
PROPOSED KHEIS SOLAR PARK 2 SOUTH EAST OF UPINGTON, NORTHERN CAPE PROVINCE

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DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

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Assessment Report
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PROJECT DETAILS

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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.

Archaeological material: Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Cumulative impacts: The impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

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

'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.

Drainage: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may or may not be present

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 on-going maintenance after implementation.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

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

Indirect impacts: Indirect or induced changes that may occur as a result 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 as a result 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 general public.

Perennial and non-perennial: Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.

Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

Photovoltaic effect: Electricity can be generated using photovoltaic solar panels which are comprised of individual photovoltaic cells that absorb solar energy to directly produce electricity. The absorbed solar radiation excites the electrons inside the cells and produces what is referred to as the Photovoltaic Effect.

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).

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.

Watercourse: as per the National Water Act means -
(a) a river or spring;

- (b) a natural channel in which water flows regularly or intermittently;
- (c) a wetland, lake or dam into which, or from which, water flows; and
- (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

Wetlands: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin et al., 1979).

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PROJECT DETAILS

CHAPTER 1

Gestamp Asetym Solar South Africa (Pty) Ltd is proposing to establish three commercial photovoltaic solar energy facilities, as well as associated infrastructure on a site located approximately 60 km south-east of Upington, in the Northern Cape Province. This development is known as the Kheis (PV) Solar Park and will comprise three development phases (to be referred to as “projects” hereafter) Each project will have varying electricity generation capacities and are referred to as follows:

Kheis Solar Park 1 – 75MW

Kheis Solar Park 2 – 55MW

Kheis Solar Park 3 – 20MW

This EMP deals only with the proposed the Kheis Solar Park 2 of the larger Kheis (PV) Solar Park project. The purpose of the proposed facility is to add new capacity for generation of power from renewable energy to the national electricity supply (which is short of generation capacity to meet current and expected demand), and to aid in achieving the goal of a 30% share of all new power generation being derived from independent power producers (IPPs), as targeted by the Department of Energy (DoE). The Kheis Solar Park 2 PV arrays are proposed to be located to the north of the larger project site located approximately 60km south-east of the town of Upington (straight line distance), (refer to **Figure 1.1**). The proposed generating capacity for this project is 55MW, covering an area of 210ha. The scope of the EIA undertaken for the project applies to the development footprint for Kheis Solar Park 2 project and associated infrastructure, including access roads, power lines, substations, cables, offices, etc. The proposed project will comprise of the following typical infrastructure:

- » Arrays of either static or tracking photovoltaic (PV) panels.
- » Mounting structures for the solar panels to be rammed steel piles or piles with pre-manufactured concrete footings.
- » Cabling between the structures, to be lain underground where practical.
- » Central inverter/transformer stations to collect all energy generated from the PV panels. The inverter’s role is to convert direct current (DC) electricity to alternating current (AC) electricity at grid frequency.
- » An on-site substation (50m x 50m) and power line (1800m) to evacuate the power from the facility into the Eskom grid via the existing Garona-Gordonia 132kV power line that traverses the site (Portion 9 of Portion 4 of the Farm Namakwari 656)
- » Internal access roads (5m wide)
- » Associated buildings including a workshop area for maintenance, storage, and control facility with basic services such as water and electricity (approximate footprint ±100 m²)

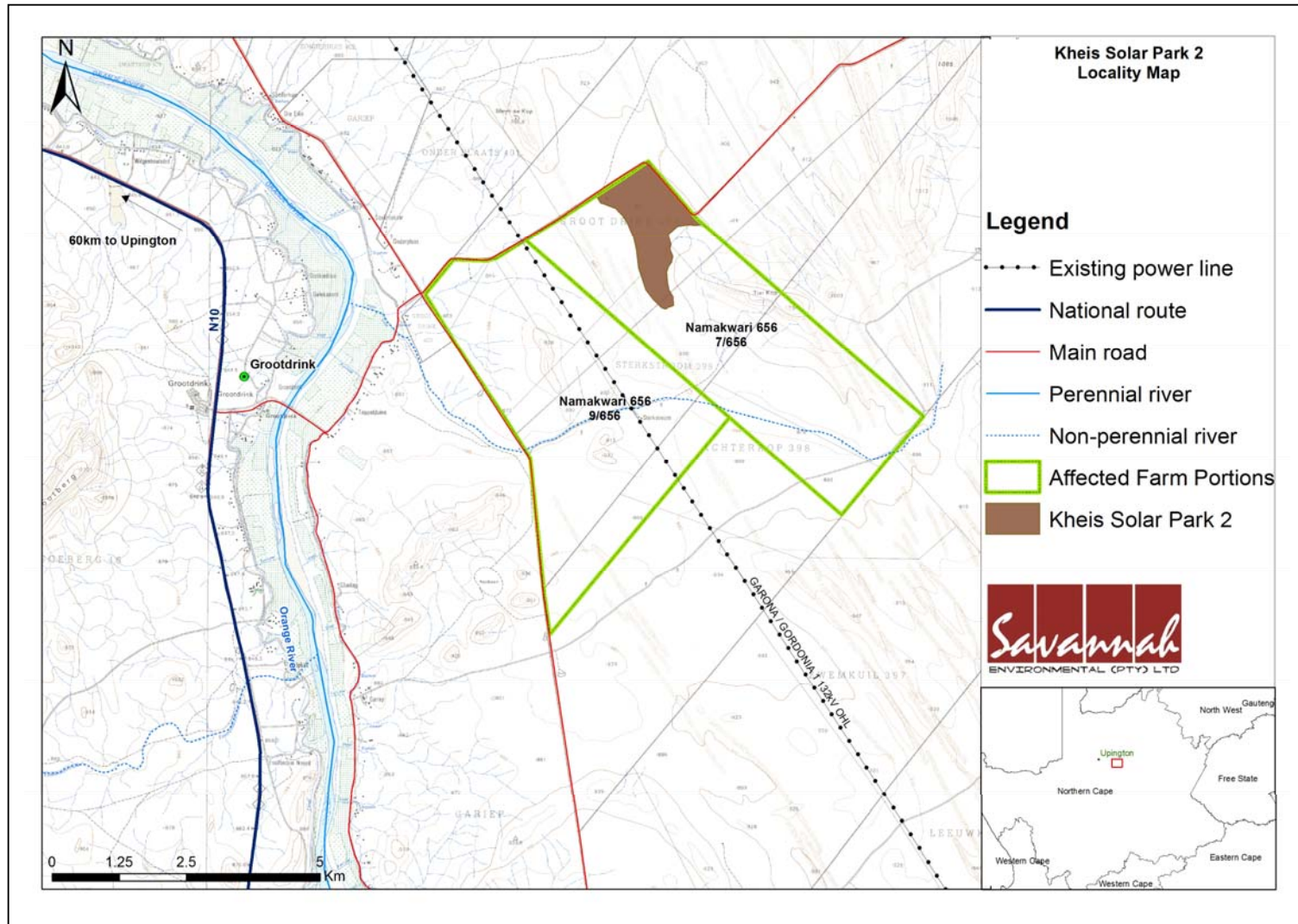


Figure 1.1: Locality map showing the broader study site identified for the proposed Kheis Solar Park 2

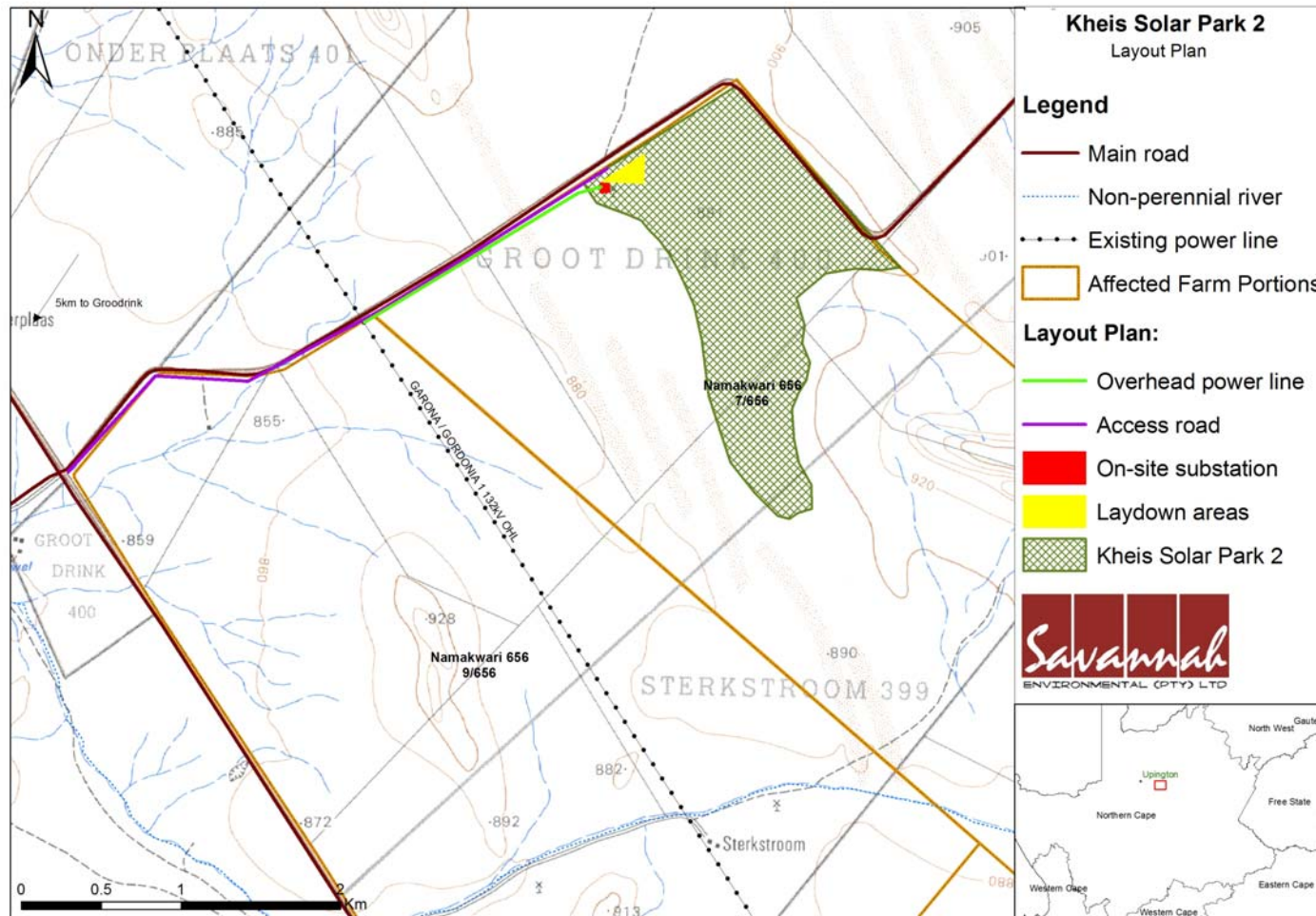


Figure 1.2: Layout map showing the location of PV facility and associated infrastructure within the proposed Kheis Solar Park 2

1.1. Activities and Components associated with the Solar Energy Facility

In order to construct the solar energy facility and its associated infrastructure, a series of activities will need to be undertaken during the design, pre-construction, construction, operation, and decommissioning phases which are discussed in more detail below.

1.1.1 Design and Pre-Construction Phase

Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to confirmation of the micro-siting footprint (i.e. the precise location of the PV panels, substation and the plant's associated infrastructure) and a geotechnical survey. Geotechnical surveys are executed by geotechnical engineers and geologists to acquire information regarding the physical characteristics of soil and rocks underlying a proposed site. The purpose is to design earthworks and foundations for structures and to execute earthwork repairs necessitated due to changes in the subsurface environment.

A power line servitude survey will also be conducted. If necessary, a walk through survey will be undertaken for ecological/heritage resources prior to construction.

1.1.2 Construction Phase

The construction the proposed project is expected to extend over a period of approximately 15-18 months and create at least 250-300 employment opportunities at peak. The majority of the employment opportunities, specifically the low and semi-skilled opportunities, are likely to be available to local residents in the area. The majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community, representing a significant positive social benefit in an area with limited employment opportunities. The construction phase will entail a series of activities including:

Undertake Site Preparation

Site preparation involves construction of new access roads and improvement of existing on-site construction access roads with compacted native soil, installation of drainage crossings, setup of construction staging areas, storm water management work, preparation of land areas for array installation, and other activities needed before installation of the solar arrays can begin. The work would involve trimming of vegetation, selected compacting and grading, and setup of modular offices and other construction facilities.

The PV arrays require a relatively level and stable surface for safe and effective installation. Topographic, geotechnical, and hydrologic studies will be used to determine the necessary grading and compaction.

Trenching would occur within each array to bury the electrical cables. The trenches would be up to ~ 1.8m in width and 2m deep, for a total combined length of approximately 10 km. Minimal ground disturbance may occur within the trenched corridors to restore them after soil has been replaced in the trenches, so that the corridor can conform to the existing surface contours.

Transport of Components and Construction Equipment to Site

The components for the proposed facility will be transported to site by road. Some of the substation components may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989)¹ by virtue of the dimensional limitations (i.e. size and weight). The typical civil engineering construction equipment will need to be brought to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.), as well as the components required for the establishment of the substation and power line.

Establishment of Access Roads to the Site

The site can be accessed via the N10 onto a gravel road that runs parallel to the project site; or alternatively via the N14 onto a secondary road (gravel) heading south parallel to the site. Within the site itself, access will be required to the individual facility components for construction purposes (and later limited access for maintenance). Upgrade of access roads within the site will be required and new access roads will be required (~5m wide). Access track construction would normally comprise of compacted rock-fill with a layer of higher quality surfacing stone on top. The strength and durability properties of the rock strata at the proposed site are not known at this stage; this will need to be assessed via a geotechnical study to be conducted by the project proponent. Depending on the results of these studies, it may be possible in some areas, to strip off the existing vegetation and ground surface and level the exposed formation to form an access track surface. The final layout of the access roads will be determined following the identification of site related sensitivities.

¹ A permit will be required for the transportation of these abnormal loads on public roads.

Installation of the PV Power Plant

The construction phase involves installation of the solar PV panels and the entire necessary structural and electrical infrastructure to make the plant operational. In addition, preparation of the soil and improvement of the access roads would continue throughout the majority of the construction process. For array installation, typically vertical support posts are driven into the ground. Depending on the results of the geotechnical report a different foundation method, such as screw pile, helical pile, micropile or drilled post/pile could be used. The posts will hold the support structures (tables) on which PV modules would be mounted. Brackets attach the PV modules to the tables. Trenches are dug for the underground AC and DC cabling and the foundations of the inverter enclosures and transformers are prepared. While cables are being laid and combiner boxes are being installed, the PV tables are erected. Wire harnesses connect the PV modules to the electrical collection systems. Underground cables and overhead circuits connect the Power Conversion Stations (PCS) to the PVCS and from the PVCS to the onsite substation.

Establishment of Ancillary Infrastructure

Ancillary infrastructure for each project will include; a workshop, laydown area and office. The laydown area will be a temporary structure. The establishment of these areas/facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

Construct on-site Substation and Power line

Substations are constructed in the following simplified sequence:

- Step 1:** Survey the area
- Step 2:** Final design of the substation and placement of the infrastructure
- Step 3:** Vegetation clearance and construction of access roads (where required)
- Step 4:** Construction of foundations
- Step 5:** Assembly and erection of infrastructure on site, connect conductors
- Step 6:** Rehabilitation of disturbed area and protection of erosion sensitive areas

The expected lifespan of the proposed on-site substation associated with each PV facility is 35 – 50 years. During the life-span of the substation, on-going maintenance is performed. Inspections are undertaken.

Power lines are constructed in the following simplified sequence:

- Step 1:** Survey of the route
- Step 2:** Selection of best-suited conductor, towers, insulators, foundations
- Step 3:** Final design of line and placement of towers
- Step 4:** Vegetation clearance and construction of access roads (where required)
- Step 5:** Tower pegging
- Step 6:** Construction of foundations
- Step 7:** Assembly and erection of towers on site
- Step 8:** Stringing of conductors
- Step 9:** Rehabilitation of disturbed area and protection of erosion sensitive areas

Construction of the power line is required to be undertaken in accordance with the specifications of the Environmental Management Programme (EMPr), as well as in compliance with Eskom's technical requirements.

Undertake Site Rehabilitation

As construction is completed in an area, and as all construction equipment is removed from the site, the site must be rehabilitated where practical and reasonable. Upon completion of commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.

1.1.3 Operational Phase

Each solar energy facility is expected to be operational for a minimum of 25 years, with an opportunity for a lifetime of 50 years or more with equipment replacement and repowering. The project will operate continuously, 7 days a week, during daylight hours. While the project will be largely self-sufficient upon completion of construction, monitoring and periodic, as needed maintenance activities will be required. Key elements of the Operation and Maintenance plan include monitoring and reporting the performance of the project, conducting preventative and corrective maintenance, receiving visitors, and maintaining security of the project. The operational phase (for one solar energy facility) will create 7-15 full-time employment positions. No large scale energy storage mechanisms for the facility which would allow for continued generation at night or on cloudy days are proposed.

1.1.4 Decommissioning Phase

Depending on the continued economic viability of the facility following the initial 25-year operational period, each solar energy facility will either be decommissioned or the operational phase will be extended. If it is deemed financially viable to extend the operational phase, existing components would either continue to operate or be disassembled and replaced with new, more efficient technology/infrastructure available at that time. However, if the decision is made to decommission the facility, the following activities will form part of the project scope.

When the project is ultimately decommissioned, the equipment to be removed will depend on the proposed land use for the site at that time. For example, depending on the power needs at the time of decommissioning, the on-site substations could remain for use by the utility or other industrial activity.

Below is a discussion of expected decommissioning activities.

» **Site Preparation**

Site preparation activities will include confirming the integrity of the access to the site to accommodate the required decommissioning equipment.

» **Disassemble and Remove Existing Components**

All above ground facilities that are not intended for future use at the site will be removed. Underground equipment (e.g. foundation, wiring) will either be removed, or cut off 1m below the ground surface, and the surface restored to the original contours. Much of the above ground wire, steel, and PV panels of which the system is comprised are recyclable materials and would be recycled to the extent feasible. The components of the plant would be deconstructed and recycled or disposed of in accordance with regulatory requirements. The site will be rehabilitated and can be returned to the agricultural or other beneficial land-use

1.2 Findings of the Environmental Impact Assessment

From the assessment of potential impacts undertaken within this EIA, it is concluded that there are no environmental fatal flaws associated with the site proposed for Kheis Solar Park 2 solar energy facility. Potential environmental impacts and some areas of high sensitivity were however identified (refer to **Figure 1.3**). In summary, the most significant environmental impacts associated with Kheis Solar Park 2 solar energy facility, as identified through the EIA, include:

- » Impacts on ecology on the site.

- » Impacts on the local soils, land capability and agricultural potential of the site.
- » Visual impacts mainly due to the solar panels and partly due to other associated infrastructure (power line, access road etc.).
- » Social and economic impacts.
- » Cumulative impacts.

» **Impacts on Ecology**

Two vegetation units were identified within the Kheis Solar Park 2 footprint. Calcareous low shrub plains occupy most of the Kheis Solar Park 2 site and are of lower sensitivity. The second vegetation association is the mixed shrub (occurs as a transition between the calcareous plains and dune fields) classified as having a Medium-Low sensitivity. A small footprint of the layout falls within the medium-high sensitivity of this unit with high value grasslands. Impacts in these are considered to be acceptable to some degree due to sections of these system-fringes that are severely affected by bush encroachment resulting in reduced sensitivity in some areas. The ecological sensitivity assessment identified those parts of the site that have high conservation value or that may be sensitive to disturbance. The habitats considered most sensitive on the site include:

- » Duneveld
- » Larger drainage channels
- » Rocky outcrops
- » Undulating calcrete and sandy plains

These areas are avoided by the proposed infrastructure, which is located largely in an area of low sensitivity. From an ecology perspective, it is not expected that the development will compromise the survival of any specific flora or terrestrial vertebrate species on the study area or beyond if mitigation measures are fully implemented. The most significant impacts are expected to be on ecosystem health and functionality, which should remain relatively intact if all mitigation recommendations are implemented.

» ***Impact on Soils, Land Capability and Agricultural Potential***

Hutton soils which occur on the broader site (Portion 7 and 9 of Farm Namakwari 656) are highly prone to wind erosion due to the sandy texture of the soil. It is, therefore, important that there should be strict adherence to the Environmental Management Programme and good soil management measures regarding the management of stormwater runoff and water erosion control should be implemented during all phases of the project. With the implementation of good soil management measures the impact of the PV Facility on soils can be managed to an acceptable level, without significant erosion issues during the lifespan of the facility.

The study area has limited agricultural potential, and the proposed development area is aligned to avoid key grazing areas located in dune areas. The significance of agricultural impacts is influenced by the fact that the site has extremely limited agricultural potential, with a land capability of class 7, non-arable, low potential grazing land. The site is used only for grazing of cattle. No agriculturally sensitive areas occur within the proposed Kheis Solar Park 2 footprint. The major limitations to agriculture are the aridity and lack of access to water, as well as the very sandy soils with limited water and nutrient holding capacity, and in some places limited soil depth. The development will have **low to medium** negative impacts on agricultural resources and productivity. The conclusion of this assessment is that from an agricultural impact perspective the development can proceed as proposed, subject to the recommended mitigation measures provided being implemented.

» ***Visual Impacts***

The visual surroundings of the proposed Kheis Solar Park 2 site, especially within a 2km radius, will be visually impacted upon for the anticipated operational lifespan of the facility (i.e. 20 - 30 years). There are no major urban developments near (within 4km of) the proposed Kheis Solar Park 2 development site, but additional viewer incidence (and expected negative viewer perception) will be concentrated within the homesteads and farm residences within the study area at 2km, located primarily along the Orange River. The FM Safaris Game Farm, located north-west of the Kheis Solar Park 2, is also considered as a sensitive visual receptor. Visitors (mainly hunters) to this farm and game lodge generally would not expect to view electricity generation infrastructure when visiting the region for recreational purposes. These observers may be negatively affected by the Kheis Solar Park 2 development. Additionally, Kheis Solar Park 2 could potentially have a high visual impact on road users travelling along the secondary road (for a short period when they pass the facility) located north of the Kheis Solar Park 2, site-specific mitigation measures are recommended in order to reduce/mitigate the potential visual impact to moderate.

During the decommissioning or post-closure phase of the project, all of the infrastructure will be removed, recycled or re-used off-site. The residual visual impacts of the site are expected to include scarring of the landscape in the areas affected by infrastructure. With the implementation of appropriate management measures such as rehabilitation of disturbed areas and planting of vegetation and visual screening methods at receptors / key viewpoints, this scarring and visual impact could be reduced and removed in the long-term.

The anticipated visual impacts identified through the EIA process (post mitigation measures) are on average expected to be of **low to moderate** significance. The

Kheis Solar Park 2 development is therefore not considered to be fatally flawed from a visual perspective.

» ***Heritage Impacts***

There were no heritage sensitive areas identified on the Kheis Solar Park 2 site. Two heritage artefacts of low heritage significance occur outside the development footprint for Kheis Solar Park 2 and will not be impacted by the development footprint of the PV facility. There is no heritage no go areas within the site development footprint for Kheis Solar Park 2.

This study has identified that of the geological units that underlie the project area only the Gordonia Formation is potentially fossiliferous and may be negatively impacted. The potential risk for any negative impact on the palaeontological heritage in Kheis Solar Park 2 is categorised as improbable due to the general scarcity of fossils in the unit and as *no fossil materials* were located within the project area.

The impact of the project on **heritage resource** is rated as **low significance**. However, a preconstruction walk-through survey by an archaeologist is recommended to be undertaken for the PV facility and associated infrastructure. Should substantial archaeological or paleontological (fossils) remains or graves be exposed during construction, SAHRA should be alerted as soon as possible such that appropriate action (e.g. recording, sampling or collection) can be taken by a professional archaeologist or palaeontologist. It is recommended that a close examination of all excavations be made while they are occurring during construction within the Gordonia Formation sands.

» ***Social and Economic Impacts***

The proposed project could have negative and positive **social and economic impacts of low (negative) and high (positive) significance** for post mitigation and enhancement respectively. Kheis Solar Park 2 55MW facility will provide opportunities for employment and skills development in the local area during both the construction and operational phases. Another potential spin-off from the development is the stimulation of the local economy, including development of industries specifically to provide services and goods for solar facilities, and general retail businesses and accommodation. Potential negative impacts include the threats to public safety from construction and traffic activity, potential increased crime and health risks such as HIV/Aids particularly during construction and if people move into the area hoping to secure jobs. Social dissent is also possible if people perceive that recruitment processes are unfair and biased. Other impacts on the social environment include impacts associated with traffic and infrastructure

(such as local roads). It is important that potential negative effects are managed as per the recommended mitigation measures to prevent these from developing into unacceptable cumulative impacts. Positive impacts of job creation and stimulation of the local economy can be progressed and cumulatively contribute to a desired outcome if enhancements measures (as contained in the socio-economic specialist study and draft EMPr) are implemented.

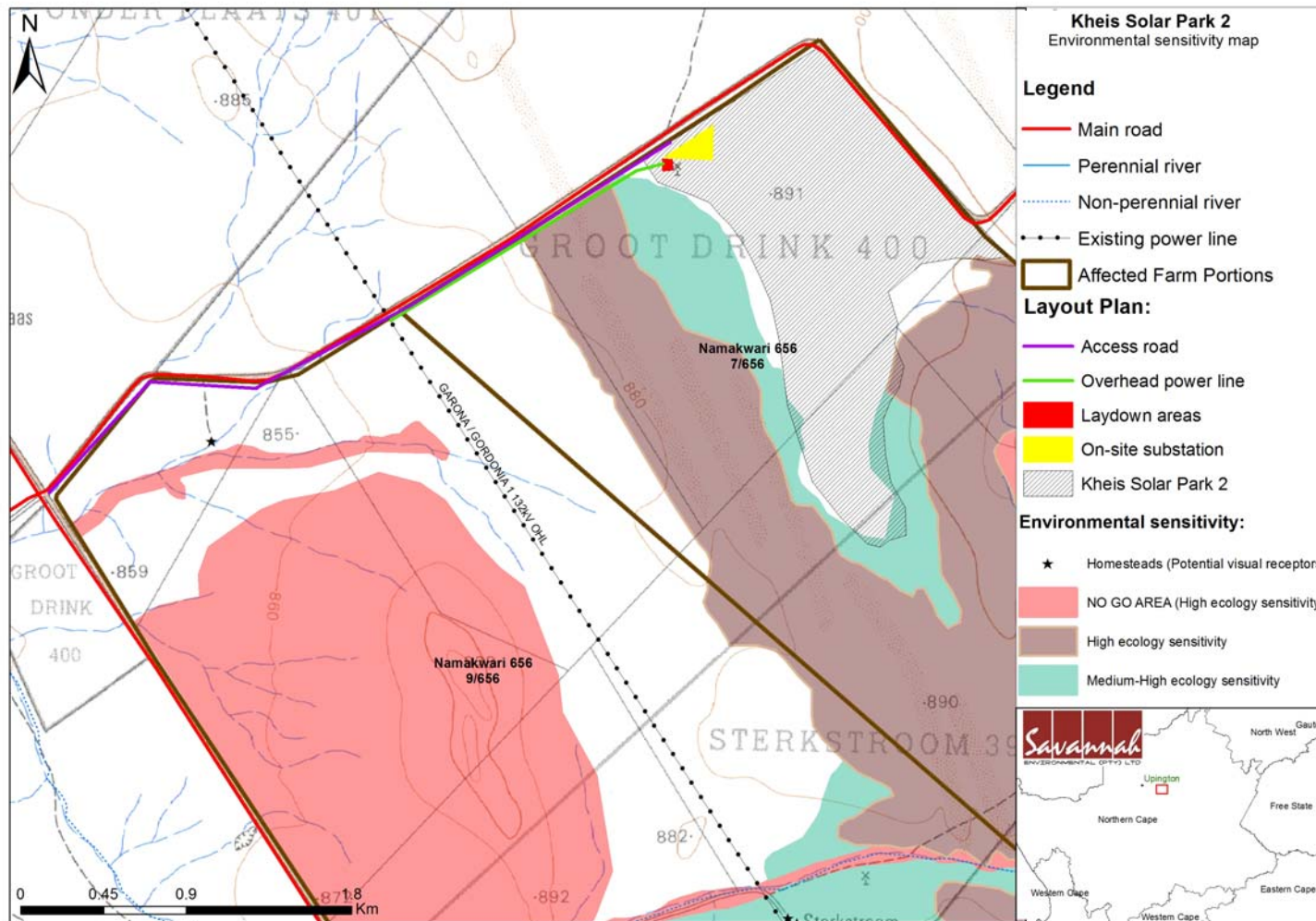


Figure 1.3: Environmental Sensitivity map for the proposed Kheis Solar Park 2

PURPOSE AND OBJECTIVES OF THE EMPR

CHAPTER 2

An Environmental Management Programme (EMPr) is defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts associated with the planning, construction, operation and decommissioning of a project are avoided or mitigated, and that the positive benefits of the projects are enhanced.”² The objective of this EMPr is to provide consistent information and guidance for implementing the management and monitoring measures established in the permitting process and help achieve environmental policy goals. The purpose of an EMPr is to ensure continuous improvement of environmental performance, reducing negative impacts and enhancing positive effects during the construction and operation of the facility. An effective EMPr is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMPr provides specific environmental guidance for the construction and operation phases of a project, and is intended to manage and mitigate construction and operation activities so that unnecessary or preventable environmental impacts do not result. These impacts range from those incurred during start up (i.e. site clearing and site establishment), during the construction activities themselves (i.e. erosion, noise, dust, and visual impacts), during site rehabilitation (i.e. soil stabilisation, re-vegetation), during operation and during decommissioning (i.e. similar to construction phase activities).

This Environmental Management Programme has been compiled for the design, construction and operation of the 55MW Kheis Solar Park 2. This EMPr is applicable to all employees and contractors working on the pre-construction, construction, and operation and maintenance phases of the project. The document will be adhered to, updated as relevant throughout the project life cycle.

