Dispersive, duplexed soil areas
» Areas with fine grained soil material with a low porosity
» Areas which undergo overland flow of water.
» Areas close to water

» Irrigated areas
» Compacted areas
» Rivers
» Drainage lines
» And any areas where developments cause water flow to accelerate on a soil surface.
» Coarsely gravelly covered surfaces

4. Precautionary management activities to avoid erosion

In the assessment process the ECO and the contractor must assess all:

» Infrastructure and equipment placements and function to ensure that the infrastructure or equipment is not causing accelerating soil erosion on the site.
» Construction activities to ensure that no erosion indicators are forming as a result of the construction activities.

5. Monitoring

5.1. General Erosion

The ECO must assess the site for erosion indicators in the monitoring process, which include:

» Bare soil
» Desiccation cracks
» Terracettes
» Sheet erosion
» Rill erosion (small erosion features with the same properties and characteristics as gullies)
» Hammocking (Soil build-up)
» Pedestalling (Exposing plant roots)
» Erosion pavements
» Gullies
» Evidence of Dispersive soils

In the assessment process, the ECO and the contractor must assess all:

» Infrastructure and equipment placements and function to ensure that the infrastructure or equipment is not causing accelerated soil erosion on the site.
» Construction activities to ensure that no erosion indicators are forming as a result of the construction activities.

If any activities or placement of equipment cause pooling on the site, degrade the vegetation, result in removal of the surface or subsurface soil horizons, create

compacted surfaces with steep gradients, or minimise runoff areas, the erosion potential on the site will increase.

If any erosion features are begin forming or are present as a result of the activities mentioned above the ECO must:

» Assess the situation.
» Take photographs of the soil degradation.
» Determine the cause of the soil erosion.
» Inform and show the relevant contractors the soil degradation.
» Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan.
» Monitor that the contractor is taking action to stop the erosion and assist them where needed.
» Report and monitor the progress of the rehabilitation weekly and recorded all the findings in a site diary.
» All actions with regards to the incidents must be reported on a monthly compliance report which will be submitted to the department.

The contractor/ developer (with the ECO's consultation) must:

» Select a system to treat the erosion
» Design the treatment system
» Implement the system
» Monitor the area to see if the system functions like it should, if the system fails, the method must be adapt or adjust to ensure the accelerated erosion is controlled.
» Monitoring must continue until the area has been stabilised

5.2. Stormwater Management

The ECO is responsible to monitor the site and the activities to ensure that no unnatural soil degradation is taking place.

The ECO must assess the site for erosion indicators such as:

» Bare soil
» Exposed plant roots, pedestalling
» Sheet erosion
» Rill erosion
» Hammocking
» Erosion pavements
» Terracettes
» Gullies

In the assessment process the ECO and the contractor must assess all:

» Disturbed watercourse areas by the development: roads, bridges, river crossings, cabling, permanent laydown areas, crane pads and any other remaining hard surfaces.
» Construction activity limited to specified areas. Stockpiles of aggregate and material will be positioned at least 50 m away from drainage lines and wetlands.

If any erosion features are present as a result of the activities mentioned above the ECO must:

» Assess the situation
» Take photographs of the soil degradation.
» Determine the cause of the erosion.
» Inform and show the relevant contractors the soil degradation.
» Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan.
» Monitor that the contractor is taking action to stop the erosion and assist them where needed.
» Monitor the rehabilitation weekly and record the findings in a site diary.
» All actions with regards to the incidents must be reported on in the monthly compliance monitoring report.

The contractor/ developer must (with the ECO's consultation):

» Select a system to treat the erosion
» Design the treatment system
» Implement the system
» Monitor the area to ensure that the erosion has been addressed adequately.
» Monitor the erosion until the area has been stabilised.

6. Rehabilitation

The following erosion control measures and rehabilitation specifications must be implemented to ensure that good environmental practice is conducted and environmental compliance is achieved.

6.1. General Erosion Management

In this section the equipment needed to remediate erosion, the precautionary measures which must be taken to avoid erosion and mitigation requirements for already degraded areas.

6.1.1. Equipment

The civil works contractor may use the following instruments to combat erosion when necessary:

» Reno mattresses
» Slope attenuation
» Hessian material
» Shade catch nets
» Gabion baskets
» Mulching Run-off control (increase the amounts of runoff areas to disperse the water)
» Silt fences
» Storm water channels and catch pits
» Shade / catch nets
» Soil bindings
» Geofabrics
» Hydroseeding and/or re-vegetating
» Mulching over cleared areas
» Stone packing
» Tilling (roughing the surface)

6.1.2. Methods to prevent accelerated erosion

The following practises should be considered and adhered to:

» Ensure steep slopes are stabilised.
» Ensure that steep slopes are not stripped of vegetation and left to dry out and become water repellent (which will case increased runoff and a decreased infiltration rate) increasing the erosion potential.
» Ensure that all water on site (rain water or water wastage from the construction process) does not result in any surface flow (increase velocity and capacity of water) as a result of the poor drainage systems.
» Ensure that pooling of water on site is avoided, as the site and the general area consists of dispersive soils, pooling will cause an increase of infiltration on one area, causing the subsurface to begin eroding.
» Ensure that heavy machinery does not compact those areas which are not intended to be compacted (i.e. areas intended to be managed), as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. where compaction does occur, the areas should be ripped.
» Ensure that compacted areas have adequate drainage systems to avoid pooling and surface flow.
» Prevent the concentration or flow of surface water or stormwater down cut or fill slopes, or along pipeline routes or roads, and ensure measures to prevent erosion are in place prior to construction.

» Ensure that stormwater and any runoff generated by hard surfaces should be discharged into retention swales or areas with rock rip-rap. These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that surface flows are managed prior to being discharged back into a natural watercourse to support the maintenance of natural base flows within the ecological systems and prevent erosion, i.e. hydrological regime (water quantity and quality) is maintained.
» Ensure siltation and sedimentation through the use of the erosion equipment mentioned structures.
» Ensure that all stormwater control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local ground watertable in low quantities (to reduce runoff but prevent subsurface erosion).
» Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
» Ensure that vegetation clearing is conducted in parallel with the construction progress across the site to minimise erosion and/or run-off.
» Ensure that large tracts of bare soil which would cause dust pollution in high winds, or have high erosion susceptibility and increase sedimentation in the lower portions of the catchment are controlled through temporary surface covering.
» Ensure no diversion of water flows in catchment occurs.
» Ensure that dust control measures are implemented, but prevent over-wetting/ saturating the area (to cause pooling) and run-off (that may cause erosion and sedimentation).
» Watercourse (stream) crossings should not trap any run-off, thereby creating inundated areas, but allow for free flowing watercourses.

6.1.3. Mitigation for previously degraded areas

Previously degraded areas could pose a threat to construction activities in the area and must therefore be stabilised, then remediated and rehabilitated through:

» Protecting, stabilise and isolate the degraded areas to ensure no further damage is caused by erosion due to construction activities.
» Increase the drainage in the area but avoid pooling.
» Prevent increasing sedimentation in areas that have been chocked by soils from degraded areas.
» Once construction has been completed, a method statement must be drafted for the rehabilitation of the previously degraded areas, using equipment mentioned above and implemented.
» Stabilisation of steep slopes must be undertaken.
» Ensure that bare soil is covered and hydro seeded to reduce topsoil loss.

6.2. Methodologies

The following erosion control measures and rehabilitation specifications may be required to be implemented to ensure that good environmental practice is conducted and environmental compliance is achieved.

» Topsoil covered with a geotextile or hessian material and a grass seed mixture (see Rehabilitation Specifications).
» Logging or stepping following the contours of the slope, to reduce surface runoff.
» Earth or rock-pack cut-off berms.
» Packed branches to roughen the surface and promote infiltration.
» Benches (sand bags).
» Stabilisation of near vertical slopes (1:1 – 1:2), if created during construction, will be required to utilise hard structures that have a natural look. The following methods may be considered:
  - Gabions (preferred method with geotextile material).
  - Retaining walls.
  - Stone pitching.
» The slopes of all stream diversions must be protected. The following methods may be considered:
  - Reno mattresses (preferred method), ensure that the reno mattresses are buried deep into the subsurface, to avoid undercutting from the water.
  - Coarse rock (undersize rip-rap)
  - Sandbags.
  - Stone packing with geotextile
» Where feasible use rubber dams as stream diversions when establishing water course crossings. Although (and considering that these are non-perennial watercourses) the recommendation is to construct watercourse crossings during dry periods (or no flow periods), where possible.
» Any concentration of natural water flow caused by road works or hardstands areas will be treated as follows:
  - if water flow is sub-critical, nothing is required
  - if water flow is supercritical, the outlets will be provided with protection (either gabions or stone pitching – depending on the flows) to release water subcritical back into the watercourse at a low velocity.

6.3. Engineering Specifications

A detailed Stormwater Management Plan describing and illustrating the proposed stormwater control measures must be prepared by the Civil Engineers and this includes erosion control.

Requirements for project design:

» Erosion control measures to be implemented before and during the construction period, including the final stormwater control measures (post construction).

» The location, area/extent (m²/ha) and specifications of all temporary and permanent water management structures or stabilisation methods.
» A resident Engineer to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
» The Developer holds ultimate responsibility for remedial action in the event that the approved stormwater plan is not correctly or appropriately implemented and damage to the environment is caused.
» Concrete lined drains placed adjacent to road to transfer the water to the existing water courses.
» Frequent gravel drains hydroseeded placed on permanent roadway edges.
» At the point where stormwater is discharged, energy dissipaters to be constructed to reduce the flow rate of run-off.
» All cut and fill banks will be seeded with an approved seed mix (as per the rehabilitation specifications) to ensure bank stabilisation and the elimination of potential erosion. Reno mattresses may be used to ensure that the area remains stable.

6.4. Rehabilitation Specifications

» Employ a Horticultural Landscape Contractor to fulfil the rehabilitation of disturbed areas post-construction.
» A detailed Rehabilitation Plan describing and illustrating the proposed rehabilitation activities on site must be prepared i.e. areas of top soiling, seeding and replanting of vegetation; species mix; requirements for fertilisation; seed sowing rates; watering etc. (i.e. bill of quantities).
» The following document should be consulted for further support with respect to information regarding rehabilitation, namely: The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.
» These specifications may be modified by the Horticultural Landscape Contractor on consideration of site conditions.

6.5. Post- and during construction rehabilitation activities

» Correct and appropriate stockpile management of topsoil will be required during the construction phase.
» Rehabilitation of disturbed areas will be implemented as these areas become available for rehabilitation.
» Disturbed areas will include, for example: construction camp site, areas where underground cabling has been layed/buried, roadsides of new access roads.

7. Rehabilitation steps to mitigate the eroded areas

» Stockpiled topsoil must be spread over disturbed areas (150 – 200mm thick) just prior to planting/seeding.
» Rip and scarify along the contours of the newly spread topsoil prior to watering and seeding.
» Organic fertilizers or compost shall be used if site conditions require it and can be applied as part of hydro-seeding applications.
» Seed should be sown into weed-free topsoil that has been stockpiled (i.e. original topsoil from the site).
» Indigenous plants shall be used to rehabilitate disturbed areas.
» Applying the seed through hydromulching (hydro-seeding) is advantageous (or organic mulching after seeding).
» Watering is essential and rehabilitation should ideally occur during the wet season.
» The topsoil in the area is vulnerable to erosion therefore the hydro-seeded surfaces must be covered with a shade cloth material or natural fibre (hessian material) to reduce the loss of soil while the plants establish.

7.1. 'Watering' to avoid erosion

» Movement of livestock in newly rehabilitated areas must be restricted, where possible, while taking into consideration drinking areas/paths.
» Watering the rehabilitated areas should be undertaken in the wet/rainy season essential but if this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth).
» Generous watering during the first two weeks, or until the seeds have germinated, is required (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for germination to occur.
» For grass to establish (once germination has occurred), rainfall or irrigation is needed at regular intervals, ideally every few days and possibly every day if weather conditions require it.
» During dry periods, with no rainfall, 100 litres per m^2 (or 100mm of rain) over a month or more, may be necessary to establish plants capable of surviving dry weather (or otherwise specified by the Horticultural Landscape Contractor).

7.2. Seeding

The developer should make use of an appropriate mix of grass species for rehabilitation 9to be determined in consultation with a suitably qualified ecologist) and they must be mixed for sowing either in summer or in winter. Grass species application (Rutherford, 2006) is at the rate secified as kg/ha.

7.3. Steep slopes

» Areas that have a steep gradient and require seeding for rehabilitation purposes should be adequately protected against potential run-off erosion e.g. with coir geotextile netting or other appropriate methodology.
» Provision for wind should also be made on these slopes to ensure the fine grained soil is not removed.

7.4. Maintenance and duration

» Rehabilitation will occur during construction, as areas for plant rehabilitation become available.
» The rehabilitation period post construction is estimated to be over a period of 6 (minimum) to 12 months (maximum), or a time period specified by the Horticultural Landscape Contractor, particularly if planting of trees and shrubs occurs.
» The rehabilitation phase (including post seeding maintenance) should be at least 6 months (depending on time of seeding and rainfall) to ensure establishment of plants with a minimum 80% cover achieved (excluding alien plant species).
» If the plants have not established and the 80% is not achieved within the specified maintenance period, maintenance of these areas shall continue until at least 80% cover is achieved (excluding alien plant species).
» Additional seeding may be necessary to achieve 80% cover.
» Any plants that die during the maintenance period must be replaced.
» Succession of natural plant species should be encouraged.

8. Conclusion

The Erosion Management Plan is a document to assist the contractor, the Developer and the ECO with guidelines on how to manage erosion. The implementation of management measures is not only good practice to ensure minimisation of degradation, but also necessary to ensure comply with legislative requirements. This document forms part of the EMP, and is required to be considered and adhered to during the design, construction, operation and decommissioning phases of the project.

9. References

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Appendix F:

Grievance Mechanism for Public Complaints and Issues

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GRIEVANCE MECHANISM / PROCESS

AIM

The aim of the grievance mechanism is to ensure that grievances / concerns raised by local landowners and or communities are addressed in a manner that is:

- Fair and equitable;
- Open and transparent;
- Accountable and efficient.

It should be noted that the grievance mechanism does not replace the right of an individual, community, group or organization to take legal action should they so wish. However, the aim should be to address grievances in a manner that does not require a potentially costly and time consuming legal process.

