PROPOSED DEEP RIVER WIND ENERGY FACILITY & ASSOCIATED INFRASTRUCTURE ON A SITE NEAR HUMANSDORP EASTERN CAPE PROVINCE

CONSTRUCTION & OPERATION ENVIRONMENTAL MANAGEMENT PLAN FOR THE DEEP RIVER WIND ENERGY FACILITY

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PROJECT DETAILS

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Title	:	Environmental Impact Assessment Process Draft Environmental Management Plan: Proposed Deep River Wind Energy Facility & Associated Infrastructure on a site near Humansdorp, Eastern Cape
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DEFINITIONS AND TERMINOLOGY

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.

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.

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.

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:

i. The land, water and atmosphere of the earth;
ii. Micro-organisms, plant and animal life;
iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

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 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 ongoing maintenance after implementation.

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

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.

Natural properties of an ecosystem (*sensu* Convention on Wetlands): Defined in Handbook 1 as the "…physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (See http://www.ramsar.org/).

Ramsar convention on wetlands: "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional, and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world." As of March 2004, 138 nations have joined the Convention as Contracting Parties, and more than 1300 wetlands around the world, covering almost 120 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (Refer http://www.ramsar.org/). South Africa is a Contracting Party to the Convention.

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).

Regional methodology: The Western Cape Department of Environmental Affairs and Development Planning (DEADP) have developed a guideline document entitled *Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape - Towards a Regional Methodology for Wind Energy Site Selection*

(Western Cape Provincial Government, May 2006). The methodology proposed within this guideline document is intended to be a regional level planning tool to guide planners and decision-makers with regards to appropriate areas for wind energy development (on the basis of planning, environmental, infrastructural and landscape parameters).

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.

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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PURPOSE & OBJECTIVES OF THE EMP *CHAPTER 1*

An Environmental Management Plan (EMP) 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 EMP 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 EMP 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 EMP is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMP 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 EMP has been developed as a set of environmental specifications (i.e. principles of environmental management for the proposed Deep River 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 EMP by the project implementer as well as compliance monitors). During its lifecycle, projects journey through four distinctive phases, as presented in Figure 1. The EMP is accordingly separated into measures dealing with the various project phases.

The EMP 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 EMP, ensuring the minimisation of adverse environmental impacts to an acceptable level.

VentuSA Energy 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 EMP through its integration into the contract documentation. Since this EMP is part of the EIA process undertaken for the proposed Deep River Wind Energy Facility, it is important that this document be read in conjunction with the Scoping Report (August 2010) and EIA Report (January 2011), as well as the Environmental Authorisation (once issued). This will contextualise the EMP and enable a thorough understanding of its role and purpose in the integrated environmental management process. This EMP for construction and operation activities has been compiled in accordance with Section 34 of the EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project.

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 EMP. 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 EMP 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).

PROJECT DETAILS *CHAPTER 2*

VentuSA Energy is proposing to establish the Deep River Wind Energy Facility and associated infrastructure on a site located approximately 17 km west of Humansdorp in the Eastern Cape province, within the Kou-Kamma Local Municipality. The larger site covers an area of approximately 7 km^2, which is larger than the development footprint for the facility. The facility will include the following infrastructure:

» A cluster of up to **50[2] wind turbines** to be constructed over an area of ~ 7 km^2
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of up to 90 m (i.e. each blade up to 45 m in length)
» **Concrete hexagon foundations** to support the turbine towers. Each foundation is proposed to have a dimension of 16 m x 16 m x 2.5 m deep[3].
» **Underground 33 kV cabling of approximately 1 m deep**, linking the wind turbines to a proposed 132 kV substation. The cabling will follow the internal access roads as far as possible.
» **132 kV substation with a** high-voltage (HV) yard footprint of approximately 80 m x 90 m.
» New **overhead 132 kV power line** to connect to Eskom's existing Melkhout Substation (~12 km east).
» **Internal roads** (approximately 8 m in width depending on the proposed crane) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new roads.
» **Service buildings**, including a storage building (40m x 20m), and a security office.

The facility is proposed on the following farm portions (refer to Figure 2.1):
» Portion 4 of Deepriviermond 358
» Portion 16 of Deepriviermond 358
» The remaining extent of Farm 891

The EMP 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.

[2] The current turbine layout has 25 turbines as a result of the design process thus far which has taken environmental and technical constraints into consideration. However, the EIA application remains for a facility of up to 50 turbines.
[3] The foundations will be finalised based on the detailed geotechnical assessment of the site.

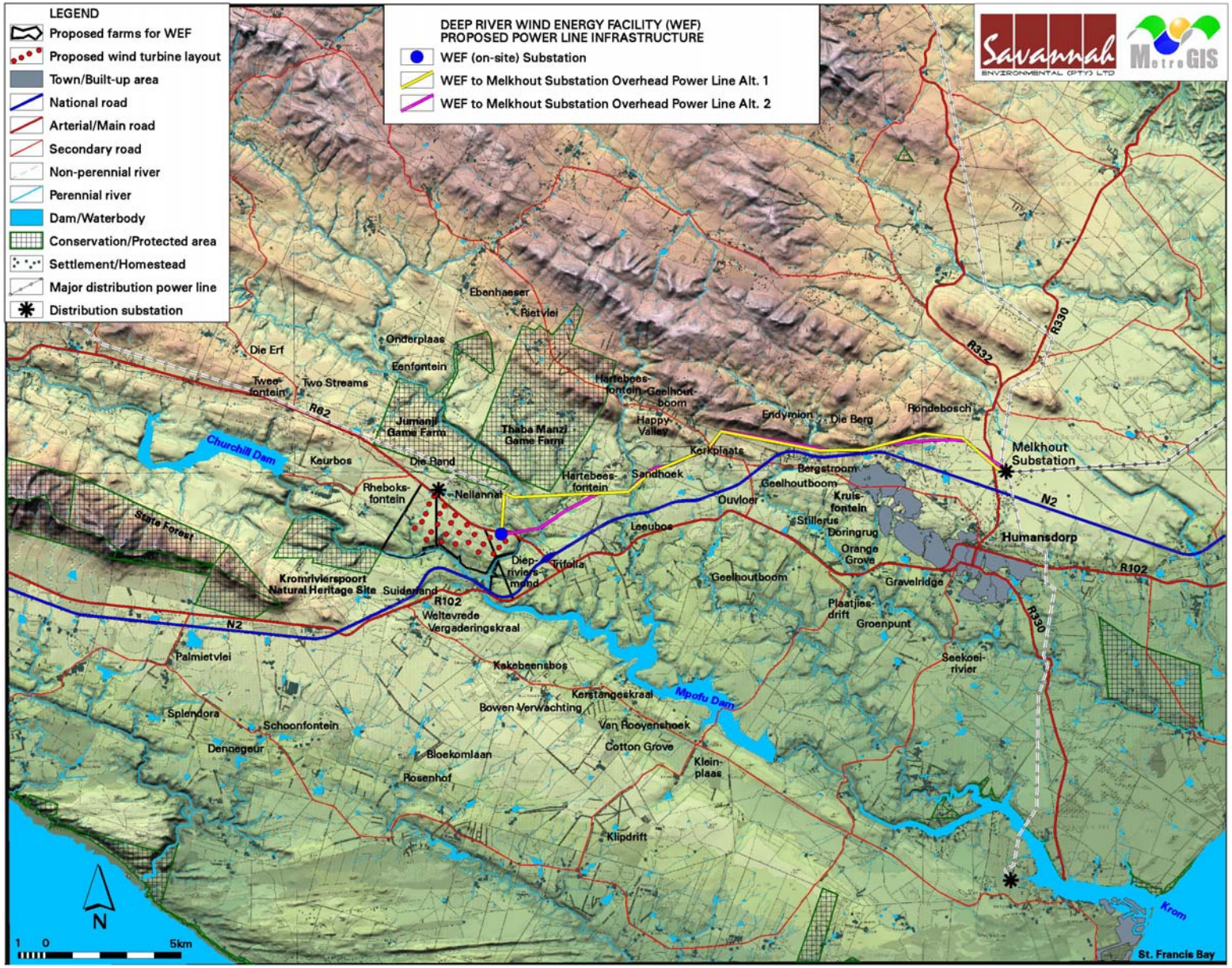


Figure 2.1: Locality map showing provisional wind turbine layout, proposed substation site and power line corridors

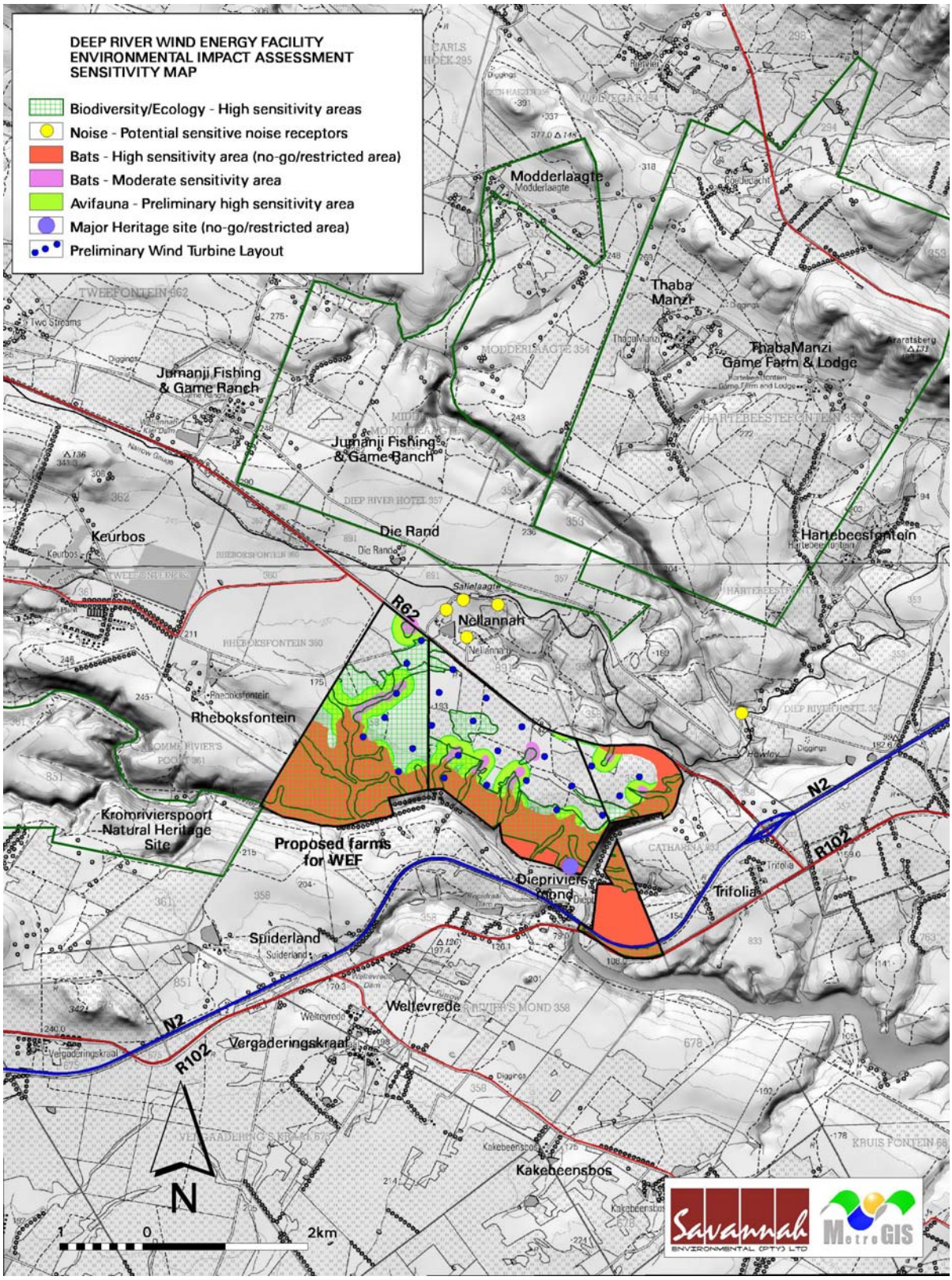


Figure 2.2: Areas of potential sensitivity identified through the EIA process

2.1 Activities and Components associated with the Facility

The main activities/components associated with the Deep River Wind Energy Facility are detailed in Table 2.1.

Table 2.1: Activities Associated with Planning, Construction, Operation and Decommissioning of the Facility

Main Activity / Project Component	Components of Activity	Details
	Planning	
Conduct technical surveys	» Geotechnical survey by geotechnical engineer; » Site survey and confirmation of the turbine micro-siting footprint; » Survey of substation site; and » Survey of power line servitude to determine tower locations.	» All surveys are to be undertaken prior to initiating construction.
	Construction	
Establishment of access roads to the site	» Upgrade access/haul roads to the site, as required (this only refers to the main access roads leading directly to site itself). Establish internal access roads: 6 m wide permanent roadway within the site between the turbines for use during construction and operation phase. » Temporary track (adjacent to and utilising part of the permanent road) of approximately 8 m in width for use by the crawler crane during construction phase only.	» 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 of up to 8 m in width is required to be established on the site (as advised to be required by VentuSA Energy).
Undertake site preparation	» Site establishment of offices / workshop with ablutions and stores, contractors yards » Establishment of internal access roads	» These activities will require the stripping of topsoil, which will need to be appropriately stockpiled for use in rehabilitation.

Main Activity / Project Component	Components of Activity	Details
	(permanent and temporary roads) » Clearance of vegetation at the footprint of each turbine » Excavations for foundations	
Establishment of lay down areas on site	» Lay down areas (temporary footprint 60 m x 40 m) 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 up to 60 m x 60 m 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 16 m x 16 m x 2.5 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.
Transport of components and equipment to site	» Flatbed trucks will be used to transport all components to site: * Turbine units consist of a tower comprised of 4 segments, a nacelle, and three rotor blades (each of up to 52 m in length).	» Turbine units consist of a tower comprised of 4 segments, a nacelle, and three rotor blades. Components of various specialised construction, lifting 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

Main Activity / Project Component	Components of Activity	Details
	* 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, cement mixers, 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, substation and visitors centre foundations	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 small 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.

Main Activity / Project Component	Components of Activity	Details
Construct substations and ancillary infrastructure.	» Substations and associated components; » Security fencing around high-voltage (HV) yard; and » An operations and maintenance facility, including a storage building, security office, is proposed. Some of the existing on-site buildings may be utilised where practical.	» A temporary construction area is needed for containers, toilets, and equipment. » Permanent operational buildings are as follows: * Operations and maintenance facility, including a storage building (40 m x 20 m), security office (10 m x 5 m) will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. » A lay down area for building materials and equipment associated with these buildings will also be required. » The on-site substations will be constructed with a HV yard footprint of up to 80 m x 90 m. » The substations 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 wind turbines to the on-site substation	» 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 substation to power grid	» One new sections of 132kV overhead power line feeding into the Melkhout 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.

Main Activity / Project Component	Components of Activity	Details
Commissioning of the facility	» Wind energy facility commissioning	» 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 and unit performance. Physical adjustments may be needed such as changing the pitch of the blades.
Undertake site remediation	» Remove all construction equipment from the site. » Rehabilitation of temporarily disturbed areas where practical and reasonable.	» On full commissioning of the facility (or a phase thereof), any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.
Operation		
Operation	» Operation of turbines within the wind energy facility.	» Once operational, the wind energy facility will be monitored remotely. » No permanent staff will be required on site for any extended period. 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.	» 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 associated with this facility would only be decommissioned once it has reached the end of its economic life.

Main Activity/Project Component	Components of Activity	Details
	equipment and lifting cranes. » Preparation of the site (e.g. lay down areas, construction platform) » Mobilisation of construction equipment	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 and replace existing turbines	» A large crane will be used to disassemble the turbine and tower sections.	» Turbine components would be reused, recycled, or disposed of in accordance with regulatory requirements. » The hours of operation for noisy construction activities are guided by the Environment Conservation Act (noise control regulations). If the project requires construction work outside of the designated hours, regulatory authorities, and affected stakeholders will be consulted and subsequent negotiations will be made to ensure the suitability of the revised activities.

STRUCTURE OF THIS EMP *CHAPTER 3*

The first two chapters provide background to the EMP 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 VentuSA Energy to achieve environmental compliance. For each of the phases of implementation for the wind 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 EMP 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 line
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 EMP 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 EMP was compiled by:

	Name	Company
EMP Compilers:	John von Mayer	Savannah Environmental
	Karen Jodas	Savannah Environmental
Specialists:	David Hoare - ecology	David Hoare Consulting
	Johan Binneman - heritage	Eastern Cape Heritage Consultants
	Andrew Jenkins - ornithologist	Avisense Consulting
	Iain Paton - soils and erosion	Outeniqua Geotechnical Services cc
	Morne de Jager – noise	MENCO (M2 Environmental Connections)
	Lourens du Plessis - visual	MetroGIS
	Tony Barbour - social	Tony Barbour Consultants
	Werner Marais - bats	Animalia Consulting
	Billy de Klerk – Palaeontology	Albany Museum

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 Plans for other power generation projects throughout South Africa, including numerous wind energy facilities.

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

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 wind energy facility development site, several high sensitivity areas were identified (refer to Figure 2.2).

It is most probable that bat activity will be elevated in the riparian valleys, its associated vegetation, slopes, drainage and moist areas. Therefore no turbines should be placed in areas indicated as having a High Bat Sensitivity. The localities of turbines 15, 20 and 25 should be revised and alternatives proposed. Turbines located in areas of Moderate Bat Sensitivity should preferably be considered to be moved to alternative locations, but if not possible they must at least be prioritized in post construction monitoring and implementation of mitigation measures.

In order to minimise collision risk for soaring birds and commuting bustards, cranes and wetland species along valleys, and to limit disturbance impacts on forest patches a number of high sensitivity avifaunal areas have been demarcated. These include the

area within at least 250 m of the edge of the south-west edge of the plateau, overlooking the Krom River, or the north-east edge, overlooking the Diep River as well as areas 150 m from the centre of any wetlands/farm dams on the site (to minimise collision risk for Blue Cranes and wetland species). Avifaunal 'no-go' areas will be demarcated after completion of the proposed bird monitoring programme, if necessary.

The Early Stone Age heritage site is a "no go" area for development.

A "walk down" of final the power line route will be required to be conducted by a certified professional archaeologist / heritage consultant.

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 substations » 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 heritage sites, as detailed within the EIA report and relevant appendices.	Engineering Design Consultant / turbine supplier VentuSA Energy	Tender design, design review stage
Access roads to be carefully planned to minimise the impacted area and prevent unnecessary over compaction of soil.	VentuSA Energy	Design phase
No infrastructure should be located within mapped areas of high bat sensitivity (refer to Figure 2.2). The localities of turbines 15, 20 and 25 should be revised and alternatives proposed.	VentuSA Energy	Design phase
Should the layout (or type of wind turbines used) change significantly during the final design, it is recommended that the new layout be remodelled/reviewed in terms of the potential noise impact by an independent acoustics specialist.	VentuSA Energy	Design phase
A monitoring programme should be implemented to document the effect of the wind turbines on birds. This should take place before construction (to provide	VentuSA Energy in consultation with relevant Specialist	Pre-construction, construction, operation

Mitigation: Action/control	Responsibility	Timeframe
a benchmark), and continue during construction and during operation. The monitoring protocols as required by the EIA report for avifauna should be implemented.		
Use bird-friendly power line tower and conductor designs.	VentuSA Energy	Design phase
Minimise the length of any new power lines installed as far as possible.	VentuSA Energy	Design phase
A detailed geotechnical investigation is required for the design phase for all infrastructure components.	VentuSA Energy	Design phase
Compile a comprehensive stormwater management plan for hard surfaces (e.g. substation footprints) as part of the final design of the project.	VentuSA Energy	Design phase
Identify construction areas and restrict construction activity to these areas	ECO/Contractor	Pre-construction, construction
Undertake pre-construction heritage survey of the power line alignment to determine if any adjustments are necessary to mitigate impacts on heritage resources.	Relevant Specialists	Design stage - once layout is finalised
No development must take place near the visible heritage site – "no go" area (Figure 2.2). If adjacent areas are considered for development, a professional archaeologist must be appointed to conduct a walk through and be on site to monitor the excavations when construction for roads and the turbine foundations begins.	Relevant Specialists	Design & Pre-construction

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.
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.

Performance Indicator	» Power line alignments meet environmental objectives. » Selected alignments, substation sites and turbine layout minimises any negative environmental impacts and maximises any benefits.
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 the ECO prior to the commencement of construction.

OBJECTIVE: Initiate Bird Monitoring Programme

A monitoring programme should be implemented by VentuSA Energy (in consultation with an avifauna specialist) to establish population sizes and any migration routes, and to determine risk of collisions based on flight behaviour and patterns. This should take place before construction (to provide a benchmark), during construction and during operation. This is seen as critical to furthering the understanding of avifaunal impacts and wind energy facilities on the site and in South Africa. Further details are included in Appendix A of this EMP.

Project component/s	List of project components affecting the objective » Power line » Wind turbines
Potential Impact	» Mortality of birds due to collision with turbines and power line infrastructure.
Activity/risk source	» Turbines and power 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 scientist and agency to conduct pre- and post-construction monitoring.	VentuSA Energy	Pre-construction
Implement monitoring programme.	Monitoring Agency	Pre-construction, construction, operation
Refine monitoring protocol and determine the extent of radar deployment if required. Periodically collate and analyse pre-construction monitoring data. Review report on the full year of pre-construction monitoring, and integrate findings into construction EMP and broader mitigation scheme.	Advising Scientist	Pre-construction, construction, operation

Performance Indicator	» Clear and logical recommendations on why, how and when to institute mitigation measures to reduce avian impacts of the development, from pre-construction to operational phase.
Monitoring	» An incident reporting system should be used to record non-conformances to the EMP.

MANAGEMENT PLAN FOR WIND 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 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 species using the site.

5.2. Objectives

In order to meet this goal, 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. The Contractor must take all reasonable measures to ensure the safety of the public in the surrounding area. Where the public could be exposed to danger by any of the works or site activities, the Contractor must, as appropriate, provide suitable flagmen, barriers and/or warning signs in English, Afrikaans and any other relevant local languages, all to the approval of the Project Manager.

Project component/s	Project components affecting the objective: » Wind turbines » Access roads

	» Substation » Power Line
Potential Impact	» Hazards to public » Security of materials » Substantially increased damage to sensitive 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 sensitive vegetation in areas outside immediate development footprint; <1ha of construction related disturbance in sensitive areas outside fenced footprints; 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	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
Minimise vegetation clearance associated with site establishment activities	Contractor	Site establishment
All development footprints for roads, buildings, underground cables, laydown areas and turbine footings should be appropriately fenced off and clearly indicated with flags and/or danger tape strips. 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	Contractor	Erection: during

Mitigation: Action/control	Responsibility	Timeframe
toilets. Provide adequate sanitary facilities and ablutions for construction workers (1 toilet per every 15 workers) at appropriate locations on site.		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 waste collection bins at site where construction is being undertaken.	Contractor	Erection: during site establishment Maintenance: duration of contract within a particular area
Fencing of development footprints in sensitive areas in order to minimise disturbance to adjacent sensitive areas and to make it clear to contractors where they should and should not go.	ECO	Prior to any construction activity

Performance Indicator	» No unnecessary environmental impacts associated with site established » Site is secure and there is no unauthorised entry » No members of the public/ landowners injured
Monitoring	» An incident reporting system will be used to record non-conformances to the EMP » 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: Control loss of indigenous natural vegetation and species of conservation concern

There are three vegetation types that are mapped for the area that includes the site, namely Tsitsikamma Sandstone Fynbos (classified as Vulnerable), Langkloof Shale Renosterveld (classified as Critically Endangered) and Humansdorp Shale Renosterveld (classified as Endangered). The Endangered and Critically Endangered vegetation types are protected under the Draft National List of Threatened Ecosystems (GN1477 of

2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004). Although Tsitsikamma Sandstone Fynbos is not listed on the Draft National List of Threatened Ecosystems (GN1477 of 2009), the fact that it is classified as Vulnerable indicates that it is of conservation concern. Any remaining patches of natural vegetation on site therefore have a high to very high conservation value. The vegetation on site has been classified at a Provincial level, through the Eastern Cape Biodiversity Conservation Plan (ECBCP), as having elevated conservation value. The area is also within the Cape Floristic Region, one of the earth's 25 hotspots. Remaining indigenous natural vegetation on site is therefore considered to have high sensitivity and conservation value.

Significant parts of the study area (42%) have been cultivated, mostly on the flat areas above the river valleys. Field examination of the site indicates that large parts of the site (55%) are still in a natural state in relatively good condition (including wetlands and terrestrial vegetation). A small proportion of the site (3%) is natural, but degraded vegetation. Natural vegetation consists of fynbos on southern slopes, wetland vegetation in drainage lines and river valleys and renosterveld on the flats in upland areas.

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 » Loss of populations of threatened plant species
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	» To retain natural vegetation in the highly sensitive areas the site » To minimise footprints of disturbance of vegetation/habitats on-site » To minimise loss of indigenous vegetation » No loss of species of conservation concern » Ecologically functional and flourishing natural vegetation in the area, with rare species flowering and setting seed successfully

Mitigation: Action/control	Responsibility	Timeframe
Turbines should not be placed within natural vegetation (turbine numbers 6, 13, 14, 16, 22 and 23 must be moved and turbines 15, 19, 20, 24 and 25 omitted from the development	VentuSA Energy	Planning and construction
For infrastructure that remains within natural vegetation, undertake specialist plant species	VentuSA Energy Specialist	Planning and construction

Mitigation: Action/control	Responsibility	Timeframe
assessment prior to construction. This should take place during flowering period of potentially affected species (will require surveys at different times of year to target all affected species).		
The construction impacts must be contained to the footprint of the infrastructure.	Contractor	Construction
Internal access roads and underground cables should be aligned as much as possible along existing linear disturbances, e.g. roads on site, or the edges of cultivated lands, and away from steep slopes and drainage lines as much as possible.	VentuSA Energy Contractor	Planning and construction
Unnecessary impacts on surrounding natural vegetation must be avoided.	Contractor	Construction
Rehabilitate any disturbed areas immediately to stabilise landscapes.	Contractor	Construction

Performance Indicator	» No loss of natural vegetation within "no-go" areas. » No loss of individuals or populations of threatened plant species within project control area and immediate surroundings.
Monitoring	» Ongoing monitoring of area by environmental manager during construction and operation to ensure no habitats or buffer areas are affected by construction or operational activities. » The environmental manager should be responsible for driving this process. » Reporting frequency depends on legal compliance framework. » After construction, evaluate whether any natural vegetation identified as highly sensitive lost due to construction.

OBJECTIVE: Limit damage to wetlands & watercourses

Project component/s	» Any infrastructure or activity that will result in disturbance to wetlands
Potential Impact	» Damage to wetland areas by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands). 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 damage to wetlands or watercourses within project area

Mitigation: Action/control	**Responsibility**	**Timeframe**
Avoid wetlands and watercourses as far as possible. Move turbines 13, 14, 16, 23 >30m from mapped wetlands than they are currently situated	VentuSA Energy	Planning and construction
Internal access roads and underground cables should be aligned as much as possible along existing linear disturbances.	VentuSA Energy Contractor	Planning and construction
For any new construction where impacts are unavoidable, cross watercourses perpendicularly to minimise disturbance footprints	VentuSA Energy Contractor	Planning and construction
Rehabilitate any disturbed areas immediately to stabilise landscapes.	Contractor	Construction
Control stormwater and runoff water	Contractor	Construction
Appoint an independent environmental control officer during construction and an environmental manager during operation whose duty it will be to minimise impacts on surrounding sensitive habitats	VentuSA Energy Contractor	Planning and construction
Obtain a permit from DWA to impact on any wetland or water resource	VentuSA Energy Contractor	Planning and construction

Performance Indicator	» No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses
Monitoring	» Water quality monitoring to take place on a regular basis. This should include the water quality and quantity leaving the project area through the watercourses (should be monitored within main drainage systems that exit site). » Habitat loss in watercourses should be monitored before and after construction. » The environmental manager should be responsible for driving this process. » Reporting frequency depends on legal compliance framework.

OBJECTIVE: Control alien invasive plants

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 ongoing 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

Performance Indicator	» For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	» Ongoing monitoring of area by environmental control officer during construction » Ongoing 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: Protection of Avifauna

The proposed facility could have a significant, long-term impact on the avifauna of the surrounding area. The proposed Deep River Wind Energy Facility could have a significant, long-term impact on components of the avifauna of the surrounding area. The most obvious and immediate negative impacts are likely to be on the bustards and cranes which forage and possibly nest on the site, and on the soaring raptors which may visit the area from nesting or roosting sites nearby. These priority species may be disturbed by the construction of the wind energy facility, and/or lose foraging habitat (in terms of the area covered by the construction footprint and by displacement from areas with operating turbines), and/or sustain mortalities in collisions with the turbine blades, or by collision with or electrocution on the new power infrastructure.

These effects may be reduced to acceptable and sustainable levels by adherence to a proposed mitigation scheme. A comprehensive programme to fully monitor the actual impacts of the facility on the broader avifauna of the area is recommended and outlined, from pre-construction and into the operational phase of the project. Full clarity on the likely environmental impact of this facility can only be reached once pre-construction monitoring has been completed.

Project component/s	» Wind energy facility (turbines) » Power line » Substation
Potential Impact	» Disturbance to or loss of birds as a result of collision with the turbine blades » Disturbance to or loss of birds as a result of collision with the overhead power line » Electrocution on power line and substation
Activity/risk source	» Starting pre-construction monitoring too late » Appointment of unqualified personnel to do the monitoring » Misinterpretation of either the pre- or post-construction monitoring data » Lack of clear communication between the scientist analysing the monitoring data and the client
Mitigation: Target/Objective	» More accurately determine the impact of the operating wind energy facility on priority bird species » Minimise impacts associated with collisions and electrocutions » 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 scientist and agency to conduct pre- and post-construction monitoring	VentuSA Energy	As soon as possible / practical
Refine monitoring protocol and determine the extent of radar deployment required	Relevant scientist, VentuSA Energy	As soon as possible / practical
Appoint radar technologists to service the project, and acquire/hire hardware, software and relevant expertise, IF radar use is approved	Relevant scientist, VentuSA Energy	As soon as possible / practical
Start pre-construction monitoring	Monitoring agency	1 year before construction is due to start
Periodically collate an analyse pre-construction monitoring data	Relevant scientist and radar specialist (if applicable)	Every 3 months of monitoring
Review report on the 6-12 months of pre-construction monitoring, and integrate findings into construction EMP and broader mitigation scheme	Relevant scientist, monitoring agency and radar specialist (if applicable), in negotiation with the client	After a year of pre-construction monitoring
Ensure construction EMP is applied	ECO	During construction
Refine post-construction monitoring protocol in terms of results pre-construction, and determine the extent of radar deployment required	Relevant scientist, monitoring agency and radar specialist (if applicable), in negotiation with VentuSA Energy	As soon as possible / practical after construction completed
Start post-construction monitoring	Monitoring agency	6 months after construction is completed
Periodically collate and analyse post-construction monitoring data	Relevant scientist and radar specialist (if applicable)	Every 3 months of monitoring
Review report on the full year of post-construction monitoring, and integrate findings into operational EMP and broader mitigation scheme	Relevant scientist, monitoring agency and radar specialist (if applicable), in negotiation with the client	1 year post-construction
Review the need for further post-construction	Relevant scientist,	1 year post-

Mitigation: Action/control	Responsibility	Timeframe
monitoring	monitoring agency and radar specialist (if applicable), in negotiation with VentuSA Energy	construction

Performance Indicator	» Regular provision of clearly worded, logical and objective information on the interface between the local avifauna and the proposed/operating wind energy facility » Clear and logical recommendations on why, how and when to institute mitigation measures to reduce avian 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: 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 on 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, crops, 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.	VentuSA Energy & Contractor	Duration of construction
Provide adequate fire fighting equipment onsite.	VentuSA Energy & 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	Contractor	As required

Mitigation: Action/control	Responsibility	Timeframe
livestock, damage to infrastructure etc for losses associated with fires resulting from negligence or non-compliance.		

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	» VentuSA Energy and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Control runoff and soil erosion & degradation

The soil resource on the site needs to be conserved as far as possible to minimise the cumulative impact on the local environment.

A set of strictly adhered to mitigation measures are required to effectively limit the impact on the environment. The disturbance areas where human impact is likely are the focus of the mitigation measures laid out below.

Project component/s	» Wind turbines » Access roads » Substation » Power line » Sealed surfaces (e.g. roofs, concrete surfaces, compacted road surfaces, paved roads, / areas). » All other infrastructure
Potential Impact	» Degradation of soil and/or local geology » Soil erosion » Siltation of riverine areas
Activities/risk sources	» Water and wind erosion of cleared and excavated areas » Excavation, mixing, dumping, stockpiling and compaction of soil » Concentrated discharge of water from construction activity » Site preparation and earthworks » Foundations or plant equipment installation » Mobile construction equipment movement on site » Power line construction activities » River/stream/drainage line road crossings

Mitigation: Target/Objective	» To minimise degradation of rock and soil by construction activity » To conserve topsoil by stockpiling and re-using in disturbance areas » To minimise erosion of soil from site during construction » To minimise deposition of soil into riverine areas

Mitigation: Action/control	Responsibility	Timeframe
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil.	Engineer, ECO	Pre-construction, construction
Dust control on construction site: implementation of appropriate dust control measures.	Contractor	Construction
Erosion features must be immediately stabilised with appropriate erosion control measures, if they develop	Contractor	Construction
Where access roads cross natural drainage lines, culverts must be designed to allow free flow. Regular maintenance must be carried out.	VentuSA Energy Contractor	Design Pre-construction, construction
Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. Limit the height of stockpiles as far as possible to reduce compaction.	Contractor	Site establishment, any earthwork related activity, duration of construction
Erosion control measures: Run-off attenuation on slopes (sand bags, logs), silt fences, stormwater catch-pits, shade nets, or temporary mulching over denuded areas.	Contractor/ECO	Erection: before construction Maintenance: duration of contract
Rehabilitate any disturbed areas immediately after construction in that area is complete in order to stabilise landscapes.	Contractor	Post-construction
Vehicular traffic must be controlled during construction, confining access and roadways, where possible, to proposed or existing road alignments.	Contractor	Duration of contract
Internal access roads should be kept to a minimum. Use existing roads wherever possible.	Contractor	Site establishment
Where temporary tracks are required (e.g. for use by crawler crane) these are to be ripped and rehabilitated as soon use of the track in an area is no longer required.	Contractor	Duration of contract
Control depth of excavations and stability of cut faces/sidewalls.	Engineer/ECO/ Contractor	Before construction, Maintenance over duration of contract

Performance Indicator	» Acceptable level of soil erosion around site, as approved by ECO » Acceptable level of increased siltation in drainage lines, as approved by ECO » Acceptable level of soil degradation, as approved by ECO » Acceptable state of excavations, as approved by ECO » No activity in restricted areas
Monitoring	» Ongoing monitoring of area by environmental control officer during construction » 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: Avoid the potential impacts on family structures and social networks associated with presence of construction workers from outside the area

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can affect local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour of male construction workers, including:

» An increase in alcohol and drug use
» An increase in crime levels
» An increase in teenage and unwanted pregnancies
» An increase in prostitution
» An increase in sexually transmitted diseases (STDs)

Project component/s	Construction and establishment activities associated with the wind energy facility, including infrastructure etc.
Potential Impact	The presence of construction workers who live outside the area and who are housed in local towns can affect family structures and social networks.
Activities/risk sources	Construction workers can affect negatively on family structures and social networks, especially in small, rural communities.
Mitigation: Target/Objective	To avoid and or minimise the potential impact of construction workers on the local community. This can be achieved by maximising the number of locals employed during the construction phase and minimising the number of workers housed on the site.

Mitigation: Action/control	Responsibility	Timeframe
Identify local contractors who are qualified to undertake	VentuSA Energy	Tender stage

Mitigation: Action/control	Responsibility	Timeframe
the required work		pre-construction
Ensure that low-skilled workers are sourced from the local area as far as possible. However, there are practical constraints such as the amount of suitable work force that is available in the area). This should be included in the tender documents. VentuSA should aim for a minimum of 80% of the low-skilled workers to be sourced from the local area (where this is possible, and where the workforce exists in these areas). This should be included in the tender documents. Construction workers should be recruited from the local area in and around the towns of Kaaredouw and Humansdorp.	VentuSA Energy and contractors	Pre-construction
Develop a Code of Conduct to cover the activities of the construction workers housed on the site. Ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct. Construction workers should attend a brief session before they commence activities. The aim of the briefing session is to inform them of the rules and regulations governing activities on the site as set out in the Code of Conduct.	VentuSA Energy / contractors	Prior to commencement of construction

Performance Indicator	» Employment policy and tender documents that set out local employment targets completed before construction phase commences. » Maximum number of semi and unskilled labour locally sourced where possible / practical. » Code of Conduct drafted before commencement of construction phase » Briefing session with construction workers held at outset of construction phase.
Monitoring	» ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

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

The construction phase is expected to extend over a period of 24 months and create approximately 50 employment opportunities. The work associated with the construction phase will be undertaken by contractors and will include the establishment of the access roads and services and the erection of the wind turbines.

Project	Construction and establishment activities associated with the wind energy

component/s	facility, including infrastructure etc.
Potential Impact	The opportunities and benefits associated with the creation of local employment and business should be maximised.
Activities/risk sources	The employment of outside contractors who make use of their own labour will reduce the employment and business opportunities for locals. Employment of local labour will maximise local employment opportunities.
Mitigation: Target/Objective	VentuSA Energy, in discussions with various stakeholders should aim to employ a maximum percentage of the low-skilled workers from the local area where possible.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that a maximum number of the low-skilled workers are sourced from the local area as far as possible.	VentuSA Energy, Contractors	Before construction phase commences
Where required, implement appropriate training and skills development programmes prior to the initiation of the construction phase to ensure that the above target is met.	VentuSA Energy	Prior to the initiation of the construction phase
Develop a database of local BEE service providers and ensure that they are informed of tenders and job opportunities.	VentuSA Energy	Before construction phase commences
Identify potential opportunities for local businesses in terms of involvement with construction activities.	VentuSA Energy	Tender design, review stage

Performance Indicator	» Employment and business policy document that sets out local employment targets completed before construction phase commences. » Maximum semi and unskilled labour locally sourced where possible / practical. » Database of potential local BEE services providers in place before construction phase commences. » Skills audit to determine need for training and skills development programme undertaken before construction starts.
Monitoring	» Appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: To avoid and or minimise the potential impact on current and future farming activities during the construction phase

The final footprint of disturbance associated with the facility is a small percentage of the farmland where turbines will be located and is linked to the foundation of the individual wind turbines, services roads, substation, and power line. The impact on farmland associated with the construction phase can be mitigated by minimising the footprint of

the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase.

Project component/s	Construction phase activities associated with the establishment of the wind energy facility and associated infrastructure.
Potential Impact	The footprint of the wind energy facility and associated infrastructure will result in a loss of land that will affect on farming activities on the site.
Activities/risk sources	The footprint taken up by the wind energy facility and associated infrastructure.
Mitigation: Target/Objective	To minimise the loss of land taken up by the wind energy facility and associated infrastructure and to enable farming activities to continue where possible, specifically grazing.

Mitigation: Action/control	Responsibility	Timeframe
Minimise the footprint of the wind energy facility and the associated infrastructure.	VentuSA Energy and contractor	Duration of construction
Investigate the possibility of allowing farmers in the area to continue to use the site for their agricultural activities	VentuSA Energy	Duration of construction
Compile and implement a rehabilitation plan to ensure rehabilitation of disturbed areas on completion of the construction phase.	VentuSA Energy and specialist	Construction and post-construction

Performance Indicator	» No complaints regarding impacts on farming activities.
Monitoring	» ECO to monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE: Noise control

The future noise projections indicated that the construction activities, as modelled for the worst case scenario, would comply with both the Noise Control Regulations (GN R154) and the acceptable day rating levels as per the SANS 10103:2004 guidelines.

Various construction activities would be taking place during the development of the facility, but due to the distance from the closest potentially sensitive receptors, it poses little to no noise risk to them. The significance of this noise impact was defined to be of a low significance. However, mitigation measures were still proposed that could further reduce the potential noise impacts, risks and the probability of any complaints being registered.

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 meters 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 meters) 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	At least 2 days, but not more than 5 days before activity is to commence
Ensure that all equipment are maintained and fitted with the required noise abatement equipment.	ECO	Weekly inspection
Measure the peak noise levels of equipment used when operational and keep database of noise levels	Acoustical Consultant / Approved Noise Inspection Authority	Start of project Quarterly during construction phase
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 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	Contractor	Site establishment;

Mitigation: Action/control	Responsibility	Timeframe
excessive. Ensure that damage to roads is repaired on completion of construction phase.		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. » Dust suppression measures on roads implemented for all heavy vehicles 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: Protection of sites of heritage value / fossil resources

The main cause of impacts to archaeological sites 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.

It is considered highly unlikely that significant palaeontological heritage would be found within the study area. 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 material or human remains are uncovered during further development of the site, all work must immediately cease and be should reported to the Albany Museum and/or 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 » Substation » Power line
Potential Impact	» Heritage objects or artefacts found on site are inappropriately managed or destroyed » Disturbance to fossil resources » Disturbance to the cultural landscape
Activity/risk source	» Site preparation and earthworks » Foundations or plant equipment installation » Mobile construction equipment movement on site » Power line construction activities
Mitigation:	» To ensure that any heritage objects found on site are treated

Target / Objective	appropriately and in accordance with the relevant legislation » To ensure that the cultural landscape and sense of place is maintained as far as possible.

Mitigation: Action / control	Responsibility	Timeframe
Areas required to be cleared during construction must be clearly marked in the field to avoid unnecessary disturbance of adjacent areas (which will not be surveyed in detail by a heritage specialist).	Contractor in consultation with Specialist	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 the geological staff at either the Albany Museum or Rhodes University in Grahamstown or the Council for Geosciences in Port Elizabeth.	ECO	Construction
If a heritage object is found, work in that area must be stopped immediately, and appropriate specialists brought in to assess to site, notify the administering authority of the item/site, and undertake due/required processes.	VentuSA Energy /Contractor in consultation with Specialist	Duration of contract

Performance Indicator	» Zero disturbance outside of designated work areas » All heritage items located are dealt with as per the legislative guidelines » A record is kept of all instances of accidental disturbance of heritage material, as well as post construction review of impacts on landscape context.
Monitoring	» Supervision of all clearing and earthworks by ECO throughout construction phase

OBJECTIVE: Minimisation of visual impacts associated with construction

The construction phase of the facility should be sensitive to potential observers in the vicinity of the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.

Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required),

timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

Project component/s	» Wind turbines » Substation » Power line » Access roads
Potential Impact	» Temporary visual intrusion
Activity/risk source	» Transportation of wind energy facility, substation and power line components to the site » Construction activities on-site, along power line corridor and at substation sites » The potential scarring of the landscape due to the creation of new access roads/tracks or the unnecessary removal of vegetation
Mitigation: Target/Objective	» Minimise contrast with surrounding environment and visibility of the construction activities to people in the area

Mitigation: Action/control	Responsibility	Timeframe
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	Contractor	Duration of contract
The activities and movement of construction workers and construction site vehicles will be restricted to the immediate construction site.	Contractor	Construction
Limit access to the construction sites along existing access roads.	Contractor	Construction
The general appearance of construction activities, construction equipment camps, and lay-down areas will be maintained by means of the timely removal of rubble and disused construction materials.	Contractor	Construction
Avoid the unnecessary removal of vegetation for the distribution power line servitudes and limit access to the servitudes (during both construction and operational phases) along existing access roads.	Contractor	Duration of contract
Implement an environmentally responsive planning approach to roads and infrastructure to limit cut and fill requirements.	VentuSA Energy Contractor	Pre-construction, Construction
Rehabilitate all disturbed areas, including cut and fill slopes to acceptable visual standards.	Contractor	Post-construction

Performance Indicator	» No complaints regarding visual intrusion associated with construction activities
Monitoring	» Ensure that mitigation measures are implemented during construction to minimise visual impacts on surrounding communities

	» An incident reporting system will be used to record non-conformances to the EMP

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 » Substation » 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 source	» Transportation of project components to site
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
All relevant permits for abnormal loads must be applied for from the relevant authority.	Contractor, Transportation contractor)	Pre-construction
A designated access (or accesses) to the proposed site must be created to ensure safe entry and exit.	Contractor	Pre-construction
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)	Pre-construction
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

Mitigation: Action/control	Responsibility	Timeframe
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

Performance Indicator	» No traffic incidents involving VentuSA Energy personnel or appointed contractors » 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 B of this EMP.

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	Contractor	Duration of

Mitigation: Action/control	Responsibility	Timeframe
and on a sealed surface.		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 be required must be obtained, and the conditions attached to such permits and approvals will be compiled with.	Contractor	Duration of 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	Contractor	Duration of

Mitigation: Action/control	Responsibility	Timeframe
detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.		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
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 EMP

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 EMP, 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 EMP and the Environmental Authorisation (once issued) will be included in all tender documentation and Contractors contracts.	VentuSA Energy	Tender process
An ECO must be permanently on site throughout the road construction, cable laying, and turbine foundation excavation periods, and at other times should visit the site at least once a week.	VentuSA Energy	Duration of construction
Contractors must use chemical toilets/ablution facilities situated at designated areas of the site; no abluting will be permitted outside the designated area. These facilities must be regularly serviced by appropriate contractors.	Contractor (and sub-contractor/s)	Duration of contract
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 VentuSA Energy must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.	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	Contractor (and sub-contractor/s)	Construction

Mitigation: Action/control	Responsibility	Timeframe
ending. The costs of transportation must be borne by the contractor		

Performance Indicator	» Compliance with specified conditions of Environmental Authorisation, EIA report and EMP » No complaints regarding contractor behaviour or habits » Code of Conduct drafted 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 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

5.3. Institutional Arrangements: Roles and Responsibilities for the Construction Phase of the Wind Energy Facility

As the Proponent, VentuSA Energy must ensure that the implementation of the wind energy facility 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 EMP, and the implementation of the EMP through its integration into the contract documentation. VentuSA Energy will retain various key roles and responsibilities during the construction of the wind energy facility. These are outlined below.

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 VentuSA Energy and its Contractor(s) are made aware of all stipulations within the EMP.
- Ensure that the EMP 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 EMP, the conditions of the Environmental Authorisation (once issued), and all relevant environmental legislation.

The **Site Manager** (VentuSA Energy'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 Plan.
- Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
- Have overall responsibility of the EMP and its implementation.
- Conduct audits to ensure compliance to the EMP.
- 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.

The **Environmental Control Officer** (ECO) will be responsible for monitoring, reviewing, and verifying compliance by the Contractor with the environmental specification. Accordingly, 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 Plan.
- Be fully knowledgeable with the contents with all relevant environmental legislation, and ensure compliance with them.
- Ensure that the contents of this document are communicated to the Contractor site staff and that the Site Manager and Contractor are constantly made aware of the contents through discussion.
- Ensure that the compliance of the EMP is monitored through regular and comprehensive inspection of the site and surrounding areas.
- Ensure that if the EMP conditions or specifications are not followed then appropriate measures are undertaken to address this.

- Monitoring and verification must be implemented to ensure that environmental impacts are kept to a minimum, as far as possible.
- Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements.
- Ensure that activities on site comply with all relevant environmental legislation.
- Ensure that a removal is ordered of any person(s) and/or equipment responsible for any contravention of the specifications of the EMP.
- Ensure that the compilation of progress reports for submission to the Project Manager, with input from the Site Manager, takes place on a regular basis, including a final post-construction audit.
- Ensure that there is communication with the Site Manager regarding the monitoring of the site.
- Ensure that any non-compliance or remedial measures that need to be applied are reported.

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

- 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 EMP.
- 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 EMP (i.e. ensure their staff are appropriately trained as to the environmental obligations).

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 EMP

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 EMP 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
» 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.

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.

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 EMP. 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 EMP 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.
» 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.

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 EMP, but also to monitor any environmental issues and impacts which have not been accounted for in the EMP 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, VentuSA Energy will 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 EMP, 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.

MANAGEMENT PLAN 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 substation and maintenance building, and disturbed areas associated with the power line tower foundations, substation site and access roads.

Project component/s	» Wind energy facility (including laydown areas) » Power line servitude and associated service road » 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 » Recognisable Fynbos or Renosterveld in rehabilitated areas within two years of rehabilitation commencing

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 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

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 PLAN 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 that frequent the area, in particular monitoring of bird strikes, bird nesting activities and water bird uses of the wetlands/ephemeral pans 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: Minimisation of visual impacts

The primary visual impact, namely the appearance and dimensions of the wind energy facility (mainly the wind turbines) is not possible to mitigate to any significant extent within this landscape. 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 energy facility, including access roads » Substations » Power line and service roads for power line servitudes
Potential Impact	» Risk to aircraft in terms of the potential for collision » Enhanced visual intrusion » Impact on ambient lighting conditions
Activity/risk source	» Size/scale of turbines » Substation and associated lighting » Aviation lighting » Access roads » Power line » Other associated infrastructure
Mitigation: Target/Objective	» 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 substation in order to eliminate the risk of additional night-time visual impacts.

Mitigation: Action/control	Responsibility	Timeframe
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 synchronous flashing lights on the turbines representing the outer perimeter of the facility.	VentuSA Energy	Erection, maintenance
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.	VentuSA Energy	Construction, operation, maintenance

Mitigation: Action / control	Responsibility	Timeframe
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.	VentuSA Energy	Erection, maintenance
Maintain the general appearance of the facility in an aesthetically pleasing way.	VentuSA Energy	Operation, maintenance
Undertake regular maintenance of light fixtures.	VentuSA Energy	Operation, maintenance
Limit access to the wind energy facility site, power line and substation to along existing access roads.	VentuSA Energy	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.	VentuSA Energy	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 relative darkness, until lighting is required for security or maintenance purposes.	VentuSA Energy / lighting engineer	Operation, maintenance

Performance Indicator	» Minimised visual intrusion on surrounding areas » Appropriate visibility of infrastructure to aircraft » The effective containment of the light to the substation site.
Monitoring	» 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.

OBJECTIVE: Protection of avifauna

During operation of the facility, the threat of collision of avifauna with the turbine blades is the most concerning issue. However, the real extent of this threat is not currently well understood within the South African context due to the limited numbers of turbines in South Africa with which bird interactions have been monitored. Lighting of turbines and other infrastructure has the potential to attract birds, thereby increasing the risk of collisions with turbines. Infrastructure associated with the facility often also impacts on birds. Overhead power lines also pose a collision and possibly an electrocution threat to certain bird species.

Project component/s	» Wind energy facility (turbines) » Power line » Substations
Potential Impact	» Disturbance to or loss of birds as a result of collision with the turbine blades » Disturbance to or loss of birds as a result of collision with the overhead power line » Electrocution on power line and substation
Activity/risk source	» Spinning turbine blades » Overhead power line » substations
Mitigation: Target/Objective	» Minimise impacts associated with collisions and electrocutions

Mitigation: Action/control	Responsibility	Timeframe
Use bird friendly design of towers to minimise electrocutions	VentuSA Energy Environmental Manager	Construction - 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)	VentuSA Energy Environmental Manager	Construction - operation
Review monitoring report on the full year of post-construction monitoring, and integrate findings into operational EMP and broader mitigation scheme	Advising scientist, monitoring agency and radar specialist (if applicable), in negotiation with the client	1 year post-construction
Review the need for further monitoring	Advising scientist, monitoring agency and radar specialist (if applicable), in	1 year post-construction

Mitigation: Action/control	Responsibility	Timeframe
	negotiation with the client	

Performance Indicator	» Reduced impacts on avifauna from operation of the facility
Monitoring	» Observation of avifaunal populations and incidence of injuries/death from collisions from turbine blades or power line.

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
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 » Water storage tank » 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.	VentuSA Energy	Operation
Storage areas for hazardous substances must be appropriately sealed and bunded.	VentuSA Energy	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.	VentuSA Energy	Operation
Care must be taken to ensure that spillage of oils and	VentuSA Energy	Operation,

Mitigation: Action/control	Responsibility	Timeframe
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.		maintenance
Waste handling, collection, and disposal operations must be managed and controlled by a waste management contractor.	VentuSA Energy /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.	VentuSA Energy	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.	VentuSA Energy	Operation
General waste must be recycled where possible or disposed of at an appropriately licensed landfill.	VentuSA Energy	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	VentuSA Energy	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	VentuSA Energy	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), but would not comply with the guidelines as proposed by SANS 10103:2004 during periods when the wind speeds exceeds 6 m/s. This non-compliance however was due to the ambient sound levels associated with wind induced noises at these higher wind speeds. The significance of this noise impact was determined to be low. Mitigation measures are however, 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)	Operational Phase
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
Defining the ambient sound levels over a 24 hour period before the operational phase starts inside and outside of the dwellings of at least 3 Potentially Sensitive Receptors	Acoustical Consultant / Approved Noise Inspection Authority	Before operational phase commence
Design and implement a noise monitoring programme	Acoustical Consultant / Approved Noise Inspection Authority	Before operational phase commence
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. Noise monitoring programme to be developed and implemented at the start of operation.

OBJECTIVE: **Maximise local employment and business opportunities associated with the operational phase.**

Project component/s	» Day to day operational activities associated with the wind energy facility including maintenance etc.
Potential Impact	» The opportunities and benefits associated with the creation of local employment and business should be maximised
Activity/risk source	» The operational phase of the wind energy facility will create approximately 50 full time employment opportunities.
Mitigation: Target/Objective	» In the medium to long term employ as many locals as possible to fill the 50 full time employment opportunities.

Mitigation: Action/control	Responsibility	Timeframe
As far as practical, the entire workforce of permanent staff should be based in local towns of Kaaredouw and Humansdorp. VentuSA Energy should commit to implementing a 5-year training and skills development and training programme. The initial local content target is 30%, however, after 5 years the objective is to have all the employment opportunities taken up by locals.	VentuSA Energy	Develop programme during the construction phase
Identify local members of the community who are suitably qualified or who have the potential to be employed full time.	VentuSA Energy	Identify members during the construction phase

Performance Indicator	» 5 year training and skills development programme developed and designed before construction phase completed » Potential local community members identified before construction phase completed.
Monitoring	VentuSA Energy must monitor indicators listed above to ensure that they have been met for the operational phase.

OBJECTIVE: Maximise the potential tourism opportunities during the operational phase. Highlight the benefits of renewable energy projects.

Project component/s	» Wind energy facility
Potential Impact	» The proposed wind energy facility has the potential to provide Kou-Kamma Municipality with an attraction that would improve its attraction to tourists. The development also has the potential to promote the benefits of renewable energy projects.
Activity/risk source	» The establishment of a wind energy facility has the potential to create and attraction for visitors to the area. The development also has the potential to promote the benefits of renewable energy projects.
Mitigation: Target/Objective	» To enhance the potential tourism and renewable energy opportunities associated with the proposed wind energy facility.

Mitigation: Action/control	Responsibility	Timeframe
Liaise with representatives from the Kou-Kamma Municipality and tourism organisations to raise awareness of the proposed wind energy facility	VentuSA Energy	During the construction phase
Establish a renewable energy interpretation centre at the site. The centre should be equipped with information boards that provide visitors with information on the project and other relevant information.	VentuSA Energy	Outset of the construction phase.

Performance Indicator	» Meeting with Kou-Kamma Local Municipality and local tourism organisations during the construction phase. » Establishment of interpretation centre.
Monitoring	Independent monitoring to ensure that they have been met for the operational phase.

MANAGEMENT PLAN 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 Turbine

A large crane will be brought on site. It will be used to disassemble the turbine and tower sections. These components will be reused, recycled, or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades.

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 (~90) is relatively small. Decommissioning is also similar to the construction phase in that it will also create temporary employment opportunities.
Activity/risk source	» Decommissioning of the wind energy facility.
Mitigation: Target/Objective	» To avoid and or minimise the potential social impacts associated with decommissioning phase of the wind energy facility.

Mitigation: Action/control	Responsibility	Timeframe
VentuSA Energy 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.	VentuSA Energy	Decommissioning
VentuSA Energy should investigate the option of relocating employees to other wind energy facilities when the Deep River Wind Energy Facility is decommissioned (if feasible).	VentuSA Energy	Decommissioning
VentuSA Energy 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.	VentuSA Energy	Decommissioning

Performance Indicator	South African Labour legislation at the relevant time
Monitoring	Retrenchments should comply with South African Labour legislation of the day

APPENDIX A:
BIRD MONITORING PROGRAMME

PROPOSED BIRD MONITORING PROGRAMME

The primary aims of a long-term monitoring programme would be to:

(i) Determine the densities of birds resident (especially Denham's Bustard and Blue Crane) within the impact area of the wind energy facility before construction of the facility, and afterwards, once the facility, or phases of the facility, become operational.

(ii) Document patterns of bird activity and movements in the vicinity of the proposed wind energy facility before construction, and afterwards, once the facility is operational.

(iii) Identify sensitive and no-go areas for turbine placement to inform the final layout of the facility and the environmental management plan for both the construction and operational phases of the project.

(iv) Monitor patterns of bird activity and movement in relation to weather conditions, time of day and season for at least a full calendar year after the facility is commissioned.

(v) Register and as far as possible document the circumstances surrounding all avian collisions with the turbines for at least a full calendar year after the facility becomes operational.

Bird density and activity monitoring should focus on rare and/or endemic, potentially disturbance or collision prone species, which occur with some regularity in the area (Table 2, Appendix 1 of Avifauna Impact Assessment). Ultimately, the study should provide much needed quantitative information on the effects of the facility on the distribution and abundance of birds, and the actual risk it poses to the local avifauna, and serve to inform and improve mitigation measures to reduce this risk. It will also establish a precedent and a template for research and monitoring of avian impacts at possible, future wind energy sites in the region. This programme outline is informed by monitoring studies established in other countries, but is based substantially on those developed for both the Darling and the Klipheuwel wind power demonstration facilities in South Africa. The bulk of the work involved should be done by an expert ornithologist or under the supervision of such.

The protocols set out there pre-date the final drafting of the standard monitoring protocols for pre- and post-construction monitoring of birds at South African wind energy developments, as drawn up by the Birds & Wind Energy Specialist Group. Once the latter protocols have been finalised, they should supplement, and where necessary supercede, the measures stipulated here, as determined by the specialist advising the monitoring programme.

Monitoring protocols

Avian densities before and after

A set of at least 10 walk-transect routes, each of at least 1000 m in length, should be established in areas representative of all the avian habitats present within a 10 km radius of the centre of the development site. Each of these should be walked at least once every two months over at least 6-12 months immediately preceding construction, and at least once every two months over the same calendar period, at least six months after the facility is commissioned. The transects should be walked after 06h00 and before 09h00, and the species, number and perpendicular distance from the transect line of all birds seen should be recorded for subsequent analysis and comparison.

In addition, any cliff-lines situated within or close to the development area (e.g. those just downstream of the Churchill Dam wall) should be surveyed for cliff-nesting raptors at least once every six months using documented protocols, all sightings of key species (Table 2 of Avifauna Impact Assessment) on site should carefully plotted and documented, and the major waterbodies/farm dams on and close to the development area should be surveyed for wetland species on each visit to the study area, using the standard protocols set out by the CWAC initiative.

Bird activity monitoring

Monitoring of bird activity in the vicinity of the facility should be done over a 2-3 day period at least every two months for at least the 6-12 months preceding construction, and at least once per quarter for a full calendar year starting at least 6-12 months after the facility is commissioned. Each monitoring day should involve:

(i) Half-day counts of all priority species flying over or past the impact area (see passage rates below)

(ii) Opportunistic surveys of large terrestrial species and raptors seen when travelling around the site.

Passage rates of priority bird species

Counts of bird traffic over and around the proposed/operational facility should be conducted from suitable vantage points (and a number of these should be selected and used to provide coverage of avian flights in relation to all areas of the site), and extend alternately from dawn to midday, or from midday to dusk, so that the equivalent of four full days of counts is completed each count period. This should provide an adequate (if minimal) sample of bird movements around the facility in relation to a representative cross-section of conditions and times of day, for all seasons of the year.

Once in position at the selected count station, the observer should record (preferably on a specially designed data sheet) the date, count number, start-time and conditions at start - extent of cloud cover, temperature, wind velocity and visibility – and proceed with the count. The counts should detail all individuals or flocks of the stipulated priority bird species, all raptors, and any additional species of particular interest or conservation concern, seen flying within 500 m of the envisaged or actual periphery of the facility. Each record should include the following data: time, updated weather assessment, species, number, mode of flight (flapping, gliding, soaring), flight activity (commuting, hunting other), direction of flight, vertical zoning relative to the envisaged or actual turbine string (low – below or within the rotor arc, medium – within *c.*100 m of the upper rotor arc, high – >100 m above the upper rotor arc), and horizontal zoning relative to the envisaged or actual turbine string (near – through the turbine string or within the outer rotor arc, middle – within *c.*100 m of the outer rotor arc, distant - >100 m beyond the outer rotor arc) and, for post construction monitoring, notes on any obvious evasive behaviour or flight path changes observed in response to the wind energy facility. The time and weather conditions should again be noted at the end of each count.

Avian collisions

Collision monitoring should have two components: (i) experimental assessment of search efficiency and scavenging rates of bird carcasses on the site, and (ii) regular searches of the vicinity of the wind farm for collision casualties.

Assessing search efficiency and scavenging rates

The value of surveying the area for collision victims only holds if some measure of the accuracy of the survey method is developed (Morrison 2002). To do this, a sample of suitable bird carcasses (of similar size and colour to the priority species – e.g. Egyptian Goose *Alopochen aegyptiacus*, domestic waterfowl and pigeons) should be obtained and distributed randomly around the site without the knowledge of the surveyor, some time

before the site is surveyed. This process should be repeated opportunistically (as and when suitable bird carcasses become available) for the first two months of the monitoring period, with the total number of carcasses not less than 20. The proportion of the carcasses located in surveys will indicate the relative efficiency of the survey method.

Simultaneous to this process, the condition and presence of all the carcasses positioned on the site should be monitored throughout the initial two-month period, to determine the rates at which carcassess are scavenged from the area, or decay to the point that they are no longer obvious to the surveyor. This should provide an indication of scavenge rate that should inform subsequent survey work for collision victims, particularly in terms of the frequency of surveys required to maximise survey efficiency and/or the extent to which estimates of collision frequency should be adjusted to account for scavenge rate. Scavenger numbers and activity in the area may vary seasonally so, ideally, scavenge and decomposition rates should be measured twice during the monitoring year, once in winter and once in summer.

Collision victim surveys

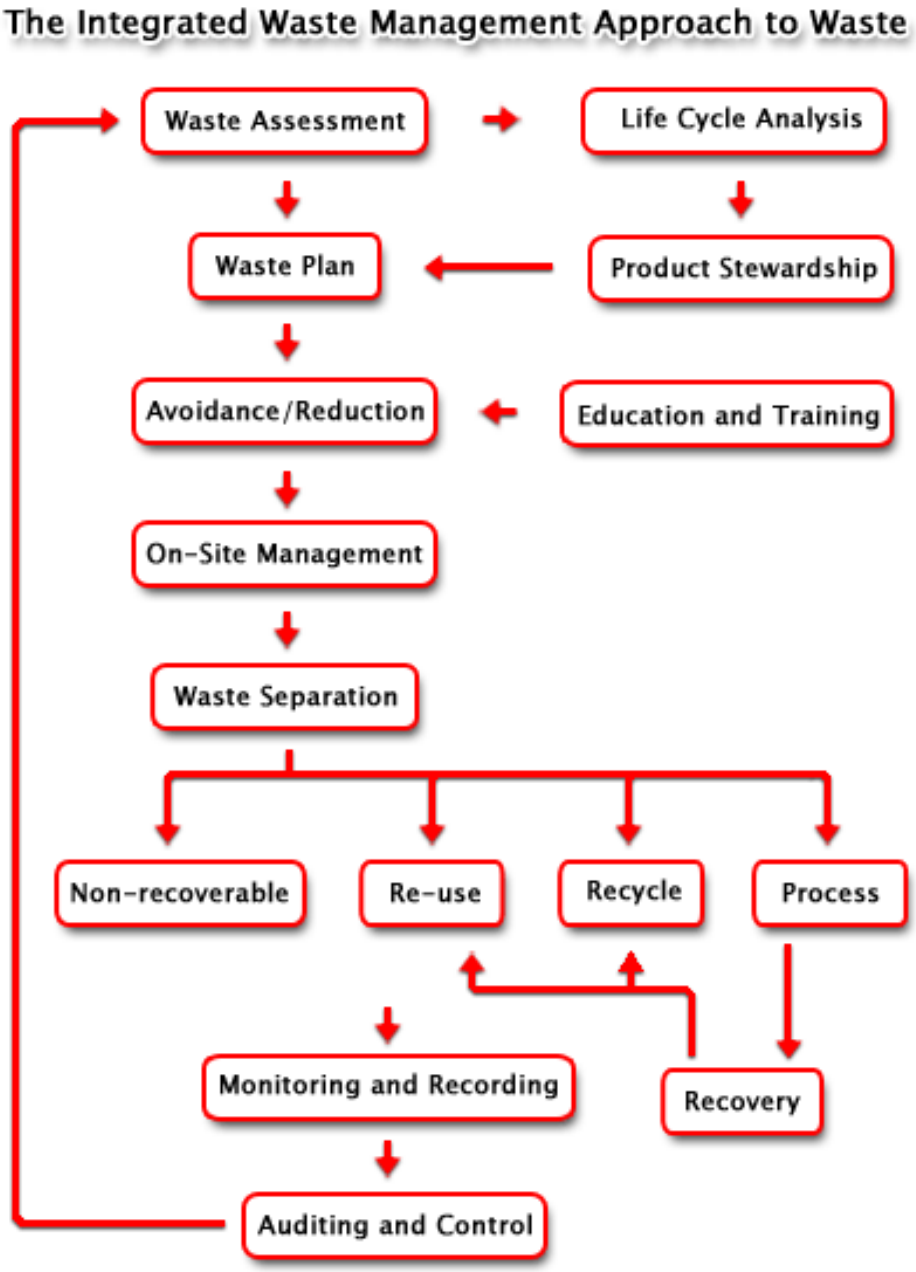
The area within a radius of at least 50 m of each of the turbines at the facility should be checked regularly for bird casualties. The frequency of these surveys should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period (see above), but they should be done at least weekly for the first two months of the study. The area around each turbine, or a larger area encompassing the entire facility, should be divided into quadrants, and each should be carefully and methodically searched for any sign of a bird collision incident (carcasses, dismembered body parts, scattered feathers, injured birds). All suspected collision incidents should be comprehensively documented, detailing the precise location (preferably a GPS reading), date and time at which the evidence was found, and the site of the find should be photographed with all the evidence *in situ*. All physical evidence should then be collected, bagged and carefully labeled, and refrigerated or frozen to await further examination. If any injured birds are recovered, each should be contained in a suitably-sized cardboard box. The local conservation authority should be notified and requested to transport casualties to the nearest reputable veterinary clinic or wild animal/bird rehabilitation centre. In such cases, the immediate area of the recovery should be searched for evidence of impact with the turbine blades, and any such evidence should be fully documented (as above).

In tandem with surveys of the wind farm for collision casualties, sample sections of any new lengths of power line associated with the development should also be surveyed for collision victims using established protocols .

APPENDIX B:
GUIDELINE FOR INTEGRATED MANAGEMENT OF CONSTRUCTION WASTE

GUIDELINE FOR INTEGRATED MANAGEMENT OF CONSTRUCTION WASTE

Waste is broadly defined by the Department of Water Affairs in 1994 as: 'an undesirable or superfluous by-product, emission, residue or remainder of any process or activity'. 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 C:
PRELIMINARY GEOTECHNICAL ASSESSMENT / EARTHWORKS

GEOTECHNICAL ASPECTS

Foundations for wind turbines

The design of foundations for wind turbines primarily concerns the resistance to overturning forces induced by wind loading and the foundation type is largely dependent on geotechnical conditions.

The simplest form of foundation is the spread footing on very dense soil or engineered fill. This is essentially a gravity foundation that relies upon the weight of the soil overburden and concrete to provide sufficient vertical force to counteract horizontal forces during extreme wind loading. These footings are typically suited to a relatively shallow founding medium of a few meters and a trench is excavated to reach this level. The typical geometry of a spread footing for a wind turbine is 15-20m in diameter/width and 2-3m deep, resulting in an excavation of some 600m3 of material.

Rock socketed piers are used where a competent rock layer exists at relatively shallow depths and rely primarily upon end bearing and secondarily upon side wall friction and sufficient lateral earth pressures.

Piled foundations are used in areas where competent founding mediums are found at greater depths.

Rock anchored footings are used where hard competent rock is found at surface or at very shallow depths and the footing is attached to the rock with steel anchors.

The site under consideration is largely underlain by shallow sandstone rock which is considered a suitable founding medium due to its high end bearing capacity. A comprehensive geotechnical investigation will have to be undertaken by the developer in order to determine the depth and characteristics of the optimal founding medium in order to allow the engineer to design the foundations.

Internal access roads and crane platforms

Access roads are required onto site and between turbines for the transportation of turbine components. The access roads are normally constructed with a gravel wearing course on a selected subgrade and the roads need to be wide enough to accommodate abnormally long low-beds with restricted turning capabilities. Maximum road curvatures, camber and gradients are strictly adhered to in the design process. The natural gradients of the site are gentle to moderate and some cut and fill operations may be required for the construction of internal access roads.

A stable platform is required at the base of each turbine for the operation of cranes to be used in the construction process. The footprint of the platform is typically 1000m^2. This crane pad is typically constructed on a cut and filled levelled platform upon which imported subbase gravel layers are placed and compacted. Imported natural construction materials may be required for the construction of the platforms, depending on the findings of the geotechnical investigation (still to be commissioned).

Underground services

Excavations for underground services are likely to encounter shallow rock in certain areas. In areas underlain by Table Mountain Group rocks, a tracked excavator with a rock bucket may be required to rip through weathered sandstone. Excavated material is unlikely to meet specifications for selected granular material for pipe bedding (SABS 1200 LB) but may be used as selected fill material if approved by the engineer. Pipe bedding materials are likely to be imported from nearby commercial quarries.

Summary of geotechnical constraints

A basic preliminary assessment of the geotechnical nature of the study area affords the opportunity to identify any potential fatal flaws with the proposed site, such as potentially unstable geology, and other geotechnical constraints. A basic assessment of the main geotechnical constraints that may impact on the civil engineering design is given in the table below.

Geotechnical constraints on the proposed development

Geotechnical Constraint	Effect on the proposed development	Severity	Comment & recommendations
Collapsible & compressible soil	Soil horizons with a potentially collapsible or compressible fabric unsuitable for foundations.	Low-Medium	Heavy structures & turbines should be founded on very dense residual gravels, intact rock or engineered fill, depending on local conditions and expected loads.
Differential settlement (DS)	Foundations placed across different soil types or rock may settle differentially.	Medium	Rock types and soil thickness will vary across the site. Recommend found individual turbines on same medium.
Bearing capacity	Soils with low in situ bearing capacity resulting in high settlements of heavy structures if not compacted or engineered properly	Medium	Transported soils: 30-80kPa, depending on level of consolidation. Not suitable for turbines. Residual soils: 80-250kPa, depending on type, structure and consistency. Possibly suitable. Sandstone rock: 250kPa-1mPa, depending on lithology, structure and state of weathering. Ideal.

Geotechnical Constraint	Effect on the proposed development	Severity	Comment & recommendations
Saturated soils, groundwater problems, perched or permanent water tables	Seepage from sidewalls of excavations affecting stability or dewatering of trenches necessary.	Low	Minor shallow perched water tables may occur at the interface between transported soils and residual weathered rock, but unlikely to pose problems.
Active soil	Heaving clays affecting foundation stability	Low-Medium	Presence of active clay is possible in residual weathered Baviaanskloof Fm or Gydo Fm. Turbines should be founded below clay on rock.
Topography	Sites with high relief resulting in higher construction costs.	Low-medium	Access is generally easy but some cut and fill may be required for access roads on the eastern portion of the site.
Excavations	Boulders or rock affecting excavations	Medium-high	Shallow weathered rock expected in all areas
	Unstable excavations requiring shoring	Medium	Excavations into soil with vertical sidewalls will be unstable. Excavations into rock to be checked for stability by geologist.
Slope stability	Geological instability causing damage to structures founded on slopes	Low-medium	Natural steep slopes to the south of the site are considered marginally stable.
Seismic activity	Structures at risk of damage due to seismicity	Low	Area is considered to be seismically stable.
Flood potential or storm water damage	Low lying areas affected by poor drainage.	Low	The majority of the development footprint lies on the plateau which is generally well drained
	Steep slopes affected by uncontrolled run-off	Low-medium	The steep slopes to the south and east of the plateau area are considered marginally stable and are not recommended for development.
Unconsolidated fill	Unconsolidated fill material affecting foundations	Low	Minor fill associated with existing farm buildings and dams
Availability of local construction material	Large distances to nearest quarry for sources of suitable construction material negatively affect construction costs	Low	Nearest commercial aggregate quarry is Zwartebosch near Humansdorp (~20km).
Mining Activity	Past, present or future mining activity which may affect development of the site	Low	No known existing mining activity

The above geotechnical appraisal highlights some potential constraints, none of which are considered insurmountable. A detailed geotechnical investigation should be undertaken before the engineering design phase to provide more detail and to confirm

the recommendations given herein. Specialist geotechnical input is recommended during the construction of foundations.