This EMPr has been compiled in accordance with Section 33 of the EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project. The EMPr has been developed as a set of environmental specifications (i.e. principles of environmental management), 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).

² Provincial Government Northern Cape, Department of Environmental Affairs and Development Planning: *Guideline for Environmental Management Plans*. 2005

This EMPr has the following objectives:

- » Outline mitigation measures and environmental specifications which are required to be implemented for the planning, construction and rehabilitation, operation, and decommissioning phases of the project in order to manage and minimise the extent of potential environmental impacts associated with the facility.
- » Ensure that all the phases of the project do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- » Identify entities responsible for the implementation of the measures and outline functions and responsibilities.
- » Propose mechanisms and frequency for monitoring compliance, and preventing long-term or permanent environmental degradation.
- » Facilitate appropriate and proactive responses to unforeseen events or changes in project implementation that was not considered in the EIA process.

The management and mitigation measures identified within the Environmental Impact Assessment (EIA) process are systematically addressed in this EMPr, and ensure the minimisation of adverse environmental impacts to an acceptable level.

The developer must ensure that the implementation of the project complies with the requirements of all environmental authorisations, permits, and obligations emanating from relevant environmental legislation. This obligation is partly met through the development and the implementation of this EMPr and through its integration into the contract documentation. Since this EMPr is part of the EIA process for Kheis Solar Park 2, it is important that this document be read in conjunction with the final Scoping and EIA Reports compiled for this project. This will contextualise the EMPr and enable a thorough understanding of its role and purpose in the integrated environmental management process. Should there be a conflict of interpretation between this EMPr and the environmental authorisation, the stipulations in the environmental authorisation shall prevail over that of the EMPr, unless otherwise agreed by the authorities in writing. Similarly, any provisions in legislation overrule any provisions or interpretations within this EMPr.

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

KEY LEGISLATION APPLICABLE TO THE DEVELOPMENT CHAPTER 3

The following legislation and guidelines have informed the scope and content of this EMP:

- » National Environmental Management Act (Act No. 107 of 1998)
- » EIA Regulations, published under Chapter 5 of the NEMA (GNR R543 in Government Gazette 33306 of 18 June 2010)
- » Guidelines published in terms of the NEMA EIA Regulations, in particular:
 - * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010)
 - * Public Participation in the EIA Process (DEA, 2010)
 - * Integrated Environmental Management Information Series (published by DEA)
- » Kheis Municipality Integrated Development Plan (2012-2017)
- » ZF Mgcawu District Municipality Integrated Development Plan (2012-2017)
- » International guidelines – the Equator Principles and the International Finance Corporation and World Bank Guidelines.

Several other Acts, standards or guidelines have also informed the project process and the scope of issues assessed in this report. A listing of relevant legislation is provided in Table 3.1 and Table 3.2.

Table 3.1: Relevant legislative permitting requirements applicable to the proposed Kheis Solar Park 2

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Legislation			
National Environmental Management Act (Act No 107 of 1998)	<p>The EIA Regulations have been promulgated in terms of Chapter 5 of the Act. Listed activities which may not commence without an environmental authorisation are identified within these Regulations.</p> <p>In terms of S24(1) of NEMA, the potential impact on the environment associated with these listed activities must be assessed and reported on to the competent authority charged by NEMA with granting of the relevant environmental authorisation.</p> <p>In terms of GN R543, R544, R545 and R546 of 18 June 2010, a Scoping and EIA Process is required to be undertaken for the proposed project.</p>	<p>Department of Environmental Affairs – competent authority</p> <p>Department of Environmental and Nature Conservation (DENC)- commenting authority</p>	<p>The listed activities triggered by the proposed solar energy facility have been identified and assessed in the EIA process being undertaken (i.e. Scoping and EIA).</p> <p>This EIA Report will be submitted to the competent and commenting authority in support of the application for authorisation.</p>
National Environmental Management Act (Act No 107 of 1998)	<p>In terms of the Duty of Care Provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised.</p> <p>In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.</p>	Department of Environmental Affairs	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section has found application during the EIA Phase through the consideration of potential impacts (cumulative, direct, and indirect). It will continue to apply throughout the life cycle of the project.
Environment Conservation Act (Act No 73 of 1989)	National Noise Control Regulations (GN R154 dated 10 January 1992)	Department of Environmental Affairs	Noise impacts are expected to be associated with the construction

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
		Department of Environmental and Nature Conservation (DENC)- Kheis Local Municipality	phase of the project and are not likely to present a significant intrusion to the local community. Therefore is no requirement for a noise permit in terms of the legislation. On-site activities should be limited to 6:00am - 6:00pm, Monday – Saturday (excluding public holidays). Should activities need to be undertaken outside of these times, the surrounding communities will need to be notified and appropriate approval will be obtained from DEA and the Local Municipality.
National Water Act (Act No 36 of 1998)	Water uses under S21 of the Act must be licensed, unless such water use falls into one of the categories listed in S22 of the Act or falls under the general authorisation (and then registration of the water use is required). Consumptive water uses may include the taking of water from a water resource and storage - Sections 21a and b. Non-consumptive water uses may include impeding or diverting of flow in a water course - Section 21c;	Department of Water Affairs Provincial Department of Water Affairs	A water use license (WUL) is required to be obtained if wetlands or drainage lines are impacted on, or if infrastructure lies within 500m of such features. Should water be extracted from a borehole on site or from the Orange River for use within the facility, a water use license will be

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	and altering of bed, banks or characteristics of a watercourse - Section 21i.		<p>required in terms of Section 21(a) and 21 (b) of the National Water Act.</p> <p>The storage of water in reservoirs may also require approval from DWA.</p>
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	<p>A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act.</p> <p>Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act.</p> <p>S53 Department of Mineral Resources: Approval from the Department of Mineral Resources (DMR) may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.</p>	Department of Mineral Resources	<p>Within the study area they are old borrow pits and discontinued mines and their overburden heaps have remained. The overburden materials provide an ideal source for such filling material for these and other applications within the development. Using this material will also prevent additional impacts that would be caused by a new borrow pit. Alternatively, the infilling or depositing of material for access roads will be obtained from a registered borrow pit) no mining permit or right is required to be obtained.</p>
National Environmental Management: Air Quality Act (Act No 39 of 2004)	<p>Measures in respect of dust control (S32) and National Dust Control Regulations of February 2014.</p> <p>Measures to control noise (S34) - no regulations promulgated yet.</p>	Department of Environmental Affairs	<p>No permitting or licensing requirements arise from this legislation. However, National, provincial and local ambient air</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			<p>quality standards (S9 - 10 & S11) to be considered.</p> <p>Measures in respect of dust control (S32) and the National Dust Control Regulations of February 2014.</p> <p>The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.</p>
<p>National Heritage Resources Act (Act No 25 of 1999)</p>	<ul style="list-style-type: none"> » Stipulates assessment criteria and categories of heritage resources according to their significance (S7). » Provides for the protection of all archaeological and palaeontological sites, and meteorites (S35). » Provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority (S36). » Lists activities which require developers any person who intends to undertake to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development (S38). 	<p>South African Heritage Resources Agency</p>	<p>An HIA and PIA has been undertaken as part of the EIA Process to identify heritage sites (refer to Appendix F&G), there are not sensitive heritage object found on site, should a heritage resource be impacted upon, a permit may be required from SAHRA.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<ul style="list-style-type: none"> » Requires the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites as part of tourism attraction (S44). 		
<p>National Environmental Management: Biodiversity Act (Act No 10 of 2004)</p>	<ul style="list-style-type: none"> » Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened and protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened 	<p>Department of Environmental Affairs</p>	<p>Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species.</p> <p>An ecological study has been undertaken as part of the EIA Phase. As such the potentially occurrence protected species and the potential for them to be affected has been considered. This report is contained in Appendix F.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>and in need of protection, (G 34809, GN 1002), 9 December 2011).</p> <p>» This Act also regulates alien and invader species.</p>		
<p>Conservation of Agricultural Resources Act (Act No 43 of 1983)</p>	<p>» Prohibition of the spreading of weeds (S5)</p> <p>» Classification of categories of weeds & invader plants (Regulation 15 of GN R1048) & restrictions in terms of where these species may occur.</p> <p>» Requirement & methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R1048).</p>	<p>Department of Agriculture</p>	<p>This Act will find application throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented.</p> <p>The permission of agricultural authorities will be required if the Project requires the draining of vleis, marshes or water sponges on land outside urban areas. There are none for the projects.</p>
<p>National Forests Act (Act No. 84 of 1998)</p>	<p>According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.</p>	<p>National Department of Forestry</p>	<p>A licence is required for the removal of protected trees. There were protected tree species recorded during the ecological survey within the broader study area. Few <i>Acacia</i> species and <i>Boschias</i> are the largest are the most obvious woody plants.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			Should protected trees need to be removed; a permit will be required to be obtained from DAFF.
National Veld and Forest Fire Act (Act 101 of 1998)	<p>In terms of S12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material.</p> <p>In terms of S17, the applicant must have such equipment, protective clothing, and trained personnel for extinguishing fires.</p>	Department of Agriculture, Forestry and Fisheries (DAFF)	While no permitting or licensing requirements arise from this legislation, this Act will find application during the construction and operational phase of the project.
Hazardous Substances Act (Act No 15 of 1973)	<p>This Act regulates the control of substances that may cause injury, or ill health, or death due to their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products.</p> <p>Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc, nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be</p>	Department of Health	It is necessary to identify and list all the Group I, II, III, and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	declared as Group I or Group II substance Group IV: any electronic product; and Group V: any radioactive material. The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.		
Development Facilitation Act (Act No 67 of 1995)	Provides for the overall framework and administrative structures for planning throughout the Republic. S(2-4) provide general principles for land development and conflict resolution.	Kheis Local Municipality	The applicant must submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the Act.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – <ul style="list-style-type: none"> » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of	National Department of Water and Environmental Affairs (hazardous waste) Provincial Department of Environmental Affairs (general waste)	As no waste disposal site is to be associated with the proposed project, no permit is required in this regard. General waste handling, storage and disposal during construction and operation is required to be undertaken in accordance with the requirements of the Act, as detailed in the EMPs for each Phase (refer to Appendix K-M). The DWAF (1998) Waste Management Series. Minimum Requirements for the Handling,

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>this Act (GN 921), A Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities.</p> <p>Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that:</p> <ul style="list-style-type: none"> » The containers in which any waste is stored, are intact and not corroded or in » any other way rendered unfit for the safe storage of waste. » Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented. 		<p>Classification and Disposal of Hazardous Waste will also need to be considered.</p> <p>The volumes of solid waste to be generated and stored on the site during construction and operation of the facility will not require a waste license (provided these remain below the prescribed thresholds).</p> <p>The contractor's camp will result in sewage and grey water handling. Sewage is regarded as hazardous waste in terms of this Act. However the volume of hazardous waste generated from the construction and operation of the facility will not exceed the specified threshold volumes within the Waste Act (i.e. an annual throughout capacity of 2000m³) and therefore a waste license from National DEA will not be required.</p>
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land in the Province	Department of Agriculture	Subdivision will have to be in place prior to any subdivision approval in terms of S24 and S17 of the Act.
National Road Traffic Act (Act No 93	» The technical recommendations for highways	» South African	An abnormal load/vehicle permit

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
of 1996)	<p>(TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed.</p> <ul style="list-style-type: none"> » Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts. » The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations. 	<p>National Roads Agency Limited (national roads)</p> <ul style="list-style-type: none"> » Provincial Department of Transport 	<p>may be required to transport the various components to site for construction. These include route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads. Transport vehicles exceeding the dimensional limitations (length) of 22m. Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).</p>
Provincial Legislation			
Northern Cape Nature Conservation Act, Act No. 9 of 2009	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the	Northern Cape Department of Environment and Nature Conservation	A collection/destruction permit must be obtained from Northern Cape Nature Conservation for the removal of any protected plant species found on site. Additionally, a permit for the

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	<p>appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:</p> <ul style="list-style-type: none"> » Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property; » Aquatic habitats may not be destroyed or damaged; » The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. » The Act provides lists of protected species for the Province. 		<p>disturbance or destruction of indigenous species must be applied for.</p>
<p>Astronomy Geographic Advantage Act (Act No. 21 of 2007)</p>	<ul style="list-style-type: none"> » The Astronomy Geographic Advantage Act (No. 21 of 2007) provides for the preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy; for intergovernmental co-operation and public consultation on matters concerning nationally significant astronomy advantage areas and for matters connected thereto. » Chapter 2 of the act allows for the declaration of astronomy advantage areas whilst Chapter 3 pertains to the management and control of astronomy advantage areas. Management and control of astronomy advantage areas include, 	<p>South Africa Kilometre Array</p>	<p>On 19 February 2010, the Minister of Science and Technology (the Minister) declared the whole of the territory of the Northern Cape province, excluding Sol Plaatje Municipality, as an astronomy advantage area for radio astronomy purposes in terms of Section 5 of the Act and on 20 August 2010 declared the Karoo Core Astronomy Advantage Area for the purposes of radio astronomy.</p>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	amongst others, the following: » Restrictions on use of radio frequency spectrum in astronomy advantage areas; » Declared activities in core or central astronomy advantage area; » Identified activities in coordinated astronomy advantage area; and » Authorisation to undertake identified activities.		

Table 3.2: Standards and guidelines applicable to the Kheis Solar Park 2 Facility

Theme	Standard/Guidelines	Summary
Air	South African National Standard (SANS) 69	Framework for setting and implementing national ambient air quality standards
	SANS 1929: Ambient Air Quality	Sets limits for common pollutants
Noise	SANS 10328:2003: Methods for Environmental Noise Impact Assessments	General procedure used to determine the noise impact
	SANS 10103:2008: The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication	Provides noise impact criteria
	National Noise Control Regulations	Provides noise impact criteria
	SANS 10210: Calculating and Predicting Road Traffic Noise	Provides guidelines for traffic noise levels
Waste	DWAF (1998) Waste Management Series. Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste	DWAF Minimum Requirements
	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) – National norms and standard for the storage of waste.	» Provides uniform national approach relating the management of waste facilities » Ensure best practice in management of waste storage » Provides minimum standards for the design and operation of new and existing waste storage

Theme	Standard/Guidelines	Summary
Water	Best Practise Guideline (G1) Stormwater Management DWA 2006	Provides guidelines to the management of storm water
Water	South African Water Quality Guidelines	Provides water quality guidelines
Others	<ul style="list-style-type: none"> » Kheis Municipality Integrated Development Plan (2012-2017) » ZF Mgcawu District Municipality Integrated Development Plan (2012-2017) 	According to the Municipal Systems Act of 2000, all Municipalities have to undertake an Integrated Development Planning (IDP) process to produce Integrated Development Plans (IDPs). As the IDP is a legislative requirement it has a legal status and it supersedes all other plans that guide development at local government level.

STRUCTURE OF THIS EMPr

CHAPTER 4

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

- » Pre-Construction (Planning & Design) activities;
- » Construction activities;
- » Operation activities; and
- » Decommissioning activities.

These chapters set out the procedures necessary for Gestamp Asetym Solar South Africa (Pty) Ltd, as the project developer, to minimise environmental impacts and achieve environmental compliance. For each of the phases of implementation, an over-arching environmental **goal** is stated. In order to meet this goal, a number of **objectives** are listed. The EMPr 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 EMPr table has been established for each environmental objective. The information provided within the EMPr table for each objective is illustrated below:

OBJECTIVE: Description of the objective, which is necessary to meet the overall goals; which take into account the findings of the EIA specialist studies

Project Component/s	» List of project components affecting the objective.
Potential Impact	» Description of potential environmental impact if objective is not met.
Activity/Risk Source	» Description of activities which could affect achieving objective.
Mitigation: Target/Objective	» Description of the target and/or desired outcomes of mitigation.

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

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

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

- » Planned activities change (i.e. in terms of the components and/or layout of the facility);
- » Modification to or addition to environmental objectives and targets;
- » Relevant legal or other requirements are changed or introduced; and
- » 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 or should be modified.

4.1 Project Team

This draft EMPr was compiled by Sheila Muniongo who holds a Bachelor degree with Honours in Environmental Management and has three years experience in the environmental field. Her key focus is on environmental impact assessments, public participation, environmental management plans and programmes, as well as mapping using ArcGIS for a variety of environmental projects. She is currently involved in several EIAs for renewable energy project EIAs across the country. Specialists involved in the preparation of management measures include:

	Name	Company
EMP Compilers:	Sheila Muniongo Karen Jodas Jo-Anne Thomas	Savannah Environmental
Specialists:	Marianne Strohbach	Savannah Environmental
	David Morris	McGregor Museum
	Barry Millstead	BM Geological Services Museum
	Anna-Marie Roux	Zone Land Solutions
	Johann Lanz	Johan Lanz Consulting
	Lourens du Plessis	MetroGIS

The Savannah Environmental team have extensive knowledge and experience in EIAs and environmental management, having been involved in EIA processes over the past fifteen years. They have managed and drafted EMPrs for other

power generation projects throughout South Africa, including numerous wind and solar energy facilities.

ROLES AND RESPONSIBILITIES

CHAPTER 5

5.1 Roles and Responsibilities for the Construction Phase of the Solar Energy Facility

As the Proponent, Gestamp Asetym Solar South Africa (Pty) Ltd must ensure that the implementation of the solar energy facility complies with the requirements of any and all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMPr, and the implementation of the EMPr through its integration into the contract documentation. Gestamp Asetym Solar South Africa (Pty) Ltd will retain various key roles and responsibilities during the construction of the solar energy facility. These are outlined below.

Specific responsibilities of the Owner's Representatives; Environmental Control Officer and EPC Contractor for the construction phase of this project are as detailed below.

The **Owner's Representative (i.e. General Manager and/or Site Manager)** will:

- » Ensure all specifications and legal constraints specifically with regards to the environment are highlighted to the Contractor(s) so that they are aware of these.
- » Ensure that Gestamp Asetym Solar South Africa (Pty) Ltd and its Contractor(s) are made aware of all stipulations within the EMPr.
- » Ensure that the EMPr is correctly implemented throughout the project cycle by means of site inspections and meetings. This will be documented as part of the site meeting minutes.
- » Be fully knowledgeable with the EIA for the project, the EMPr, the conditions of the facility Environmental Authorisation, and all relevant environmental legislation.

The **Owner's Engineer (i.e. Project Manager and/or Site manager)** will:

- » Be fully knowledgeable with the contents and conditions of the facility Environmental Authorisation.
- » Be fully knowledgeable with the contents of the EMPr.
- » Have overall responsibility for the implementation of the EMPr .
- » Ensure there is communication with the Project Manager, the ECO, and relevant discipline engineers on matters concerning the environment.
- » Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
- » Confine activities to the demarcated construction site.

An independent³ **Environmental Control Officer (ECO)** must be appointed by the project proponent prior to the commencement of any authorised activities and will be responsible for monitoring, reviewing and verifying compliance by the Contractor with the environmental specifications of the EMPr and the conditions of the Environmental Authorisation. Accordingly, the ECO will:

- » Be fully knowledgeable with the contents with the EIA.
- » Be fully knowledgeable with the contents with the conditions of the facility Environmental Authorisation.
- » Be fully knowledgeable with the contents with the EMPr.
- » 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 EMPr is monitored through regular and comprehensive inspection of the site and surrounding areas.
- » Ensure that if the EMPr 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 appropriate measures are undertaken to address any non-compliances recorded.
- » Ensure that a removal is ordered of any person(s) and/or equipment responsible for any contravention of the specifications of the EMPr.
- » 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.
- » Independently report to DEA in terms of compliance with the specifications of the EMPr and conditions of the facility Environmental Authorisation .
- » Keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.

³A person who is not from any of the parties involved in the design or construction of the Solar Energy Facility

Contractors and Service Providers: 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:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » A copy of the EMPr must be easily accessible to all on-site staff members.
- » Employees must be familiar with the requirements of this EMPr and the environmental specifications as they apply to the construction of the proposed facility.
- » Prior to commencing any site works, all employees and sub-contractors must have attended an environmental awareness training course which must provide staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Staff will be informed of environmental issues as deemed necessary by the ECO.

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

- » Ensuring adherence to the environmental management specifications.
- » Ensuring that appropriate Method Statements are drafted submitted to the Site Manager (and ECO) for approval before any work is undertaken.
- » 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).

Environmental officer:

- » Ensure that environmental issues receive adequate attention in the site induction training
- » prepare and conduct awareness training (e.g. posters, tool box talks, signage)
- » conduct monthly observation and inspection and audit of all work places
- » monitor Contractor's compliance with EA, EMP, and any permits and licenses on site
- » conduct daily observations and monthly environmental audits of all Contractor's and work areas
- » ensure that all environmental monitoring programmes are carried out according to protocols and schedules
- » monitoring of completed work (e.g. areas top-soiled, re-vegetated, stabilised etc.)
- » maintain site documentation related to environmental management (permits, CEMP, method statements, EA, reports, audits, monitoring results, receipts for waste removal etc.)
- » Inspect and report on environmental incidents and check corrective action
- » keep a regular photographic record of all environmental incidents
- » management of complaints register
- » review and of method statements prepared by contractors
- » audit site performance against environmental method statements

5.2. Roles and Responsibilities for the Operation Phase of the Solar Energy Facility

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of Solar Energy Facility Operations Manager, and Environmental Manager for the operation phase of this project are detailed below.

The **Facility Manager** will:

- » Ensure that adequate resources (human, financial, technology) are made available and appropriately managed for the successful implementation of the operational EMPr.
- » Conduct annual basis reviews of the EMPr to evaluate its effectiveness.
- » Take appropriate action as a result of findings and recommendations in management reviews and audits.
- » Provide forums to communicate matters regarding environmental management.

The **Environmental Manager** will:

- » Develop and Implement an Environmental Management System (EMS) for the solar energy facility and associated infrastructure.
- » Manage and report on the facility's environmental performance.
- » Maintain a register of all known environmental impacts and manage the monitoring thereof.
- » Conduct internal environmental audits and co-ordinate external environmental audits.
- » Liaise with statutory bodies such as the National and Provincial Department of Environmental Affairs (DEA) on environmental performance and other issues.
- » Conduct environmental training and awareness for the employees who operate and maintain the solar energy facility.
- » Compile environmental policies and procedures.
- » Liaise with interested and affected parties on environmental issues of common concern.
- » Track and control the lodging of any complaints regarding environmental matters.

MANAGEMENT PROGRAMME: PRE-CONSTRUCTION (PLANNING & DESIGN)

CHAPTER 6

Overall Goal: undertake the pre-construction activities (planning and design phase) in a way that:

- » Ensures that the design of the facility responds to the identified environmental constraints and opportunities.
- » Ensures that pre-construction activities are undertaken in accordance with all relevant legislative requirements
- » Ensures that adequate regard has been taken of any landowner and community concerns and that these are appropriately addressed through design and planning (where appropriate).
- » Ensures that the best environmental options are selected for the linear components, including the access roads and power line alignments.
- » Enables the solar energy facility construction activities to be undertaken without significant disruption to other land uses and activities in the area.

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

6.1 Objectives

OBJECTIVE PD1 : Ensure the facility design responds to identified environmental constraints and opportunities

The most sensitive landscape features for planning purposes in the study area will be the presence of protected trees and plants.. These areas should be excluded from any development footprint wherever possible.

A stormwater management plan must be compiled (usually done by an engineering company as part of the final design) that details how storm water runoff will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces.

Project Component/s	<ul style="list-style-type: none">» PV panels.» Substation.» Access roads.» Power line.» Laydown areas and construction camp area
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Potential Impact	» Impact on identified sensitive areas.
Activities/Risk Sources	» Positioning of all the facilities components.
Mitigation: Target/Objective	» The design of the facility responds to the identified environmental constraints and opportunities. » Site sensitivities are taken into consideration and avoided as far as practical, thereby mitigating potential impacts.

Mitigation: Action/Control	Responsibility	Timeframe
Plan and conduct pre-construction activities in an environmentally acceptable manner	Developer	Design phase
Consider design level mitigation measures recommended by the specialists, especially with respect to ecology, heritage and visual aesthetics, as detailed within the EIA report and relevant appendices.	Engineering Design Consultant / Developer	Tender Design & Design Review Stage
Access roads to be carefully planned to minimise the impacted area and prevent unnecessary over compaction of soil.	Developer	Design phase
A comprehensive stormwater management plan must be compiled that details how storm-water will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces.	Developer	Design phase
A detailed geotechnical investigation is required for the design phase. This should be undertaken with due regard for all environmental legislative requirements.	Developer	Design phase
Submit a final layout to DEA prior to the commencement of construction. This layout should provide information on all components of the project.	Developer	Pre-construction
Obtain all relevant permits (e.g. protected plants and trees) prior to construction in an area.	Developer	Pre-construction
A traffic management plan must be prepared for site access roads to minimise or where possible avoid the hazards which could result from increased traffic and to ensure that traffic flow is not adversely affected. This document would be a working document to be updated as and when required.	Contractor	Pre-construction

Performance Indicator	» The design meets the objectives and does not degrade the environment. » Design and layouts respond to the mitigation measures and recommendations in the EIA Report.
Monitoring	» Review of the design by the Project Manager and the Environmental Control Officer (ECO) prior to the commencement of construction.

OBJECTIVE PD2 : Ensure the selection of the best environmental option for the alignment of the power lines, development areas and access roads

The study area is covered by Lower Gariiep Broken Veld (NKb 1), Bushmanland Arid Grassland (NKb 3), Gordonia Duneveld (SVkd 1) and fractions of the Kalahari Karroid Shrubland (NKb 5) as described by Mucina and Rutherford (2006). Riparian vegetation occurs on the banks of small ephemeral water washes that drain into the nearby Orange River west of the study area. Only the vegetation along the Orange River itself is currently regarded as a threatened ecosystem, and will only be impacted on if impacts of the proposed development are not adequately mitigated.

Vegetation units that could be identified within the Kheis Solar Park 2 site are listed below with their sensitivity and their conservation value:

- » Association 1: *Leucosphaera bainesii* – *Zygophyllum dregeanum* calcareous low shrub plains occupy most of the developable parts of the study area. Species composition is very diverse, with forb and low shrub dominating most areas.
 - o Conservation value: Medium
 - o Sensitivity: **Low**
- » Association 3: *Rhigozum trichotomum* – *Stipagrostis ciliata* mixed shrub occur as a transition between the calcareous plains and dune fields. More surface sand creates a more favourable environment for perennial grasses, but soil depth is restricted by underlying calcrete, hence the density of large trees is considerably lower than on the duneveld.
 - o Conservation value: Medium to high
 - o Sensitivity: **Medium-High** (where the vegetation structure consists of open grassed areas interspersed with smaller groups of higher trees and shrubs) and **Medium-low** (where there is excessive disturbance from bush encroachment). NB: the majority of Kheis Solar Park 2 falls within the Medium-low portion of this vegetation unit (with a small part occupying the Medium-High area).

Of the vegetation associations within the broader study area, the duneveld, larger drainage channels, and outcrops should be treated as No Go Zones due to their high conservation value. Even on the undulating calcrete and sandy plains, ground disturbance should be minimised, and existing gravel roads and tracks used as far as possible to lower the extent of the footprint.

Localised occurrences of species of conservation concern –geophytes, succulents and protected trees, do occur. Where impact on such species cannot be avoided,

plants that can be relocated, especially geophytes and succulents, must be part of a search-and rescue operation.

The section below also provides a guideline for the Search & Rescue Plan on site and will need to be supplemented with the relevant methodology depending on the final placement of infrastructure.

Project Component/s	<ul style="list-style-type: none"> » PV Array » Grid connection and associated servitudes » Access roads » Workshop, guardhouses, substation and other related infrastructure » Temporary construction camps » Protective fencing around development » Potential topsoil stockpiles and/or borrow pits
Potential Impact	<ul style="list-style-type: none"> » Substantially increased loss of species of conservation concern and other natural vegetation at construction phase, waste of on-site plant resources, lack of locally sourced material for rehabilitation of disturbed areas; » Increased cost of rehabilitation
Activities/Risk Sources	<ul style="list-style-type: none"> » Construction related loss and damage to natural vegetation and fauna
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Rescue, maintenance and subsequent replanting of at least all bulbous and most succulent protected plant species within the specific land portion

Mitigation: Action/Control	Responsibility	Timeframe
Ecological footprint investigation and recording of localities of all red data species and indication of presence of other species of conservation concern (Design Phase)	Ecologist	Prior to commencement of activity
<ul style="list-style-type: none"> » Search and Rescue (S&R) of all protected plants that will be affected by the development, especially species occurring in long term and permanent, hard surface development footprints (i.e. all buildings, new roads and tracks, laydown areas, and panel positions) should take place. <ul style="list-style-type: none"> o The necessary permits must be in place » Plants that can be considered for rescue and included in subsequent rehabilitation programs are all tubers, bulbs, and indigenous succulents » All development footprints must be surveyed and pegged out as soon as possible, after which a local horticulturist/contractor with Search and Rescue experience should be appointed to undertake the S&R. 	Horticultural Contractor, monitored and approved by ECO	Prior to construction

Mitigation: Action/Control	Responsibility	Timeframe
<ul style="list-style-type: none"> » All rescued species should be transplanted immediately or bagged (or succulents left to first air-dry before planting) and kept in the horticulturist's or a designated on-site nursery, and should be returned to site or land portion once all construction is completed and rehabilitation of disturbed areas is required. This nursery should be appropriately managed to ensure the maintenance of the plant specimens for reuse in rehabilitation. » As far as possible, replanting should occur in spring to early summer once sufficient rains have fallen, in order to facilitate establishment. 		
<p>In line with specifications regarding permissible biodiversity and the rehabilitation plan, a minimum percentage cover of vegetation must be established and permanently maintained post construction</p>	Developer and horticultural contractor	After construction, throughout operational phase
<p>All cable trenches, excavations, etc, through sensitive areas should be excavated carefully in order to minimise damage to surrounding areas and biodiversity.</p> <ul style="list-style-type: none"> » The trenches must be checked on a daily basis for the presence of trapped animals. » Any animals found must be removed in a safe manner, unharmed, and placed in an area where the animal will be comfortable. » If the ECO or contractor is unable to assist in the movement of a fauna species, ensure a member of the conservation authorities assists with the translocation. » All mammal, large reptiles and avifauna species found injured during construction will be taken to a suitably qualified veterinarian or rehabilitation centre to either be put down in a humane manner or cared for until it can be released again » Sociable weavers' nests occur within the development area should be avoided as far as possible. Nests may only be removed with a permit and by a suitably qualified specialist, usually supervised by conservation staff. 	Contractor / ECO	Duration of construction
<p>Performance Indicator</p>	<ul style="list-style-type: none"> » Rescue of species of conservation concern » No damage or injury to fauna » Re-establishment of rescued species 	
<p>Monitoring</p>	<ul style="list-style-type: none"> » ECO to monitor Search and Rescue, continue search and rescue 	

	<p>operations during the construction process where it becomes necessary after the initial S&R</p> <ul style="list-style-type: none"> » It may be possible that geophytic species may emerge during construction that were not accounted for in the original S&R plan – once observed the ECO should consult the botanists on the identification and possible S&R for those plant species
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OBJECTIVE PD3: To ensure effective communication mechanisms

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

Project component/s	» Solar energy facility
Potential Impact	» Impacts on affected and surrounding landowners and land uses
Activity/risk source	<ul style="list-style-type: none"> » Activities associated with solar energy facility construction » Activities associated with solar energy facility operation
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Effective communication with affected and surrounding landowners » Addressing of any issues and concerns raised as far as possible in as short a timeframe as possible

Mitigation: Action/control	Responsibility	Timeframe
Compile and implement a grievance mechanism procedure for the public (as outlined in Appendix A) to be implemented during both the construction and operational phases of the facility. This procedure should include details of the contact person who will be receiving issues raised by interested and affected parties, and the process that will be followed to address issues. This procedure should be in line with the South African Labour Law.	Developer	Pre-construction (construction procedure) Pre-operation (operation procedure)
Liaison with landowner is to be undertaken prior to the commencement of construction in order to provide sufficient time for him to plan agricultural activities.	Developer / Contractor	Pre-construction

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

MANAGEMENT PROGRAMME: CONSTRUCTION

CHAPTER 7

Overall Goal: Undertake the construction phase in a way that:

- » Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
- » Enables construction activities to be undertaken without significant disruption to other land uses and activities in the area, in particular concerning noise impacts, farming practices, traffic and road use, and effects on local residents.
- » Minimises the impact on any remaining indigenous natural vegetation and habitats of ecological value (i.e. drainage lines).
- » Minimises impacts on fauna using the site.
- » Minimises the impact on heritage site should they be uncovered.

7.1 Objectives

In order to meet the overall goal for construction, the following objectives, actions, and monitoring requirements have been identified.

OBJECTIVE C1: Securing the site and site establishment

Project Component/s	<ul style="list-style-type: none"> » Area infrastructure (i.e. PV panels, and substation). » Linear infrastructure (i.e. power line, and access roads). » Laydown areas and site camps
Potential Impact	<ul style="list-style-type: none"> » Hazards to landowners and public. » Damage to indigenous natural vegetation, due largely to ignorance of where such areas are located. » Loss of threatened plant species
Activities/Risk Sources	<ul style="list-style-type: none"> » Open excavations (foundations and cable trenches). » Movement of construction vehicles in the area and on-site. » Site clearance and levelling activities.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » 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 the immediate development footprint.

Mitigation: Action/Control	Responsibility	Timeframe
Secure site, working areas and excavations in an appropriate manner, as agreed with the Environmental Officer.	Contractor	Erection: during site establishment

Mitigation: Action/Control	Responsibility	Timeframe
		Maintenance: for duration of Contract
The Contractor must take all reasonable measures to ensure the safety of the public in the surrounding area.	Contractor	Erection: during site establishment Maintenance: for duration of Contract
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 and any other relevant locally spoken languages, all to the approval of the Site Manager.	Contractor	Erection: during site establishment Maintenance: for duration of Contract
Where necessary to control access, fence and secure area (especially relevant to no-go areas).	Contractor	Erection: during site establishment Maintenance: for duration of Contract
Contractors and construction workers must be informed of the no-go areas.	Developer	Construction
Fence and secure Contractor's equipment camp.	Contractor	Erection: during site establishment Maintenance: for duration of Contract
Perimeter fencing around the broader site/ farm portions for the wind energy facility ((which is clearly indicated with flags to be implemented. All deep excavations must be adequately protected. There is to be no unauthorised disturbance outside the demarcated development footprint. Any activities outside the development footprint to be authorised by the Owner's Representative.	Contractor	Erection: during site establishment Maintenance: for duration of Contract

Performance Indicator	<ul style="list-style-type: none"> » Site is secure and there is no unauthorised entry. » No members of the public/ landowners injured. » Appropriate and adequate waste management facilities provided at construction site. » No disturbance of vegetation outside of development footprint.
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Monitoring	<ul style="list-style-type: none"> » An incident reporting system will be used to record non-conformances to the EMPr. » ECO to monitor all construction areas on a continuous basis until all construction is completed. Non-conformances will be immediately reported to the site manager.
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OBJECTIVE C2: Environmentally Sensitive Location Of Temporary Construction Equipment Camps On Site

The purpose of this camp is to confine activities and storage of equipment to one designated area to limit the potential ecological impacts associated with this phase of the project. The laydown area(s) will be used for assembly purposes and the general placement/storage of construction equipment. Construction equipment and materials may need to be stored at an appropriate location on the site for the duration of the construction period. There are designated areas as shown on the layout plan. Deviations from this should be agreed with the ECO prior to these being implemented.

Project Component/s	<ul style="list-style-type: none"> » Construction equipment camps (temporary) » Facilities for storing, mixing and general handling of materials » Access roads
Potential Impact	<ul style="list-style-type: none"> » Damage to and loss of indigenous biodiversity; » Damage to and/or loss of topsoil; » Initiation of accelerated erosion; » Compacting of ground; » Pollution of the surrounding environment due to inadequate or inappropriate facilities; and » Impacts on landowners
Activities/Risk Sources	<ul style="list-style-type: none"> » Vegetation clearing and levelling of equipment storage area/s; and » Access to and from the equipment storage area/s.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To minimise impacts on the social and biophysical environment; and » To limit equipment storage to within the demarcated site.

Mitigation: Action/Control	Responsibility	Timeframe
The location of the construction equipment camp will take cognisance of any ecologically and heritage sensitive areas identified. The final location of this construction equipment camp shall be approved by the project ECO.	Contractor	Pre-construction
No temporary site camps will be allowed outside the footprint of the development area.	Contractor	Contract duration
Any deviation from the approved construction	Contractor	Contract duration

Mitigation: Action/Control	Responsibility	Timeframe
equipment camp and/or laydown area location, or any other temporary area may not be undertaken without approval from the ECO.		
As far as possible, minimise vegetation clearing and levelling for equipment storage areas.	Contractor	Erection: Site establishment Maintenance: contract duration
Prepare sites in line with other mitigation measures outlined to minimise damage to environment and biodiversity. After demarcation, the site may not be cleared without the inspection of mitigation measures undertaken and approval of the ECO	Contractor, in consultation with the ECO'	Contract duration
Rehabilitate and re-vegetate all disturbed areas at the construction equipment camp as soon as construction is complete within an area.	Contractor	Duration of Contract

Performance Indicator	<ul style="list-style-type: none"> » No visible erosion scars once construction in an area is completed. » No claims regarding damage due to unauthorised removal of vegetation or loss of fauna. » All damaged areas successfully rehabilitated one year after completion. » No damage to drainage lines and/or pan areas. » Appropriate waste management and zero pollution.
Monitoring	<ul style="list-style-type: none"> » Regular audits of the construction camps and areas of construction on site. » A photographic record must be established before, during and after mitigation. » An incident reporting system should be used to record non-conformances to the EMPr.

OBJECTIVE C3: Minimise loss and disturbance to mammals, reptiles and amphibians

Prior to any earthworks (including road construction) in a demarcated area, The ECO needs to inspect the area and supervise the removal and relocation of any individual of mammal, reptile or amphibian that may be on the site, either in burrows or just traversing the area. Sociable weavers' nests occur within the development area should be avoided as far as possible. Nests may only be removed with a permit and by a suitably qualified specialist, usually supervised by conservation staff.

Fences and roads must be constructed in such a way that they do not prevent the natural migration of small mammals, reptiles, or amphibians.

Project Component/s	<ul style="list-style-type: none"> » PV Array » Grid connection and associated servitudes » Access roads and fences
Potential Impact	<ul style="list-style-type: none"> » Loss of habitat and natural resources to small mammals, reptiles and amphibians » Associated decline of populations of above fauna
Activities/Risk Sources	<ul style="list-style-type: none"> » Permanent obstruction of natural migration routes
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Creation of safe passage across roads or passages through fences

Mitigation: Action/Control	Responsibility	Timeframe
Prior to the disturbance of any area, the ECO must assess the area for any burrowing mammal, reptile or amphibian and supervise the relocation of such to a similar habitat out of the construction/footprint area	Contractor Specialist	Prior to and during construction
Ensure that off-road impact by heavy machinery is restricted to designated areas only and only previously disturbed sites or designated laydown areas are used for storing and handling materials and machinery	Contractor	Prior to and during construction
It would be advisable and desirable to create several migration openings at regular intervals at the base of fences (i.e. holes of a diameter of about 30 - 50 cm with a reinforced edge from poles or tyre-edges). This is to allow small mammals to freely move through the fences without damaging fences by digging or standing the risk of getting trapped in partially damaged fences, whilst minimising the effect of habitat fragmentation on smaller vertebrates that would be most affected by habitat fragmentation.	Contractor	Prior to and during construction
Fences must be regularly checked, especially during construction, for illegally set snares and such reported to the ECO and/or site manager and removed immediately	Contractor	Prior to and during construction
After decommissioning, remove all foreign material and rip area to facilitate the establishment of vegetation and implement a suitable rehabilitation plan of the area	Contractor	Prior to and during construction

Performance Indicator	<ul style="list-style-type: none"> » No animal death caused by construction activities » No illegal snaring of fauna » Continued safe movement of small fauna across the largest portions of the proposed development, except within areas where the type of infrastructure or use thereof may be
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	dangerous to the animals
Monitoring	<ul style="list-style-type: none"> » EO to monitor and keep record of animal deaths on site and report any incidences to management for immediate remedial action. » Continued monitoring of fence lines and other infrastructure to ensure they pose no danger to small fauna and implement mitigation measures if fauna deaths are detected.

OBJECTIVE C4: To avoid and/or minimise the potential negative impact on current and future farming activities during the construction phase

Construction and operational activities of the proposed facility could lead to the loss of productive farm land. This could be either due to extensive loss of topsoil, soil seed banks, natural vegetation, erosion, or pollution.

Project component/s	<ul style="list-style-type: none"> » PV Array » Grid connection and associated servitudes » Access roads » Workshop, guardhouses, substation and other related infrastructure » Temporary construction camps » Temporary staff facilities » Protective fencing around development » Potential topsoil stockpiles
Potential Impact	<ul style="list-style-type: none"> » The footprint of the developments will result in a loss of land that will impact on current farming activities on the site » Within the footprint, a change of plant species composition with lower productivity and agricultural potential can be expected due to removal, disturbance and continued long-term shading of vegetation » A largely reduced vegetation cover will cause the ecosystem be more prone to erosion and irreversible degradation » Disturbance of indigenous vegetation creates opportunities for the establishment of invasive vegetation or creation of surfaces that do not support the permanent (re-) establishment of vegetation » Accidental release of harmful substances could potentially cause extensive pollution of wetland and water resources on and beyond the farm portion if not contained immediately
Activities/risk sources	<ul style="list-style-type: none"> » The footprint taken up by the development » Clearing of vegetation and landscaping on footprint area » Introduction and/or further distribution of invasive plant species » Excessive fragmentation of habitats » Accelerated erosion with extensive loss of topsoils and associated natural seedbanks and nutrients

Mitigation: Target/Objective	<ul style="list-style-type: none"> » To minimise the loss of land and desirable indigenous vegetation by the construction of the development and to enable selected farming activities (e.g. grazing by small livestock) to continue where possible
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Mitigation: Action/control	Responsibility	Timeframe
Minimise the footprint of the development where possible, at the same time avoid impacting on sensitive habitats <ul style="list-style-type: none"> » The footprint for <i>all</i> development components should be defined before the construction phase commences » The specific EMPs shall provide for the mitigations of the impacts of the different types of development components, e.g. if topsoil will have to be stored, a topsoil management plan will have to be drafted <ul style="list-style-type: none"> o Note: topsoil shall at all times be treated as a valuable agricultural resource 	Contractor and relevant specialists, to be monitored by ECO	Before and during construction, operational phase
Rehabilitate disturbed areas on completion of the construction phase. Details of the rehabilitation programme should be contained in the relevant EMP. <ul style="list-style-type: none"> » Rehabilitation targets must be set according to the original vegetation as described in the ecological specialist report 	Contractor, rehabilitation specialist, to be monitored and approved by ECO	Ongoing during construction phase
Monitor erosion and manage all occurrences according to the erosion management plan	Contractor, to be monitored and approved by ECO and EO	Ongoing, from construction to decommissioning
Eradicate all weeds and alien invasive plants as far as practically possible <ul style="list-style-type: none"> » Continually monitor the re-emergence of these species and manage according to the invasive species management plan 	Contractor, to be monitored and approved by ECO and EO	Ongoing, from construction to decommissioning

Performance Indicator	<ul style="list-style-type: none"> » All relevant and specific EMPs also agreed upon by the land owner and then diligently implemented by the contractor and developer » Stable vegetation cover throughout the development area as determined desirable to curb erosion and maintain ecosystem functionality, alternatively a protective gravel or stone cover over areas that cannot be revegetated, the latter must be fully permeable
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Monitoring	<ul style="list-style-type: none"> » Regular monitoring and audits of construction activities and the footprint area by the ECO to prevent any degradation of the ecosystem » A photographic record must be established before, during and after
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	mitigation » An incident reporting system should be used to record non-conformances to the EMP, followed by the necessary action from the developer to ensure full compliance
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OBJECTIVE C5: Minimisation of disturbance to topsoil

Topsoil conservation is an integral part of rehabilitation efforts and helps to maintain the productive capability and ecological functionality of rangelands.

Removal of topsoil should be done if possible where:

- » Areas will be excavated
- » Areas will be severely compacted
- » Areas will be buried with excavated material
- » Areas will be permanently covered with altered surfaces

Topsoil must at all times be treated as a valuable natural resource, and may thus not be discarded or degraded. In many sections of the development area, topsoils are very shallow or rocky, which would make topsoil removal difficult. Grading in such areas should be kept as low as possible.

Project Component/s	» PV Array supports and trenching » Grid connection and associated servitudes » Access roads » Workshop, guardhouses, substation and other related infrastructure » Potential topsoil stockpiles and/or borrow pits
Potential Impact	» Loss of topsoil and natural resources and biological activity within the topsoil » Loss of natural regeneration potential of soils » Loss of agricultural potential of soils.
Activity/Risk Source	» Site preparation and earthworks » Excavation of foundations and trenches » Construction of site access road » Power line construction activities » PV array construction activities » Stockpiling of topsoil, subsoil and spoil material.
Mitigation: Target/Objective	» To retain full biological activity and functionality of topsoil » To retain desirable natural vegetation, where possible » To minimise footprints of disturbance of vegetation/habitats » Remove and store all topsoil on areas that are to be excavated;

	and use this topsoil in subsequent rehabilitation of disturbed areas » Minimise spoil material
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Mitigation: Action/Control	Responsibility	Timeframe
Areas to be cleared must be clearly marked on-site to eliminate the potential for unnecessary disturbance. » All woody material cleared must be shredded to coarse chips	Contractor in consultation with Specialist	Pre-construction
Construction activities must be restricted to demarcated areas so that impact on topsoil is minimised.	Contractor	Before and during construction, operational phase
Salvaging topsoil: » Topsoil must always be salvaged and stored separately from subsoil and lower-lying parent rock or other spoil material. <ul style="list-style-type: none"> ○ Topsoil stripping removes up to 30 cm or less of the upper soils, depending on the site conditions. ○ In cultivated areas, depth of topsoil may increase and needs to be confirmed with the land owner » Prior to salvaging topsoil the depth, quality and characteristics of topsoil should be known for every management area. <ul style="list-style-type: none"> ○ This will give an indication of total volumes of topsoil that need to be stored to enable the proper planning and placement of topsoil storage. ○ Different types of topsoil – rocky soils and sands or loams must be stored separately » Topsoils should be removed (and stored) under dry conditions to avoid excessive compaction whenever topsoil will have to be stored for longer than one year.	Contractor	Before and during construction
Storing topsoil: » Viability of stored topsoil depends on moisture, temperature, oxygen, nutrients and time stored. » Rapid decomposition of organic material in warm, moist topsoils rapidly decreases microbial activity necessary for nutrient cycling, and reduces the amount of beneficial micro-organisms in the soil. » Stockpile location if not adjacent to a linear development: <ul style="list-style-type: none"> ○ At least 50 m from any wetland or watering point 	Contractor	Before and during construction

Mitigation: Action/Control	Responsibility	Timeframe
<ul style="list-style-type: none"> o Ideally a disturbed but weed-free area » <i>Topsoil is typically stored in berms with a width of 150 – 200 cm, and a maximum height of 100 cm, preferably lower</i> <ul style="list-style-type: none"> o Place berms along contours or perpendicular to the prevailing wind direction o Adhere to the following general rule: the larger the pile of topsoil storage needs to be, the shorter should be the time it is stored » Topsoil handling should be reduced to stripping, piling (once), and re-application. Between the piling and reapplication, stored topsoils should not undergo any further handling except control of erosion and (alien) invasive vegetation » Where topsoil can be reapplied within six months to one year after excavation, it will be useful to store the topsoil as close as possible to the area of excavation and re-application, e.g. next to cabling trenches <ul style="list-style-type: none"> o In such case, use one side of the linear development for machinery and access only o Place topsoil on the other/far side of this development, followed by the subsoil (also on geotextile) o If there will be a need for long-term storage of topsoil in specified stockpiles, this must be indicated in the design phase already and accompanied by a detailed topsoil stockpile management plan » In cases where topsoil has to be stored longer than 6 months or during the rainy season, soils should be kept as dry as possible and protected from erosion and degradation by: <ul style="list-style-type: none"> o Preventing puddling on or between heaps of topsoil o Or covering topsoil berms o Preventing all forms of contamination or pollution o Preventing any form of compaction o Monitoring establishment of all invasive vegetation and removing such if it appears o Keeping slopes of topsoil at a maximal 2:1 ratio o Monitoring and mitigating erosion where it appears o Where topsoil needs to be stored in excess of one year, it is recommended to either cover the topsoil or allow an indigenous grass cover to grow on it – if this does not happen spontaneously, seeding should be considered 		

Mitigation: Action/Control	Responsibility	Timeframe
<p>Reapplying topsoils:</p> <ul style="list-style-type: none"> » Spoil materials and subsoil must be back-filled first, then covered with topsoil <ul style="list-style-type: none"> ○ It is recommended that where feasible, spoil materials be used to fill in and close old mine pits in the development area that currently pose a great safety risk to man and animals » Generally, topsoils should be re-applied to a depth equal to slightly greater than the topsoil horizon of a pre-selected undisturbed reference site » The minimum depth of topsoil needed for revegetation to be successful is approximately 20 cm » If the amount of topsoil available is limited, a strategy must be worked out to optimise revegetation efforts with the topsoil available » Reapplied topsoils should be landscaped in a way that creates a variable microtopography of small ridges and valleys that run parallel to existing contours of the landscape. The valleys become catch-basins for seeds and act as run-on zones for rainfall, increasing moisture levels where the seeds are likely to be more concentrated. This greatly improves the success rate of revegetation efforts. » To stabilise reapplied topsoils and minimise raindrop impact and erosion: <ul style="list-style-type: none"> ○ Use organic material from cleared and shredded woody vegetation where possible ○ Alternatively, suitable geotextiles or organic erosion mats can be used as necessary » Continued monitoring will be necessary to detect any sign of erosion early enough to allow timeous mitigation 	Contractor	Before and during construction
<p>Re-applied topsoils need to be re-vegetated as soon as possible, following the revegetation and rehabilitation plan.</p>	Contractor	Before and during construction, monitored during operational phase
<p>If an activity will mechanically disturb below surface in any way, then the upper 10-30 cm of topsoil (depending on the specific topsoil depth at the site of disturbance) should first be stripped from the entire disturbed surface and stockpiled for re-spreading during rehabilitation.</p>	Contractor	Duration of the construction phase
<p>Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them.</p>	Contractor	Duration of the construction

Mitigation: Action/Control	Responsibility	Timeframe
		phase
Dispose of all subsurface spoils from excavations where they will not impact on agricultural land (for example on road surfaces) or where they can be effectively covered with topsoil.	Contractor	Duration of the construction phase

Performance Indicator	<ul style="list-style-type: none"> » Minimal disturbance outside of designated work areas. » Topsoil appropriately stored, managed, and rehabilitated.
Monitoring	<ul style="list-style-type: none"> » Monitoring of appropriate methods of vegetation clearing and soil management activities by ECO throughout construction phase. » An incident reporting system will be used to record non-conformances to the EMP. » Regular monitoring of topsoil after construction by developer until such topsoil can be regarded as fully rehabilitated, stable and no longer prone to accelerated erosion » Establish an effective record keeping system for each area where soil is disturbed for constructional purposes. These records should be included in environmental performance reports, and should include all the records below. » Record the GPS coordinates of each area. » Record the date of topsoil stripping. » Record the GPS coordinates of where the topsoil is stockpiled. » Record the date of cessation of constructional (or operational) activities at the particular site. » Photograph the area on cessation of constructional activities. » Record date and depth of re-spreading of topsoil. » Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.

OBJECTIVE C6: Manage and reduce the impact of invasive vegetation

Within the project area invasive species – indigenous and alien - occur, which all have a potential of reproducing to such an extent that the ecosystem within and beyond the project area could be impaired. Additional alien species grow along major transport routes to the area and thus could be potentially spread there as well. Indigenous invasive species that need to be controlled. *Acacia mellifera* subsp. *mellifera*, *Rhigozum trichotomum*, *Lycium* species, *Phaeoptilum spinosum*

Alien invasives that must be controlled and eradicated to prevent degradation:

. Weeds and potentially invasive species on and around the site that need to be monitored and managed: *Prosopis* species, *Salsola kali*, *Opuntia* species,

Argemone ochroleuca, *Nicotiana glauca*, *Tribulus zeyheri*, *Tribulus terrestris*,
Datura species

Project Component/s	<ul style="list-style-type: none"> » Permanent and temporary infrastructure » Access roads
Potential Impact	<ul style="list-style-type: none"> » Impacts on natural vegetation » Impacts on soil » Impact on faunal habitats » Degradation and loss of agricultural potential
Activity/Risk Source	<ul style="list-style-type: none"> » Transport of construction materials to site » Movement of construction machinery and personnel » Site preparation and earthworks causing disturbance to indigenous vegetation » Construction of site access road » Stockpiling of topsoil, subsoil and spoil material » Routine maintenance work – especially vehicle movement
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To significantly reduce the presence of weeds and eradicate alien invasive species » To avoid the introduction of additional alien invasive plants to the project control area » To avoid further distribution and thickening of existing alien plants on the project area » To complement existing alien plant eradication programs in gradually causing a significant reduction of alien plant species throughout the project control area

Mitigation: Action/Control	Responsibility	Timeframe
Compile a detailed invasive plant management and monitoring programme as guideline for the entire construction, operational and decommissioning phase <ul style="list-style-type: none"> » This plan must contain WfW-accepted species-specific eradication methods » It must also provide for a continuous monitoring programme to detect new infestations 	Specialist	Pre-construction
Avoid creating conditions in which invasive plants may become established: <ul style="list-style-type: none"> » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Shred all non-seeding material from cleared invasive shrubs and other vegetation and use as mulch as part of the rehabilitation and revegetation plan » Where possible, destroy seeding material of weeds and invasives by piling burning (in designated areas or suitable containers) » Do not import soil from areas with alien plants 	Contractor, monitored by ECO	Construction phase Operational phase

Mitigation: Action/Control	Responsibility	Timeframe
<ul style="list-style-type: none"> » Eradicate all invasive plants that occur within the development's temporary and permanent footprint areas » Ensure that material from invasive plants that can regenerate – seeds, suckers, plant parts are adequately destroyed and not further distributed 	Contractor, monitored by ECO Contractor, monitored by ECO	Construction phase Operational phase
<ul style="list-style-type: none"> » Immediately control any alien plants that become newly established using registered control measures 	Contractor, monitored by ECO	Construction phase Operational phase
Risks from alien invasives do not only arise from invasives present within the footprint area, but also from alien invasives along the verges of the major transport routes, especially invasive grasses and smaller weeds. Similarly, invasives can be spread by construction processes to surrounding areas. To avoid the distribution of weeds and invasive plants, establish a routine amongst contractors/all staff to regularly check: <ul style="list-style-type: none"> » that clothing and shoes are free of mud and seeds » that foot wells inside vehicles and mats are cleared of weed seed » radiator and grill, along wheel trims, around wheels, mud flaps, undercarriage of vehicle or other moving machinery for mud and seed » 	Contractor, monitored by ECO	Construction phase Operational phase

Performance Indicator	<ul style="list-style-type: none"> » Visible reduction of number and cover of alien invasive plants within the project area. » Improvement of vegetation cover from current dominance of invasive shrubs to dominance of perennial grasses and dwarf shrubs » No establishment of additional alien invasive species.
Monitoring	<ul style="list-style-type: none"> » Ongoing monitoring of area by ECO during construction. » Ongoing monitoring of area by EO during operation » Audit every two to three years by a suitably qualified botanist to assess the status of infestation and success of eradication measures » If new infestations are noted these must be recorded. A comprehensive eradication programme with the assistance of the WfW (Working for Water) Programme is advisable.

OBJECTIVE C7: Appropriate management of the construction site and construction workers

It is expected that all construction staff will reside within existing accommodation in nearby townships. No staff may be accommodated on site. Construction

equipment and machinery may need to be stored at an appropriate location on the site for the duration of the construction period, and temporary staff facilities will have to be made available. However, washing and servicing of vehicles on site is not permitted.

Project Component/s	Project components affecting the objective: <ul style="list-style-type: none"> » Construction equipment camps » Facilities for storing, mixing and general handling of materials » Access roads
Potential Impact	<ul style="list-style-type: none"> » Damage to indigenous natural vegetation; » Damage to and/or loss of topsoil; » Initiation of accelerated erosion; » Compacting of ground; and » Pollution of the surrounding environment due to excessive dust, inadequate and/or inappropriate facilities provided or procedures implemented
Activities/Risk Sources	<ul style="list-style-type: none"> » Vegetation clearing and levelling of temporary construction or storage area/s; » Transport to and from the temporary construction or storage area/s; » Types of materials or equipment and the manner in which they are stored or handled; » Dust emissions
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To minimise impacts on the biophysical environment » To prevent any residual or cumulative impacts arising from temporary construction or storage areas

Mitigation: Action/Control	Responsibility	Timeframe
<ul style="list-style-type: none"> » The location of the construction equipment camp and all access routes will take cognisance of any ecologically sensitive areas identified. » The location of this construction equipment camp shall be approved by the project ECO or the specialist doing the pre-commencement footprint investigation 	Contractor/ECO	Pre-construction
No temporary site camps will be allowed outside the footprint of the development area. <ul style="list-style-type: none"> » To minimise the footprint, temporary storage of equipment and materials on site should be kept at a minimum 	Contractor, monitored by ECO	Construction
As far as possible, minimise natural and semi-natural vegetation clearing for equipment storage areas. <ul style="list-style-type: none"> » Aim to locate the temporary construction camps on already disturbed areas 	Contractor, monitored by ECO	During site establishment
Staff shall be supplied with adequate facilities aimed at preventing any kind of pollution	Contractor, monitored by	Construction, Operational

Mitigation: Action/Control	Responsibility	Timeframe
<ul style="list-style-type: none"> » Cooking on open fires must be prohibited, if staff need cooking/kitchen facilities on site, such should be provided by the contractor 	ECO	phase
<p>Identify and demarcate construction areas, servitudes, and access for general construction work and restrict construction activity to these areas.</p> <ul style="list-style-type: none"> » Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling) » Create specific turning points and parking areas for vehicles and heavy machinery as needed » Strictly prohibit any driving outside designated areas and roads » Control dust 	Contractor, ECO to control	Before and during construction, operational phase
<p>To limit the possible distribution of undesirable species and possible pollutants onto site:</p> <ul style="list-style-type: none"> » Regularly check clothing and vehicles for mud and seed and clear in an appropriate manner (see invasive plant management for more details) » Do not wash down any machinery or vehicle within the farm portion, including the footprint area » No vehicles shall be serviced on the affected land portion » All materials moved onto the development site must be free of weeds or any other undesirable organisms or pollutants » It is recommended that fuels, lubricants and other chemicals only be stored on site if absolutely necessary, and then in a manner that prevents any accidental spillage 	Contractor, ECO to control	Before and during construction, operational phase
Rehabilitate and revegetate all disturbed areas at the construction equipment camp as soon as construction is complete within an area and mitigate erosion where required as per specific management plans	Contractor, rehabilitation contractor, monitored by ECO	Construction, operational phase

Performance Indicator	<ul style="list-style-type: none"> » No visible erosion scars or any pollution once construction in an area is completed » All damaged areas successfully rehabilitated one year after completion » No damage to drainage lines or other types of wetland areas » Appropriate waste management
Monitoring	<ul style="list-style-type: none"> » Regular monitoring and audits of the construction camps and temporary structures on site by the ECO » A photographic record must be established before, during and after mitigation

» An incident reporting system should be used to record non-conformances to the EMP, followed by the necessary action from the developer to ensure full compliance

OBJECTIVE C8: Maximise local employment and business opportunities associated with the construction phase

Employment opportunities will be created during the construction phase (i.e. ~300 staff at peak periods of construction), specifically for semi-skilled and unskilled workers. The unemployment rate in the study area is noted to be high and there will therefore be individuals in the area in search of employment. Employment of locals and the involvement of local SMMEs would enhance the social benefits associated with the project, even if the opportunities are only temporary. The procurement of local goods could furthermore result in positive economic spin-offs.

