ENVIRONMENTAL MANAGEMENT PROGRAMME

29 Solar Electricity Infrastructure near Dealesville, Free State

Version 2
December 2018

Part 3 of "CSIR. 2018. Substantive Amendment to the Environmental Authorisation issued for Edison PV and shared electricity infrastructure, Dealesville, Free State. CSIR Report Number: CSIR/IU/021MH/IR/2018/0004/A. Stellenbosch."

Prepared by: Council for Scientific and Industrial Research
Prepared for: 29 Solar (Pty) Ltd

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List of Abbreviations

EMPr	Environmental Management Programme
EIA	Environmental Impact Assessment
PV	Photovoltaic
DEA	Department of Environmental Affairs
EIAr	Environmental Impact Assessment Report
NEMA	National Environmental Management Act
MW	Megawatt
ECO	Environmental Control Officer
SAHRA	South African Heritage Resource Agency

1. Version of this Environmental Management Programme

In 2018 the Applicant (29 Solar (Pty) Ltd) applied to the DEA for Substantive Amendment to the EA of Edison PV and the hared 29 Solar Electricity Infrastructure. This updated Environmental Management Programme (EMPr) constitutes the separate EMPr for the 29 Solar Electricity Infrastructure. The only changes to this document are the removal of any reference to the separate section on the EMPr for Edison PV, updated maps (Figure 3 and Figure 4) which reflects updated layout of the electricity infrastructure, and updated project specification of the electricity infrastructure capacity (voltage) (Table 4 and Table 5).

The proposed changes do not influence the findings of the authorised EIAr, nor does it constitute a change in the potential impacts and their mitigation measures, the listed activities authorised in the original and valid EA, or the rights and responsibilities of the Applicant in terms of the EA and EMPr.

2. Introduction

This draft EMPr was approved in 2016 when the Department of Environmental Affairs (DEA) granted Environmental Authorisation for the proposed Edison photovoltaic (PV) 100 megawatt (MW) facility and associated shared 29 Solar electricity infrastructure (DEA reference no. 14/12/16/3/3/2/851).

This project forms part of a suite of five PV projects with shared electricity infrastructure proposed by 29 Solar (Pty) Ltd (hereafter referred to as 29 Solar) and are collectively referred to as the *29 Solar Dealesville Development*.

The EMPr is intended as a "living" document and should continue to be updated regularly. It constitutes a specific environmental management plan for the 29 Solar Electricity Infrastructure.

The EIA team involved in preparing this EMPr is listed in Table 1 below. This team includes a number of specialists which have provided input throughout the process.

Table 1: The EIA team consisting on Environmental Assessment Practitioners in a management role, and various specialists to provide technical expertise.

NAME	ORGANISATION	ROLE/STUDY
Environmental Assessment Practitioners		
Paul Lochner	CSIR	**Technical Advisor and Quality Assurance (EAPSA) Certified**
Surina Laurie	CSIR	**Project Leader (*Pr. Sci. Nat.)***
Luanita Snyman-Van der Walt	CSIR	**Project Manager (*Cand. Sci. Nat.)***
Specialists		
Rudi Greffrath (fauna & flora ecologist)	Digby Wells (Pty) Ltd	**Ecological Impact Assessment (including Terrestrial Ecology, Wetlands and Aquatic Ecology)**
Crystal Rowe (flora ecologist)		
Russell Tate (aquatic ecologist)		
Danie Otto (terrestrial and aquatic ecologist)		
Phil Patton (ornithologist)	Digby Wells (Pty) Ltd	**Avifauna Impact Assessment**
Henry Holland	Private	**Visual Impact Assessment**

NAME	ORGANISATION	ROLE/STUDY
Dr. Jayson Orton	ASHA Consulting (Pty) Ltd	**Heritage Impact Assessment (Archaeology and Cultural Landscape)**
Lloyd Rossouw	Palaeo Field Services	**Desktop Palaeontological Impact Assessment**
Julian Conrad	GEOSS	**Geohydrological Assessment**
Johann Lanz	Private	**Soils and Agricultural Potential Assessment**
Dr. Hugo van Zyl (EIA Phase)	Independent Economic Researchers	**Socio-economic**

3. Approach to preparing the EMPr

3.1 Compliance of this EMPr with the NEMA and EIA Regulations

This EMPr satisfies the requirements of Section 24N of the National Environmental Management Act (NEMA) (Act 107 of 1998) as well as Appendix 4 of the 2014 NEMA Environmental Impact Assessment (EIA) Regulations, as amended in 2017 (GN 326) . An overview of where these requirements are met in this EMPr is presented in Table 2.

Table 2: Requirements of an EMPr as defined in terms of NEMA (Act 107 of 1998) and Appendix 4 of the 2014 EIA Regulations (GN R982), as amended in 2017 (GN 326).

Section 24N of the NEMA	Requirements for a EMPr in terms of Section 24N of the NEMA (Act 107 of 1998)	Location in this EMPr
(2) (a)	*information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts or objectives in respect of-* *(i) planning and design;* *(ii) pre-construction and construction activities;* *(iii) the operation or undertaking of the activity in question;* *(iv) the rehabilitation of the environment; and* *(v) closure, if applicable;*	Section 5 Section 6
(2) (b)	*details of-* *(i) the person who prepared the environmental management programme; and* *(ii) the expertise of that person to prepare an environmental management programme;*	Section 1
(2) (c)	*a detailed description of the aspects of the activity that are covered by the environmental management programme;*	Section 4
(2) (d)	*information identifying the persons who will be responsible for the implementation of the measures contemplated in paragraph (a);*	Section 3 Section 5 Section 6
(2) (e)	*information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance;*	Section 5 Section 6
(2) (f)	*as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and*	Section 5 Section 6 Section 9 Section 10

Section 24N of the NEMA	Requirements for a EMPr in terms of Section 24N of the NEMA (Act 107 of 1998)	Location in this EMPr
(2) (g)	*a description of the manner in which it intends to-* *(i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;* *(ii) remedy the cause of pollution or degradation and migration of pollutants; and* *(iii) comply with any prescribed environmental management standards or practices.*	Section 5 Section 6 Section 15 Section 16
(3) (a)	*set out time periods within which the measures contemplated in the environmental management programme must be implemented;*	Section 5 Section 6
(3) (b)	*contain measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of prospecting or mining operations or related mining activities which may occur inside and outside the boundaries of the prospecting area or mining area in question; and*	N/A
(3) (c)	*develop an environmental awareness plan describing the manner in which-* *(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and* *(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment.*	Section 5 Section 6
Appendix 4 of the EIA Regulations	**Requirements for a EMPr in terms of Appendix 4 of the 2014 NEMA EIA Regulations (GN R982), as amended in 2017 (GN 326)**	**Location in this EMPr**
(1) (a)	*Details of -* *(i) the EAP who prepared the EMPr; and* *(ii) the expertise of the EAP to prepare an EMPr, including a curriculum vitae;*	Appendix A
(1) (b)	*a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description*	Section 4
(1) (c)	*a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;*	Section 4
(1) (d)	*a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including-* *(i) planning and design;* *(ii) pre-construction activities;* *(iii) construction activities;* *(iv) rehabilitation of the environment after construction and where applicable post closure; and* *(v) where relevant, operation activities;*	Section 5 Section 6
(1) (f)	*a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraphs (d) will be achieved, and must, where applicable, include actions to –* *(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;* *(ii) comply with any prescribed environmental management standards or practices;* *(iii) comply with any applicable provisions of the Act regarding closure, where applicable; and* *(iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;*	Section 5 Section 6

Section 24N of the NEMA	Requirements for a EMPr in terms of Section 24N of the NEMA (Act 107 of 1998)	Location in this EMPr
(1) (g)	*the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);*	Section 5 Section 6
(1) (h)	*the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);*	Section 5 Section 6
(1) (i)	*an indication of the persons who will be responsible for the implementation of the impact management actions;*	Section 3 Section 5 Section 6
(1) (j)	*the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;*	Section 5 Section 6
(1) (k)	*the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);*	Section 5 Section 6
(1) (l)	*a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;*	Section 5 Section 6
(1) (m)	*an environmental awareness plan describing the manner in which-* *(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and* *(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and*	Section 18 Section 5 Section 6
(1) (n)	*any specific information that may be required by the competent authority.*	N/A

3.2 Goals for environmental management

The overall goal for environmental management for the 29 Solar Dealesville Development is to construct and operate the project in a manner that achieves the goals presented in Figure 1.

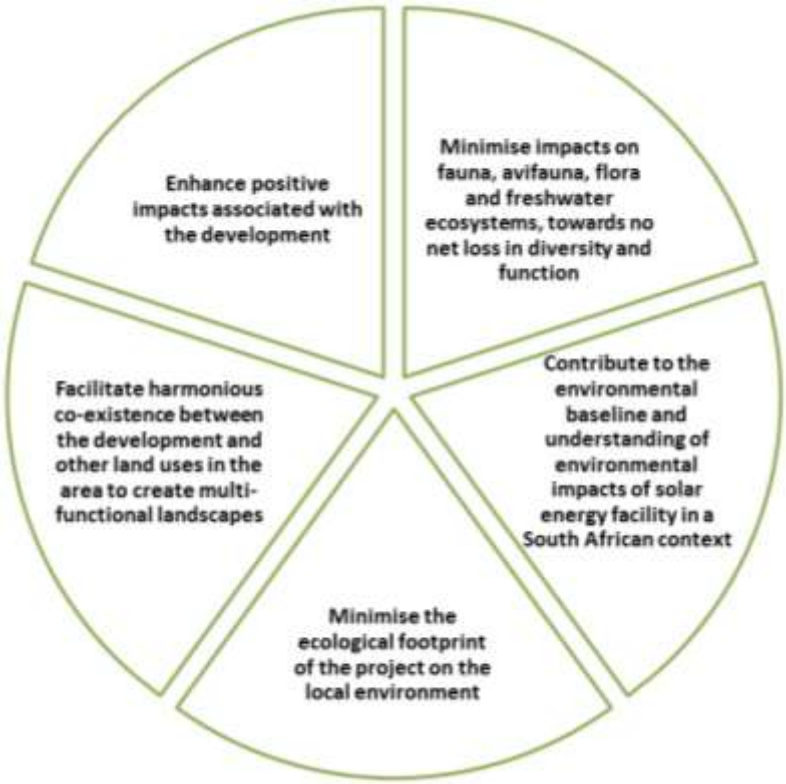


Figure 1: Environmental management goals for the 29 Solar Dealesville Development.

4.2 Mitigation hierarchy

This EMPr strives to recommend avoidance, management, mitigation and monitoring actions towards enhancing positive impacts, and avoiding damage or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate potential impact. Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is described in Figure 2.

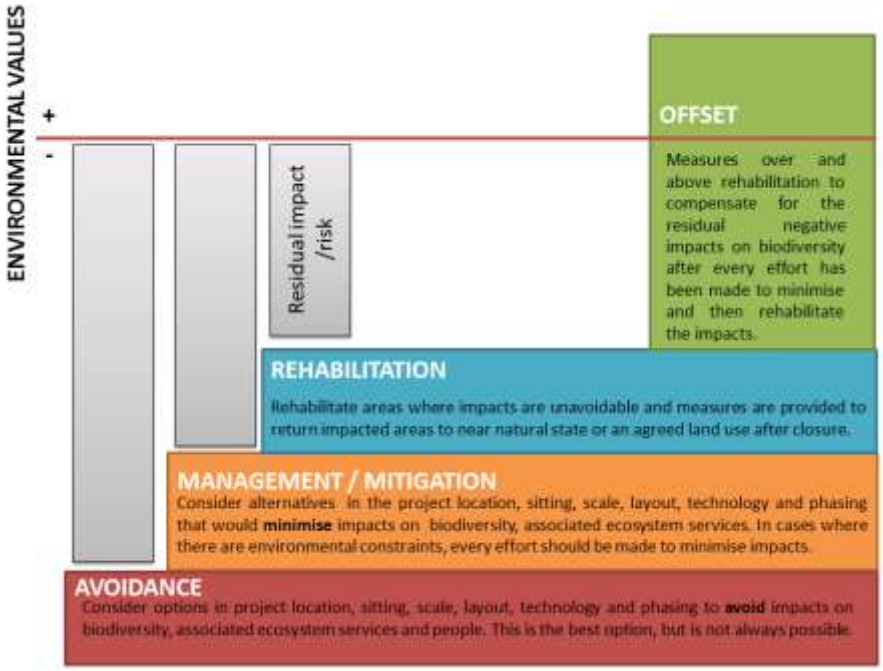


Figure 2: Mitigation hierarchy (after Rio Tinto, 2013).

3.3 Contents of the EMPr

Where applicable, this EMPr addresses the four phases of the project cycle: (1) Project Design phase; (2) Construction phase; (3) Operational phase; and (4) Decommissioning phase.

The draft EMPr follows an approach of identifying over-arching outcomes and objectives, accompanied by management actions that are aimed at achieving these objectives. The management actions are presented in a table format in order to show the links between the goal and associated objectives, actions, responsibilities, monitoring requirements and targets. The management plans for the design, construction, operational and decommissioning phases consist of the following components:

- **Impact**: The potential positive or negative impact of the development that needs to be enhanced, mitigated or eliminated;
- **Mitigation/Management action**: The actions needed to achieve the objectives and outcomes of enhancing, mitigating or eliminating impacts;
- **Monitoring**: The key monitoring actions required to check whether the outcomes are being achieved, taking into consideration methodology, frequency and responsibility.

3.4 Development envelopes and environmental sensitivities

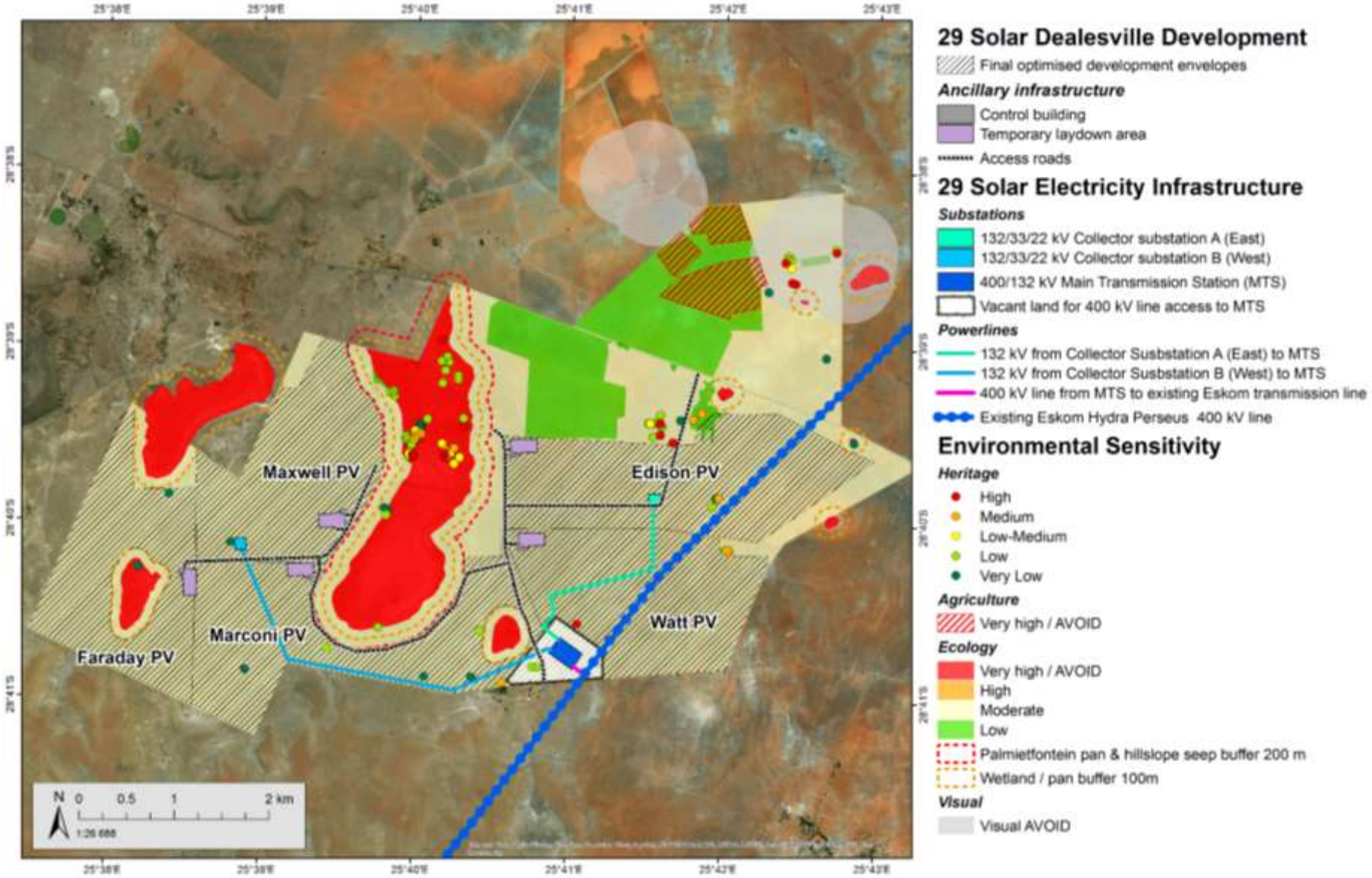


Figure 3: Environmental sensitivity map indicating the optimised 29 Solar PV development envelopes and layout that avoid identified environmental setbacks and buffers.

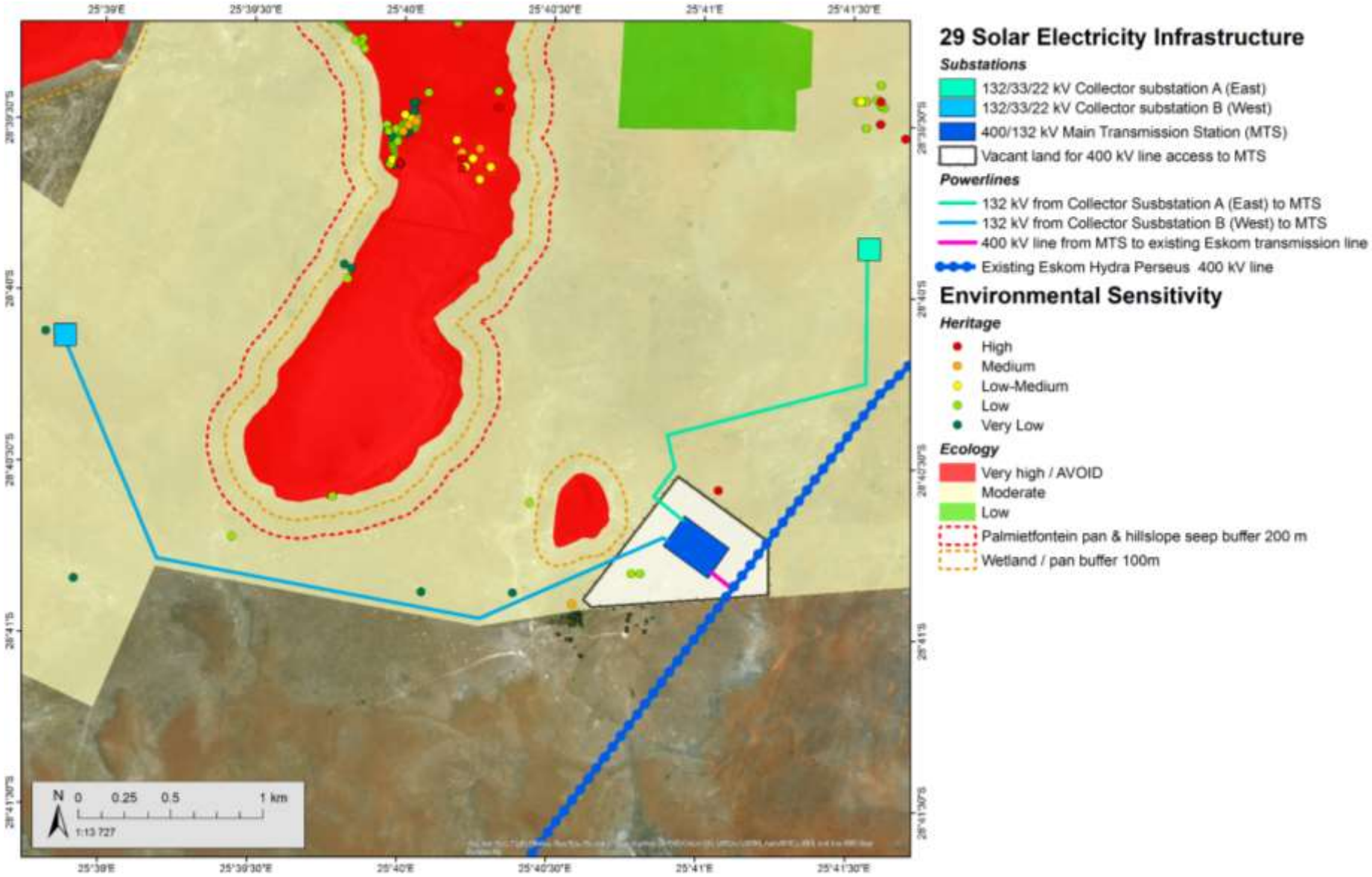


Figure 4: Environmental sensitivity map indicating the proposed collector substations, Main Transmission Station, and routings for the 132 kV and 400 kV powerlines.

4. Roles and responsibilities

To achieve the goals set out in this EMPr there are responsibilities that need to be defined for the following key roles (Table 3):

- Project Developer;
- Environmental Control Officer (ECO); and
- Lead Contractor.

Table 3: Roles and responsibilities associated with the construction, operation and decommissioning of the 29 Solar Dealesville Development in line with this EMPr.

Role	Responsibilities
Project Developer (29 Solar)	The Project Developer is the 'owner' of the project and, as such, has the following responsibilities: ➢ Be familiar with the recommendations and mitigation measures of this EMPr; ➢ Ensure that the conditions of the Environmental Authorisation issued in terms of NEMA are fully adhered to; ➢ Ensure that other necessary permits or licenses are obtained and complied with; ➢ Appoint the ECO and the Lead Contractor. It is proposed that 29 Solar will implement the Self-Build Option for the shared electrical infrastructure to be constructed. Following the construction phase, the associated electrical infrastructure will either be transferred into the ownership of Eskom or otherwise remain in the ownership of 29 Solar. This entails that should Eskom take ownership of the electrical infrastructure, the operational, maintenance and decommissioning requirements will be their responsibility.
ECO	Responsibilities of the ECO are to ➢ Oversee the implementation of the EMPr during the construction and operational phases, monitoring environmental impacts; ➢ Record-keeping and monitoring of compliance with conditions of the Environmental Authorisation; ➢ Ensure compliance to the plans included in the EMPr following approval of the Final EMPr. These plans are: - Alien invasive management plan - Plant rescue and protection plan - Re-vegetation and habitat plan - Open space management plan - Erosion management plan - Monitoring system to detect any leakage or spillage all hazardous substances - Environmental awareness plan The lead contractor and sub-contractors may have their own ECOs, or designate ECO functions to certain personnel.

Role	Responsibilities
	CONSTRUCTION PHASE responsibilities of the Project Developer's ECO: ➢ Confirm the construction procedure and designated activity zones through on-site meetings with the Contractor prior to the commencement of construction activities to; ➢ Monitor of site activities every 1 - 2 weeks (weekly / biweekly) to ensure adherence to the specifications contained in the EMPr, using a monitoring checklist that is to be prepared by the ECO at the start of the construction phase; ➢ Prepare the monitoring reports based on the weekly/biweekly site visits ; ➢ Report on any non-conformances within 48 hours of identification of such non-conformance to the relevant agents; and ➢ Conduct an environmental inspection on completion of the construction period and 'sign off' on the construction process with the Contractor. OPERATIONAL PHASE responsibilities of the Project Developer's ECO: ➢ Oversee the implementation of the EMPr for the operational phase; ➢ Ensure that the necessary environmental monitoring takes place as specified in the EMPr; and ➢ Update the EMPr and ensure that records are kept of all monitoring activities and results. DECOMMISSIONING PHASE responsibilities of the Project Developer's ECO: ➢ Oversee the implementation of the EMPr for the decommissioning phase; and ➢ Conduct an environmental inspection on completion of decommissioning and 'sign off' the site rehabilitation process.
Contractor	The Contractor and its sub-constructors are responsible for overall execution of the activities envisioned in the construction phase, including implementation and compliance with the recommendations and conditions specified in this EMPr. Furthermore the Contractor's responsibilities are to: ➢ Ensure that all appointed contractors and sub-contractors are aware of this EMPr and their responsibilities in relation to the plan; ➢ Meet on-site with the Project Developer's ECO prior to the commencement of construction activities to confirm the construction procedure and designated activity zones; ➢ Ensure that each subcontractor employ an ECO (or have a designated ECO function) to monitor and report on the daily activities on-site during the construction period; ➢ Implement the overall construction programme, project delivery and quality control for the construction of the solar project; ➢ Oversee compliance with the Health, Safety and Environmental Responsibilities specific to the project management related to project construction; ➢ Promote total job safety and environmental awareness by employees, contractors and sub-contractors and stress to all employees and contractors and sub-contractors the importance that the project proponent attaches to safety and the environment;

Role	Responsibilities
	➢ Ensure that safe, environmentally acceptable working methods and practices are implemented and that sufficient plant and equipment is made available properly operated and maintained, to facilitate proper access and enable any operational to be carried out safely; ➢ Ensure that all appointed contractors and sub-contractors repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained in the EMPr, to the satisfaction of the Project Developer's ECO. ➢ Implement the Traffic, Transportation and Road Maintenance Management Plan set out in this EMPr (Section 11); ➢ Implement the Storm Water Management Plan set out in this EMPr (Section 12).

5. Project details

Table 4: Project details for the proposed 29 Solar Electricity Infrastructure

	General
Closest town:	Dealesville
Local Municipality:	Tokologo
District Municipality:	Lejweleputswa
Province:	Free State
	29 Solar Electricity Infrastructure
Electricity infrastructure:	• Two 132/33/22 kV collector substations • One 400/132 kV Main Transmission Station (MTS) • 132 kV overhead transmission lines connecting the collector substation to the MTS • 400 kV transmission line looping into existing 400 kV Eskom transmission line
Connection to National Electricity Grid:	Loop-in-loop-out (LILO) of existing 400 kV Eskom line
Footprint area:	120 m x 120 m (per collector substation) 300 m x 200 m (MTS)
Location (centre point of substations):	Collector substation A (East): 28°39'51.37"S; 25°41'33.51"E Collector substation B (West): 28°40'7.97"S; 25°38'52.37"E MTS: 28°40'43.81"S; 25°40'59.21"E
Land portions:	Cornelia RE 1550 [SG Code: F00400000000155000000; Area 85.26 ha] Modderpan RE 750 [SG Code: F00400000000075000000; Area 428 ha] Mooihoek RE 1551 [SG Code: F00400000000155100000; Area 342.81 ha] Doornhoek RE 37 [SG Code: F00400000000003700000; Area 416.84ha] Palmietfontein RE 140 [SG Code: F00400000000014000000; Area 810.75ha] Sterkfontein 4/ 639 [SG Code: F00400000000063900004; Area 237.24 ha] Brakfontein 3/ 636 [SG Code: F00400000000063600003; Area 183.6 ha]

Table 5: Summary of project components and their maximum specifications.

Component	Specification
ELECTRICITY INFRASTRUCTURE	
132/33/22 kV collector substations (x2)	Footprint area: 120 m x 120 m = 14 400 m^2 = 1.44 ha; Height: 21 m
400/132 kV MTS	Footprint area: 200 m x 300 m = 60 000 m^2 = 6 ha; Height: 25 m
132 kV transmission lines	Height: 35 m Length: 6.5 km
400 kV transmission lines	Height: 35 m Length: 138 m

6. EMPr for the 29 Solar Electricity Infrastructure

6.1 Project planning and design

PROJECT PLANNING AND DESIGN Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.1.1 <u>Heritage Resources</u>				
Impact to palaeontological (none expected)	➢ Achieve a layout that minimizes the potential later impacts to palaeontological resources	**IDENTIFICATION, AVOIDANCE / MITIGATION** • Appoint a professional palaeontologist to appraise the final development footprint; • Ensure that project layout minimizes impact to exposures of Ecca bedrock and to areas around springs and pans; and • Based on the pre-construction footprint appraisal the appointed palaeontologist will recommend further actions to avoid/mitigate and monitor potential impacts to palaeontological features. • Should avoidance of the identified resources not be possible, they must be recorded and a mitigation permit must be applied for at SAHRA by a professional archaeologist or palaeontologist.	Once-off	❖ Project Developer
Impact to archaeology and graves (none expected)	➢ Achieve a layout that minimizes the potential later impacts to archaeological resources and/or graves.	**AVOIDANCE** • Take cognizance of the archaeological sites and graves reported in the HIA (see Section 19 of this EMPr) when designing facility layout; • The set of graves at waypoint 926 must be fenced with a permanent stock fence set at least 5 m away from all sides of the graves. A pedestrian gate must be provided to facilitate access; • Avoid as many known heritage resources identified with a buffer distance of 20 m. ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid sensitive heritage features identified by the specialist with a buffer of 20 m.*	Once-off	❖ Project Developer

PROJECT PLANNING AND DESIGN				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Impact to natural and cultural landscape (none expected)	➢ Reduce the degree of visual contrast in the landscape.	**MITIGATION** • Use neutral earth-coloured paint on the built elements of the facility.	Once-off	❖ Project Developer
6.1.2 <u>Fauna and flora</u>				
Impacts to flora and fauna (incl. avifauna)		**AVOIDANCE** • Completely avoid the Very High ecologically sensitive areas (pans and hillslope seep) ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid ecologically sensitive areas identified by the specialist (pans, hillslope seep, with 100 – 200 m buffers as specified).*	Once-off	❖ Project Developer
6.1.3 <u>Avifauna</u>				
Electrocution of birds	➢ Minimise the risk of bird electrocutions	**AVOIDANCE** • Avoid electrocution of birds by designing the power line with a bird friendly structure. • All line structures must be used in tandem with the standard Eskom Bird Perch to provide safe perching substrate high above the dangerous hardware. This is particularly important given the recorded occurrence of Vultures in the area.	Once-off	❖ Project Developer ❖ ECO

PROJECT PLANNING AND DESIGN Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.1.4 <u>Wetlands and aquatic ecology</u>				
Destruction of wetlands, pans and their associated buffer areas	➢ Avoid loss of wetlands, pans and wetland buffers ➢ Minimise the risk of soil destabilisation and sedimentation of wetlands	**AVOIDANCE** • Exclude wetlands and the associated buffers. ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid ecologically sensitive areas identified by the specialist (pans, hillslope seep, with 100 – 200 m buffers as specified).*	Once-off	❖ Project Developer
6.1.5 <u>Agriculture and soil potential</u>				
Loss of agricultural soil	➢ Avoid loss of agricultural soil	**AVOIDANCE** • Set up the facility and the agreements with land owners in such a way that facilitates grazing of small stock within the panel areas during the operational phase. ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid sensitive agricultural areas identified by the specialist.*	Once-off	❖ Project Developer
6.1.6 <u>Visual Resources</u>				
Visual intrusion on existing views of sensitive visual receptors	➢ Minimise visual intrusion	**MANAGEMENT / MITIGATION** • Design buildings and structures to include appropriate colours for blending into the background landscape	Continual	❖ Project Developer ❖ Contractor

PROJECT PLANNING AND DESIGN Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		• Infrastructure materials, coatings and paints should be chosen based on minimal reflectivity. • Paint grouped structures the same colour to reduce visual complexity and contrast. • Implement a phased approach to preparation (i.e. clearance of vegetation, grading, contouring and compacting) and construction of the solar field in a practical sense to minimise the area of soil exposed and duration of exposure; • Demarcate and strictly control parking areas so that vehicles are limited to specific areas only; • Night lighting of the construction sites should be minimised within requirements of safety and efficiency.		
Night lighting impacts	➢ Minimise impacts to the regional nightscape	**MANAGEMENT/MITIGATION** • A lighting plan that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised; • The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts; • Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security; • Low-pressure sodium light sources should be used to reduce light pollution; • Light fixtures should not spill light beyond the project boundary; • Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously.	Once-off	❖ Project Developer ❖ Contractor ❖ ECO

PROJECT PLANNING AND DESIGN Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.1.7 <u>Socio-economics</u>				
Social impact associated with an influx of people	➢ Limit impacts associated with the presence of workers and work seekers including those associated with negative impacts on social structures and increased 'social ills' such as increased crime levels, increased alcohol and drug use, increased teenage and unwanted pregnancies, increased prostitution and increases in sexually transmitted diseases (STDs).	**MANAGEMENT & MONITORING** • Establish a Monitoring Forum for the project. The Forum should be established before the construction phase commences and should include key stakeholders, including representatives from the local community, local councillors and the contractor. The role of the Forum would be to monitor the project and the implementation of the recommended mitigation measures. • Develop a Code of Conduct, in consultation with representatives from the Monitoring Forum, for the project. The Code should identify what types of behaviour and activities by workers are not permitted in agreement with surrounding land owners and residents. For example, access on land that is not part of the development will not be allowed (no short cuts by workers going from home to site over land that is not part of the project).	Before construction begins	❖ Project Developer ❖ Contractor
Impacts on surrounding land owners	➢ Limit impacts on surrounding land owners associated with potential for:	**MANAGEMENT & MONITORING** • Develop a Code of Conduct, in consultation with representatives from the Monitoring Forum, for the project. The Code should identify what types of behaviour and activities by workers are not permitted in agreement with surrounding land owners	Before construction begins	❖ Project Developer ❖ Contractor

PROJECT PLANNING AND DESIGN				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
	- Further deterioration of local roads - Increased risk of crime such as stock theft and poaching - Damage to farm infrastructure such as fences - Increased littering - Increased potential for veld fires	• Implement measures to assist and, if needed, fairly compensate potentially affected surrounding landowners whereby damages to farm property, stock theft or significant disruptions to farming activities can be minimized or reduced. Measures should be agreed on before construction commences. For these to be fairly dealt with, it will be necessary to set up a Monitoring Programme in collaboration with neighbouring land owners that is specifically designed to provide clarity on impacts and risks. Aspects or risks that should be monitored need to be agreed on with neighbouring land owners. The applicant should formally commit to mitigation and potential compensation actions that may arise from the Monitoring Programme. • A fire management plan should be drawn up prior to construction in agreement with neighbouring land owners. This plan should clearly specify what types of behaviour would not be acceptable with appropriate sanction for transgressions. The applicants should also ensure that they join the local fire protection agency. Fire breaks around the site should be constructed as a first order of business before any other construction works begin. • The EMPr must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested. See Section 17 of this EMPr.		
Impacts on tourism	➢ Limit impacts on tourism and recreation	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	See Visual, Ecological and Agricultural specialist recommendations

PROJECT PLANNING AND DESIGN				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Impact on surrounding property values	➢ Limit impacts on property values	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	See Visual, Ecological and Agricultural specialist recommendations

6.2 Construction phase

CONSTRUCTION PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
6.2.1 <u>Heritage Resources</u>				
Damage or destruction of palaeontological resources	Minimise the risk of significant palaeontological resources being disturbed.	**IDENTIFICATION, AVOIDANCE / MITIGATION** • Appoint a professional palaeontologist to study the pre-construction geo-technical report in order to ascertain the potential impacts to Ecca bedrock and whether any monitoring may be required.	Pre-construction, as soon as geo-technical report is available.	❖ Project Developer
		• Appointed palaeontologist should assess the project site for potential spring deposits and pan dunes. • Appointed palaeontologist should monitor any excavations of > 60 cm deep into Ecca bedrock in order to record and/or sample any fossils that might be revealed; and • Conduct an audit to verify that the necessary permits are obtained by the palaeontologist, if required.	Once-off, well before construction begins	
		• Once construction commences all aspects of the project should be carried out within the approved footprint so as to avoid impacts to sites not falling within the study area.	Once-off	
		• Conduct an audit to verify that the necessary permits are obtained by the palaeontologist, if required.	Once-off	❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		• Should any objects of archaeological or palaeontological remains be found during construction activities, work must immediately stop in that area and the ECO must be informed. • The ECO must inform the SAHRA and contact an archaeologist and/or palaeontologist, depending on the nature of the find, to assess the importance and rescue them if necessary (with the relevant SAHRA permit). No work may be resumed in this area without the permission from the ECO and SAHRA. • If the newly discovered heritage resource is considered significant a Phase 2 assessment may be required. A permit from the responsible heritage authority will be needed.		
Impact of site clearing to archaeological heritage resources	➢ Minimise the risk of significant archaeological sites and/or graves being disturbed.	**AVOIDANCE** • Avoid the heritage resources identified in with a buffer distance of 20 m • Ensure that no activity takes place outside of the authorized construction footprint • If the sites can be avoided then the Environmental Control Officer (ECO) should ensure that they are cordoned off and/or protected from harm as required. • Should any objects of archaeological or palaeontological remains be found during construction activities, work must immediately stop in that area and the ECO must be informed. • The ECO must inform the SAHRA and contact an archaeologist and/or palaeontologist, depending on the nature of the find, to assess the importance and rescue them if necessary (with the relevant SAHRA permit). No	Once-off	❖ Contractor ❖ Appointed archaeologist ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		work may be resumed in this area without the permission from the ECO and SAHRA. • If the newly discovered heritage resource is considered significant a Phase 2 assessment may be required. A permit from the responsible heritage authority will be needed. *In the event that the AVOID action cannot be implemented:* **MITIGATION** • Ensure that all heritage resources requiring mitigation are mitigated prior to the start of construction. • Appoint a professional archaeologist to excavate and collect of samples of artefacts from the Stone Age site, and map and record historical ruins. This should happen 6 months prior to construction to allow the archaeologist time to obtain a permit, conduct the work, analyse the material and obtain a positive comment from South African Heritage Resource Agency (SAHRA).		
Impact of site clearing to graves	➢ Avoid/mitigate potential impacts to archaeological features	**AVOIDANCE** • Avoid all graves with a minimum buffer distance of 5 m, ideally 20 m. • The set of graves at waypoint 926 must be fenced with a permanent stock fence set at least 5 m away from all sides of the graves. A pedestrian gate must be provided to facilitate access. *In the event that the AVOID action cannot be implemented:* **MITIGATION** • Ensure that all construction and operation activities take place within the authorised construction footprint so as to minimise damage to heritage resources that have not been mitigated.	Once-off	❖ Project Developer ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		MONITORING • If any archaeological material or human burials are uncovered during the course of development – immediately halt work in the area. The find needs to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.	Continually	❖ Project Developer ❖ Contractor ❖ ECO
Damage to off-site graves by staff	➢ Avoid/mitigate vandalisation and destruction of off-site graves	**AVOIDANCE/ MITIGATION** • Ensure that development footprint is fenced and that staff are not allowed off site.	Once-off	❖ Operations and maintenance contractor
Damage to unidentified heritage resources	➢ Avoid damage/destruction of heritage resources	• When cables for the transmission lines are strung during the construction phase, the cables should not be allowed to drag through sites located between towers.	Once-off	❖ Project Developer ❖ Contractor ❖ ECO
6.2.2 <u>Avifauna</u>				
Avifauna habitat destruction for site clearing	➢ Minimise the risk of avifaunal habitat destruction	**IDENTIFICATION, AVOIDANCE / MITIGATION** • Preconstruction walk through of the facility in order to locate species of conservation concern that can be translocated as well as comply with permitting conditions.	Once-off	❖ Contractor ❖ Appointed ornithologist ❖ ECO
	➢ Minimise disturbance footprint ➢ Rehabilitation of habitat	**AVOIDANCE** • Keep the footprint of the disturbed area to the minimum and designated areas only. • Adhere to existing roads. **MANAGEMENT / MITIGATION** • Vegetate and irrigate open areas to limit erosion, but take care not to promote erosion by irrigating.		❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party

		• Minimise removal of vegetation during construction and operation will be minimised to reduce the risk of excessive open areas occurring.
		• All disturbed sites must be rehabilitated
		• Site remediation should be implemented using indigenous, local plant species, e.g.
		  ○ *Cynodon dactylon*
		  ○ *Digitaria eriantha*
		  ○ *Eragrostis plana*
		  ○ *Heteropogon contortus*
		  ○ *Themeda triandra*
		• Remediation must be completed by qualified personnel with the correct equipment in the correct season (wet season).
		• Removal of vegetation must be followed closely by rehabilitation within 3 months of disturbance.
		
		See Section 9 of this EMPr.		

	➢ Create environmental awareness	**MANAGEMENT**
		• Provide preconstruction environmental induction for all construction staff and visitors on site to ensure that basic environmental principles are adhered to.
		• This includes awareness as to:
		  ○ No littering;
		  ○ Appropriate handling of pollution and chemical spills;
		  ○ Avoiding fire hazards;
		  ○ Minimise wildlife interactions; and
		  ○ Remain within demarcated construction areas.
			Once-off preconstruction	❖ Operations and maintenance contractor
				❖ ECO

CONSTRUCTION PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Loss of avifauna diversity due to disturbance and barrier effects due to establishment of facility	➢ Mitigate potential transformation, fragmentation and destruction of avifauna habitat	**MITIGATION** • The footprint of the construction phase, including laydown yards, roads and buildings must be kept to a minimum. So as to not disturb birds or destroy available habitat.	Once-off	❖ Operations and maintenance contractor ❖ ECO
		MONITORING • Monitor bird fatalities – the monitoring plan must indicate what species are affected and at what time/season these occur, and should follow Bird life SA recommendations.	Continuously	❖ Operations and maintenance contractor ❖ Ornithologist as advisor
		MITIGATION, MONITORING • Remove alien vegetation, preferably as juveniles, with caution to prevent the spread of seeds and therefore the plants. • An Alien Vegetation Management Plan must be implemented. And alien plants should be monitored biannually after construction for 5-7 years. See Section 7 of this EMPr.		❖ Operations and maintenance contractor ❖ Botany specialist as advisor
Bird collisions with powerlines	➢ Minimise the risk of bird collisions, injuries and fatalities.	**MONITORING** • Conduct an Avifauna walkthrough before construction starts.	Once-off	❖ Contractor ❖ Appointed ornithologist ❖ ECO
		AVOIDANCE / MANAGEMENT • Utilize underground cabling as far as possible. • Install bird reflectors/deflectors	Once-off	❖ Contractor

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.2.3 <u>Fauna & Flora</u>				
Stripping of vegetation for construction of roads	➢ Identify and confirm the presence/absence of sensitive species.	**IDENTIFICATION, AVOIDANCE / MITIGATION** • Preconstruction walk through of the facility in order to locate species of conservation concern that can be translocated as well as comply with permitting conditions. See Section 8 of this EMPr. ***NOTE:*** *This action is extremely important as the field investigation took place in during drought conditions (January, 2016).* *It is strongly recommended that an additional flora Red Data survey is conducted prior to the clearing of any habitat associated with the site.*		❖ Contractor ❖ Appointed fauna and flora specialist ❖ ECO
	➢ Create environmental awareness	**MANAGEMENT** • Provide preconstruction environmental induction for all construction staff and visitors on site to ensure that basic environmental principles are adhered to. • This includes awareness as to: o No littering; o Appropriate handling of pollution and chemical spills; o Avoiding fire hazards; o Minimise wildlife interactions; and o Remain within demarcated construction areas		❖ Operations and maintenance contractor ❖ ECO
	➢ Minimise disturbance footprint ➢ Revegetation and rehabilitation	**AVOIDANCE** • Minimise removal of vegetation during construction and operation to reduce the risk of excessive open areas occurring.	Once-off	❖ Operations and maintenance contractor

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party

		• Keep the footprint of the disturbed area to the minimum and designated areas only.
		• Adhere to existing roads, and if new roads are constructed, these must not cross sensitive areas such as the ridges or drainage lines.
		MANAGEMENT / MITIGATION
		• Vegetate and irrigate open areas to limit erosion, but take care not to promote erosion by irrigating.
		• Removal of vegetation must be followed closely by rehabilitation within 3 months of disturbance.
		• All disturbed sites must be rehabilitated
		• Site remediation should be implemented using indigenous, local plant species, e.g.
		  ○ *Cynodon dactylon*
		  ○ *Digitaria eriantha*
		  ○ *Eragrostis plana*
		  ○ *Heteropogon contortus*
		  ○ *Themeda triandra*
		• Remediation must be completed by qualified personnel with the correct equipment in the correct season (wet season).
		
		See Section 9 of this EMPr.
				❖ Ecological restoration/rehabilitation specialist as advisor
				❖ ECO

Impacts to fauna and flora during site preparation and construction	➢ Minimise disturbance footprint	**AVOIDANCE** • Keep the footprint of the disturbed area to the minimum and designated areas only • Removal of vegetation during construction and operation must be minimised to reduce the risk of excessive open areas occurring. • Adhere to existing roads.		❖ Operations and maintenance contractor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
	➢ Revegetation and rehabilitation	**MANAGEMENT** • Removal of vegetation must be followed closely by rehabilitation by specialists qualified in this vegetation type's remediation. See Section 9 of this EMPr.		❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
	➢ Minimise the risk of soil erosion and indirect water contamination	**MANAGEMENT / MITIGATION** • Vegetate and irrigate open areas to limit erosion and dust. • Improving growth conditions through decreasing run-off, increasing infiltration and increasing the build-up of organic material to reduce soil erosion risk. • Increased water runoff due to removal of vegetation could act as a pathway to contaminate water sources with sediment. The contamination of water by hazardous materials is also a real possibility and all possible precautions must be taken to avoid this. See Section 15 of this EMPr.		❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
	➢ Reduce risk to protected animals	**MANAGEMENT / MITIGATION** • Construction phase activities will increase the local dust levels and noise level, which includes noise and dust from heavy machinery and trucks. The increased traffic of heavy duty vehicles and machinery will pose a threat to animals in the area. **MONITORING** • If the following protected animals are encountered, the environmental manager (ECO) must be alerted: o Aardvark (*Orycteropus afer*), o Bat-eared fox (*Otocyon megalotis*) o Blesbuck (*Damaliscus pygargus phillipsi*)	Continually	❖ Contractor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		○ Cape fox (*Vulpes chama*) ○ Steenbok (*Raphicerus campestris*) • Special care must be taken during construction not to harm these animals, if afforded the opportunity these animals will move away.		
Soil disturbance and spread of alien species	➢ Minimise soil disturbance	**AVOIDANCE** • Keep the footprint of the disturbed area to the minimum and designated areas only. • Adhere to existing roads **MITIGATION** • Vegetate and irrigate open areas to limit erosion, but take care not to cause erosion by irrigating. • Removal of vegetation during construction and operation will be minimised to reduce the risk of excessive open areas occurring.		❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
	➢ Proper removal of alien vegetation to reduce the risk of spread and invasion ➢ Prevent establishment and invasion of alien species	**MITIGATION** • Remove alien vegetation, preferably as juveniles, with caution to prevent the spread of seeds and therefore the plants.	Once-off	❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
		MONITORING • Monitoring for alien plants initially every three months for one year after closure and rehabilitation.	Every 3 months for 1 yr after decommissioning	
		MONITORING • Monitor for alien plants after development for between 5-7 years on an annual basis. See Section 7 of this EMPr.	Annually for 5 – 7 yrs after decommissioning	

CONSTRUCTION PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Impacts of access control and fencing to plants and animals	➢ Avoid habitat fragmentation ➢ Avoid electrocution of small animals (e.g. snakes and tortoises)	**AVOIDANCE** • Construct all electric fencing with a bottom strand not lower that 30 cm to the ground, in order for tortoises and snakes to pass safely.	Once-off	❖ Contractor ❖ ECO
6.2.4 <u>Wetlands and aquatic ecology</u>				
Sedimentation of wetlands due to soil destabilisation	➢ Minimise the risk of erosion and sedimentation of wetlands	**AVOIDANCE** • Keep the footprint of the disturbed area to the minimum and designated areas only. • Site clearing should only take place before a section is due to be constructed.	Once-off	❖ Contractor ❖ ECO
		• Vehicles are not allowed to traverse the pans.	Continual	
		MANAGEMENT / MITIGATION • Erosion control measures should be put in place to limit erosion and areas should be revegetated See Section 15 of this EMPr.	Once-off	
		MONITORING If any buffers or wetlands are impacted on, it is recommended that monitoring takes place during construction. ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid ecologically sensitive areas identified by the specialist (pans, hillslope seep, with 100 – 200 m buffers as specified).*		❖ Contractor ❖ ECO
6.2.5 <u>Agriculture and soil potential</u>				
Soil erosion	➢ Minimise the risk of soil erosion	**MANAGEMENT / MITIGATION**	Once-off	❖ Contractor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		• Implement an effective system of storm water run-off control using bunds and ditches, where it is required (at points where water accumulation might occur) • The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. See Section 12 of this EMPr.		
Loss of topsoil through soil profile disturbance (such as levelling, excavations, road surfacing)	➢ Proper topsoil management	**MANAGEMENT / MITIGATION** • Strip available topsoil from entire area and stockpile for re-spreading during rehabilitation. • Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. • During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. • Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of potential agricultural land.	Once-off when an activity will mechanically disturb the soil below surface in any way	❖ Contractor ❖ ECO
Dust deposition	➢ Mitigate potential impacts that may occur beyond the footprint due to dust deposition	**MANAGEMENT / MITIGATION** • Implement standard construction site dust control measures of damping down with water where dust generation occurs	Continually as required	❖ Contractor ❖ ECO
Stock theft and predation	➢ Increase security against stock theft and predation	**MANAGEMENT / MITIGATION** • Ensure that the security fencing around the facility is jackal proof (whilst still adhering to fencing recommendation of electrical fences allowing 30 cm gap from the ground). • Record all periods when the panel area is used for grazing of small stock.	Once-off	❖ Contractor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		• Specifically record whether any predation to small stock occurs or not within the panel area. • In the event of any predation taking place, the fence must be inspected and repaired to be jackal proof again.		
6.2.6 <u>Geohydrology</u>				
Groundwater contamination through accidental spillage / fuel leakage	➢ Minimise the risk of groundwater contamination	**MANAGEMENT** • Vehicles must be regularly serviced and maintained. **AVOIDANCE** • Construction vehicles and equipment should also be refuelled on an impermeable surface.	Continually	❖ Contractor
		AVOIDANCE • Install drip trays for any engines that stand in one place for an excessive length of time. • Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area.	Once-off	❖ Contractor ❖ ECO
Groundwater contamination through stormwater outflows		**AVOIDANCE** • Keep drainage channels clear of debris and litter. **MITIGATION** • If any potentially contamination liquids are spilled in the stormwater channels they must be cleaned up.	Continually	❖ Contractor ❖ ECO
Groundwater over-abstraction	➢ Minimise the risk of groundwater over-abstraction leading to permanent lowering of groundwater level.	**MONITOR** • If groundwater is abstracted for the project, monitor the production borehole water levels, flow rates and quality.	Annually	❖ Contractor ❖ Geohydrologist as advisor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.2.7 <u>Visual Resources</u>				
Visual intrusion on existing views of sensitive visual receptors	➢ Minimise visual intrusion	**AVOIDANCE** • Night time construction should be avoided where possible; and	Continually	❖ Contractor ❖ ECO
		MITIGATION • Where possible, the type of power line towers used for the proposed power line should be similar to existing power line towers in the landscape.	Once-off	❖
		MANAGEMENT / MITIGATION • Implement a phased approach to preparation (i.e. clearance of vegetation, grading, contouring and compacting) and construction of the solar field in a practical sense to minimise the area of soil exposed and duration of exposure; • Clearly demarcate and monitor construction boundaries. • Demarcate and strictly control parking areas so that vehicles are limited to specific areas only; • Night lighting of the construction sites should be minimised within requirements of safety and efficiency.	Continually	❖
Night lighting impacts	➢ Minimise impacts to the regional nightscape	**MANAGEMENT/MITIGATION** • A lighting plan that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised; • The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts; • Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security;	Once-off	❖ Contractor ❖ ECO

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		• Low-pressure sodium light sources should be used to reduce light pollution; • Light fixtures should not spill light beyond the project boundary; • Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously.		
6.2.8 <u>Socio-economics</u>				
Expenditure related impacts on aspects such as jobs.	➢ Maximise positive impacts associated with expenditure on the construction and operation of the project	• Maximise positive impacts through tendering, procurement and employment policies. • Set targets for use of local labour and maximise opportunities for the training of unskilled and skilled workers. • Use local sub-contractors where possible	Quarterly auditing of achievement of socio-economic benefit goals with corrective actions if needed	❖ Project Developer ❖ Contractor
Social impact associated with an influx of people	➢ Limit impacts associated with the presence of workers and work seekers including those associated with negative impacts on social structures and increased 'social ills' such as increased crime levels, increased alcohol and drug use, increased teenage and unwanted	• Implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase. • Make necessary arrangements to enable workers from outside the area to return home over weekends and or on a regular basis during the construction phase. This would reduce the risk posed by non-local construction workers to local family structures and social networks.	Continually	❖ Project Developer ❖ Contractor

CONSTRUCTION PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
	pregnancies, increased prostitution and increases in sexually transmitted diseases (STDs).			
Impacts on surrounding land owners	➢ Limit impacts on surrounding land owners associated with potential for: - Further deterioration of local roads - Increased risk of crime such as stock theft and poaching - Damage to farm infrastructure such as fences - Increased littering - Increased potential for veld fires	• Manage and monitor the movement of workers on and off the site. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis. • Ensure proper disposal of waste, especially plastics.	Continually	❖ Project Developer ❖ Contractor
Impacts on tourism	➢ Limit impacts on tourism and recreation	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	
Impact on surrounding property values	➢ Limit impacts on property values	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	

6.3 Operational phase

OPERATIONAL PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
6.3.1 Heritage Resources				
Alteration of the cultural and natural landscape by built elements	➢ Reduce visual contrast of infrastructure to the cultural landscape	**MITIGATION** • Use neutral, earthy-coloured paint on the built elements of the development so as to reduce the visual contrast in the landscape.	Continually as required	❖ Operations and maintenance contractor
Damage to off-site graves by staff	➢ Avoid/mitigate vandalisation and destruction of off-site graves	**AVOIDANCE / MITIGATION** • Ensure that development footprint is fenced and that staff are not allowed off site.	Once-off	❖ Operations and maintenance contractor
Damage to unidentified heritage resources	➢ Avoid damage/destruction of heritage resources	**AVOIDANCE** • During line maintenance and cutting of grass below the lines, care must be taken around identified heritage sites.	Continually	❖ Operations and maintenance contractor ❖ ECO
5.3.2 Avifauna				
Electrocution of birds	➢ Minimise the risk of bird collisions, injuries and fatalities.	**MANAGEMENT/MITIGATION** • Regular maintenance of electricity infrastructure (substations and powerlines) to remove bird nesting sites.	Continually as required	❖ Operations and maintenance contractor ❖ Ornithologist as advisor ❖ ECO
5.3.3 Fauna and flora				
Impacts of access control and fencing to plants and animals	➢ Allow movement of grazing animals ➢ Minimise the impacts of habitat fragmentation	**MANAGEMENT** • Employ veld management measures. • Allow gaps in fencing for grazing animal species (mostly livestock, possibly wild animals) to move between grazing areas, during prescribed times of the year.		❖ Operations and maintenance contractor ❖ Landowners/farmers as advisors ❖ ECO

OPERATIONAL PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
5.3.4 <u>Wetlands and aquatic ecology</u>				
Sedimentation of wetlands due to soil destabilisation	• Minimise the risk of erosion and sedimentation of wetlands	**MANAGEMENT / MITIGATION** • Implement and maintain a storm water management system. • Prevent diversion of water after heavy rainfalls from outside the pan catchment being diverted into the pan system See Section 12 of this EMPr.	Continual	❖ Operations and maintenance contractor ❖ ECO
Degradation of aquatic ecosystems	• Monitor potential changes in aquatic ecology	**MONITORING** • Conduct habitat assessment during the wet season (October to March) to determine if habitat deterioration is occurring. 15% deviation from baseline conditions to be investigated further.	Annual	❖ Operations and maintenance contractor ❖ Appointed aquatic ecologist ❖ ECO
		• Conduct invertebrate assessment during the wet season (October to March) determine if water quality deterioration is occurring. 15% deviation from baseline conditions to be investigated further.	Annual	
		• Standard water quality monitoring during the wet season (October to March) to determine if water quality deterioration is occurring. 15% deviation from baseline conditions to be investigated further. ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid ecologically sensitive areas identified by the specialist (pans, hillslope seep, with 100 – 200 m buffers as specified).*	Monthly (when water is available)	

OPERATIONAL PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
5.3.5 <u>Agriculture and soil potential</u>				
Soil erosion	➢ Minimise the risk of soil erosion	**MANAGEMENT / MITIGATION** • Implement an effective system of storm water run-off control using bunds and ditches, where it is required (at points where water accumulation might occur). • The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. See Section 12 of this EMPr.	Once-off	❖ Operations and maintenance contractor ❖ ECO
5.3.6 <u>Geohydrology</u>				
Groundwater contamination through accidental spillage / fuel leakage	➢ Minimise the risk of groundwater contamination	**MANAGEMENT** • Vehicles must be regularly serviced and maintained. **AVOIDANCE** • Construction vehicles and equipment should also be refuelled on an impermeable surface.	Continually	❖ Operations and maintenance contractor ❖ ECO
		AVOIDANCE • Install drip trays for any engines that stand in one place for an excessive length of time. • Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area.	Once-off	❖ Operations and maintenance contractor ❖ ECO
Groundwater contamination through stormwater outflows		**AVOIDANCE** • Keep drainage channels clear of debris and litter. **MITIGATION** • If any potentially contamination liquids are spilled in the stormwater channels they must be cleaned up.	Continually	❖ Operations and maintenance contractor ❖ ECO

OPERATIONAL PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
Groundwater over-abstraction	➢ Minimise the risk of groundwater over-abstraction leading to permanent lowering of groundwater level.	**MONITOR** • If groundwater is abstracted for the project, monitor the production borehole water levels, flow rates and quality.	Annually	❖ Operations and maintenance contractor ❖ Geohydrologist as advisor ❖ ECO
5.3.7 Visual Resources				
Landscape impact on a rural agricultural landscape containing large scale electrical infrastructure	➢ Minimise visual landscape impact	**MANAGEMENT / MITIGATION** • Ensure that structures remain as non-reflective as possible, and buildings remain as unobtrusive as possible by implementing a building maintenance. • Maintenance of access roads should not cause further disturbance and damage to the surrounding landscape.	Continually	❖ Operations and maintenance contractor ❖ ECO
Visual intrusion on the views of sensitive visual receptors	➢ Minimise visual intrusion	**MANAGEMENT / MITIGATION** **Substations and buildings** • Use appropriately coloured materials for structures to blend in with the backdrop of the project where this is technically feasible and the colour or paint will not have a deleterious effect on the functionality of the structures; • Appropriate colours for smooth surfaces often need to be two to three shades darker than the background colour to compensate for shadows that darken most textured natural surfaces; • Materials, coatings and paints should be chosen based on minimal reflectivity where possible; and • Paint grouped structures the same colour to reduce visual complexity and contrast.	Continually as required	❖ Operations and maintenance contractor ❖ ECO

OPERATIONAL PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
Night lighting impacts	➢ Minimise impacts to the regional nightscape	**MANAGEMENT/MITIGATION** • A lighting plan that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised; • The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts; • Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security; • Low-pressure sodium light sources should be used to reduce light pollution; • Light fixtures should not spill light beyond the project boundary; • Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously.	Once-off	❖ Contractor ❖ ECO
5.3.8 <u>Socio-economics</u>				
Expenditure related impacts on aspects such as jobs	➢ Maximise positive impacts associated with expenditure on the construction and operation of the project	**MANAGEMENT** • Maximise positive impacts through tendering, procurement and employment policies. • Set targets for use of local labour and maximise opportunities for the training of unskilled and skilled workers. • Use local sub-contractors where possible	Yearly auditing of achievement of socio-economic benefit goals with corrective actions if needed	❖ Project Developer ❖ Operations and maintenance contractor
Contribution to socio-economic and enterprise development initiatives	➢ Maximise positive impacts associated with project's contribution to socio-economic and enterprise development initiatives	**MANAGEMENT & MONITORING** • Close liaison with local municipal and other stakeholders involved in socio-economic development in order to ensure that any projects are integrated into wider strategies and plans with regard to socio-economic development.	Ongoing liaison and regular meetings with stakeholders	❖ Project Developer ❖ Operations and maintenance contractor

OPERATIONAL PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Social impact associated with an influx of people	➢ Limit impacts associated with the presence of workers and work seekers including those associated with negative impacts on social structures and increased 'social ills' such as increased crime levels, increased alcohol and drug use, increased teenage and unwanted pregnancies, increased prostitution and increases in sexually transmitted diseases (STDs).	**MANAGEMENT & MONITORING** • Implement and apply the Code of Conduct established for the project prior to its commencement with assistance from the stakeholder Monitoring Forum for the project. • Continue with the Monitoring Programme set up prior to the commencement of construction and respond to its findings.	Ongoing and with regular Monitoring Forum meetings	❖ Project Developer ❖ Contractor
Impacts on surrounding land owners	➢ Limit impacts on surrounding land owners associated with potential for: - Further deterioration of local roads - Increased risk of crime such as stock theft and poaching - Damage to farm infrastructure such as fences - Increased littering - Increased potential for veld fires	**MANAGEMENT & MONITORING** • Implement and apply the Code of Conduct established for the project prior to its commencement with assistance from the stakeholder Monitoring Forum for the project. • Continue with the Monitoring Programme set up prior to the commencement of construction and respond to its findings.	Ongoing and with regular Monitoring Forum meetings	❖ Project Developer ❖ Contractor
Impacts on tourism	➢ Limit impacts on tourism and recreation	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	

OPERATIONAL PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Impact on surrounding property values	➢ Limit impacts on property values	*Implement avoidance, management, mitigation and monitoring provided by the visual, ecological and agricultural specialist recommendations (i.e. implement all other actions proposed in the EMPr).*	See Visual, Ecological and Agricultural specialist recommendations	
		• Monitor impacts on values with the assistance of an independent valuer. If it is independently confirmed that value reductions have taken place and they cannot be mitigated, then this information can be used as a basis for negotiation and/or mediation between the applicant and neighbouring land owners focused on compensation. *It does, however, need to be recognized that compensation is not necessarily required under South African law. Legal implications would therefore need to be considered further should impacts be found during monitoring.*	Particulars to be decided between applicant and land owners with inputs from independent valuer	❖ Project Developer in co-operation with neighbouring land owners ❖ Independent property valuer

5.4 Decommissioning phase

DECOMMISSIONING PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
5.4.1 <u>Heritage Resources</u>				
Impact of facility decommissioning the facility to heritage resources	➢ Avoid/mitigate potential impacts to heritage resources	**AVOIDANCE / MITIGATION** • Ensure that all decommissioning activities take place within the authorised construction footprint so as to minimise damage to heritage resources.	Continually as required	❖ Operations and maintenance contractor ❖ ECO

DECOMMISSIONING PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
5.4.2 <u>Fauna & Flora</u>				
Impacts to fauna and flora during disassembly and removal of infrastructure	➢ Minimise potential impacts to fauna and flora	**AVOIDANCE** • The demolition of infrastructure may require vehicles making use of non-designated areas; special care must be taken not to destroy rehabilitated areas. • Avoid destruction of vegetation, creation of favourable habitat for fast growing invasive species and ground compaction. • Prevent possible spillages from construction vehicles and machinery. • Remove all hard surfaces from site to reduce runoff. See Section 9 of this EMPr.	Once-off	❖ Operations and maintenance contractor ❖ ECO
Establishment and spread of alien vegetation	➢ Proper removal of alien vegetation to reduce the risk of spread and invasion ➢ Prevent establishment and invasion of alien species	**MANAGEMENT / MITIGATION** • Remove alien vegetation, preferably as juveniles, with caution to prevent the spread of seeds and therefore the plants.	Once-off	❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
		MONITORING • Monitoring for alien plants initially every three months for one year after closure and rehabilitation.	Every 3 months for 1 yr after decommissioning	
		MONITORING • Monitor for alien plants after development for between 5-7 years on an annual basis. See Section 7 of this EMPr.	Annually for 5 – 7 yrs after decommissioning	

DECOMMISSIONING PHASE				
Aspect	**Objective/Outcome**	**Action**	**Frequency**	**Responsible Party**
Remediation of the site	➢ Proper removal of alien vegetation to reduce the risk of	**MITIGATION** • All disturbed sites must be rehabilitated • Site remediation should be implemented using indigenous, local plant species, e.g. ○ *Cynodon dactylon* ○ *Digitaria eriantha* ○ *Eragrostis plana* ○ *Heteropogon contortus* ○ *Themeda triandra* • Remediation must be completed by qualified personnel with the correct equipment in the correct season (wet season). • Removal of vegetation must be followed closely by rehabilitation within 3 months of disturbance. See Section 9 of this EMPr.	Once-off Monitoring for 3 months	❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO
5.4.3 <u>Wetlands and aquatic ecology</u>				
Sedimentation of wetlands due to soil destabilisation	• Minimise the risk of erosion and sedimentation of wetlands	**MITIGATION** • Rehabilitation of roads on site to prevent the creation of preferential flow paths; • Maintain absence of alien vegetation, keeping it out of the pan catchment; • Implement and maintain a storm water management system that prevents heavy rainfalls outside the pan catchment being diverted into the pan system See Section 12 of this EMPr.	Once-off	❖ Operations and maintenance contractor ❖ Ecological restoration/rehabilitation specialist as advisor ❖ ECO

DECOMMISSIONING PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
5.4.4 <u>Agriculture and soil potential</u>				
Soil erosion	➢ Minimise the risk of soil erosion	**MANAGEMENT / MITIGATION** • Implement an effective system of storm water run-off control using bunds and ditches, where it is required (at points where water accumulation might occur) • The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. See Section 12 of this EMPr.	Once-off	❖ Contractor ❖ ECO
Loss of topsoil through soil profile disturbance (such as levelling, excavations, road surfacing)	➢ Proper topsoil management	**MANAGEMENT / MITIGATION** • Strip available topsoil from entire area and stockpile for re-spreading during rehabilitation. • Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. • During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. • Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of potential agricultural land.	Once-off when an activity will mechanically disturb the soil below surface in any way	❖ Contractor ❖ ECO
Dust deposition	➢ Mitigate potential impacts that may occur beyond the footprint due to dust deposition	**MANAGEMENT / MITIGATION** • Implement standard construction site dust control measures of damping down with water where dust generation occurs	Continually as required	❖ Contractor ❖ ECO

DECOMMISSIONING PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
5.4.5 <u>Geohydrology</u>				
Groundwater contamination through accidental spillage / fuel leakage	➢ Minimise the risk of groundwater contamination	**MANAGEMENT** • Vehicles must be regularly serviced and maintained. **AVOIDANCE** • Construction vehicles and equipment should also be refuelled on an impermeable surface.	Continually	❖ Contractor
		AVOIDANCE • Install drip trays for any engines that stand in one place for an excessive length of time. • Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area.	Once-off	❖ Contractor ❖ ECO
Groundwater over-abstraction	➢ Minimise the risk of groundwater over-abstraction leading to permanent lowering of groundwater level.	**MONITOR** • If groundwater is abstracted for the project, monitor the production borehole water levels, flow rates and quality.	Annually	❖ Contractor ❖ Geohydrologist as advisor ❖ ECO
6.3.2 <u>Visual Resources</u>				
Visual intrusion on views of sensitive visual receptors	➢ Minimise visual disturbance during decommissioning activities	**AVOIDANCE** • Working at night should be avoided where possible **MANAGEMENT/MITIGATION** • Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes; • Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a	Continual	❖ Operations and maintenance contractor ❖ ECO

DECOMMISSIONING PHASE Aspect	Objective/Outcome	Action	Frequency	Responsible Party
		mix of indigenous species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape; • Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape; • Night lighting of reclamation sites should be minimised within requirements of safety and efficiency.		

7. Alien Invasive Management Plan

OBJECTIVE/OUTCOME: Avoid the establishment and spread of alien invasive species during all phases of the development

- Vegetate and irrigate open areas to limit erosion, but take care not to promote erosion by irrigating.
- All encountered alien plant species recorded on site should be removed.
- Remove alien vegetation, preferably as juveniles, with caution to prevent the spread of seeds and therefore the plants.
- Monitor alien plants initially every three months for one year after closure and rehabilitation.
- Monitor for alien plants after development for between 5-7 years on an annual basis.

Table 6: Alien plant control mechanisms for key invasive species that may be present / establish on site.

Species	Control mechanism
Agave americana	Chemical control with triclopyr (-amine salt) 90 / 270 g/L SL.
Caesalpinia gilliesii	Mechanical control for juveniles in the form of hand-pulling. Adults can be cut to stumps and treated with a herbicide: Clopyralid / triclopyr (-amine salt) 90 / 270 g/L SL.
Eucalyptus camuldulensis	Mechanical control for juveniles in the form of hand-pulling. Adults can be cut to stumps and treated with a herbicide: Clopyralid / triclopyr (-amine salt) 90 / 270 g/L SL.
Opuntia ficus-indica	Monosodium methanearsonate (MSMA) can be used in addition to glyphsphate 359g/L

8. Plant Rescue and Protection Plan

OBJECTIVE/OUTCOME: Avoid and mitigate potential impacts to listed and protected plant species and their habitats

- Preconstruction walk through of the facility in order to locate species of conservation concern that can be translocated as well as comply with permitting conditions.
- Removal of vegetation must be followed closely by rehabilitation by specialists qualified in this vegetation type's remediation.
- Prevent and manage the establishment of alien vegetation (as per Alien Invasive Management Plan, Section 7 of this EMPr)
- Minimise removal of vegetation during construction and operation will be minimised to reduce the risk of excessive open areas occurring.
- All disturbed sites must be rehabilitated.
- Remediation must be completed by qualified personnel with the correct equipment in the correct season (wet season).

9. Re-vegetation and Habitat Rehabilitation Plan

OBJECTIVE/OUTCOME: Re-vegetate open areas and rehabilitate disturbed areas

- Removal of vegetation must be followed closely by rehabilitation by specialists qualified in the specific vegetation type's remediation.
- Vegetate and irrigate open areas to limit erosion and dust.
- Take care not to promote erosion by irrigating.
- Improving growth conditions through decreasing run-off, increasing infiltration and increasing the build-up of organic material to reduce soil erosion risk.
- Minimise removal of vegetation during construction and operation will be minimised to reduce the risk of excessive open areas occurring.
- All disturbed sites must be rehabilitated.
- Site remediation should be implemented using indigenous, local plant species, e.g.
    - *Cynodon dactylon*
    - *Digitaria eriantha*
    - *Eragrostis plana*
    - *Heteropogon contortus*
    - *Themeda triandra*
- Remediation must be completed by qualified personnel with the correct equipment in the correct season (wet season).
- Removal of vegetation must be followed closely by rehabilitation within 3 months of disturbance.

10. Open Space Management Plan

OBJECTIVE/OUTCOME: Prevent occurrence of excessive open areas

- Minimise removal of vegetation during construction and operation will be minimised to reduce the risk of excessive open areas occurring
- Removal of vegetation must be followed closely by rehabilitation by specialists qualified in this vegetation type's remediation.
- Vegetate and irrigate open areas to limit erosion, but take care not to promote erosion by irrigating.
- Re-vegetate wit indigenous species such as:
    - *Cynodon dactylon*
    - *Digitaria eriantha*
    - *Eragrostis plana*
    - *Heteropogon contortus*
    - *Themeda triandra*

11. Traffic, Transportation and Road Maintenance Management Plan

OBJECTIVE/OUTCOME: Effectively manage additional traffic generation, transportation and maintenance of existing roads.

- Adhere to existing roads and road rules associated with them (for instance speed limits).
- Obtain permits from relevant administrative authority in the event of abnormal load transportation to and from site.
- Strictly regulate speed limit of construction vehicles.
- Demarcate and strictly control parking areas so that vehicles are limited to specific areas only;
- Ensure that roadworthy and safety standards are implemented for construction vehicles.
- Avoid construction vehicles movement on public roads during peak traffic times (06-00 – 09:00 and 16:00 – 19:00).
- Implement clear and visible signalling to indicate the movement of vehicles and when turning onto or off access roads to ensure safe access to and from the site.
- Maintain the pre-construction condition of public roads being utilised by construction vehicles. Pre-construction condition of roads should be supported by photographic evidence for record-keeping.
- In the event that the condition of public roads being used by construction vehicles are significantly degraded due to use, the developer should restore road condition to its pre-construction condition.

12. Storm Water Management Plan

OBJECTIVE/OUTCOME: Manage storm water runoff to prevent adverse impacts to terrestrial and aquatic ecosystems.

- Implement an effective system of storm water run-off control using bunds and ditches, where it is required (at points where water accumulation might occur).
- The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.
- Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.

13. Fire Management Plan

OBJECTIVE/OUTCOME: Reduce the risk of fire in the grassland environment

- Construct fire-breaks around the site/footprint area before any other construction begins.
- Prohibit smoking on-site or alternatively indicate designated smoking areas for staff.
- Prohibit open fires.
- Designate cooking areas for staff where fire hazard will be insignificant.
- Educate staff of the dangers of open and unattended fires.
- Educate staff as to proper fire safety.
- Enforce proper waste management including disposal of flammable material (e.g. cigarette butts and packaging).
- Place firefighting equipment at appropriate locations on site and ensure staff are aware of such equipment and associated procedure.

14. Erosion Management Plan

OBJECTIVE/OUTCOME: Prevent soil erosion and rehabilitate eroded areas.

- Vegetate and irrigate open areas to limit erosion, but take care not to promote erosion by irrigating.
- Re-vegetate wit indigenous species such as:
    - *Cynodon dactylon*
    - *Digitaria eriantha*
    - *Eragrostis plana*
    - *Heteropogon contortus*
    - *Themeda triandra*

- Remove all hard surfaces from site to reduce runoff.
- Strip available topsoil from entire area and stockpile for re-spreading during rehabilitation.
- Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them.
- During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.
- Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of potential agricultural land.
- Establish an effective record keeping system for each area where soil is disturbed for constructional and decommissioning purposes.

15. Leakage / Spillage Monitoring System

OBJECTIVE/OUTCOME: Prevent and monitor accidental leakages and spillages

- All vehicles and other equipment (generators etc.) must be regularly serviced to ensure they do not spill oil. Vehicles should be refuelled on paved (impervious) areas. If liquid product is being transported it must be ensured this does not spill during transit.
- Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.
- Diesel fuel storage tanks must be above ground in a bunded area.
- Engines that stand in one place for an excessive length of time must have drip trays.
- Vehicle and washing areas must also be on paved surfaces and the by-products removed to an evaporative storage area or a hazardous waste disposal site (if the material is hazardous).
- Establish an effective record keeping system for accidental leakage/spillage incidents.

16. Protection of Hydrological Features Measures

OBJECTIVE/OUTCOME: Prevent water contamination

- All water supplied for human consumption throughout the project should comply with the SANS 241:2015.
- Ensure that the use of groundwater should not compromise availability to other users e.g. agricultural and domestic use.
- Exclude wetlands and the associated buffers.
    - ***NOTE**: Upon completion of this EMPr the project developer has optimised their project footprints to avoid ecologically sensitive areas identified by the specialist (pans, hillslope seep, with 100 – 200 m buffers as specified).*
- Implement and maintain a storm water management system that prevents heavy rainfalls outside the pan catchment being diverted into the pan system.
- Measures need to be put in place to ensure that the groundwater is not contaminated.
- The following aspects are considered important:
    - All vehicles and other equipment (generators etc.) must be regularly serviced to ensure they do not spill oil. Vehicles should be refuelled on paved (impervious) areas. If liquid product is being transported it must be ensured this does not spill during transit.
    - Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.
    - Diesel fuel storage tanks must be above ground in a bunded area.
    - Engines that stand in one place for an excessive length of time must have drip trays.
    - Vehicle and washing areas must also be on paved surfaces and the by-products removed to an evaporative storage area or a hazardous waste disposal site (if the material is hazardous).
- If groundwater is abstracted for the project, monitoring of the production borehole water levels, flow rates and quality will be required. This is best done under the guidance of a registered geohydrologist.
- Inform the Department of Water and Sanitation immediately in the event of any surface water or groundwater contamination.

TP Ntili (ATTENTION: W GROBLER)
Department of Water Affairs (Free State)
Regional Director
051 405 9281
082 803 3204
P.O. Box 528, Bloemfontein, 9300
Department of Water Affairs, 2nd Floor, Bloem Plaza Building, Cnr Charlotte Maxeke and East Burger Street, Bloemfontein, 9300

Contact persons:
Mr. Ntili: NtiliT@dwa.gov.za
Ms. MdhluliL MdhluliS2@dwa.gov.za

ADDITIONAL INFORMATIO REGARDING HYDROLOGICAL RESOURCES

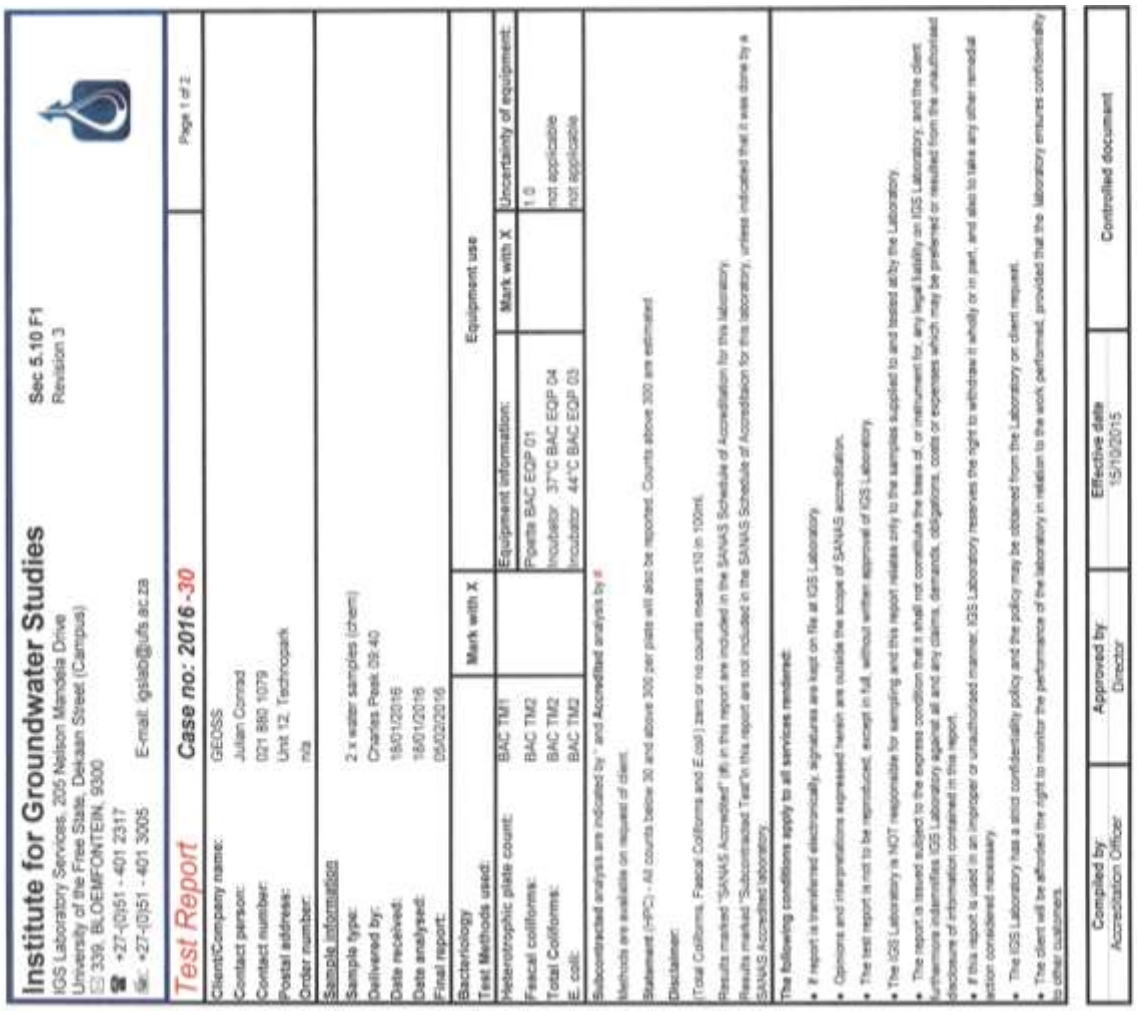
- **Dealesville Waste Water Treatment Works suitable capacity:** 2 M ℓ/day

- **Hydrocensus results**

Table 7: Hydrocensus results – comments.

ID	X	Y	Total Depth	EC (mS/m)	pH	Use	Comment
HBH1*	-28.654577	25.657494	30m	-	-	Sheep	Reportedly high yielding used to supply the main farm house. Sample collected.
HBH2	-28.668985	25.649018	20m	61.3	8.1	Sheep	No yield data available, owner bought farm after the borehole was drilled. Sample taken.
HBH3	-28.681997	25.650176	15m	171	7.9	Sheep	No yield data available, owner bought farm after the borehole was drilled.
HBH4	-28.669078	25.638569	20m	540	7.9	Sheep	No yield data available, owner bought farm after the borehole was drilled.
HBH5	-28.659372	25.666778	6m	97	8	Wild game	Pumps in to water reservoir. Field chem test.
HBH6	-28.664719	25.698878	~30m	55	8	Wild game	Pumps in to water reservoir. Field chem test.
HBH7	-28.664719	25.698878	~30m	-	-	Wild game	2.5 L/s yield, only used when the wind pump is not working to supply animals.
HBH8	-28.677739	25.695253	20m	-	-	Wild game	Pumps in to water trough. Trough was empty.
HBH9	-28.677739	25.695253	30m	-	-	Wild game	7.5 L/s yield, only used when the wind pump is not working to supply animals.
HBH10*	-28.680997	25.681285	20m	60	8.6	Wild game	Pumps in to water reservoir. Field chem test. Sample taken. Yield = 2.5 L/s.
HBH11	-28.68179	25.677518	30m	-	-	None	Mono-pump is installed but has no motor. Yield = 6.25 L/s.
HBH12	-28.671835	25.688448	~30m	-	-	None	The borehole was drilled by the town for water supply. It was too low yielding. Has a reported yield of 2.5 L/s.
HBH13	-28.655737	25.697399	30m	60	8.1	Cattle	According to the land owner the boreholes have an estimated yield of between 1.5 - 2.0 L/s. they are used to supply water to roughly 50 cattle.
HBH14	-	-	30m	-	-	Cattle	According to the land owner the boreholes have an estimated yield of between 1.5 - 2.0 L/s. they are used to supply water to roughly 50 cattle.

- **Chemical analysis results**



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Sec 5.10 F1
Revision 3

Page 1 of 2

Test Report **Case no: 2016 -30**

Client/Company name:	GEOSS
Contact person:	Julian Conrad
Contact number:	021 880 1079
Postal address:	Unit 12, Technopark
Order number:	n/a

Sample information

Sample type:	2 x water samples (chem)
Delivered by:	Charles Peak 09:40
Date received:	18/01/2016
Date analysed:	18/01/2016
Final report:	05/02/2016

Bacteriology Test Methods used:		Mark with X	Equipment use			
			Equipment information:	Mark with X	Uncertainty of equipment:
Heterotrophic plate count:	BAC TM1				
Fecal coliforms:	BAC TM2		Pipette BAC EQP 01		1.0
Total Coliforms:	BAC TM2		Incubator 37°C BAC EQP 04		not applicable
E. coli:	BAC TM2		Incubator 44°C BAC EQP 03		not applicable

Subcontracted analysis are indicated by * and Accredited analysis by #

Methods are available on request of client.

Statement (HPC) - All counts below 30 and above 300 per plate will also be reported. Counts above 300 are estimated

Disclaimer:

(Total Coliforms, Fecal Coliforms and E.coli) zero or no counts means ≤10 in 100ml.

Results marked "SANAS Accredited" (#) in this report are included in the SANAS Schedule of Accreditation for this laboratory

Results marked "Subcontracted Test"in this report are not included in the SANAS Schedule of Accreditation for this laboratory, unless indicated that it was done by a SANAS Accredited laboratory.

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Compiled by:	Approved by:	Effective date	Controlled document
Accreditation Officer	Director	15/10/2015	

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Sec 5.10 F1
Revision 3

Test Report Case no. 2016- 30

Determinand	Units	South African National Standard (SANS) 241:2006&2015 for drinking water	Sample name: HBh1 # 1525	Sample name: HBh10 #1525
			Lab number:	
		Class 1 (Recommended levels) Class 2 (Maximum allowable for limited time)	30-1.	30-2
		Value		Value
Chemical report				
pH	pH units	5.5 tot 9.7	8.4	7.21
Electrical conductivity	mS/m	≤ 170	185	62
Calcium as Ca	mg/L	150 - 300	20.4	53.1
Magnesium as Mg	mg/L	70 - 100	74.3	33.5
Sodium as Na	mg/L	≤ 200	340	32.3
Potassium as K	mg/L	50 - 100	2.79	3.67
P-Alkalinity	mg/L		0	0
M-Alkalinity	mg/L		422	292
Fluoride as F	mg/L	≤ 1.5	0.63	0.48
Chloride as Cl	mg/L	≤ 300	319	28
Nitrite as N	mg/L		0.1	<0.01
Bromide as Br	mg/L	**3	2.71	0.26
Nitrate as N	mg/L	≤ 11	0.60	4.09
Phosphate as PO_4	mg/L	*15.33	<1	<0.1
Sulphate as SO_4	mg/L	≤ 500	206	34
Calcium Hardness	mg/L	375 - 750	51	133
Magnesium Hardness	mg/L	287 - 410	305	137
Total Hardness as $CaCO_3$	mg/L	662 - 1160	356	270
Total Dissolved Solids	mg/L	≤ 1200	1390	493
Iron as Fe	mg/L	≤ 0.300	0.024	0.045
Manganese as Mn	mg/L	≤ 0.100	<0.010	<0.010

Chemistry note:
The parameters higher than specifications are clearly marked.

Signature: _____

L Deysel (Technical signatory / Technical manager)

END OF REPORT

From: DWAF Domestic use guidelines	
Hardness Range	**Description of Hardness**
0 - 50	Soft
50 - 100	Moderately soft
100 - 150	Slightly hard
150 - 200	Moderately hard
200 - 300	Hard
> 300	Very hard

17. Waste Management Plan

OBJECTIVE/OUTCOME: Promote proper waste disposal, waste reduction, re-use, and recycling opportunities

- Ensure an adequate and sustainable use of resources.
- Ensure that waste generated during this phase is taken to an appropriate registered landfill.
- Waste separation is encouraged and therefore receptacles should be labelled to reflect the different waste types. All operational waste (concrete, steel, rubbles etc.) to be removed from the site and waste hierarchy of prevention, as the preferred option, followed by reuse, recycling, and recovery must be implemented, where possible.
- Other non-hazardous solid waste (e.g. packaging material) to be disposed of at a licensed landfill.
- All liquid waste (used oil, paints, lubricating compounds and grease) to be packaged and disposed of by appropriate means.
- Adequate containers for the cleaning of equipment and materials (paint, solvent) must be provided as to avoid spillages.
- Waste water from construction and painting activities must be collected in a designated container and disposed of at a suitable disposal point off site.
- Control and implement waste management plans provided by contractors. Ensure that relevant legislative requirements are respected.
- In the event that, during any phase of the development, it is found that the municipal services (waste removal [solid and liquid non-hazardous waste, as well as sewage]) are not sufficiently provided by the Municipality, the Developer should make use of independent/private waste removal services and obtain safe waste disposal dockets.

18. Environmental Awareness Plan

OBJECTIVE/OUTCOME: Create employee awareness around environmental responsibility and risks

- Provide preconstruction environmental induction for all construction staff and visitors on site to ensure that basic environmental principles, and measures set out in this EMPr, are adhered to. This includes awareness as to:
    - No littering;
    - Appropriate handling of pollution and chemical spills;
    - Avoiding fire hazards;
    - Minimise wildlife interactions; and
    - Remain within demarcated construction areas.
- Implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase.
- Educate staff of the dangers of open and unattended fires.
- Educate staff as to proper fire safety.
- Prohibit smoking on-site or alternatively indicate designated smoking areas for staff.
- Ensure that adequate firefighting equipment is available and easily accessible on site.

19. Recorded Heritage Resources on the 29 Solar Dealesville Development site.

GPS No.	Co-ordinates	Description	Heritage significance
859	S28 38 32.4 E25 42 26.0	Historical foundations and features. Some ceramics, glass and metal lying about. Most is relatively modern, perhaps mid-20th century.	Low-Medium
860	S28 38 40.7 E25 42 17.4	Large depression, presumably excavated in the past, containing stone alignments and a low density scatter of MSA hornfels artefacts that have been exposed by the excavation.	Very Low
861	S28 38 37.3 E25 42 26.2	Graveyard with six formal graves of farm labourers with dates of death from 1971 to 1997. There is a mound of dolerite rocks just outside the fence that could represent a seventh grave but this seems unlikely. Although not considered a heritage resource because it is younger than 60 years, the graveyard is still of high significance because it contains human remains.	High AVOID
862	S28 38 37.6 E25 42 27.8	Two graves of (presumably) white people. One is dated 1900 (Bekker) while the other was a baby who died in 1887 (Muras).	High AVOID
863	S28 39 02.9 E25 42 40.1	A lightly deflated area where dolerite gravel has become exposed. A few MSA artefacts are evident amongst the gravel.	Very Low
864	S28 38 28.3 E25 42 25.0	Historical foundation of stone. Some are disturbed.	Low
865	S28 38 29.4 E25 42 24.6	Historical foundation of stone. Some are disturbed.	Low
866	S28 38 29.4 E25 42 25.9	Historical foundation of stone. Some are disturbed.	Low
867	S28 38 30.6 E25 42 23.7	Two stone-packed dolerite grave mounds.	High AVOID
868	S28 38 25.7 E25 42 43.6	A historical stone foundation but with a pile of bricks lying at one end.	Low
869	S28 38 26.8 E25 42 43.5	An area of packed calcrete rocks. Seems too large for a conventional grave, though it could either be a double grave or something else entirely.	Unknown (High?) AVOID or test and exhume
870	S28 39 24.0 E25 41 48.6	Dolerite stone kraal. It is in poor condition with sections of walling having collapsed. It is 27 m long and 12 m wide but with a 10 m by 5 m addition to its northern side.	Medium AVOID or record
871	S28 39 21.8 E25 41 51.6	Various stone, brick and cement features in this area. Not very old cement. This is also the southern end of the tree-lined avenue. It is only the avenue that is significant.	Medium AVOID avenue
872	S28 39 25.6 E25 41 31.4	Dolerite rock on the crest of a low hill with grinding patches on it. There are also three proper grooves. Another rock a few meters away has two more ground patches. No artefacts were seen.	Low-medium
873	S28 39 25.4 E25 41 32.5	Dolerite rock with a single shallow grinding groove on it.	Low
874	S28 39 25.4 E25 41 31.0	Dolerite rock with a single grinding groove on it.	Low
874	S28 39 25.4 E25 41 31.0	Dolerite rock with a single grinding groove on it.	Low
874	S28 39 25.4 E25 41 31.0	Dolerite rock with a single grinding groove on it.	Low
874	S28 39 25.4 E25 41 31.0	Dolerite rock with a single grinding groove on it.	Low
875	S28 39 22.7 E25 41 35.5	Historical foundation in brick but with lots of calcrete lying around the area.	Low
876	S28 39 25.3 E25 41 34.7	Two dolerite stone features/foundations. Lots of metal lying around the general area and a number of 20th century bottles.	Low
877	S28 39 30.1 E25 41 32.7	Stone foundation of calcrete with some dolerite.	Low
878	S28 39 29.6 E25 41 35.5	Small mound of dolerite and calcrete that is almost certainly a grave. A second patch of rocks is very disturbed and may or may not represent a second grave.	High AVOID
879	S28 39 26.5 E25 41 36.1	Stone foundation of dolerite and calcrete.	Low
880	S28 39 26.3 E25 41 35.5	Stone foundation of dolerite and calcrete.	Low
881	S28 39 25.6 E25 41 35.5	A single grave packed with dolerite and calcrete. There is an ash heap with much glass on it 5 m to the north of the grave.	High AVOID
882	S28 39 25.0 E25 41 36.4	A small hollow that holds water and may have been used in prehistoric and historic times as a water source. (Not a heritage resource but noted for contextual reasons.)	---

GPS No.	Co-ordinates	Description	Heritage significance
883	S28 39 32.0 E25 41 40.4	A graveyard lying up against the southern fence of the property with 13 graves in it. Two are formal graves dated 1902 and 1980, while there is one with head and footstones only and ten stone-packed mounds.	High AVOID
884	S28 39 24.5 E25 41 43.6	An alignment of dolerite rocks.	Very Low
885	S28 39 31.5 E25 42 51.0	Borrow pit with some artefacts exposed around the edges of the excavation.	Very Low
886	S28 39 50.6 E25 41 58.4	Farmhouse ruin with stone foundation and both sun-dried and fired bricks in the walls. Modern (early-mid-20th century) additions have been made. Largely collapsed now.	Medium AVOID or record
887	S28 39 50.8 E25 41 57.4	A circular dolerite stone feature, maybe the base of a water tank.	Very Low
888	S28 39 34.4 E25 40 15.1	Calcrete gravel patch along the margin of the pan with dense hornfels artefact scatter. Most is likely to be MSA.	Low-medium AVOID or sample impacted patches in this area.
889	S28 39 36.2 E25 40 13.8	As for 888	Very Low
890	S28 39 37.8 E25 40 17.4	As for 888	Low-Medium See 888
891	S28 39 39.9 E25 40 15.2	As for 888	Low-Medium See 888
892	S28 39 38.0 E25 40 11.7	Two possible graves on the edge of the pan. They are loose piles of dolerite and calcrete.	Low-Medium See 888
893	S28 39 37.8 E25 40 12.3	As for 888	Low-Medium See 888
894	S28 39 36.3 E25 40 11.7	As for 888	Unknown (?High) AVOID or test and exhume
895	S28 39 35.4 E25 40 11.7	As for 888 but an extra dense patch of artefacts.	Medium See 888
896	S28 39 33.2 E25 40 10.4	As for 888	Low-Medium See 888
897	S28 39 30.7 E25 40 01.0	Historical stock enclosure built of dolerite and calcrete. It has four enclosed spaces within it. It should be noted that rocks have been removed from these structures for use along the current fence.	Low-Medium AVOID or record
898	S28 39 29.5 E25 40 01.7	Ruin, probably a house. It is entirely collapsed. Stone foundation still in place and bricks are sun-dried, low-fired and high-fired.	Low-Medium See 888
899	S28 39 30.0 E25 40 02.3	A large ash heap that has modern materials on it as well, especially glass and metal.	Medium AVOID or test excavation
900	S28 39 31.7 E25 39 59.7	House ruin, perhaps the main farmhouse for this complex. It has a double skin and rubble fill walls made from dolerite blocks (both natural and dressed) and dressed calcrete blocks. The walls are 'cemented' together with mud and some modern cement appears on the western face.	Low-Medium Avoid or record
902	S28 39 30.6 E25 39 56.5	A small dolerite foundation.	Low
903	S28 39 31.2 E25 39 56.5	A dolerite stone feature of unknown function.	Very Low
904	S28 39 31.8 E25 39 56.7	Low density historical dump with glass, ceramics and metal. One LSA flake.	Low
905	S28 39 32.7 E25 39 57.6	Stone features related to the wind pump.	Very Low
906	S28 39 33.6 E25 39 58.5	A large stone foundation of dolerite and calcrete.	Low
907	S28 39 36.6 E25 39 57.5	Small boulder with three cupules in it on a 30 degree sloping face. The cupules are 65 mm, 70 mm and 60 mm from west to east. They are definitely Stone Age because, although mostly smooth inside, they are weathered and well-patinated.	Low-Medium Collect
908	S28 39 37.2 E25 39 57.2	A small stone feature of dolerite blocks.	Very Low
909	S28 39 37.6 E25 39 57.4	A dolerite and calcrete foundation. There are some fragments of metal, glass and ceramics in this general area.	Low

GPS No.	Co-ordinates	Description	Heritage significance
910	S28 39 37.5 E25 39 59.5	A single fenced grave with a cement headstone that has fallen apart.	High AVOID
911	S28 39 37.6 E25 39 58.0	An area on the dolerite ridge with much quarrying evident. No doubt the source of some of the building stone for the complex.	Very Low
912	S28 39 37.0 E25 39 59.0	A graveyard with six formal graves and one stone-packed grave. There are three Van Heerden's and three Coetzee's.	High AVOID
913	S28 39 32.1 E25 40 00.2	A stone feature of dolerite.	Very Low
914	S28 39 31.7 E25 40 00.8	A stone alignment of dolerite.	Very Low
915	S28 39 55.9 E25 39 49.6	A single grinding patch on a dolerite outcrop.	Very low
916	S28 39 57.6 E25 39 48.8	Oval-shaped historical kraal.	Low
917	S28 39 55.2 E25 39 48.1	A possible ground patch on a dolerite outcrop. A very clear one lies a few meters to the northeast.	Very Low
918	S28 40 35.6 E25 39 46.3	A patch of calcrete gravel with hornfels artefacts on the edge of the pan.	Low
919	S28 40 43.1 E25 39 26.3	Historical dam lined with calcrete.	Low
920 920B	S28 40 52.2 E25 40 04.6 S28 40 48.3 E25 39 57.4	Points on what appears to be an old road alignment.	Very Low
921	S28 40 52.2 E25 40 22.9	Light scattering of hornfels artefacts in a pan.	Very Low
922	S28 40 54.2 E25 40 34.8	LSA and MSA artefacts occur in the sand around the Constantia spring. There are likely to be buried artefacts here too but it is hard to tell what is there or how significant it is likely to be.	Medium AVOID
923	S28 40 48.6 E25 40 48.4	A foundation made of dolerite and calcrete.	Low
924	S28 40 48.7 E25 40 46.4	A calcrete-lined historical dam.	Low
925	S28 40 36.4 E25 40 26.1	An exposure of calcrete gravel with low density scatters of hornfels artefacts in it in various places along the pan edge.	Low
926	S28 40 33.8 E25 41 04.0	Set of 11 graves and a spare pile of calcrete rocks. Some pieces of glass lying about and also a small bottle (possibly a spice bottle used for flowers left at a grave). [In telephonic conversation with the land owner he suggested these piles were from clearing rocks from ploughed lands, but I am adopting the precautionary principle because there are no lands nearby.]	High (unless they turn out not to be graves) AVOID
927	S28 40 08.3 E25 42 02.0	Oval-shaped piled-stone enclosure of about 7 m x 10 m. It has largely collapsed. Could be Stone Age and related to the engraving site on the crest of the koppie. A handful of well-patinated artefacts found within the enclosure are probably far older.	Medium AVOID entire ridge
928	S28 40 08.4 E25 42 01.4	A bedrock grinding hollow and a second lighter ground patch on dolerite exposures.	Low AVOID entire ridge
929	S28 39 53.8 E25 41 56.0	A dolerite-lined dam which has had modern changes to it but the original structure may be old.	Low
930	S28 40 50.6 E25 38 54.6	Light scatter of hornfels artefacts exposed in farm road.	Very Low
931	S28 40 16.1 E25 38 12.5	Hornfels artefacts exposed along the edge of the pan.	Very Low
932	S28 39 51.2 E25 38 24.4	Rows of trees and fence posts suggesting an earlier cultural landscape feature.	Very low
933	S28 40 07.2 E25 38 48.5	Low density hornfels scatter on the crest of a low hill with dolerite bedrock exposed.	Very low
934	S28 39 17.2 E25 39 51.8	Ash heap with modern materials on it. It is unknown whether older material might be preserved below.	Low
935	S28 39 16.3 E25 39 51.2	Small ash heap with modern materials on it. It is unknown whether older material might be preserved below.	Low
936	S28 39 15.6 E25 39 51.3	Ash heap with modern materials on it. It is unknown whether older material might be preserved below.	Low

GPS No.	Co-ordinates	Description	Heritage significance
936	S28 39 15.6 E25 39 51.3	Ash heap with modern materials on it. It is unknown whether older material might be preserved below.	Low
937	S28 39 15.8 E25 39 49.9	Small ash heap with modern materials on it. It is unknown whether older material might be preserved below.	Low
938	S28 39 28.8 E25 40 00.2	Large historical foundation of dolerite and calcrete.	Low-Medium
939	S28 39 27.9 E25 40 02.0	Stone feature of dolerite and calcrete.	Very Low
940	S28 39 26.8 E25 40 01.8	Dolerite stone feature.	Very Low
941	S28 39 26.5 E25 40 02.4	Dolerite stone feature.	Very Low
941	S28 39 26.5 E25 40 02.4	Dolerite stone feature.	Very Low
942	S28 39 24.8 E25 40 04.7	Stone-lined dam that is silted up and no longer functional. Close to a wind pump.	Low
943	S28 39 27.5 E25 40 18.7	Pile of calcrete blocks that looks a bit like a grave.	Unknown (High?) AVOID or test and exhume
944	S28 39 24.6 E25 40 19.0	A calcrete stone foundation and a second feature that appears to be more of a pile of calcrete rocks.	Low
945	S28 39 03.5 E25 40 12.4	A semi-circular calcrete feature with a few pieces of glass lying around the area. Also several other small indeterminate mounds of calcrete (not graves though).	Low
946	S28 39 04.4 E25 40 12.3	Dolerite and calcrete stone feature and small calcrete stone alignment nearby.	Very Low
947	S28 39 05.3 E25 40 13.0	A dolerite foundation with many pieces of both dolerite and calcrete lying around the immediate area. Some glass and metal fragments also present.	Low
948	S28 39 08.4 E25 40 11.5	Area of calcrete gravel on the edge of a pan containing hornfels artefacts. Some seem fairly fresh though not possible to tell if LSA present. Definitely some MSA material though.	Low
949	S28 39 12.6 E25 40 10.4	Similar hornfels scatter but located with sand a short distance from the edge of the pan.	Low
950	S28 39 11.2 E25 40 16.7	Area of calcrete gravel on the edge of a pan containing hornfels artefacts.	Low
951	S28 39 10.1 E25 40 16.8	Area of calcrete gravel on the edge of a pan containing hornfels artefacts. Definitely includes both LSA and MSA with the former exemplified by a typical thumbnail scraper that is completely unpatinated.	Low
952	S28 39 04.9 E25 40 10.2	Small dolerite stone feature.	Low
953	S28 38 57.8 E25 40 10.2	Small unfenced graveyard with six graves. The mounds are rectangular and built up with dolerite blocks. All have dolerite headstones on their western ends (mostly collapsed) – one of these is engraved with fine horizontal lines similar to a writing slate.	High AVOID

20. Additional recommendations from the South African Heritage Resources Agency

- During line maintenance and cutting of grass below the lines, care must be taken around identified heritage sites. Additionally, when cables for the transmission lines are strung during the construction phase, the cables should not be allowed to drag through sites located between towers.
- Should avoidance of the identified resources not be possible, they must be recorded and a mitigation permit must be applied for at SAHRA by a professional archaeologist or palaeontologist.
- Should any objects of archaeological or palaeontological remains be found during construction activities, work must immediately stop in that area and the Environmental Control Officer (ECO) must be informed.
- The ECO must inform the South African Heritage Recourse Agency (SAHRA) and contact an archaeologist and/or palaeontologist, depending on the nature of the find, to assess the importance and rescue them if necessary (with the relevant SAHRA permit). No work may be resumed in this area without the permission from the ECO and SAHRA.
- If the newly discovered heritage resource is considered significant a Phase 2 assessment may be required. A permit from the responsible heritage authority will be needed.

APPENDIX 1: ENVIRONMENTAL IMPACT ASSESSMENT PRACTITIONERS' CURRICULUM VITAES

Curriculum Vitae of Surina Laurie – Project Leader

SURINA LAURIE

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Name of firm	CSIR
Name of staff	Surina Laurie
Profession	Environmental Assessment Practitioner
Position in firm	Project Manager/Senior Environmental Assessment Practitioner
Years' experience	7 years
Nationality	South African
Professional Registration	Pri. Sci. Nat. 400033/15 (Environmental Science)

Biographical sketch

Surina has more than 7 years' experience as an Environmental Assessment Practitioner (EAP). She completed both her BSc in Conservation Ecology and MPhil in Environmental Management (part-time) at the University of Stellenbosch. With her honours project, she worked closely with the Endangered Wildlife Trust Riverine Rabbit Working Group and was responsible for determining the conservation opportunity for the Riverine Rabbit in the Karoo. With this project, she gained valuable experience in how to interact and manage stakeholders in such a way that a project's objectives and conservation goals are met without the stakeholders not being included in the decision-making process. The management of stakeholders and the ability to incorporate and/or adequately reflect their input are considered to be an essential component of an Environmental Impact Assessment (EIA) process.

With her Masters' thesis she researched and addressed why there is a need to undertake a Cost Benefit Analysis (CBA) as part of any EIA. The need for a CBA stems from the fact that losing environmental services will have an economic impact on a regional/national level in the long term but this is usually not considered during an EIA process. A CBA will look at both the economic benefits (profit) from a project and the economic losses because of loss of ecosystem services or rehabilitation costs. By including a CBA in an EIA, both the economic and environmental financial implications (not just the environmental significance of an impact) of a project will be considered by the decision making authority prior to the issuing of Environmental Authorisations or permits. To further expand her knowledge in this field, she has recently obtained a Postgraduate Certificate in Environmental Economics from the University of London.

She has experience as a project manager and project leader for Basic Assessments and Scoping and Environmental Impact Assessments for various sectors, including renewable energy, industry and tourism.

Education

2015 – 2016 (Part-time)	*Postgraduate Certificate* *Environmental Economics* *University of London*
2013	*Project Management Course* *University of Cape Town Graduate School of Business*
2011-2012 (Part-time)	*MPhil Environmental Management* *University of Stellenbosch*
2007-2010	*BSc Conservation Ecology* *University of Stellenbosch*

Employment record	Feb 2014 to present	*CSIR* *Project Manager- Environmental Assessment Practitioner*
	Sept 2011 to Jan 2014	*WSP Environmental (Pty) Ltd* *Environmental Consultant*
	Nov 2010 to Aug 2011	*EnviroAfrica* *Junior Environmental Consultant*

Experience record

Abridged experience in Environmental Impact and Basic Assessment processes:

Date	Project Description	Role	Client
2018 – Ongoing	Three Basic Assessment Processes for the proposed development of three distribution lines and three 115 MW Solar PV Facilities (Vryburg PV 1, PV 2, and PV 3) near Vryburg, North-West.	Project Manager	Veroniva (Pty) Ltd – Energy
2017 – Ongoing	Basic Assessment for the Proposed Development of a Transmission Line and associated electrical infrastructure to support the proposed Skeerhok Solar Energy Facilities, north-east of Kenhardt, Northern Cape Province	Project Leader	Juwi Renewable Energies (PTY) Ltd
2017 - 2018	Scoping and Environmental Impact Assessment for the Proposed Development of a 100 MW Solar Photovoltaic Facility (SKEERHOK PV 1) on the farm Smutshoek 395, Portion 0, north-east of Kenhardt, Northern Cape Province	Project Leader	Juwi Renewable Energies (PTY) Ltd
2017 - 2018	Scoping and Environmental Impact Assessment for the Proposed Development of a 100 MW Solar Photovoltaic Facility (SKEERHOK PV 2) on Portion 9 of farm Gemsbok Bult 120, north-east of Kenhardt, Northern Cape Province	Project Leader	Juwi Renewable Energies (PTY) Ltd
2017 - 2018	Scoping and Environmental Impact Assessment for the Proposed Development of a 100 MW Solar Photovoltaic Facility (SKEERHOK PV 3) on the farm Smutshoek 395, Portion 0, north-east of Kenhardt, Northern Cape Province	Project Leader	Juwi Renewable Energies (PTY) Ltd
2016 - 2017	Basic Assessment Processes: Proposed development of three Distribution Lines and electrical grid infrastructure to connect to the proposed Sutherland WEF, Sutherland 2 WEF and Rietrug WEF to the National Grid, near Sutherland in the Northern and Western Cape	Project Leader	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2016 - 2017	Mainstream Sutherland WEFs Amendment 1 and 2	Project Leader	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2016	Environmental Screening Study for the potential development of two Solar PV projects in the North West Province	Project Manager	Veroniva (PTY) Ltd
2016	Basic Assessment process for the proposed construction of supporting electrical infrastructure to the Victoria West Wind Energy Facility, Victoria West, Northern Cape	Project Manager	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2016	Amendment application to the Victoria West renewable energy facility in order to add additional wind turbines to site, Victoria West, Northern Cape	Project Manager	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2015 - 2016	Scoping and Environmental Impact Assessment for 3 x 75 MW Solar PV facilities and associated electrical infrastructure near Kenhardt, Northern Cape a	Project Leader	Mulilo Renewable Project Development (Pty) Ltd
2015 - 2016	Scoping and Environmental Impact Assessment for 5 x 100 MW Solar PV facilities near Dealesville, Free State.	Project Leader	29Solar Capital
2015	Review of the validity of the appeals received against the EA issued for the construction of an 11 MW Hydro Power Station, Groblershoop, Northern Cape Province	Project Manager	Department of Environmental Affairs
2014 -2016	Integrated Scoping and EIA process for the development of twelve (12) Photovoltaic (PV) or Concentrated Photovoltaic (CPV) Solar Facilities with a generating capacity of 75 MW/100 MW each, near Dealesville, Free State.	Project Manager	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2014 - 2015	Integrated Scoping and EIA process for the construction of three Photovoltaic (PV) or Concentrated Photovoltaic (CPV) Solar Facilities with a generating capacity of 75 MW each on the farms remaining extent of Portion 3 of the Farm Gemsbok Bult 120 and Boven Rugzeer remaining extent of 169, located 30 km	Project Manager	Mulilo Renewable Project Development (Pty) Ltd

	north-east of Kenhardt. Two of the projects will be located on the farm remaining extent of Portion 3 of the Farm Gemsbok Bult 120 and one on Boven Rugzeer remaining extent 169.		
2013-2014	Basic Assessment for the construction of three additional petroleum storage tanks at the Cape Town Harbour.	Environmental Consultant	FFS Refiners (Pty) Ltd
2013-2014	Scoping and EIA for the construction of a Sewage Package Plant on Robben Island.	Environmental Consultant	Department of Public Works
2013	Development of an EMPr for the undertaking of maintenance work on the Stilbaai Fishing Harbour's Slipway located in Stilbaai, Western Cape, South Africa. In order to be compliant to the requirements of the National Environmental Management Act (Act 107 of 1998) and Environmental Impact Assessment (EIA) Regulations, a Maintenance Management Plan (MMP) needed to be developed to manage the environmental impacts associated with maintenance work that is scheduled to be undertaken on the Stilbaai Fishing Harbour's Slipway as well as any future on-going maintenance requirements.	Environmental Consultant	Department of Public Works
2012-2014	Waste Management License for the proposed storage of Ferrous HMS 1+2, Shredded Ferrous and Bales located at the K/L Berth at Duncan Road, Port of Cape Town	Environmental Consultant	The New Reclamation Group (Pty) Ltd
2012-2014	Scoping and EIA for the construction a biodiesel refinery in the Coega Industrial Development Zone (IDZ). The proposed project entails the import of used vegetable oil from the USA and converting it through various processes to biodiesel which will be exported to Europe. The proposed project requires an Air Emissions License, a Waste Management License and Environmental Authorisation.	Environmental Consultant	FIS Biofuels (Ltd)
2013-2013	Basic Assessment for the proposed redevelopment of Berths B, C and D in Duncan Dock at the Port of Cape Town.	Assistant Environmental Consultant	FPT (Pty) Ltd
2011- 2012	Development of an EMPr for the Eerstelingsfontein Opencast Project (EOP).	Assistant Environmental Consultant	Exxaro Resources Limited
2011-2014	Basic Assessment for the proposed reinstatement of the Blue Stone Quarry located on Robben Island.	Assistant Environmental Consultant	Department of Public Works
2011	Scoping and EIA for the proposed upgrade to the Struisbaai WWTW.	Assistant Environmental Consultant	Cape Agulhas Municipality
2011	Basic Assessment for the construction of a cellular mast.	Environmental Consultant	MTN (Pty) Ltd
2010-2011	Basic Assessment for the construction of a Heritage Centre.	Environmental Consultant	Waenhuiskrans Arniston Community Development Trust
2010-2011	Scoping and EIA for the rezoning of the area from open space to residential, the construction of six residential units and the upgrading of the existing Waste Water Treatment Plant.	Environmental Consultant	Private developer

Experience in undertaking the Socio-economic assessments

Date	Project Description	Role	Client
2018	Socio-economic assessment of the proposed development of the Kleinsee Wind Energy Facility and associated electrical infrastructure, Kleinsee, Northern Cape Province	Specialist	Juwi (Pty) Ltd
2017 – Ongoing	Strategic Environmental Assessment (SEA for a Phased Gas Pipeline Network and expansion of Electricity Grid Infrastructure (EGI) for South Africa – Socio-Economic and Planning Specialist	Specialist	National DEA, DOE, DPE, Transnet, iGas and Eskom
2017-Ongoing	Strategic Environmental Assessment (SEA for a the identification of Aquaculture Development Zones – Socio-Economic Specialist	Specialist	DEA and DAFF

		Speaking	*Reading*	*Writing*
Language capabilities	Afrikaans	Excellent	Excellent	Excellent
	English	Excellent	Excellent	Excellent

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Current employer:	CSIR Environmental Management Services
Position in Firm:	Senior Environmental Scientist and Assessment Practitioner
Years' experience:	4 yrs 9 mo
Specialisation:	Environmental Assessment and Management; Geographic Information Systems; Landscape & Urban Ecology

BIOSKETCH

Luanita commenced work at CSIR in January 2014, after completing a BSc. Botany-Zoology-Tourism, a BSc. Hons. in Environmental Science, as well as a MSc. in Environmental Science at the North West University, Potchefstroom Campus. She is pursuing an MSc. In Geographical Information Science at Vrije Universiteit Amsterdam, and is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (Reg. no. 400128/16).

Her work at the CSIR involves strategic environmental assessment and management, with a focus on Geographic Information System (GIS) analyses for environmental assessment and decision-making.

PROJECT TRACK RECORD

Completion	Description	Role	Client
In progress	Substantive amendment to the Environmental Authorisation of the Edison PV solar development.	Project manager and Environmental Assessment Practitioner.	29 Solar
In progress	Sustainable Development Goal Lab on "Africa's first Decision-Theatres".	Project manager	Future Earth
In progress	Strategic Environmental Assessment for Gas Pipeline Corridors and Electricity Grid Expansion.	Integrating Author and Editor: Biodiversity and Ecology	DEA
In progress	GEF funded biodiversity and land use projects	Project management, technical/specialist support, and mentoring	SANBI
In progress	Strategic Environmental Assessment Aquaculture Development in South Africa	Project member – Technical GIS and mapping	Department of Environmental Affairs
March 2018	Scoping and Environmental Impact Assessment for the proposed development of the Kap Vley Wind Energy Facility near Kleinzee in the Northern Cape	Specialist study: Aquatic Ecology	juwi Renewable Energies
March 2018	Scoping and Environmental Impact Assessment for the proposed development of a 100 MW Solar Photovoltaic Facility near Kenhardt in the Northern Cape Province	Specialist study: Visual Impact Assessment	juwi Renewable Energies
September 2017	Sustainable Development Goal Lab on "Mainstreaming resilience into climate change adaptation and disaster risk planning."	Project leader	Future Earth; Stockholm Resilience Centre; University of Tokyo (funders)
June 2017	Strategic Environmental Assessment for the development of Shale Gas in South Africa	Project officer	Department of Environmental Affairs
December 2017	Guidance for Resilience in the Anthropocene: Investments for development (GRAID) – African Cities.	Project member: Sustainability assessment guideline	Stockholm Resilience Centre (funder)
January 2017	Environmental and Social Impact Assessment for the Floating Liquid Natural Gas project near Kribi, Cameroon.	Project member – Technical GIS and mapping, ecology inputs	Golar
October 2016	Environmental Screening Study for the Giyani Waste Oil Boiler, Limpopo: Environmental management plan for the Hi-Hanyile essential oil distillery	Project manager	CSIR Enterprise Creation for Development

Completion	Description	Role	Client
September 2016	Scoping and Environmental Impact Assessment for 5 x 100 MW Solar PV facilities near Dealesville, Free State.	Project manager and Environmental Assessment Practitioner	29 Solar
June 2016	Environmental and Social Impact Assessment for the Bomono Early Field Development Project, Cameroon.	Project member - Technical GIS and mapping, ecology inputs	EurOil
May 2016	Scoping and Environmental Impact Assessment for the proposed Development of a 7 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Mulilo
April 2016	Scoping and Environmental Impact Assessment for the Proposed Development 3 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Scatec
April 2016	Strategic Environmental Assessment for identification of electricity grid infrastructure development corridors in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
February 2016	Environmental Impact Assessment for the development of 12 Solar PV projects near Dealesville, Free State.	Project member - Technical GIS and mapping, ecology inputs, stakeholder engagement	Mainstream Renewable Energy
September 2015	Environmental Screening Study for the Proposed Vaayu Energy SA Wind Energy Facility near Wesley, Eastern Cape	Project leader	Vaayu Energy
February 2015	Environmental Screening Study for Biochar- and Composting facilities in the Umzimvubu Catchment	Project member - Technical GIS and mapping & ecology inputs	Department of Environmental Affairs
March 2015	Strategic Environmental Assessment for identification of renewable energy zones for wind and solar PV projects in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
November 2014	Rapid environmental screening study for WASA wind monitoring masts (11-15) in the eastern cape, Kwazulu-Natal and Free State provinces, South Africa	Project member - Technical GIS and mapping	CSIR Built Environment
August 2014	Environmental Screening Study for the importation of Liquid Natural Gas into the Western Cape	Project member - Technical GIS and mapping, ecology inputs	Western Cape Government
March 2014	Environmental Screening Study for a Proposed LNG Terminal at Saldanha and associated pipeline infrastructures to Atlantis and Mossel Bay, Western Cape	Project member - Technical GIS and mapping, ecology inputs	PetroSA

PAST EMPLOYMENT RECORD

2014 - 2015 Environmental Scientist and Assessment Practitioner (Intern). Council for Scientific and Industrial Research – Environmental Management Services (EMS), Implementation Unit (IU) - Stellenbosch.

QUALIFICATIONS

2017 - current	MSc. Geographic Information Science	Vrije Universiteit, Amsterdam, Netherlands
2013	MSc. Environmental Science *(Cum Laude)*	North West University, Potchefstroom, South Africa
2010	BSc. Hons. Environmental Science	North West University, Potchefstroom, South Africa
2009	BSc. Botany- Zoology-Tourism	North West University, Potchefstroom, South Africa

SOFTWARE SKILLS

- ESRI Arcmap (adept)
- Microsoft Office (Word, Excel, Powerpoint, Visio, Project) (adept)
- Google Earth
- Vensim PLE
- ERDAS IMAGINE (basic)
- PostGreSQL (basic)

PEER REVIEWED PUBLICATIONS

Snyman-van der Walt, L., et al. Mainstreaming resilience into urban climate change adaptation and planning: the case of water management in the City of Cape Town. *In* Springer ebook on "Science for Sustainable Societies" (Book Chapter; In Preparation).

Schreiner, G.O., De Jager, M.J., Snyman-Van der Walt, L., Dludla, A., Lochner, P.A., Wright, J. G., Scholes, R.J., Atkinson, D., Hardcastle, P., Kotze, H., Esterhuyse, S. 2018. 'Evidence-based and participatory processes in support of shale gas policy development in South Africa'. *In:* Whitton, J., Cotton, M., Charnley-Parry, I.M. & Brasier, K. (*Eds*.) Governing Shale Gas: Development, Citizen Participation and Decision Making in the US, Canada, Australia and Europe. London, UK: Routledge.

Schreiner, G.O. & Snyman-van der Walt, L. 2018. Risk modelling of shale gas development scenarios in the central Karoo. *International Journal of Sustainable Development and Planning*, 13(2): 294-306.

Scholes, R.J., Schreiner, G.O. & Snyman-Van der Walt, L., 2017, 'Scientific assessments: Matching the process to the problem', *Bothalia,* 47(2), a2144. https://doi.org/10.4102/abc. v47i2.2144.

Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7

Burns, M., Atkinson, D., Barker, O., Davis, C., Day, L., Dunlop, A., Esterhuyse, S., Hobbs, P., McLachlan, I., Neethling, H., Rossouw, N., Todd, S., Snyman-Van der Walt, L., Van Huyssteen, E., Adams, S., de Jager, M., Mowzer, Z. and Scholes, B. 2016. Scenarios and Activities. In Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M.(*Eds*.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR.

Van Wilgen, B.W., Boshoff, N., Smit, I.P., Solano-Fernandez, S. & Van der Walt, L. 2016. A bibliometric analysis to illustrate the role of an embedded research capability in South African National Parks. *Scientometrics,* 107:185-212.

Van der Walt, L., Cilliers, S. S., Kellner, K., Du Toit, M.J., Tongway, D. 2014. To what extent does urbanisation affect fragmented grassland functioning? *Journal of Environmental Management*, 151, 517-530.

Van der Walt, L., Cilliers, S. S., Du Toit, M. J., & Kellner, K. 2014. Urban Ecosystems Conservation of fragmented grasslands as part of the urban green infrastructure : How important are species diversity, functional diversity and landscape functionality? *Urban Ecosystems*, 18(1): 87-113. DOI 10.1007/s11252–014–0393–9.

Van der Walt, L., Cilliers, S. S., Kellner, K., Tongway, D., & van Rensburg, L. 2012. Landscape functionality of plant communities in the Impala Platinum mining area, Rustenburg. *Journal of Environmental Management*, 113, 103–116. doi:10.1016/j.jenvman.2012.08.024. DOI: http://dx.doi.org/10.1016/j.jenvman.2014.11.034.

Breedt, J.A.D., Brewer, I., Coetzer, A., Van der Walt, L. & Cilliers, S.S., 2012. "Landskapsfunksionaliteit en plantdiversiteit in stedelike en landelike gefragmenteerde grasvelde in die Potchefstroom omgewing", *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 31(1), Art. #279, 1 page. http://dx.doi. org/10.4102/satnt.v31i1.279.

Van der Walt, L., Cilliers, S.S., Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. *South African Journal of Botany*. 77(2): 563.

CONFERENCES

Snyman-van der Walt, L. & Laurie, S. 2017. Sustainable Development Goals Lab: Mainstreaming resilience into climate change adaptation and disaster risk planning. 7th International Conference on Sustainability Science, Stockholm Sweden. 24 – 26 August 2017. TOdB: CSIR/IU/021MH/EXP/2017/0015/A

Snyman-van der Walt, L. 2017. Conference Presentation. GIS analysis and stakeholder input to identify strategic areas for aquaculture development: National Strategic Environmental Assessment for Aquaculture Development in South Africa; International Association for Impact Assessment - South Africa Conference, Worcester, 15 – 18 August 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0010/A

Snyman-van der Walt, L. 2017. Key results of the South African shale gas scientific assessment: science for policy and responsible decision-making. Conference Presentation at 2017 2017 Southern African Systems Analysis Centre Capacity Development Programme. Stellenbosch, 12 July 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0008/A.

Snyman-van der Walt, L. 2017. National Strategic Environmental Assessment for aquaculture development in South Africa: GIS analysis for identifying optimal areas for marine and freshwater aquaculture development presentation at World Aquaculture Conference, Cape Town, 26-30 June 201, TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0006/A.

Schreiner, G.O. & Snyman-van der Walt, L. 2017. Modelling social-ecological risks of shale gas development in the Central Karoo: key results of the South African shale gas scientific assessment. CSIR document number: CSIR/IU/021MH/EXP/2017/0005/A. Oral presentation at the American Association of Petroleum Geologists workshop on exploration and development of unconventional hydrocarbons: understanding and mitigating geotechnical challenges through conventional wisdom, Cape Town, South Africa, 20 June 2017.

Schreiner, G.O, Snyman-Van der Walt, L., Fischer, D. & Cape, L. 2017. Scenarios-based risk model for shale gas scientific assessment. Conference proceedings from the International Association of Impact Assessment International Conference 2017, Montreal, Canada. 4-7 April 2017.

Van der Walt, L., Cilliers, S.S., Du Toit, M.J. & Kellner, K. 2013. Conservation of fragmented grasslands as part of the green infrastructure: how important are species diversity, functional diversity, and landscape functionality? Oral presentation at the First Congress of SURE (Society of Urban Ecology), Berlin, Germany, 25-27 July 2013.

Van der Walt, L., Cilliers, S.S., Kellner, K. & Du Toit, M.J. 2012. Landscape functionality and plant diversity in urban and rural grassland fragments in the Tlokwe Municipal area, North-West, South Africa. Poster presentation at the 38th Annual South African Association of Botanists (SAAB) Conference, Pretoria, South Africa, 15-18 January 2012.

Van der Walt, L., Cilliers, S.S. & Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. Oral presentation at the 37th Annunal South African Association of Botanists (SAAB) Conference, Grahamstown, South Africa, 17-19 January 2011.

RELEVANT COURSES

2018
- GeoServices-4-Sustainability Summer School. Module: *Geo-Application Development* and Module: *Advanced Remote Sensing*, Eberswalde University for Sustainable Development, Germany.

2015
- Effective skills for dealing with challenging meetings, Conflict Dynamics (cc), CSIR Stellenbosch.
- Foundation Level Course in Science Communication and Working with the Media, CSIR, Stellenbosch.

2014
- CiLLA Project Management 1 Course, CSIR Stellenbosch.

2012
- Transboundary Protection of Biodiversity, North West University Law Faculty (South Africa) and Justig Liebig University (Germany), NWU Potchefstroom.

2010
- Control of alien invasive species, Centre for Wildlife Management, University of Pretoria.

PROFESSIONAL AFFILIATIONS/REGISTRATIONS

2015-current
- South African Council for Natural Scientific Professions (SACNASP), Professional Natural Scientist (Reg. no. 400128/16).

2014-current
- International Association for Impact Assessment (IAIA) South Africa (Membership Number: 3584)

2014-2015
- South African Council for Natural Scientific Professions (SACNASP), Candidate Professional Natural Scientist (Reg. no. 100276/14).

2011-2012
- South African Association of Botanists (SAAB)

HONOURS AND AWARDS

2017
- CSIR Implementation Unit Excellence Awards: Collaboration Award – Team Shale Gas Strategic Environmental Assessment.

2016
- CSIR Excellence Awards: Collaboration Award finalist – Team Shale Gas Strategic Environmental Assessment.

2015
- CSIR Implementation Unit Excellence Awards: Human Capital Development Award – Team Special Needs & Skills Development.
- Award: Best MSc Student in the Faculty of Natural Science, Potchefstroom Campus, North West University

2014
- Award: Best Masters Degree Student (S2A3 Bronze Medal) for Environmental Science and Technology, Potchefstroom Campus, North West University

2013	• Award: Mildred vd Merwe-Radloff Award for Best MSc Thesis – Botany, Potchefstroom Campus, North West University
2007-2013	• Golden Key International Academic Honours Association

LANGUAGE CAPABILITY

	Speaking	**Reading**	**Writing**
Afrikaans	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent