
PROPOSED HERTZOGVILLE PV 2 - PHASE 1 FREE STATE PROVINCE (DEA REF. NO 14/12/16/3/3/2/258/1)

CONSTRUCTION & OPERATION DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

Submitted as part of the Final EIA 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.

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

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.

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.

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 public.

Photovoltaic cell: Semiconductors which absorb solar radiation to produce electricity

Photovoltaic effect: Electricity can be generated using photovoltaic panels (semiconductors) which are comprised of individual photovoltaic cells that absorb solar energy to 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).

Renewable energy feed-in tariff: REFITs are used to promote renewable energy and have been adopted in over 36 countries worldwide. The establishment of the REFIT in South Africa provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector, and to promote competitiveness between renewable and conventional energies in the medium and long-term. Under the National Energy Regulator Act (Act No. 40 of 2004), the Electricity Regulation Act (Act No. 4 of 2006), and all subsequent relevant amendment acts, the National Energy Regulator of South Africa (NERSA) has the mandate to determine the prices at and conditions under which electricity must be supplied by licence.

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.

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PURPOSE & OBJECTIVES OF THE EMP

CHAPTER 1

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

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

The EMP has been developed as a set of environmental specifications (i.e. principles of environmental management for the proposed Hertzogville PV 2: Phase 1 Plant), 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). During its lifecycle, projects journey through four distinctive phases, i.e. construction, rehabilitation, operation, and decommissioning. The EMP is accordingly separated into measures dealing with the various project phases.

The EMP has the following objectives:

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

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

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

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

Suncorp / Solar Reserve JV must ensure that the implementation of the project complies with the requirements of any environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development and the implementation of the EMP through its integration into the contract documentation. Since this EMP is part of the EIA process undertaken for the proposed Hertzogville PV 2: Phase 1 project, it is important that this document be read in conjunction with the EIA report, as well as the Environmental Authorisation (once issued). This will contextualise the EMP and enable a thorough understanding of its role and purpose in the integrated environmental management process. This EMP for construction and operation activities has been compiled in accordance with Section 33 of the EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project.

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

- » Ensuring that employees have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » Ensuring that a copy of the EMP is readily available on-site, and that all site staff are aware of the location and have access to the document. Employees will be familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the facility.
- » Ensuring that, prior to commencing any site works, all employees and sub-contractors are given some form of Environmental Awareness Training. This training

must provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.

- » Ensuring awareness of any other environmental matters, which are deemed necessary by the Environmental Control Officer (ECO).

The EMP is a dynamic document, which must be updated when required. It is considered critical that this draft EMP be updated to include site-specific information and specifications as required throughout the life-cycle of the facility. This will ensure that the project activities are planned and implemented taking sensitive environmental features into account.

PROJECT DETAILS

CHAPTER 2

Suncorp / Solar Reserve JV(a joint venture between Suncorp / Solar Reserve South Africa (Pty) Ltd is proposing to establish a commercial photovoltaic solar energy facility of up to 150MW (comprising two development phases), as well as associated infrastructure on a site located approximately 12 km south of Hertzogville in the Free State Province. The project is referred to as the Hertzogville PV 2 project. **This EMP only deals with the EIA conclusions and recommendations for Phase 1 of the Hertzogville PV 2 project (DEA Ref. No: 14/12/16/3/3/2/258/1).**

A larger site has been identified for consideration within an Environmental Impact Assessment (EIA). Phase 1 of the Hertzogville PV 2 project will have an electricity generating capacity of up to 75MW. Associated infrastructure includes a substation, access roads and power line/s. An area of 849ha in extent (entire farm portion) was identified for investigation at the start of the EIA process. However the preliminary facility layout indicates that an area of 150ha would be directly impacted on (i.e. less than 20% of the entire farm portion).

Phase 1 will include the following infrastructure and activities:

- » An array of PV panels (up to 3m in height)
- » Mounting structure to be either rammed steel piles or piles with pre-manufactured concrete footings to support the PV panels;
- » Internal access roads; and
- » Cabling between the project components, to be lain underground where practical.

Common infrastructure to be utilised by both Phase 1 and Phase 2 of the proposed facility includes:

- » Upgrade of the Hertzogville 132/22kV Rural Substation which is located on the Farm Albert 986;
- » A power line that is likely to connect to the Hertzogville 132/22kV Rural Substation;
- » Fencing;
- » Workshop area for maintenance and storage; and
- » Office, toilets and water storage tanks.

The location of Phase 1 and Phase 2 of the Hertzogville PV 2 project are shown in Figure 2.1.

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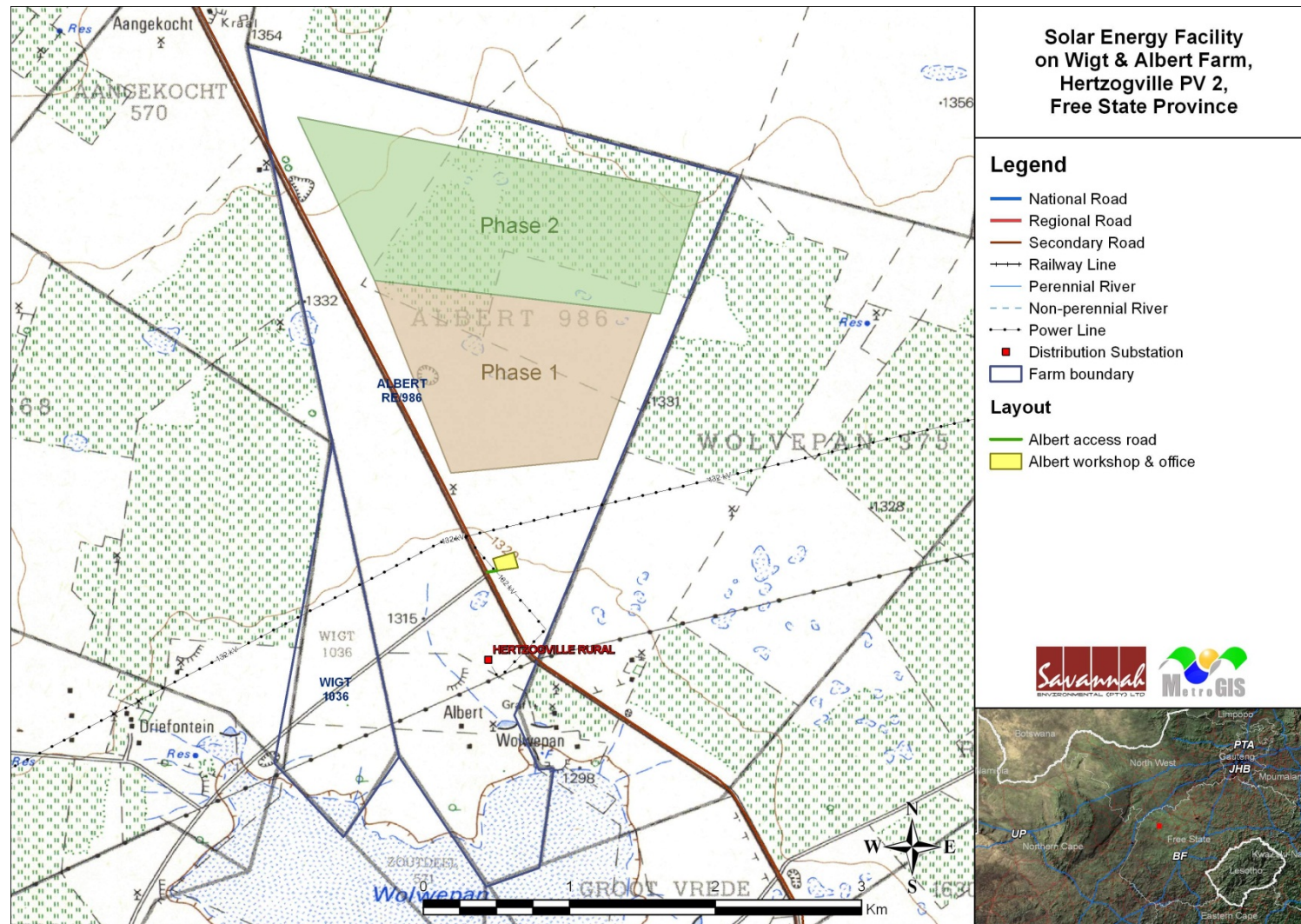


Figure 2.1: Locality map showing the location of Phase 1 and Phase 2 of the Hertzogville PV 2 project on the Remainder of Farm Albert 986, Free State Province

Solar energy facilities, such as those using PV panels use the energy from the sun to generate electricity through a process known as the Photovoltaic Effect. This effect refers to photons of light colliding with electrons, and therefore placing the electrons into a higher state of energy to create electricity. Solar PV facilities comprise of the following components:

The Photovoltaic Cell

A photovoltaic (PV) cell can consist of a thin film technology or polycrystalline silicone cell which acts as a semiconductor used to produce the photovoltaic effect. Individual PV cells are linked and placed behind a protective glass sheet to form a photovoltaic panel. The PV technology may be static or tracking.

The Inverter

The photovoltaic effect produces electricity in direct current. Therefore an inverter must be used to change it to alternating current.

The Support Structure

The PV panels will be attached to a support structure approximately 2-3 meters off the ground set at an angle so to receive the maximum amount of solar radiation. The angle of the panel is dependent on the latitude of the proposed facility and the angles may be adjusted to optimise for summer or winter solar radiation characteristics.

The PV panels are designed to operate continuously for more than 20 years, unattended and with low maintenance.

A summary of the technical information for the 75MW facility is shown in **Table 2.1** below:

Information (Size and technical & Heights) for a 75MW PV Plant	
PV Panel coverage area	150 hectares (for a 75MW plant)
Fencing area	To cover perimeter of plant
Workshop area	100m x 100m
New substation and voltage	150m x 150m
laydown area (size in hectares)	100 by 100m
Water tanks (size, capacity and how many)	10 x 30 litre tanks
Office / workshop (size)	25m x 30 m
water treatment deionisation plant	25m x 40m
Access roads (width)	~ 4 m wide
PV Technology	Fixed mounted polycrystalline static or tracking
Installed capacity	75MW

Panel Spec (installed capacity)	280 watt
Panel Dimensions	15m x 15 m
Number of Panels	~350,000
Number of inverters	38 x 2MW units
Distribution Transformers as part of inverters	2 x 40MVA
Main Transformer capacity	2MVA
Final Height of installed panels from ground level	2-3 m
Height of inverters	2m
Height of Transformers	2m
Height of Buildings	5m
Height of Fencing	~2- 5 metres

2.1. Construction Phase

The construction phase of the proposed facility would entail the erection of solar panels. The PV cells will be arranged in arrays. The frames will be fixed onto the ground with the use of concrete, depending on the soil conditions at the site. This will make the installation of the plant less invasive for the territory and facilitate the decommissioning at the end of its production cycle. The height of the PV panel structure will be up to 2-3 m.

Inverters will be installed to facilitate the connection between the solar energy facility and the Eskom electricity grid via the Hertzogville 132/22kV Rural Substation. The position of the inverters within the footprint of the broader site will be informed by the final positioning of the PV components.

Site preparation activities will include clearance of vegetation at the footprint of certain components (i.e. invertors and transformer position) and the establishment of the internal access roads. The PV panels will be sited a certain distance away from each other (to avoid shading). The vegetation between the panels will not be cleared and will be mechanically maintained. Clearing activities, where required, will involve the stripping of topsoil which will need to be stockpiled and/or spread on site.

Access to the site already exists via gravel roads. However, internal gravel access road (3 to 5 metres wide) will be constructed on the site for maintenance purposes. It is proposed that concrete foundations will be used at the base of invertors and transformers. However, use of concrete will be minimised as far as possible.

Environmental Process

In terms of the Environmental Impact Assessment (EIA) Regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, Act No. 107 of 1998), authorisation is required from the National Department of Environmental Affairs

(DEA) (in consultation with the FS Free State Department of Economic Development, Tourism and Environmental Affairs (FS DEDTEA)), for the establishment of the proposed installation. In terms of sections 24 and 24D of NEMA, as read with the EIA Regulations of GNR543; GNR544; GNR545; and GNR546, a EIA process is required to be undertaken for the construction of the proposed facility. This project has been registered with National DEA under reference number **14/12/16/3/3/2/258/1**.

Savannah Environmental has been appointed as the independent environmental consultants to undertake the EIA to identify and assess any potential environmental impacts. As part of these environmental studies, interested and affected parties (I&APs) have been actively involved through a public involvement process.

In terms of the findings of the EIA, various planning, construction, and operation-related environmental impacts were identified, including:

- » Local site-specific biophysical (flora, fauna and soils) impacts as a result of physical disturbance/modification to the site with the establishment of the facility.
- » Visual impacts.
- » Impacts on the social environment.

The main findings of the EIA include:

a) Local Site-specific Impacts

The construction of Phase 1 of the Hertzogville OV 2 facility will lead to permanent disturbance of an area of approximately 150 ha in extent. Permanently affected areas include the area for the PV panels and associated infrastructure, as well as the internal power line route. From the specialist investigations undertaken for the proposed solar energy facility development site, it was determined that the majority of the site is impacted on to some extent by grazing activities. Areas of sensitivity within the proposed development site were identified through the EIA process. These relate to the local ecology (vegetation, habitat for fauna, a pan that occurs on the site (refer to the sensitivity map – Figure 6.1)), and include:

- » There is one shallow channelled watercourse on site, as well as a two small pans. These have been rated as being of high sensitivity and should be avoided as far as possible. According to the National Water Act, these are classified as water resources. Any impacts on drainage lines require a permit from the National Department of Water Affairs. Placing PV panels on the drainage line that occurs on the site is not recommended and can easily be avoided by not placing PV panels in this area.
- » All other remaining natural areas on site, all of which contain moderate densities of protected trees. These areas are rated as being of moderate sensitivity.

In order to minimise potential impacts during construction on these sensitive areas within the site, the following recommendations have been made:

- » Pans and their associated riparian vegetation should be avoided as far as possible. Where this is not possible, a water use license to impact on these areas may be required to be obtained from the Department of Water Affairs.
- » Areas of disturbance should be limited to within the development footprint.
- » Use should be made of existing access roads as far as possible.
- » Implementation of the Environmental Management Programme during the lifespan of the facility.
- » Ensure that power line towers are constructed at least 50 m from the drainage lines (i.e. span the watercourses).

b) Visual Impacts

The potential visual impacts from the visibility of the PV facility ranges from moderate to low, and is not considered to be a fatal flaw from a visual perspective. The main consideration in this regard is the relatively low occurrence of potentially sensitive visual receptors and the fact that the surrounding topography contains the extent of visual impact, screening areas farther afield in the west, north and east.

c) Impacts on the Social Environment

The land surrounding the proposed facility is primarily undeveloped farm land that is very sparsely populated. Impacts on the social environment are expected during both the construction phase and the operational phase of the solar energy facility. Impacts are expected at both a local and regional scale. Impacts on the social environment as a result of the construction of the solar energy facility can be mitigated to impacts of low significance or can be enhanced to be of positive significance to the region. Construction crew camps may be established on the site, and if required construction workers may also be housed in the nearest towns or other available/existing accommodation. Construction activities on the site will be restricted to daylight hours, and the construction phase is anticipated to extend for a minimum period of 8-months.

Negative impacts during construction relate mainly to impacts due to presence of construction workers and visual impact imposed by the facility on the local environment. There will be a positive impact due to employment creation, which is a much needed due to the high unemployment levels in the area. The positive impact due to employment creation will be lower than during operation as there will be a limited number of staff required compared to the construction phase. The findings of the SIA undertaken for the proposed project indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project.

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

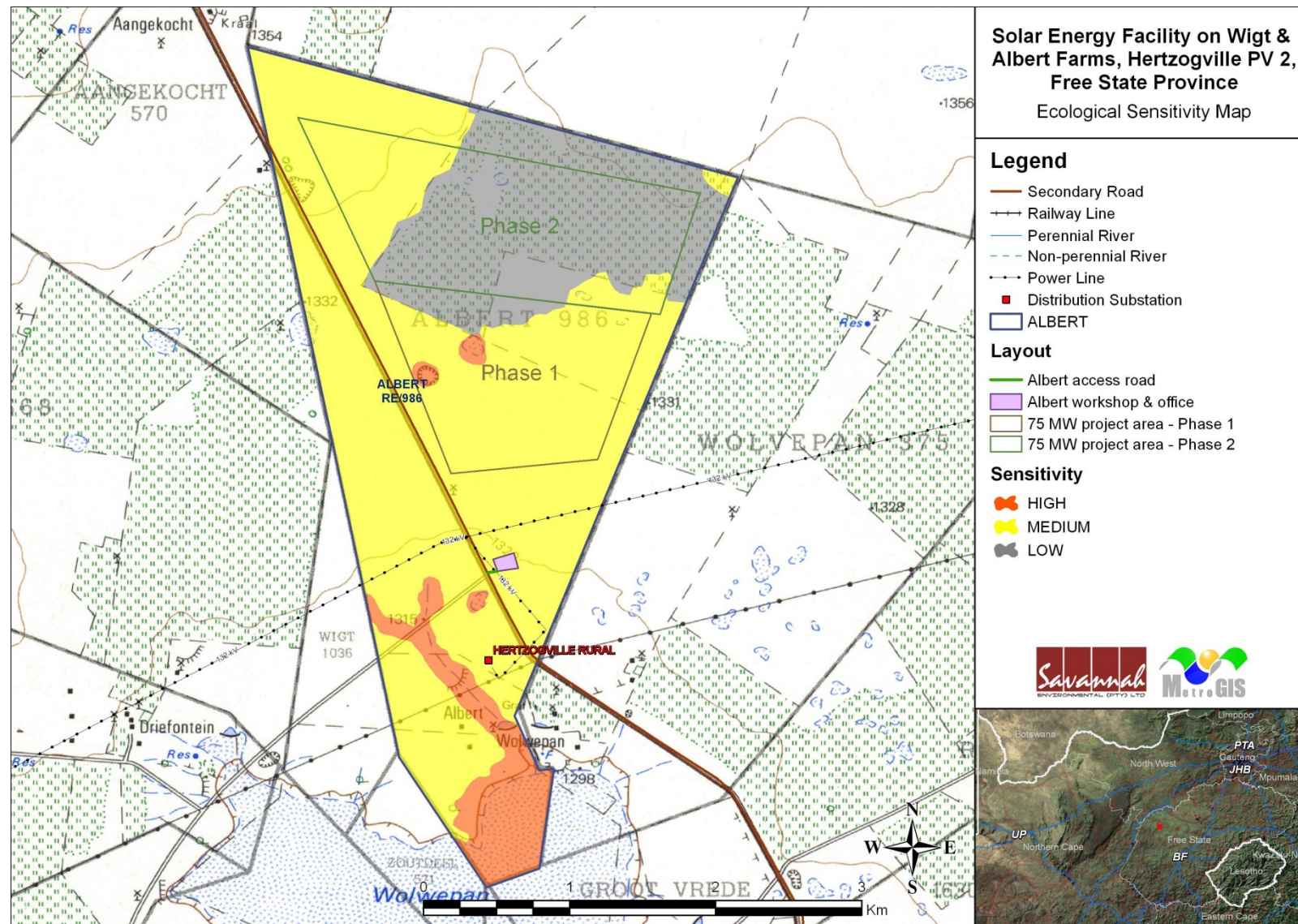


Figure 2.2: Potentially sensitive areas on the site

These factors have been taken into account in evaluating sensitivity within the study area (Figure: 2.2). The sensitivity classification is as follows:

- » HIGH: There are two small pans that occur on the site. According to the National Water Act, pans are classified as wetlands or water resources. Pans on site are classified as having high sensitivity. Pans are protected according to the National Water Act (Act 36 of 1998). Ecologically, they are areas that provide moderate value ecosystem goods and services. From the project point of view, these are areas where infrastructure should preferably not be placed or a permit will be required in order to place infrastructure there and/or offsets and mitigation measures must be implemented to minimize impacts.
- » MEDIUM: Remaining patches of natural vegetation in the study area are classified as having medium sensitivity. These are areas of natural vegetation which are potential habitat for various animal species of conservation concern. From the project point of view, these are areas where infrastructure should be placed with caution or mitigation measures must be implemented to minimize impacts.
- » LOW: Areas where there is no remaining natural vegetation are classified as having low sensitivity. From the project point of view, these are areas (which make up majority of the site) where it is preferred that infrastructure is placed.

Activities and Components associated with the PV Plant

The main activities/components associated with PV Plant are detailed in Table 2.1.

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

Main Activity/Project Component	Components of Activity	Details
Planning		
Conduct technical surveys	<ul style="list-style-type: none"> » Geotechnical survey by geotechnical engineer. » Site survey and confirmation of the infrastructure micro-siting footprint. 	<ul style="list-style-type: none"> » All surveys are to be undertaken prior to initiating construction.
Construction		
Undertake site preparation	<ul style="list-style-type: none"> » Clearance of vegetation at the infrastructure footprints. » Where required, some levelling of the land may occur. » Excavation of trenches for underground cables. 	<ul style="list-style-type: none"> » These activities will require the stripping of topsoil, which will need to be appropriately stockpiled for use in rehabilitation.
Construction of internal access roads	<ul style="list-style-type: none"> » Construct a 3 to 5 m wide gravel roads around the site. 	<ul style="list-style-type: none"> » The proposed internal access roads will be comprised of gravel tracks or compacted rock-fill.
Construct infrastructure foundations	<ul style="list-style-type: none"> » Mounting structures will either be pile driven, screwed or pre-cast concrete footings 	<ul style="list-style-type: none"> » Mounting structures will not involve the utilization of concrete, but would involve be pile driven, screwed or pre-cast concrete footings.
Transport of components and equipment to site	<ul style="list-style-type: none"> » Trucks will be used to transport all components to site: * The normal civil engineering construction equipment for the civil works (e.g. trucks, graders, compaction equipment, cement mixers, etc.). 	<ul style="list-style-type: none"> » The equipment will be transported to the site using appropriate National and Provincial routes, and the dedicated access/haul road to the site itself.
Establishment of PV panels	<ul style="list-style-type: none"> » PV panels are transported in containers. » The steel structures will be assembled on site. 	<ul style="list-style-type: none"> » The steel mounting structures, manufactured in South Africa, are custom made for the site. They

Main Activity/Project Component	Components of Activity	Details
		are assembled on site.
Connection of PV panels to the substation	» The PV panels will be connected to the on-site substation via underground cabling (where practical).	» The installation of these underground cables will require the excavation of trenches of approximately 400 mm – 1000 mm cm deep within which they can then be laid.
Connect substation to the grid	» The electricity is proposed to be evacuated into the Hertzogville 132/22 kV substation.	» The electricity generated at the site will run through underground cables through the site and will connect to Eskom's substation.
Undertake site rehabilitation	» Remove all construction equipment from the site. » Rehabilitation of temporarily disturbed areas where practical and reasonable.	» On full commissioning of the facility (or a phase thereof), any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.
Operation		
Operation	» PV panels. » Associated infrastructure.	» The operational phase is proposed to run for a period of approximately 20 years. » During this time, full time security, maintenance, supervision, and monitoring teams will be required on site. » The PV facility will be operational during daylight hours only but not under circumstances of mechanical breakdown, or maintenance activities. » No energy storage mechanisms (i.e. batteries) which would allow for continued generation at night or on cloudy days are proposed. » Water storage tanks will be used to collect water for the cleaning of the PV Panels. Approximately 2 million litres of water per annum will be required per year for cleaning and for domestic use on the plant. Water is planned to be collected using

Main Activity/Project Component	Components of Activity	Details
		several storage tanks (approximately 10 20 or 30 litre tanks will be required). Water supply with either be obtained from a borehole on site or transported to the site via water trucks pending water authority engagement, water availability and limits in the area. The PV panels are likely to be cleaned with water two or three times a year, depending on the prevailing climatic conditions.
Maintenance & Security	» Maintenance during the life cycle of the facility would include emergency repairs, routine panel maintenance, routine maintenance of medium voltage equipment and maintenance of the site.	» The panels will be cleaned with water. » 24 hour on-site security, 2m – 5m high perimeter fencing, and 2-6 security guards.
Decommissioning		
Site preparation	» Preparation of the site. » Mobilisation of construction equipment.	» Depending on the economics of the development following the operational period, the plant will either be decommissioned or the operational phase will be extended. If it is deemed financially viable to continue, existing components may be disassembled and replaced with 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.
Disassemble panels	» The panels will be disassembled and removed.	» The components of the plant will be disassembled and removed. Thereafter they will be reused and recycled (where possible) or disposed of in accordance with regulatory requirements.

STRUCTURE OF THIS EMP

CHAPTER 3

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

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

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

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

Project component/s	List of project components affecting the objective, i.e.: » PV panels » Ancillary infrastructure		
Potential Impact	Brief description of potential environmental impact if objective is not met		
Activity/risk source	Description of activities which could impact on achieving objective		
Mitigation: Target/Objective	Description of the target; include quantitative measures and/or dates of completion		
Mitigation: Action/control	Responsibility	Timeframe	
List specific action(s) required to meet the mitigation target/objective described above.	Who is responsible for the measures	Time periods for implementation of measures	

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

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

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

3.1. Project Team

This draft EMP was compiled by:

	Name	Company
EMP Compilers:	Ravisha Ajodhapersadh	Savannah Environmental
	Jo-Anne Thomas	Savannah Environmental
Specialists:	David Hoare (Ecology)	David Hoare Consulting cc
	Johan van der Waals (Soil and Agricultural Potential)	Terrasoil Science
	Jaco van der Walt (Heritage resources)	Heritage Contracts and Archaeological Consulting CC (HCAC)
	Ingrid Snyman (Social)	Batho Earth
	Lourens du Plessis (Visual)	MetroGIS

The Savannah Environmental team have extensive knowledge and experience in environmental impact assessment and environmental management, having been involved in EIA processes over the past ten (10) years. They have managed and drafted Environmental Management Programmes for other power generation projects throughout South Africa, including numerous renewable energy facilities.

MANAGEMENT PROGRAMME FOR THE PV PLANT: PLANNING & DESIGN

CHAPTER 4

4.1. Goal for Planning and Design

Overall Goal for Planning and Design: Undertake the planning and design phase of the PV plant in a way that:

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

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

4.2. Objectives

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

From the specialist investigations undertaken for the proposed photovoltaic plant development site, both Option 1 and 2 sites are considered to have similar impacts. The sites have possible indigenous and threatened/protected vegetation; however the investigation indicated that there was no vegetation (plants/trees) of significance which would be impacted by the proposed facility. The only topographic feature on the site is a dry pan. The sites have also been identified as having potential Red Data Fauna that might be supported. None of the Red data fauna was recorded during the investigation.

The impacts associated with the proposed development on this site are considered acceptable from an environmental perspective, and potential impacts to the environment can be mitigated to acceptable levels.

Project component/s	Project components affecting the objective: » PV panels » Access roads » Ancillary infrastructure
Potential Impact	Design fails to respond optimally to the identified environmental considerations
Activities/risk sources	Site layout (Figure 2.2 Sensitivity Map)
Mitigation: Target/Objective	To ensure that the design of the facility responds to the identified environmental constraints and opportunities

Mitigation: Action/control	Responsibility	Timeframe
Consider design level mitigation measures recommended by the specialists, especially with respect to Biodiversity, as detailed within the EIA report and relevant appendices.	Engineering Design Consultant, and Suncorp / Solar Reserve JV	Design phase
A detailed geotechnical investigation is required for the design phase.	Suncorp / Solar Reserve JV	Design phase
Compile a comprehensive stormwater management plan for hard surfaces as part of the final design of the project.	Engineering design consultant	Design phase
Access roads within the site to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil.	Engineer	Pre-construction, and construction
Balance technical and financial considerations against environmental constraints and opportunities in finalising the design of key elements.	Suncorp / Solar Reserve JV	Tender design, and design review stage
No structures must be erected within a distance of 95,0 metres measured from the centre line of secondary road S101 without the written approval issued by this Department for the relaxation of the building line (structures include any overhead power line that will be erected parallel with or across the alignment of a provincial).	Suncorp / Solar Reserve JV	Design phase

Performance Indicator	» Design meets objectives and does not degrade the environment. » Design and layouts respond to the mitigation measures and recommendations in the EIA report.
Monitoring	Ensure that the design implemented meets the objectives and mitigation measures in the EIA report through review of the design by the Project Manager, and ECO prior to the commencement of construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the facility

Project component/s	PV Facility and ancillary infrastructure (i.e. access road, power lines, offices and workshop).
Potential Impact	Primary visual impact of the facility due to the presence of the PV panels and associated infrastructure as well as the visual impact of lighting at night.
Activities/risk sources	The viewing of the above-mentioned by observers on or near the site (i.e. within 2 km of the site) as well as within the region.
Mitigation: Target/Objective	Optimal planning of infrastructure to minimise visual impact.

Mitigation: Action/control	Responsibility	Timeframe
Determine and agreed with the relevant landowner on the method of visual screening methods for the farm Klein Wolwepan Farm.	Suncorp / Solar Reserve JV / design consultant	Design Phase
Retain a buffer (approximately 30-50m wide) of intact natural vegetation along the perimeter of the development site. This buffer may be within or behind the security fence.	Suncorp / Solar Reserve JV / design consultant	Early in the planning phase.
Retain and maintain natural vegetation in all areas outside of the development footprint.	Suncorp / Solar Reserve JV / design consultant	Early in the planning phase.
Plan the ancillary buildings in such a way and in such a location that clearing of vegetation is minimised.	Suncorp / Solar Reserve JV / design consultant	Early in the planning phase.
Consolidate infrastructure and make use of already disturbed sites rather than pristine areas.		
Consult a lighting engineer in the design and planning of lighting to ensure the correct specification and placement of lighting and light fixtures for the facility and the ancillary infrastructure. The following is recommended: <ul style="list-style-type: none"> » Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself); » Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights; » Making use of minimum lumen or wattage in fixtures; » Making use of down-lighters, or shielded fixtures; » Making use of Low Pressure Sodium lighting or other types of low impact lighting. 	Suncorp / Solar Reserve JV / design consultant	Early in the planning phase.

Mitigation: Action/control	Responsibility	Timeframe
» Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.		
Performance Indicator	Minimal exposure of PV panels, ancillary infrastructure and lighting at night to observers on or near the site (i.e. within 2km) and within the region.	
Monitoring	Not applicable.	

MANAGEMENT PROGRAMME FOR PV PLANT: CONSTRUCTION

CHAPTER 5

5.1. Overall Goal for Construction

Overall Goal for Construction: Undertake the construction phase of the PV facility in a way that:

- » Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
- » Enables the construction activities to be undertaken without significant disruption to other land uses in the area, in particular concerning farming practices, traffic and road use, and effects on local residents.

5.2. Institutional Arrangements: Roles and Responsibilities for the Construction Phase of the PV Plant

As the Proponent, Suncorp / Solar Reserve JV must ensure that the implementation of the PV facility complies with the requirements of all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMP, and the implementation of the EMP through its integration into the contract documentation. Suncorp / Solar Reserve JV will retain various key roles and responsibilities during the construction of the PV facility. These are outlined below.

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

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

The **Project Manager** will:

- » Ensure that all specifications and legal constraints specifically concerning the environment are highlighted to the Contractor(s) so that they are aware of these.
- » Ensure that Suncorp / Solar Reserve JV and its Contractor(s) are made aware of all stipulations within the EMP.

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

The **Site Manager** (Suncorp / Solar Reserve JV's on-site representative) will:

- » Be fully knowledgeable with the contents of the EIA.
- » Be fully knowledgeable with the contents and conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents of the Environmental Management Programme.
- » Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
- » Have overall responsibility of the EMP and its implementation.
- » Conduct audits to ensure compliance to the EMP.
- » Ensure there is communication with the Project Manager, the Environmental Control Officer, and relevant discipline Engineers on matters concerning the environment.
- » Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
- » Confine activities to the demarcated construction site.

The **Environmental Control Officer** (ECO) will be responsible for monitoring, reviewing, and verifying compliance by the Contractor with the environmental specification. Accordingly, the ECO will:

- » Be fully knowledgeable with the contents of the BAR.
- » Be fully knowledgeable with the contents with the conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents with the EMP.
- » Be fully knowledgeable with the contents with all relevant environmental legislation, and ensure compliance with them.
- » Ensure that the contents of this document are communicated to the Contractor site staff and that the Site Manager and Contractor are constantly made aware of the contents through discussion.
- » Ensure that the compliance of the EMP is monitored through regular and comprehensive inspection of the site and surrounding areas.
- » Ensure that if the EMP conditions or specifications are not followed then appropriate measures are undertaken to address this.
- » Monitoring and verification must be implemented to ensure that environmental impacts are kept to a minimum, as far as possible.

- » Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements.
- » Ensure that activities on site comply with all relevant environmental legislation.
- » Ensure that a removal is ordered of any person(s) and/or equipment responsible for any contravention of the specifications of the EMP.
- » Ensure that the compilation of progress reports for submission to the Project Manager, with input from the Site Manager, takes place on a regular basis, including a final post-construction audit.
- » Ensure that there is communication with the Site Manager regarding the monitoring of the site.
- » Ensure that any non-compliance or remedial measures that need to be applied are reported.
- » Independently report to DEA in terms of compliance with the specifications of the EMP and conditions of the Environmental Authorisation (once issued).

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

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

5.3. Objectives

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

OBJECTIVE: Site establishment and securing the site

Site establishment is the first activity which is to be undertaken within the construction phase. The Contractor must take all reasonable measures to ensure the safety of the public in the surrounding area. Where the public could be exposed to danger by any of the works or site activities, the Contractor must, as appropriate, provide suitable flagmen, barriers and/or warning signs in English, Afrikaans and any other relevant local languages, all to the approval of the Site Manager.

Project component/s	Project components affecting the objective: » PV panels and ancillary infrastructure
Potential Impact	» Hazards to landowners and public » Security of materials
Activities/risk sources	Movement of construction vehicles in the area and on-site
Mitigation: Target/Objective	To secure the site against unauthorised entry To protect members of the public/landowners/residents

Mitigation: Action/control	Responsibility	Timeframe
Secure site, working areas and excavations in an appropriate manner, as agreed with the ECO.	Contractor	Erection: during site establishment Maintenance: for duration of contract
Where necessary to control access, fence and secure area.	Contractor	Erection: during site establishment Maintenance: for duration of contract
Fence and secure Contractor's equipment camp.	Contractor	Erection: during site establishment Maintenance: duration of contract
Identify disturbance areas and restrict construction activity to these areas.	ECO / Contractor	Pre-construction, and construction
Establish the necessary ablution facilities with chemical toilets. Provide adequate sanitary facilities and ablutions for construction workers (1 toilet per every	Contractor	Erection: during site establishment

Mitigation: Action/control	Responsibility	Timeframe
15 workers) at appropriate locations on site.		Maintenance: duration of contract
Ablution or sanitary facilities should not be located within 100 m from a 1:100 year flood line including water courses, wetlands or within a horizontal distance of less than 100 m, whichever is applicable.	Contractor	During site establishment, construction and maintenance
Supply adequate numbers of waste collection bins in appropriate locations on the site where construction is being undertaken.	Contractor	Erection: during site establishment Maintenance: for duration of contract within a particular area
All unattended open excavations shall be adequately demarcated and/or fenced). Adequate protective measures must be implemented to prevent unauthorised access to the working area and the internal access/haul routes.	Contractor	Erection: during site establishment Maintenance: for duration of contract

Performance Indicator	<ul style="list-style-type: none"> » No unnecessary environmental impacts associated with site established. » Site is secure and there is no unauthorised entry. » No members of the public/ landowners injured.
Monitoring	<ul style="list-style-type: none"> » An incident reporting system will be used to record non-conformances to the EMP. » ECO to monitor all construction areas on a continuous basis until all construction is completed; immediate report backs to site manager in terms of non-conformances recorded.

OBJECTIVE: Enhance employment opportunities and address economic inequities within the study area and invest in capacity building and skills training

Employment opportunities could be created during the construction phase as some of the construction activities would entail manual labour such as the erection of the fence, creation of fire breaks, and mount installation.

It is foreseen that it would be possible to make use of local labour for some of the construction activities. Opportunities for SMMEs to be considered for some of the construction activities should be looked at. 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	Employment creation and the availability of required skills in the local communities
Potential Impact	The opportunities and benefits associated with the creation of local employment and business could be maximised
Activities/risk sources	Unavailability of locals with the required skills resulting in locals not being employed and labour be sourced from outside the Lekwa-Teemane Local Municipality area
Mitigation: Target/Objective	Suncorp / Solar Reserve JV and their EPC partner, in cooperation with the Lekwa-Teemane Local Municipality, should aim to employ a maximum number of the unskilled, low-skilled and semi-skilled workers from the local area where possible. Should the necessary skills not be readily available, skills training and capacity building should be undertaken.

Mitigation: Action/control	Responsibility	Timeframe
It is recommended that the main contractor employ local unskilled labour (directly or through local sub-contractors) from the study area as far as possible to enhance the benefits to the local communities during the construction phase.	Suncorp / Solar Reserve JV & EPC Partner	Pre-Construction & Construction Phase
Project contracts between Suncorp / Solar Reserve JV and the main contractor should stipulate the use of local labour for unskilled and semi-skilled positions and tasks.	Suncorp / Solar Reserve JV & EPC Partner	Pre-Construction Construction
Suncorp / Solar Reserve JV and their EPC partner or main contractor should identify and involve relevant community representatives and local organisations which could assist them in identifying people whose skills may correspond with the job specifications.	Suncorp / Solar Reserve JV & EPC Partner	Pre-construction Construction
Suncorp / Solar Reserve JV should ensure an equitable process whereby minorities and previously disadvantaged individuals (women) are also taken into account.	Suncorp / Solar Reserve JV & EPC Partner	Pre-Construction & Construction Phase
It is recommended that Suncorp / Solar Reserve JV implements a capacity building and skills transfer programme once construction starts.	Suncorp / Solar Reserve JV & EPC Partner	Construction
On-going on-site training should focus on the development of transferable skills to enable employees to find employment at similar projects once this construction process has ended. This would further ensure long term benefits to the individuals involved.	Suncorp / Solar Reserve JV & EPC Partner	Construction

Mitigation: Action/control	Responsibility	Timeframe
Suncorp / Solar Reserve JV and their EPC partner should create conditions that are conducive for the involvement of entrepreneurs, small businesses and SMMEs during the construction and operational process. This could include an open and widely communicated (in local languages) tender process.	Suncorp / Solar Reserve JV & EPC Partner	All Phases
Workers should preferable not be allowed to be accommodated on site.	Suncorp / Solar Reserve JV & EPC Partner	Construction

Performance Indicator	<ul style="list-style-type: none"> » Job opportunities, especially of lower skilled positions, are primarily awarded to members of local communities. » A skills development plan is developed and implemented. » Skills training and capacity building initiatives are implemented according to the skills development plan. » Local SMMEs and/or entrepreneurs awarded the opportunity to become involved in the tender process where feasible. » Local procurement is implemented during operational phase » Locals are employed for the operation and management of the facility
Monitoring	<ul style="list-style-type: none"> » Suncorp / Solar Reserve JV, community leaders and Lekwa-Teemane Local Municipality must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: To minimise the potential impact on safety and security

Even though construction workers are not preferred to be accommodated on site, there is a strong possibility that the developer would accommodate workers on site, 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. Materials and goods would be stored on site in some type of storage facility for the duration of the construction period, and this in itself can lure criminals to the area. The negative impacts associated with the inflow of workers could, however, be limited should a local labour force be used.

Project component/s	<ul style="list-style-type: none"> » Solar facility. » Associated infrastructure.
Potential Impact	Outside workers are involved in criminal activities.
Activities/risk sources	<ul style="list-style-type: none"> » Safety of individuals and animals are at risk. » Theft of construction material.
Mitigation: Target/Objective	Employment of local labour should be maximised and strict security measures should be implemented at the construction site.

Mitigation: Action/control	Responsibility	Timeframe
Employing local community members could minimise the potential for criminal activity or perceived perception of an increase in criminal activity due to the presence of an outside workforce.	Contractor	Pre-construction
Screening of workers that apply for work could be useful to lessen perceived negative perceptions about the outside workforce.	Contractor	Pre-construction
Construction workers should be easily identifiable by wearing uniforms and even identity tags.	Contractor	Construction
Local community members and property owners should be informed of the presence of the outside workforce, the construction schedule, and movement of workers.	Suncorp / Solar Reserve JV	Construction
Property owners, their workers, as well as local communities should be motivated to be involved in crime prevention by reporting crimes to the appropriate authorities.	Suncorp / Solar Reserve JV, and local communities	All phases of project
The construction site should be fenced and access to the area controlled.	Suncorp / Solar Reserve JV, and contractor	All phases of project
Workers should preferable not be allowed to be accommodated on site. From a social perspective it is preferred that no workers should thus be accommodated on site at night. Should this, however, be considered, the developer should be obliged to consult the neighbouring property owners in this regard and to address their concerns.	Suncorp / Solar Reserve JV & EPC Partner	Construction

Performance Indicator	No criminal activities and theft are reported to be linked with the construction force.
Monitoring	Project proponent, and appointed ECO must monitor indicators listed above to ensure that they have been implemented.

OBJECTIVE: Management of dust and emissions to air

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

Project component/s	Construction and establishment activities associated with the establishment of the PV facility and associated infrastructure.
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Potential Impact	Dust and particulates from vehicle movement to and on-site, temporary stockpiles, and vegetation clearing affecting the surrounding residents. Release of minor amounts of air pollutants (for example NO ₂ , CO and SO ₂) from vehicles and construction equipment. Limit and address dust generation on site linked to construction activities
Activities/risk sources	<ul style="list-style-type: none"> » Clearing of vegetation and some topsoil. » Excavation, grading, scraping. » Transport of materials, equipment, and components on access roads. » Re-entrainment of deposited dust by vehicle movements. » Wind erosion from topsoil and spoil stockpiles and unsealed roads and surfaces. » Fuel burning vehicle engines. » Inadequate dust control measures, excessive vehicle movement on unpaved roads
Mitigation: Target/Objective	<ul style="list-style-type: none"> » To ensure emissions from all vehicles are minimised, where possible, for the duration of the construction phase. » To minimise nuisance to the community from dust emissions and to comply with workplace health and safety requirements for the duration of the construction phase. » Minimise generation of dust

Mitigation: Action/control	Responsibility	Timeframe
Appropriate dust suppressant must be applied on all exposed areas and stockpiles as required to minimise/control airborne dust.	Construction team and engineer	Duration of contract
Haul vehicles moving outside the construction site carrying material that can be wind-blown must be covered with tarpaulins.	Contractor	Duration of contract
Speed of construction vehicles must be restricted, as defined by the ECO.	Contractor, and ECO	Duration of contract
Limit vehicle movement on unpaved areas to the absolute minimum.	Construction team and engineer	Duration of contract
Disturbed areas must be re-vegetated as soon as practicable once construction is completed in an area.	Contractor	Completion of construction
Construction vehicles and equipment must be maintained in a road-worthy condition at all times.	Contractor	Duration of contract
If monitoring results or complaints indicate inadequate performance against the criteria indicated, then the source of the problem must be identified, and existing procedures or equipment modified to ensure the problem is rectified.	Contractor	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » No complaints from affected residents or community regarding dust or vehicle emissions from construction activities. » Dust suppression measures implemented for all areas that require such measures during the construction phase.
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	<ul style="list-style-type: none"> » Visual assessment of dust generated on site. » 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	<p>Monitoring must be undertaken to ensure emissions are not exceeding the prescribed levels via the following methods:</p> <ul style="list-style-type: none"> » Regular inspections of dust generation by construction activities throughout the construction phase. » Immediate reporting by personnel of any potential or actual issues with nuisance dust or emissions to the Site Manager. » A complaints register must be maintained, in which any complaints from residents/the community will be logged. Complaints will be investigated and, where appropriate, acted upon. » Monitor construction site and surrounds » An incident reporting system must be used to record non-conformances to the EMP.

OBJECTIVE: Control impacts on Ecology

The vegetation type on site is grasslands, which is classified as Least Threatened. In addition, the vegetation on site is secondary grassland that has developed in previously cultivated areas. No indigenous natural vegetation is therefore considered to be potentially affected by the proposed project.

Project Component/s	PV facility.
Potential Impact	Irreversible habitat alteration.
Activities/Risk Sources	Construction activities, maintenance activities.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Preventing irreversible impacts within the areas. » Preventing loss of protected and/or threatened flora and fauna.

Mitigation: Action/Control	Responsibility	Timeframe
The removal or picking of any indigenous plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged, or tampered with unless agreed to by the ECO.	ECO, Contractor	Construction, operational phases
No painting or marking of rocks or vegetation to identify locality or other information shall be allowed as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required.	ECO, Contractor	Construction, operational phases

Mitigation: Action/Control	Responsibility	Timeframe
Make use of existing access roads, ensuring proper upgrade/ construction/ maintenance in order to limit erosion and proliferation of weeds.	Contractor	Construction, operational phases
Use of branches of trees and shrubs for fire making purposes is strictly prohibited.	ECO, Contractor	Construction, operational phases
Prevent open fires; provide demarcated fire-safe zones, facilities, and fire control measures.	ECO, Contractor	Construction, operational phases
Fire-fighting equipment shall be made available on all vehicles and at various suitable points within the development site.	ECO, Contractor	Construction, operational phases
No animal may be hunted, trapped, or killed for any purpose whatsoever.	ECO, Contractor	Construction, operational phases
In the event that animals are present that may pose a risk to human safety, a suitable animal handler must be requested to remove the animal in an environmentally responsible manner. This specifically refers to snakes and scorpions.	ECO, Contractor	Construction, operational phases
Identify areas where surface disturbances will occur and remove topsoil to a depth of approximately 0.75m.	Contractor	Construction phase
Ensure immediate surface restoration and re-sloping in order to prevent erosion, taking cognisance of local contours and landscaping.	ECO, contractor	Construction phase

Performance Indicator	The vegetation types on site is grasslands, which is classified as Least Threatened. In addition, the vegetation on site is secondary grassland that has developed in previously cultivated areas.
Monitoring	Implement a monitoring programme of which the aims and objectives should be to monitor: <ul style="list-style-type: none"> » Compliance to the approved EMP; » Status of invasive species on site.

OBJECTIVE: Control alien invasive plants

Alien invasive plants should be controlled on site throughout the life-cycle of the facility.

Project Component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species.
Activities/Risk Sources	Construction of power line infrastructure,
Mitigation: Target/Objective	Target: no alien plants within project control area Time period: construction, operation

Mitigation: Action/Control	Responsibility	Timeframe
Avoid creating conditions in which alien 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 » Do not import soil from areas with alien plants 	Construction team, management (environmental officer)	Construction,
Establish an on-going monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act).	Construction team, management (environmental officer)	Construction,
Immediately control any alien plants that become established using registered control methods.	Construction team, management (environmental officer)	Construction,

Performance Indicator	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	On-going monitoring of area by environmental control officer during construction On-going monitoring of area by environmental manager during operation <ul style="list-style-type: none"> » Annual audit of project area and immediate surroundings by qualified botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency

depends on legal compliance framework

OBJECTIVE: Limit impacts on threatened birds due to collisions with power lines

Martial Eagle, all VU) and five Near Threatened bird species (Blue Korhaan, Caspian Tern, Lanner Falcon, Secretarybird, White Pelican) that have a medium to high probability of utilising available habitats in the study area, either for foraging or breeding. The only species likely to use parts of the site for breeding are Kori Bustard and Grass Owl. The other eight species, the Blue Crane, Blue Korhaan, Caspian Tern, Lanner Falcon, Lesser Kestrel, Martial Eagle, White Pelican and Secretarybird, may use the site or parts of the site for foraging. Loss of a relatively small area of foraging will not affect these species significantly and the project is assessed as being unlikely to have an important impact on any these seven species.

Project Component/s	Overhead power lines
Potential Impact	Loss of individuals of threatened bird species (especially Bustards) due to collisions with overhead power lines.
Activities/Risk Sources	Operation of power line
Mitigation: Target/Objective	Limit loss of individuals of threatened birds due to collision with overhead power lines

Mitigation: Action/Control	Responsibility	Timeframe
Attach devices to overhead power lines to make them more visible to affected bird species. The exact nature and positioning of such devices should be determined in consultation with a bird specialist.	Environmental management team, management (environmental officer)	Operation

Performance Indicator	No loss of threatened birds due to collisions with power lines
Monitoring	» Monitor bird mortality along power line due to collisions on a continuous basis.

OBJECTIVE: Control runoff and soil erosion & degradation

The soil resource on the site needs to be conserved as far as possible to minimise the cumulative impact on the local environment. A set of strictly adhered to mitigation measures are required to effectively limit the impact on the environment. The disturbance areas where human impact is likely are the focus of the mitigation measures laid out below.

Project component/s	<ul style="list-style-type: none"> » PV panels. » Sealed surfaces (e.g. roofs, concrete surfaces, compacted road surfaces, paved roads, / areas). » Soil stabilisation, construction of impoundments and erosion mitigation structures. » All other infrastructure.
Potential Impact	<ul style="list-style-type: none"> » Loss of agricultural potential. » Large scale erosion and sediment generation.
Activities/risk sources	<ul style="list-style-type: none"> » Water and wind erosion of cleared and excavated areas. » Excavation, mixing, dumping, stockpiling, and compaction of soil. » Concentrated discharge of water from construction activity. » Site preparation and earthworks. » Foundations or plant equipment installation. » Mobile construction equipment movement on site. » Poor planning of rainfall surface runoff and storm water management.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Minimise degradation of soil by construction activity. » Conserve topsoil by stockpiling and re-using in disturbance areas. » Minimise erosion of soil from site during construction. » Minimise deposition of soil into drainage lines. » Prevention of eroded materials and silt rich water running off the site

Mitigation: Action/control	Responsibility	Timeframe
Identify disturbance areas and restrict construction activity to these areas.	ECO, contractor	Pre-construction, and construction
Any new access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil.	Engineer/ ECO	Pre-construction, and construction
Any erosion features which develop must be immediately stabilised with appropriate erosion control measures.	Contractor	Construction
Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. Limit the height of stockpiles as far as possible to	Contractor	During site establishment, and any activity

Mitigation: Action/control	Responsibility	Timeframe
reduce compaction.		related to earthworks as well as the duration of construction
Rehabilitate any disturbed areas immediately after construction in that area is complete in order to stabilise landscapes.	Contractor	Post-construction
Ensuring that the slope of stockpiled material is such that surface runoff is minimal.	Contractor	Duration of contract
Erosion control measures: run-off attenuation on slopes (sand bags, logs), silt fences, stormwater catch-pits, shade nets, or temporary mulching over denuded areas. Surface structures such as swales and berms can also be used.	Contractor/ ECO and Engineer	Erection: before construction Maintenance: duration of contract
Vehicular traffic must be controlled during construction, confining access and roadways, where possible, to proposed or existing road alignments.	Contractor	Duration of contract
As far as possible, access to the facility construction site should be restricted to a single access point.	Contractor	Duration of contract
Internal access roads should be kept to a minimum. Use existing roads wherever possible.	Contractor	During site establishment
Movement of vehicles on-site is to be on approved and formalised access roads only, which shall be adequately maintained throughout construction. Where temporary tracks are required these are to be ripped and rehabilitated as soon use of the track in an area is no longer required.	Contractor	Duration of contract
Develop and implement adequate erosion control measures.	Contractor and Engineer	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » Acceptable level of soil erosion around site, as approved by ECO. » Acceptable level of increased siltation in drainage lines, as approved by ECO. » Acceptable level of soil degradation, as approved by ECO. » Acceptable state of excavations, as approved by ECO. » No activity in restricted areas. » Assessment of storm water structures and erosion mitigation measures. » Measurement of actual erosion and sediment generation.
Monitoring	<ul style="list-style-type: none"> » On-going monitoring of area by ECO during construction. » An incident reporting system will record non-conformances. » Monitor and measure sediment generation and erosion damage

OBJECTIVE: Protection of sites of heritage value

Although no sites, features or objects of cultural heritage significance were identified in the study area, it may be possible that sites will be uncovered during excavation activities associated with construction. If at any stage during the construction phase any archaeological artefact is observed, work must be stopped immediately and this occurrence reported to the South African Heritage Resources Agency (Head office: Tel: (021) 462 4502 Fax: (021) 462 4509)) and/or a professional archaeologist as soon as possible so that appropriate mitigation measures can be implemented.

Project component/s	<ul style="list-style-type: none"> » PV facility. » All other infrastructure.
Potential Impact	Heritage objects or artefacts found on site or uncovered during construction activities are inappropriately managed or destroyed.
Activity/risk source	<ul style="list-style-type: none"> » Site preparation and earthworks. » Foundations or plant equipment installation. » Mobile construction equipment movement on site.
Mitigation: Target/Objective	To ensure that any heritage objects found on site are treated appropriately and in accordance with the relevant legislation.

Mitigation: Action/control	Responsibility	Timeframe
If a heritage object is found, work in that area must be stopped immediately, and appropriate specialists brought in to assess to site, notify the administering authority of the item/site, and undertake due/required processes.	Suncorp / Solar Reserve JV, contractor, and heritage specialist	Duration of contract
Authorisation for exhumation and reinterment must be obtained from the relevant local or regional council where the grave older than 60 years is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).	Suncorp / Solar Reserve JV, contractor, and heritage specialist	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » Zero disturbance outside of designated work areas. » All heritage items located are dealt with as per the legislative guidelines. » A record is kept of all instances of accidental disturbance of heritage material, as well as post construction review of impacts on landscape context.
Monitoring	Supervision of all clearing and earthworks by the ECO throughout

construction phase.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the facility

The visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site and all disturbed areas.

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 (i.e. within 2 km 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.	Suncorp / Solar Reserve JV / contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	Suncorp / Solar Reserve JV / contractor	Early in the construction phase.
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.	Suncorp / Solar Reserve JV / contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Suncorp / Solar Reserve JV / contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.	Suncorp / Solar Reserve JV / contractor	Throughout the construction phase.
Reduce and control construction dust through the use of approved dust suppression techniques as and when	Suncorp / Solar Reserve JV / contractor	Throughout the construction phase.

Mitigation: Action/control	Responsibility	Timeframe
required (i.e. whenever dust becomes apparent).		
Restrict construction activities to daylight hours as far as possible in order to negate or reduce the visual impacts associated with lighting.	Suncorp / Solar Reserve JV / contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. Consult an ecologist to give input into rehabilitation specifications.	Suncorp / Solar Reserve JV / contractor	Throughout and at the end of the construction phase.

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	<ul style="list-style-type: none"> » Monitoring of vegetation clearing during construction (by contractor as part of construction contract). » Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).

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

The construction phase of the PV facility may involve the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents. The main wastes expected to be generated by the construction of the facility will probably consist of some construction and general solid waste. A guideline for integrated management of construction waste is included as Appendix A of this EMP.

Project component/s	Storage and handling of chemicals, and waste. Maintenance of vehicles and planning of vehicle service areas.
Potential Impact	<ul style="list-style-type: none"> » Release of contaminated water from contact with spilled chemicals. » Generation of contaminated wastes from used chemical containers. » Pollution of the surrounding environment through inappropriate waste management practices. » Litter or contamination of the site or water through poor waste management practices. » Pollution of water and soil resources. » Oil, fuel and other hydrocarbon pollution.

Activity/risk source	<ul style="list-style-type: none"> » PV panel construction activities. » Building construction activities. » Packaging and other construction wastes. » Hydrocarbon use and storage. » Spoil material from site preparation. » Poor maintenance of vehicles and poor control over service areas.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons. » Ensure that the storage and maintenance of machinery on-site does not cause pollution of the environment or harm to persons. » Comply with waste management guidelines. » Minimise production of waste. » Ensure appropriate waste handling, storage, and disposal. » Avoid environmental harm from waste disposal. » Adequate maintenance and control over service areas

Mitigation: Action/control	Responsibility	Timeframe
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Contractor	Duration of contract
Corrective action must be undertaken immediately if a complaint is made, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing preventive measures.	Contractor	Duration of contract
In the event of a major spill or leak of contaminants, the relevant authorities should be notified as per the notification of emergencies/incidents, as per the requirements of NEMA.	Contractor	Duration of contract
Spilled cement must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	Contractor	Duration of contract
Routine servicing and maintenance of vehicles must not take place on-site outside of designated areas (except for emergencies). If repairs of vehicles must take place on site, an appropriate drip tray must be used to contain any fuel or oils.	Contractor	Duration of contract
All stored fuels to be maintained within a bunded area and on a sealed surface.	Contractor	Duration of contract
Construction machinery must be stored in an appropriately sealed area.	Contractor	Duration of contract
The storage of flammable and combustible liquids such as oils will be in designated areas which are appropriately bunded, and stored in compliance with MSDS files.	Contractor	Duration of contract

Mitigation: Action/control	Responsibility	Timeframe
Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals will be complied with.	Contractor	Duration of contract
Construction contractors must provide specific detailed waste management method statements to deal with all waste streams.	Contractor	Pre-construction
Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap), and contaminated waste. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control.	Contractor	Duration of contract
Where possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection, separation, and storage of waste streams (such as wood, metals, general refuse etc.).	Contractor	Duration of contract
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Contractor	Duration of contract
No waste may be buried or burnt on site	Contractor	Duration of contract
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	Contractor	Duration of contract
Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Contractor	Duration of contract
Documentation (waste manifest) must be maintained detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.	Contractor	Duration of contract
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	Completion of construction
Service vehicles adequately	Construction team and engineer	Duration of contract
Maintenance of service areas, regular clean-up	Construction team and engineer	Duration of contract

Performance Indicator	<ul style="list-style-type: none"> » No chemical spills outside of designated storage areas. » No water or soil contamination by spills. » No complaints received regarding waste on site or indiscriminate dumping. » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately. » Provision of all appropriate waste manifests for all waste streams. » Assessment number and extent of spillages on a regular basis.
Monitoring	<ul style="list-style-type: none"> » Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase. » A complaints register must be maintained, in which any complaints from the community will be logged. » Complaints will be investigated and, if appropriate, acted upon. » Observation and supervision of waste management practices throughout construction phase. » Waste collection to be monitored on a regular basis. » Waste documentation completed. » A complaints register will be maintained, in which any complaints from the community will be logged. » An incident reporting system will be used to record non-conformances to the EMP. » Monitor construction and service sites.

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

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

Project component/s	All components and activities occurring during the construction phase.
Potential Impact	Pollution/contamination of the environment. Disturbance to the environment.
Activity/risk source	Contractors are not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment.
Mitigation: Target/Objective	To ensure appropriate management of actions by on-site personnel in order to minimise impacts to the surrounding environment.

Mitigation: Action/control	Responsibility	Timeframe
The terms of this EMP and the Environmental Authorisation (once issued) will be included in all Contractors contracts.	Suncorp / Solar Reserve JV	Tender process
An ECO must be permanently on site during any construction close to drainage lines and wetlands and at other times should visit the site at least once a week.	Suncorp / Solar Reserve JV	Duration of construction
Contractors must use chemical toilets/ablution facilities situated at designated areas of the site; no abluting will be permitted outside the designated area. These facilities must be regularly serviced by appropriate contractors.	Contractor, and sub-contractors	Duration of contract
Cooking/meals must take place in a designated area; no firewood or kindling may be gathered from the site or surrounds.	Contractor, and sub-contractors	Duration of contract
All litter must be deposited in a clearly marked, closed, animal-proof disposal bin in the construction area; particular attention needs to be paid to food waste.	Contractor, and sub-contractors	Duration of contract
No one other than the ECO or personnel authorised by said individual may disturb flora or fauna outside of the demarcated construction area/s.	Contractor, and sub-contractors	Duration of contract
Contractors must ensure that all workers are informed at the outset of the construction phase about the consequences of stock theft and trespassing on adjacent farms.	Contractor, and sub-contractors	Construction

Performance Indicator	<ul style="list-style-type: none"> » Compliance with specified conditions of Environmental Authorisation, (once issued), EIA report, and the EMP. » No complaints regarding contractor behaviour or habits. » Code of Conduct drafted before commencement of construction phase. » Briefing session with construction workers held at outset of construction phase.
Monitoring	<ul style="list-style-type: none"> » Observation and supervision of Contractor practices throughout construction phase. » A complaints register will be maintained, in which any complaints from the community will be logged. Complaints will be investigated and, if appropriate, acted upon. » An incident reporting system will be used to record non-conformances to the EMP.

5.4. Detailing Method Statements

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

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

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

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

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

5.5. Awareness and Competence: Construction Phase of the PV Plant

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

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

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » Ensuring that a copy of the EMP is readily available on-site, and that all site staff are aware of the location and have access to the document. Employees will be familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the facility.
- » Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended a some form of Environmental Awareness Training. The course must 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 appropriate communication tools are used to outline the environmental "do's" and "don'ts" (as per the environmental awareness training course) to employees.
- » Records must be kept of those that have completed the relevant training.

5.6. Monitoring Programme: Construction Phase of the PV Plant

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

A monitoring programme must be in place not only to ensure conformance with the EMP, but also to monitor any environmental issues and impacts which have not been accounted for in the EMP that are, or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly

dictated, Suncorp / Solar Reserve JV will determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Project Manager will ensure that the monitoring is conducted and reported.

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

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

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

MANAGEMENT PROGRAMME FOR THE PV PLANT: REHABILITATION OF DISTURBED AREAS

CHAPTER 6

6.1. Overall Goal for the Rehabilitation of Disturbed Areas

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

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

6.2. Objectives

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

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

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

Project component/s	<ul style="list-style-type: none"> » PV facility. » Internal access roads (i.e. those not required for operation and maintenance).
Potential Impact	<ul style="list-style-type: none"> » 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"> » Temporary access roads/tracks. » Other disturbed areas/footprints.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure and encourage site rehabilitation of disturbed areas. » Ensure that the site is appropriately rehabilitated following the execution of the works, such that residual environmental impacts (including erosion) are remediated or curtailed.

Mitigation: Action/control	Responsibility	Timeframe
All temporary facilities, equipment, and waste materials must be removed from site as soon as practically possible after construction is complete.	Contractor	Following execution of the works
All temporary fencing and danger tape must be removed once the construction phase has been	Contractor	Following completion of

Mitigation: Action/control	Responsibility	Timeframe
completed.		construction activities in an area
Necessary drainage works and anti-erosion measures must be installed, where required, to minimise loss of topsoil and control erosion.	Contractor	Following completion of construction activities in an area
Disturbed areas must be rehabilitated/re-vegetated with appropriate natural vegetation and/or local seed mix. Re-use of native/indigenous plant species removed from disturbance areas in the rehabilitation phase.	Contractor, and rehabilitation specialist	Following completion of construction activities in an area
Re-vegetated areas may have to be protected from wind erosion and maintained until an acceptable plant cover has been achieved.	Suncorp / Solar Reserve JV, and rehabilitation specialist	Post-rehabilitation
On-going alien plant monitoring and removal must be undertaken on all areas of natural vegetation on an annual basis.	Suncorp / Solar Reserve JV, and rehabilitation specialist	Post-rehabilitation

Performance Indicator	<ul style="list-style-type: none"> » All portions of site, including construction equipment camp and working areas, cleared of equipment and temporary facilities. » Topsoil replaced on all areas and stabilised. » Disturbed areas rehabilitated and acceptable plant cover achieved on rehabilitated sites. » Completed site free of erosion and alien invasive plants.
Monitoring	<ul style="list-style-type: none"> » On-going inspection of rehabilitated areas in order to determine effectiveness of rehabilitation measures implemented. » On-going alien plant monitoring and removal should be undertaken on an annual basis.

MANAGEMENT PROGRAMME FOR THE PV PLANT: OPERATION

CHAPTER 7

7.1. Overall Goal for Operation

Overall Goal for Operation: To ensure that the operation of the PV plant 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 PV facility in a way that:

- » Ensures that operation activities are properly managed in respect of environmental aspects and impacts.
- » Ensures the operation activities are 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 and other receptors in terms of visual impacts.

7.2. Objectives

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

OBJECTIVE: Maintenance of rehabilitated areas

In order to ensure the long-term environmental integrity of the site following construction, maintenance the areas rehabilitated post-construction must be undertaken until these areas have successfully re-established. Fire breaks should be established, where appropriate, to limit both incoming and outgoing veld fires.

Project component/s	<ul style="list-style-type: none"> » PV facility. » Ancillary buildings.
Potential Impact	Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention.
Activity/risk source	<ul style="list-style-type: none"> » Foundations. » Other disturbed areas.
Mitigation: Target/Objective	Ensure and encourage site rehabilitation of disturbed areas.

Mitigation: Action/control

Responsibility

Timeframe

Fire breaks should be established and maintained, where appropriate.	Suncorp / Solar Reserve JV/ Contractor	Duration of contract
Maintenance of erosion control measures.	Suncorp / Solar Reserve JV/Contractor	Operation
Implementation of a storm water management plan.	Suncorp / Solar Reserve JV/Contractor	Operation
Appoint an environmental manager during operation whose duty it will be to minimise impacts on surrounding sensitive habitats.	Suncorp / Solar Reserve JV/Contractor	Operation

Performance Indicator	Successful rehabilitation of disturbed areas.
Monitoring	On-going alien plant monitoring and removal should be undertaken on an annual basis.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the facility

The solar facility would replace an area that was once used for sheep and cattle grazing. With the change in land activity, there would be impacts such glare from the panels during the day and the solar plant would need to be maintained in good condition.

Project component/s	Solar facility and ancillary infrastructure (i.e. access road, power lines, offices and workshop).
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 (i.e. within 2 km of the site).
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 turbines the internal roads, servitudes and the ancillary buildings.	Suncorp / Solar Reserve JV / operator	Throughout the operational phase.
Maintain roads to forego erosion and to suppress dust.	Suncorp / Solar Reserve JV / operator	Throughout the operational phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	Suncorp / Solar Reserve JV / operator	Throughout the 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 on-going basis (by operator).

OBJECTIVE: Limit possible negative impacts on the quality of life of the host communities

Project component/s	<ul style="list-style-type: none"> » Changes or disruptions in the daily living and working activities of neighbouring residents. » Possible safety and security risks as a result of the proposed project » Change in visual character of the area.
Potential Impact	<ul style="list-style-type: none"> » Possible increase in dust and noise. » Traffic related impacts. » Change in visual character. » Possible increase in crime due to influx of people to the area.
Activity/risk source	<ul style="list-style-type: none"> » Increased risk of accidents due to increase in vehicle movement. » Possible degradation of local roads. » Change in visual character. » Possible increase in crime due to influx of people to the area. » Increased health risks during construction phase.
Mitigation: Target/Objective	Limit any negative impacts on the host communities' daily living and movement patterns

Mitigation: Action/control	Responsibility	Timeframe
Maintain the general appearance of the facility as a whole, the internal roads, servitudes and the ancillary buildings.	Suncorp / Solar Reserve JV / operator	Throughout the operational phase.
Maintain roads to forego erosion and to suppress dust.	Suncorp / Solar Reserve JV / operator	Throughout the operational phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	Suncorp / Solar Reserve JV / operator	Throughout the operational phase.
Security personnel should be permanently on-site once construction starts.	Suncorp / Solar Reserve JV, EPC Partner and Contractor	Operational Phases
Emergency plans should be developed and reviewed in conjunction with the Lekwa-Teemane Local Municipality and local emergency services.	Suncorp / Solar Reserve JV, EPC Partner and Contractor	Operation
Procedures and measures to prevent, and in worst cases, attend to emergencies and fires should thus be implemented by Suncorp / Solar Reserve JV and their EPC partner and communicated with the surrounding	Suncorp / Solar Reserve JV, EPC Partner and Contractor	Operation

Mitigation: Action/control	Responsibility	Timeframe
property owners		
Information distributed as part of the existing HIV/Aids awareness campaigns should again be focused on and communicated to the local workforce.	Suncorp / Solar Reserve JV, EPC Partner and Contractor	Operation
The PV facility should be operated in compliance with all relevant environmental regulations.	Suncorp / Solar Reserve JV	Operation
Engineering aspects and the design of the facility should ensure that no environmental pollution occurs. Proper waste, water and sanitation infrastructure and facilities must thus be installed	Suncorp / Solar Reserve JV, EPC Partner and Contractor	Operation
The panel mounts should have the lowest height practically possible.	Suncorp / Solar Reserve JV /Contractor	Operation
It should be ensured that there is no reflection from the panels.	Suncorp / Solar Reserve JV /Contractor	Operation
The design of buildings should blend in with the surrounding environment.	Suncorp / Solar Reserve JV /Contractor	Operation
Lighting issues should receive the attention it deserves to avoid any light pollution at night.	Suncorp / Solar Reserve JV /Contractor	Operation
The mitigation measures of the Visual Impact Assessment should be strictly implemented	Suncorp / Solar Reserve JV /Contractor	Operation

Performance Indicator	<ul style="list-style-type: none"> » No noise and dust pollution » Limited intrusions on host communities » Limited or no reports from property owners regarding problems with construction activities and workforce » No degradation of local roads » No increased accidents » No reports of fires and other emergencies » No security threats and no increase in criminal activities that could be attributed to individuals involved in the facility's construction and operation » Limited visual impact of facility
Monitoring	<ul style="list-style-type: none"> » Suncorp / Solar Reserve JV, their EPC Partner, the Lekwa-Teemane Local Municipality and appointed ECO must monitor indicators listed above to ensure that they have been implemented

OBJECTIVE: Appropriate handling and storage of chemicals and hazardous substances for the substation.

The operational phase of the PV facility may involve handling and management for appropriate handling and storage of chemicals and hazardous substances for the substation for the substation.

Project component/s	Storage and handling of chemicals, and waste.
Potential Impact	<ul style="list-style-type: none"> » Release of contaminated water from contact with spilled chemicals. » Generation of contaminated wastes from used chemical containers. » Pollution of the surrounding environment through inappropriate waste management practices. » Oil, fuel and other hydrocarbon pollution.
Activity/risk source	<ul style="list-style-type: none"> » Hydrocarbon use and storage. » Maintenance of the substation.
Mitigation: Target/Objective	<ul style="list-style-type: none"> » Ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons. » Ensure that the storage and maintenance of the substation does not cause pollution of the environment or harm to persons. » Comply with waste management guidelines. » Minimise production of waste. » Ensure appropriate waste handling, storage, and disposal. » Avoid environmental harm from waste disposal. » Adequate maintenance and control over service areas

Mitigation: Action/control	Responsibility	Timeframe
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	Suncorp / Solar Reserve JV / operator	Operation
Corrective action must be undertaken immediately if a complaint is made, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing preventive measures.	Suncorp / Solar Reserve JV / operator	Operation
In the event of a major spill or leak of contaminants, the relevant authorities should be notified as per the notification of emergencies/incidents, as per the requirements of NEMA.	Suncorp / Solar Reserve JV / operator	Operation
All stored fuels to be maintained within a bunded area and on a sealed surface.	Suncorp / Solar Reserve JV / operator	Operation
The storage of flammable and combustible liquids such	Suncorp / Solar	Operation

Mitigation: Action/control	Responsibility	Timeframe
as oils will be in designated areas which are appropriately bunded, and stored in compliance with MSDS files.	Reserve JV / operator	
Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals will be complied with.	Suncorp / Solar Reserve JV / operator	Operation
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	Suncorp / Solar Reserve JV / operator	Operation
Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Suncorp / Solar Reserve JV / operator	Operation
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.	Suncorp / Solar Reserve JV / Operator	Operation

Performance Indicator	<ul style="list-style-type: none"> » No chemical spills outside of designated storage areas. » No water or soil contamination by spills. » No complaints received regarding waste on site or indiscriminate dumping. » Assessment number and extent of spillages on a regular basis.
Monitoring	<ul style="list-style-type: none"> » Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout operational phase.

MANAGEMENT PROGRAMME FOR THE PV PLANT: DECOMMISSIONING

CHAPTER 8

The infrastructure which will be utilised for the proposed PV facility is expected to have a lifespan of up to 20 years (with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and replacement of the infrastructure with more appropriate technology/infrastructure available at that time.

8.1. Site Preparation

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

8.2 Disassemble and Replace Existing Infrastructure

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

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

Decommissioning of the solar facility would result in job losses and this could impact negatively on those employed at the facility.

Project component/s	Decommissioning phase of the PV facility.
Potential Impact	<ul style="list-style-type: none">» Decommissioning will result in job losses, which in turn can result in a number of social impacts, such as reduced quality of life, stress, depression etc.» 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
Suncorp / Solar Reserve JV should ensure that retrenchment packages are provided for all staff that stand to lose their jobs when the facility is decommissioned. Retrenchments should comply with South African Labour legislation of the day.	Suncorp / Solar Reserve JV	Decommissioning.

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

OBJECTIVE: The mitigation and possible facility

Decommissioning of the solar plant would result in the removal of the infrastructure. The exposed land would need to be rehabilitated once the infrastructure is removed.

Project component/s	Solar facility and ancillary infrastructure (i.e. access road, power lines, offices and workshop).
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.
Activity/risk source	The viewing of the above mentioned by observers on or near the site (i.e. within 2 km of the site).
Mitigation: Target/Objective	Only the infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas.

Mitigation: Action/control	Responsibility	Timeframe
Remove infrastructure not required for the post-decommissioning use of the site. This may include the offices, workshop, storage areas, access roads etc.	Suncorp / Solar Reserve JV / operator	During the decommissioning phase.
Rehabilitate access roads not required for the post-decommissioning use of the site. Consult an ecologist to give input into rehabilitation specifications.	Suncorp / Solar Reserve JV / operator	During the decommissioning phase.
Monitor rehabilitated areas quarterly for at least a year following decommissioning, and implement remedial action as and when required.	Suncorp / Solar Reserve JV / operator	Post decommissioning.

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.
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Monitoring

Monitoring of rehabilitated areas quarterly for at least a year following decommissioning.

Standard Specifications for Earthworks: Environmental measures

Topsoil

Prior to construction, the topsoil areas to be disturbed should be stripped to a depth to be confirmed by the engineer and set aside for spreading to all areas to be reinstated after the construction. Temporary topsoil stock piles must be covered with net or shade cloth to protect them.

Once all grades have been finalised and prepared, topsoil should be spread evenly to all areas to be re-vegetated.

Erosion and sedimentation control

1. During construction the Contractor shall protect areas susceptible to erosion by installing necessary temporary and permanent drainage works as soon as possible and by taking other measures necessary to prevent the surface water from being concentrated in streams and from scouring the slopes, banks or other areas.
2. A Method statement shall be developed and submitted to the Engineer to deal with erosion issues prior to bulk earthworks operations commencing.
3. Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted and the areas restored to a proper condition.
4. Stabilisation of cleared areas to prevent and control erosion shall be actively managed. The method of stabilisation shall determine in consultation with the ECO. Consideration and provision shall be made for the following methods (or combination):
 - a) Brush cut packing
 - b) Mulch or chip cover
 - c) Straw stabilising
 - d) Watering
 - e) Planting/sodding
 - f) Hand seed-sowing
 - g) Hydroseeding
 - h) Soil binders and anti erosion compounds
 - i) Mechanical cover or packing structures
 - i. Gabions & mattresses
 - ii. Geofabric
 - iii. Hessian cover
 - iv. Armourflex
 - v. Log/ pole fencing
 - vi. Retaining walls
5. Traffic and movement over stabilised areas shall be restricted and controlled and damage to stabilised areas shall be repaired and maintained to the satisfaction of the ECO.
6. Anti-erosion compounds shall consist of all organic or inorganic material to bind soil particles together and shall be a proven product able to suppress dust and erosion. The application rate shall conform to the manufacturer's recommendations. The material used shall be of such a quality that indigenous seeds may germinate and not prohibit growth.

Blasting

1. A current and valid authorisation shall be obtained from the relevant authorities and copied to the Engineer prior to any blasting activity.
2. A Method Statement shall be required for any blasting related activities.
3. All Laws and Regulations applicable to blasting activities shall be adhered to at all times.
4. A qualified and registered blaster shall supervise all blasting and rock splitting operations at all times.
5. The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area.)
6. The Contractor shall allow for good quality vibration monitoring equipment and record keeping on site at all times during blasting operations.
7. The Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on site.
8. The Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting / drilling shall be repaired at the Contractor's expense to the satisfaction of the Engineer.
9. The Contractor shall ensure that adequate warning is provided immediately prior to all blasting. All signals shall also be clearly given.
10. The contractor shall use blast mats for cover material during blasting. Topsoil may not be used as blast cover.
11. During demolition the Contractor shall ensure, where possible that trees in the area are not damaged.
12. Appropriate blast shaping techniques shall be employed to aid in the landscaping of blast areas, and a Method Statement to be approved by the Engineer, shall be required in this regard.
13. At least one week prior to blasting, the relevant occupants/owners of surrounding land shall be notified by the Contractor and any concerns addressed. Buildings within the potential damaging zone of the blast shall be surveyed preferably with the owner present and any cracks or latent defects pointed out and recorded either using photographs or video. Failing to do so shall render the Contractor fully liable for any claim of whatsoever nature, which may arise. The Contractor shall indemnify the Employer in this regard.

Borrow pits and quarries

1. All borrow pit sites shall be clearly indicated on plan.
2. Prior to the onset of any quarrying or borrow pit activities the Contractor shall establish from the Engineer whether authorisation has been obtained, both in terms of the Minerals and Petroleum Resources Development Act 28 of 2002 (via the compilation of an Environmental Management Programme Report) and in terms of the National Environmental Management Act (via the Environmental Impact Assessment process). No excavation or blasting activities shall commence before the necessary authorizations are in place.
3. Borrow pits to be used must be approved by the engineer and shall at all times be operated according to the regulations promulgated in terms of the Minerals Act (No 50 of

1991): Mine Health and Safety Act (NO 29 of 1996) and Noise and Nuisance Regulations of the Environment Conservation Act (No 73 of 1989).

4. Only a single lane access for construction vehicles shall be provided at borrow pit and quarry sites. New access roads require approval by the Engineer.
5. Stormwater and groundwater controls shall be implemented.
6. Machinery, fuels and hazardous materials vulnerable to flooding shall be stored out of flood risk areas.
7. Vehicles leaving borrow pits shall not deposit/shed mud, sand and debris onto any public road.
8. All loads shall be covered with a tarpaulin or similar to prevent dangers and nuisance to other road users.
9. Borrow pits shall be fenced to prevent unauthorized persons and vehicles from entering the area. Fences shall also be stock and game proof.
10. Rehabilitation and re-vegetation of borrow pits sites shall be according to a method statement to be approved by the ECO.
11. The contractor shall ensure that blasted faces of the pit shall be shape-blasted to the approval of the Site Manager.
12. Where required, dust and fly-rock prevention methods shall be detailed in a Method Statement to be approved by the Site Manager.
13. During the rehabilitation of borrow pits, the slope or the borrow pit shall be graded to blend with the natural terrain and be stabilized to prevent erosion.

Drilling and jackhammering

1. The Contractor shall submit a Method Statement detailing his proposals to prevent pollution during drilling operations. This shall be approved by the Site Manager prior to the onset of any drilling operations.
2. The Contractor shall take all reasonable measures to limit dust generation as a result of drilling operations.
3. Noise and dust nuisances shall comply with the applicable standards.
4. The Contractor shall ensure that no pollution results from drilling operations, either as a result of oil and fuel drips, or from drilling fluid.
5. All affected parties shall be informed at least one week prior to the onset of the proposed drilling/jackhammering operations, and their concerns addressed.
6. Drill coring with water or coolant lubricants shall require a Method Statement approved by the Site Manager.
7. Any areas or structures damaged by the drilling and associated activities shall be rehabilitated by the Contractor to the satisfaction of the Site Manager.

Earthworks

1. The excavations on site shall be done in accordance with SABS 1200 D or DB, as applicable.
2. Prior to Earthworks (including site clearance) starting on site, a search and rescue operation shall be undertaken as per the requirements set out in the EMP.

2. All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities.
3. Defined access routes to and from the area of operations as well as around the area of operation shall be detailed in a Method Statement for approval by the Site Manager.
4. No equipment associated with the activity shall be allowed outside of these areas unless expressly permitted by the Site Manager.
5. Mechanical methods of rock breaking, including Montabert type breakers, jackhammers, have noise and dust impacts that shall be addressed.
6. Residents shall be notified at least one week prior to these activities commencing, and their concerns addressed.
7. Chemical breaking shall require a Method Statement approved by the Site Manager.

Trenching

1. Trenching for services shall be undertaken in accordance with the engineering specifications (SABS 1200DE) with the environmental amplifications contain herein, where applicable.
2. Trenching shall be kept to a minimum through the use of single trenches for multiple service provision.
3. The planning and selection of trench routes shall be undertaken in liaison with the Engineer and cognisance shall be given to minimising the potential for soil erosion.
4. Trench routes with permitted working areas shall be clearly defined and marked with painted stakes prior to excavation.
5. The stripping and separation of topsoil shall occur as stipulated by the Engineer. Soil shall be stockpiled for use as backfilling as directed by the engineer.
6. Trench lengths shall be kept as short as practically possible before backfilling and compacting.
7. Trenches shall be backfilled to the same level as (or slightly higher to allow for settlement) the surrounding lard surface to minimise erosion. Excess soil shall be stockpiled in an area approved by the engineer.
8. Immediately after backfilling, trenches and associated disturbed working areas shall be planted with a suitable plant species and regularly watered. Where there is a particularly high erosion risk, a fabric such as Geojute (biodegradable) shall be used in addition to planting.

Dust

1. The Contractors shall be solely responsible for the control of dust arising from the Contractor's operations and for any costs against the Employer for damages resulting from dust.
2. The Contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the Site Manager.
3. Removal of vegetation shall be avoided until such time as soil stripping is required and similarly exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible.

4. Excavation, handling and transport of erodible materials shall be avoided under high wind conditions or when a visible dust plume is present.
5. During high wind conditions the Site Manager will evaluate the situation and make recommendations as to whether dust damping measures are adequate, or whether working will cease altogether until the wind speed drops to an acceptable level.
6. Where possible, soil stockpiles shall be located in sheltered areas where they are not exposed to the erosive effects of the wind. Where erosion of stockpiles becomes a problem, erosion control measures shall be implemented at the discretion of the Site Manager.
7. Vehicle speeds shall not exceed 40km/h along dust roads or 20km/h when traversing unconsolidated and non-vegetated areas.
8. Appropriate dust suppression measures shall be used when dust generation is unavoidable, e.g. dampening with water, particularly during prolonged periods of dry weather in summer. Such measures shall also include the use of temporary stabilising measures (e.g. chemical soil binders, straw, brush packs, clipping etc.)
9. Straw stabilisation shall be applied at a rate of one bale/ 10m² and harrowed into the top 100mm of top material for all completed earthworks.

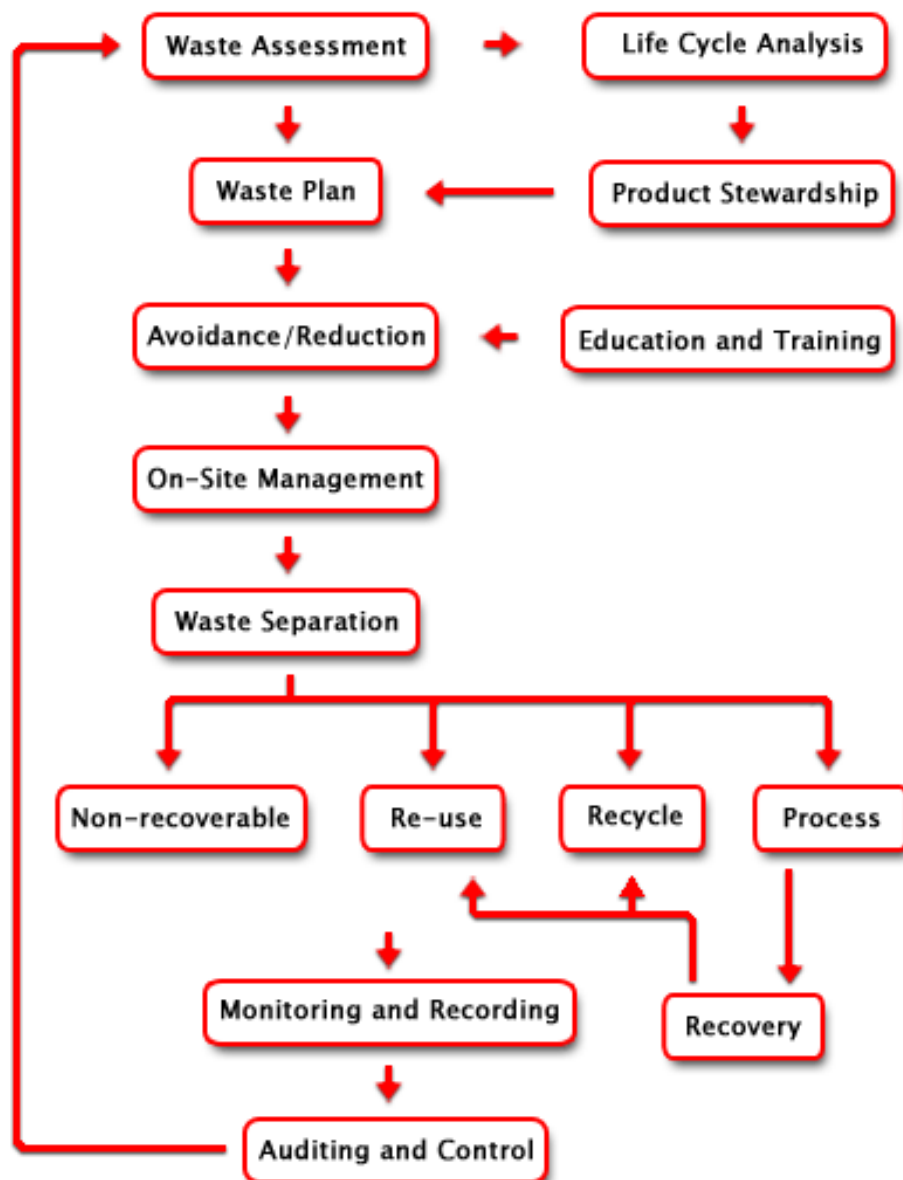
Imported materials

1. Imported materials shall be free of weeds, litter and contaminants.
2. Sources of imported material shall be listed and approved by the Engineer or the Engineer's representative (ER) on Site.
3. The Contractor shall provide samples to the ER for approval.
4. Stockpile areas shall be approved by the ER before any stockpiling commences.

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