Project Component/s	Construction and establishment activities associated with the establishment of the solar energy facility, including infrastructure .
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 to undertake the work and 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	Employ local labour as far as possible

Mitigation: Action/Control	Responsibility	Timeframe
Where required, implement appropriate training and skills development programmes prior to the initiation of the construction phase.	Developer	Where required, training and skills development programmes to be initiated prior to the initiation of the construction phase
Skills audit to be undertaken to determine training and skills development requirements.	Developer	Skills audit to determine need for training and skills development programme undertaken within 1-month of commencement of

Mitigation: Action/Control	Responsibility	Timeframe
		construction phase commences.
Develop a database of local BEE service providers and ensure that they are informed of tenders and job opportunities.	Developer	Database of potential local BEE services providers to be completed before construction phase commences.
Identify potential opportunities for local businesses.	Developer	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » Employment and business policy document that sets out local employment and targets completed before construction phase commences. » Majority of semi and unskilled labour locally sourced. » 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 within 1 month of commencement of construction phase.
Monitoring	<ul style="list-style-type: none"> » The proponent and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE C9: Avoid the potential impacts on family structures and social networks associated with presence of construction workers from outside the area

While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on the local community. In this regard the most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to the potential behaviour of male construction workers, including an increase in alcohol and drug use, an increase in crime levels, the loss of girlfriends and or wives to construction workers, an increase in teenage and unwanted pregnancies, an increase in prostitution and an increase in sexually transmitted diseases.

The potential risk to local family structures and social networks is, however, likely to be low. The low and semi-skilled workers are likely to be local residents and will therefore form part of the local family and social network.

Project Component/s	Construction and establishment activities associated with the establishment of the solar energy facility, including infrastructure.
Potential Impact	The presence of construction workers who live outside the area and who are housed in local towns can impact on family structures and social networks.
Activities/Risk Sources	The presence of construction workers can impact 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
Ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct. Ensure that construction workers attend a briefing session before activities on site commence. 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.	Contractors	Prior to the commencement of construction
Ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct.	Contractors	Prior to the commencement of construction
Construction workers who are found guilty of breaching the Code of Conduct must follow disciplinary processes in terms of the South African Labour Laws. All dismissals must be in accordance with South African labour legislation.	Contractors	Construction phase
Provide opportunities for workers to travel to their home town at regular intervals or over weekends.	Contractors	Construction phase
Adhere to OHS legal requirements and measures contained in the EMP	Contractors	Construction
Establish and implement OHS procedures for employees on site, including use of Personal Protection Equipment (PPE)	Contractors	Construction

Performance	» Employment policy and tender documents that sets out local
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Indicator	employment and targets completed before construction phase commences. <ul style="list-style-type: none"> » Majority of semi and unskilled labour locally sourced. » Local construction workers employed have proof that they have lived in the area for five years or longer. » Tender documents for contractors include recommendations for construction camp. » Code of Conduct drafted before commencement of construction phase. » Briefing session with construction workers held at outset of construction phase.
» Monitoring	» The proponent and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE C10: Minimise impacts related to traffic management and transportation of equipment and materials to site (Traffic Management and Transportation Plan)

The construction phase of the project will be the most significant in terms of generating traffic impacts; resulting from the transport of equipment (including PV panels 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 and external works outside the site boundary.

Transport to site of materials, water and other requirements to site will be via the via a secondary (gravel) road that bridges the Orange River from the N10 national road near Grootdrink; or alternatively via the N14 onto a secondary road heading south next to the site. The site is therefore appropriately located for easy transport of components and equipment as well as labour movement to and from the site., minor upgrades to existing farm roads will be undertaken and no new roads outside of the development area are anticipated.

The section below provides a guideline for the Traffic Management and Transportation Plan on site and will need to be supplemented with the relevant final transport plan devised by the EPC partner during the final design phase of the facility.

Project Component/s	» Delivery of any component required within the construction phase.
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Potential Impact	<ul style="list-style-type: none"> » Impact of heavy construction vehicles on road surfaces, and possible increased risk in accidents involving people and animals. » Traffic congestion, particularly on narrow roads or on road passes where overtaking is not permitted. » Deterioration of road pavement conditions (both surfaced and gravel road) due to abnormal loads.
Activities/Risk Sources	<ul style="list-style-type: none"> » Construction vehicle movement. » Speeding on local roads. » Degradation of local road conditions. » Site preparation and earthworks. » Foundations or plant equipment installation. » Transportation of ready-mix concrete from off-site batching plant to the site. » Mobile construction equipment movement on-site. » Power line and substation construction activities.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Minimise impact of traffic associated with the construction of the facility on local traffic volume, existing infrastructure, property owners, animals, and road users. » To minimise potential for negative interaction between pedestrians or sensitive users and traffic associated with the facility construction » To ensure all vehicles are roadworthy and all materials/equipment are transported appropriately and within any imposed permit/licence conditions

Mitigation: Action/Control	Responsibility	Timeframe
The contractor's plans, procedures and schedules, as well as the anticipated intrusion impacts should be clarified with affected parties prior to the commencement of construction activities on site.	Developer	Pre-construction
Source general construction material and goods locally where available to limit transportation over long distances.	Developer and Contractor	Pre-construction and construction
Appropriate dust suppression techniques must be implemented to minimise dust from gravel roads.	Developer	Construction
Construction vehicles and those transporting materials and goods should be inspected by the contractor or a sub-contractor to ensure that these are in good working order and not overloaded.	Contractor	Construction
Strict vehicle safety standards should be implemented and monitored.	Developer	Construction
All relevant permits for abnormal loads must be applied for from the relevant authority.	Contractor (or appointed transportation contractor)	Pre-construction

Mitigation: Action/Control	Responsibility	Timeframe
A designated access to the proposed site must be created to ensure safe entry and exit.	Contractor	Pre-construction
No deviation from approved transportation routes must be allowed, unless roads are closed for whatever reason outside the control of the contractor.	Contractor	Duration of contract
Appropriate road management strategies must be implemented on external and internal roads with all employees and contractors required to abide by standard road and safety procedures.	Contractor (or appointed transportation contractor)	Pre-construction
Any traffic delays because of construction traffic must be co-ordinated with the appropriate authorities.	Contractor	Duration of contract
The movement of all vehicles within the site must be on designated roadways. Signage must be appropriately maintained and placed in areas visible to all road users.	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). Signage must be appropriately maintained and placed in areas visible to all road users.	Contractor	Duration of contract
Appropriate maintenance of all vehicles must be ensured.	Contractor	Duration of contract
All vehicles of the contractor 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
Signs must be placed along construction roads to identify speed limits, travel restrictions and other standard traffic control information.	Contractor	Duration of contract
<ul style="list-style-type: none"> » Install temporary high visibility advanced warning signs Types W107 and W108 (intersection ahead) on the gravel road both directions prior to construction. » Install permanent high visibility advance warning signs - Types W107 and W108 (Intersection Ahead) - on the gravel road once operation commences » Maintain communication with the Northern Cape Provincial road authority regarding their requirements for measures to be instituted 	Contractor	Duration of contract

Performance » Vehicles keeping to the speed limits within the site and on

Indicator	public roads. » Vehicles are in good working order and safety standards are implemented. » Local residents and road users are aware of vehicle movements and schedules. » No construction traffic related accidents are experienced. » Local road conditions and road surfaces are up to standard. » Complaints of residents are not received (e.g. concerning the speeding of heavy vehicles).
Monitoring	» Developer and or appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE C11: To avoid and or minimise the potential impact of the activities during the construction on the safety of local communities and the potential loss of stock and damage to farm infrastructure

An inflow of workers could, as a worst case scenario and irrespective of the size of the workforce, pose some security risks. Criminals could also use the opportunity due to “outsiders” being in the area to undertake their criminal activities.

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure .
Potential Impact	» Impact on safety of farmers and communities (increased crime) and potential loss of livestock due to stock theft by construction workers and also damage to farm infrastructure, such as gates and fences.
Activities/Risk Sources	» The presence of construction workers on the site can pose a potential safety risk to local farmers and communities and may result in stock thefts. The activities of construction workers may also result in damage to farm infrastructure.
Mitigation: Target/Objective	» To avoid and or minimise the potential impact on local communities and their livelihoods.

Mitigation: Action/Control	Responsibility	Timeframe
Inform all workers of the conditions contained in the Code of Conduct.	Contractor	Pre-construction
Dismiss all workers that do not adhere to the code of conduct for workers. All dismissals must be in accordance with South African labour legislation	Contractor	Construction
Compensate farmers / community	Contractors	Construction phase

Mitigation: Action/Control	Responsibility	Timeframe
members at full market related replacement cost for <i>proven</i> losses resulting from contractors on the site, which may include livestock loss, damage to infrastructure .		
Develop & Implement a Health & Safety Plan. Train staff on the H&S Plan	Developer & Contractor	Construction & Operations

Performance Indicator	» All construction workers made aware of Code of Conduct within first week of being employed.1
Monitoring	» The proponent and or appointed ECO must report on the indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE C12: Management of dust, vehicle emissions and damage to roads

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 establishment of the PV facility, including infrastructure
Potential Impact	» Heavy vehicles can generate noise and dust impacts. Movement of heavy vehicles can also damage roads.
Activities/Risk Sources	» The movement of heavy vehicles and their activities on the site can result in noise and dust impacts and damage roads.
Mitigation: Target/Objective	» To avoid and or minimise the potential noise and dust impacts associated with heavy vehicles, and minimise damage to roads.

Mitigation: Action/Control	Responsibility	Timeframe
Maintain communication with Northern Cape Provincial Roads authority regarding their requirements for measures to be instituted regarding use of and impacts on the N10 and N14 road.	Developer and Contractor	Duration of Construction
Implement appropriate dust suppression measures for heavy vehicles: » wetting roads on a regular basis » ensuring that vehicles used to transport sand and building materials are fitted with	Contractors	Duration of Construction

Mitigation: Action/Control	Responsibility	Timeframe
tarpaulins or covers.		
Ensure that all vehicles are road-worthy; drivers are qualified and are made aware of the potential noise, dust and safety issues.	Contractors	Duration of Construction
Ensure that drivers adhere to speed limits within the site and on public roads. Vehicles should be fitted with recorders to record when vehicles exceed the speed limit.	Contractors	Duration of Construction
Ensure that damage to roads attributable to construction activities associated with the PV facility is repaired before completion of construction phase.	Contractors	Duration of Construction
Clearly demarcate construction areas	Contractors	Duration of Construction

Performance Indicator	<ul style="list-style-type: none"> • Dust suppression measures 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	<ul style="list-style-type: none"> » The proponent and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase

OBJECTIVE C13: Minimise soil degradation and erosion (Erosion management Plan)

Compacted and/or denuded and disturbed soils are usually prone to surface capping – even more so if the soils are dispersive or have a fine texture due to higher clay or loam contents. Such capped soils are prone to ever increasing erosion, creating a dysfunctional landscape and ecosystem that rapidly loses soil, nutrients and seeds from the ecosystem.

Naturally occurring herbaceous and dwarf shrub vegetation not only protects the soil surface from direct raindrop impact, but a high portion of biomass in the upper 20 – 50 cm of the soil significantly increases rapid infiltration of rainwater, whilst also binding soil particles and thus preventing erosion. A highly disturbed or reduced vegetation layer will thus naturally be accompanied by higher runoff levels and accelerated erosion, especially during extreme weather events.

The measures below indicate the minimum mitigation that will be required for erosion and storm water control. A more specific erosion management plan will be possible after the final layouts and choice of PV array components are known.

Definitions:

Accelerated soil erosion: Soil erosion induced by human activities and ultimately leading to irreversible degradation of the ecosystem and loss of ecosystem functionality

Project Component/s	Project components affecting the objective: <ul style="list-style-type: none"> » PV Array » Grid connection and associated servitudes » Access roads » Workshop, guardhouses, substation and other related infrastructure » Potential topsoil stockpiles and/or borrow pits
Potential Impact	<ul style="list-style-type: none"> » Loss of topsoil and natural resources and biological activity within the topsoil » Loss of natural regeneration potential of soils » Loss of agricultural potential of soils.
Activity/Risk Source	<ul style="list-style-type: none"> » Rainfall and wind erosion of disturbed areas » Excavation, stockpiling and compaction of soil » Concentrated discharge of water from construction activity and new infrastructure » Storm water run-off from sealed, altered or bare surfaces » Construction equipment and vehicle movement on site » Cabling and road construction activities » Power line construction activities » Roadside drainage ditches » Premature abandonment of follow-up monitoring and adaptive management of rehabilitation
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To minimise erosion of soil from site during construction » To minimise deposition of soil into drainage lines » To minimise damage to vegetation by erosion or deposition » To minimise damage to rock, soil, animals and vegetation by construction activity » No accelerated overland flow related surface erosion as a result of a loss of vegetation cover » No reduction in the surface area of natural drainage lines and other wetland areas as a result of the establishment of infrastructure » Minimal loss of vegetation cover due to construction related activities » No increase in runoff into drainage lines as a result of construction of project related infrastructure » No increase in runoff into drainage lines as a result of road

construction		
Mitigation: Action/Control	Responsibility	Timeframe
Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling)	Contractor, ECO to control	Before and during construction
New access roads and other servitudes to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil. Special attention to be given to roads and tracks that cross drainage lines.	Contractor, ECO to control	Before and during construction
Rehabilitate disturbance areas as soon as construction in an area is completed as per the rehabilitation plan.	Contractor, ECO to control	Immediately after construction, monitored during operational phase
<p>General erosion control measures:</p> <ul style="list-style-type: none"> » Runoff control and attenuation can be achieved by using any or a combination of sand bags, logs, silt fences, storm water channels and catch-pits, shade nets, geofabrics, seeding or mulching as needed on and around cleared and disturbed areas <ul style="list-style-type: none"> o Ensure that all soil surfaces are protected by vegetation or a covering to avoid the surface being eroded by wind or water. » Ensure that heavy machinery does not compact areas that are not meant to be compacted as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. » Prevent the concentration or flow of surface water or storm water down cut or fill slopes or along pipeline routes or roads and ensure measures to prevent erosion are in place prior to construction. » Storm water and any runoff generated by hard impervious surfaces should be discharged into retention swales or areas with rock rip-rap. These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that flows are managed prior to being discharged back into the natural water courses, thus not only preventing erosion, but also supporting the maintenance of 	Contractor, ECO to control	Construction, operational phase

Mitigation: Action/Control	Responsibility	Timeframe
<p>natural base flows within these systems, i.e. hydrological regime (water quantity and quality) is maintained.</p> <ul style="list-style-type: none"> » Mitigate against siltation and sedimentation of wetlands using the above mentioned structures and ensure that no structures cause erosion. » Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation. » Vegetation clearing should occur in parallel with the construction progress to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment » If implementing dust control measures, prevent over-wetting, saturation, and run-off that may cause erosion and sedimentation » Water course / river crossings should not trap any run-off, thereby creating inundated areas, but allow for free flowing water 		
<p>Control depth of excavations and stability of cut faces/sidewalls</p>	<p>Contractor, to be monitored by ECO</p>	<p>Site establishment & duration of contract</p>
<p>Compile a comprehensive storm water management method statement, as part of the final design of the project and implement during construction and operation.</p>	<p>Developer, Contractor, to be monitored by ECO</p>	<p>Site establishment & duration of contract</p>
<p>Where access roads cross natural drainage lines or wetlands, culverts (or other appropriate measures) must be designed to allow free flow. Regular maintenance must be carried out.</p>	<p>Contractor, ECO to control</p>	<p>Construction phase Operational phase, monitored throughout</p>
<p>All vehicles on site must be appropriate to access the site. No off-road driving is permitted unless authorised by the ECO.</p>	<p>Contractor, to be monitored by ECO</p>	<p>Pre-construction, Construction & operation</p>

<p>Performance Indicator</p>	<ul style="list-style-type: none"> » Minimal level of soil erosion around site » Minimal level of increased siltation in drainage lines or pans » Minimal level of soil degradation » Acceptable state of excavations, as determined by EO & ECO » Progressive return of disturbed and rehabilitated areas to the
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	desired end state (Refer also to the Plant Rescue and Rehabilitation Plan)
Monitoring	<ul style="list-style-type: none"> » Fortnightly inspections of the site by ECO » Fortnightly inspections of sediment control devices by ECO » Fortnightly inspections of surroundings, including drainage lines by ECO » Immediate reporting of ineffective sediment control systems » An incident reporting system must record non-conformances according to the EMP.

OBJECTIVE C14: Limit impacts on heritage resources

Generally very sparse heritage traces were found over most of the proposed development area in two portions of the Namakwari property, designated Kheis Solar 1. From an archaeological perspective the observed heritage resources over the areas surveyed were found to be mainly of low density and low significance. A colonial era farm dwelling, modified through time, and now in a state of ruin, was recorded at Sterkstroom. It is not considered to be of major heritage significance. The potential risk for any negative impact on the paleontological heritage in Kheis Solar Park 2 is categorised as improbable due to the general scarcity of fossils in the unit and as *no fossil materials* were located within the project area

Project component/s	Any road or other linear construction over and above what is necessary and any spatial extension of other components addressed in this EIA.
Potential Impact	The potential impact if this objective is not met is that wider areas or extended linear developments may result in further destruction, damage, excavation, alteration, removal or collection of heritage objects from their current context on the site.
Activity/risk source	Activities which could impact on achieving this objective include deviation from the planned lay-out of infrastructure without taking heritage impacts into consideration.
Mitigation: Target/Objective	Mitigation measures are not considered necessary. However, a facility environmental management plan must take cognizance of heritage resources in the event of any future extensions of any infrastructure.

Mitigation: Action/control	Responsibility	Timeframe
Should archaeological sites, graves or	Environmental	Environmental

Mitigation: Action/control	Responsibility	Timeframe
fossils be exposed during construction work, work in the area must be stopped and the find must immediately be reported to a suitably qualified heritage practitioner such that an investigation and evaluation of the finds can be made.	management provider with on-going monitoring role set up by the developer.	management plan to be in place before commencement of development.
If required, measures must be put in place to prevent vandalism of any archaeological heritage.	Contractor	Construction
The EO must be trained in basic archaeological site identification in order to immediately inform the archaeologist of any chance discovery of archaeological sites or burials. The archaeologist will then implement the required legal steps in terms of the applicable section of the NHRA.	Contractor Specialist	Construction
The Contractor shall make provision for accidental discovery of archaeological sites and graves on the construction site. In the event that any sites found are significant enough to warrant conservation, the Contractor shall ensure that the requirements of SAHRA are fulfilled.	Contractor	Construction
The Contractor shall also prepare the necessary documentation and obtain the permits from the SAHRA to construct through a site which is directly affected by the construction works but is considered to be of low significance. It should be noted that buildings 60 years and older must be assessed and a permit obtained from SAHRA before demolition is considered.	Contractor	Construction
Exclusion of the western-most fringe of the proposed development area	Contractor	Construction

Performance Indicator	Inclusion of further heritage impact consideration in any future extension of infrastructural elements.
Monitoring	Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility.

OBJECTIVE C15: The mitigation and possible negation of the visual impacts associated with the construction of the solar energy facility.

During the construction phase heavy vehicles, components, equipment and construction crews will frequent the area and may cause, at the very least, a cumulative visual nuisance to landowners and residents in the area as well as road users. 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	Construction site
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (within 2km of the site).
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	Developer	Pre-construction
Reduce the construction period through careful logistical planning and productive implementation of resources.	Developer	Construction
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	Developer	Construction
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Developer	Construction
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.	Developer	Construction
Reduce and control construction dust	Developer	Construction

Mitigation: Action/Control	Responsibility	Timeframe
through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).		
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Developer	Construction
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.	Developer	Construction

Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of construction contract).

OBJECTIVE C16: Appropriate handling and management of waste

The main wastes expected to be generated by the construction of the solar energy facility will include general construction waste, hazardous waste (i.e. fuel), and liquid waste (including grey water and sewage). In order to manage the wastes effectively, guidelines for the assessment, classification, and management of wastes, along with industry principles for minimising construction wastes must be implemented. A guideline for integrated management of construction waste is included as Appendix D and a generic waste management plan is included as Appendix F.

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Power line. » Ancillary buildings. » Access roads.
Potential Impact	<ul style="list-style-type: none"> » Inefficient use of resources resulting in excessive waste generation. » Litter or contamination of the site or water through poor waste management practices.
Activity/Risk	<ul style="list-style-type: none"> » Packaging.

Source	<ul style="list-style-type: none"> » Other construction wastes. » Hydrocarbon use and storage. » Spoil material from excavation, earthworks, and site preparation.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To comply with waste management legislation. » To minimise production of waste. » To ensure appropriate waste storage and disposal. » To avoid environmental harm from waste disposal.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure that sanitation facilities are well managed and used appropriately so as not to pose a health and environmental hazard, waste manifests should be developed for the ablutions showing proof of disposal of sewage at appropriate water treatment works.	Contractor	Duration of contract
Construction method and materials should be carefully considered in view of waste reduction, re-use, and recycling opportunities.	Contractor	Duration of contract
Construction contractors must provide specific detailed waste management plans to deal with all waste streams.	Contractor	Duration of contract
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 as required. 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 practically 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).	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
Uncontaminated waste will be removed at least weekly for disposal; other wastes will be removed for recycling/ disposal at an appropriate frequency.	Contractor	Duration of contract
Hydrocarbon and other hazardous waste must be contained and stored in sealed containers within an appropriately bunded area.	Contractor	Duration of contract
Waste must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
Documentation (waste manifest) must be maintained detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.	Contractor	Duration of contract
Regularly serviced chemical toilets facilities must be used to ensure appropriate control of sewage, proof . of disposal for this waste needs to be kept on record	Contractor	Duration of contract
Upon the completion of construction, the area must be cleared of potentially polluting materials.	Contractor	Completion of construction
Dispose of all solid waste collected at an appropriately registered waste disposal site. Waste disposal shall be in accordance with all relevant legislation and under no circumstances may waste be burnt on site.	Contractor	Duration of construction
Where a registered waste site is not available close to the construction site, provide a method statement with regard to waste management.	Contractor	Duration of construction

Performance Indicator	<ul style="list-style-type: none"> » 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	<ul style="list-style-type: none"> » Observation and supervision of waste management practices throughout construction phase. » Waste collection will be monitored on a regular basis. » Waste documentation completed. » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon. » An incident reporting system will be used to record non-conformances to the EMPr.

OBJECTIVE C17: Appropriate handling and storage of chemicals, hazardous substances

The construction phase will involve the storage and handling of a variety of chemicals including fuels, adhesives, abrasives, oils and lubricants, paints and solvents.

Project	» Storage and handling of chemicals, hazardous substances.
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Component/s	
Potential Impact	<ul style="list-style-type: none"> » Release of contaminated water from contact with chemicals or hazardous substances. » Generation of contaminated wastes from used chemical or hazardous substances containers.
Activity/Risk Source	<ul style="list-style-type: none"> » Vehicles associated with site preparation and earthworks. » Construction activities of area and linear infrastructure. » Hydrocarbon use and storage.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure that the storage and handling of chemicals, hazardous substances 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.

Mitigation: Action/Control	Responsibility	Timeframe
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Contractor	Pre-construction and implement for 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 halting further contamination, 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
Cement dust, slurry from cement batching, or spilled cement must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	Contractor	Duration of contract
Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility.	Contractor	Duration of contract
Routine servicing and maintenance of vehicles must not to take place outside of designated areas on-site (except in the case of emergency). Where repairs of vehicles take place, an appropriate sealed surface and/or drip tray must be used to contain any fuel or oils.	Contractor	Duration of contract
All stored fuels to be maintained within a bund and on a sealed surface. The bunded area must be provided	Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
with a tap-off system through which spillages and leakages that might occur will be removed without any spillage outside the bunded area.		
Fuel storage areas must be inspected regularly to ensure bund stability, integrity, and function.	Contractor	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 Material Safety Data Sheets (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
The sediment control and water quality structures used on-site must be monitored and maintained in an operational state at all times.	Contractor	Duration of contract
Upon the completion of construction, the area must be cleared of potentially polluting materials.	Contractor	Duration of contract
Spilled concrete will be allowed to dry and removed as soon as possible. Hardened concrete can either be recycled at a crushing facility or batching plant, disposed of as spoil, or be disposed of at a general waste landfill site as waste. This excludes dry cement powder.	Contractor	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » No chemical spills outside of designated storage areas. » No unattended water or soil contamination by spills. » No complaints received regarding waste on site or indiscriminate dumping.
Monitoring	<ul style="list-style-type: none"> » Implement an effective monitoring system to detect any leakage or spillage of all hazardous substances. » 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. » An incident reporting system will be used to record non-conformances to the EMPr.

OBJECTIVE C18 : To avoid and/or minimise the potential risk of increased veld fires during the construction phase

The increased presence of people on the site could increase the risk of veld fires, particularly in the dry season.

Project Component/s	» Construction and establishment activities associated with the establishment of PV facility, including 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
No cooking and no open fires allowed on site. This includes no smoking onsite.	Contractor (and sub-contractor/s)	Duration of contract
Provide adequate fire fighting equipment onsite.	Developer and contractors	Duration of construction
Provide fire-fighting training to selected construction staff.	Contractors	Duration of construction
Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to infrastructure attributable to the construction activities.	Contractors	Duration of construction
Join the local Fire Protection Agency	Developer	Pre-construction

Performance Indicator	<ul style="list-style-type: none"> » Designated areas for fires and smoking identified on site at the outset of the construction phase. » Fire fighting equipment and training provided before the construction phase commences. » Proven compensation claims resolved and settled.
Monitoring	» The developer and/or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

OBJECTIVE C19: Effective management of concrete batching plants

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

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

Project component/s	» Batching plant and associated activities
Potential Impact	<ul style="list-style-type: none"> » Dust emissions » Release of contaminated water » Generation of contaminated wastes from used chemical containers » Inefficient use of resources resulting in excessive waste generation
Activity/risk source	<ul style="list-style-type: none"> » Operation of the batching plant » Packaging and other construction wastes » Hydrocarbon use and storage » Spoil material from excavation, earthworks and site preparation
Mitigation: Target/Objective	» To ensure that the operation of the batching plant does not cause pollution to the environment or harm to persons

Mitigation: Action/control	Responsibility	Timeframe
Where possible concrete batching plants should be sited such that impacts on the environment or the amenity of the local community from noise, odour or polluting emissions are minimised	Contractor	Construction phase
The provision of natural or artificial wind barriers such as trees, fences and landforms may help control the emission of dust from the plant.	Contractor	Construction phase
Where there is a regular movement of vehicles, access and exit routes for heavy transport vehicles should be planned to minimise noise and dust impacts on the environment	Contractor	Construction phase
The concrete batching plant site should demonstrate good maintenance practices, including regular sweeping to prevent dust build-up.	Contractor	Construction phase
The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in a	Contractor	Construction phase

Mitigation: Action/control	Responsibility	Timeframe
sheltered position to minimise the effects of the wind.		
Water sprays or a dust suppression agent should be correctly applied to reduce dust emissions from aggregate material.	Contractor	Construction phase
Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point. Belt cleaning devices at the conveyor head may also assist to reduce spillage.	Contractor	Construction phase
The site should be designed and constructed such that clean stormwater, including roof runoff, is diverted away from contaminated areas and directed to the stormwater discharge system.	Contractor	Construction phase
Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with applicable legislation	Contractor	Construction phase
Contaminated stormwater and process wastewater should be captured and recycled where possible. A wastewater collection and recycling system should be designed to collect contaminated water.	Contractor	Construction phase
Areas where spills of oils and chemicals may occur should be equipped with easily accessible spill control kits to assist in prompt and effective spill control	Contractor	Construction phase
Ensure that all practicable steps are taken to minimise the adverse effect that noise emissions. This responsibility includes not only the noise emitted from the plant and equipment but also associated noise sources, such as radios, loudspeakers and alarms	Contractor	Construction phase
Where possible, waste concrete should be used for construction purposes at the batching plant or project site.	Contractor	Construction phase
Empty cement bags should be collected and disposed appropriately.	Contractor	Construction phase

Performance Indicator	<ul style="list-style-type: none"> » No complaints on dust » No water or soil contamination by chemical spills » No complaints received regarding waste on site or indiscriminate dumping
Monitoring	<ul style="list-style-type: none"> » Observation and supervision of chemical storage and handling

	<p>practices and vehicle maintenance throughout construction phase</p> <ul style="list-style-type: none"> » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMPr » Developer or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase
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OBJECTIVE C20: Management of the Contractors Camp during construction to avoid negative environmental impacts

The construction camp will include workshop, ablutions and storage area. The location of the construction camp and accommodation facilities must be reflected in the layout plan.

Project component/s	<ul style="list-style-type: none"> » Construction camp - Housing facilities (including kitchens, canteens, toilets, bedrooms and open spaces)
Potential Impact	<ul style="list-style-type: none"> » Water contamination » Waste generation – potential soil pollution » Noise » Traffic » Safety risks
Activities/risk sources	<ul style="list-style-type: none"> » Construction workers » Living areas » Noise due to people residing on the site
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Appropriate management of housing facilities » Zero complaints from surrounding landowners/ community/ stakeholders » Zero pollution/ contamination due to construction camp and facilities

Mitigation: Action/control	Responsibility	Timeframe
A Method Statement for the management of the contractors housing facility and camp considering the recommendations below is to be submitted to the ECO for approval.	Contractor and ECO	Prior to the start of construction
Ensure placement of accommodation/ construction camp away from the resident	Contractor and ECO	Prior to the start of construction

Mitigation: Action/control	Responsibility	Timeframe
farmer's household.		
Ablution facilities shall be provided for use by construction staff residing on site.	Contractor	Construction
Waste bins shall strategically be located around the labour camp for ease of waste management	Contractor	Construction
No littering, burning or burying of waste shall be allowed. The waste should be removed regularly and appropriately disposed of.	Contractor	Construction
Develop a waste management plan for the construction camp.	Contractor	Construction
Excessive noise shall be prohibited at the accommodation facilities.	Contractor	Construction
No open fires shall be permitted out of the designated areas	Contractor	Construction
Safe water for drinking shall be provided at the labour camp	Contractor	Construction
Access to the labour camp shall be limited to labourers residing on site	Contractor	Construction
Designated areas for smoking shall be provided at the labour camp	Contractor	Construction
Due care must be employed in ensuring that water is not wasted at the labour camp	Contractor	Construction
The construction camp used to house equipment an accommodate must be located in a disturbed or low sensitivity area and must be screened off as far as practical during the entire construction phase.	Contractor	Construction
Avoid light pollution due to the construction camp and keep lighting to a minimum.	Contractor	Construction
The location of the construction equipment camp will take cognisance of any ecologically sensitive areas identified. The final location of this construction equipment camp shall be approved by the project ECO and agreed with the landowner.	Contractor	Pre-construction
No temporary site camps will be allowed outside the footprint of the development area.	Contractor	Contract duration
Rehabilitate and re-vegetate all disturbed	Contractor	Duration of Contract

Mitigation: Action/control	Responsibility	Timeframe
areas at the construction equipment camp as soon as construction is complete within an area.		

Performance Indicator	<ul style="list-style-type: none"> » Appropriate management of housing facilities » No complaints from surrounding landowners/ community/ stakeholders » No pollution/ contamination due to construction camp and facilities
Monitoring	<ul style="list-style-type: none"> » ECO to monitor the construction camp for duration of construction period

7.2 Detailing Method Statements

OBJECTIVE C21: Ensure all construction activities are undertaken with the appropriate level of environmental awareness to minimise environmental risk

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

The method statements are not written by the ECO since a method statement is a written submission to the ECO and the Owner's Representative by the EPC Contractor in collaboration with his/her EO.

There are two types of method statements, (1) method statements which carryover throughout the project; which is applicable to all activities and, (2) specific method statements used for one task only. The carryover method statements would be method statements pertaining to (waste management, dust control, cement and concrete batching, top soil management, hydrocarbon and emergency spill procedures, alien and invasive plant control, rehabilitation and plant management, erosion management, storage and management of hazardous substances) the specific method statements are specifically related to one activity. This kind of method statements are drawn up at the beginning of each new task.

The Method Statement must cover applicable details with regard to:

- » Details of the responsible person/s
- » 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.

Method Statements must be compiled for all activities which affect any aspect of the environment and should be applied consistently to all activities. Specific method statements could include:

- » Construction procedures (for example: site clearing, working within watercourses).
- » Materials and equipment to be used.
- » Transporting the equipment to and from the site.
- » How the equipment will be used while on site.
- » How and where the material will be stored.
- » The containment (or action to be taken if containment is not possible) of the leaks or spillages of any liquid or material that may occur.
- » Timing and location of activities.
- » Compliance/Non compliances with the EMPr specifications and any other information that is deemed necessary.
- » Method Statement for Corrective Actions

The Contractor may not commence the activity covered by the Method Statement until it has been approved by the Owner's Representative except in the case of emergency activities and then only with the consent of the Owner's Representative. Approval of the Method Statement will not absolve the Contractor from their obligations or responsibilities in terms of their contract. The content and requirements of Method Statements are to be clearly explained to all plant operators and general workers

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

Once a method statement has been submitted it must be evaluated and checked to ensure that all the activities mentioned on the statement are conducted in a manner which ensures environmental compliance. If all the information on the method statement is correct and compliant, the contractor and the EO must sign the statement. Once all the parties have signed the method statements, copies must be made and submitted to all management parties on site, including the ECO and the EO.

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

7.3 Awareness and Competence: Construction Phase of the Solar Energy Facility

OBJECTIVE C22: To ensure all construction personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm

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

The Contractors obligations in this regard include the following:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » Ensuring that a copy of the EMPr is readily available on-site, and that all site staff are aware of the location and have access to the document.
- » Employees will be familiar with the requirements of the EMPr and the environmental specifications as they apply to the construction of the facility.
- » Employees must undergo training for the operation and maintenance activities associated with a PV plant and have a basic knowledge of the potential environmental impacts that could occur and how they can be minimised and mitigated.

- » Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended an Environmental Awareness Training course.
- » The course should be sufficient to provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Awareness of any other environmental matters, which are deemed necessary by the ECO.
- » Ensuring that employee information posters, outlining the environmental "do's" and "don'ts" (as per the environmental awareness training course) are erected at prominent locations throughout the site.
- » Ensure that construction workers have received basic training in environmental management, including the storage and handling of hazardous substances, minimisation of disturbance to sensitive areas, management of waste, and prevention of water pollution.
- » Records must be kept of those that have completed the relevant training.
- » Training should be done either in a written or verbal format but must be appropriate for the receiving audience.
- » Refresher sessions must be held to ensure the contractor staff are aware of their environmental obligations as practically possible.

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

7.3.1 Environmental Awareness Training

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

7.3.2 Induction Training

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

This induction training should include discussing the developer's environmental policy and values, the function of the EMPr and Contract Specifications and the importance and reasons for compliance to these. The induction training must

highlight overall do's and don'ts on site and clarify the repercussions of not complying with these. The non-conformance reporting system must be explained during the induction as well. Opportunity for questions and clarifications must form part of this training. A record of attendance of this training must be maintained by the SHE Officer on site.

7.3.3 Toolbox Talks

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

7.4 Monitoring Programme: Construction Phase

OBJECTIVE C23: To monitor the performance of the control strategies employed against environmental objectives and standards

A monitoring programme must be in place not only to ensure conformance with the EMPr, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are, or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly dictated, the developer 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 EMPr, will conduct monitoring activities, and will report any non-compliance or where corrective action is necessary to the Site Manager and/or any other monitoring body stipulated by the regulating authorities. The ECO must have the appropriate experience and qualifications to undertake the necessary tasks. The following reports will be applicable:

7.4.1 Non-Conformance Reports

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

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

7.4.2 Monitoring Reports

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

7.4.3 Final Audit Report

A final environmental audit report must be submitted to DEA upon completion of the construction and rehabilitation activities. This report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions (as appropriate) and the requirements of the EMPr.

MANAGEMENT PROGRAMME: REHABILITATION

CHAPTER 8

Overall Goal: 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.

8.1. Objectives

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

OBJECTIVE R1: Ensure appropriate rehabilitation of disturbed areas such that residual environmental impacts are remediated or curtailed

Immediately after clearing of vegetation, the soil surface must be inspected for signs of erosion and stabilised as soon as possible. After completion of construction, such erosion stabilisation should preferably be with a cover of vegetation. A perennial vegetation cover of at least 30%, preferably more, will be desirable (where it is permissible).

The aim of the first vegetation cover is to form a protective, relatively dense indigenous layer to slow runoff, increase moisture infiltration into the soil, and gradually change the soil nutrient status in order for it to be more favourable for other desirable indigenous vegetation to become established.

The first vegetation layer must be developed further until a desirable end state, as determined during the design phase and taking the original vegetation description as guideline, is established.

Project Component/s	Project components affecting the objective: <ul style="list-style-type: none"> » PV Array supports and trenching » Grid connection and associated servitudes » Access roads » Workshop, guardhouses, substation and other related infrastructure » Potential topsoil stockpiles and/or borrow pits
Potential Impact	<ul style="list-style-type: none"> » Within the footprint, a change of plant species composition with lower productivity and agricultural potential can be expected due to removal, disturbance and continued long-term shading of vegetation » A largely reduced vegetation cover will cause the ecosystem to

	<ul style="list-style-type: none"> » be more prone to erosion and irreversible degradation » Disturbance of indigenous vegetation creates opportunities for the establishment of invasive vegetation or creation of surfaces that do not support the permanent (re-) establishment of vegetation » Loss of natural regeneration potential of soils » Loss of agricultural potential of soils.
Activity/Risk Source	<ul style="list-style-type: none"> » Site preparation and earthworks » Excavation of foundations and trenches » Construction of site access road » Power line construction activities » PV array construction activities » Stockpiling of topsoil, subsoil and spoil material.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Recreate a non-invasive, acceptable vegetation cover that will facilitate the establishment of desirable and/or indigenous species » Prevent and accelerated erosion of ecosystem degradation

Mitigation: Action/Control	Responsibility	Timeframe
Rehabilitation of surface		
Prior to the application of topsoil <ul style="list-style-type: none"> » subsoil shall be shaped and trimmed to blend in with the surrounding landscape or used for erosion mitigation measures » ground surface or shaped subsoil shall be ripped or scarified with a mechanical ripper or by hand to a depth of 15 – 20 cm » compacted soil shall be ripped to a depth greater than 25 cm and the trimmed by hand to prevent re-compacting the soil » any foreign objects, concrete remnants, steel remnants or other objects introduced to the site during the construction process shall be cleared before ripping, or shaping and trimming of any landscapes to be rehabilitated takes place » shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscapes 	Contractor, ECO to control	During and after construction
Application of topsoil <ul style="list-style-type: none"> » topsoils shall be spread evenly over the ripped or trimmed surface, if possible not deeper than the topsoil originally removed » the final prepared surface shall not be smooth but furrowed to follow the natural contours of the land » the final prepared surface shall be free of any pollution 	Contractor, ECO to control	During and after construction

Mitigation: Action/Control	Responsibility	Timeframe
<p>or any kind of contamination</p> <ul style="list-style-type: none"> » care shall be taken to prevent the compaction of topsoil 		
<p>Soil stabilisation</p> <ul style="list-style-type: none"> » mulch, if available from shredded vegetation, shall be applied by hand to achieve a layer of uniform thickness » mulch shall be rotovated into the upper 10 cm layer of soil <ul style="list-style-type: none"> o this operation shall not be attempted if the wind strength is such as to remove the mulch before it can be incorporated into the topsoil » measures shall be taken to protect all areas susceptible to erosion by installing temporary and permanent drainage work as soon as possible <ul style="list-style-type: none"> o where natural water flow-paths can be identified, subsurface drains or suitable surface drains and chutes need to be installed » additional measures shall be taken to prevent surface water from being concentrated in streams and from scouring slopes, banks or other areas » runnels or erosion channels developing shall be back-filled and restored to a proper condition <ul style="list-style-type: none"> o such measures shall be effected immediately before erosion develops at a large scale » where erosion cannot be remedied with available mulch or rocks, geojute or other geotextiles shall be used to curtail erosion 	Contractor, ECO to control	Construction phase Operational phase, followed up until desired end state is reached
<p>Borrow-pits (if required)</p> <ul style="list-style-type: none"> » shall be shaped to have undulating, low-gradient slopes and surfaces that are rough and irregular, suitable for trapping sediments and facilitation of plant growth » upon completion of rehabilitation these reshaped and revegetated areas shall blend into the natural terrain 	Contractor, ECO to control	After construction
Revegetation		
<ul style="list-style-type: none"> » revegetation of the final prepared area is expected to occur spontaneously to some degree where topsoils could be re-applied within 6 months » revegetation will be done according to an approved planting/landscaping plan according to the desirable end states and permissible vegetation 	Contractor, ECO to control	Construction phase Operational phase, followed up until desired end state is reached

Mitigation: Action/Control	Responsibility	Timeframe
<p>Re-seeding</p> <ul style="list-style-type: none"> » revegetation can be increased where necessary by hand- seeding indigenous species <ul style="list-style-type: none"> * previously collected and stored seeds shall be sown evenly over the designated areas, and be covered by means of rakes or other hand tools * commercially available seed of grass species naturally occurring on site can be used as alternative » re-seeding shall occur at the recommended time to take advantage of the growing season » in the absence of sufficient follow-up rains after seeds started germinating, irrigation of the new vegetation cover until it is established shall become necessary to avoid loss of this vegetative cover and the associated seedbank 	<p>Contractor, ECO to control</p>	<p>Construction phase Operational phase, followed up until desired end state is reached</p>
<p>Planting of species:</p> <ul style="list-style-type: none"> » the composition of the final acceptable vegetation will be based on the vegetation descriptions of the original ecological EIA investigation, and will include rescued plant material » geophytic plants shall be planted in groups or as features in selected areas » during transplanting care shall be taken to limit or prevent damage to roots » plants should be watered immediately after transplanting to help bind soil particles to the roots (or soil-ball around rooted plants) and so facilitate the new growth and functioning of roots 	<p>Contractor, ECO to control</p>	<p>Construction phase Operational phase, followed up until desired end state is reached</p>
<p>Traffic on revegetated areas:</p> <ul style="list-style-type: none"> » designated tracks shall be created for pedestrian of vehicle traffic where necessary » Disturbance of vegetation and topsoil must be kept to a practical minimum, no unauthorised off road driving will be allowed » All livestock shall be excluded from newly revegetated areas, until vegetation is well established 	<p>Contractor, ECO to control</p>	<p>Construction phase Operational phase</p>
<p>Establishment:</p> <ul style="list-style-type: none"> » The establishment and new growth of revegetated and replanted species shall be closely monitored <ul style="list-style-type: none"> o Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created 	<p>Contractor, ECO to control</p>	<p>Construction phase Operational phase, followed up until desired end state is reached</p>

Mitigation: Action/Control	Responsibility	Timeframe
Monitoring and follow-up treatments		
Monitor success of rehabilitation and revegetation and take remedial actions as needed according to the respective plan » Erosion shall be monitored at all times and measures taken as soon as detected » Where necessary, reseedling or replanting will have to be done if no acceptable plant cover has been created	ECO during construction, suitable designated person / contractor after that	Construction phase Operational phase
Weeding: » It can be anticipated that invasive species and weeds will germinate on rehabilitated soils <ul style="list-style-type: none"> o These need to be hand-pulled before they are fully established and/or reaching a mature stage where they can regenerate o Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications 	Contractor	Construction phase Operational phase

Performance Indicator	<ul style="list-style-type: none"> » No activity in identified no-go areas » Natural configuration of habitats as part of ecosystems or cultivated land is retained or recreated, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist » The structural integrity and diversity of natural plant communities is recreated or maintained » Indigenous biodiversity continually improves according to the pre-determined desirable end state <ul style="list-style-type: none"> o This end state, if healthy, will be dynamic and able to recover by itself after occasional natural disturbances without returning to a degraded state » Ecosystem function of natural landscapes and their associated vegetation is improved or maintained
Monitoring	<ul style="list-style-type: none"> » Fortnightly inspections of the site by ECO during construction » An incident reporting system must record non-conformances to the EMP » Quarterly inspections and monitoring of the site by the ECO or personnel designated to the rehabilitation process until 80% of the desired plant species have become established <ul style="list-style-type: none"> o These inspections should be according to the monitoring protocol set out in the rehabilitation plan » Thereafter annual inspections according to the minimal monitoring protocol

MANAGEMENT PROGRAMME: OPERATION

CHAPTER 9

Overall Goal: To ensure that the operation of the solar 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 facility in a way that:

- » Ensures that operation activities are properly managed in respect of environmental aspects and impacts.
- » Enables the solar energy facility operation activities to be undertaken without significant disruption to other land uses in the area, in particular with regard to farming practices, traffic and road use, and effects on local residents.
- » Minimises impacts on fauna using the site.

An environmental manager must be appointed during operation whose duty it will be to ensure the implementation of the operational EMPr.

9.1. Objectives

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

OBJECTIVE OP1: Protection of indigenous natural vegetation, fauna and maintenance of rehabilitation

Indirect impacts on vegetation and fauna during operation could result from maintenance activities and the movement of people and vehicles on site and in the surrounding area. In order to ensure the long-term environmental integrity of the site following construction, maintenance of the areas rehabilitated post-construction must be undertaken until these areas have successfully re-established.

Project component/s	<ul style="list-style-type: none">» Areas requiring regular maintenance.» Route of the security team.» Areas disturbed during the construction phase and subsequent rehabilitation at its completion.» Areas where the natural microclimate and thus vegetation composition has changed due to structures such as PV panels erected.
Potential Impact	<ul style="list-style-type: none">» Disturbance to or loss of vegetation and/or habitat.» Environmental integrity of site undermined resulting in reduced

	visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention.
Activity/Risk Source	<ul style="list-style-type: none"> » Movement of employee vehicles within and around site. » Excessive shading by PV panels. » Altered rainfall interception and resultant runoff patterns by infrastructure.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Maintain minimised footprints of disturbance of vegetation/habitats on-site. » Ensure and encourage plant regrowth in non-operational areas of post-construction rehabilitation.

Mitigation: Action/Control	Responsibility	Timeframe
Vehicle movements must be restricted to designated roadways.	Operator	Operation
No disturbance of vegetation outside of the project site must occur.	Operator	Operation
Existing roads must be maintained to ensure limited erosion and impact on areas adjacent to roadways.	Operator	Operation
An on-going invasive and alien plant monitoring and eradication programme must be implemented, where necessary (refer to Appendix B).	Operator	Operation
A botanist familiar with the vegetation of the area should monitor the rehabilitation success and alien plant removal on an annual basis.	Operator in consultation with Specialist	Annual monitoring until successful re-establishment of vegetation in an area
<p>All cable trenches, excavations, , through sensitive areas should be excavated carefully in order to minimise damage to surrounding areas and biodiversity.</p> <ul style="list-style-type: none"> » The trenches must be checked on a daily basis for the presence of trapped animals. » Any animals found must be removed in a safe manner, unharmed, and placed in an area where the animal will be comfortable. » If the ECO or contractor is unable to assist in the movement of a fauna species, ensure a member of the conservation authorities assists with the translocation. » All mammal, large reptiles and avifauna species found injured during construction will be taken to a suitably qualified veterinarian or rehabilitation centre to either be put down in a humane manner or cared for until it can be 	Contractor / ECO	Operation

Mitigation: Action/Control	Responsibility	Timeframe
released again		
A botanist familiar with the vegetation of the area should monitor the vegetation composition and – density immediately adjacent to new infrastructure and decide on additional revegetation measures that may be required to maintain sufficient vegetation to prevent habitat degradation and accelerated erosion, especially underneath/around PV panels.	Operator in consultation with Specialist	Annual monitoring until successful re-establishment of vegetation in an area

Performance Indicator	<ul style="list-style-type: none"> » No further disturbance to vegetation or terrestrial faunal habitats. » Continued improvement of rehabilitation efforts. » No disturbance of vegetation outside of project site. » No further thickening of invasive shrubs on site. » Gradual disappearance of all alien plant species on site.
Monitoring	<ul style="list-style-type: none"> » Observation of vegetation on-site by facility manager and environmental manager. » Regular inspections to monitor plant regrowth/performance of rehabilitation efforts and weed infestation compared to natural/undisturbed areas.

OBJECTIVE OP2: Manage and reduce the impact of invasive vegetation

Within the project area invasive species – indigenous and alien - occur, which all have a potential of reproducing to such an extent that the ecosystem within and beyond the project area could be impaired. Additional alien species grow along major transport routes to the area and thus could be potentially spread there as well. Indigenous invasive species that need to be controlled include *Acacia mellifera* subsp. *mellifera*, *Rhigozum trichotomum*, *Lycium* species, *Phaeoptilum spinosum*.

Alien invasives that must be controlled and eradicated to prevent degradation include *Prosopis* species.

Weeds and potentially invasive species on and around the site that need to be monitored and managed include *Salsola kali*, *Opuntia* species, *Argemone ochroleuca*, *Nicotiana glauca*, *Tribulus zeyheri*, *Tribulus terrestris*, *Datura* species.

It can be expected that more species may be added after the pre-commencement walk-through survey. A detailed Invasive Management Plan need to be drafted after this walk-through. Operational standards must adhere to those set out by

Working for Water (Appendix B). The use of chemicals may only commence with the approval of the relevant authorities.

Project Component/s	<ul style="list-style-type: none"> » PV Array » Grid connection and associated servitudes » Temporary construction camps » Workshops and/or other permanent infrastructure » Access roads
Potential Impact	<ul style="list-style-type: none"> » Impacts on natural vegetation. » Impacts on soil. » Impact on faunal habitats. » Loss of agricultural potential.
Activity/Risk Source	<ul style="list-style-type: none"> » Transport of construction materials. » Movement of construction machinery and personnel. » Site preparation and earthworks causing disturbance to indigenous vegetation. » Construction of site access road. » Stockpiling of topsoil, subsoil and spoil material.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To avoid the introduction of additional alien invasive plants to the project control area. » To avoid further distribution and thickening of existing alien plants on the project area. » To complement existing alien plant eradication programs in gradually causing a significant reduction of alien plant species throughout the project control area.

Mitigation: Action/Control	Responsibility	Timeframe
Compile a detailed invasive plant management and monitoring programme as guideline for the entire construction, operational and decommissioning phase. This plan must contain WfW-accepted species- specific eradication methods. It must also provide for a continuous monitoring programme to detect new infestations	Specialist	Pre-construction
Avoid creating conditions in which invasive plants may become established: <ul style="list-style-type: none"> » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Shred all non-seeding material from cleared invasive shrubs and other vegetation an use as mulch as part of the rehabilitation and revegetation plan » Do not import soil from areas with alien plants 	Operator	Construction phase Operational phase
» Eradicate all invasive plants that occur within the development's temporary and permanent footprint	Operator	Construction phase

Mitigation: Action/Control	Responsibility	Timeframe
areas » Ensure that material from invasive plants that can regenerate – seeds, suckers, plant parts are adequately destroyed and not further distributed		Operational phase
» Immediately control any alien plants that become newly established using registered control measures	Operator	Construction phase Operational phase

Performance Indicator	» Visible reduction of number and cover of alien invasive plants within the project area. » Improvement of vegetation cover from current dominance of invasive shrubs to dominance of perennial grasses and dwarf shrubs » No establishment of additional alien invasive species.
Monitoring	» Ongoing monitoring of area by the environmental manager during operation » Audit every two to three years by a suitably qualified botanist to assess the status of infestation and success of eradication measures » If new infestations are noted these must be recorded. A comprehensive eradication programme with the assistance of the WfW (Working for Water) Programme is advisable.

OBJECTIVE OP3: The mitigation and possible negation of visual impacts associated with the decommissioning of the Kheis Solar Park 2

Project Component/s	The solar energy facility and ancillary infrastructure (i.e. panels, access roads, substation, workshop and power line).
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (within 2km).
Mitigation: Target/Objective	Well maintained and neat facility.

Mitigation: Action/Control	Responsibility	Timeframe
Maintain the general appearance of the facility as a whole, including the panels, servitudes and the ancillary structures.	Operator	Throughout operational phase
Monitor the implementation of mitigation measures, and implement remedial action as and when required.	Operator	Throughout operational phase
Maintain roads and servitudes to forego erosion and to suppress dust.	Operator	Throughout operational phase
Monitor rehabilitated areas, and implement remedial action as and when required.	Operator	Throughout operational phase
Maintain the general appearance of the facility as a whole, including the panels, servitudes and the ancillary structures.	Operator	Throughout operational phase
Monitor the implementation of mitigation measures, and implement remedial action as and when required.	Operator	Throughout operational phase
Maintain roads and servitudes to forego erosion and to suppress dust.	Operator	Throughout operational phase
Monitor rehabilitated areas, and implement remedial action as and when required.	Operator	Throughout operational phase

Performance Indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.
Monitoring	Monitoring of the entire site on an ongoing basis (by operator).

OBJECTIVE OP4: Minimise soil degradation and erosion (Erosion Management Plan)

The soil on site may be impacted in terms of:

- » Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern across the entire site which is underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion).

- » Uncontrolled run-off relating to construction activity (excessive wetting, uncontrolled discharge, etc.) will also lead to accelerated erosion and possible sedimentation of drainage systems.
- » Degradation of the natural soil profile due to pollution.

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

Project Component/s	<ul style="list-style-type: none"> » PV panels. » Power line. » Ancillary buildings. » Access roads.
Potential Impact	<ul style="list-style-type: none"> » Soil degradation. » Soil erosion. » Increased deposition of soil into drainage systems. » Increased run-off over the site.
Activities/Risk Sources	<ul style="list-style-type: none"> » Poor rehabilitation and/or revegetation of cleared areas. » Rainfall - water erosion of disturbed areas. » Wind erosion of disturbed areas. » Concentrated discharge of water from construction activity.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure rehabilitation of disturbed areas is maintained. » Minimise soil degradation (i.e. wetting). » Minimise soil erosion and deposition of soil into drainage lines. » Ensure continued stability of embankments/excavations.

Mitigation: Action/Control	Responsibility	Timeframe
Rehabilitate disturbance areas should the previous attempt be unsuccessful.	Operator	Operation
Maintain erosion control measures implemented during the construction phase (i.e. run-off attenuation on slopes, bags, logs), silt fences, storm water catch-pits, and shade nets).	Operator	Operation
Develop and implement an appropriate stormwater management plan for the operational phase of the facility	Operator	Operation

Performance Indicator	<ul style="list-style-type: none"> » Acceptable level of soil erosion around site, as determined by the environmental manager. » Acceptable level of increased siltation in drainage lines, as determined by the site manager.
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Monitoring	» Inspections of site on a bi-annual basis by the operation phase ECO
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OBJECTIVE OP5: Minimise dust and air emissions

During the operational phase, limited gaseous or particulate emissions are anticipated from the facility. Windy conditions and the movement of vehicles on site may lead to dust creation.

Project Component/s	» Hard engineered surfaces. » On-site vehicles.
Potential Impact	» Dust and particulates from vehicle movement to and on-site.
Activities/Risk Sources	» Re-entrainment of deposited dust by vehicle movements. » Wind erosion from unsealed roads and surfaces. » Fuel burning vehicle and construction engines.
Mitigation: Target/Objective	» To ensure emissions from all vehicles are minimised, where possible. » To minimise nuisance to the community from dust emissions and to comply with workplace health and safety requirements.

Mitigation: Action/Control	Responsibility	Timeframe
Roads must be maintained to a manner that will ensure that nuisance impacts to the community from dust is not visibly excessive.	Operator	Operation
Appropriate dust suppressants must be applied to the roads as required to minimise/control airborne dust.	Operator	Duration of contract
Speed of vehicles must be restricted on site, as defined by the Environmental Manager.	Operator	Duration of contract

Performance Indicator	» No complaints from affected residents or community regarding dust or vehicle emissions. » Dust suppression measures implemented where required.
Monitoring	» Immediate reporting by personnel of any potential or actual issues with nuisance dust or emissions to the Site Manager. » A complaints register must be maintained, in which any complaints from residents/the community will be logged, and thereafter complaints will be investigated and, where appropriate, acted upon. » An incident reporting system must be used to record non-conformances to the EMPr.

OBJECTIVE OP6: Ensure the implementation of an appropriate fire management plan during the operation phase

The increased presence of people on the site could increase the risk of veld fires, particularly in the dry season.

Project Component/s	» Operation and maintenance of the solar 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. In addition, fire can pose a risk to the solar energy facility infrastructure.
Activities/Risk Sources	» The presence of operation and maintenance personnel 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
Join the local Fire Protection Agency.	Operator	Operation
Provide adequate fire fighting equipment at specified localities on the PV facility to meet emergencies from fire.	Operator	Operation
Provide adequate fire fighting equipment on site.	Operator	Operation
Provide fire-fighting training to selected operation and maintenance staff.	Operator	Operation
Ensure that appropriate communication channels are established to be implemented in the event of a fire.	Operator	Operation
Fire breaks should be established where and when required. Cognisance must be taken of the relevant legislation when planning and burning firebreaks (in terms of timing).	Operator	Operation
Upon completion of the construction phase, an emergency evacuation plan must be drawn up to ensure the safety of the staff and surrounding land users in the case of an emergency.	Operator	Operation
Contact details of emergency services should be prominently displayed on site.	Operator	Operation

Performance Indicator	» Fire-fighting equipment and appropriate training provided before the operational phase commences. » Appropriate fire breaks in place and maintained.
Monitoring	» Developer must monitor indicators listed above to ensure that they have been met.

OBJECTIVE OP7: Maximise local employment and business opportunities associated with the operational phase

The facility is expected to be operational for 25 years during which time approximately 7-15 staff members are expected to be required on-site. Therefore, long-term direct job opportunities for locals could exist, although limited. However, in an area with such high unemployment figures, these limited opportunities should still be seen as a positive impact on the quality of life of those benefiting from the employment.

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

Project Component/s	» Day to day operational activities associated with the PV facility, including maintenance .
Potential Impact	» The opportunities and benefits associated with the creation of local employment and business should be maximised
Activities/Risk Sources	» The operational phase of the PV facility will create up to 15 full time employment opportunities.
Mitigation: Target/Objective	» In the medium to long term employ as many locals as possible to fill the full time employment opportunities.

Mitigation: Action/Control	Responsibility	Timeframe
The workforce staff is likely to be based in the region. The developer should commit to implementing a training and skills development and training programme to maximise employment for locals.	Operator	Prior to commencement of operation
Identify local members of the community who are suitably qualified or who have the potential to be employed full time.	Operator	Prior to commencement of operation

Performance Indicator	» Training and skills development programme developed and designed before construction phase completed. » Potential locals identified before construction phase completed.
Monitoring	» The developer must monitor indicators listed above to ensure that they have been met for the operational phase.

OBJECTIVE OP8: Appropriate handling and management of waste

The operation of the facility will involve the storage of chemicals and hazardous substances, as well as the generation of limited waste products. The main wastes expected to be generated by the operation activities includes general solid waste, and liquid waste. A guideline for integrated management of waste is included as Appendix D of this EMPr.

Project Component/s	<ul style="list-style-type: none"> » Substation. » Operation and maintenance staff. » Workshop.
Potential Impact	<ul style="list-style-type: none"> » Inefficient use of resources resulting in excessive waste generation. » Litter or contamination of the site or water through poor waste management practices. » Contamination of water or soil because of poor materials management.
Activity/Risk Source	<ul style="list-style-type: none"> » Transformers and switchgear for the substations. » Ancillary buildings.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Comply with waste management legislation. » Minimise production of waste. » Ensure appropriate waste disposal. » Avoid environmental harm from waste disposal. » Ensure appropriate storage of chemicals and hazardous substances.

Mitigation: Action/Control	Responsibility	Timeframe
Hazardous substances (such as used/new transformer oils) must be stored in sealed containers within a clearly demarcated designated area.	Operator	Operation
Storage areas for hazardous substances must be appropriately sealed and banded.	Operator	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.	Operator	Operation
Care must be taken to ensure that spillage of oils and other hazardous substances are limited during maintenance. Handling of these materials should take place within an appropriately sealed and banded area. Should any accidental spillage take place, it	Operator	Operation and maintenance

Mitigation: Action/Control	Responsibility	Timeframe
must be cleaned up according to specified standards regarding bioremediation.		
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Operator	Operation and maintenance
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Operator / waste management contractor	Operation
Waste handling, collection, and disposal operations must be managed and controlled by a waste management contractor.	Operator/ 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	Operator	Operation
General waste must be recycled where possible or disposed of at an appropriately licensed landfill.	Operator	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	Operator	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Operator	Operation

Performance Indicator	<ul style="list-style-type: none"> » 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	<ul style="list-style-type: none"> » Waste collection must be monitored on a regular basis. » Waste documentation must be completed and available for inspection » 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 environmental manager . » All appropriate waste disposal certificates accompany the monthly reports.

OBJECTIVE OP9: To avoid and or minimise the potential impacts of safety, noise and dust and damage to roads during the operational phase

Project Component/s	» Construction and establishment activities associated with the establishment of the PV facility, including infrastructure .
Potential Impact	» Heavy vehicles can generate noise and dust impacts. Movement of heavy vehicles can also damage roads.
Activities/Risk Sources	» The movement of heavy vehicles and their activities on the site can result in noise and dust impacts and damage roads.
Mitigation: Target/Objective	» To avoid and or minimise the potential noise and dust impacts associated with heavy vehicles, and minimise damage to roads.

Mitigation: Action/Control	Responsibility	Timeframe
Establish and maintain a register for their periodic review that logs all complaints raised by the landowner, occupiers or the general public about operational activities. The register shall be regularly updated and records maintained, including the name of the complainant, his or her domicile and contact details, the date and nature of the complaint and if any action that was taken to rectify the problem.	Operator	Operational Life of Facility
Institute and maintain security and access control to the site	Operator	Operational Life of Facility
Set up signage warning of on-site hazards	Operator	Operational Life of Facility
Conduct regular technical inspections and site maintenance activities.	Operator	Operational Life of Facility
maintain security fencing on the perimeter and around electrical substations	Operator	Operational Life of Facility
Develop and implement emergency response procedures and carry out regular review of emergency response procedures	Operator	Operational Life of Facility

OBJECTIVE OP10: To avoid and or minimise the potential impacts due to cleaning of the PV panels using water

In certain instances, water is also used for cleaning the panels to remove dust or dirt that builds up on the panels.

Project Component/s	» Cleaning PV panels with water
Potential Impact	» Run-Off, erosion / sedimentation
Activities/Risk Sources	» Cleaning PV panels with water
Mitigation: Target/Objective	» No negative impacts due to use of water for cleaning panels

Mitigation: Action/Control	Responsibility	Timeframe
Use as little water as possible for cleaning the panels	Operator	Operational Life of the facility
Confirm a legal source of water prior to the operational phase of the project and obtain any required water use license	Operator	Operational Life of the facility
Regular inspection during cleaning events to monitor use of water	Operator	Operational Life of the facility
Re-use grey water if possible	Operator	Operational Life of the facility

OBJECTIVE OP11: To avoid and or minimise the potential impacts of the power line during maintenance events

The expected lifespan of the proposed power line is approximately 40 years, depending on the maintenance undertaken on the power line structures. During the life-span power line, on-going maintenance is performed. Power line inspections are undertaken on an average of 1 – 2 times per year, depending on the area. During this maintenance period, the line is accessed via the access routes established during the construction phase. Maintenance of the power line is required to be undertaken in accordance with the specifications of this EMPr.

The management of power line servitude is dependent on the details and conditions of the agreement between the project development company, the

landowner and Eskom, and are therefore site-specific. These may, therefore, vary from one location to another. However, it is a common occurrence that there is a dual responsibility for the maintenance of the servitude:

- » Eskom will be responsible for the tower structures, maintenance of access roads, watercourse crossings, and gates and fences relating to servitude access.
- » The landowner will retain responsibility for the maintenance of the land and land use within the servitude (e.g. cropping activities, veld management, .).

Exceptions to the above may arise where, for example dual use is made of the access roads and gates or specific land use limitations are set by Eskom within the servitude which directly affects the landowner. Maintenance responsibilities are, ultimately, clearly set out in the servitude agreement. Once agreed upon, these maintenance agreement conditions must be deemed to form part of this EMPr and must be adhered to at all times.

Indirect impacts on vegetation and fauna during operation could result from maintenance activities and the movement of people and vehicles on site and in the surrounding area. In order to ensure the long-term environmental integrity of the site following construction, maintenance of the areas rehabilitated post-construction must be undertaken until these areas have successfully re-established.

Project component/s	» Power Line Servitude
Potential Impact	» Disturbance to or loss of fauna and/or habitat » Increased erosion
Activity/risk source	» Management of power lines servitude area
Mitigation: Target/Objective	» To minimise disturbance of natural vegetation/habitats within the servitude » To minimise erosion

Mitigation: Action/control	Responsibility	Timeframe
Utilise existing access roads as far as possible	Operator (Eskom) and maintenance contractors	Operations & Maintenance
Clear servitude of alien vegetation along power line servitude and implement an appropriate alien plant management plan.	Operator (Eskom) and maintenance contractors	Operations & Maintenance
Implement appropriate erosion management measures within the servitude area. The servitude and its access route must be monitored for signs of	Operator (Eskom) and maintenance contractors	Operations & Maintenance

Mitigation: Action/control	Responsibility	Timeframe
erosion, and signs of erosion remedied immediately		
Maintain erosion control measures implemented during the construction phase (i.e. run-off attenuation on slopes (sand bags, logs), silt fences, storm water catch-pits, and shade nets	Operator (Eskom) Operator	Operations
<ul style="list-style-type: none"> » Marking power lines appropriately (with bird flight diverters) to increase visibility to birds. » Minimising length of power lines as much as possible. » Ensuring power lines are properly insulated and bird friendly prior to installation. » Responding rapidly to high risk sections of power lines where collision mortalities are high. 	Operator (Eskom) /Developer	Operations & Maintenance
<ul style="list-style-type: none"> » For vegetation clearance/trimming (e.g. protected plants and trees), a permit must be obtain all relevant permits 	Developer	Operations & Maintenance

Performance Indicator	<ul style="list-style-type: none"> » Limited disturbance to natural vegetation/habitats within the servitude area
Monitoring	<ul style="list-style-type: none"> » Annual monitoring must be carried out together with monitoring of the remainder of the development to detect and eradicate new infestations of alien plant species before they become well established and may spread » Monitoring of erosion within servitude.

MANAGEMENT PROGRAMME: DECOMMISSIONING

CHAPTER 10

The solar infrastructure which will be utilised for the proposed solar energy facility is expected to have a lifespan of 25 years (i.e. 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 solar infrastructure with more appropriate technology/infrastructure available at that time.

The relevant mitigation measures contained under the construction section should be applied during decommissioning and therefore is not repeated in this section. It must be noted that decommissioning activities will need to be undertaken in accordance with the legislation applicable at that time, which may require this section of the EMP to be revisited and amended.

Should the activity ever cease or become redundant, the applicant shall undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

10.1. Site Preparation

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

10.2 Disassemble Infrastructure

Disassembled components will be reused, recycled, or disposed of in accordance with regulatory requirements.

OBJECTIVE D1: To avoid and or minimise the potential impacts associated with the decommissioning phase

Project Component/s	» Decommissioning phase of the PV facility and associated infrastructure
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 . However, the number of people

	affected 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 PV facility
Mitigation: Target/Objective	» To avoid and or minimise the potential social impacts associated with decommissioning phase of the PV facility.

Mitigation: Action/control	Responsibility	Timeframe
Explore options of re-use and recycling of the PV facility components/ structures. This will be informed by legislative requirements, environmental analyses and costs at the time.	Developer	Prior to decommissioning
Where disposal of components and materials is required, this must be appropriately carried out in accordance with prevailing legal requirements, in designated waste disposal facilities.	Developer	When PV facility is decommissioned
Retrenchments should comply with South African Labour legislation of the day	Developer	When PV facility is decommissioned
Undertake site rehabilitation to restore the environment to a condition whereby the natural functioning of the ecosystem can take place	Developer	When PV facility is decommissioned
If scarring of the landscape/ site occurs, utilised landscaping to restore the site	Developer	When PV facility is decommissioned
Re-vegetate disturbed areas utilising indigenous plant species.	Developer	When PV facility is decommissioned
Correct salvage, disposal and preferably also recycling of PV panels	Developer and relevant waste management specialist	When PV facility is decommissioned

Performance Indicator	» South African Labour legislation relevant at the time » Area appropriately rehabilitated.
Monitoring	» Monitoring of decommissions activities

FINALISATION OF THE EMPr

CHAPTER 11

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

**APPENDIX A:
GRIEVANCE MECHANISM FOR PUBLIC COMPLAINTS
AND ISSUES**

GRIEVANCE MECHANISM / PROCESS

AIM

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

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

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

Proposed generic grievance process

- Local landowners, communities and authorities will be informed in writing by the proponent (the renewable energy company) of the grievance mechanism and the process by which grievances can be brought to the attention of the proponent.
- A company representative will be appointed as the contact person for grievances to be addressed to. The name and contact details of the contact person will be provided to local landowners, communities and authorities.
- Project related grievances relating to the construction, operational and or decommissioning phase must be addressed in writing to the contact person. The contact person should assist local landowners and or communities who may lack resources to submit/prepare written grievances.
- The grievance will be registered with the contact person who, within 2 working days of receipt of the grievance, will contact the Complainant to discuss the grievance and agree on suitable date and venue for a meeting. Unless otherwise agreed, the meeting will be held within 2 weeks of receipt of the grievance.
- The contact person will draft a letter to be sent to the Complainant acknowledging receipt of the grievance, the name and contact details of Complainant, the nature of the grievance, the date that the grievance was raised, and the date and venue for the meeting.
- Prior to the meeting being held the contact person will contact the Complainant to discuss and agree on who should attend the meeting. The people who will be required to attend the meeting will depend on the nature of the grievance. While the Complainant and or proponent are entitled to invite their legal representatives to attend the meeting/s, it should be made clear that to all the parties involved in the process that the grievance mechanism

process is not a legal process. It is therefore recommended that the involvement of legal representatives be limited.

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

- The draft report will be made available to the Complainant and the proponent for comment before being finalised and signed by all parties. Unless otherwise agreed, comments on the draft report must be forwarded to the company representative appointed to manage the grievance mechanism within 4 working days.

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

**APPENDIX B:
DEPARTMENT OF WATER AFFAIRS: WORKING
FOR WATER PROGRAMME PRINCIPLES FOR
INVASIVE PLANT SPECIES**

METHODS FOR ALIEN SPECIES REMOVAL

The sections below are taken from the Department of water Affairs: Working for Water Programme, whose guidelines and policies on alien plant species removal should be adhered to.

In general the use of herbicide by is strongly discouraged – unless for direct stump applications in areas at least 30 m from any type of wetland. This is due to the potential for herbicide and related compounds to be distributed into the wetland areas and thus damaging indigenous vegetation all along the watercourses and beyond.

Any control programme for alien vegetation must include the following 3 phases:

- Initial control: drastic reduction of existing population
- Follow-up control: control of seedlings, root suckers, and coppice growth
- Maintenance control: sustain low alien plant numbers with annual control

2.1. Mechanical Clearing

2.1.1. ADULT PLANTS AND SAPLINGS

2.1.1.1. Felling

Consider as first option where possible, but see section 3 regarding kill standing – although this is only mandatory in pristine or near-natural environments, kill standing may have to be considered where the tree to be felled on the project area is very large or tilted and by falling it could significantly damage the surrounding habitat or other structures.

Where trees are to be felled and removed, the stem/trunk shall be cut as close to the ground as possible but not higher than 150mm, using chainsaws, bow saws, brush cutters or cane knives. Where felling is to be followed by herbicide treatment the cut shall either be made by means of a saw, so as to produce a clean, flat and generally horizontal surface or in the case of suitably small, thin barked species, the stem shall be cut with a lopper. A slasher or kapmes should preferably not be used because of the diagonal cut that is produced. This minimises the herbicide absorption and the “sharp sticks” are a Health and Safety risk.

In the case of larger trees, they shall, where possible, be felled to fall uphill in order to reduce breakage and minimise the danger to workmen.

Felled material and other dead material (brush and logs) shall not be allowed to block or impede water courses and must be removed from all water courses, either 30 m away from the river or out of the flood line itself.

Felled material (thicker than 7 cm) shall be debranched and cross cut in manageable logs of not longer than 2,4 m or in lengths as directed and then stacked in windrows (brush lines) with the contour or moved to or from identified locations as directed by Project Management.

The logs and brush shall be stacked separately, at least 3 m apart. Windrows shall be with gaps of 2 m every 15 m and be as narrow as possible but not wider than 3 m. Where windrows are impractical heap stacking may be allowed after approval by the Project Manager. Heaps shall be spaced at a minimum distance of 20 m with a maximum ground cover of 16 m² in other words heaps of maximum 4 X 4 m.

Windrows must be a minimum of 10 meters away from any indigenous forest (10 or more closely spaced indigenous trees). On a slope nothing should be packed below the indigenous forest, because burning of the windrows will cause damaged to the indigenous forest by burning up into it.

2.1.1.2. Ring barking

Where ring barking is directed, the Contractor shall remove all bark (including the inner bark or phloem) from ground level to 50 cm up or such lesser distance as may be specified. All bark must be removed to below ground level for good results. Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out.

Bush knives or hatchets should be used for debarking. Herbicide can be applied to the exposed bark except in the case of Wattle spp. In the case of smaller trees and saplings with soft, thin skinned bark (especially *Acacia* and *Hakea* species.) the stem shall be beaten with the back of a hatchet and the bark peeled off.

2.1.1.3. Frilling

Where frilling is directed, the Contractor shall, at a height of approximately 50 cm, using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to affect the cuts around the entire stem and apply herbicide into the cuts.



The Frilling Method

2.1.1.4. Bark Stripping

Where bark stripping is specified all bark shall be stripped from the trunk between ground level and 1 m above ground level.

2.1.2. SEEDLINGS

2.1.2.1. Manual clearing

Where seedlings are relatively sparse, less than 1 m high and soil suitably soft or where specified in the Project Specification (where seedlings are growing in sensitive areas where chemicals cannot be used due to the risk of contamination or effect on adjacent plant populations or for any other reason), seedlings shall be removed by hand pulling which shall be so carried out as to ensure the removal of the roots. Hand pulled plants shall be left hanging on other vegetation or deposited in a pile to reduce the possibility of re-growth.

Where seedlings are dense or are too well established to be removed by hand and the Project Management has not directed hand pulling or herbicide treatment of the undisturbed plants, the seedlings shall be cut using a lopper or brush cutter (written approval must be obtained) and the stems then treated with herbicide.

It is anticipated that after initial clearing, every year there will be a multitude of seedlings of alien species emerging. Cleared sites will thus have to be constantly monitored, and as soon as a seedling can be identified as alien invasive species, these must be pulled out by hand.

2.2. Chemical Treatment

2.2.1. Foliar spray

(Not recommended due to potential distribution of poison beyond target plants and thus killing of indigenous species)

Where foliar spray has been specified, the spray shall be applied as to the leaves of the whole plant to the point of drip-off. Spraying shall not be done when the leaves are wet or in windy conditions. The herbicide shall under all circumstances be mixed with a suitable colour dye (if the product has no built in dye) and a wetting agent if specified on the herbicide label. Where the same herbicide is use for different methods e.g. foliar and cut-stump, different colour dyes must be used to identify the different herbicide mix ratios.

Spraying shall be done using a back-pack spraying system with a solid cone nozzle which allows for consistent, thorough application of the herbicide (e.g. Spraying systems TG 0,5 (or as indicated in the herbicide policy).

2.2.2. Cut-stump treatment



Where stumps are to be treated with herbicide the herbicide shall under all circumstances be mixed with a suitable colour dye (if the product has no built in dye) and a wetting agent if specified on the herbicide label, this shall be applied as soon as possible but not later than 15 minutes after felling, stripping or frilling. In the case of felled stumps all sawdust shall first be brushed off the cut surface.

A knapsack or handheld pressurised spray can, with a narrow angle solid cone nozzle or adjustable nozzle set to a solid spray, should be used. The pressure should be as low as possible to avoid the herbicide from bouncing off the sprayed surface and to minimise contamination; attention must be paid to achieving an even coverage only on the outer rim (Cambium area).

2.2.3. Basal bark application

(Only after written approval has been obtained, due to environmental damage caused by diesel)

Where directed and after written approval, herbicide shall be applied directly to the basal bark of trees. The herbicide shall be applied by knapsack sprayer as a coarse, low

pressure spray, using a narrow angle solid cone nozzle, all around the basal stem or trunk of the plant, from the ground up to the height as specified on the herbicide label, as well as to any exposed roots. The area to be treated shall be thoroughly wetted by the herbicide. Attention shall be paid to ensuring adequate application taking note of the condition and age of the bark.

In the case of multi-stemmed plants, each stem shall be treated.

2.3. Kill Standing vs. Felling

This section is to further explain the National Circular 18 of 2002 under the same heading.

As this National Circular contains a policy clause on the operational approach all WfW projects need to align their operations accordingly as a matter of urgency. The policy should be interpreted as follows (National policy in *Italic* font with interpretation in normal font):

All trees must be killed standing (i.e. NOT felled), except when the following applies: (where cut stump operations are underway on a property this will be allowed to be finished if negotiations for the property has already been concluded and written into the landowner's agreement, negotiations on new areas should thus be adapted accordingly as no further cut stump operations will be allowed except as indicated below):

- *Danger to lives & property and the tree must be removed* (it is the responsibility of Project Management to assess this with the assistance of the landowner. These findings must be recorded in writing and should form part of the landowner's agreement. The person collecting the data for contract generation should be informed accordingly)
- *All alien clearing within two tree lengths of roads, buildings, power lines etc* (fences should be added to the possibilities. It is the responsibility of Project Management to assess this with the assistance of the landowner. These findings must be recorded in writing and should form part of the landowner's agreement. The person collecting the data for contract generation should be informed accordingly)
- *Specific requirement of a partnership to fell* (this will be when the Programme and what it stands for will directly benefit from an operation other than frilling e.g. secondary industry operations, if this is not the case then the landowner must contribute to the price difference due to a change in the preferred operational method)
- *Where required to remove trees for specific flood-control measures* (no frilling should take place within the riparian zone that is the 1:20 year flood level or closer than 30 metres from the natural bank of a river. Trees in these areas should be removed.)
- *Where frilling is not a practical method due to tree growth form, treatment efficacy* (It is the responsibility of Project Management to assess this. If these exceptions

influence the workload then the person collecting the data for contract generation should be informed of such exceptions)

- *Where the frilling of trees increases the fire danger in the area* (where such a scenario is suspected Project Management should liaise with the landowner and also get the opinion of a reputable person, these findings should be recorded in writing and added to the landowner's agreement)

In most cases the resistance towards frilling are based on the aesthetics of the area after the operation. The most economical and effective method of eradicating invasive alien vegetation within the Programme's guidelines should remain the prime objective of efforts. It is the obligation and responsibility of people in all spheres of management to maximise the effect and efficiency of any eradication programme.

2.4. Species-specific clearing methods

Various herbicides have been registered for the control of alien invasive species. The first option though should always be felling the species as low as possible, followed by localised stump treatment and the remaining only as last-resort alternatives or where the alien is a vicious multi-stemmed scrambler, such as the bramble.

Chemicals do not only come at a cost, but will require proper storage, management, and handling. For operation details refer to the Working for Water Operational Standards spreadsheet provided separately.

Information for each invasive alien species as encountered on the project area, as well as alien invasive species that are highly likely to become established after initial clearing, is listed below.

OBJECTIVE: Optimise Operational Standards for Clearing of Invasive Alien Plants

The Contractor must take all reasonable measures to ensure the efficient use of manpower, operational equipment and chemicals for the systematic eradication of alien invasives on site.

Project component/s	Project components affecting the objective: <ul style="list-style-type: none"> » solar energy turbines » access roads » substation » power line
Potential Impact	<ul style="list-style-type: none"> » Hazards to landowners, workers and public » Security of materials » Substantially increased damage to adjacent sensitive vegetation and wetland areas
Activities/risk sources	<ul style="list-style-type: none"> » Operation of equipment » Use of herbicides » Use of fire » Distribution of regenerative material of invasive alien plants
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure effective systematic removal of invasive alien plants » To prevent additional spreading of invasive alien plants » To maintain low numbers and eventually eradicate unwanted species from the project area » To prevent any spillage of chemicals into the surrounding environment » To prevent and reverse damage to wetlands/pans caused by invasive alien plants » To protect members of the public/landowners/residents
Timeframe	<ul style="list-style-type: none"> » Training required: training schedule and training opportunities identified and started within three months of commencement of clearing

	<ul style="list-style-type: none"> » Initial control involving planning and drastic reduction of existing population: during site establishment and construction phase » Follow-up control: control of seedlings, root suckers and coppice growth: during construction and operational phase » Maintenance control: sustain low alien plant numbers with annual control: during operational and decommissioning phase 	
Abbreviations	<ul style="list-style-type: none"> » Working for Water Programme (WfW) » Health and Safety (H&S) 	
Responsibility	RESPONSIBLE PERSON OR UNIT	
	PROJECT MANAGER	PM
	CONTRACTOR/COMMUNITY WORKER	C
	ENVIRONMENTAL CONTROL OFFICER / COMMUNITY LIASION OFFICER	ECO
	TRAINING UNIT	TU
	PLANNING UNIT	PU

Mitigation: Action/control	Responsibility
1. PROJECT OPERATIONAL PLANNING	
1.1. Creation of detailed map of the area: Provides an overview of the project and it must indicate the following:	
<ul style="list-style-type: none"> • Project boundaries 	PU
<ul style="list-style-type: none"> • Area/s where workers are sourced from 	PM
<ul style="list-style-type: none"> • Other features relevant to project wetlands, invasive thickets, grazing areas, cultivated areas 	PM, PU

Mitigation: Action/control	Responsibility
<ul style="list-style-type: none"> Clearly indicate areas that need to be cleared and divide into different Management Units according to location and most prevalent invasive 	PM, PU
1.2. Strategic plan and safety	
<ul style="list-style-type: none"> Project Management to create an Area Strategic Plan / Method Statement for clearing alien invasive vegetation 	ECO, PM
<ul style="list-style-type: none"> Project Management to be familiar with the Area Strategic Plan 	ECO, PM
<ul style="list-style-type: none"> Evidence of Rules & Regulations given and explained to Contractor or Community Workers (this should include the Operating Standards) 	PM, C
<ul style="list-style-type: none"> Emerging and potential weeds reported through agreed communication lines, ecologist can be consulted for proper identification 	PM
<ul style="list-style-type: none"> A copy of the emergency plan and telephone numbers must be on site, workers must demonstrate knowledge thereof 	PM
1.3. Management Unit Clearing Plan (MUCP)	
<ul style="list-style-type: none"> It must be up to date 	PU, PM
<ul style="list-style-type: none"> A clearing strategy must be evident and supported by the planned priorities 	PU, PM
<ul style="list-style-type: none"> Project Managers must be able to show actual work done vs. planned work, supported by fixed point photographs 	PM

2. TOOLS AND EQUIPMENT	
2.1. Hand tools in good condition and used correctly	
<ul style="list-style-type: none"> Hand tools(e.g. lopper, pruning saw etc.) must be best suited to the work and the size of plants being cleared 	PM, C
<ul style="list-style-type: none"> The tools must have correct and properly secured handles and must be in safe working order 	C
<ul style="list-style-type: none"> A sharpening stone/file, with a hand grip, must be on site 	C
<ul style="list-style-type: none"> Gloves and goggles must be worn when sharpening tools 	C
<ul style="list-style-type: none"> The tools must be used in the correct manner; clearing must be done using the correct techniques 	C, PM
<ul style="list-style-type: none"> Safe working distances of at least two (2) tool-reach lengths apart must be maintained 	C, PM
2.2. Chainsaws good condition and used correctly	
<ul style="list-style-type: none"> Operators have received certified training in chainsaw operation, felling, cross-cutting and de-branching techniques and have been assessed for competence every six months. For training opportunities contact the regional WfW or otherwise qualified entity 	PM, TU
<ul style="list-style-type: none"> The chainsaws must be best suited to the clearing work and timber size 	PM, C
<ul style="list-style-type: none"> There must be a service maintenance schedule for all chainsaws Services (daily, weekly) are done and recorded 	PM, C
<ul style="list-style-type: none"> Safety and operational features must be in good order as per standard checklist 	PM, C
<ul style="list-style-type: none"> Chainsaw work is planned and executed for safe and efficient production 	PM, C
<ul style="list-style-type: none"> Correct felling / clearing techniques are applied 	PM, C
<ul style="list-style-type: none"> Correct cross-cutting and de-branching techniques are applied. 	PM, C

<ul style="list-style-type: none"> • Correct re-fuelling procedures are followed to prevent spillages 	C
<ul style="list-style-type: none"> • Chain sharpening is correctly done with the correct tools at each refueling 	C
2.3. In-field fuel site	
<ul style="list-style-type: none"> • A cleared area, at least six (6) metres from rest areas, demarcated with hazard tape must be used to store fuel 	C
<ul style="list-style-type: none"> • Fuel and oil containers at the in-field fuel site must be stored on an absorbent drip-mat or drip-tray 	C
<ul style="list-style-type: none"> • A 2 kg dry chemical powder (DCP) fire extinguisher must be at least 3m distant from the fuel site and easily visible 	C
3. STORES, WORKSHOPS AND OFFICES	
3.1. Stores, workshops and offices	
<ul style="list-style-type: none"> • Buildings and containers must be secure and provide safe storage space for equipment and/or supplies 	PM
<ul style="list-style-type: none"> • The office / stores area must show a high standard of housekeeping (A place for everything, everything in its place) 	PM
3.2. Herbicide stores	
<ul style="list-style-type: none"> • The building / container must meet the Herbicide Policy standards 	PM
<ul style="list-style-type: none"> • A Material Safety Data Sheet and Label must be in the store for each stock category of herbicide stored. (Each product.) 	PM
<ul style="list-style-type: none"> • Herbicides must be issued with reference to the WIMS contract number 	PM
<ul style="list-style-type: none"> • There must be stock control of empty containers. 	

<ul style="list-style-type: none"> • Empty containers must be stored until removal by a registered recycling company 	ECO
<ul style="list-style-type: none"> • Excess, undiluted herbicide must be returned to the stores and noted on the stock sheet. Excess, diluted herbicide must be stored in a UV-resistant container and allocated to another treatment within 2 days or returned to a suitable container in the stores 	ECO, C
<ul style="list-style-type: none"> • Burning of empty containers by Project staff or Contractor is prohibited 	PM, C
3.3. Fuel and flammable liquids stores	
<ul style="list-style-type: none"> • The building / container must be suitable for the liquids stored in them 	ECO
<ul style="list-style-type: none"> • Quantities limited to allowed maximum per class where proper storage facilities are not available: <ul style="list-style-type: none"> ○ Class I – 45L (petrol, thinners) ○ Class II – 270L (diesel, lube oils) 	
<ul style="list-style-type: none"> ○ Class I – 45L (petrol, thinners) 	PM
<ul style="list-style-type: none"> ○ Class II – 270L (diesel, lube oils) 	PM
<ul style="list-style-type: none"> • Proper housekeeping and handling procedures must be evident 	PM
<ul style="list-style-type: none"> • Adequate measures to deal with spillage and contamination e.g. spill kit 	PM
<ul style="list-style-type: none"> • Correct signage and fire-fighting equipment e.g. dry chemical powder fire extinguisher of at least 2.25kg 	PM
3.4. Storage at contractor stores / houses: Where contractors cannot make use of proper dedicated stores, the following standards apply:	
<ul style="list-style-type: none"> • All equipment, supplies, herbicides, fuel and oils must be safely and securely stored with controlled access, in a suitable lockable building, container or a lockable trailer 	C
<ul style="list-style-type: none"> • A 1kg dry chemical powder (DCP) fire extinguisher must be available outside the store / container 	C

<ul style="list-style-type: none"> PM to annually verify and keep record of inspection of compliance regarding storing facilities at contractors store / house 	PM
4. HERBICIDES	
4.1. General	
<ul style="list-style-type: none"> Workers must be specifically allocated and trained to work with herbicides and demonstrate knowledge of the risk of working with the selected chemicals and how to avoid that risk 	TU, PM
<ul style="list-style-type: none"> Only registered herbicides as detailed in the WfW herbicide policy or on the product label may be used 	PM
<ul style="list-style-type: none"> A Material Safety Data Sheet (MSDS) and Label must be in the field for each product used 	PM, C
<ul style="list-style-type: none"> Written approval must be obtained via the approved communication channels from the National Office to use an unregistered herbicide for a particular specie or situation 	PM, ECO
<ul style="list-style-type: none"> Mix water must be clean & clear (not muddy) 	C, PM
<ul style="list-style-type: none"> Spray mix adjuvants (e.g. wetters, buffers etc.) must be used according to label instructions 	PM, C
<ul style="list-style-type: none"> In the absence of a built-in colourant a suitable dye must be used in applications 	PM, C
<ul style="list-style-type: none"> Contractors and applicators must demonstrate an understanding of why herbicide applications should not be done in unsuitable weather conditions; e.g. foliar application in windy conditions 	C
<ul style="list-style-type: none"> Quality check records must show that application methods are monitored for targeting, rates and spray drift 	C, PM
<ul style="list-style-type: none"> Where there is a risk of herbicide applicators entering water, knapsacks should be filled only half full 	C, PM
<ul style="list-style-type: none"> PM must submit a Herbicide-used sheet for every completed contract, information must be captured 	PM, PU

• Herbicide applicators must demonstrate an understanding of spot spray patterns	C
• For cut-stump / frill / ring-barking, coverage must be even and spraying must be monitored to limit excessive run-off	C
4.2. Equipment	
• Equipment must be properly maintained according to regular scheduled services	C
• Equipment must not leak. Faulty equipment must be serviced or decommissioned	C
• Equipment appropriate to the application method and treatment must be used.	PM, C
• When using knapsack sprayers the following apply:	
o Knapsack sprayers must be fitted with pressure regulators set to the correct pressure (1bar / 100Kpa) or fitted with a constant flow valve	PM, C
o Knapsack sprayers must be fitted with the correct nozzle in good condition, appropriate for the application method used (e.g. TG1; FL5VS; TFVS2 or equivalent)	PM, C
• Lances must be secured to prevent damage when transporting.	C
• Washing of equipment must take place in a designated area, using the triple-rinse method	C
4.3. Safe storage and handling in-field	
• In a designated, shaded demarcated area	C
o Away from rest / eating areas	C
o At least 20m from any water body	C
o Away from crops, gardens etc.	C

o Floor area covered suitable absorbent material	C
o Bucket & spade must be available in case of spills	C
o Clean water, washing bucket, soap & towel must be available for persons handling the herbicide & equipment	C
• Mixing containers must be UV resistant and leak proof	C
• Mixing containers must be clearly labeled, showing the brand name and concentration of the contents	C
• Refilling, mixing, washing and rinsing should only be done within the demarcated area	C
• Empty product containers must be triple-rinsed and punctured before it is returned to the store	C
• Rinsed water must be recycled for subsequent mixes	C
• Contractors must have proper records of daily herbicide mixtures and issues and actual herbicide use in the contracting teams on-site	C
5. SAFETY	
5.1. Hazard Identification and Risk Assessments (HIRA)	
• The HIRA process to be developed, recorded and available at the project / area and knowledge demonstrated by everyone.	PM,C
• Site Emergency Evacuation Plan must be drafted and communicated to all personnel.	PM,C
• Where relevant, hazards in the working area must be taped off. e.g. trenches, holes, hang-ups etc.	C
• The Written Safe Work Procedures Manual must be available, understood and adhered to by all working staff.	PM, C

5.2. First Aid kit	
<ul style="list-style-type: none"> A first aid kit, fully stocked according to the standard stock list, must be easily accessible at all work sites, and regularly inspected by the PM. 	PM, C
<ul style="list-style-type: none"> All first aid treatment and usage of stock must be recorded in the dressing book kept on site / regional office. 	C, PM
<ul style="list-style-type: none"> The First Aid kit must be under control of a trained First Aider with a current valid certificate 	C, PM
<ul style="list-style-type: none"> There must be an alternative trained First Aider of opposite gender in the team 	C
<ul style="list-style-type: none"> A list of emergency numbers must be kept in the first aid box e.g. ambulance, doctor, hospital, fire brigade, poison info centre 	C, PM
<ul style="list-style-type: none"> A copy of the competency certificate of the first-aider must be kept on-site in the H&S file. 	C, PM
5.3. Personal Protective Equipment and Clothing (PPE)	
<ul style="list-style-type: none"> PPE must meet the minimum prescribed standards of quality (EU or SABS). 	C, PM
<ul style="list-style-type: none"> PPE must be replaced when it becomes ineffective through wear & tear. 	C, PM
<ul style="list-style-type: none"> PPE must be provided with due consideration to the hazard exposure as well as the PPE requirements as per occupation 	C, PM
<ul style="list-style-type: none"> A record must be kept of all PPE issued to contractors and workers, and signed for by them, with the acknowledgement to wear the PPE. 	PM, C
<ul style="list-style-type: none"> Project must conform to acceptable H&S Guidelines 	PM, C
5.4. Substance abuse	
<ul style="list-style-type: none"> The use of any mind altering substances is not allowed on-site (e.g. alcohol, dagga). 	PM, C

<ul style="list-style-type: none"> Persons in the WfW programme must demonstrate knowledge of the potential dangers and the workplace policy of drug use 	ECO, PM, C
5.5. Extreme Weather Conditions	
<ul style="list-style-type: none"> Demonstrate knowledge that no work in / near / on water bodies may take place during rain or lightning. 	PM,C
<ul style="list-style-type: none"> No felling or spray application of herbicides may take place during high wind conditions 	PM,C
<ul style="list-style-type: none"> The contractor should be informed of any adverse weather conditions 	PM
6. METHOD OF WORK	
6.1. Appropriate clearing methods applied	
<ul style="list-style-type: none"> A process of appropriate clearing method selection must be followed and recorded - use the species guide provided 	PM
<ul style="list-style-type: none"> Handling / processing of cleared material must be kept to a minimum, but due to a potential fire hazard and the allelopathic effect of leaf litter, cleared material must not be left on site. A specific area must be designated to stack and process material to make maximum use of wood for community members, whilst regenerative material must be destroyed by controlled burning. 	PM, C
<ul style="list-style-type: none"> A copy of the Treatment Methods table must be available in the Project Office 	PM
<ul style="list-style-type: none"> No frilling / ring barking is allowed within two (2) tree lengths of roads, fences, telephone and power lines, infrastructure (e.g. buildings) or in the riparian zone of a river 	PM
6.2. Follow-up done timeously	
<ul style="list-style-type: none"> An up-to-date follow-up plan must be used to ensure treatment is done on time 	PM

<ul style="list-style-type: none"> For foliar treatment there must be sufficient newly-growing foliage and plants must not exceed hip height 	PM, C
<ul style="list-style-type: none"> When follow-up operations are not done at the most cost-efficient stage, there must be specific reasons on record including cost/person day variations between planned and actual follow-up to be recorded 	PM
6.3. Efficient team operation	
<ul style="list-style-type: none"> Operational planning for the specific site must be evident. Different tasks must be coordinated in an efficient manner for optimum productivity. If possible, every management unit mapped should have its own team allocated. 	PM, C
<ul style="list-style-type: none"> Tool use and tasks must be in line with the site-specific requirements 	C
<ul style="list-style-type: none"> Daily or weekly production tasks must be set and actual production must be measured and recorded 	C
6.4. Work methods conform to WfW standards	
<ul style="list-style-type: none"> Record of inspection of method, quantity and quality according to the contract. 	PM, C
<ul style="list-style-type: none"> All invasive alien species treated within the contract boundaries 	PM, C
7. ENVIRONMENTAL AWARENESS	
7.1. Site clean and free of litter and waste	
<ul style="list-style-type: none"> There must be no litter from clearing activities on work sites, at any time and there must be a litter bag on site at the demarcated gathering area, cleared or removed daily and disposed of in an acceptable manner. 	C

<ul style="list-style-type: none"> Existing litter not cleared in light of possible health risks, that may be associated with certain waste, reported to PM and disposal solution with relevant authority found 	PM, C
<ul style="list-style-type: none"> Project Manager and contractors to demonstrate knowledge that soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site. 	PM, C
<ul style="list-style-type: none"> When loose waste material is transported on vehicles, it must be adequately tied down / covered and contained. 	PM, C
7.2. Sanitation	
<ul style="list-style-type: none"> As far as practically possible, provide formal sanitation (chemical or water-born). Where this is not possible, a spade and toilet paper must be easily accessible on every site. 	C
<ul style="list-style-type: none"> Human waste and used toilet paper must be buried at least 20 m distant from any watercourses or bodies and at least 50 cm deep. 	C
<ul style="list-style-type: none"> In sensitive areas (urban sites, wetlands) a portable toilet must be provided on site and the waste removed and disposed of in an acceptable manner. 	C
<ul style="list-style-type: none"> Clean water and soap must be provided and used for hand washing. 	C
<ul style="list-style-type: none"> The workers should be informed of personal hygiene and demonstrate its practice 	C, PM
<ul style="list-style-type: none"> Where relevant, sufficient toilets per gender need to be available 	C, PM
7.3. Access routes	
<ul style="list-style-type: none"> Existing access routes must be used. Where new access routes or paths are required, these must be planned and made in co-operation with the landowner / manager and marked with hazard tape 	PM, C
7.4. Indigenous plants and animals	
<ul style="list-style-type: none"> Indigenous plants should not be damaged where possible and animals must not be harmed. 	C

<ul style="list-style-type: none"> • Alien trees with bird nests must be killed standing where possible. Site records must be kept. 	PM, C
<ul style="list-style-type: none"> • Collection of plant parts of alien plants for medicinal or other purposes, may only take place with the appropriate permission. Collection records must be kept. 	C
<ul style="list-style-type: none"> • Identify and protect indigenous plants and animals, especially: 	
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Red list data species (none recorded) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Protected plants (see species of conservation concern) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Sensitive communities (wetlands only, no other recorded on project area) 	C
<ul style="list-style-type: none"> <ul style="list-style-type: none"> ○ Wetlands 	C
<ul style="list-style-type: none"> • No species of animal may be poached, snared, hunted, captured or willfully harmed, damaged or destroyed. Snares must be reported to land owners, PM or conservation authorities and removed immediately. 	C
<ul style="list-style-type: none"> • Snakes and other reptiles that may be encountered on the treatment area must not be killed. 	C
<ul style="list-style-type: none"> • Anthills and/or termite nests that occur must not be disturbed. 	C
<ul style="list-style-type: none"> • Keep the relevant managers informed of dangerous or problem animals. Record sightings and encounters. 	PM, C
<ul style="list-style-type: none"> • Keep food and rubbish out of reach of scavengers, e.g. apes and birds. 	C
<p>7.5. Invasive alien plant identification (IAP)</p>	
<ul style="list-style-type: none"> • Alien invasive plants including aquatic alien plants must be identified, where required expert assistance must be used. 	PM, C
<ul style="list-style-type: none"> • The relevant species to be removed must be pointed out to contractors and workers on site. 	PM

<ul style="list-style-type: none"> • Damage to indigenous / desirable vegetation must be minimised. 	C
7.6. Alien invasive dispersal	
<ul style="list-style-type: none"> • Where cleared material must be moved from the site, measures must be taken to prevent dispersal of reproductive material (e.g. seeds, cuttings). 	PM, C
<ul style="list-style-type: none"> • Chipped plant material must be free of seed if used off-site (e.g. mulch). 	PM, C
<ul style="list-style-type: none"> • Plants which have been removed must not be transported across or near to rivers or dams in which the species is absent. 	PM, C
<ul style="list-style-type: none"> • Removed plants must not be stacked on top of indigenous flora. 	PM, C
<ul style="list-style-type: none"> • Method and specifications chosen with due consideration of impact on the site, natural vegetation & regeneration. 	PM
<ul style="list-style-type: none"> • Methods used must ensure that weeds are not distributed by the contractor and employees 	PM, C
7.7. Site stabilisation / anti-erosion / rehabilitation measures	
<ul style="list-style-type: none"> • Stack larger cut logs along the contour and below knee height with 2 m gaps at 10 to 15 m intervals for access, escape, animal movement and to reduce run-off and soil movement where there is an enhanced erosion risk along stream banks or steeper slopes 	PM, C
<ul style="list-style-type: none"> • Preserve indigenous plant cover and adapt treatment methods to allow indigenous plants to colonize the site. 	PM, C
<ul style="list-style-type: none"> • Identify sites requiring additional stabilisation structures / measures / re-vegetation and obtain expert advice & planning to implement. 	PM
<ul style="list-style-type: none"> • Take precautionary measures to protect stabilising plants (planted & natural) during follow-up spraying. 	C

7.8. Site stabilisation / anti-erosion / rehabilitation records	
<ul style="list-style-type: none"> Sites must be mapped and a unique Treatment Area number must be assigned. Comprehensive planting / maintenance records must be kept; including dates, species and number of plants and follow-up care. 	PM
<ul style="list-style-type: none"> A record of input costs must be kept, including: materials, plants, seeds, person-days etc. 	PM
8. FIRE FIGHTING AND PROTECTION	
8.1. Fire Precautions on work sites	
<ul style="list-style-type: none"> Smoking allowed in safe indicated areas, designated by the contractor / manager / landowner. 	PM, C
<ul style="list-style-type: none"> No fires are allowed on work sites. 	PM, C
<ul style="list-style-type: none"> Site specific reaction / evacuation rules must be applied in the case of wild fires. 	C
<ul style="list-style-type: none"> Basic appropriate fire-fighting equipment must be available at each work site; a minimum of five fire beaters and one filled knapsack fire-fighting pump, or alternative suitable equipment. 	PM, C
<ul style="list-style-type: none"> Where fuels and machines are used on site, a 2 kg dry chemical powder fire extinguisher in working condition must be available. 	PM, C
<ul style="list-style-type: none"> Fire Fighting & Extinguishing Equipment inspected and recorded. 	PM
8.2. Fire Protection	
<ul style="list-style-type: none"> The project must be a member of the Fire protection Association (FPA) and attend meetings where applicable 	ECO, PM
<ul style="list-style-type: none"> In FPA areas, the project must be on their communication network. 	ECO, PM

<ul style="list-style-type: none"> Fieldwork may not take place during red days or extreme danger rating days. (Contact Working on Fire office) 	ECO, PM
9. TRAINING	
9.1. Induction	
<ul style="list-style-type: none"> All new workers must receive orientation before starting work. 	PM
9.2. Compulsory functional training	
<ul style="list-style-type: none"> All training, including refresher courses, is compulsory. 	TU, PM
<ul style="list-style-type: none"> All training must be provided to workers and contractors within three months of commencement of work 	TU, PM
<ul style="list-style-type: none"> Project Managers must hold a valid training certificate, on file, for all the training courses required in their project. Alternatively, arrangement must be made with the WfW Programme or suitably qualified units to provide such training 	PM
<ul style="list-style-type: none"> Training must be in line with the latest WFW Training Policy 	TU, PM
<ul style="list-style-type: none"> Area / Project Managers must pass an Environmental Pest Control Course and apply for PCO Registration with the National Dept. Agric - Registrar. 	TU
<ul style="list-style-type: none"> Contractors - Limited Pest Control course. 	TU
<ul style="list-style-type: none"> Herbicide Applicators – WfW Herbicide Applicators course. 	TU
<ul style="list-style-type: none"> Other workers – Herbicide Awareness training. 	TU
<ul style="list-style-type: none"> Chain saw operators - chainsaw handling and maintenance, felling, cross-cutting and de-branching techniques. 	TU

<ul style="list-style-type: none"> Copies of all herbicide training certificates received and Pest Control Licenses must be available with the PM and contractor on-site. 	PM, C
9.3. Training Plan & Profiles	
<ul style="list-style-type: none"> The Training Annual Plan of Operations must be displayed. 	PM
<ul style="list-style-type: none"> The plan must be based on the WFW training matrix and policy. 	TU, PM
9.4. Training Records	
<ul style="list-style-type: none"> All training capture sheets, attendance registers, evaluation forms, and certificates must be filed in the Regional Training Manager’s office or Area office. 	TU, PM
<ul style="list-style-type: none"> All Department of Labour monitoring sheets, correspondence, financial records and training schedules must be filed in the Regional Training Manager’s office or Area office. 	TU
9.5. Accreditation	
<ul style="list-style-type: none"> All training must be aligned to unit standards, where possible. 	TU
<ul style="list-style-type: none"> All training must be provided by accredited training providers, where possible. 	TU
Performance Indicator	<ul style="list-style-type: none"> » Project area is consistently cleared of invasive alien vegetation » Remnants of alien vegetation removed from where they were cleared to make way for the proposed development and rehabilitation of natural vegetation surrounding the development » No indication of further degradation and/or pollution of the areas surrounding the development » No members of staff/ public/ landowners injured
Monitoring	<ul style="list-style-type: none"> » Regular visual inspection of cleared areas for signs of resprouting, alien plant seedling emergence, new alien species invasions » An incident reporting system will be used to record non-conformances to the EMP.

- » Public complaints register must be developed and maintained on site.
- » ECO to monitor all construction areas on a continuous basis until all construction is completed; immediate report backs to site manager.
- » ECO to address any infringements with responsible contractors as soon as these are recorded.

**APPENDIX C:
PRINCIPLES FOR EROSION MANAGEMENT**

PRINCIPLES FOR EROSION MANAGEMENT

1. Purpose

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

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

2. Legislation and Standards

Soil conservation pertaining to erosion has been a topic within legislation form the 1930's till today in South Africa. Relevant legislation:

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

3. Areas with a high soil erodability potential

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

- » Any areas without vegetation cover
- » Excavated areas
- » Steep areas
- » Areas where the soil has been degraded already
- » Dispersive, duplexed soil areas
- » Areas with fine grained soil material with a low porosity
- » Areas which undergo overland flow of water.
- » Areas close to water
- » Irrigated areas
- » Compacted areas
- » Rivers
- » Drainage lines
- » And any areas where developments cause water flow to accelerate on a soil surface.
- » Coarsely gravelly covered surfaces

4. Precautionary management activities to avoid erosion

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

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

5. Monitoring

7.1. General Erosion

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

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

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

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

If any activities or placement of equipment cause pooling on the site, degrade the vegetation, result in removal of the surface or subsurface soil horizons, create compacted surfaces with steep gradients, or minimise runoff areas, the erosion potential on the site will increase.

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

- » Assess the situation.
- » Take photographs of the soil degradation.
- » Determine the cause of the soil erosion.

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

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

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

7.2. Stormwater Management

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

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

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

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

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

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

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

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

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

6. Rehabilitation

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

6.1. General Erosion Management

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

6.1.1. Equipment

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

- » Reno mattresses
- » Slope attenuation
- » Hessian material
- » Shade catch nets
- » Gabion baskets

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

6.1.2. Methods to prevent accelerated erosion

The following practises should be considered and adhered to:

- » Ensure steep slopes are stabilised.
- » Ensure that steep slopes are not stripped of vegetation and left to dry out and become water repellent (which will case increased runoff and a decreased infiltration rate) increasing the erosion potential.
- » Ensure that all water on site (rain water or water wastage from the construction process) does not result in any surface flow (increase velocity and capacity of water) as a result of the poor drainage systems.
- » Ensure that pooling of water on site is avoided, as the site and the general area consists of dispersive soils, pooling will cause an increase of infiltration on one area, causing the subsurface to begin eroding.
- » Ensure that heavy machinery does not compact those areas which are not intended to be compacted (i.e. areas intended to be managed), as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. where compaction does occur, the areas should be ripped.
- » Ensure that compacted areas have adequate drainage systems to avoid pooling and surface flow.
- » Prevent the concentration or flow of surface water or stormwater down cut or fill slopes, or along pipeline routes or roads, and ensure measures to prevent erosion are in place prior to construction.
- » Ensure that stormwater and any runoff generated by hard surfaces should be discharged into retention swales or areas with rock rip-rap. These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that surface flows are managed prior to being discharged back into a natural watercourse to support the maintenance of natural base flows within the ecological systems and prevent erosion, i.e. hydrological regime (water quantity and quality) is maintained.
- » Ensure siltation and sedimentation through the use of the erosion equipment mentioned structures.

- » Ensure that all stormwater control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local ground watertable in low quantities (to reduce runoff but prevent subsurface erosion).
- » Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
- » Ensure that vegetation clearing is conducted in parallel with the construction progress across the site to minimise erosion and/or run-off.
- » Ensure that large tracts of bare soil which would cause dust pollution in high winds, or have high erosion susceptibility and increase sedimentation in the lower portions of the catchment are controlled through temporary surface covering.
- » Ensure no diversion of water flows in catchment occurs.
- » Ensure that dust control measures are implemented, but prevent over-wetting/saturating the area (to cause pooling) and run-off (that may cause erosion and sedimentation).
- » Watercourse (stream) crossings should not trap any run-off, thereby creating inundated areas, but allow for free flowing watercourses.

6.1.3. Mitigation for previously degraded areas

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

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

6.2. Methodologies

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

- » Topsoil covered with a geotextile or hessian material and a grass seed mixture (see Rehabilitation Specifications).
- » Logging or stepping following the contours of the slope, to reduce surface runoff.
- » Earth or rock-pack cut-off berms.
- » Packed branches to roughen the surface and promote infiltration.
- » Benches (sand bags).

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

6.3. Engineering Specifications

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

Requirements for project design:

- » Erosion control measures to be implemented before and during the construction period, including the final stormwater control measures (post construction).
- » The location, area/extent (m²/ha) and specifications of all temporary and permanent water management structures or stabilisation methods.
- » A resident Engineer to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
- » The Developer holds ultimate responsibility for remedial action in the event that the approved stormwater plan is not correctly or appropriately implemented and damage to the environment is caused.
- » Concrete lined drains placed adjacent to road to transfer the water to the existing water courses.
- » Frequent gravel drains hydroseeded placed on permanent roadway edges.

- » At the point where stormwater is discharged, energy dissipaters to be constructed to reduce the flow rate of run-off.
- » All cut and fill banks will be seeded with an approved seed mix (as per the rehabilitation specifications) to ensure bank stabilisation and the elimination of potential erosion. Reno mattresses may be used to ensure that the area remains stable.

6.4. Rehabilitation Specifications

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

6.5. Post- and during construction rehabilitation activities

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

7. Rehabilitation steps to mitigate the eroded area

- » Stockpiled topsoil must be spread over disturbed areas (150 – 200mm thick) just prior to planting/seeding.
- » Rip and scarify along the contours of the newly spread topsoil prior to watering and seeding.
- » Organic fertilizers or compost shall be used if site conditions require it and can be applied as part of hydro-seeding applications.
- » Seed should be sown into weed-free topsoil that has been stockpiled (i.e. original topsoil from the site).
- » Indigenous plants (e.g. grass species such as *Cynodon dactylon*, *Eragrostis curvula*) shall be used to rehabilitate disturbed areas.

- » Applying the seed through hydromulching (hydro-seeding) is advantageous (or organic mulching after seeding).
- » Watering is essential and rehabilitation should ideally occur during the wet season.
- » The topsoil in the area is vulnerable to erosion therefore the hydro-seeded surfaces must be covered with a shade cloth material or natural fibre (hessian material) to reduce the loss of soil while the plants establish.

7.1. 'Watering' to avoid erosion

- » Movement of livestock in newly rehabilitated areas must be restricted, where possible, while taking into consideration drinking areas/paths.
- » Watering the rehabilitated areas should be undertaken in the wet/rainy season essential but if this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth).
- » Generous watering during the first two weeks, or until the seeds have germinated, is required (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for germination to occur.
- » For grass to establish (once germination has occurred), rainfall or irrigation is needed at regular intervals, ideally every few days and possibly every day if weather conditions require it.
- » During dry periods, with no rainfall, 100 litres per m² (or 100mm of rain) over a month or more, may be necessary to establish plants capable of surviving dry weather (or otherwise specified by the Horticultural Landscape Contractor).

7.2. Seeding

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

7.3. Steep slopes

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

7.4. Maintenance and duration

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

8. Conclusion

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

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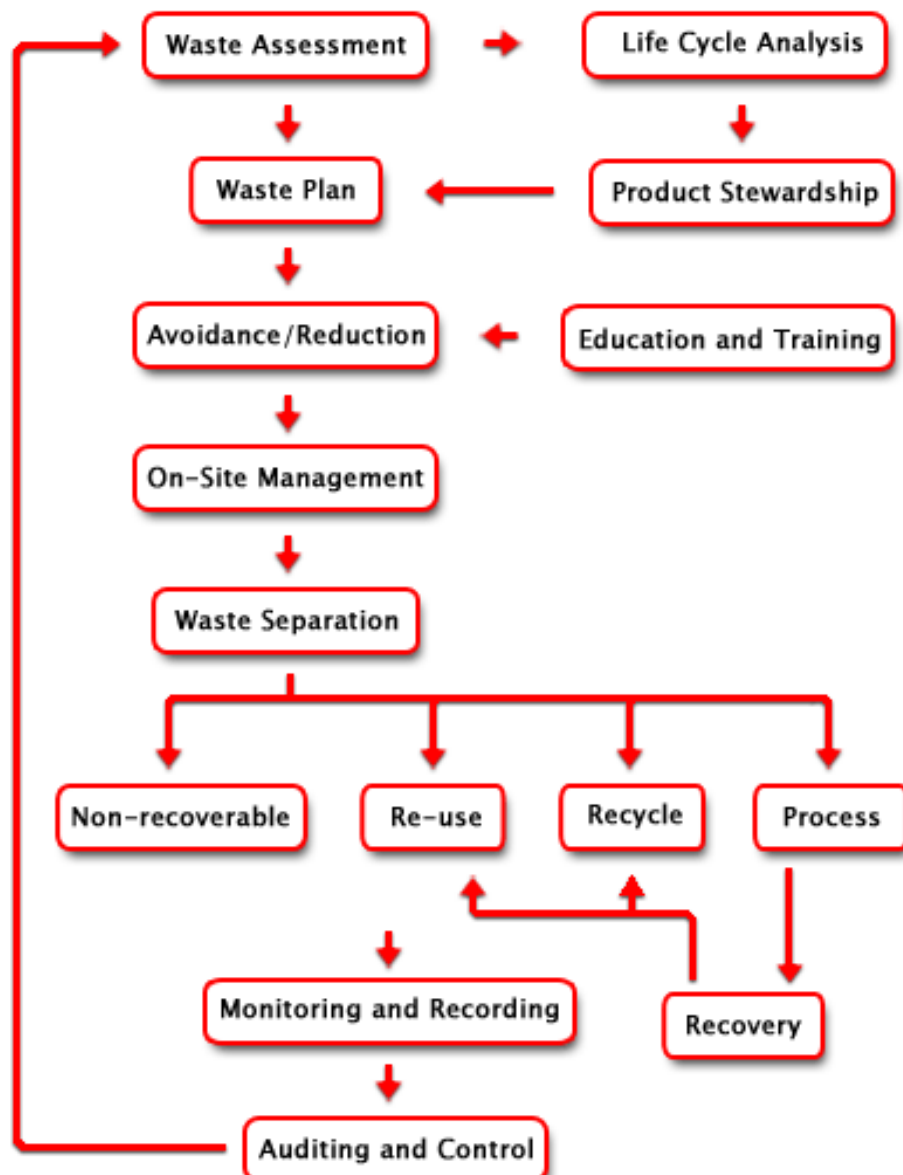
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**APPENDIX D:
GUIDELINES FOR INTEGRATED MANAGEMENT OF
CONSTRUCTION WASTE**

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.

The Integrated Waste Management Approach to Waste



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 E:
PRINCIPLES FOR PLANT SEARCH AND RESCUE,
REHABILITATION AND RE-VEGETATION**

METHODS FOR PLANT RESCUE AND HABITAT REHABILITATION

List of Abbreviations

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

List of Definitions:

Accelerated soil erosion: Soil erosion induced by human activities.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1. Purpose

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

The objective of the plan is therefore to provide:

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

2. Scope

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

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

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

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

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

3. Legislation and Standards

Relevant legislation:

- » Conservation of Agricultural Resources Act 43 of 1983
- » Environmental Conservation Act 73 of 1989
- » National Forestry Act 84 of 1998
- » National Environmental Management Act 107 of 1998
- » Northern Cape Nature Conservation Act (Act No. 9 of 2009)

4. Effect of clearing alien vegetation

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

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

5. Effect of removing individuals of species of conservation concern

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

6. General: Plant rescue and protection

Successful plant rescue can only be achieved if:

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

6.1. Time of planting

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

7. General: IAP removal

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

Information can be obtained from the relevant website:

<http://www.dwaf.gov.za/wfw>

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

8. General: Rehabilitation and re-vegetation

Successful rehabilitation can only be achieved with:

- » A long-term commitment
- » Practical, adaptive management
- » Viable goals of desired outcomes

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

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

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

8.1. Map and create management areas

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

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

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

- » what will happen there
- » what needs to be mitigated – including storm water- and erosion management
- » which management units need priority intervention/mitigation
- » how will this mitigation / intervention be done (method statements) including schedule of work
- » realistic and desirable end states including list of species that should be established to initiate rehabilitation after initial revegetation

- » approximate timeframes
- » monitoring protocol to evaluate success or failures of interventions
 - establish permanently marked transects and monitor with fixed-point photography
- » who will be responsible for doing what
- » how will different actions be integrated to achieve and maintain or improve the desirable end state of the environment of that management unit

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

8.2. Setting realistic rehabilitation goals

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

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

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

8.3. Remove or ameliorate the cause of degradation

This will include:

- » Physical rehabilitation of topsoil where it has been removed.
- » Topsoil on areas that have not been cultivated are considered as the upper 20 - 30 cm only. These contain the most important nutrients, micro flora and –fauna essential for nutrient cycling processes. Topsoils are also an important source of seeds.
- » Subsoils and overburden substrata lack the above elements and will first have to be used for physical rehabilitation of landscapes as and where necessary, and then overlain with topsoils

- » Stabilisation of topsoils and prevention of erosion – refer to the Erosion management plan
- » Removal of all invasive vegetation – refer to the Invasive Management Plan
 - Where it is desirable to use brush or logs of the cleared vegetation for soil stabilisation, such material must be free of regenerative material – e.g. seeds or root suckers

8.4. Initial revegetation

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

8.5. Plant Search and Rescue

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

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

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

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

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

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

For drainage areas:

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

8.7. Monitoring and follow-up action

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

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

The following are the minimum criteria that should be monitored:

- » Composition and density of replanted vegetation, distinguishing between species introduced for initial revegetation only and species that are part of the pre-determined desirable end state
- » Associated nature and stability of surface soils
 - It is recommended that permanent transects are marked and surveyed annually according to the LFA technique (Tongway and Hindley 2004), adapted to integrate both surface soil characteristics and the vegetation to be monitored
- » Re-emergence of IAPs
 - If noted, remedial action must be taken immediately according to Working for Water specifications
- » Nature and dynamics of riparian zones
 - Stability of riparian vegetation
 - Any form of bank erosion, slumping or undercutting

- Stability of channel form and width of streams – if this increases, it shows that vegetation on plains and/or riparian areas and upper drainage lines are not yet in a stable enough state to be fully functional in reducing excess runoff and the ecosystem overall is losing valuable resources

8.8. Timeframes and duration

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

9. Conclusion

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

10. References and further reading

- Clewell, A., Rieger, J. and Munro, J. (2005). *Guidelines for Developing and Managing Ecological Restoration Projects, 2 Edition*. www.ser.org and Tucson: Society for Ecological Restoration International.
- Coetzee, K. (2005). *Caring for Natural Rangelands*. Scottsville: University of KwaZulu-Natal Press.
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- Tongway, D.J. and Hindley, N.L. (2004) *Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes*, CSIRO Sustainable Ecosystems, CANBERRA, AUSTRALIA.
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A. APPENDIX: RECOMMENDED OPERATIONAL STANDARDS

OBJECTIVE: Revegetate and Rehabilitate disturbed areas

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

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

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

Project component/s	Project components affecting the objective: <ul style="list-style-type: none"> » Turbines » Access roads and cabling between and to turbine units » Power line » Sealed surfaces (e.g. roofs, concrete surfaces, compacted road surfaces, paved roads / areas) » Substation » All other infrastructure
Potential Impact	<ul style="list-style-type: none"> » Loss of suitable substrate for a stable vegetation cover » De-stabilisation and/or alteration of substrate and hence degradation of vegetation cover, significant change in species composition or loss of agricultural potential » Loss of suitable habitat for flora and fauna » Leaky ecosystem due to loss of nutrients and moisture from the system, leading to a less resilient vegetation cover and loss of ecosystem function and -services » Degradation and/or loss of riparian areas and wetlands on and beyond the project boundaries » A loss of indigenous vegetation cover and possibly endangered species » Disturbance of fauna species
Activities/risk sources	<ul style="list-style-type: none"> » Rainfall and wind erosion of disturbed areas » Excavation, stockpiling and compaction of soil » Existing IAPs as well as clearing thereof » Concentrated discharge of water from construction activity or new

	<p>infrastructure</p> <ul style="list-style-type: none"> » Storm water run-off from sealed, altered or bare surfaces » Mobile construction equipment movement on site » Cabling and access roads construction activities » Power line construction activities » River/stream/drainage line road crossings » Roadside drainage ditches » Project related infrastructure » Premature abandonment of follow-up monitoring and adaptive management of rehabilitation
Mitigation: Target/ Objective	<ul style="list-style-type: none"> » To minimise loss of plant species of conservation concern » To minimise unfavourable runoff conditions and loss of resources from the ecosystems » To minimise erosion of soil from site during and after construction » To minimise and mitigate unfavourable alteration to drainage lines, especially incision » To minimise damage to indigenous vegetation during and after construction » No accelerated overland flow related surface erosion as a result of project infrastructure » No reduction in the surface area or general nature and functionality of wetlands (drainage lines and other wetland areas) as a result of the establishment of infrastructure on the project areas and beyond its boundaries » A clear reduction of IAPs on the project area and replacement thereof by indigenous vegetation according to a pre-determined desirable end state

Mitigation: Action/control	Responsibility	Timeframe
Planning		
Classify the entire project area into management units according to current land cover and state of the environment and map accordingly	Developer / Contractor	Prior to construction
<p>For each management unit</p> <ul style="list-style-type: none"> » establish what interventions will be necessary relating to IAPs, soil erosion management, topsoil handling, landscape rehabilitation and revegetation » where rehabilitation and revegetation will be necessary, decide on the desired end state of vegetation for that management unit and create a list of species to be established on specific sites » outline the management of construction activities, including topsoils, excavated materials and felled biomass in a manner that will optimise the rehabilitation goals as fast and as effective as possible for that management unit 	Developer / Contractor in collaboration with ECO and land-users	Prior to construction
Plant Rescue and indigenous plant materials		
<p>All harvested plant materials shall be labelled with</p> <ul style="list-style-type: none"> » Genus as minimum, species if known » Habitat from which materials were collected 	ECO	Prior to construction

Mitigation: Action/control	Responsibility	Timeframe
<p>Indigenous plant materials for re-vegetation:</p> <ul style="list-style-type: none"> » All plant material shall be obtained from the search-and-rescue operation on the site prior to clearing or from local nurseries or reputable seed providers » Indigenous materials shall only be removed from their habitat with the necessary permits whenever applicable » Each plant removed shall be handled, packed and stored in a manner suitable for that species » Removed plants shall be protected from windburn or other damage during transportation » No plants or plants with exposed roots shall be subjected to excessive exposure to drying winds and sun, or subjected to water logging » All plants shall be kept free from plant diseases and pests and protected from rodents or other damaging agents » All indigenous plants that have been removed prior to clearing shall be returned to conditions resembling their original habitat as close as practically possible 	Contractor in collaboration with ECO	Before, during and after construction
<p>Seed stocks for rehabilitation</p> <ul style="list-style-type: none"> » Seed can be used for cultivation of desirable species for revegetation » Seed shall be utilised for direct sowing or hydroseeding » Seed collected from the site must be dried and stored in a suitable facility under cool (7-10°C), dry, insect free conditions until required for cultivation or seeding. Only viable, ripe seed shall be used » Seed harvested shall be insect- and pathogen free » Seed harvested shall not contain materials of any invasive species » Prior to clearing, seed should be collected from the site on a regular basis as species start to seed to maximise the amount of fully developed seed secured » From sites that will be cleared, 100% of all seeds available may be collected » From sites adjacent to the development, 25% of seeds can be collected for rehabilitation 	Contractor and ECO	Before, during and after construction
<p>Site-specific nursery</p> <ul style="list-style-type: none"> » On-site nursery facilities shall be erected for the holding of rescued plant material and the propagation of appropriate species for re-vegetation » Where nursery facilities can only cater for rescued plants, a suitable (local) nursery shall be identified that will be willing to receive seeds collected and propagate the necessary species for later revegetation » Soil or other propagation media, were used, shall be weed- and pathogen free » Argentine ants shall be controlled at all times » The area where plants are stored shall be kept free of 	Contractor, ECO to control	Prior to construction

Mitigation: Action/control	Responsibility	Timeframe
weeds <ul style="list-style-type: none"> » Plants stored in the designated area shall be protected from rodents, excessive sun and wind, and inspected regularly until being planted for pathogens and pests, and then treated accordingly » The nursery shall be adequately secured to prevent loss or theft of species 		
Protected flora <ul style="list-style-type: none"> » Ensure that no indigenous protected flora is removed from its original habitat in the project area without legal documents from the relevant authorities 	ECO	Before, during and after construction
Topsoil		
Avoid <ul style="list-style-type: none"> » Management units that will not be developed or selected elements – trees, rocky outcrops on site shall be maintained in situ and demarcated clearly to prevent any disturbance during construction » These units will be considered as NO-GO areas during construction 	Contractor and ECO	Before, during and immediately after construction
Invasives <ul style="list-style-type: none"> » Remove all invasive shrubs as per the Working for Water specifications 	Contractor, ECO to control	Before, during and after construction
Mulch <ul style="list-style-type: none"> » all trees felled shall be debranched and the logs used in controlling erosion from re-landscaped topsoils and/or adding surface roughness and organic matter to topsoils to be rehabilitated » all cut branches from trees, as well as all shrubs cleared from the construction site shall be shredded to mulch, either by a chipper or by hand to sticks no longer than 10 cm » preparation of mulch shall be done at source » mulched material shall be free of seed-bearing invasive plant material » the mulch shall be suitably stored – bagged if necessary - and will be used in rehabilitation and soil erosion management on the site » should additional mulch be used for rehabilitation, this should be obtained from invasive shrubs of areas not cleared » mulch shall be stored for as short a period as possible 	Contractor, ECO to control	Before, during and immediately after construction
Storage of topsoil and subsoil: <ul style="list-style-type: none"> » topsoils constitute the upper 20 – 30 cm of soil only, lower layers of soil are regarded as subsoil » stockpiling of topsoils and subsoils shall only be done on previously transformed areas, and be kept at least 50 m from any remaining natural vegetation » care shall be taken during stockpiling to prevent the 	Contractor, ECO to control	During and immediately after construction

Mitigation: Action/control	Responsibility	Timeframe
<p>mixing of topsoil with subsoil and/or any other material</p> <ul style="list-style-type: none"> » topsoils shall be stored in heaps no higher than 100 cm, and shall be re-applied as soon as possible » care shall be exercised during stockpiling of topsoils to prevent compaction thereof » topsoils shall be adequately protected from erosion by preventing concentration of surface water and scouring of slopes » erosion of topsoils has to be contained and repaired as soon as it occurs, before large scale erosion and loss of topsoil develops » any logs obtained during clearing operations can be used in continuous rows to curtail erosion where necessary. Geojute (geotextile) shall be used additionally if the logs are not sufficient to remedy any erosion – for details refer to the erosion management plan » where topsoils need to be stored longer than 6 months, such stockpiles shall be revegetated, even if this has to include re-seeding to achieve an acceptable cover of vegetation 		
<p>Boulders and rocks</p> <ul style="list-style-type: none"> » where removed during clearing, should be stored separately and used in the rehabilitation program » boulders and rocks must be partially buried within the topsoil layer wherever practical to provide greater soil-holding stability and reduce water erosion » placement of rocks and boulders shall mimic the natural occurrence of rocks and boulders in the area 	Contractor, ECO to control	During and after construction
Rehabilitation of surface		
<p>Prior to the application of topsoil</p> <ul style="list-style-type: none"> » subsoil shall be shaped and trimmed to blend in with the surrounding landscape or used for erosion mitigation measures » ground surface or shaped subsoil shall be ripped or scarified with a mechanical ripper or by hand to a depth of 15 – 20 cm, » compacted soil shall be ripped to a depth greater than 25 cm and the trimmed by hand to prevent re-compacting the soil » any rubbish, concrete remnants, steel remnants or other objects introduced to the site during the construction process shall be cleared before ripping, or shaping and trimming of any landscapes to be rehabilitated takes place » shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscapes 	Contractor, ECO to control	During and after construction

Mitigation: Action/control	Responsibility	Timeframe
<p>Application of topsoil</p> <ul style="list-style-type: none"> » topsoils shall be spread evenly over the ripped or trimmed surface, if possible not deeper than the topsoil originally removed » the final prepared surface shall not be smooth but furrowed to follow the natural contours of the land » the final prepared surface shall be free of any pollution or any kind of contamination » care shall be taken to prevent the compaction of topsoil » where applicable, the final prepared surface will also contain scattered rocks and/or logs to mimic the natural condition of the original habitat or area and to aid in soil stabilisation and erosion control 	Contractor, ECO to control	During and after construction
<p>Soil stabilisation</p> <ul style="list-style-type: none"> » mulch from brush shall be applied by hand to achieve a layer of uniform thickness » mulch shall be rotovated into the upper 10 cm layer of soil <ul style="list-style-type: none"> ○ this operation shall not be attempted if the wind strength is such as to remove the mulch before it can be incorporated into the topsoil » in very rocky areas a layer of mulch shall be applied prior to adding the topsoil » measures shall be taken to protect all areas susceptible to erosion by installing temporary and permanent drainage work as soon as possible <ul style="list-style-type: none"> ○ where natural water flow-paths can be identified, subsurface drains or suitable surface drains and chutes need to be installed » additional measures shall be taken to prevent surface water from being concentrated in streams and from scouring slopes, banks or other areas <ul style="list-style-type: none"> ○ if mulch is limited, available mulch, together with harvested seeds, should be concentrated in these hollows to promote rapid re-vegetation in them » runnels or erosion channels developing shall be back-filled and restored to a proper condition <ul style="list-style-type: none"> ○ such measures shall be effected immediately before erosion develops at a large scale » where erosion cannot be remedied with available mulch, logs or rocks, geojute shall be used to curtail erosion 	Contractor, ECO to control	During and after construction
<p>Borrow-pits</p> <ul style="list-style-type: none"> » shall be shaped to have undulating, low-gradient slopes and surfaces that are rough and irregular, suitable for trapping sediments and facilitation of plant growth » upon completion of rehabilitation these reshaped and revegetated areas shall blend into the natural terrain 	Contractor, ECO to control	After construction

Mitigation: Action/control	Responsibility	Timeframe
Revegetation		
<p>Recreate a non-invasive, acceptable vegetation cover that will facilitate the establishment of desirable and/or indigenous species</p> <ul style="list-style-type: none"> » revegetation of the final prepared area is expected to occur spontaneously to some degree where topsoils could be re-applied within 6 months » revegetation will be done according to an approved planting/landscaping plan according to the management units initially delineated and their respective desirable end states and permissible vegetation 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
<p>Re-seeding</p> <ul style="list-style-type: none"> » revegetation can be increased where necessary by hand- seeding indigenous species <ul style="list-style-type: none"> ○ previously collected and stored seeds shall be sown evenly over the designated areas, and be covered by means of rakes or other hand tools » re-seeding shall occur at the recommended time to take advantage of the growing season » in the absence of sufficient follow-up rains after seeds started germinating, watering of the new vegetation cover until it is established shall become necessary to avoid loss of this vegetative cover and the associated seedbank » where, after initial re-seeding, the no acceptable vegetation cover has established within 12 months, hydroseeding should be considered as an option for follow-up revegetation work » sowing rates of seeds used during hydro-seeding should be obtained from the relevant supplier and in accordance with the existing environment 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
<p>Planting of species</p> <ul style="list-style-type: none"> » species to be planted include all rescued species » the size of planting holes shall be sufficiently large to ensure that the entire root system is well covered with topsoil » soil around the roots of container plants shall not be disturbed » bulbous plants shall be planted in groups or as features in selected areas » before placement of larger plant specimens into prepared holes, the holes shall be watered if not sufficiently moist » during transplanting care shall be taken to limit or 	Contractor, ECO to control	Successively during construction , as construction of individual components is completed, then followed up until desired end state is

Mitigation: Action/control	Responsibility	Timeframe
<p>prevent damage to roots</p> <ul style="list-style-type: none"> » plants should be watered immediately after transplanting to help bind soil particles to the roots (or soil-ball around rooted plants) and so facilitate the new growth and functioning of roots 		reached
<p>Traffic on revegetated areas</p> <ul style="list-style-type: none"> » designated tracks shall be created for pedestrian or vehicle traffic where necessary » Disturbance of vegetation and topsoil must be kept to a practical minimum, no unauthorised off road driving will be allowed » All livestock shall be excluded from revegetated areas 	Contractor	Before, during and after construction
<p>Establishment</p> <ul style="list-style-type: none"> » The establishment and new growth of revegetated and replanted species shall be closely monitored » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created 	Contractor	Successively during construction , as construction of individual components is completed, then followed up until desired end state is reached
Monitoring and follow-up treatments		
<p>Monitor success of rehabilitation and revegetation and take remedial actions as needed according to the respective plan</p> <ul style="list-style-type: none"> » Erosion shall be monitored at all times and measures taken as soon as detected » Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created 	ECO during construction, suitable designated person/institution after that	During and after construction , during operational and decommissioning phase
<p>Weeding</p> <ul style="list-style-type: none"> » It can be anticipated that invasive species and weeds will germinate on rehabilitated soils <ul style="list-style-type: none"> o These need to be hand-pulled before they are fully established and/or reaching a mature stage where they can regenerate o Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications 		
Performance Indicator	<ul style="list-style-type: none"> » No activity in identified no-go areas » Acceptable level of activity within disturbance areas, as 	

	<p>determined by ECO</p> <ul style="list-style-type: none">» Natural configuration of habitats as part of ecosystems or cultivated land is retained or recreated, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist» The structural integrity and diversity of natural plant communities is recreated or maintained» Indigenous biodiversity continually improves according to the pre-determined desirable end state<ul style="list-style-type: none">○ This end state, if healthy, will be dynamic and able to recover by itself after occasional natural disturbances without returning to a degraded state» Ecosystem function of natural landscapes and their associated vegetation is improved or maintained
Monitoring	<ul style="list-style-type: none">» Fortnightly inspections of the site by ECO during construction» An incident reporting system must record non-conformances to the EMP.» Quarterly inspections and monitoring of the site by the ECO or personnel designated to the rehabilitation process until 80% of the desired plant species have become established<ul style="list-style-type: none">○ These inspections should be according to the monitoring protocol set out in the rehabilitation plan» Thereafter annual inspections according to the minimal monitoring protocol

B. APPENDIX: CHECKLIST OF ACTIONS FOR REHABILITATION PLANNING

<p>Conceptual Planning</p>	<ul style="list-style-type: none"> » Identify rehabilitation site locations and its boundaries » Identify ownership of rehabilitation program » Describe improvements that are anticipated following rehabilitation » Identify the kind of ecosystem to be rehabilitated at each site » Identify rehabilitation goals and desirable end state » Identify physical site conditions in need of repair » Identify stressors in need of regulation or re-initiation to maintain the integrity of the ecosystem, such as aliens, erosion, fire-regime » Identify the list and kinds of interventions of abiotic and biotic interventions that are and will be needed » Identify landscape restrictions and whether or not its integrity is dependent on a functioning ecosystem outside the project area » Determine project funding and sources » Identify labour sources and equipment needs » Identify biotic resource needs and sources, e.g. suitable topsoil, seeds » Identify any permit requirements or other legal issues » Determine project duration » Outline adaptable strategies for long-term protection and management
<p>Preliminary Tasks</p>	<ul style="list-style-type: none"> » Appoint a rehabilitation practitioner who is in charge of all the technical aspects of rehabilitation » Appoint a restoration team and train where necessary to ensure effective implementation » Prepare a budget to accommodate the completion of preliminary tasks » Document existing site conditions, also describing biota » Conduct pre-project monitoring as needed, including soil chemistry, that may affect the success of the rehabilitation program » Establish a reference site or past reference that represents the desired end state of the site » Gather information on key species to be re-introduced » Conduct investigations as needed to assess the effectiveness of restoration methods and strategies used in similar habitats up to date » Decide if rehabilitation goals are realistic or need modification » Prepare a list of objectives that need to be reached to achieve restoration goals » Ensure liaison with affected stakeholders, especially as far as rehabilitation goals are concerned » Investigate available accedes and infrastructure needed to facilitate implementation of rehabilitation
<p>Implementation phase</p>	<ul style="list-style-type: none"> » Describe the interventions that will be implemented to attain each set objective » Acknowledge potential for passive restoration where viable » Prepare performance standards and monitoring protocols to measure the attainment of each objective » Schedule tasks needed to fulfil each objective

	<ul style="list-style-type: none">» Obtain equipment, supplies and biotic resources as needed» Prepare an appropriate budget
Implementation tasks	<ul style="list-style-type: none">» Mark boundaries and work areas» Install permanent monitoring fixtures» Implement restoration tasks
Post-implementation tasks	<ul style="list-style-type: none">» Protect the rehabilitation site against initial disturbance, including herbivores» Perform post-implementation maintenance, especially continued monitoring and eradication of emerging IAPs» Monitor site at least once per year, using the LFA technique, and identify needs for adaptive management
Evaluation	<ul style="list-style-type: none">» Assess monitoring data to determine whether performance standards are met and rehabilitation objectives reached and maintained» Conduct an ecological evaluation of the newly completed rehabilitation

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

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

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

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

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

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

**APPENDIX F:
WASTE MANAGEMENT PLAN**

ENVIRONMENT PROCEDURE

Waste Management Plan

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Introduction

Sound waste management is better achieved when an Integrated Waste Management System is implemented. This is more evident on sites or in areas where different parties and aspects are involved. Integrated Waste Management is better achieved when system is underlined by sound environmental principles. These principles derived from section 2 of the National Environmental Management Act (Act 107 of 1998). The following principles apply to waste management.

A **Precautionary approach** will be followed in the sense that harm to health and the environment is prevented when waste is generated, treated and disposed off. XXX PTY Ltd as the generator of waste have to abide by the **Duty of Care** principle by ensuring that waste is disposed off in a manner that is environmentally sound and responsible. Management of waste must also follow an **Integrated and Holistic Approach** integrating health, safety and the environment in to the management approach and managing all aspects as a whole. By following the Best Practical Environmental Option one selects and implements the most sustainable management option in terms of the environment and the people surrounding it. The last principle that has to be considered in waste management is the **Polluter Pays** principle. This principle indicates that the costs for remediation and prevention of further pollution will fall on the responsible party.

Purpose of this document

A Waste Management Plan plays a key role in achieving sustainable waste management. This document is set to indicate the procedure that has to be followed during the handling, storage, transportation and disposal of waste that is generated from the activities on site.

Scope

The Waste Management Plan Procedure provides guidelines for waste management and applicable to employees, sub-contractors working on behalf of Triamic Construction Pty Ltd. at West Coast One Wind energy.

Waste Management Strategy

Waste will be managed according to the waste hierarchy as set in the National Environmental Management: Waste Act (Act 59 of 2008).The waste hierarchy dictates that the generation of waste should be avoided and minimised. If this is not possible the most desirable options will be reuse, recycle and recover waste. The last option will be disposal.

When waste is disposed it must be done in an environmentally safe manner and at a disposal site that is permitted and authorised to dispose of that waste. It is the generators duty to ensure that such disposal sites have sound and responsible management practices.

Waste will be segregated at source to facilitate re-use, recycling, and recovery. Segregation of waste will be made possible by means of waste containers that

are allocated and marked for different waste streams that are identified within the content of this document.

Emergency Procedures will be followed in the unforeseen event of a spill or if waste burns on site. (Emergency preparedness and Response Plan – XXX).

All employees will receive training on waste management issues by means of induction training and toolbox talks that will take place once per week. Littering on site is prohibited. No person is allowed to discard of any litter on site except in bins provided for that purpose.

Waste generation

Daily operational activities will generate general waste, metal waste as well as hazardous waste on monthly basis. Figures of these wastes are not yet known and will vary within project cycles as there will be times of acceleration in activity and times decreased activity.

Sources of waste will include: empty containers, office paper, plastic water bottles, and food waste canteens, printer cartridges, and used vehicle oil from workshops

Legal Requirements

The following sources of South African Law have been identified and will form the basis of the (WMP). Triamic Construction Pty Ltd will comply with all environmental policies or Acts that apply to the Project, and the Project Manager should familiarize himself with, and have access to, the following pieces of legislation as a minimum:

- Constitution of South Africa (Act No. 108 of 1996);
- National Environmental Management Act (Act 107 of 1998);
- National Environmental: Waste Act (Act No. 59 of 2008);
- Hazardous Substances Act (Act No. 15 of 1973);
- Impacts and Aspects Register;
- West Coast One Environmental Management Plan (EMP) (Revision 1, February 2013 and
- West Coast One Environmental Authorisation (Reference No. 12/12/20/1581).
- Minimum Requirements for the Disposal of Waste by Landfill, Edition 3 (2005); and
- Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, Edition 3 (2005).

Definations and Abbreviations

a. Defination of waste relevant to operations

- Environment** Surroundings within which human exists and that are made up of:
- The land, water and atmosphere of the earth;
 - Micro- organisms, plant and animal life;
 - Any part or combination of the above and the interrelationships among and between them; and

- The physical, chemical, aesthetic and cultural properties and conditions of foregoing that influence human health and well-being. (NEMA Act, Act No. 107 of 1998).

Waste	means any substance, whether or not that substance can be reduced, re-used, recycled or recovered: <ul style="list-style-type: none"> a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of; b) which the generator has no further use of for the purposes of production; c) that must be treated or disposed of; or d) that is identified as a waste by the minister, by notice in the Gazette, but: <ul style="list-style-type: none"> i) a by-product is not considered waste; and ii) any portion of waste, once re-used, recycled and recovered, ceases waste.
Hazardous	Means a source of or exposure to danger (NEMA, 1998)
Recovery	Means the controlled extraction of a material or the retrieval of energy from waste to produce a product
Recycle	a process where waste is reclaimed for further use, which process involves the separation of waste from a waste stream for further use and the processing of that separated material as a product or raw material.
Re-use	to utilise articles from the waste stream again for a similar or different purpose without changing the form or properties of the articles
Container	means a disposable or re-usable vessel in which waste is placed for the purposes of storing, accumulating, handling, transporting, treating or disposing of that waste, and includes bins, bin –liners and skips
Disposal	Means the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into air or any land.
Hazardous Waste	Waste that has the potential to cause a negative threat/impact to humans and/or the environment. It includes, but is not limited to, batteries, neon lights, fluorescent lights, printer cartridges, oil, paint, paint containers, oil filters, IT equipment etc.
General waste	Waste which does not pose an immediate hazard or threat to health or to the environment' and includes the following waste flows: domestic waste, construction and demolition waste, business waste, insert waste.
EMP	Environmental Management Plan. A detailed plan of action prepared to ensure that recommendations for preventing the negative environmental Impacts and where possible improving the environment are implemented during the life cycle of the project. (West Coast one- project EMP).

b. Abbreviations

ECO	Environmental Control Officer
EMP	Environmental Management Plan
WMP	Waste Management Plan
NEM: WA (Act 59 of 2009)	National Environmental Management: Waste
DWA	Department of Water Affairs
I&AP	Interested and Affected Parties/Person

Responsibilities

- i) The Triamic Construction Pty Ltd Environmental Officer shall be responsible for compliance with this waste management plan and ensure that all waste generated during construction activities on site is managed in safely and in accordance with legislations..
- ii) Triamic Construction Pty Ltd EO shall provide the Team HSE and ECO with a written monthly waste report, detailing both compliance with the environmental Specifications as well as Environmental Performance;
- iii) It is the responsibility of all employees to segregate at source and store waste in the appropriate bins and in designated areas and to ensure that waste is kept to a minimum and environment is not polluted and contaminated.

General waste

a. Management of general waste

General waste will be segregated at source and place in the correct waste bins designated for each waste stream. General waste will not be stored on site for longer than 30 days and will be collected and emptied on a weekly basis by waste management company for disposal.

b. General waste stream

This is waste that does not pose an immediate threat to health or the environment. Most of these waste streams will be designated to be re-used, recycle and recovered.

- i) Compactable General waste
This is any waste type that are small in size and that can be compacted
 - General waste: waste that does not fall within the defined waste streams that will be disposed of in landfill. Domestic waste will be discarded in

waste bins that are labelled "General Waste". Source of this waste will be kitchen, beverage cans, plastic waste and cartons.

- Waste papers: These are waste paper boxes that are unwanted. This waste will be discarded in waste bins labelled "Waste paper, Boxes"

ii) Un-compactable general waste

This is waste that is large in size that cannot be disposed of in normal waste bins or skip. Most of the waste types in this category can be recycled or re-used within the operations on a construction site or can be recycled in to the local community.

- Scrap metals: all metal or steel that is discarded or termed off-cuts will form the bulk of the scrap metal waste stream. These metals will be placed in waste bins labelled "Metal Waste"

c. Recycling Procedure

All scrap/metal waste generated will be collected and sent to the recycling facilities for recycling purpose. Used oil shall be collected by recycling companies where applicable.

Hazardous waste

a. Management of hazardous waste

Hazardous waste will be stored in a safe and responsible manner. Hazardous waste will not be stored on site for more than 30 days. This hazardous waste will be placed in a waste bin labelled "Hazardous Waste" and will be collected and disposed of as Hazardous waste at approved landfill site. All hazardous waste types will be identifiable at all times. Incompatible waste type will be stored separately.

b. Hazardous waste types

- Hydrocarbon contaminated materials: such as soil due to spills and oil leaks;
- Used equipments/vehicles oils: from vehicles being serviced at workshop;
- Printing cartridges; and
- Chemical waste (such as used oil, paint, insecticide).

Waste bins

a. Waste bins conditions

Triamic Construction Pty Ltd will ensure that the waste bins used are suitable for the waste that is to be stored within. The waste bins will be in a good condition, not be corroded and may not permit leachate or be otherwise unfit for the safe storage of waste designated to that container. Bins will have mechanisms in place to prevent waste from becoming wind blow litter and it must be scavenger proof. Hazardous waste bins will be sealed to ensure that no spillages can occur. These bins will be

also be labelled so as to identify type of waste, date of storage commencement and generator details.

b. Inspections of waste bins

Waste bins will be inspected on a daily basis to ensure that they remain in an acceptable condition for safe storage of waste. These inspections will be documented and records will be kept for future references.

c. Placement of waste bins

The bins will be placed in centralised locations in order to ensure that it is accessible to all employees. The waste bins will be emptied and the waste will be taken to the relevant designated areas (the central storage area or the waste transfer station) awaiting collection by waste removal companies.

Waste storage areas and collection points

a. Specifications of waste storage areas

Waste will be managed in such a way as to prevent it from becoming a nuisance such as odor and to prevent the breeding of vermin and vectors. Management practices will ensure that no environmental harm is caused. All waste area will be clearly marked with signs to specify that waste is being stored in that area and to indicate what the nature of waste is. Storage areas will be fenced with access control to prevent unauthorised access.

i) General waste storage areas

Storage areas for general waste will be kept clean and neat, with a high level of housekeeping.

ii) Hazardous waste storage areas

Storage areas for hazardous waste will be having a roof to divert rain water from waste containers and must be fully bunded (110%) with pollution collection measurements in place in case of any spills or leakages. A high level of house keeping must be maintained in and around the storage. A file with (MSDS) documents and waste acceptance forms must be kept on site.

b. Requirements of collection points

Points from which waste is collected to be taken to the storage areas or the transfer stations will be clearly accessible for vehicles.

d. Waste removal schedule

Waste bins will be emptied on a regular basis. This will either be daily, weekly or when bins have reached their capacity. A call for service will be issued to the waste removal company when bins are full.

General rules

a. Records

All waste removal records will be maintained on site where it is accessible to all interested and affected parties. These records will include an updated list of the waste streams and volumes generated and disposed of, all collection certificates and disposal certificate and all material recycled or re-used and the volume thereof.

b. Review

Triamic Construction Pty Ltd Project Manager and Triamic Construction Pty Ltd Environmental Officer will review this Waste Management Plan on a monthly basis.

c. Reporting

Waste disposal figures will be reported on a monthly basis to the the Team Aurora HSE and ECO.

Conclusion

Compliance and implementation of this procedure will ensure effective management of waste on site. Triamic Construction Pty Ltd and their sub-contractors will comply with the requirements of the EMP, the project RoD and other legislative requirements that may have an impact on waste management in general.

References

- (Emergency preparedness and Response Plan
- ISO 14001:2004;
- West Coast One Environmental Management Plan (EMP) (Revision 1, February 2013
- West Coast One Environmental Authorisation (Reference No. 12/12/20/1581).