Proposed generic grievance process

- Local landowners, communities and authorities will be informed in writing by the proponent (the renewable energy company) of the grievance mechanism and the process by which grievances can be brought to the attention of the proponent.
- A company representative will be appointed as the contact person for grievances to be addressed to. The name and contact details of the contact person will be provided to local landowners, communities and authorities.
- Project related grievances relating to the construction, operational and or decommissioning phase must be addressed in writing to the contact person. The contact person should assist local landowners and or communities who may lack resources to submit/prepare written grievances.
- The grievance will be registered with the contact person who, within 2 working days of receipt of the grievance, will contact the Complainant to discuss the grievance and agree on suitable date and venue for a meeting. Unless otherwise agreed, the meeting will be held within 2 weeks of receipt of the grievance.
- The contact person will draft a letter to be sent to the Complainant acknowledging receipt of the grievance, the name and contact details of Complainant, the nature of the grievance, the date that the grievance was raised, and the date and venue for the meeting.
- Prior to the meeting being held the contact person will contact the Complainant to discuss and agree on who should attend the meeting. The people who will be required to attend the meeting will depend on the nature of the grievance. While the Complainant and or proponent are entitled to invite their legal representatives to attend the meeting/s, it should be made clear that to all the parties involved in the process that the grievance mechanism process is not a legal process. It is therefore recommended that the involvement of legal representatives be limited.

- The meeting will be chaired by the company representative appointed to address grievances. The proponent will provide a person to take minutes of and record the meeting/s. The costs associated with hiring venues will be covered by the proponent. The proponent will also cover travel costs incurred by the Complainant, specifically in the case of local, resource poor communities.
- Draft copies of the minutes will be made available to the Complainant and the proponent within 4 working days of the meeting being held. Unless otherwise agreed, comments on the Draft Minutes must be forwarded to the company representative appointed to manage the grievance mechanism within 4 working days of receipt of the draft minutes.
- In the event of the grievance being resolved to the satisfaction of all the parties concerned, the outcome will recorded and signed off by the relevant parties. The record should provide details of the date of the meeting/s, the names of the people that attended the meeting/s, the outcome of the meeting/s, and where relevant, the measures identified to address the grievance, the party responsible for implementing the required measures, and the agreed upon timeframes for the measures to be implemented.
- In the event of a dispute between the Complainant and the proponent regarding the grievance, the option of appointing an independent mediator to assist with resolving the issue should be discussed. The record of the meeting/s will note that a dispute has arisen and that the grievance has not been resolved to the satisfaction of all the parties concerned;
- In the event that the parties agree to appoint a mediator, the proponent will be required to identify three (3) mediators and forward the names and CVs to the Complainant within 2 weeks of the dispute being declared. The Complainant, in consultation with the proponent, will identify the preferred mediator and agree on a date for the next meeting. The cost of the mediator will be borne by the proponent. The proponent will provide a person to take minutes of and record the meeting/s.
- In the event of the grievance, with the assistance of the mediator, being resolved to the satisfaction of all the parties concerned, the outcome will recorded and signed off by the relevant parties, including the mediator. The record should provide details on the date of the meeting/s, the names of the people that attended the meeting/s, the outcome of the meeting/s, and where relevant, the measures identified to address the grievance, the party responsible for implementing the required measures, and the agreed upon timeframes for the measures to be implemented.
- In the event of the dispute not being resolved, the mediator will prepare a draft report that summaries the nature of the grievance and the dispute. The report should include a recommendation by the mediator on the proposed way forward with regard to the addressing the grievance.
- The draft report will be made available to the Complainant and the proponent for comment before being finalised and signed by all parties. Unless otherwise agreed, comments on the draft report must be forwarded to the company representative appointed to manage the grievance mechanism within 4 working days.

The way forward will be informed by the recommendations of the mediator and the nature of the grievance. As indicated above, the grievance mechanism does not replace the right of an individual, community, group or organization to take legal action should they so wish. In the event of the grievance not being resolved to the satisfaction of Complainant and or the proponent, either party may be of the opinion that legal action may be the most appropriate option.

Appendix G:

Construction Waste Guidelines

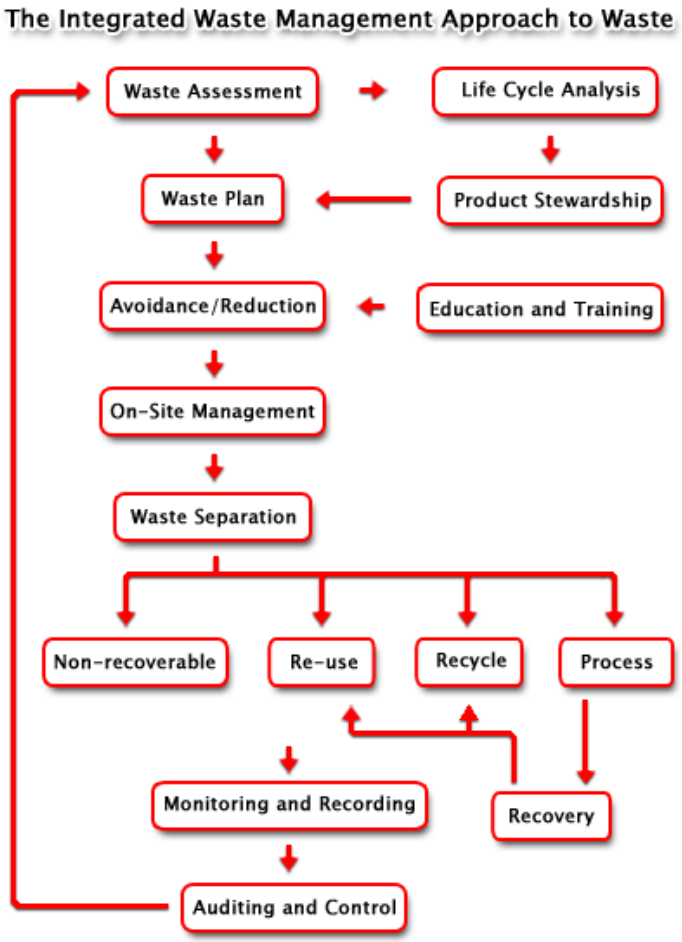
GUIDELINE FOR INTEGRATED MANAGEMENT OF CONSTRUCTION WASTE

Waste is defined in the National Environmental Management: Waste Act (Act No 59 of 2008) as follows:

"any substance, whether or not that substance can be reduced, re-used, recycled and recovered:
(a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;
(b) which the generator has no further use of for (he purposes of production;
(c) that must be treated or disposed of; or
(d) that is identified as a waste by the Minister by notice in the Gazette,

and includes waste generated by the mining, medical or other sector, but—
(i) a by-product is not considered waste; and
(ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste"

An integrated approach to waste management on site is needed. Such an approach is illustrated in the figure below.



Source: http://www.enviroserv.co.za/pages/content.asp?SectionId=496

1. Waste Assessment

A detailed waste assessment is necessary to understand the waste types and volumes being produced. In order to achieve this, construction practices must be measured and analysed.

2. Waste Plan

A waste plan must be developed to provide appropriate solutions for managing the entire waste stream on site. The objective of the plan should be to reduce the volumes of waste to disposal and thereby to reduce the cost of management of the waste stream without compromising environmental standards. The plan should include recovery, re-use and recycle recommendations.

Construction Waste Management is the practice of reducing the actual waste that goes to the landfill site. Waste reduction is best met by recycling, and construction wastes offer several opportunities in this regard. In fact, 80% of the wastes found in construction waste piles are recyclable in some form or another. Wood, concrete, bricks, metals, glass and even paint offer several options for recycling.

There are three basic steps for construction waste management, i.e. Reduce, Reuse, and Recycle. **Reduce** is the prevention of the waste from arising and optimising material usage. Waste avoidance and waste reduction can be achieved through improved education and training - by improving efficiencies and by making staff environmentally aware.

Reuse is using existing materials instead of throwing these away. Reusing does not mean that it needs to be reused on the same construction site. Selling or donating waste materials to a third party is one option of construction waste management.

Recycle is somewhat limited since it only allows for those items that can be used on-site. The most important step for recycling of construction waste is on-site separation. Initially, this will take additional effort and training of construction personnel. Targets should be set for the levels of recycling. Once separation habits are established, on-site separation can be done at little or no additional cost.

3. What to Recycle

Before recycling construction waste, identify who will accept it. This is important in designating type of waste to separate, and in making arrangements for drop-off or delivery of materials. Materials that can be recycled include:

» Cardboard and Paper
» Wood

» Metals
» Plastics
» Glass
» Paints, Stains, Solvents and Sealants
» Oil

4. Materials Separation

Successful recycling requires good clean uniform collections of single waste types. This is most effectively achieved by separating the waste streams close to source rather than at the landfill site. Containers for material recycling must be set up on site and clearly labelled. Construction personnel must be trained in material sorting policy, and bins must be monitored periodically to prevent waste mixing as a result of construction employees throwing rubbish into the bins.

Some materials will require bins or storage that protect these from rain. Other bins may be locked to prevent tampering.

5. Recycling and Waste Minimisation Guidelines

» *Wood*
- Optimise building dimensions to correspond to standard wood dimensions in order to reduce the need for cutting.
- Store wood on level blocking under cover to minimize warping, twisting and waste.

» *Metals*
- During construction, separate metals for recycling, including copper piping, wire, aluminium, iron and steel, nails and fasteners, galvanized roofing. It is critical to keep lead out of landfills because it could leach into groundwater.

» *Cardboard and Paper*
- Avoid excessively packaged materials and supplies. However, be sure packaging is adequate to prevent damage and waste.
- As far as possible, use recyclable packaging.
- Separate cardboard waste, bundle, and store in a dry place.
- Minimise the number of blueprints and reproductions necessary during the design and construction process.

» *Plastic*
- Avoid excessively packaged materials and supplies. However, be sure packaging is adequate to prevent damage and waste.
- As far as possible, use recyclable packaging.

Since more than 60 different types of plastic resins exist, the Plastics Federation of South Africa has adopted a voluntary number coding system for each category of plastics to aid in their sorting by material type for recycling (Bruyns et al, 2002). The most common resin types are itemised in Table 1.

Table 1: Identification System for Plastic

Id Number	Plastic Resin Type
1	PET (polyethylene terephthalate)
2	HDPE (high-density polyethylene)
3	PVC (polyvinyl chloride) or V (vinyl)
4	LDPE (low-density polyethylene)
5	PP (polypropylene)
6	PS (polystyrene)
7	Other (laminates, etc.)

» *Paints, Stains, Solvents and Sealants*

* Unused materials should be taken to a hazardous waste collection facility.

6. On-site Management

Good supervision of the waste management programme on site is critical to success. Management of the entire on-site program is critical to ensure smooth operations.

7. Auditing and Control

The success of the waste plan is determined by measuring criteria such as waste volumes, cost recovery from recycling, cost of disposal. Recorded data can indicate the effect of training and education, or the need for education. It will provide trends and benchmarks for setting goals and standards. It will provide clear evidence of the success or otherwise of the plan. Finally, good record keeping and control, becomes a continuous waste assessment process, allowing the waste plan to be improved and adjusted as required.

8. Useful contacts:

http://www.transpaco.co.za/page5.htm
Transpaco, a manufacturing and distribution company operating extensively in the plastics and packaging industries, conducts plastic reclamation and recycling.

http://www.jclenterprises.co.za/
JCL Enterprises for plastic sales of quality recycled plastic materials as well as the recycling of plastic.

http://www.rosefoundation.org.za/
The Rose Foundation specialises in the collection and recycling of used motor (engine) oil.

Information Sources:

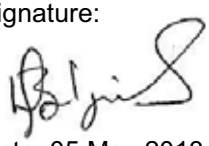
http://www.greenbuilder.com/sourcebook/ConstructionWaste.html#Guidelines
http://www.enviroserv.co.za/pages/Content.asp?SectionID=587
http://www.enviroserv.co.za/pages/content.asp?SectionId=496
Programme for the Implementation of the National Waste Management Strategy. DEAT, May 2000
Residential Construction Waste Management Demonstration and Evaluation. Prepared for U.S. Environmental Protection Agency by NAHB Research Center, May 2, 1995

Appendix H:
Geotechnical Report

ZEN WIND FARM

(GOUDA, WESTHERN CAPE)

PRELIMINARY FEASIBILITY GEOTECHNICAL INVESTIGATION REPORT

Name: Deon Blignaut Signature:  Date: 05 May 2013	Name:_____ Signature:_____ Date:_____	Name:_____ Signature:_____ Date:_____
Compiled By:	**Approved By:**	**Approved By:**
AVENG GRINAKER-LTA Ground Engineering	**SAVANNAH Environmental**	VENTUSA ENERGY

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1. INTRODUCTION

During mid-April this year Aveng Grinaker-LTA Ground Engineering was approached by VentuSA Energy (Pty) Ltd to conduct a Feasibility Geotechnical Investigation on their Zen Wind Farm Project located outside Gouda in the Western Cape.

This renewable energy project is one of a few that will be privately funded where the end product will be sold to the parastatal Eskom will assist them in their shortcoming of supplying electricity in South Africa.

The purpose of this factual Geotechnical Investigation is to give the reader an overview and a better understanding of the soil conditions within the study area to be able to make accurate calculations regarding the founding solutions required for the 46No. Wind Turbine Generators (WTG). These WTG towers (Figure 1) will consist of a 100m high mast fitted with a 3MWatt turbine driven by 60m length blades delivering a total of 138MWatt to a substation on site for distribution on the national grid by Eskom.

2. SITE LOCATION

The study area of approximately 2 000 hectares is situated between the small towns of Gouda and Saron on either side of the R44 road towards Porterville, in the Western Cape Province (Figure 2). Running next to and parallel to this road in a north-western direction is the seasonal Klein Berg River which further divides the study area into almost equal proportions. The flood plain on the northern side of the river is covered with a deposit in excess of 3m thick of well sorted sand which falls within a current mining licence.

Figure 1: Typical Wind Turbine Generator Tower.

The topography on the southern portion of the study area on the farm called Molenaars Drift is relatively flat with a gentle southern slope where the slope of the portion on the Bonne Esperance farm increase as you approaches the Winterhoek Mountains. Access onto the portions is easy through a network of well-kept farm tracks for light vehicles following the gradient contours. Accessible from Cape Town and the International Airport along the N1 Highway through Wellington is well signed with an approximate distance of 130km.

The area under study does not show any erosion and is mainly used for wheat cultivation separated by fenced off grassland and natural fynbos field camps for antelope, cattle and sheep grazing.

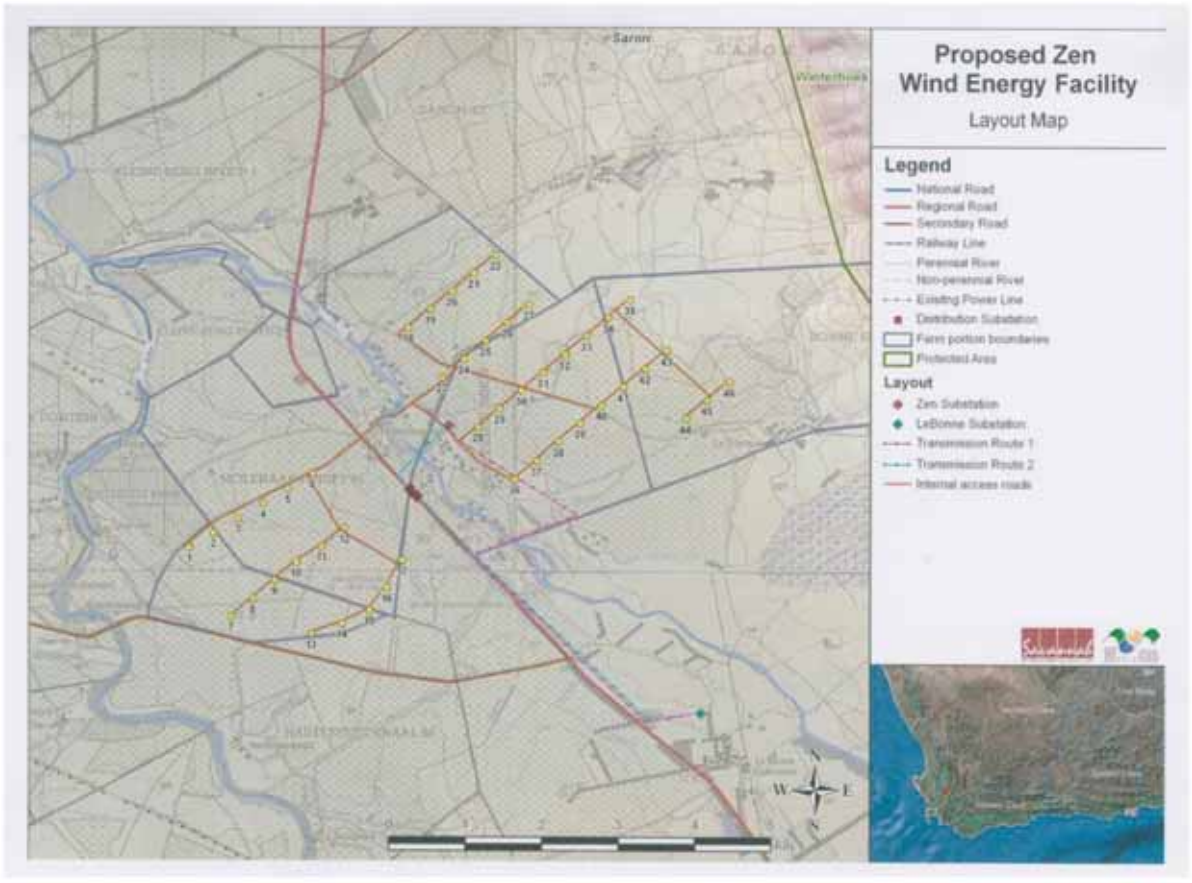


Figure 2: Locality Map of Zen Wind Farm showing WTG positions.

The dominant wind in this area is from the South-Eastern direction across the cold Atlantic Ocean which makes it ideal as the density is higher.

This is a winter rainfall area with an average of 600mm per season as measured at the Voëlvlei Dam less than 10km away since 2002 where the highest was 862mm during 2007. There is a network of well-maintained channels to direct the runoff into the Klein Berg River.

There is one large man-made dam on the study area along the slope on the Eastern side of the study area close to TWG position No.46 (Figure 2) which assists to control and contain the excess runoff water from the mountain.

Crossing the Klein Berg River onto the Northern section of the study area behind the farm house and shed is along a poorly constructed single lane low water culvert that gets flooded occasionally within a season where runoff is back to normal relatively quick.

3. SITE GEOLOGY

The regional geological setting for the study area is of the Malmesbury Group and is mapped on sheet 3318B Malmesbury and sheet 3319A Ceres by the Council for Geoscience. The geology is further divided in the Boland Subgroup followed by the Porterville Formation. Confirmation of these outcrops on site is evident throughout their strike and dip on Figure 3.

The study area bedrock consists of late-Precambrian age 547 to 560Ma Malmesbury Group of grey fine-grained greywacke sandstone and phyllitic shale. The sediments were originally deposited on an ancient continental slope and were subsequently metamorphosed by mild heat and pressure and folded tightly in a North-West direction so the rock layers are now almost vertical.

In some places the shale metamorphosis has taken place at a higher heat to alter this argillaceous rock into phyllite slate where the micro-fissured crystals impart a silky sheen to the surface of cleavage.

Covering the bedrock unconformally is a well-developed unconsolidated stratigraphic unit of recent Quaternary System sedimentary fluvial deposit. By the well roundedness of the pebbles and cobbles and the size of the boulders must this water source have been large and constant from the catchment area of the iced capped high mountains towards the North-East.

Deep scoured channels are formed bedded with pebble, cobbles and boulders which are often cross bedded and associated with white, well sorted sand which are typical of a mature braided river system. These sand deposits are only developed on the flood plain of the northern side (Figure 2) of the Klein Berg River where the river flow cuts into the shale bedrock and migrates towards the South.

A single unconsolidated layer of clast-supported conglomerate forming an unconformity with the bedrock is typical within these well-developed thick sands. The Northern fynbos area is characterized by a boulder layer of a thickness up to 2m where the size rarely exceeds 250mm and is clast-supported by pebbles and cobbles.

Greywacke rock has not been intersected during any method of investigation and is only evident as outcrops. This once sedimentary sandstone rock which undergone metamorphism consists of large angular, weather resistant, detrital quartz and feldspar phenocysts set in a fine grained matrix.

There are a number of dolerite dykes on a regional scale consisting of dark grey, fine to medium grained rock with augite and plagioclase as major constituents. They vary in width from a fraction of a meter to as much as 22m at Llandudno approx. 140km away.

4. METHOD OF INVESTIGATION

For this feasibility phase of the Geotechnical Investigation was it decided to give a detailed factual report on all the various geotechnical soil related items as requested by our client and set out in our proposal dated 04 April 2013 Ref. No. db2013/04/SW.

To perform this proposal within the given budget it was decided to execute 11No. Test Pit soil profiles with a Tractor Loader Backhoe (TLB) (Appendix 7.1) and at the same location conduct 11No. Dynamic Probe Super Heavy (DPSH) tests (Appendix 7.2) to prove depth to bedrock. From experience working in these soil conditions it was evident

that the 3m reach of a TLB would be insufficient at some location so it was decided that the depth to bedrock must be confirmed with a DPSH rig.

Soil samples were taken for laboratory testing (Appendix 7.3) at TLB test pit positions to locate construction material for the upgrade of existing roads and construction of new roads, temporary crane tower pads, storm water and cable trenches. Samples were mainly tested for California Bearing Ratio (CBR) and Road Indicators.

All soil profiles have been logged according to the SAICE Standard Guidelines for Soil and Rock Logging, 2010.

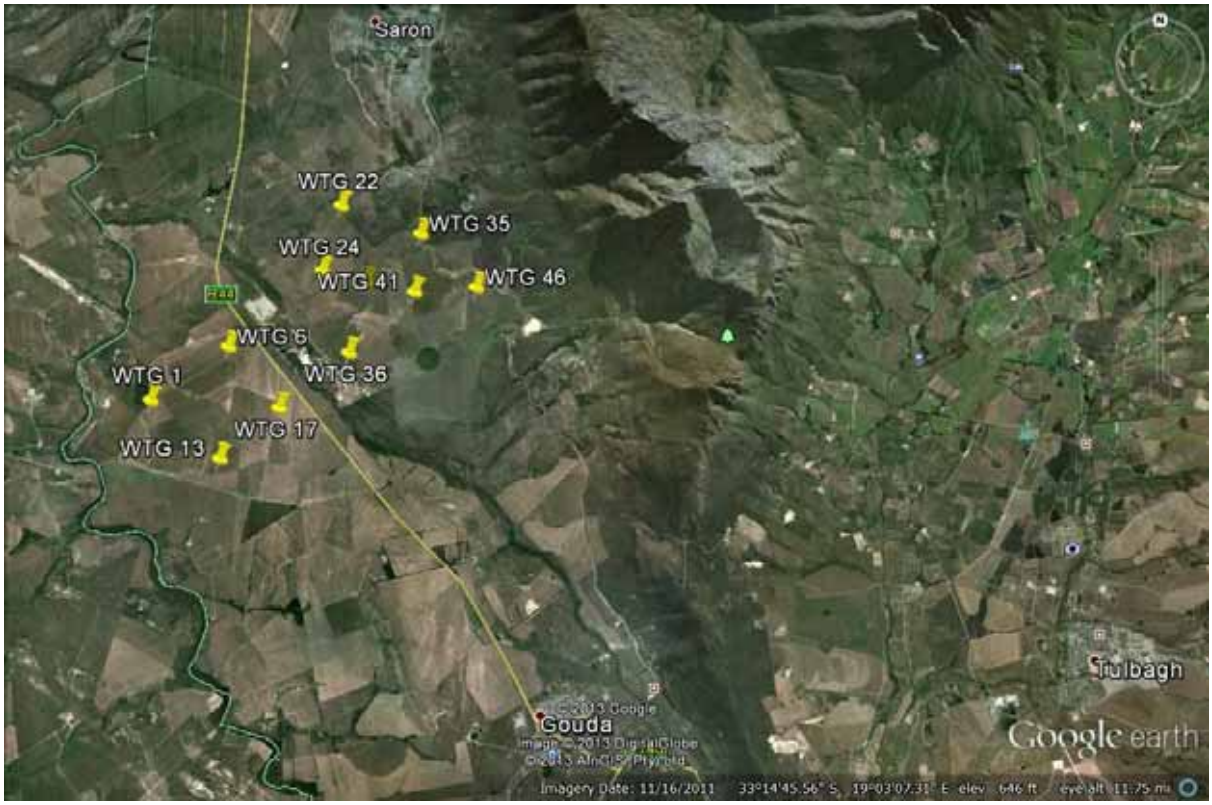


Figure 3: Map of area showing Wind Turbine Generation test positions.

5. GEOTECHNICAL EVALUATION

The study area has been eroded over the past millions of years by a braided river system where we see it today as the seasonal Klein Berg River. The evidence is the deposits of reworked clays with desiccation cracks and a trace of pebbles and cobbles with a well-developed sub-rounded layer of boulders scoured into vertically laminated shale bedrock.

Most test pits show this single layer of matrix-supported, quartzitic sandstone of medium hard rock, sub-rounded, boulders (<300mm diam.) on the bottom scoured contact with the shale commonly referred to as the Pebble Marker.

A typical TLB Test Pit soil profile is as follows;

- 0,0 – 0,7m; moist, l/brown-white, loose, fine-med. grained, intact with small roots at top, well sorted, collapsible, cross bedded, single layer of matrix-supported boulders on bottom contact (Pebble Marker), often with abundant clast-supported quartzitic sandstone med. hard rock pebbles, cobbles and boulders, **Sand/Boulders (<300mm diam.)**, alluvial.
- 0,7 – 1,4m; moist, grey, mottled yellow, stained black vertical bedding, firm, fine grained, often metamorphosed into Phyllitic Shale, **Residual Shale**, Malmesbury Group, Porterville Formation.
- 1,4 – 2,1m refusal; moist, grey, moderately weathered, fine grained, vertically laminated bedding, often metamorphosed into Phyllitic Shale, soft rock, **Shale**, Malmesbury Group, Porterville Formation.

Collapsible material is encountered in TP's 22, 24, 31 and 36 which are associated with loose alluvial sand, with or without boulders (Figure 3).

There is a clear deep channel cutting into the shale bedrock between positions WTG35 and WTG41 (Appendix 7.2) which could extend with further investigation which is evident from the DPSH test false refusal at position WTG22 and WTG31 in Table 1.

WTG Position:	Test Pit Refusal Depth (m):	DPSH Refusal Depth (m):	Bearing Value kN/m^2(BS8004,1986): (indication only)	Comment:
1	1,5	2,4	250	
6	1,8	2,1	250	
13	1,9	1,5	220	
17	1,4	0,9	300	
22	Out of reach	1,2	160	False – boulder
24	Out of reach	4,2	370	
31	Out of reach	1,5	170	False – boulder
35	Out of reach	8,4	190	
36	1,3	1,8	230	
41	Out of reach	13,5	190	
46	Out of reach	3,9	360	

Table 1: Test Pit and DPSH Test Refusal Depths.

In Table 1 it is evident that the DPSH test results always need interpretation from the other test methods as false refusals can easily be misread.

There is no correlation between the outcrops in the study area and the depth to bedrock from the Test Pit and DPSH test results. A strong relationship of depth to bedrock is evident however by comparing Test Pit profiles and DPSH test results within a 5m range from each other (Table 1). For the purpose of this investigation it was not required to map the geological features within the study area.

The catchment area of the Klein Berg River is in the valleys of the Waterval Mountain Reserve crossing the Tulbagh and Wolseley valleys to the Witsenberg Mountain range. As this river cuts through the Nuwekloof Pass it is collected in a weir where the outflow into the Klein Berg River gets controlled by a draw off into a canal feeding the water towards the Voëlvlei Dam reservoir. This dam is the major water source for domestic and industrial use for Cape Town and surrounding areas.

A similar canal that also feeds into the Voëlvlei Dam runs along the Northern boundary of the study area. This makes the calculation easy for the annual rainfall figures over the km^2 catchment area for the 50 year and 100 year Klein Berg River flood line as only during occasional times of excess water where the canal cant coup, does it over flow into its natural course along this river.

It is generally accepted that boreholes drilled into the Malmesbury Group Aquifer yield <2L/s. Exploration boreholes drilled in the shale at Atlantis approx. 50km from our study area yielded between 0,1 to 0,3L/s (Parsons and Flanagan 2006). Estimates of recharge have been made by Bredenkamp and Vandoolaeghe (1982) to be 15% of the mean annual precipitation.

It is expected that the Malmesbury Group aquifer is very small and that the seasonal groundwater level variation is likely to be insignificant and under relatively low hydraulic gradient flowing south-west towards the coast line.

6. RECOMMENDATION

The testing method applied here is to get maximum information on the soil profile leading to bedrock as well as a confirmation of the depth to bedrock. The WTG positions has been selected in such a way to represent all the soil conditions encountered on site as well as getting maximum coverage across the site (Figure 3).

For these large structures that need to be constructed where there is high compression loads as well as high tension moments further investigation on each WTG position is recommended.

To monitor the ground water fluctuations for water sampling during the constructability phase to measure if there is a sudden drop in the level of ground water or any contamination of the ground water we recommend that piezometers to be installed at strategic positions across site.

The clays intersected showed no indication of any shear movement as zero slickensided surfaces are evident which rules out any active clay present within the study area.

Piled foundations are recommended for 4No. WTG positions – at No's. 22, 31, 35 and 41where the bedrock is in excess of 5m depth as well as with very low (below 200kPa) allowable bearing capacity shallower for a spread footing. Open auger piling with temporary casing in some cases up to 4m is recommended. If there should be a high perched water table present should the concrete be tremmied.

For the remaining tower positions spread footing is recommended where excavatability will be difficult. Depth of excavation will vary according to the unweathered bedrock and the size of the base will depend on the tower moments. At shallow bedrock condition the size of a base can be reduced by anchoring it down using dowels.

Buoyancy is defined where the up-trust on a structure is equal to the weight of the water it displaced. Using this principle one should be able to calculate the uplift force on a foundation where a high water table is present.

A borrow pit for roads, laydown areas and cable trench backfill material must be further investigated. Bearing capacity loads up to 200kPa will easily be achieved from the pebble, cobble and boulder material within the study area.

7. REFENCES

7.1. Geotechnical Characterisation in Wind Farms, DG200076-C, Feb. 2009.

7.2. Guidelines for soil and rock logging in South Africa, AEG, SAICE, SAIEG, ABA Brink and RMH Bruin, 2nd impression, 2002.

7.3. Earthquake Hazards in Southern Africa, Seismological Series 10, Geological Survey of South Africa, LM Fernandez and JA Guzman, 1979.

7.4. Diamond Drilling Handbook, WF Heinz, Third Edition, 1994.

7.5. A Guide to Practical Engineering in SA, G Byrne and AD Berry, Fourth Edition, 2008.

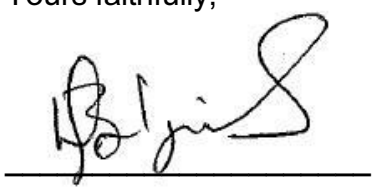
7.6. Craig's soil Mechanics, JA Knappett and RF Craig, Eighth Edition, 2012.

7.7. Hydraulics in Civil and Environmental Engineering, Andrew Chadwick, John Morfett and Martin Borthwick, Fourth Edition, 2004.

7.8. Gouda Wind Farm Geotechnical Report, Ref.No. db2012/06/T4738, 05 Nov.2012.

We trust that we have interpreted your requirements correctly and thank you for affording us this opportunity to be of service to you. Should you need any further clarifications please do not hesitate to contact the undersigned.

Yours faithfully,



DEON BLIGNAUT ***Pr.Sci.Nat.***
Engineering Geologist
Cell: 083 356 4385

8. APPENDICES

No.	Section	Pages	00	01	02	03	04	05
7.1	Test Pit Soil Profile	11	X					
7.2	DPSH Test results	11	X					
7.3	Laboratory Test Results	3	X					

APPENDIX 7.1

TEST PIT SOIL PROFILES

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 1***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33°14' 51.1", E - 18° 57' 42.3" Elev. 61m	
CONTRACTOR:	Ground Engineering		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted, slightly cohesive, massive, CLAYEY SAND, alluvium.	
20			
30			
40			
50			
60			
70			
80		Moist, grey, streaked brown, highly weathered, fine grained, vertically laminated, very soft rock, SHALE, Malmesbury Group, Porterville Formation.	
90			
100			
110			
120			
130			
140			
150			
160	ظ	Refusal:	
170		- mod. weathered, soft rock, SHALE.	
180		- no water inflow	
190		- no collapse of side wall	
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320		**Notes:** No perched water table encountered. No samples taken. Cultivated fields. Cold and wet weather from constant rain. Undulating and grading contacts between stratigrafy.	

Test Pit Picture

Legend		Excavation
⸗	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated:** 18 April 13
ظ	Refusal	**Method:** Machine Pit/Trence
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω 1	Disturbed sample / number	**Geohydrology**
◙	Undisturbed sample	**Seepage level:** Nil
▓	Perble marker	
▶	Indicator tests	**Water rest level:** Nil
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech	**TEST PIT:**	***WTG 6*** **DATE:** 18-Apr-13
SITE:	Bonne Esperance	**LOGGED BY:**	Deon Blignaut
CLIENT:	VentuSA Energy (Pty)Ltd	**COORDINATES:**	S - 33° 14' 18.9", E - 18° 58' 35.1" Elev. 74m
CONTRACTOR:	**Ground Engineering**	**MACHINE:**	TLB - CAT 424D

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted, slightly cohesive, massive, CLAYEY SAND, alluvium.	
40 50 60 70 80 90 100 110 120 130 140 150 160 170 180		Moist, l/brown, highly weathered, fine grained, vertically laminated, very soft rock, SHALE, Malmesbury Group, Porterville Formation.	
190	ظ	Refusal: - mod. weathered, soft rock, SHALE. - no water inflow - no collapse of side wall	
200 210 220 230 240 250 260 270 280 290 300 310			
320 330		**Notes:** No perched water table encountered. No samples taken. Cultivated fields. Cold and wet weather. Grading undulating contacts between stratigrafy.	

Test Pit Picture

Legend		**Excavation**
≢	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level:** Nil
▒	Perble marker	
⍞►	Indicator tests	**Water rest level:** Nil
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 13***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33° 15' 25.8", E - 18° 58' 33.6" Elev. 72m	
CONTRACTOR:	**Ground Engineering**		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted, slightly cohesive, massive, CLAYEY SAND, alluvium.	
50 60 70 80 90 100 110 120 130 140 150 160 170 180 190		Moist, grey, streaked yellow, highly weathered, fine grained, vertically laminated, very soft rock, SHALE, Malmesbury Group, Porterville Formation.	
200 210 220 230 240 250 260 270 280 290 300 310 320 330	ظ	Refusal: - mod. weathered, soft rock, SHALE. - no water inflow - no collapse of side wall	
		Notes: No perched water table encountered. No samples taken. Culvated fields. Topography at slight angle. Cold and wet weather. Undulating grading contacts between stratigrafy.	
		Test Pit Picture	

Legend		**Excavation**
⸗	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
⁞▶	Indicator tests	**Water rest level: Nil**
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 17***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33° 14' 55.8", E - 18° 59' 13.4" Elev. 75m	
CONTRACTOR:	**Ground Engineering**		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40 50 60		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted, slightly cohesive, massive, CLAYEY SAND, alluvium.	
70 80 90 100 110 120 130 140		Moist, grey, streaked yellow, highly weathered, fine grained, vertically laminated, very soft rock, SHALE, Malmesbury Group, Porterville Formation.	
150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330	ظ	Refusal: - mod. weathered, soft rock, SHALE. - no water inflow - no collapse of side wall	

Notes:
No perched water table encountered. No samples taken. Cultivated fields. Cold and wet weather.
Undulating grading contact between stratigrafy.

Test Pit Picture

Legend		**Excavation**
⸗	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
⎸►	Indicator tests	**Water rest level:** None
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 22***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33° 12' 51.1", E - 18° 59' 51.2" Elev. 78m	
CONTRACTOR: Ground Engineering			**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40 50 60 70 80 90 100 110		Sl/Moist, brown, loose, intact, small roots, fine grained, well graded, abundant sub-rounded sandstone and quartzitic sandstone pebble and cobbles, clast supported, massive, BOULDERS, alluvium.	
120 130 140 150 160 170 180 190 200 210 220 230		Sl/Moist, yellow, mottled red, firm, intact structure, fine grained, CLAY, residual.	
240 250 260 270 280 290 300 310		Sl/Moist, grey, streaked yellow, highly weathered, fine grained, vertically laminated, very soft rock, RESIDUAL SHALE, Malmesbury Group, Porterville Formation. Out of Reach.	
320 330		**Notes:** No perched water table encountered. No samples taken. Grassland area. Cold and wet weather. Undulating grading contact between stratigrafy.	

Legend		**Excavation**
⇛	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
▶	Indicator tests	**Water rest level:** None
EOH	End Of Hole	

Test Pit Picture

PROJECT:	Zen Wind Farm Geotech	**TEST PIT:**	***WTG 24*** **DATE:** 18-Apr-13
SITE:	Bonne Esperance	**LOGGED BY:**	Deon Blignaut
CLIENT:	VentuSA Energy (Pty)Ltd	**COORDINATES:**	S - 33° 13' 32.3", E - 18° 59' 39.4" Elev. 67m
CONTRACTOR:	**Ground Engineering**	**MACHINE:**	TLB - CAT 424D

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40 50 60 70 80 90 100 110 120		SI/Moist, brown, loose, intact, small roots, fine grained, well graded, abundant sub-rounded sandstone and quartzitic sandstone pebble and cobbles, matrix supported, massive, BOULDERS, alluvium.	
130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310		SI/Moist, grey, highly weathered, fine grained, vertically laminated, very soft rock, strength increase with depth, RESIDUAL SHALE, Malmesbury Group, Porterville Formation.	Ω TP24-1 Ω TP24-2
320 330		Out of Reach.	

Notes:
No perched water table encountered. Samples taken. Cultivated fields with slight angled topography. Cold and wet weather.

Test Pit Picture

Legend		**Excavation**
⚒	Weak seepage	**Type:** Test Pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▒	Perble marker	
⍞	Indicator tests	**Water rest level:** None
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 31***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33° 13' 39.5", E - 19° 00' 11.4" Elev. 72m	
CONTRACTOR:	**Ground Engineering**		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240		Sl/Moist, brown, loose, intact, small roots, fine grained, well graded, abundant sub-rounded sandstone and quartzitic sandstone pebble and cobbles, clast supported, massive, BOULDERS, alluvium.	
250 260 270 280 290 300 310 320		Moist, grey, highly weathered, fine grained, vertically laminated, very soft rock, RESIDUAL SHALE, Malmesbury Group, Porterville Formation. Out of Reach.	
330 340 350		**Notes:** No perched water table encountered. No samples taken. Grassland and fynbos area with slight angled topography. Cold and wet weather.	
		Test Pit Picture	

Legend		**Excavation**
⇛	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω 1	Disturbed sample / sample numbe	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
▶	Indicator tests	**Water rest level:** None
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 35***	**DATE:** 18-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S- 33° 13' 09.4", E- 19° 00' 49.7" Elev.113m	
CONTRACTOR:	**Ground Engineering**		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40 50 60		Sl/Moist, brown, loose, intact, small roots, fine grained, well graded, abundant sub-rounded sandstone and quartzitic sandstone pebble and cobbles, massive, SANDY GRAVEL, alluvium.	
70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330		Dry, yellow, mottled red, firm, reworked, trace of pebble and cobbles, fine grained, CLAY, residual.	

Notes:
No perched water table encountered. Samples taken. Grassland and fynbos area with slight angled topography. Cold and wet weather with rainfall.

Test Pit Picture

Legend		**Excavation**
⇛	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method: Machine Pit/Trence**
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω 1	Disturbed sample / sample numbe	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
▶	Indicator tests	**Water rest level:** None
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech		**TEST PIT:**	***WTG 36***	**DATE:** 17-Apr-13
SITE:	Bonne Esperance		**LOGGED BY:**	Deon Blignaut	
CLIENT:	VentuSA Energy (Pty)Ltd		**COORDINATES:**	S - 33° 14' 22.7", E - 19° 00' 0.8" Elev. 63m	
CONTRACTOR:	Ground Engineering		**MACHINE:**	TLB - CAT 424D	

Depth (cm)	Legend	SOIL PROFILE	Sample
10			
20			
30			Ω TP36-1
40		Moist, l/brown, loose, intact, small roots, fine - med.grained, well sorted, collapsable,	
50		non-cohesive, massive, trace of boulders increase on bottom contact, SAND, alluvium.	
60			
70			Ω TP36-2
80			
90			
100			
110		Sl/moist, grey, highly weathered, fine grained, vertically laminated, flakes easely,	
120		very soft rock, PHYLITTIC SHALE, Malmesbury Group, Porterville Formation.	
130			
140	ظ	Refusal:	
150		- mod. weathered, soft rock, SHALE.	
160		- no water inflow	
170		- no collapse of side wall	
180			
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320		**Notes:** No perched water table encountered. No samples taken. Cultivated fields. Cold and wet weather from constant rain. Undulating and sharp contacts between stratigrafy.	

Test Pit Picture

Legend		Excavation
⇟	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated:** 18 April 13
ظ	Refusal	**Method:** Machine Pit/Trence
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω 1	Disturbed sample / number	**Geohydrology**
◙	Undisturbed sample	**Seepage level:** Nil
▓	Perble marker	
▶	Indicator tests	**Water rest level:** Nil
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech	**TEST PIT:**	***WTG 41*** **DATE:** 17-Apr-13
SITE:	Bonne Esperance	**LOGGED BY:**	Deon Blignaut
CLIENT:	VentuSA Energy (Pty)Ltd	**COORDINATES:**	S - 33° 13' 45.7", E - 19° 00' 46.3" Elev. 94m
CONTRACTOR:	**Ground Engineering**	**MACHINE:**	TLB - CAT 424D

Depth (cm)	Legend	SOIL PROFILE	Sample
10			
20		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted,	
30		slightly cohesive, massive, CLAYEY SAND, alluvium.	
40			
50			
60			
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
180		Sl/moist, yellow, mottled red, firm, reworked, fine grained, CLAY, residual.	
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310		Out of Reach.	
320			
330		**Notes:**	
		No perched water table encountered. No samples taken. Cultivated fields. Cold and wet weather. Grading undulating contacts between stratigrafy.	

Test Pit Picture

Legend		**Excavation**
⇟	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
ظ	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level:** Nil
▓	Perble marker	
⍞►	Indicator tests	**Water rest level:** Nil
EOH	End Of Hole	

PROJECT:	Zen Wind Farm Geotech	**TEST PIT:**	***WTG 46*** **DATE:** 17-Apr-13
SITE:	Bonne Esperance	**LOGGED BY:**	Deon Blignaut
CLIENT:	VentuSA Energy (Pty)Ltd	**COORDINATES:**	S - 33° 13' 43.1", E - 19° 01' 30.7" Elev. 106m
CONTRACTOR:	**Ground Engineering**	**MACHINE:**	TLB - CAT 424D

Depth (cm)	Legend	SOIL PROFILE	Sample
10 20 30 40		Moist, brown, loose, intact, small roots, fine - med.grained, poorly sorted, trace of pebble/cobble slightly cohesive, massive, CLAYEY SAND, alluvium.	
50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310		Sl/moist, l/brown, highly weathered, fine grained, vertically laminated, very soft rock, SHALE, Malmesbury Group, Porterville Formation.	Ω TP46-1 Ω TP46-2
320 330		**Notes:** No perched water table encountered. No samples taken. Culvated fields. Topography at slight angle. Cold and wet weather. Undulating grading contacts between stratigrafy.	

Test Pit Picture

Legend		**Excavation**
⇛	Weak seepage	**Type:** Test pit
¥	Strong seepage	**Date Excavated: 18 April 13**
⊥	Refusal	**Method:** Machine Pit/Trench
©	Compaction Tests	**Backhoe Width: 0.6 m**
----	Approximate material change	
Ω	Disturbed sample	**Geohydrology**
◙	Undisturbed sample	**Seepage level: Nil**
▓	Perble marker	
⊩▶	Indicator tests	**Water rest level: Nil**
EOH	End Of Hole	

APPENDIX 7.2

DPSH TEST RESULTS

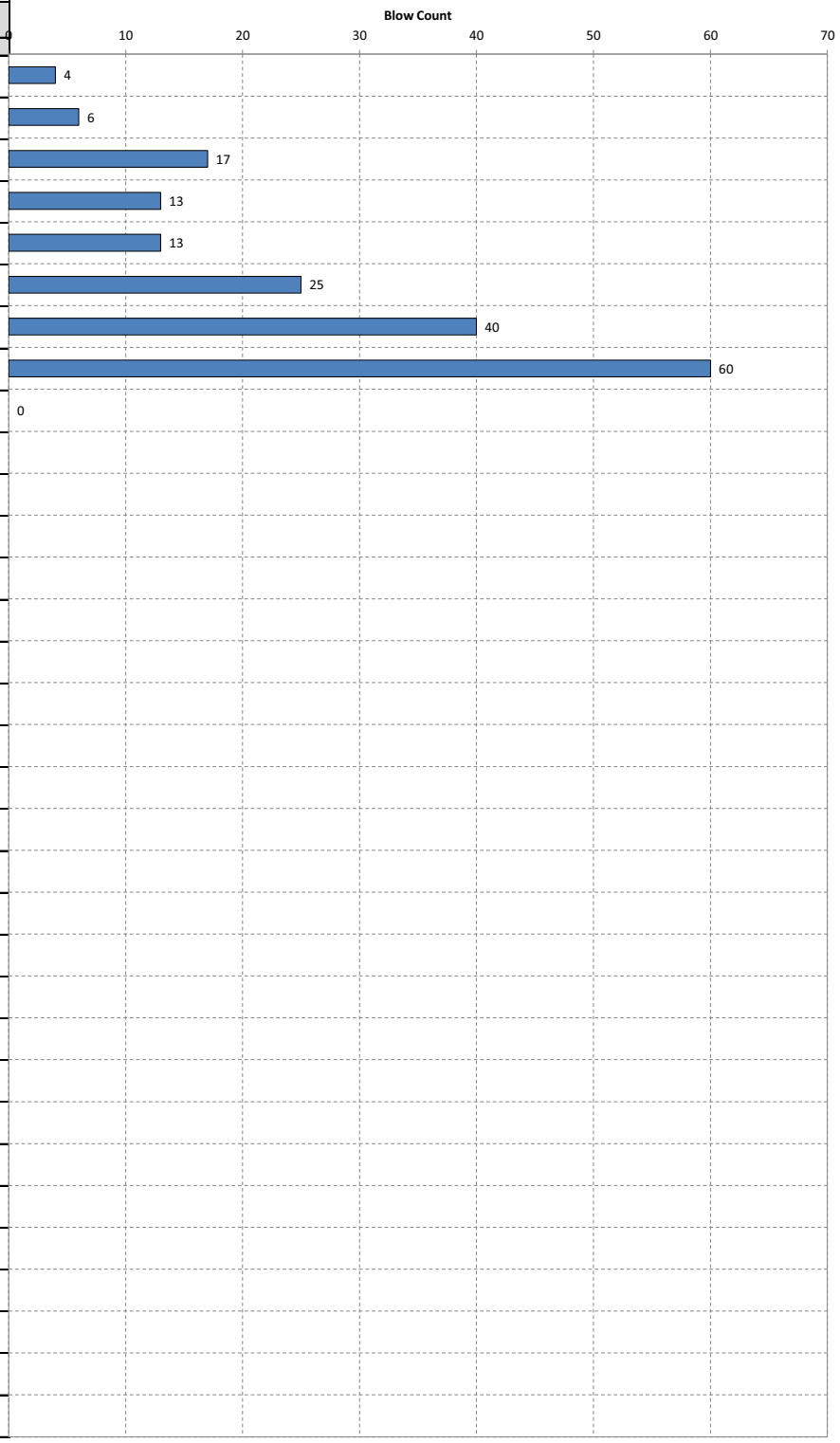
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	13:04:00 PM
Time Finish	13:15:00 PM

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 1***
0.30	4
0.60	6
0.90	17
1.20	13
1.50	13
1.80	25
2.10	40
2.40	60
2.70	Refusal: shale
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	

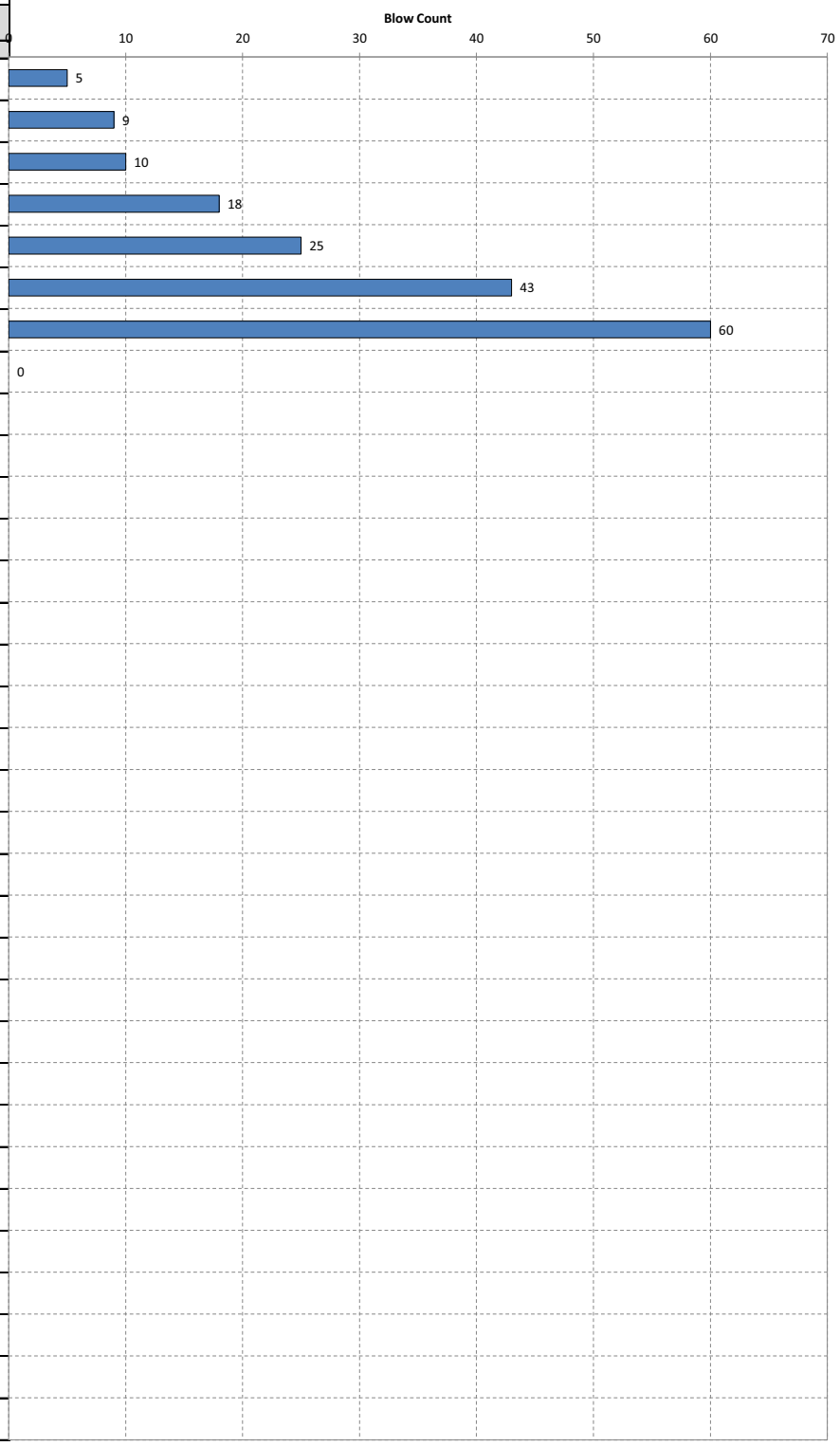


Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	11:06
Time Finish	11:20

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 6***
0.30	5
0.60	9
0.90	10
1.20	18
1.50	25
1.80	43
2.10	60
2.40	Refusal: shale
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



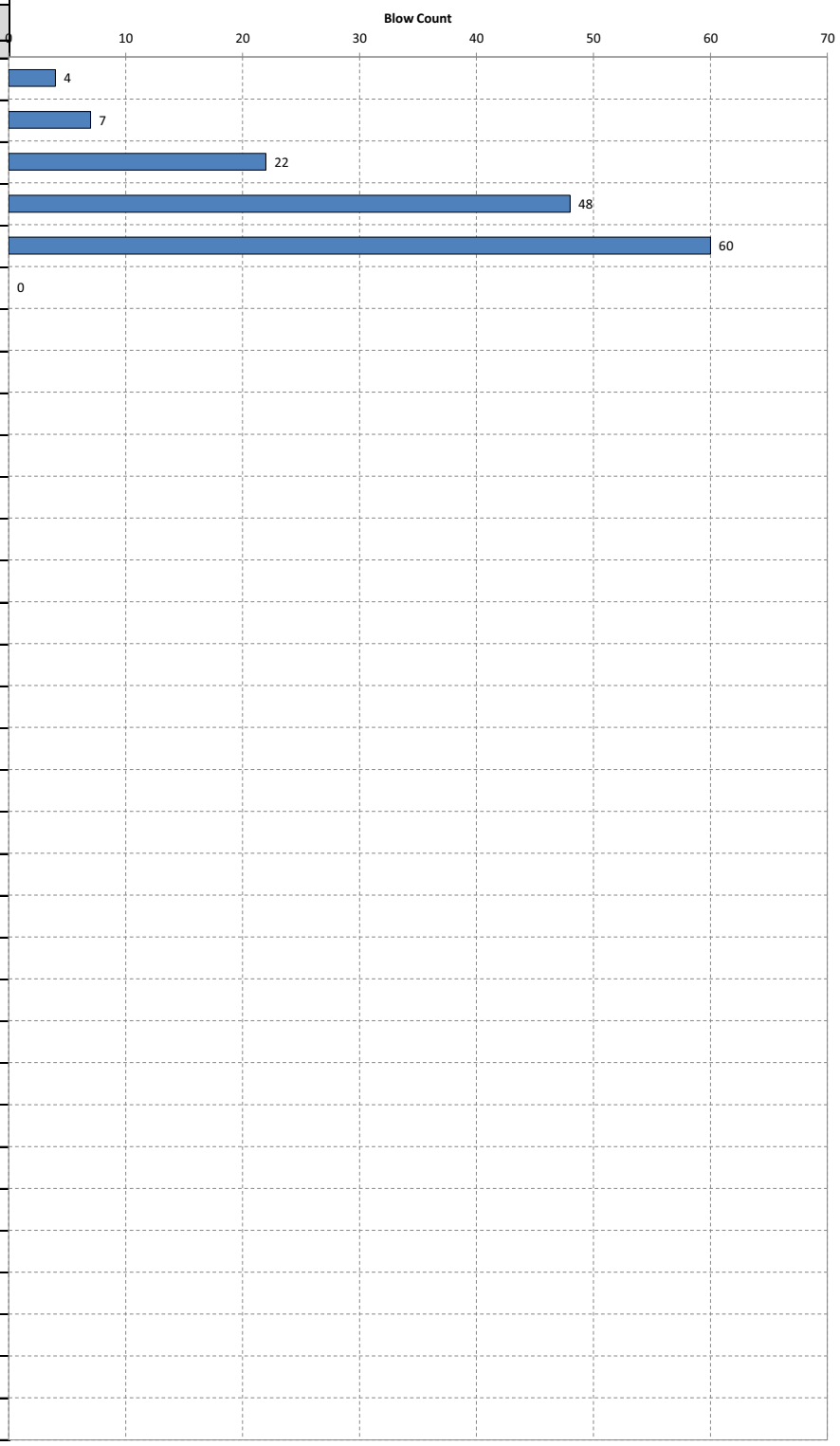
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	12:25
Time Finish	12:37

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 13***
0.30	4
0.60	7
0.90	22
1.20	48
1.50	60
1.80	Refusal: shale
2.10	
2.40	
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



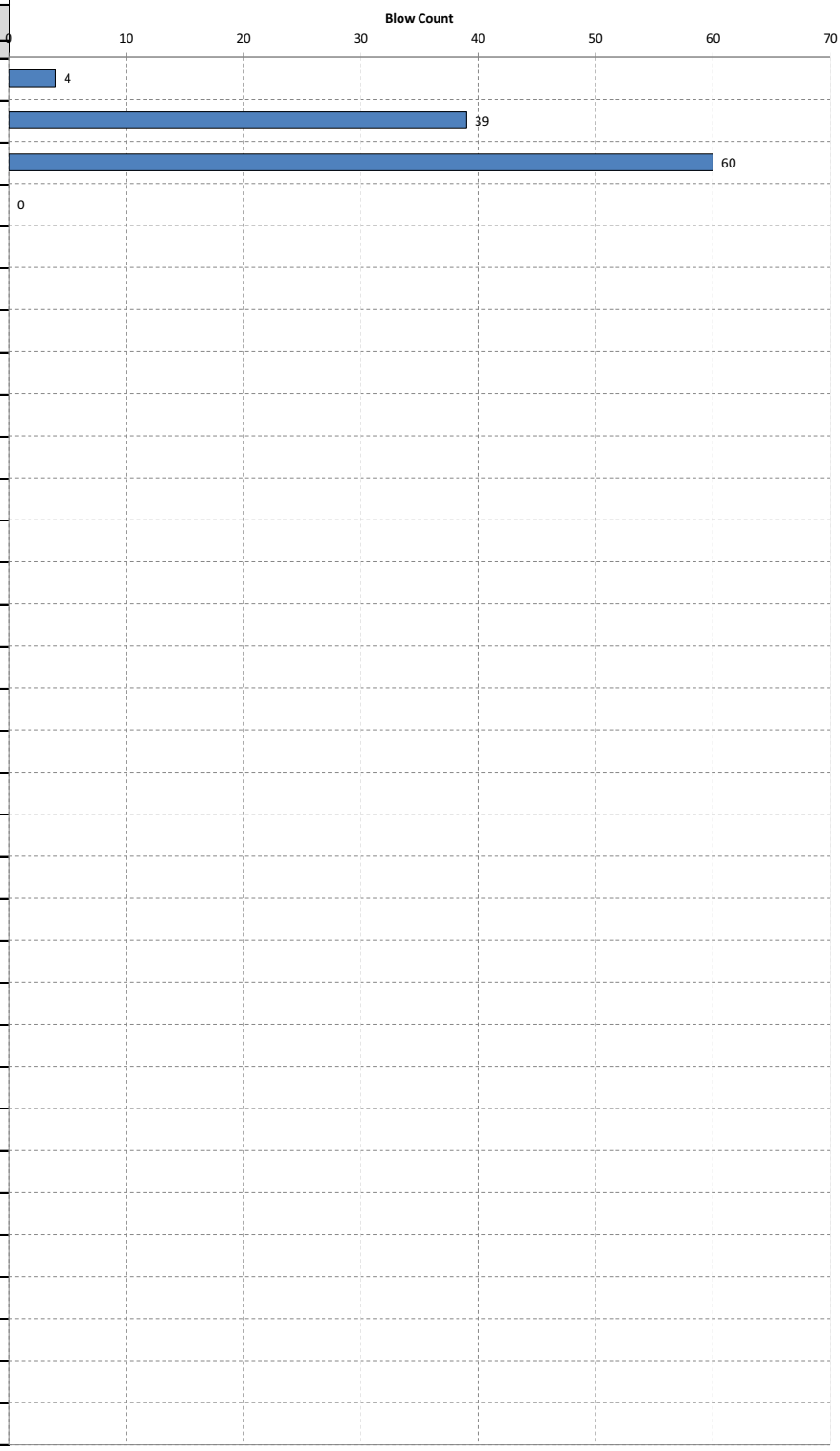
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	11:51
Time Finish	11:57

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 17***
0.30	4
0.60	39
0.90	60
1.20	Refusal: shale
1.50	
1.80	
2.10	
2.40	
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



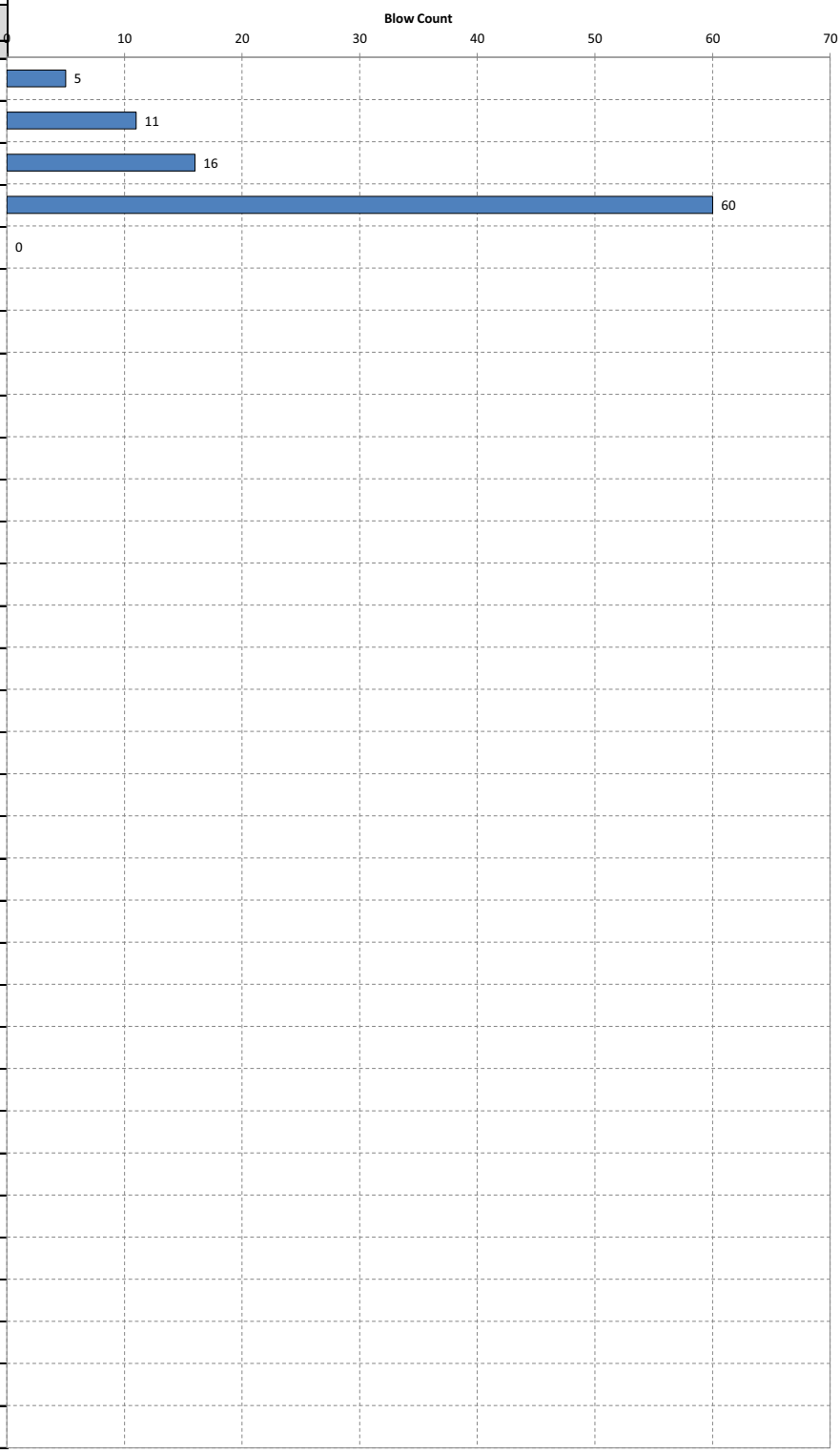
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	9:00
Time Finish	9:35

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 22***
0.30	5
0.60	11
0.90	16
1.20	60
1.50	Refusal: shale
1.80	
2.10	
2.40	
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	

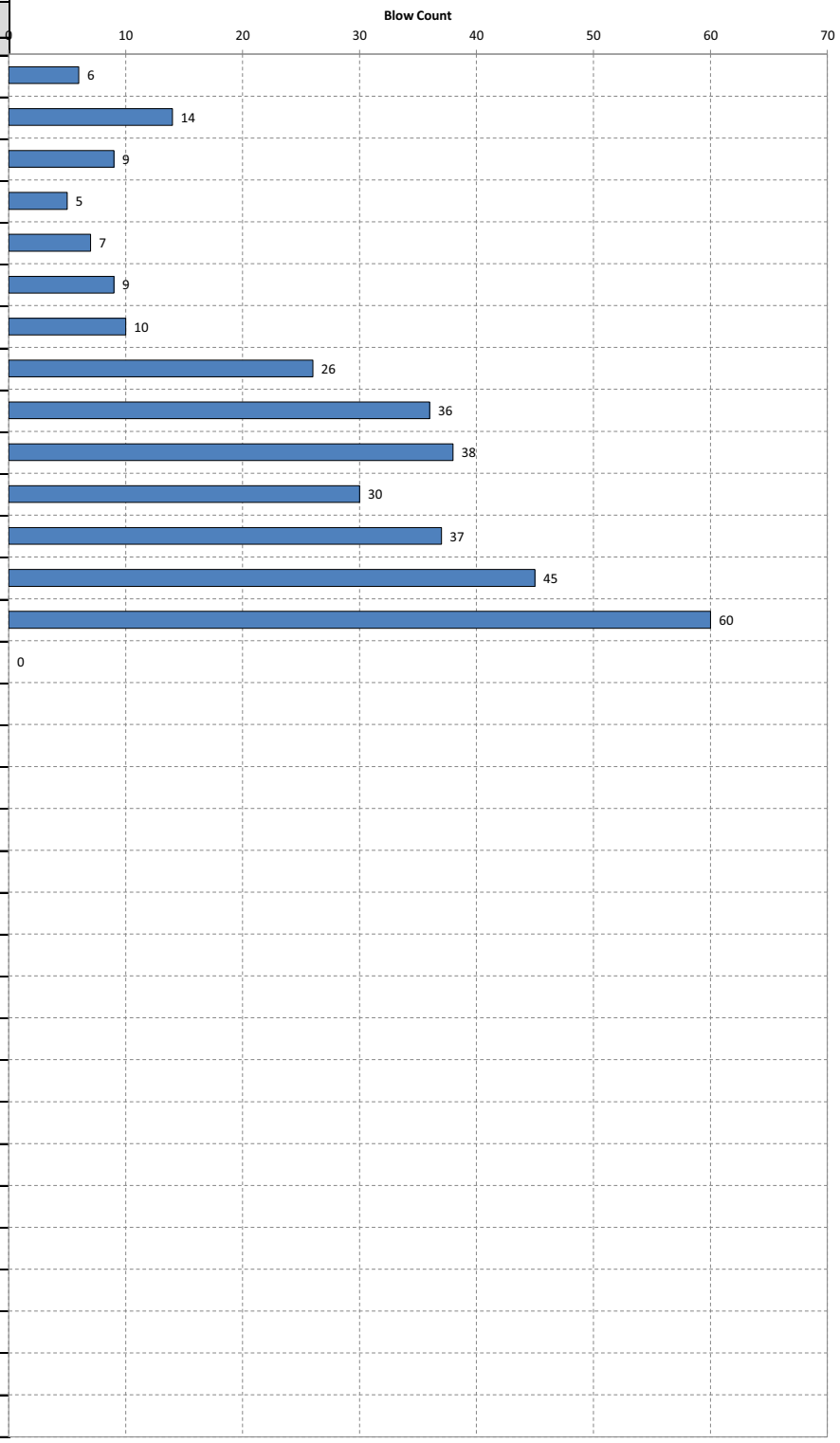


Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	17-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	17:25:00 PM
Time Finish	17:55:00 PM

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 24***
0.30	6
0.60	14
0.90	9
1.20	5
1.50	7
1.80	9
2.10	10
2.40	26
2.70	36
3.00	38
3.30	30
3.60	37
3.90	45
4.20	60
4.50	Refusal: shale
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



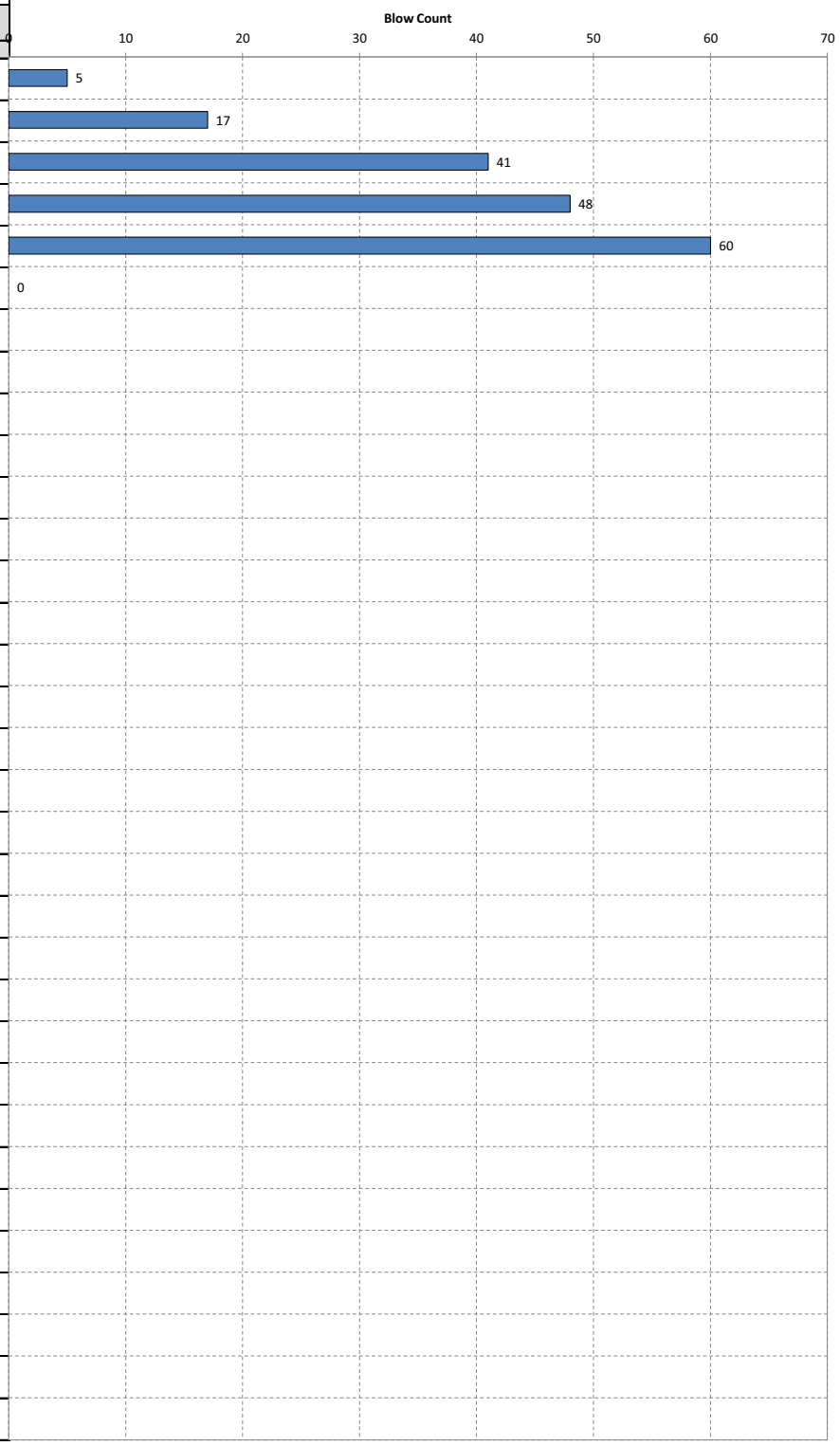
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	17-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	16:30:00 PM
Time Finish	16:50:00 PM

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 31***
0.30	5
0.60	17
0.90	41
1.20	48
1.50	60
1.80	Refusal: shale
2.10	
2.40	
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	

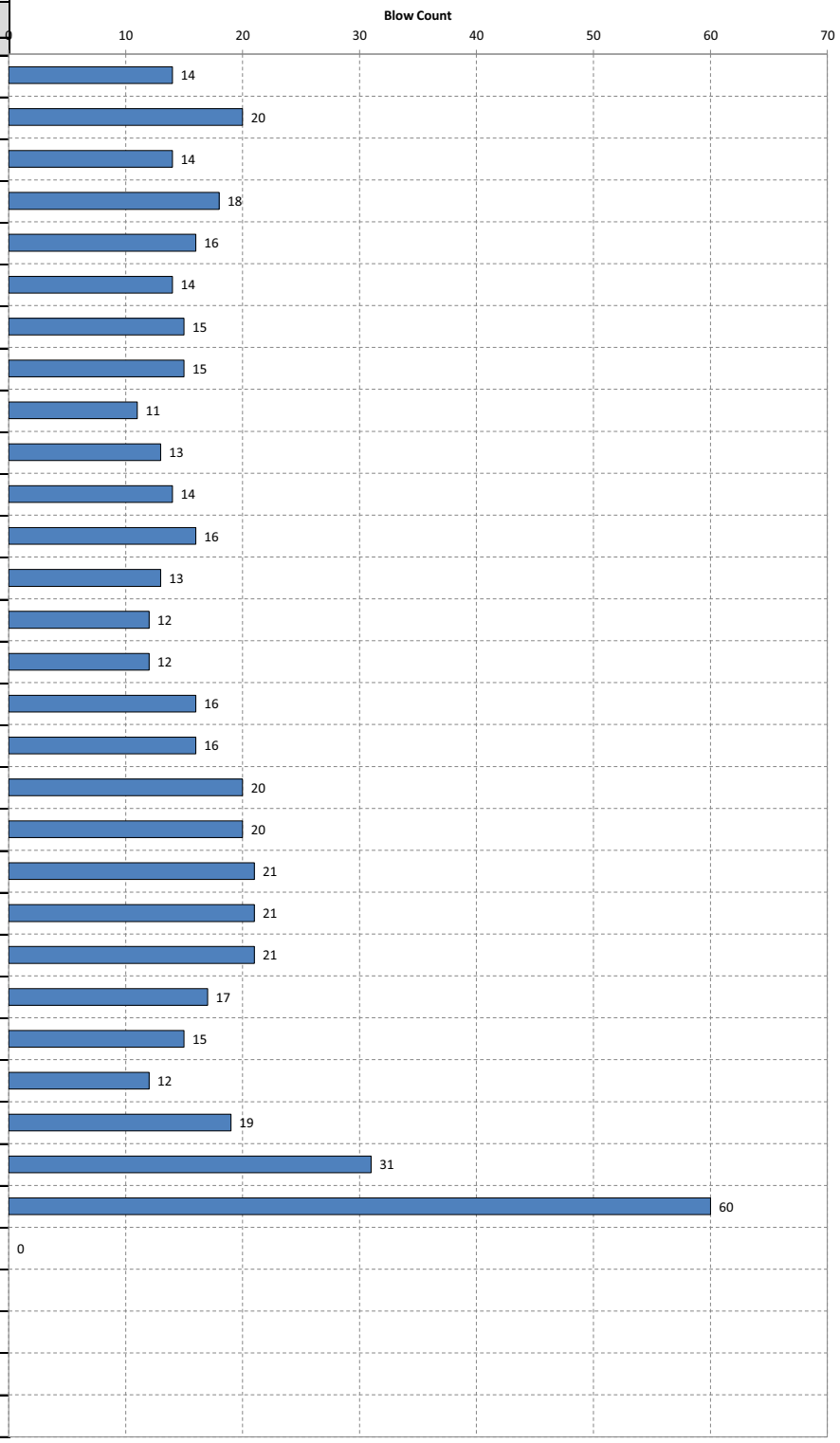


Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	17-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	12:35
Time Finish	13:25

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 35***
0.30	14
0.60	20
0.90	14
1.20	18
1.50	16
1.80	14
2.10	15
2.40	15
2.70	11
3.00	13
3.30	14
3.60	16
3.90	13
4.20	12
4.50	12
4.80	16
5.10	16
5.40	20
5.70	20
6.00	21
6.30	21
6.60	21
6.90	17
7.20	15
7.50	12
7.80	19
8.10	31
8.40	60
8.70	Refusal: shale
9.00	
9.30	
9.60	
9.90	



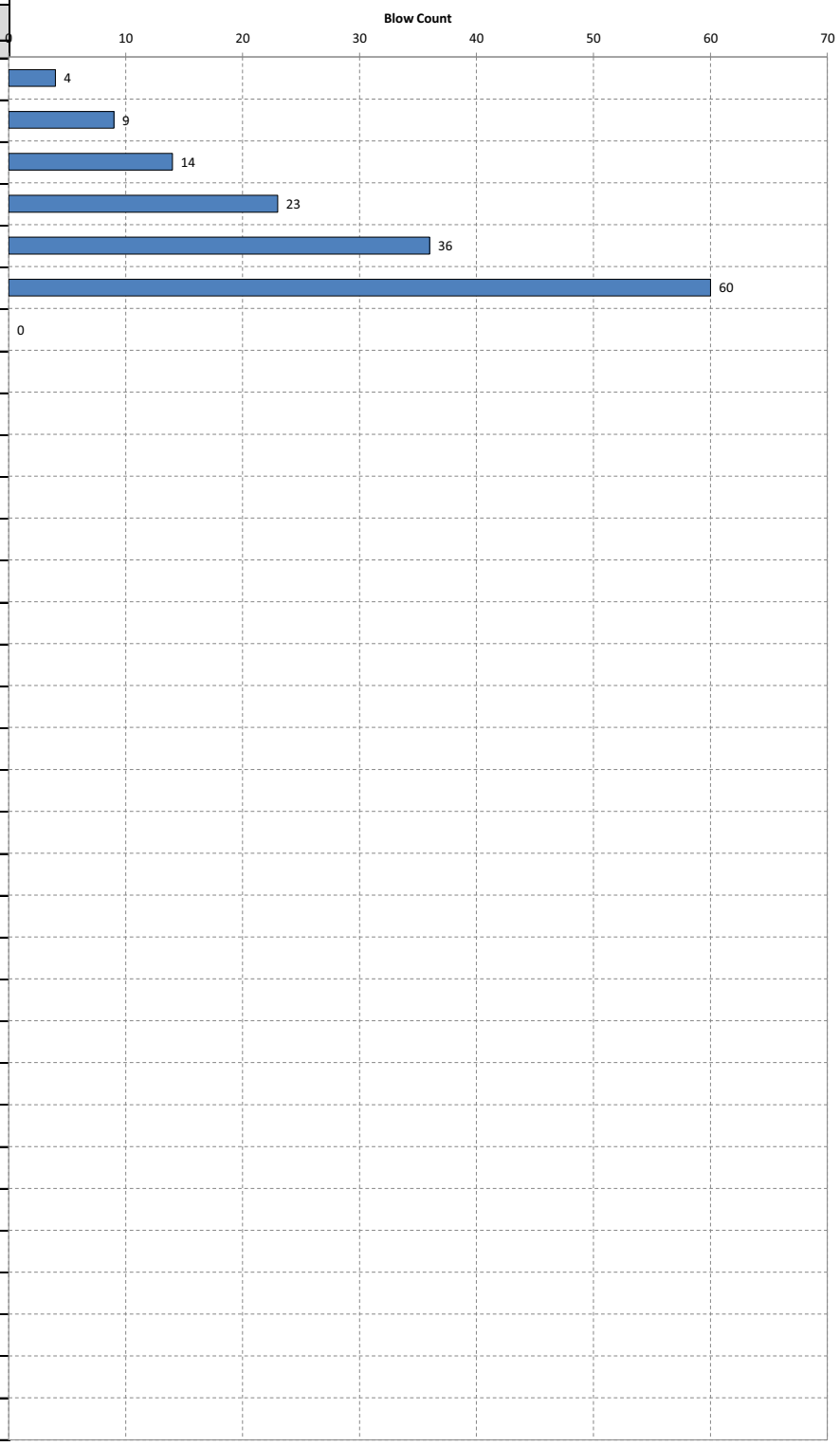
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	18-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	8:03
Time Finish	8:12

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 36***
0.30	4
0.60	9
0.90	14
1.20	23
1.50	36
1.80	60
2.10	Refusal: shale
2.40	
2.70	
3.00	
3.30	
3.60	
3.90	
4.20	
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



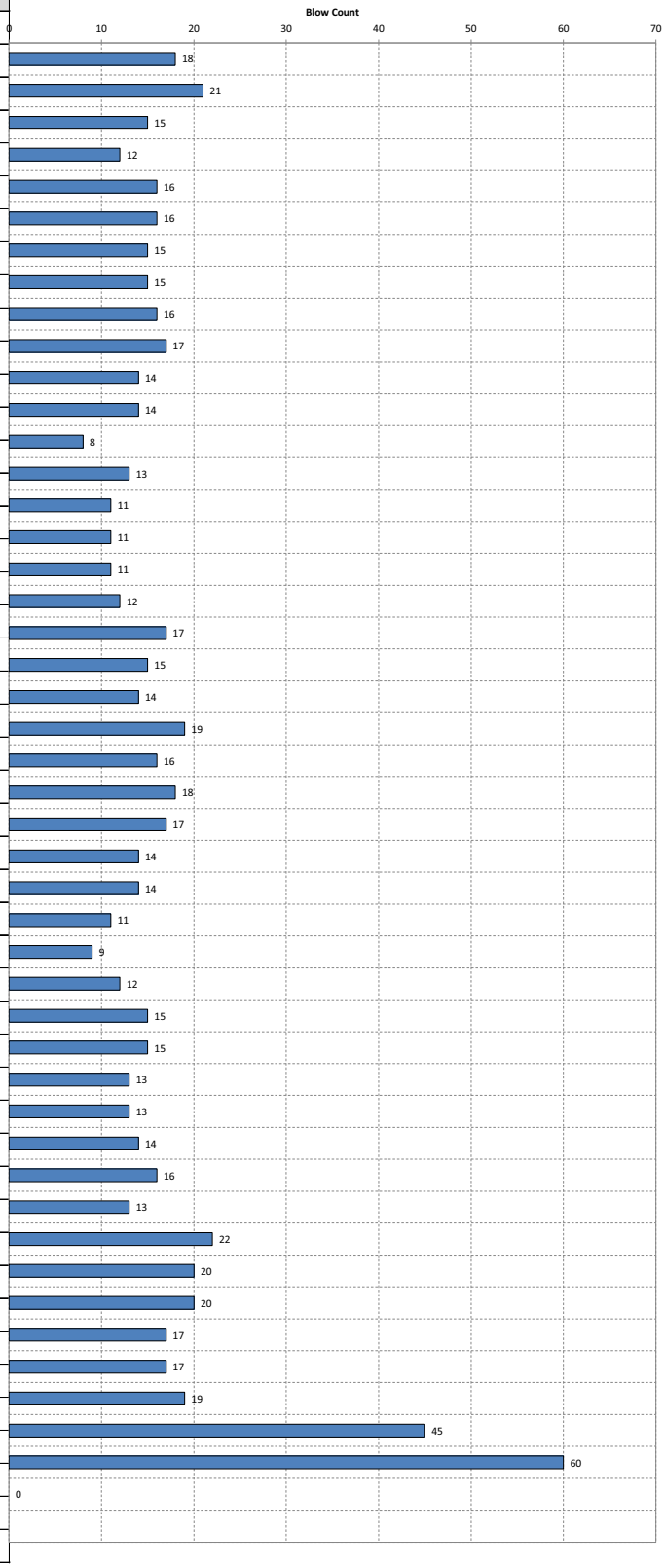
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	17-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	14:00:00 PM
Time Finish	15:40:00 PM

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 41***
0.30	18
0.60	21
0.90	15
1.20	12
1.50	16
1.80	16
2.10	15
2.40	15
2.70	16
3.00	17
3.30	14
3.60	14
3.90	8
4.20	13
4.50	11
4.80	11
5.10	11
5.40	12
5.70	17
6.00	15
6.30	14
6.60	19
6.90	16
7.20	18
7.50	17
7.80	14
8.10	14
8.40	11
8.70	9
9.00	12
9.30	15
9.60	15
9.90	13
10.20	13
10.50	14
10.80	16
11.10	13
11.40	22
11.70	20
12.00	20
12.30	17
12.60	17
12.90	19
13.20	45
13.50	60
13.80	Refusal: shale
14.10	



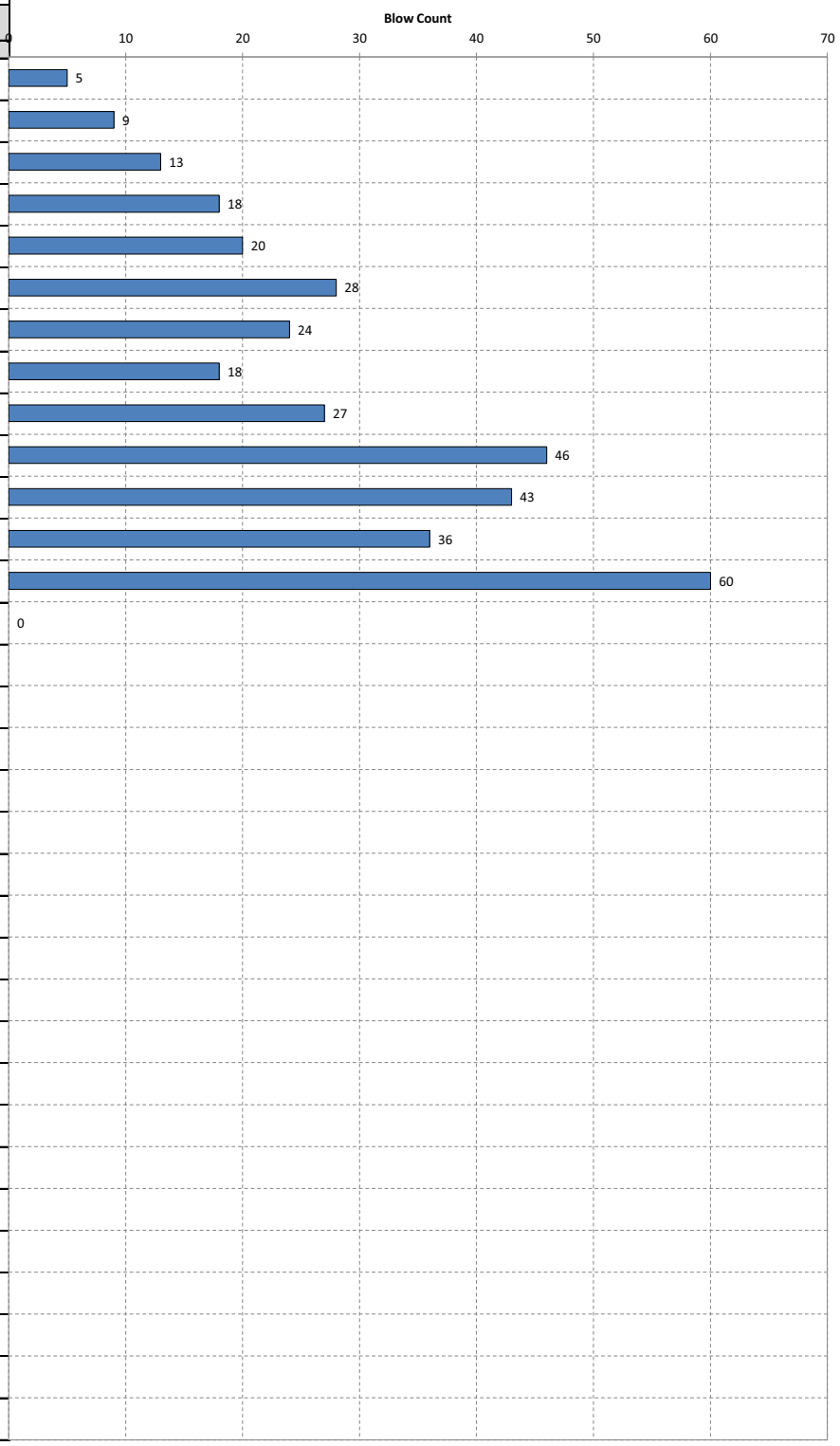
AVENG GRINAKER-LTA

Penetrometer Report

Project:	Zen Wind Farm Project	***Date:***	17-Apr-13
Contract No:	SG0007 - Bonne Esperance	***Supervisor:***	Deon Blignaut
Client:	VentuSA Energy (Pty)Ltd	***Operator:***	David Tjalana
Engineer:	David Peinke	***Hammer Mass (kg):***	63.5
		Drop Height (mm):	762

Time Start	10:53
Time Finish	11:35

Depth (m)	***Probe Number (Blow Count)*** ***WTG No. 46***
0.30	5
0.60	9
0.90	13
1.20	18
1.50	20
1.80	28
2.10	24
2.40	18
2.70	27
3.00	46
3.30	43
3.60	36
3.90	60
4.20	Refusal: shale
4.50	
4.80	
5.10	
5.40	
5.70	
6.00	
6.30	
6.60	
6.90	
7.20	
7.50	
7.80	
8.10	
8.40	
8.70	
9.00	
9.30	
9.60	
9.90	



APPENDIX 7.3

LABORATORY TEST RESULTS

CLIENT:	Aveng Grinaker- LTA Aveng Grinaker- LTA Business Park Jurgens Street Boksburg 1459	**PROJECT:**	Zen Wind Farm
		DATE:	29-04-2013
ATT:	Deon Blignaut	**REF:**	L130468

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	Residual Shale	**SAMPLE NO. :**	22094
POSITION :	Z24@3.2m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75.00	100
	63.00	99
	53.00	99
	37.50	99
	26.50	96
	19.00	91
	13.20	88
	9.50	79
	6.70	71
	4.75	65
	2.36	52
	2.00	49
	1.18	44
	0.600	38
	0.425	36
	0.300	34
	0.150	32
	0.0750	31

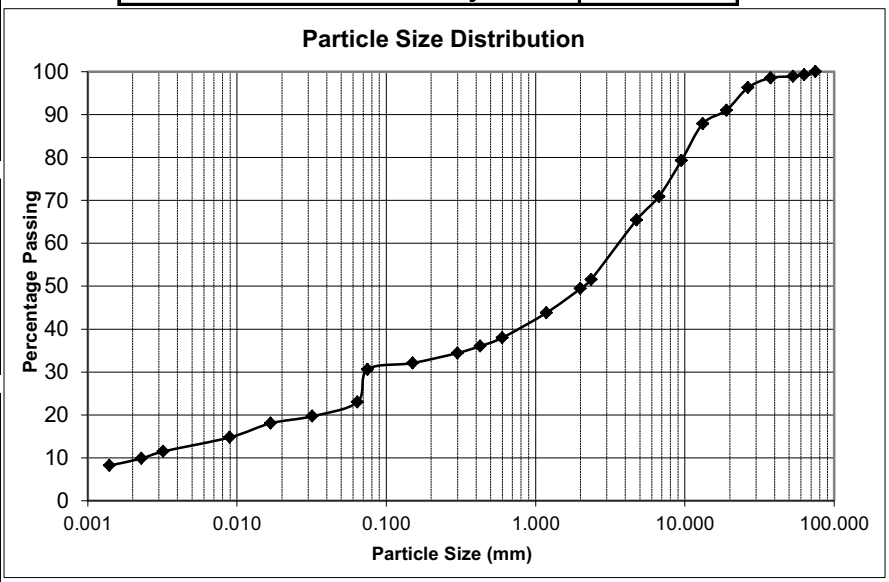
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0.0685	23
0.0349	20
0.0177	18
0.0093	15
0.0033	11
0.0023	10
0.0014	8

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

Specific Gravity:	
Initial Moisture Content (%) :	
pH :	
Conductivity mS/m :	

Atterberg Limits :	
Liquid Limit	53
Plastic Index	28
Linear Shrinkage	11.0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	1852
O.M.C. (%)	12.7
C.B.R. @ 100% Comp.	3
C.B.R. @ 98 % Comp.	3
C.B.R. @ 95 % Comp.	2
C.B.R. @ 93 % Comp.	2
C.B.R. @ 90 % Comp.	2
Swell (max) %	11.70



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	35
Sand : Percentage - 4.75mm and + 0.075mm	35
Silt : Percentage - 0.075mm and + 0.002mm	20
Clay : Percentage - 0.002mm	11

Remarks:

CLIENT:	Aveng Grinaker- LTA Aveng Grinaker- LTA Business Park Jurgens Street Boksburg 1459	**PROJECT:**	Zen Wind Farm
		DATE:	29-04-2013
ATT:	Deon Blignaut	**REF:**	L130468

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	Yellow Sand	**SAMPLE NO. :**	22095
POSITION :	Z36@0.9m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75.00	
	63.00	
	53.00	100
	37.50	99
	26.50	98
	19.00	98
	13.20	98
	9.50	96
	6.70	94
	4.75	92
	2.36	87
	2.00	86
	1.18	83
	0.600	76
	0.425	69
	0.300	54
	0.150	24
	0.0750	8

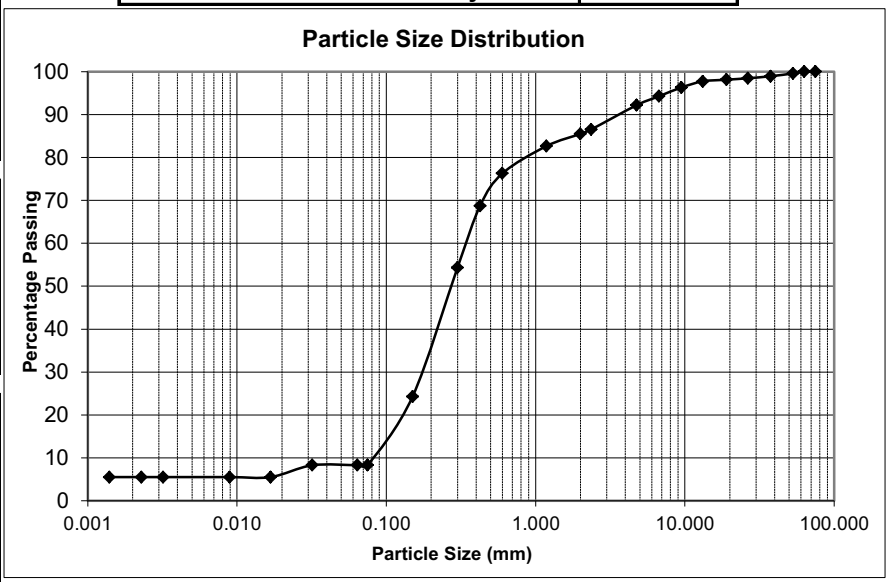
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0.0760	8
0.0380	8
0.0192	6
0.0099	6
0.0034	6
0.0024	6
0.0014	6

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

Specific Gravity:	
Initial Moisture Content (%) :	
pH :	
Conductivity mS/m :	

Atterberg Limits :	
Liquid Limit	
Plastic Index	N-P
Linear Shrinkage	

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	1916
O.M.C. (%)	9.1
C.B.R. @ 100% Comp.	48
C.B.R. @ 98 % Comp.	46
C.B.R. @ 95 % Comp.	23
C.B.R. @ 93 % Comp.	17
C.B.R. @ 90 % Comp.	12
Swell (max) %	0.00



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	8
Sand : Percentage - 4.75mm and + 0.075mm	84
Silt : Percentage - 0.075mm and + 0.002mm	3
Clay : Percentage - 0.002mm	5

For Geoscience:

Remarks:

CLIENT:	Aveng Grinaker- LTA Aveng Grinaker- LTA Business Park Jurgens Street Boksburg 1459	**PROJECT:**	Zen Wind Farm
		DATE:	29-04-2013
ATT:	Deon Blignaut	**REF:**	L130468

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	Shale	**SAMPLE NO. :**	22096
POSITION :	Z46@3.1m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75.00	
	63.00	
	53.00	
	37.50	
	26.50	
	19.00	100
	13.20	88
	9.50	78
	6.70	69
	4.75	62
	2.36	46
	2.00	44
	1.18	37
	0.600	29
	0.425	25
	0.300	22
	0.150	17
	0.0750	14

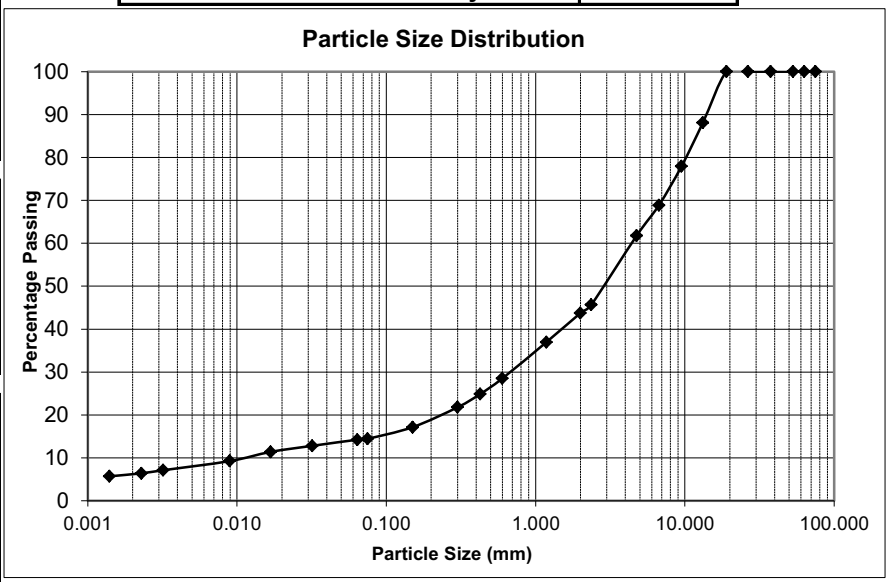
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0.0715	14
0.0360	13
0.0182	11
0.0096	9
0.0033	7
0.0024	6
0.0014	6

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

Specific Gravity:	
Initial Moisture Content (%) :	
pH :	
Conductivity mS/m :	

Atterberg Limits :	
Liquid Limit	32
Plastic Index	9
Linear Shrinkage	4.0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	1875
O.M.C. (%)	13.8
C.B.R. @ 100% Comp.	11
C.B.R. @ 98 % Comp.	10
C.B.R. @ 95 % Comp.	9
C.B.R. @ 93 % Comp.	8
C.B.R. @ 90 % Comp.	7
Swell (max) %	1.40



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	38
Sand : Percentage - 4.75mm and + 0.075mm	47
Silt : Percentage - 0.075mm and + 0.002mm	7
Clay : Percentage - 0.002mm	7

For Geoscience:

Remarks: