ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

DRAFT EIA REPORT

CONSTRUCTION OF THE SOLARRESERVE KOTULO TSATSI CONCENTRATED SOLAR PLANT 1, NORTHERN CAPE PROVINCE

DEA REFERENCE NUMBER: 14/12/16/3/3/2/694/1

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PROJECT DETAILS

DEA Reference Number	:	14/12/16/3/3/2/694/1
Title	:	Environmental Impact Assessment Process Draft EIA Report: Construction of the SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (CSP 1), Northern Cape Province
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PURPOSE OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Kotulo Tsatsi Energy, in a joint development venture with SolarReserve, proposes the development, construction and operation of a commercial solar thermal electricity generating facility (using a Central Receiver Tower and molten salt storage technology) and associated infrastructure, with a generation capacity of up to 200 megawatts (MW), located approximately 70km west of Kenhardt in the Northern Cape Province. The project known as the Kotulo Tsatsi 200MW Concentrated Solar Power Tower Plant 2, will now be known as the **SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (CSP 1).**

The site of the proposed CSP 1 project is situated within the Hantam Local Municipality which forms part of the Namakwa District Municipality, near to the boundary with the Kai-!Garib Local Municipality of the ZF Mgcawu District Municipality.

It is the developer's intention to bid the Proposed Project under the Department of Energy's (DoE) Renewable Energy Independent Power Producers Procurement (REIPPP) Programme or as part of any other Public Programme, privately owned entity, or Government entity. The power generated from the project facility will be sold to Eskom through a 20-30 year power purchase agreement (PPA) and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa.

As the project has the potential to impact on the environment, an Environmental Impact Assessment (EIA) process is required to be completed in support of an application for environmental authorisation. The Scoping Phase of the EIA process identified potential issues associated with the Proposed Project, and defined the extent of the studies required within the EIA Phase. The EIA Phase addresses the identified potential environmental impacts and benefits associated with all phases of the project including design, construction, operation and decommissioning, and recommends appropriate mitigation measures for potentially significant environmental impacts. The EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the Proposed Project.

The release of a draft EIA Report provides stakeholders with an opportunity to verify that the issues they have raised to date have been captured and adequately considered within the study. The Final EIA Report will incorporate all issues and responses prior to submission to the National Department of Environmental Affairs (DEA), the decision-making authority for the project.

INVITATION TO COMMENT ON THE DRAFT EIA REPORT

The Draft Environmental Impact Assessment Report for the proposed SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 is available for a 40- day public review and comment period at the following public places within the project area from 2 November 2015 – 12 December 2015.

» Kenhardt Public Library, Kenhardt
» Kai !Garib Local Municipality in Keimoes
» Hantam Local Municipality in Brandvlei

The report is also made available on:
» www.savannahSA.com

Please submit your comments to:
Gabriele Wood of **Savannah Environmental** P.O. Box 148, Sunninghill, 2157 Tel: 011 656 3237 Fax: 086 684 0547 Email: gabriele@savannahsa.com
The due date for comments on the Draft EIA Report is **12 December 2015**

Comments can be made as written submission via fax, post or e-mail.

EXECUTIVE SUMMARY: EIA REPORT

Introduction

South Africa has embarked on an infrastructure growth programme supported by various government initiatives, including but not limited to, the National Development Plan (NDP), the Presidential Infrastructure Coordinating Commission (PICC), the Department of Energy's Integrated Resource Plan (IRP) and National Strategy for Sustainable Development, the National Climate Change Response White Paper, the Presidency of the Republic of South Africa Medium-Term Framework and National Treasury's Carbon Tax Policy Paper. The need to expand electricity generation capacity in South Africa is based on national policy and informed by on-going strategic planning undertaken by the Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom. These efforts are in support of, among other sectors, the ever increasing, growing demand for energy, to find solutions for the current electricity shortages, as well as the need to find more sustainable and environmentally friendly energy resources.

To this end, Kotulo Tsatsi Energy, in a joint development venture with SolarReserve South Africa (Pty) Ltd, proposes the development, construction and operation of a commercial solar thermal electricity generating facility (using a Central Receiver Tower and molten salt storage technology) and associated infrastructure, with a generation capacity of up to 200 megawatts (MW), located approximately 70km west of Kenhardt in the Northern Cape Province. The project will be known as the **SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (CSP 1).** CSP 1 is proposed to form part of a larger Solar Park concept, consisting of a mix of solar technologies, including concentrated solar thermal and photovoltaic technologies. This EIA Report applies to the third of such potential projects, situated on Portion 3 of the Farm Styns Vley 280. The CSP 1 project has been allocated the DEA Reference Number: 14/12/16/3/3/2/694/1.

The site of the proposed project is situated within the Hantam Local Municipality which forms part of the Namakwa District Municipality, near to the boundary with the Kai !Garib Local Municipality of the ZF Mgcawu District Municipality.

Project infrastructure: The proposed CSP 1 project will have a total development footprint of approximately 1000 hectares and will include a central receiver tower, heliostat field, a power block including a steam turbine generator, auxiliary boilers, molten salt storage vessels / tanks and reticulation system, plant substation, power line, access roads, water supply point and supply pipeline, water storage tanks, water treatment plant, lined evaporation pond, workshop, plant assembly facility and laydown area, man camp and office buildings. The CSP Project will have an operational life of approximately 30 years.

Project Site selection: The Project is proposed to be situated on Portion 3 of the Farm Styns Vley 280 which was identified through the Scoping process as being suitable from an environmental perspective for a project of this nature. The larger project area was identified by the Developer as suited to the development of the Proposed Project due to the availability of the solar resource, proximity to a viable grid connection, support from the local municipality and willing landowner. Based on the outcomes of the Scoping evaluation, some areas of the larger study area were excluded (as potential no-go areas) and potentially more suitable areas were selected for further investigation through the EIA. Therefore, a funnel-down approach to site identification was followed in order to allow environmental sensitivity to inform the siting and preliminary layout design of the proposed project. This was further informed during the EIA by way of the specialist field investigations. This allowed for the larger study area to be divided into representative segments within which the smaller Project Sites could be defined within which additional and stand-alone CSP projects are proposed to be developed by SolarReserve and Kotulo Tsatsi Energy, with the intention that the potential environmental and social impacts be contained or consolidated to a smaller area of the larger study area. CSP 1 is proposed to be on one such segment, The proposed CSP 1 project is located south east of the first proposed CSP Project, known as the SolarReserve Kotulo Tsatsi Concentrated Solar Plant, for which an Environmental Authorisation was granted in September 2015.

The development site which showed a low impact to the environment was considered within the more detailed EIA Phase which was further informed by way of the specialist field investigations. For the CSP 1 project, based on the land capability of the greater farm portion an area of approximately 1586ha in extent was identified for specialist assessment, which allowed for the identification of specific environmental sensitive areas/receptors to be avoided and/or mitigated by the ~1 000ha project development footprint. Therefore, the approach adopted during site selection allowed for the avoidance of site sensitivities (following the mitigation hierarchy) by the ~1000ha project development footprint.

Areas of assessment: The potential impact and appropriate siting of the infrastructure within the larger site and infrastructure proposed to be constructed outside of the site boundaries has been informed by several field verified EIA phase specialist studies as listed in Table 5.2 of this report. Where relevant, EIA phase specialist studies have been undertaken to assess impacts specifically relating to the development of the proposed CSP 1 project. All infrastructure relating to CSP 1 was assessed within the relevant specialist studies, including:

» The proposed CSP project site (within a 1586 ha assessment area located within the broader study area)
» The power line corridor (within a 1 km corridor)
» The water pipeline servitude (to be aligned within existing road reserves and for which two alignments were considered)

Alternatives: The following alternatives were identified for the proposed CSP 1 facility and have been assessed in this report:

» Site and location alternatives
» Water supply pipeline alignment alternatives

Project access: The Project Site is regionally accessible via the R27 with local access via the Soafskolk Road (provincial gravel road) which is currently utilised by landowners surrounding the Proposed Project Site. The Soafskolf Road will provide access to all CSP Projects proposed to be developed. Use of the road and potential security concerns during the construction phase was identified as the most significant issue to neighbouring landowners and farmers. Stakeholder and landowner consultation meetings were held on 29 and 30 April 2015 and the Northern Cape roads authority was also consulted through a stakeholder meeting. Access to the site from Soafskolk Road will be provided via a new access road to be constructed. The road will be approximately 2.5km in length and 8m in width as described in Section 3.3 of this report.

Grid connection: Direct grid connection for the project is readily available via the Aries – Helios 400kV power line based on preliminary discussions with Eskom. An assessment of a 1km corridor along the existing power line has been undertaken for the construction of a power line to connect at Aries Substation, should such a direct grid connection be determined not to be feasible later in the planning process, or be refused by Eskom. For the scenario requiring the development of a new 132 kV power line from the project site to Aries Substation, the opportunity to align the power line parallel to the existing power line within a common corridor exists and few issues of significance were identified within the corridor which cannot be readily mitigated through avoidance of the impact.

Water supply and conveyance: Water can be readily supplied to the project during the construction and operational phases. The project requires approximately 250 000m^3 of water per annum during the operational phase. The Kai !Garib Local Municipality has issued a letter to the applicant confirming the availability of water supply (refer to Appendix C). The water supply scheme for this project is therefore supported by the Kai !Garib Local Municipality and water will be transferred directly from the Kenhardt Reservoir to the Project Site.

Water from the purification works in Lennertsville is currently conveyed via the existing water pipeline to the municipal Kenhardt Reservoir. It is from this point that water will be conveyed to the Project Site via the proposed new water pipeline. Two alignment alternatives have been considered, both of which, from the starting point at the Kenhardt Reservoir to the Project Site, are proposed to be located in existing road reserves, either in the reserve of the R27, or the reserve of the service road of the Saldanha – Sishen railway line. Both routes are similar in length and pass through similar environments, and are considered to be environmentally acceptable. There is no environmental preference regarding the pipeline routes, as long as mitigation measures are implemented.

Ecological sensitivity: The proposed project site is comprised predominantly of the mixed shrubland vegetation association ascribed to have a low ecological sensitivity. Localised areas of sensitivity were identified and are associated with valley bottom habitat and ephemeral drainage lines. A biodiversity offset has been proposed to accommodate for the cumulative ecological impacts on broad scale ecological processes (refer to Appendix F). The proposed development on the site will create a highly localised reduction of indigenous shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. .

At the request of the DEA (Item xvii of the Acceptance of Scoping Letter attached in Appendix B), the scope of the ecological specialist study was expanded to include the Ecological Support Area (ESA) identified during the EIA to occur as a faunal migration corridor to the south-west of the CSP 1 Project Site (as discussed in Section 6.7 of this report). The Northern Cape conservation authorities were approached to assist in the drafting of the ecological study terms of reference (refer to minutes in Appendix D7). The sensitive vegetation associations considered to play a role in the movement of small animal species occurring within the migration corridor area have been flagged as no-go areas and are avoided by the location of the CSP 1 project The confirmed/observed faunal migration corridor is situated to the west and well outside of the project footprint and is aligned primarily with drainage lines depicted as no-go features. This corridor supersedes that which is denoted as an Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan however to accommodate cumulative loss a proposal for a biodiversity offset has been prepared (Appendix F)

Avifauna: Potential avifaunal issues identified relate to disturbance, habitat alteration, the impact of solar flux (resulting in singed feathers or mortality) and collision with the power line infrastructure. A specialist avifaunal study was undertaken to determine the potential construction and operational impact of the proposed project on avifauna and, at the request of the DEA (Item xviii of the Acceptance of Scoping Letter attached in Appendix B2), the scope of the study was expanded to include seasonal variation, technology comparisons and relationship to the aforementioned migration corridor. An experienced and independent avifauna specialist undertook the avifauna assessment for the project. The specialist ensured that the monitoring programme included a wet season survey as well as a dry season survey, which is considered relevant for the Northern Cape. The approach to the assessment of avifauna considered and in fact exceeded the requirements as stated in the draft Guidelines to Minimise the Impact on Birds of Solar Facilities and Associated Infrastructure in South Africa, published by Birdlife South Africa. The avifauna assessment met the requirement of the Guideline that monitoring for CSP facilities should take into account seasonal variation in that on-site avifaunal monitoring was undertaken in both the dry season in September 2014 and the wet season in March 2015 (as is relevant in the Northern Cape). The avifauna on-site monitoring was undertaken for 12 days in each season (wet and dry seasons), which exceeds the 3-5 day requirement as stated in the Guideline. The fieldwork methods involved walking of sixteen 1km transects in September 2014 and nine 1km transects in March 2015 during bird-active hours in all major habitat types within the broader study area. The total number of species recorded during both surveys is considered to be low with slightly more species occurring in the wet season (48) than the dry season (42). Species of conservation importance identified as potentially being at risk of the effects of solar flux are Martial Eagles, for which a single nest was identified, and around which a buffer of 3km is prescribed. An alternative site for CSP 1 within the larger Solar Park concept was identified due to its original proximity to the nest. Species of conservation importance identified as potentially being at risk of the power line are Kori Bustard and Ludwigs Bustard. Potential avifaunal impacts have been addressed in the current layout and further monitoring is recommended to minimise the potential impact on avifauna.

Agricultural potential and land use: No agricultural potential or land use conflicts on the Project Site have been identified and all land use issues are resolved by the current layout. The region displays an arid climate suited to the use of the land for sheep farming, with no cultivated agriculture occurring on or in close proximity to the Project Site. The potential agricultural impact is assessed in Section 7.6 and in Appendix J, and apart from occupation of the site by the proposed infrastructure, indicates an overall low agricultural impact.

Water resources: The arid climate contributes to the low sensitivity of surface water resources in the area and the impact of constructing the proposed project within the drainage line has been assessed to be low (Section 7.5 and Appendix I). The results of the groundwater study (Appendix I) show that groundwater is considered to be of unsuitable yield and quality for use by the proposed CSP 1 Project. As stated above, water will be supplied directly from the municipality to service the construction and operational needs of the project.

Social: The proposed development supports the social and economic development through enabling skills development and training in order to empower individuals and promote employment creation within the local area. The development would mainly focus on economic benefits to the area and introduce a new industry into the local economy. Negative dimensions of impacts such as influx of jobseekers into the area putting pressure on the provision of basic services and poverty levels has been weighed in the impact The proposed CSP plant and associated infrastructure is unlikely to result in permanent damaging social impacts. From a social perspective it is concluded that the project could be developed subject to the implementation of the recommended mitigation measures and management actions contained in the Social Impact Assessment (Appendix Q).

Economic: The Proposed Project has been assessed be of high positive significance in terms of its contribution to the development of the economy at a local to a national level, assessed in detail in the Economic Impact Assessment (Appendix R).

Heritage: The impacts to heritage resources by the proposed development are not considered to be highly significant and the impact on archaeological sites is acceptable if the recommendations made by the Heritage Specialist are adhered to. Subject to approval from SAHRA, HCAC is of the opinion that from an archaeological point of view there is no reason why the development should not proceed if the recommendations are implemented.

The identified environmental sensitivities identified as occurring on the Project Site and the project layout plan have been overlaid onto a composite sensitivity map in Figure 1, in terms of which the following is relevant:

Infrastructure siting within the project site

» The project development footprint is located adjacent to an existing linear disturbance in the area, Soafskolk Farm road and within 3km of another linear disturbance - the Aries–Helios 400kV power line thereby making use of already disturbed areas rather than pristine sites which is found to be acceptable from an environmental perspective.
» The outer edge of the heliostat field is positioned outside the 3km avifauna buffer zone around the Marial Eagle nest. The power tower is situated approximately 4.5km from the martial eagle nest therefore the position of the heliostats and tower are found to be acceptable from an environmental perspective.
» The heliostat field infringes an area of sensitive wash and valley bottom habitat, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development. To offset the cumulative impact on broad scale ecological processes the ecological specialist recommends that a biodiversity offset be implemented as part of the authorisation conditions (Appendix F).
» The proposed grid connection is located adjacent to an existing linear disturbance in the area, Soafskolk Farm road and adjacent to another linear disturbance - the Aries–Helios 400kV power line. Therefore the location of the powerline is consolidated as much as possible with other linear infrastructure and makes use of already disturbed areas rather than pristine sites, which is found to be acceptable from an environmental perspective.
» An access road of ~1km in length branching off Soafskolk Road will be required to access the heliostat field after providing access to the administration block and project substation.
» The temporary laydown area (100ha), temporary assembly plant (100ha) and spoil area are situated north east of the heliostat field thereby located outside

areas of environmental sensitivity which is found to be acceptable from an environmental perspective.

- The evaporation pond is required to be situated at the lowest point of the site in order to be gravity fed i.e. southern section of the site. The evaporation pond is situated well away (>100m) from any ephemeral drainage line, and in an area of low groundwater contamination risk. The location of the evaporation pond is outside areas of environmental sensitivity which is found to be acceptable from an environmental perspective.

Environmental sensitivity impact statement

- The assessed ecological impacts are considered acceptable loss for a single project. However, as cumulative impacts are a concern in the area as the development of several solar plants in close proximity to one another would result in large tracts of transformed land which would potentially disrupt landscape connectivity in the area, a biodiversity offset proposal has been prepared (refer to Appendix F). The biodiversity offset is justified firstly on account of an area of sensitive wash and valley bottom habitat within CSP 1, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development; and secondly on the total footprint of the development (~1000ha) and the potential cumulative impact on broad-scale ecological processes (i.e. that more than one facility could be developed)..
- The confirmed/observed faunal migration corridor is situated to the west and well outside of the project footprint and is aligned primarily with drainage lines depicted as no-go features. This corridor supersedes that which is denoted as an Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan however to accommodate cumulative loss a proposal for a biodiversity offset has been prepared (Appendix F).
- The recommended 3km avifauna buffer zone around the martial eagle nest identified at the top of a power line tower structure has been mapped. This buffer zone does not overlap with the project development area and the martial eagle nest is situated approximately 4.5km from the power block (tower). Typically birds are at greater risk of succumbing to the effects of solar flux (singed feathers) within 100m from the tower. The evaporation pond (which could potentially be viewed by birds as an artificial waterbody thereby attracting them in the vicinity of power lines and the central receiver) has been sited appropriately in accordance with specialist recommendations to mitigate the potential for placing birds at risk from collision with power lines and at risk from the effects of solar flux in proximity to the central receiver.
- No heritage find spots are located within the CSP 1 development footprint. Two find spots within the power line corridor and two other find spots within the R27 water pipeline alignment option will not be directly affected by the facility layout.
- No noise sensitive developments are mapped within 3km of the project site.

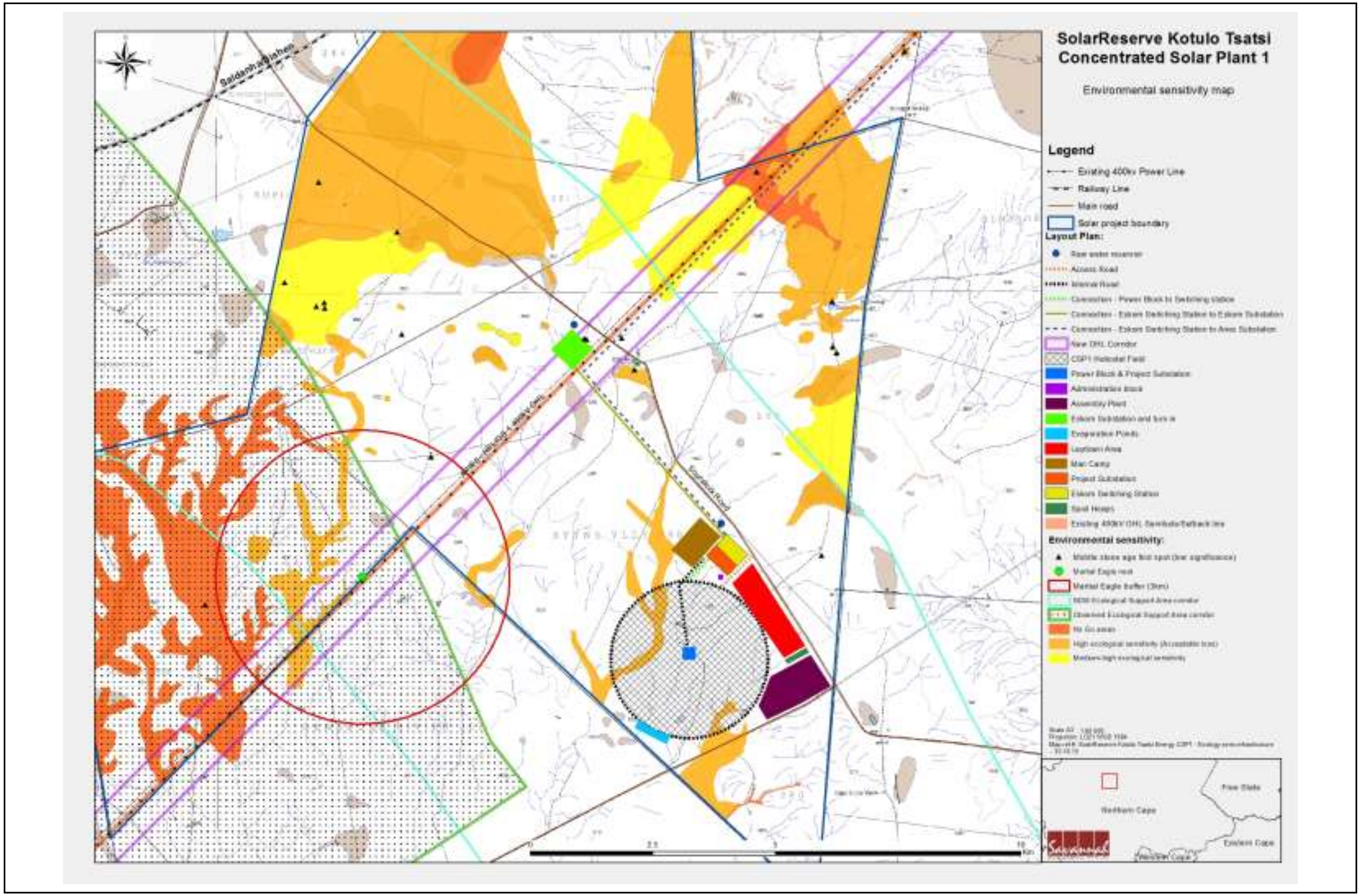

Figure 1: Combined Layout and Composite Environmental Sensitivity Map for the proposed CSP 1 Project

Biodiversity Offset
Due to loss or disturbance of an area of sensitive wash and valley bottom habitat within CSP 1 and to accommodate cumulative loss from the proposed broader development a proposal for a biodiversity offset has been prepared. The Applicant has, in consultation with an Ecological specialist, developed a draft biodiversity offset implementation plan (refer to Appendix F). This plan provides a summary of the legislative background for such an activity and provides guidelines and recommendations as to how this might occur and identifies actions that should occur in order to drive this process forward so that the Applicant can meet their commitments in this regard. The biodiversity offset implementation plan will be submitted to the DENC (and DEA) for their consideration and input.

Conclusions

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated from the proposed project conclude that the significance levels of the majority of identified negative impacts can be reduced by implementing the recommended mitigation measures. The confidence in the environmental assessment undertaken is acceptable. Taking into consideration the above and based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated infrastructure, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the impacts associated with the development of the proposed SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 can be managed and mitigated to an acceptable level. The information provided as part of the EIA process, and specifically within this EIA report, is sufficient to enable the DEA to make an informed and defendable decision. The layout plan as presented in this report has been informed by the findings of the specialist studies. The facility in its current position results in an acceptable level of loss and is considered to be the preferred layout and environmentally acceptable.

The following conditions would be required to be included within an authorisation issued for the project:

Facility layout and design

» Any component of the facility which could potentially affect areas to be of no-go environmental sensitivity should be avoided in the design and layout of the CSP Project.
» The observed Ecological Support Area (terrestrial fauna migration corridor) defined in terms of the ecological specialist study traversing a section of the larger study area in the ecological study, should be kept free of development where possible. It is recommended that faunal monitoring be undertaken should multiple projects within the larger study area be approved.

Pre-construction

- » A Search-and Rescue program will be required to be implemented to relocate protected species found on the Project Site. Permits are to be obtained for removal of protected trees and provincially protected flora that are affected by development.
- » An ecological walk through survey for the CSP Project and associated infrastructure must be undertaken prior to construction.
- » A stormwater management plan should be compiled for the developmental footprint prior to construction.
- » An avifaunal monitoring programme is required to be developed stipulating monitoring protocols and allowing for quantification of species mortality. Mitigating measures to be developed based on the programme.
- » A walk-through survey should be undertaken by an avifauna specialist for the route of the power line (for loop in – loop out scenario and new power line scenario) to identify sections of line (existing or new) requiring collision mitigation.
- » A Water Use Licenses for identified water uses (storage, abstraction and impacting of water courses) is required to be obtained from DWS.
- » A heritage walkthrough of the final layout of the CSP 1 facility is conducted prior to construction
- » Although the water pipeline and powerline corridor options are acceptable from a heritage point of view it is clear that Stone Age manifestations, graves and possibly engravings can be expected in the proposed corridors and it is therefore recommended that when the final option is determined that the alignment and pylon positions are subjected to a heritage walk through
- » A draft biodiversity offset management plan to be developed, in consultation with the Provincial Conservation Authority (DENC).
- »

Construction

- » During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.
- » Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
- » All mitigation measures detailed within this report and the specialist reports are to be implemented.
- » The draft Environmental Management Programme (EMPr) as contained within Appendix S of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed solar energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the Proposed Project is considered key in achieving the appropriate environmental management standards as detailed for this project.

» If during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find
» Approved biodiversity offset management plan to be implemented, in consultation with the Provincial Conservation Authority (DENC)

Operations

» Avifaunal deterrence measures should be implemented at the CSP Project as identified and recommended by the Avifaunal Specialist. It is proposed that an avifaunal monitoring programme for operations be developed to establish the efficacy of deterrence measures and whether any further mitigation measures are required.
» Disturbed areas need to be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species for the operation phase.
» The operational phase EMPr must be implemented and used to ensure compliance with environmental specifications and management measures
» Approved biodiversity offset management plan to be implemented, in consultation with the Provincial Conservation Authority (DENC

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APPENDICES

ABBREVIATIONS AND ACRONYMS

BID	Background Information Document
CO_2	Carbon dioxide
CSP	Concentrated Solar Power
DENC	Department of Environment and Nature Conservation
DEA	National Department of Environmental Affairs
DoE	Department of Energy
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GDP	Gross Domestic Profit
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GHG	Greenhouse Gases
GWh	Giga Watt Hour
Ha	Hectare
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IPP	Independent Power Producer
km^2	Square kilometres
kV	Kilovolt
MAR	Mean Annual Rainfall
m^2	Square meters
m/s	Meters per second
MW	Mega Watt
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NGOs	Non-Governmental Organisations
NWA	National Water Act (Act No. 36 of 1998)
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework
SKA	Square Kilometre Array

DEFINITIONS AND TERMINOLOGY

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

Base load: Base load requirement is the minimum level of demand on an electrical supply system over 24 hours. Base load power sources are those plants which can generate dependable power to consistently meet that minimum demand

Concentrated Solar Power: Solar generating facilities use the energy from the sun to generate electricity. Concentrated Solar Power facilities collect the incoming solar radiation and concentrate it (by focusing or combining it) onto a single point, thereby increasing the potential electricity generation.

Commercial Operation Date: The date after which all testing and commissioning has been completed and is the initiation date to which the seller can start producing electricity for sale (i.e. when the project has been substantially completed).

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

Commissioning: Commissioning commences once construction is completed. Commissioning covers all activities including testing after all components of the CSP Project are installed.

Construction: Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity. Construction begins with any activity which requires Environmental Authorisation.

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

Decommissioning: To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned. This usually occurs at the end of the life of a facility.

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

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

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

Emergency: An undesired/ unplanned event that results in a significant environmental impact and requires the notification of the relevant statutory body, such as a local authority.

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

Environment: the surroundings within which humans exist and that are made up of:

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

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

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

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

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

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

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

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

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

Interested and Affected party: Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups, and the public.

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

No-go areas: Areas of environmental sensitivity that should not be impacted on or utilised during the development of a project as identified in any environmental reports.

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

Pre-construction: The period prior to the commencement of construction, this may include activities which do not require Environmental Authorisation (e.g. geotechnical surveys).

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

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

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

Square Kilometre Array: a radio telescope project to be built in South Africa and Australia which would have a total collecting area of approximately one square kilometre. It will operate over a wide range of frequencies and its size will make it 50 times more sensitive than any other radio instrument operational. Within the Northern Cape, the SKA the core of the SKA will be constructed approximately 80km from Carnarvon in the Karoo.

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

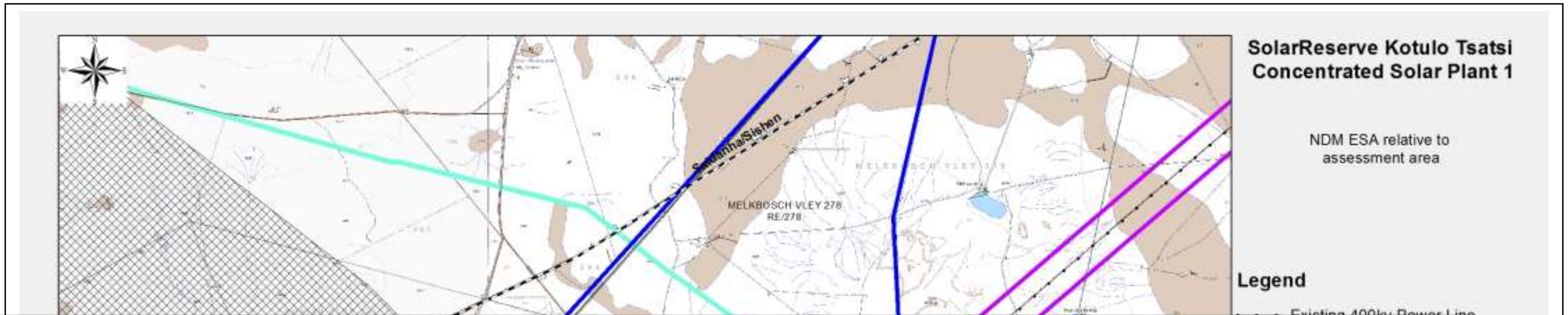
INTRODUCTION CHAPTER 1

Kotulo Tsatsi Energy, in a joint development venture with SolarReserve South Africa (Pty) Ltd (hereafter referred to as SolarReserve Kotulo Tsatsi, or the Developer), proposes the development, construction and operation of a commercial solar thermal electricity generating facility (using a Central Receiver Tower and molten salt storage technology) and associated infrastructure, with a generating capacity of up to 200 megawatts (MW), located approximately 70km west of Kenhardt in the Northern Cape Province. The project will be known as the **SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (or CSP 1).**

The site of the SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (the project) is situated within the Hantam Local Municipality which forms part of the Namakwa District Municipality, near to the boundary with the Kai !Garib Local Municipality of the ZF Mgcawu District Municipality.

The project is proposed to be located within a larger solar park concept, consisting of a mix of solar technologies, including concentrated solar thermal and photovoltaic technologies.

This EIA Report applies to the CSP tower project, situated on Portion 3 of the Farm Styns Vley 280. The proposed CSP 1 project has been allocated the DEA Reference Number: 14/12/16/3/3/2/694/1. The proposed CSP 1 project study area (Figure 1.1) is 1586 ha within the larger 20 700 ha study area considered within the scoping phase (as illustrated in Figure 1.2).


SolarReserve Kotulo Tsatsi
Concentrated Solar Plant 1
NDM ESA relative to
assessment area
Legend
Saldanha/Sishen
MELKBOSCH VLEY 278
RE/278

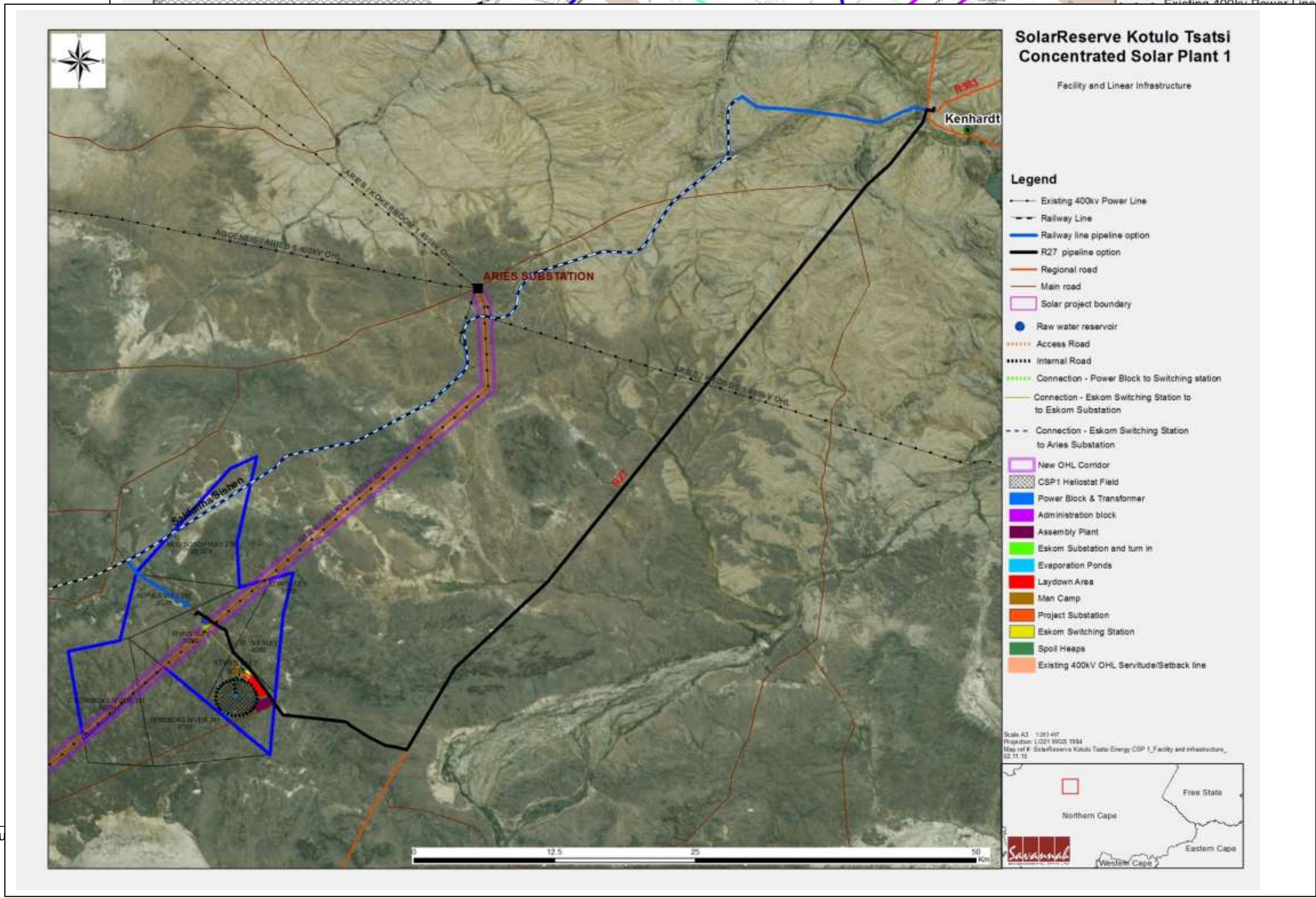

SolarReserve Kotulo Tsatsi
Concentrated Solar Plant 1
Facility and Linear Infrastructure
Kenhardt
R383
ARIES SUBSTATION
R27
Saldanha/Sishen
Legend
Existing 400kv Power Line
Railway Line
Railway line pipeline option
R27 pipeline option
Regional road
Main road
Solar project boundary
Raw water reservoir
Access Road
Internal Road
Connection - Power Block to Switching station
Connection - Eskom Switching Station to
to Eskom Substation
Connection - Eskom Switching Station
to Aries Substation
New OHL Corridor
CSP1 Heliostat Field
Power Block & Transformer
Administration block
Assembly Plant
Eskom Substation and turn in
Evaporation Ponds
Laydown Area
Man Camp
Project Substation
Eskom Switching Station
Spoil Heaps
Existing 400kV OHL Servitude/Setback line
Free State
Northern Cape
Eastern Cape
Western Cape
0
12.5
25
50
Km

Figure 1.1: Locality map showing the assessment area for the proposed site for the construction and operation of the CSP 1 Project within the broader study area, the water pipeline and power line corridor parallel to the existing Aries – Helios 400kV power line

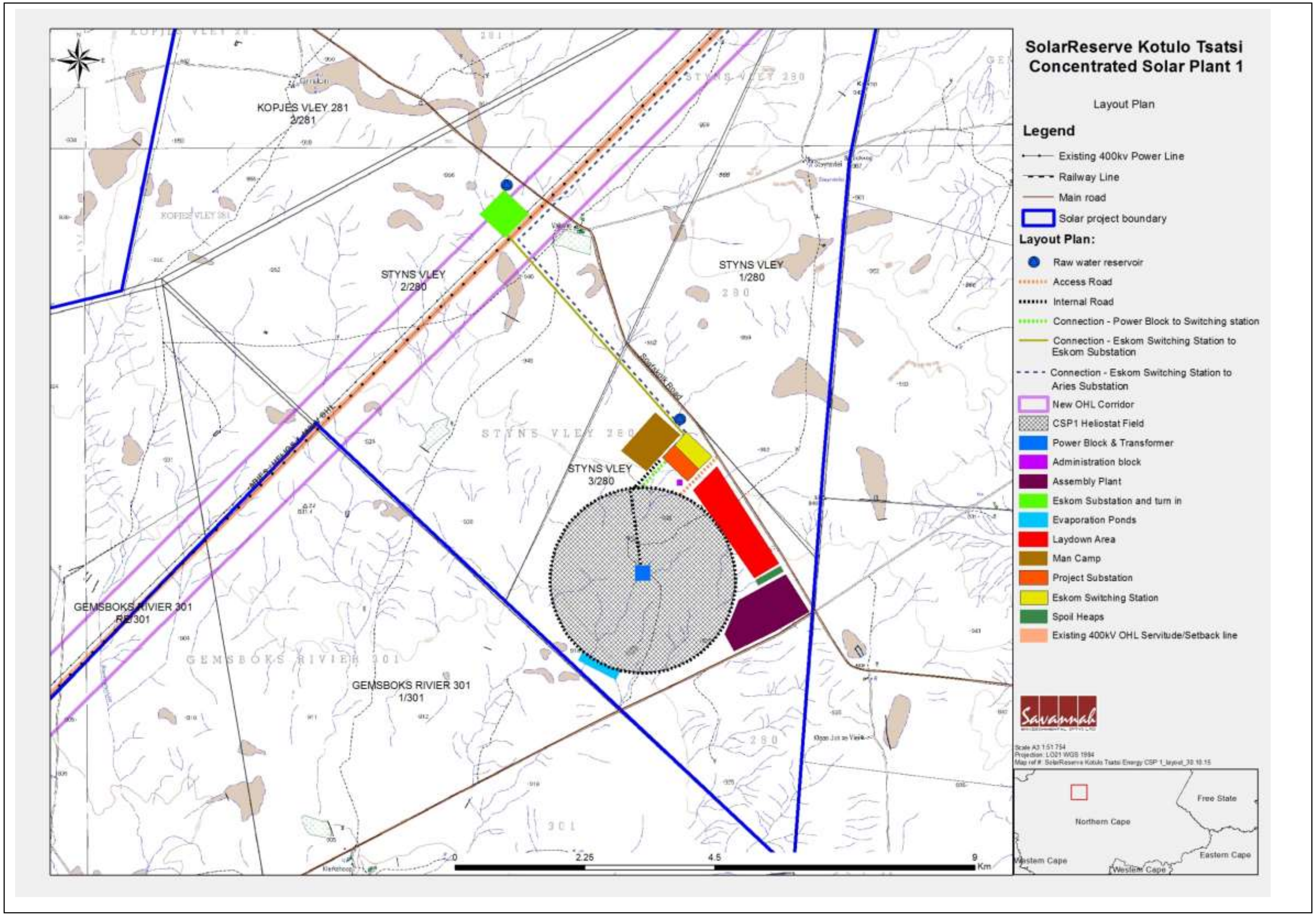


Figure 2.2: Locality map showing the proposed CSP 1 Project layout on Portion 3 of the farm Styns Vley 280elative to the broader study area

In terms of the Environmental Impact Assessment Regulations, 2010 (Government Notice No. R.544 of 18 June 2010), promulgated under Sections 24 and 24D of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998), various aspects of the Project are listed as activities that may have a detrimental impact on the environment. An Environmental Impact Assessment process is required to be completed in support of an application for Environmental Authorisation prior to the commencement of construction of the project. The Department of Environmental Affairs (DEA) is the competent authority (CA) charged with issuing a decision in respect to the Proposed Project.

A single Scoping Report which considered the construction of multiple CSP Projects, with a cumulative generating capacity of up to 1000MW, was submitted to the DEA in September 2014 and was accepted by the DEA in November 2014. Applications for each of the proposed CSP Projects were submitted to the DEA and each has been allocated a separate reference number by the DEA. Each CSP Project is consequently required to be assessed separately.

This Draft EIA Report assesses this Proposed Project and consists of ten chapters, which include:

» **Chapter 1** provides background to the Project and the environmental impact assessment, and an introduction to the rationale behind the selected site and technology proposed.
» **Chapter 2** outlines the strategic legal context for the energy planning and the Project.
» **Chapter 3** provides a description of the Proposed Project, including detail on the construction, operation and decommissioning phases, as well the need and desirability for the Project.
» **Chapter 4** provides details of the alternatives considered for the Project.
» **Chapter 5** outlines the approach to undertaking the environmental impact assessment process.
» **Chapter 6** describes the existing biophysical and socio-economic environment affected by the Project.
» **Chapter 7** provides an assessment of the potential issues and impacts associated with the Project and presents recommendations for mitigation of significant impacts.
» **Chapter 8** provides an assessment of cumulative impacts.
» **Chapter 9** presents the conclusions and recommendations based on the findings of the EIA.
» **Chapter 10** provides references used to compile the EIA Report.

1.1. Background to the Proposed CSP 1 Project

The proposed CSP 1 Project will utilise concentrated central receiver tower and molten salt storage technology to generate electricity and will have a generating capacity of up to 200MW. In order to generate electricity, the sun's rays are concentrated onto a central receiver via a heliostat field, allowing for the heating of molten salts, which in turn are used to superheat steam and drive a steam turbine generator. It is envisaged that the facility will be operated as a base load power generating plant which will feed the generated energy directly into Eskom's national power grid. Depending on Eskom's connection strategy, the CSP Project will connect to the national grid through direct connection to existing Aries – Helios 400kV power line traversing the greater study area, or via a new 132kV power line from the project on-site switching station to the Eskom Aries Substation (located approximately 50km north east of the Project Site). The proposed facility will make use of dry cooling technology. Raw water to the facility is proposed to be supplied by the Kai !Garib Local Municipality via a water pipeline to be constructed within the reserve of existing roads between the Kenhardt water reservoir (located in the town of Kenhardt) and the project reservoir.

A brief need and desirability description in terms of the project location and technology is provided below and further information regarding the need and desirability of the Project is provided in Chapter 3. A complete and detailed project description is also provided in Chapter 3.

Site selection: Why is this development proposed within this area (desirability factors)?

» The Northern Cape has the best solar resource in South Africa. Based on solar irradiation monitoring results undertaken on site, the project area is highly suited to the development of a CSP Project.
» The Project Site is situated south of Aries-Helios 400kV power line and approximately 50km from the Eskom Aries Substation. Various grid connection options are being considered to facilitate connection to the Eskom grid, including the construction of new overhead power lines adjacent to the Aries-Helios 400kV power line, and a loop in and loop out of this power line (potentially feasible based preliminary discussions with Eskom). For the scenario requiring the development of the 132kV power line, the opportunity to align the power line parallel to the existing power line within a common corridor exists.
» The Project Site is situated within a focus area (central corridor) of the Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) currently being undertaken by Eskom[1]. Various grid strengthening and expansion projects are also

[1] Eskom has identified five 100km-wide corridors where its future transmission lines will link power-generating capacity with substations, transformers and electricity users. This is based on long-range forecasts of future

being proposed by Eskom in the near vicinity of the Proposed Project area. These include the proposed Aries-Helios 765kV Transmission Power Line Project (DEA Ref. 14/12/16/3/3/2/441) and the authorised 400/50kV Eskom Substation between the Aries and Helios Substation on the Farm Moutonsvlei 1615 (DEA Ref. 12/12/20/1167).

» The Project Site is located in a very remote area of the country potentially reducing the visual (and cumulative visual) impact of this project and any potential future projects.
» The Project Site is situated in a very arid environment which is not considered optimal for agricultural land use activities having low grazing value. Overall agricultural potential of the Project Site is very low, largely restricted by the arid climate and shallow soils.
» The gradient of the land is <1%, making it ideal for CSP Project construction and operation, which requires a relatively flat surface.

Technology selection: Why consider CSP Tower Technology?

For Round 3 and 4 of the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, the Department of Energy (DoE) provided an incentive for renewable energy projects being able to contribute to peak power generation, specifically being able to generate between the hours of 16:30 and 21:30, i.e. requiring at least 5 hours of energy storage for electricity generation to continue after the sun has set (i.e. the primary energy source lost), and operate under a base load power generating plant regime.

CSP technology, through molten salt energy storage, represents an optimal technology choice to meet the energy storage requirements of the DoE for subsequent rounds and deliver the greatest value to the country as a whole through socio-economic development being created and least-cost impact on the electricity consumer. It is envisaged that the facility will be operated as a base load power generating plant. Therefore the Project is considered a preferred technology option, from a technical, financial and socio-economic perspective. Environmental feasibility as well as potential impacts of the project is determined further in this EIA report.

supply and demand requirements. The SEA is advising on the best possible route for power lines within these corridors.

Project details: What is proposed for the CSP Project?

The project is proposed to utilise central receiver (tower) including heliostat technology, a molten salt storage system, dry cooling and a conventional steam generator system to generate power. The facility will have an energy storage capacity of up to 12 hours (provided by molten salts technology) dependent on the final model and design of the system.

A solar tower system comprises of a heat collection system and a conventional electricity generation plant portion. The solar tower is erected inside the heliostat field. The heat collection system consists of heliostats (thousands of movable, flat reflective mirrors which are oriented according to the sun's position in order to capture and reflect the solar radiation) and a receivers (consisting of metal tubes which transfer the heat from the solar radiation to water or molten salt with the purpose of generating steam). The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver situated on top of the tower. The tower is 200m in height providing elevation and structurally supporting the receivers which are 50m in height and situated atop the tower – ultimately making the central receiver tower approximately 250m high. The concentrated sunlight within the receiver, heats the molten salt up to 565 °C, which then flows into a storage tank system. The collected energy in the solar tower is used to generate steam through a conventional heat exchanger system that is in turn used for electricity generation in a conventional steam turbine and generator.

This generation process, also known as the "Rankine cycle", is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

The total construction and development costs of the plant are estimated at approximately R 11.9 billion (equivalent to US$1billion). The scope of the Project, including details of all elements of the project (for the design/planning, construction, operation and decommissioning phases) is discussed in detail in Chapter 3.

1.2. Details of the Environmental Assessment Practitioners and Specialist Team

Savannah Environmental was contracted as the independent EAP to undertake both Scoping and EIA Phases for the propose projects. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of or are affiliated to Kotulo Tsatsi Energy or SolarReserve in any way. Furthermore, Savannah Environmental does not have any interests in secondary developments that could arise out of the authorisation of the Project.

Savannah Environmental is a specialist environmental consulting company providing holistic environmental management services, including environmental impact assessments and planning to ensure compliance and evaluate the risk of development, and the development and implementation of environmental management tools.

Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team. The Savannah Environmental team have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation. Reporting and project management of this phase of the EIA process has been undertaken by:

» *Karen Jodas,* is a Professional Natural Scientist and holds a Master of Science degree and is the registered EAP on the Proposed Project. She has 17 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development.
» *Michelle Moodley* holds an Honours degree in Environmental Science and has 4 years of experience in environmental management. She has undertaken EIAs for various proposed solar energy facilities and various other infrastructure projects in South Africa.
» *Sheila Muniongo* holds an Honours Bachelor degree in Environmental Management and 4 years of experience in the environmental field. Her key focus is on environmental impact assessments, public participation, environmental management programmes, and mapping through ArcGIS for variety of environmental projects. She is currently involved in several EIAs for renewable energy projects EIAs across the country
» *Gabrielle Wood* holds an Honours Degree in Anthropology, obtained from the University of Johannesburg. She has 8 years consulting experience in public participation and social research. Her experience includes the design and implementation of public participation programmes and stakeholder engagement strategies for numerous integrated development planning and infrastructure projects.

In order to adequately identify and assess potential environmental impacts associated with the proposed project, the following specialist sub-consultants have provided specialist input into this EIA report:

» Ecology (flora, fauna) – Marianne Strohbach (Savannah Environmental) and Simon Todd (Simon Todd Consulting)
» Avifauna – Rob Simmons (Birds Unlimited)
» Surface water and ground water – Martiens Prinsloo (Future Flow) Thabile Mgwebi and Ishmael Phalane (Letsolo Water and Environmental Services
» Soils and Agricultural Potential – Johan van Tol (Hydropedological Solutions)
» Heritage – Jaco van der Walt (Heritage Contracts and Archaeology Consulting)
» Palaeontology – John Almond (Naturaviva)
» Visual – Mandy van der Westhuizen (NuLeaf)
» Noise – Morne De Jager (Enviro Acoustic Research)
» Traffic – Paul van der Westhuizen (Siyazi)
» Social – Candice Hunter (Savannah Environmental) peer reviewed by Neville Bews (Neville Bews and Associates)
» Economic – Elena Broughton (Urban Econ)
» Electromagnetic Interference Assessment – Callie Fouche (ITC Services)

Refer to Appendix T for the curricula vitae for the EAPs and specialist sub-consultants.

STRATEGIC CONTEXT FOR ENERGY PLANNING CHAPTER 2

2.1. National Policy and Planning Context for Solar Energy Facility Development in South Africa

South Africa has embarked on an infrastructure growth programme supported by various government initiatives, including but not limited to, the National Development Plan (NDP), the Presidential Infrastructure Coordinating Commission (PICC), the Department of Energy's Integrated Resource Plan (IRP) and National Strategy for Sustainable Development, the National Climate Change Response White Paper, the Presidency of the Republic of South Africa Medium-Term Framework and National Treasury's Carbon Tax Policy Paper. The need to expand electricity generation capacity in South Africa is based on national policy and informed by on-going strategic planning undertaken by the Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom. These efforts are in support of, among other sectors, the ever increasing, growing demand for energy, to find solutions for the current electricity shortages, as well as the need to find more sustainable and environmentally friendly energy resources.

The hierarchy of policy and planning documentation that support the development of renewable energy projects such as solar energy facilities is illustrated in Figure 2.1. These policies are discussed in more detail in the following sections, along with the provincial and local policies or plans that have relevance to the proposed facility's development.

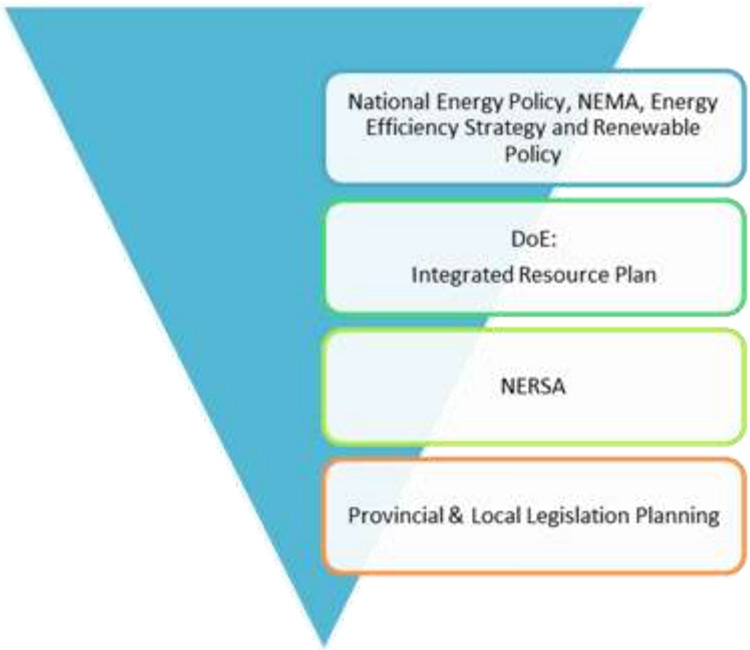


Figure 2.1: Hierarchy of electricity policy and planning documents

2.1.1 The National Energy Act (2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including solar:

> *"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements; to provide for increased generation and consumption of renewable energies (Preamble)."*

The National Energy Act aims to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors, as well as matters relating to renewable energy. The Act provides the legal framework which supports the development of renewable energy facilities for the greater environmental and social good.

2.1.2 National Development Plan 2030

The NDP aims to eliminate poverty and reduce inequality by 2030. Given the complexity of national development, the plan sets out a number of interlinked priorities, some of which include:

- » Bringing about faster economic growth, higher investment and greater labour absorption.
- » Focusing on key capabilities of people and the state.
- » Building a capable and developmental state

Enabling milestones include:

- » Increase employment from 13 million in 2010 to 24 million in 2030.
- » Establish a competitive base of infrastructure, human resources and regulatory frameworks.
- » Ensure that skilled, technical, professional and managerial posts better reflect the country's racial gender and disability makeup.
- » Increase the quality of education.
- » Provide affordable access to quality health care.
- » Establish effective, safe and affordable public transport.
- » Produce sufficient energy to support industry at competitive prices, ensuring access for poor households, while reducing carbon emissions per unit of power by about one-third.

- Ensure that all South Africans have access to clean running water in their homes.
- Make high-speed broadband internet universally available at competitive prices.
- Realise a food trade surplus, with one-third produced by small-scale farmers or households.

The National Development Plan aims to provide a supportive environment for growth and development, while promoting a more labour-absorbing economy. The proposed CSP Project will assist in reducing carbon emissions targets and create jobs in the local area as well as assist in creating a competitive infrastructure based on terms of energy contribution to the national grid.

2.1.3 National Climate Change Response White Paper (2011)

South Africa's response to climate change has two objectives: 1) to effectively manage the inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity; and 2) to make fair contribution to the global efforts to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enabled economic, social and environmental development to proceed in a sustainable manner. The paper proposes a number of approaches dealing with climate change impacts with respect to selected sectors. Energy, in this context, is considered to be one of the key sectors that provides for possible mitigations to address climate changes. The White Paper provides support for the proposed development of renewable energy facility which will contribute to managing climate change impacts, supporting the emergency response capacity as well as assist in reducing greenhouse gas emission in a sustainable manner.

2.1.4 White Paper on the Energy Policy of the Republic of South Africa (1998)

The White Paper on Energy Policy states the need to improve the energy security in the country by means of expanding the energy supply options. This implies the increase in the use of renewable energy and encouraging new entries into the generation market. The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind, and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account. Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented;
- Ensuring that an equitable level of national resources are invested in renewable technologies, given their potential and compared to investments in other energy supply options; and,
- Addressing constraints on the development of the renewable industry.

The policy states the advantages of renewable energy which include minimal environmental impacts in operation in comparison with traditional supply technologies; generally lower running costs; and high labour intensities. Disadvantages include: higher capital costs in some cases; lower energy densities; and lower levels of availability, depending on specific conditions, especially with sun and wind based systems. Nonetheless, renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future. Therefore the policy supports the advancement of renewable energy sources at ensuring energy security through the diversification of supply, which is in line with the proposed CSP Project.

2.1.5 White Paper on the Renewable Energy Policy of the Republic of South Africa (2003)

The White Paper on Renewable Energy supplements the Governments overarching policy on energy as set out in its White Paper on the Energy Policy of the republic of South Africa (DME, 1998). The White Paper on Renewable Energy Policy recognises the significance of the medium and long-term potential of renewable energy. The main aim of the policy is to create the conditions for the development and commercial implementation of renewable technologies. The White Paper on Energy Policy's position with respect to renewable energy is based on the integrated resource planning criterion of:

> *"Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options."*

This White Paper on Renewable Energy (November, 2003) sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. South Africa relies heavily on coal to meet its energy needs because it is well-endowed with coal resources; in particular. However South Africa is endowed with renewable energy resources that can be sustainable alternatives to fossil fuels, so far these have remained largely untapped. The White Paper on Renewable Energy sets a target of generating 10 000GWh from renewable energy sources. Therefore the policy supports the investment in renewable energy facilities sources at ensuring energy security through the diversification of supply.

2.1.6 National Integrated Resource Plan for South Africa (2010-2030)

The primary objective of the Integrated Resource Plan (IRP 2010) is to determine the long term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing and cost. However, the IRP 2010 also serves as input to other planning functions, *inter alia* economic development, and funding, environmental and social policy formulation. The accuracy of the IRP 2010 is to be improved by regular reviews and updates. A revised version of the plan was published in 2013. The National Integrated Resource Plan 2010 projected that an additional capacity of up to 56 539MW of generation capacity will be required to support the country's economic development and ensure adequate reserves over the next twenty years. The required expansion is more than two times the size of the existing capacity of the system. A significant component of the plan, amongst others, is the expansion of the use of renewable energy sources to reduce carbon emissions involved in generating electricity. In this regard, the IRP supports the development of 17GW of renewable energy generation by 2030. The proposed CSP 1 Project contributes to the targets in this policy.

2.2. Provincial Policy and Planning Context

2.2.1 Northern Cape Provincial Growth and Development Strategy

Planning for the promotion of economic growth and social development lies at the core of the Government's responsibility to provide a better life for the nation. It is essential to ensure that planning is integrated across disciplines, coordinated within and between different planning jurisdictions and aligned with the budgeting processes of national, provincial and local government. The core purpose of the NCPGDS is to enable stakeholders from public, private and parasternal sectors together with labour and civil society to determine a plan for sustainable growth and development of the Northern Cape. The NCPGDS sets the tone for development planning and outlines the strategic planning direction in the Province. The main objectives set by the NCPGDS for development planning in the Province are:

- » Promoting the growth, diversification and transformation of the provincial economy
- » Poverty reduction through social development
- » Developing requisite levels of human and social capital
- » Improving the efficiency and effectiveness of governance and other development institutions
- » Enhancing infrastructure for economic growth and social development

The NCPGDS aims at building a prosperous, sustainable growing provincial economy to eradicate poverty and improve social development. The proposed CSP 1 Project will contribute to growth and development of the study area by expanding economic base and creating employment opportunities.

2.2.2 Northern Cape Provincial Development and Resource Management Plan / Provincial Spatial Development Framework (PSDF) (2012)

The Northern Cape PSDF, is premised upon and gives effect to the following five strategic objectives of the National Strategic for Sustainable Development (NSSD 2011-2014):

» Enhancing systems for integrated planning and implementation
» Sustaining our ecosystems and using natural resources efficiently
» Towards green economy
» Building sustainable communities
» Responding effectively to climate change

The PSDF makes reference to the need to ensure the availability of energy. Under the economic development profile of the NC PSDF, the White Paper on Renewable Energy (2003) target of 10GWh of energy to be produced from renewable energy sources was discussed. It was also stated that the total area of high radiation in South Africa amounts to approximately 194 000km^2 of which the majority falls within the Northern Cape. It is stated in the NC PSDF that the implementation of large concentrated solar power (CSP) plants has been proposed as one of the main contributors to greenhouse gas emission reductions in South Africa. The NC PSDF also discusses economic development and that it typically responds to the availability of environmental capital (e.g. water, suitable agricultural soil, mining resources etc.) and infrastructural capital (e.g. roads, electricity, bulk engineering services etc.); over time this has resulted in the distinct development regions and corridors.

2.3. Local Policy and Planning Context

The Proposed Project is situated within the Hantam Local Municipality which forms part of the Namakwa District Municipality. The majority of the linear components of the project – that is the proposed power line between the Project Site and the Eskom Aries Switching Station and the water supply pipeline between the Kenhardt Reservoir and the Project Site are, however, located within the Kai !Garib Local Municipality of the ZF Mgcawu District Municipality. Key documents of all affected municipalities (local and district) include the following:

» Namakwa District Municipality Environmental Management Framework (EMF) and Strategic Environmental Management Plan (SEMP) (2011)
» Namakwa District Municipality Integrated Development Plan (2013-2014/2012-2016)
» Namakwa District Municipality Local Economic Development Strategy (LED) (2009)
» Siyanda (ZF Mgcawu) District Municipality Growth and Development Strategy (2007)

- Siyanda (ZF Mgcawu) District Municipality Integrated Development plan (IDP) (2013-2014)
- Hantam Local Municipality Integrated Development Plan (IDP) (2013-2014)
- Kai !Garib Local Municipality Integrated Development Plan (IDP) (2013-2014)

Each of the above has been considered in the Social Impact Assessment undertaken for the Proposed Project (refer to Appendix Q). These strategic policies at the district and local level have similar objectives, namely to accelerate economic growth, create jobs, uplift communities and alleviate poverty. The Proposed Project is considered to be in alignment with the aims of the District and Municipal policies.

2.4. Regulatory Hierarchy for Energy Generation Projects

The South African energy industry is evolving rapidly, with regular changes to legislation and industry role-players. The regulatory hierarchy for an energy generation project of this nature consists of three tiers of authority who exercise control through both statutory and non-statutory instruments – that is National, Provincial and Local levels.

At **National Level**, the main regulatory agencies are:

- *Department of Energy (DoE):* This Department is responsible for policy relating to all energy forms, including renewable energy, and is responsible for forming and approving the IRP (Integrated Resource Plan for Electricity).
- *National Energy Regulator of South Africa (NERSA):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for solar energy developments to generate electricity.
- *Department of Environmental Affairs (DEA):* This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. The DEA is the competent authority for the application for authorisation for this project, and charged with issuing the relevant environmental authorisation.
- *The South African Heritage Resources Agency (SAHRA):* SAHRA is a statutory organisation established under the National Heritage Resources Act, No 25 of 1999, as the national administrative body responsible for the protection of South Africa's cultural heritage.
- *National Department of Agriculture, Forestry, and Fisheries (DAFF):* This Department is responsible for activities pertaining to subdivision and rezoning of agricultural land. The forestry section is responsible for the protection of tree species under the National Forests Act (Act No 84 of 1998).
- *South African National Roads Agency (SANRAL):* This Agency is responsible for the regulation and maintenance of all national routes. The Proposed Project will be accessed from a provincial route branching off of the R27, which is a route controlled by SANRAL. SANRAL will also be responsible for consideration of the wayleave

application to be submitted by the developer for services (water supply pipeline) affecting the servitude of the R27.

» *National Department of Water and Sanitation:* This Department is responsible for water resource protection, and water use licensing.
» *Eskom:* Commenting authority regarding Eskom infrastructure and grid connection. Eskom will confirm at a later stage with the developer the details of the grid connection to be provided.

At the Provincial Level, the main regulatory agencies are:

» *Provincial Government of the Northern Cape – Department of Environmental and Nature Conservation (DENC):* This Department is the commenting authority for the application for authorisation.
» *Department of Transport and Public Works:* This Department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Provincial Department of Water and Sanitation:* This Department is responsible for water resource protection, and water use licensing.
» *Ngwao Boswa ya Kapa Bokone (Northern Cape Heritage Authority):* This body is responsible for commenting on heritage related issues in the Northern Cape Province.
» *Northern Cape Department of Agriculture, Land Reform and Rural Development:* This Department is responsible for all matters which affect agricultural land.
» *Northern Cape Department of Mineral Resources (DMR):* Approval from the may be required to use land surface contrary to the objects of the Act in terms of Section 53 of the Mineral and Petroleum Resources Development Act (Act No 28 of 2002). In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.

At the local level, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. In the Northern Cape, both the local and district municipalities provide this function. The solar plant is situated within the Hantam Local Municipality which forms part of the Namakwa District Municipality. The majority of the proposed power line between the project site and the Eskom Aries Substation as well as the water supply pipeline between the Kenhardt Reservoir and the Project Site will however be situated within the Kai !Garib Local Municipality of the ZF Mgcawu District Municipality. The Kai !Garib Local Municipality has committed to providing an allocation of raw water for use by the Project.

There are also numerous non-statutory bodies such as environmental non-governmental organisations (NGOs) and community based organisations (CBO) working groups that play a role in various aspects of planning and environmental monitoring that will have some influence on the proposed solar energy development in the area.

DESCRIPTION OF THE PROPOSED CSP 1 PROJECT CHAPTER 3

This chapter provides a description of the components and infrastructure which comprises the proposed CSP 1 Project, the need and desirability of the project and details the project scope which includes the planning/design, construction, operation and decommissioning activities. This chapter also explores site and technology alternatives. Lastly, it provides some insight to concentrated solar thermal facilities as a means for power generation.

The Project will utilise a central receiver tower and molten salt storage technology to generate electricity and will have a generating capacity of up to 200MW[2]. The project facility will include the following associated infrastructure: solar tower, heliostats, a power block including a steam turbine generator, auxiliary boilers, salt or direct steam storage vessels, plant substation, power line, access roads, water supply point and supply pipeline, water storage tanks, water treatment plant, lined evaporation pond, workshop, plant assembly facility and office buildings. The Proposed Project Site is located on Portion 3 of the Farm Styns Vley 280, which is situated within the Hantam Local Municipality and forms part of the Namakwa District Municipality.

The Project and associated infrastructure (excluding linear infrastructure) will have a total development footprint of ~ 1 000 hectares in extent (within a broader site of 1586 ha within the larger 20 700ha study area) and therefore occupies approximately ~4.8% of the larger study area. The proposed CSP 1 Project and associated infrastructure is described in Section 3.2.

3.1. Need and desirability of the Proposed Project

According to the DEA Guideline on Need and Desirability in terms of the Environmental Impact Assessment (EIA) Regulations (Notice 891 of 2014) the need and desirability of a development must be measured against the contents of the Integrated Development Plan (IDP), Spatial Development Framework (SDF) and Environmental Management Framework (EMF) for an area, and the sustainable development vision, goals and objectives formulated in, and the desired spatial form and pattern of land use reflected in, the area's IDP and SDF.

This section of the report considers the national, regional and local need and desirability of the Proposed Project from a policy to a land development perspective (as described in sections 3.1.1 to 3.1.6 below).

[2] This project will be bid in terms of the Department of Energy's REIPPP Programme. The current threshold for CSP Projects is 150MW. It is anticipated that this threshold could increase to 200MW in future bidding rounds. This proposed CSP Project will be required to limit output to the threshold specified by the DoE.

Due to the various project components being situated in different district and local municipalities, the policies and frameworks of each is discussed as necessary.

3.1.1 Hantam Local Municipality Integrated Development Plan

The Hantam LM Integrated Development Plan (IDP) indicates that tourism and renewable energy projects will be the future catalyst for the local economy. The vision of the municipality is a future which the municipality can strive to benefit all its inhabitants, with a cost effective community orientated municipality that puts the community's interest first. The Hantam LM focus is on economic and social development and service delivery. The proposed Project will contribute to economic and social development through employment opportunities and business opportunities in the local area.

Therefore the development of the CSP Project is desirable by the local and district municipality due to the alignment with the IDP and identified Local Economic Development (LED) goals.

3.1.2 Kai !Garib Local Municipality Integrated Development Plan

The renewable energy sector is recognised as a key economic sector. The IDP notes that a number of new opportunities have opened up for LM area since the need to facilitate the generation of sustainable energy was introduced in South Africa by Eskom and the South African government. The IDP notes that there are a number of solar projects proposed in the area and that the economic benefits from these projects are eagerly anticipated.

3.1.3 Eskom's Strategic Environmental Assessment (SEA) for identification of suitable grid infrastructure routing corridors

Coupled to the Renewable Energy SEA, Eskom's Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) is also being undertaken by the CSIR. The SEA will be focussed on corridors identified by Eskom as key areas where transmission line expansion is required in order to meet our future energy requirements. The SEA will assess the environmental, social and economic constraints and opportunities for electricity grid infrastructure development within these corridors. The results of the assessment will serve to inform suitable routing options for electricity grid infrastructure expansion.

The SEA Focus Areas consists of the following five power corridors:

» Western Coastal Corridor – along the west coast of the Cape.
» Eastern Corridor – along the east coast of the Cape and KwaZulu Natal

- **Central Corridor – from the Western Cape via the Northern Cape and Free State to Gauteng and KwaZulu Natal**
- Solar Corridor – from Northern Cape to the North West Province
- Northern Import Corridor – from Limpopo down to Gauteng and Mpumalanga

The corridors (100km in width to enable the identification of routing alternatives) are the focus areas of the SEA. The area where the CSP 1 plant is proposed is situated within the Central Corridor. Various grid strengthening and expansion projects are being proposed by Eskom in the near vicinity of the Proposed Project area. These include the proposed Aries-Helios 765kV Transmission Power Line Project (DEA Ref. 14/12/16/3/3/2/441) and the authorised 400/50kV Eskom Substation between the Aries and Helios Substation (DEA Ref. 12/12/20/1167) on the Farm Moutonsvlei 1615.

3.1.4 The Need for the CSP Project from a National Perspective

The need for harnessing renewable energy resources (such as solar energy for electricity generation) is linked to increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources and the rising cost of fossil fuels. In order to meet the long-term goal of a sustainable renewable energy industry, a target of 17.8 GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010 and incorporated in the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme initiated by the DoE. This programme has been designed so as to contribute towards a target of 3725 MW to be generated from renewable energy sources, required to ensure the continued uninterrupted supply of electricity, towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa. The energy procured through this programme will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This 17,8GW of power from renewable energy amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In responding to the growing electricity demand within South Africa, as well as the country’s targets for renewable energy, Kotulo Tsatsi Energy and SolarReserve proposes the establishment of the CSP 1 plant to add new capacity to the national electricity grid. There is also a critical deficiency in energy to supply South Africa’s baseload power needs, which can be addressed through CSP due to energy storage (unlike present PV plants).

The development of the Project would benefit the local/regional/national community by developing a renewable energy project. Surrounding communities would also benefit from the development through job creation and economic spin-offs. In addition, according to DoE bidding requirements the developer must plan for a percentage of the profit per annum from the solar energy facility to go back into the community through a social beneficiation scheme. Therefore there is a potential for creation of employment and business opportunities, and the opportunity for skills development of the local community.

The project has the potential to contribute to the national electricity supply and to increase the security of supply to consumers as well as supporting South Africa's commitment to reducing greenhouse gas emissions. Over 90% of South Africa's electricity generation is currently coal-based, resulting in annual per capita carbon emissions of approximately 8.9 tons per person, according to 2008 World Bank estimates. According to the Carbon Dioxide Information Analysis Centre, South Africa is the 13^{th} largest carbon dioxide emitting country, based on 2008 fossil-fuel CO_2 emissions. The nation is also the largest emitting country on the continent of Africa, pinpointing the importance of introducing greener solutions to the energy mix. Furthermore, it may provide both economic stimulus to the local economy through the construction process and long term employment (i.e. management and maintenance) during the operation phase of the project.

The use of solar irradiation for electricity generation is essentially a non-consumptive use of a natural resource. A solar energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard. The proposed site was selected for the development of multiple CSP Facilities based on its predicted climate (solar resource), suitable proximity in relation to the existing and available electricity grid, and minimum technical constraints from a construction and technical perspective. Studies of solar irradiation worldwide indicate that the Northern Cape Province shows great potential for the generation of solar power. The Project is located in an area of high irradiation generating up to 2240 kWh/m² annually, as shown in Figure 3.1 below.

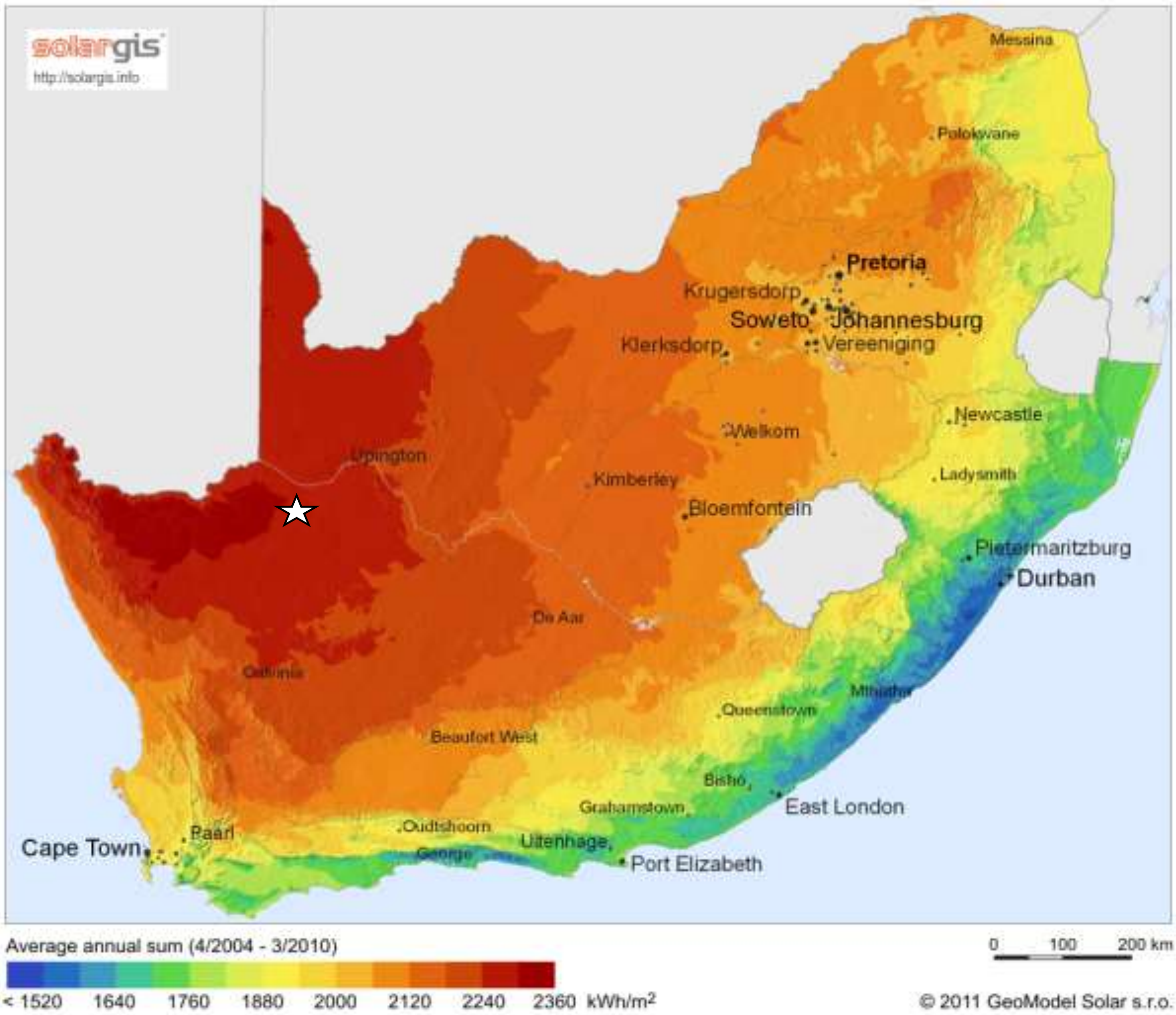


Figure 3.1 Solar irradiation map for South Africa (Source: GeoModel Solar, 2011). The study area is indicated by the white star.

3.1.5 Selection of site and investigation of alternative and least sensitive sites

The 'funnel down' process followed during site selection and impact assessment process was used specifically in order to allow the environmental sensitivity investigation to inform the siting and preliminary layout design of the proposed CSP 1 project. This report demonstrates that alternative sites within a larger 55 000 ha area have been investigated for this project following a reasonable methodology, and that due consideration of the sensitivity of the site, and ultimately the suitability of the site for the proposed project was in line with the mitigation hierarchy.

1. First, avoidance of adverse impacts as far as possible by use of preventative measures (in this instance a sensitivity analysis assisted in the avoidance of identified ecologically sensitive areas)

2. Second, minimisation or reduction of adverse impacts to 'as low as practicable' (in this instance minimisation of impact on identified ecologically sensitive areas through implementing mitigation)
3. Third, remedy or compensation for adverse residual impacts, which are unavoidable and cannot be reduced further.

Phased Sensitivity Analysis

In determining the preferred site for the proposed CSP Plant, a 'funnel-down approach' was used and commenced with the consideration of the larger 55 000ha site (refer to Section 6.4 of the Final Scoping Report, page 137).

Step 1: The full extent of the 55 000 ha study site was considered in the Scoping Study and allowed for a robust site selection process to be undertaken. Potentially sensitive areas identified through the environmental scoping study were mapped in order to define the areas which a) were to be avoided (i.e. no development considered acceptable), b) areas of some considered sensitivities which could be mitigated to acceptable environmental levels, and c) areas which were considered to be acceptable loss. The scoping phase sensitivity map provided detail from an ecological survey and ground-truthing exercise undertaken in May 2014. These potentially sensitive areas identified through the scoping study across the full extent of the broader study area included:

» Boesmanland Vloere (extensive valley floors with temporary precipitation accumulation).
» Ephemeral drainage lines (significant drainage lines with clear riverbed).
» An Ecological Support Area (ESA), delineated in the Northern Cape Bioregional Plan and the Namakwa EMF as a notational migration route across a large portion of the study area.

Step 2: The potentially sensitive areas already identified through the scoping study provided No-Go areas (i.e. avoidance of identified ecologically sensitive areas – or Step 1 in Mitigation Hierarchy). These areas were excluded from the developable area.

Step 3: Due to the proximity of the proposed project to the possible faunal migration corridor, or Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan, it was considered necessary to interrogate the relative importance of the corridor with the provincial conservation planning authority (DENC). This issue was further discussed in a meeting between the project ecologist and the relevant conservation authorities in Springbok (Geldenhuys and Cloete, September 2014). The ESA as delineated in the Namakwa Bioregional Plan is broadly mapped and based on an extrapolation of data collected for similar areas (similar abiotic and biotic environment) in the Namakwa District.

The ecological field data collected for the purposes of the ecological study suggested that the areas to the south west of the project development site display a much higher incidence of faunal movement through the landscape, particularly due to the presence of enlarged fluvial vegetation associations. Therefore based on surveyed data, it was considered reasonable that the area south of the project development site contributes to the functioning of the corridor. The ESA delineated in terms of the Namaqua Bioregional Plan and the observed ESA relative to the larger site and project development site is indicated in Figure 1 of the draft EIAr, Figure 7.1, and Figure 9.1. The study concluded that the observed corridor should be excluded from the developable area (i.e. avoidance of identified ecologically sensitive areas – or Step 1 in Mitigation Hierarchy).

Step 4: With an understanding of which areas of the site were excluded from development based on the scoping study, SolarReserve and Kotulo Tsatsi Energy compared technically feasible infrastructure layouts for the CSP project to the environmental sensitivities identified and exclusion areas mapped. Two of the three potential sites for the CSP facility were considered fatally flawed, and only one development site which showed a low impact to the environment was considered within the more detailed EIA Phase. The two fatally flawed sites were required to be relocated within the 55 000ha area as assessed through the scoping phase to be environmentally sensitive. This discarding of the sites considered to be in areas of significant environmental sensitivity, and the complete relocation (and subsequent assessment of the repositioned site) ensured the minimisation or reduction of adverse impacts to 'as low as practicable' (i.e. minimisation of impact on identified ecologically sensitive areas through implementing mitigation – or Step 2 in Mitigation Hierarchy).

Findings

This approach focussed the preferred location of the proposed developments within the 55 000 ha area to the portion of the site with the least environmental sensitivities. Following the 'funnel down approach', of the 55 000ha original area considered at scoping, an area of approximately 1586ha in extent was identified for specialist assessment in the EIA phase for CSP 1, which allowed for the identification of specific environmental sensitive areas/receptors to be avoided and/or mitigated by the 1 000ha project development footprint.

Figure 1, 2, 3, 4, and 9.1 of the Draft EIAr provides the detail of the CSP 1 project development site (and facility layout) as assessed in the EIAr and considered environmentally acceptable.

site

The following is relevant regarding the identified environmental sensitivities for the project development site:

From an ecological sensitivity perspective:

» The loss of pockets of habitat or higher sensitivity areas to development (approximately 50ha of the ~1 000ha footprint) is regarded to be an acceptable loss in terms of ecological functioning, as well as conservation thresholds.
» The proximity of the proposed CSP project to the Ecological Support Area delineated in terms of the Namakwa Bioregional Plan was investigated. Findings confirmed that the observed faunal migration corridor is situated to the south west and outside of the project footprint and is aligned primarily with drainage lines depicted as no-go features. The observed corridor supersedes that which is denoted as an Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan.

From an avifaunal sensitivity perspective:

» A martial eagle nest was identified on an adjacent Eskom power line tower and a 3km avifaunal buffer zone around a martial eagle nest was mapped.
» This buffer zone does not overlap with the project development area and the martial eagle nest would be located approximately 4.5 km from the CSP tower.

3.1.6 Receptiveness of the CSP1 Project Development Site to Development

Kotulo Tsatsi Energy and SolarReserve consider this area, and specifically the demarcated site on Portion 3 of the Farm Styns Vley 280, to be highly preferred for the development of a CSP Project. The reasons include:

» Extent of site: Availability of relatively level land of sufficient extent can be a restraining factor to CSP development, as a 200 MW solar tower system and associated infrastructure requires ~1000 ha of land space. The larger farm portion owned by the developer for the development of the proposed 1000MW broader study area is approximately 20 700 ha in extent, of which ~1586 ha was allocated for the siting of the project which has a footprint of approximately 1000ha in extent. This is approximately 9.7% of the land surface area within the broader study area. This site is therefore considered sufficient for the installation of the facility allowing for avoidance of sensitivities within the greater study area.
» Topographic conditions: The site conditions are optimum for a development of this nature, with the Project area being of a suitable gradient for a CSP Project.
» Power transmission considerations: The Project Site is situated within the Central Corridor defined in terms of Eskom's Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) conducted by the CSIR and south of the Aries-Helios 400kV power line and approximately 50km south-west from the Eskom Aries Substation. Various grid connection options are available for consideration to

facilitate connection to the Eskom grid, including the construction of new overhead power lines adjacent to the Aries-Helios 400kV power line, however the possibility to loop in and out of this power line exists based preliminary discussions with Eskom.

» Site access: the site can be readily accessed via an existing gravel access road branching off of the R27 between Kenhardt and Brandvlei, with only minor improvements to the turnoff onto the access road from the R27 required.
» Water supply considerations: Water supply will be via an existing supply from the Gariep River to Kenhardt town. A water supply pipeline between the Kenhardt Reservoir and the Project Site is proposed to be constructed within the servitude of existing roads, thereby limiting further transformation of land.
» Loss of current land use: There is no cultivated agricultural land in the study area or directly adjacent to it, which could be impacted upon by the proposed development. The Project Site is not optimal for agricultural land use activities restricted by the arid climate and shallow soils, limiting the overall agricultural potential of the site to very low.
» Climatic conditions: Climatic conditions determine the economic viability of a solar energy facility as it is directly dependent on the annual direct solar irradiation values for a particular area. The Northern Cape receives the highest average daily direct normal and global horizontal irradiation in South Africa which indicates that the regional location of the project is appropriate to a solar energy facility. Factors contributing to the location of the project include the relatively high number of daylight hours and the low number of rainy days experienced in this region. A Direct Normal Irradiation (DNI)[3] of more than 2440 kWh/m²/year is relevant for the area in which the site is located.

3.1.7 Technology choice for the proposed site

CSP is the only technology of the renewable technologies that utilises conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). One advantage of central receiver tower plants is their potential for storing solar thermal energy to use during non-solar periods and to dispatch power when it is needed most. As a result, thermal energy storage allows solar tower power plants to achieve higher annual capacity factors — from 25% without thermal storage, up to 70% or more with it. CSP Tower technology energy storage can serve peaking and mid merit demand requirements and due to its conventional power station nature has significant socio-economic benefits.

In developed countries, parabolic trough technology has dominated the concentrated solar thermal power industry for the last two decades (http://social.csptoday.com/

[3] GHI is the total amount of shortwave radiation received from above by a surface horizontal to the ground. The value of particular interest to CSP installations is the Direct Normal Irradiance (DNI) as mirrors track the suns movements throughout the day.

technology/towers-versus-troughs). It is reported that, currently, the main barrier to the promotion of CSP technology is derived from the fact that far fewer tower plants are currently in operation internationally. SolarReserve, as the technology partner in the development of the Proposed Project, have successfully constructed a number of CSP Projects worldwide.

Based on SolarReserve's evaluation of the site, CSP tower and molten salt storage technology is considered suited to the Project Site for the following reasons:

» Whereas an even or levelled land area is required for parabolic troughs, heliostats do not need to be sited on an even surface. The tower technology can even be deployed in an area of moderately transitional topography.
» As opposed to CSP trough technology, wholesale clearance of land is not a prerequisite for the installation of tower and heliostat technology. This means that the entire surface area occupied by the heliostat field will not necessarily require vegetation clearance and can be limited to the area directly beneath the individual heliostats as well as the power block. This will have environmental as well as stormwater management benefits.
» Tower plants have the potential to be much more efficient than trough plants due to far higher insolation concentration ratios.
» While trough plants produce heat at around 400˚C, towers can produce up to 550˚C. Higher temperatures allow use of more efficient turbines, reducing energy costs and improving storage times.
» Tower plants also have the potential for more efficient storage using molten salt as their working fluid, as well as the storage fluid.
» Tower plants can operate longer when solar resources are not available, as high temperatures allow for storing more energy using the same amount of heat storage media.

3.1.8 Benefits to the local economy

In addition to energy production projects, the Namakwa District Municipality Local Economic Development (LED) Plan identifies the development of the manufacturing sector linked to energy opportunities as one of its goals. Tourism potential projects include techno-tourism opportunities (related to space and energy development). The Project therefore has a role to play in the development of three economic sectors within the District Municipality in alignment with defined LED goals.

The long-term benefits for communities in general can be realised should the larger CSP study area prove acceptable (from a technical and environmental perspective), and see the rollout and construction of several facilities. Each of these facilities will contribute to the economic and social development of surrounding local communities with in excess of 1000 employment opportunities provided during construction (30 to 36 months) and 40 to 60 permanent employment opportunities provided during the operational life of the plant (typically 20 to 30 years and extendible as with conventional plant). Realisation of the full 1000MW Solar Park concept could potentially result in the creation of several thousand more employment opportunities during the construction phases and up to 200 operational phase job opportunities.

CSP technology, once economies of scale are realised through sustained roll out, can have a significant cumulative impact on local manufacturing more so than any of the other renewable technologies. A case in point being the mirror manufacturing plant already established adjacent to the Upington Airport currently serving the Khi Solar One project near Upington and currently permanently employing more than 80 people. It is anticipated that similar manufacturing industries servicing the proposed Project could be established in the closest towns. The knock-on effect could potentially result in significant additional investment and employment opportunities.

3.1.9 How the principles of environmental management as set out in section 2 of NEMA have been taken into account in the planning for the Proposed Project

The principles of NEMA have been considered in this assessment through compliance with the requirements of the relevant legislation in undertaking the assessment of potential impacts, as well as through the implementation of the principle of sustainable development where appropriate mitigation measures have been recommended for impacts which cannot be avoided. In addition, the successful implementation and appropriate management of this Project will aid in achieving the principles of minimisation of pollution and environmental degradation.

The EIA process has been undertaken in a transparent manner and all effort has been made to involve interested and affected parties, stakeholders and relevant Organs of State such that an informed decision regarding the project can be made by the Regulating Authority.

The general objectives of Integrated Environmental Management have been taken into account for this EIA report by means of identifying, predicting and evaluating the actual and potential impacts on the environment, socio-economic conditions and cultural heritage component. The risks, consequences, alternatives as well as options for mitigation of activities have also been considered with a view to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management.

3.2. Central Receiver Tower and Molten Salt Storage Technology proposed for the CSP Project

Solar power generating facilities use the energy from the sun to generate electricity. Concentrated Solar Power (CSP) collects the incoming solar radiation and concentrates it (focusing or combining it), on a single point, thereby increasing the potential electricity generation.

The proposed CSP 1 plant will consist of a central receiver tower and molten salt storage system with a generation capacity of ~200MW. Infrastructure associated with the CSP 1 Plant includes:

- » Solar collector field/Heliostat field – consists of all systems and infrastructure related to the control and operation of the heliostats.
- » Molten salt circuit – includes the thermal storage tanks for storing low and high temperature liquid salt, a central solar-thermal tower receiver, pipelines and molten salt to steam heat exchangers.
- » Power block – consists of the steam turbine and generator, as well as the air-cooled condenser and associated feedwater system.
- » Auxiliary facilities - consists of the switch yard, step-up transformers, facility start-up generators (gas or diesel-fired – dependent on detailed design).
- » Grid connection infrastructure, including:
  - o 132 kV on-site project substation
  - o Eskom 132kVswitching station
  - o Eskom 400kV sub-station
  - o 132 kV power line up to 50km in length to connect to Eskom's existing Aries Substation or 400kV loop in – loop out to the existing Aries – Helios 400kV power line
- » Access roads (roads up to 8m wide)
- » Water supply pipeline within existing road reserves (up to 95km in length).
- » Water storage reservoir and tanks (20 000m^3 and 5 000m^3).
- » Water treatment facility.
- » Wastewater treatment facility.
- » Plant assembly facility.
- » Evaporation ponds (approximately 8ha in extent).
- » Workshop and office buildings.
- » Man camp.

It is envisaged that the Project will be operated as a base load plant which feeds directly into Eskom's national power grid. The CSP Project utilises the central receiver tower with molten salt storage technology, dry cooling and conventional steam generator system to generate power. Thousands of heliostats (movable, flat reflective mirrors roughly which are oriented according to the sun's position in order to capture and reflect the solar radiation) will be used to focus the sun's thermal energy onto the central receiver tower, after which the energy will be captured within the molten salt storage circuit.

The central receiver tower is erected within the power block area inside the heliostat field. The concentrated sunlight within the receiver, heats the molten salt up to 565°C, which then flows into a storage tank. The molten salt is hereafter pumped to a heat exchanger and then to a steam turbine to generate electricity. This process, also known as the "Rankine cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy. In order to reduce the Project's water consumption, a dry cooling has been considered.

A conceptual illustration showing the power block operating system is shown in Figure 3.3 and Figure 3.4 shows an example of an operating CSP Plant developed by SolarReserve.

The heliostat field and the central receiver tower are designed for optimum power generation according to specifications. A 200MW CSP Plant requires an area of approximately 1 000 hectares (including associated infrastructure). An example of a constructed CSP Plant is illustrated in Figure 3.4.

In a typical installation, solar energy collection occurs at a rate that exceeds the maximum required to provide steam to the turbine. The thermal storage system can, therefore, be charged at the same time that the CSP Plant is producing power at full capacity. The ratio of the thermal power provided by the Plant to the peak thermal power required by the turbine generator is called the solar multiple. A Central Receiver Tower Plant could potentially operate for 40% - 65% of the year (as from such storage, the system could provide energy, even in cloudy conditions or at night) without the need for a back-up fuel source. However, without energy storage, solar technologies are limited to annual capacity factors near 25% - 30%. Today, the most used solution is the usage of steam or molten salt storage vessels that store the energy to then be distributed when required. Determining the optimum storage size to meet power-dispatch requirements is an important part of the system design process. Storage vessels can be designed with sufficient capacity to power a turbine for up to 6 to 12 hours economically.

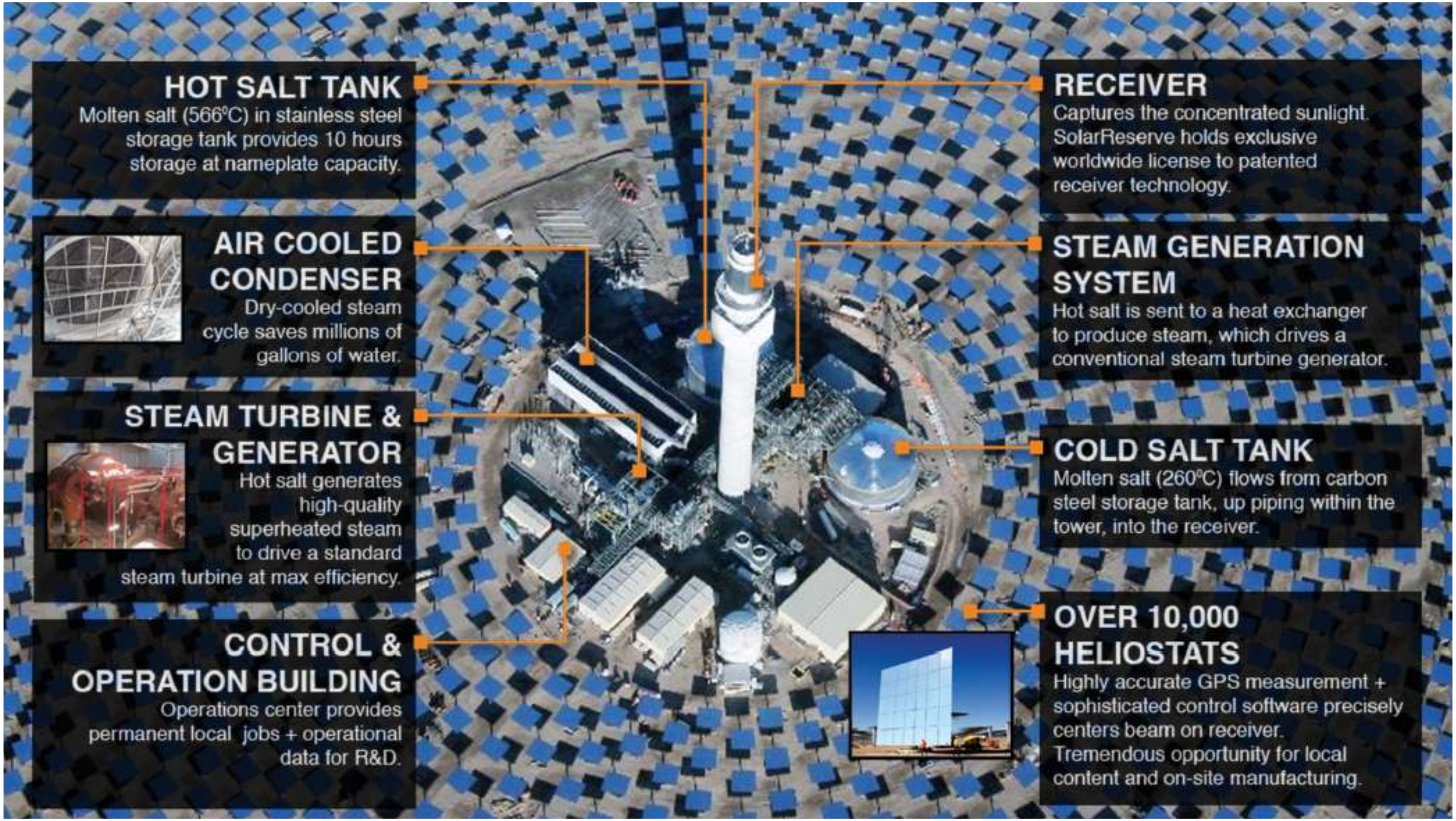


Figure 3.3: Overview of a power block and solar thermal system for a CSP Tower Plant (Courtesy: Solar Reserve South Africa)

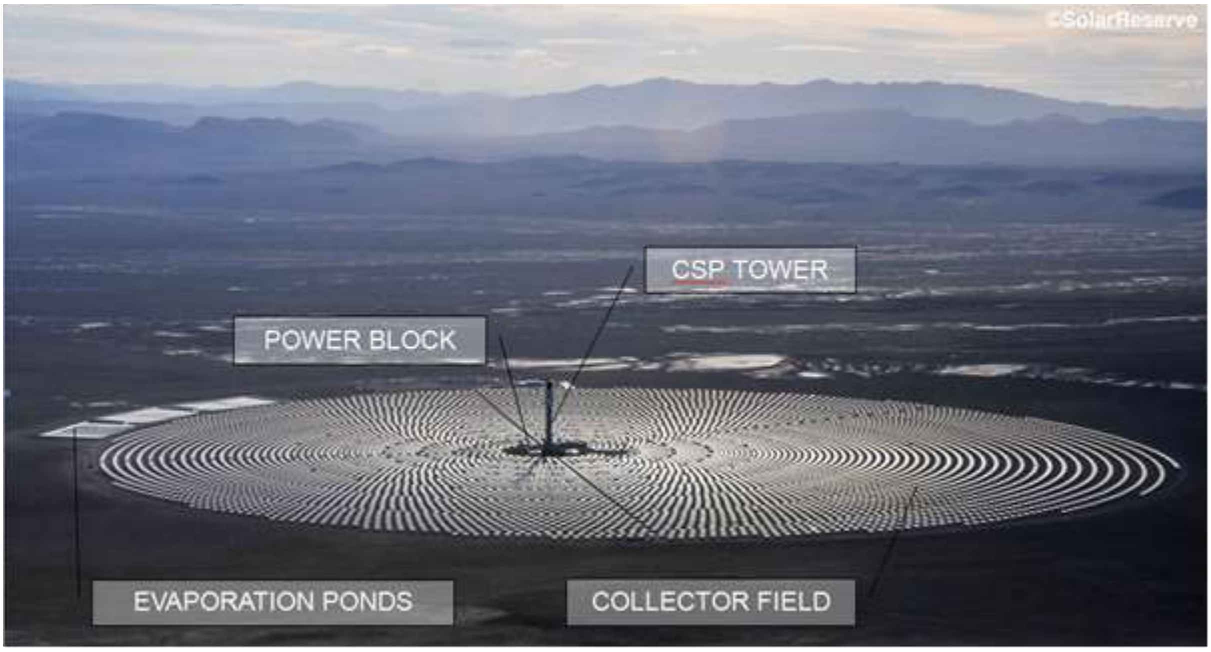


Figure 3.3: Photograph illustrating a constructed SolarReserve CSP Plant, Crescent Dunes, located in Tonopah, Nevada (courtesy of SolarReserve South Africa)

Operation of the CSP Project

The following stages form part of the operating function of the CSP systems.

Stage 1: the water is pumped from low to high pressure and steam is extracted from the steam turbine generator and is used to pre-heat the water prior to entering the steam generator system (i.e. this increases overall cycle efficiency).

Stage 2: the high pressure working fluid enters the steam generator system where it is heated by the heat transfer fluid to become superheated steam.

Stage 3: The superheated steam expands through the high pressure section of the steam turbine turning the generator to produce electricity. This steam is then reheated in a re-heater that is part of the steam generator system and sent to the low pressure steam turbine. All sections of the steam turbine generator decrease the temperature and pressure of the steam with the low pressure section extracting the last available energy until the steam is operating under vacuum pressure.

Stage 4: the wet steam from the low pressure section of the steam turbine then enters the condenser where it is condensed back into a liquid which is returned to stage 1. The solar field provides the heat input into stage 2 and for the re-heater in stage 3. As the heat transfer fluid through the solar field, light from the sun reflects off the solar collectors (i.e. heliostats) and is concentrated on the heat collection elements located at the focal point of the power tower. Fluid flowing through these elements absorbs the heat and provides a high-temperature energy source for the entire cycle.

Low quality waste heat is rejected at stage 4. As the turbine exhaust is condensed, the heat is transferred to the air cooled condenser.

Table 3.1 below describes the dimensions of the main infrastructure components the Proposed Project, while a layout of the facility is provided in Figure 3.4.

Table 3.1: Dimensions of the main infrastructure components for the proposed CSP 1 project

Infrastructure	Footprint / dimensions
Receiver Tower	Accommodated in power block. Up to 250m in height
Heliostat field	Up to 800 ha. Between 12 m and 15 m in height
Power block including steam turbine and generator	~ 242m in diameter ~ 5 ha circle
Molten salt storage tanks	2 tanks (cold and hot tank)
Water storage reservoir and tanks	Holding reservoir of 20 000m^3 and project tank of 5 000m^3.
Project on-site substation	200m x 200m
Eskom substation	600m x 600m
Masts and telecommunications	Up to 32m in height
Power line (up to 132kV) to Aries Substation	Up to 50m servitude, ~ 50km in length
400 kV power line (loop in – loop out)	55m servitude approximately 0.5km in length.
Lined evaporation pond	8 ha
Assembly facility	100 ha
Internal access roads	8m wide
Water supply point	Existing Kenhardt Reservoir
Water supply pipeline between Kenhardt and project reservoir	~95 km in length
Temporary laydown area and construction camp	~100 ha
Man camp	Up to 50 ha

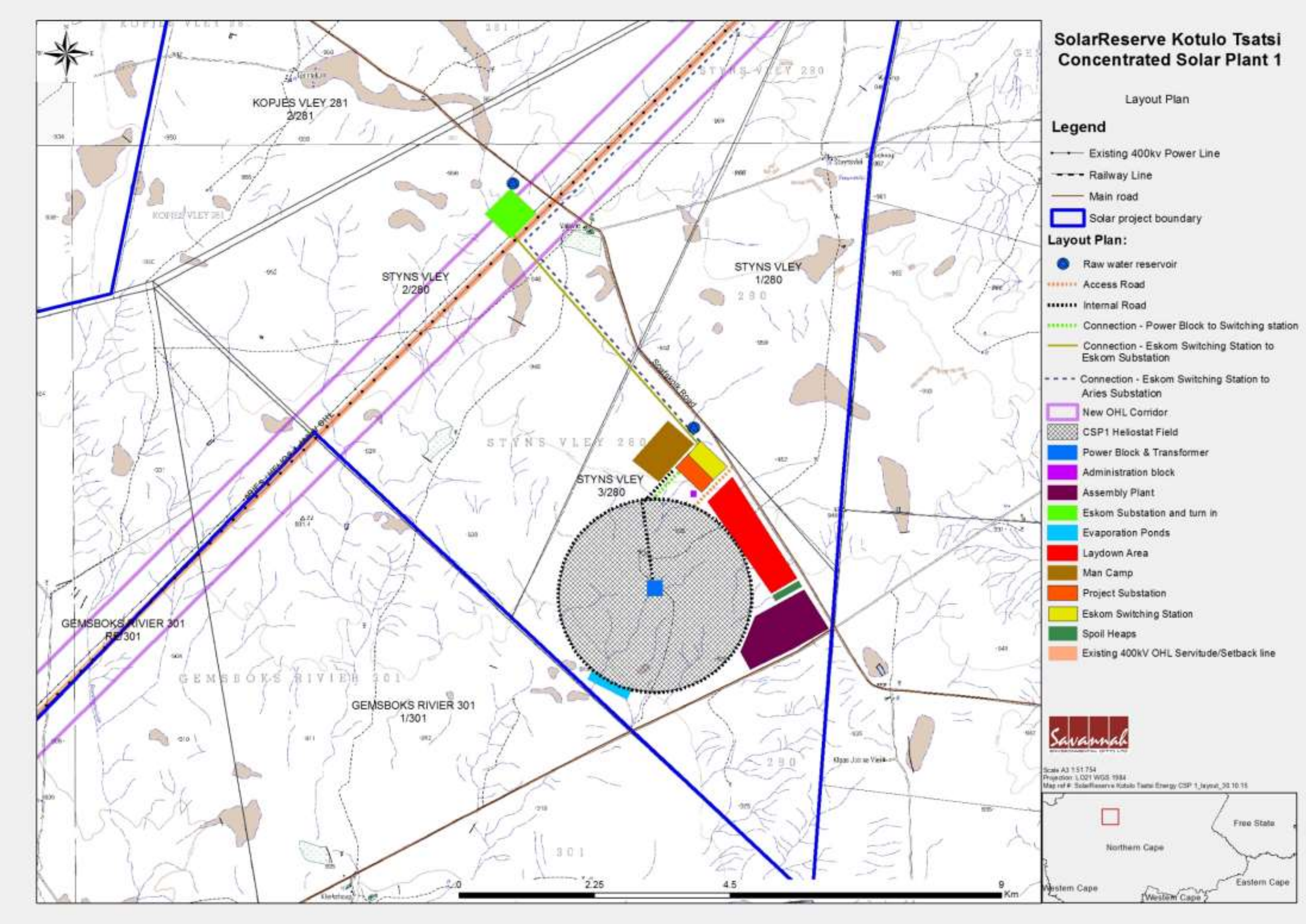


Figure 3.4: Layout Plan of the proposed CSP 1 project and associated infrastructure

3.3. Life-cycle Phases of the proposed CSP Project

3.3.1 Construction Phase

In order to construct the solar thermal plant and associated infrastructure, a series of activities will need to be undertaken. The construction phase will involve the construction and assembly of the tower, buildings, heliostats and other infrastructure required for the construction and operation of the plant, as well as the assembly and installation of the CSP and electrical systems. The construction period will extend over a period of approximately 30 to 36 months. The activities and/or facilities relevant to the construction phase are listed below, with further details provided in the section which follows:

- Implement access control
- Conduct surveys
- Establishment of Access Roads to the Site
- Undertake Site Preparation
- Transport of Components and Equipment to Site
- Refuelling of plant
- Bulk material laydown
- Construct Power Block, heliostat field and Substations
- Establishment of Ancillary Infrastructure
- Auxiliary Power Supply
- Water Supply
- Man camp and staff facilities
- Management and administration
- Waste Management
- Fire Protection
- Connect Substation to Power Grid
- Undertake Site Remediation

a) Access Control

Prior to construction of Project, the necessary security and access controls for the Project Site will be implemented and access route established. Access control and security will be required for health, safety and security reasons to the Project Site. The Project Site will be fenced off in order to prohibit unintentional and/or unauthorised entry of surrounding residents and land users to the Project Site. Access control with security personnel will be implemented throughout the project phases.

b) Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, a geotechnical survey, a site survey and confirmation of the micro-siting footprint, survey of substation site and survey of power line, water supply and road servitudes.

c) Establishment of Access Roads to the Site

The broader site can be accessed via an existing gravel access road (known as Soafskolk Road) branching off of the R27 between Kenhardt and Brandvlei. Higher traffic volumes are expected to take place during the construction phase. Minor geometric layout upgrades to improve road safety and intersection functionality are required (for the development of the CSP 1 Project as well as multiple CSP facilities within a Solar Park concept)[4]. The proposed road layout is shown in Figure 3.5.

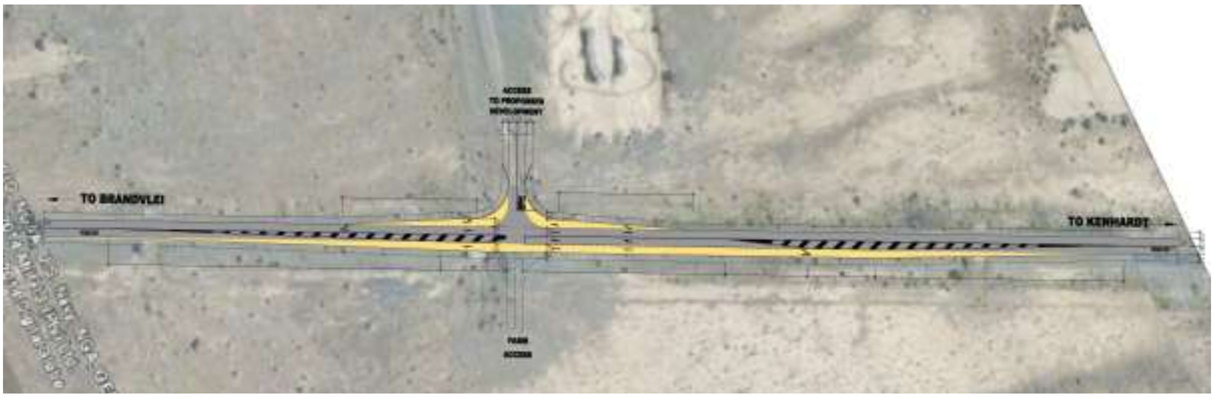


Figure 3.5: Proposed road layout at junction of Soafskolk Road with the R27

Within the site itself, access will be required to the individual facility components for construction purposes (and later limited access for maintenance). The proposed CSP 1 project access road is situated approximately 20.5km from the intersection at the R27 and can be accessed via the Soafskolk gravel road. Nearer to the Project Site, some internal access roads will be required to be constructed. The amount of earthworks and compaction required in the maintenance of the existing gravel roads and the establishment of new access roads will be established through the detailed geotechnical study to be conducted for the Project.

There will be one internal surfaced access road of approximately 8m in width which will lead directly to the power block. Between the heliostats there will be a stabilised gravel track that would be used for maintenance purposes and cleaning during the operational phase. The final layout of the access roads will be determined following the identification of site related sensitivities.

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[4] Based on the findings of the traffic impact assessment conducted.

d) Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each component and the establishment of internal access roads. In this regard, vegetation and topsoil will be stripped at the location of surface infrastructure. Topsoil will need to be stockpiled, backfilled and/or spread on site and used in the rehabilitation of construction facilities.

e) Transport of Components and Equipment to Site

The components for the proposed facility will be transported to site in sections by road. Some of the solar power facility components may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989)[5] by virtue of the dimensional limitations (i.e. length and weight). Components of various specialised construction and lifting equipment are required and will need to be transported to site. In addition, typical civil engineering construction equipment will need to be brought to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.) as well as components required for the establishment of the substation and power line.

The equipment will be transported to the site using appropriate National, Provincial and local roads, and then the dedicated access/haul road to the site itself.

f) Refuelling

Various construction equipment and vehicles will be used during the construction phase, which will require refuelling. On-site maintenance and repairs on such equipment may also be required due to the distance to the closest town(s). In this regard the fuel storage vessel will have a storage capacity of up to 20m^3 to be established on site within the 80 – 200 ha construction area described above. All fuel storage vessels are required to be bunded to 110% of the volume of the storage vessel.

g) Bulk material laydown

Laydown and storage areas will be required for the typical construction equipment which will be required on site. Hardstand areas will also need to be established for operation of cranes used on site.

h) Construct Power Block and Substation

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

A steam turbine and generator will be housed within the power block. A generator transformer and a small substation will be established outside the building. The position of the power block and substation within the site footprint will be informed by the final positioning of the solar generating components.

The construction of the power block and substation would require a survey of the site, site clearing and levelling and construction of access road/s (where required), construction of a level terrace and foundations, assembly, erection, installation and connection of equipment, and rehabilitation of any disturbed areas and protection of erosion sensitive areas.

i) Establishment of Ancillary Infrastructure

Ancillary infrastructure includes a water supply pipeline to the facility from the supply point, a de-gritting and basic filtration facility at the abstraction point (if required), a water treatment plant and water storage facilities on the site, and a blow down or evaporation pond (for wastewater from the generation process). A workshop, storage areas as well as a contractor's equipment camp will also be required.

The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

j) Auxiliary Power Supply

Approximately 15MW of power may be required during the construction phase of the CSP 1 project. It is proposed that this power be sourced from the existing power lines and/or diesel generators. The necessary applications for the connection to the grid will be submitted to Eskom for approval.

k) Water Supply

Water use
Water will be required during the construction phase for general building activities, washing of equipment and as well as for staff use (potable water). The water consumption requirements for the Proposed Project during construction are estimated at approximately 150 000 m^3 per annum. Water uses during construction include potable water for the construction crew, dust control, equipment cleaning, concrete mixing, hydraulic testing and an allowance for contingencies.

Due to the location of the site it is proposed that the project will utilise and develop its own water provision services based on the fact that these services do not reach the

Project Site. Accordingly, construction water may need to be sourced from municipal supply (by truck or via pipeline) or groundwater abstraction. The potential groundwater yields from boreholes located in the study area are discussed in Section 6.4.2. The Geohydrological Assessment conducted for the project (Appendix I) indicates that construction demand water can be sustainably abstracted from the groundwater resource, if required.

Pipeline construction
The construction of the raw water pipeline (approximately 95km) between Kenhardt and the Project Site will take place during the construction phase. Two alternatives for the alignment of the proposed pipeline have been considered, both of which, from the starting point at the Kenhardt Reservoir, are proposed to be located in existing road reserves until the pipeline connects to the 20 000m² project water storage reservoir. The alternative pipeline alignments are discussed in Section 4.3.3. Wayleave applications will be submitted by the developer to the relevant authorities having jurisdiction over a specific section of road or railway (SANRAL and Department of Roads and Public Works as well as Transnet) to obtain permission to construct the water pipeline within the road/rail reserves. Upon observation of the necessary roads authority conditions, the construction of the proposed pipeline will involve trenching and laying of pipeline, the majority of which is expected to occur within the existing road/rail reserves.

l) Man camp

A contractor's housing facility is proposed for the duration of the project construction period due to the distance between Kenhardt and Brandvlei and the limited accommodation opportunities provided there for the workforce required. It is proposed that temporary/portable housing, ablution and sewage treatment, and catering facilities be procured from external service providers. It is estimated that in total, between 1 000 to 3 000 people will be employed (directly, indirectly and/or induced) during the construction phase. Occupation will be staggered over this period and the maximum number of people housed at any given time will vary. The camp will be located at a single location however the selection of the location will be finalised in conjunction with the appointed construction contractor to ensure that the locations are appropriate from an environmental and practical perspective.

m) Waste Management

During the construction phase, general and inert building waste, as well as hazardous construction waste will be generated. Sewage/effluent waste will also be generated at the construction camp and administration ablution and sanitation facilities.

General and Inert Building Waste

In addition to the conditions of the EMPr, general and inert building waste will be collected in bins and skips and temporarily stored in the designated general and building waste storage area in covered, tip proof waste skips for collection and disposal by an appropriate waste contractor. The burying and/or burning of refuse/waste will not be permitted at any time. The mixing of general and building waste with hazardous materials will not be permitted – waste separation will occur before waste is placed in the waste skips.

The Kai !Garib Local Municipality has confirmed that general waste from the project can be disposed of at the Kenhardt Solid Waste Site (refer to Appendix C).

Hazardous Waste

In addition to the conditions of the EMPr, hazardous waste material generated during the construction phase (such as used lubricants and chemicals and empty containers/packaging from potentially contaminating consumables) will be temporarily stored on site prior to collection and disposal at a licensed hazardous waste disposal facility. This temporary waste storage area will be bunded, under cover and located on an impermeable surface.

Sewage/Effluent Waste

Ablution and sanitation facilities will be readily accessible to all employees. Due to the location of the site it is proposed that the project will construct and utilise its own sanitation services as Municipal services do not service the Project Site. All sewage/effluent water originating from these facilities will be managed utilising temporary portable chemical toilets and portable modular sewage treatment facilities (package plants). These facilities will be maintained and serviced regularly by an appropriate waste contractor. The treated effluent will be reused where possible. The resultant sludge and unusable effluent will be removed from site by a contractor where it could then be disposed of at an appropriate facility or be further treated at a municipal sewage treatment works. It is most feasible for the sewage treatment facility (modular plant) to be constructed during project initiation and be operational for the remainder of the construction phase and into operations.

n) Fire Protection

A fire protection and prevention plan will be prepared for the construction phase of the project. The primary aim of this system will be to preserve and protect human life as well as tangible goods and equipment in the event of a fire. The fire protection system will employ measures to contain and prevent fires or from veld fires entering the site/plant. A construction phase fire protection and prevention plan will be instituted accordingly. During construction, the CSP Project will be serviced with an intermediate fire protection system which may entail an auxiliary pressure pump, fire extinguishers and other portable fire-fighting equipment. In addition, a fire break along the site perimeter will be maintained.

o) Connect Substation to Power Grid

The Project Site is situated approximately 3km south of the the Aries-Helios 400kV power line and approximately 50km south-west from the Eskom Aries Substation. Two grid connection options are being considered to facilitate connection to the Eskom grid depending on Eskom's requirements (and to be advised by Eskom at time of application for a connection). These include:

» Loop in and loop out of the out of the Aries – Helios 400kV power line. The construction of a 400kV step-up substation and power line from the on-site Eskom switching station outside the Soafskolk road reserve within the development footprint of impacted farm portions to the existing power line will be required.
» Construction of a new power line of up to 132kV from the on-site Eskom switching station outside the Soafskolk road reserve within the development footprint of the impacted farm portions adjacent to the Aries-Helios 400kV power line, to the Eskom Aries Substation (up to 50km).
»

For both of the above options the construction of a high voltage switchyard and associated infrastructure including access road, security fence etc. will be undertaken

p) Undertake Site Remediation

Once construction is completed and once all construction equipment is removed, the site must be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operational phase must be closed and prepared for rehabilitation.

3.3.2 Operation Phase Activities and Facilities

The operation phase is discussed in more detail below. A simplified flow chart of the general operation of a Concentrated Solar Power Plant using Central Receiver and molten salt storage technology showing inputs and outputs of the process is shown in the table below.

Table 3.2: Process Flow for a Solar Thermal Plant – Operation phase only

Input	Process	Output
Solar energy	**Solar thermal energy generation process**	*Positive outputs:* Energy / electricity
Water		*Negative outputs:* Wastewater
Fossil fuel to start up		*Negative outputs:* Exhaust fumes / CO_2 at startup
Dosing chemicals for water treatment plant		*Negative outputs:* Wastewater/brine stream to evaporation pond

The operation phase will involve the generation of power using the CSP central receiver technology and electrical systems, as well as the day-to-day management and maintenance of associated support services and infrastructure. In this regard, the activities and/or facilities relevant to the operation phase are listed below, with further details provided in the sections which follow:

» Access and security services
» Generation of electricity using CSP technology
» Start-up and operational power supply and use
» Water supply and use
» Procurement, storage and use of consumables
» Maintenance and repair to operational equipment
» Waste management
» Emissions management
» Stormwater management infrastructure
» Management and administration facilities (including visitor and training facilities)
» Management of man camp and staff facilities
» Fire protection

a) Access and Security

Access routes established during the construction phase may be utilised during operations for staff and deliveries of consumables. The chosen access routes will be maintained by the project owner throughout the operational phase. Access control and security will be required for health, safety and security reasons. The Project Site will be enclosed by means of the relevant security measures. This will keep both the surrounding residents and land users safe from possible incidents and keep the developers investment safe. A security office with security personnel and associated communication network will be maintained throughout the project phases.

b) Power Generation

The sun's thermal energy collected across the heliostat field will heat molten salt which will be used to generate steam, which in turn will run steam turbine generators to generate electricity. Various associated electrical systems will be in place to control the power generation systems and integrate the plant with the national power grid.

Electricity produced will be supplied to either Eskom as part of the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme, or to any other Public Programme, privately owned entity, or Government entity. The exact operational profile of the plant would be dependent on generation controlled by the power purchaser's economic dispatch decisions and portfolio resource scheduling, transmission constraints and other factors, as well as on weather conditions to a limited degree. Given the inherent properties of the thermal energy storage system, the power plant can participate in the day-ahead scheduling market controlled by the power purchaser acting as scheduling coordinator for the generating unit. The plant can be run in various operating modes as indicated in Table 3.2.

Table 3.2: Facility Operating Mode Source: Technical Repor for Standard SRSA Project

Mode	Production	Collector field	Molten salt system	Power block
Standby	None	Heliostats moved from the stow position to standby aim points.	» Salt is pumped from the cold salt tank, up the tower and back to the cold salt tank. » The receiver panels are bypassed.	» Feedwater pumps are on to supply water for steam demand. » The steam turbine is rotated by the turning gear to ensure even heating. » Steam seals are established. » Vacuum is established in the condenser.
Preheat	None	Heliostats moved from standby aim points to the receiver panels to preheat the receiver.	» Salt flow is diverted to fill the receiver panels. » Hot salt flow is initiated and blended with cold salt to bring the steam generation modules up to operating temperature. » Salt is redirected into the hot salt tank once the salt temperature reaches ±580°C	» Steam from the superheater is admitted to the steam system to preheat the piping and begin heating the steam turbine. » The steam turbine is rotating on the turning gear to ensure even heating. » Steam seals are maintained. » Vacuum is maintained in the condenser.
Normal	Normal	Heliostats are focused on the receiver panels	» Cold salt flow is directed through the receiver to the hot salt tank » Salt flow control is set to limit salt temperature exiting the receiver to ±580°C.	» Hot salt is now flowing through the steam generating modules and steam flow is being generated » As steam temperature, pressure, and flow steadily increase, the steam turbine is taken off the turning gear, and the unit rolled with steam. » Once the steam parameters are sufficient, and the turbine metal temperatures have 47epressuri, the steam turbine generator is ramped to full speed, synchronized to the transmission network, and load increased to rated (dispatched) output.
Reduced Load	Substantially reduced	As per normal operation.	» Low hot salt inventory.	» Steam turbine generator is be turned down to partial load level (as low as 20%)

				» Produces sufficient electricity to support plant auxiliary loads and to keep the steam turbine generation system hot and ready for full load without cycling through the start-up process.
Supplemen -tal Heating	Normal	As per normal operation.	» Low hot salt inventory for periods less than six (6) hours » Additional hot salt can be produced by operating the diesel or Eskom powered supplemental heaters. » Cold salt is pumped through the convection heaters and delivered to the hot salt tank.	» As per normal operations.
Cloud Standby	Normal (while steam is still being produced)	As per normal operation.	» The salt flow is taken off automatic control. » Cold salt flow continues through the receiver panels to the hot salt tank until the salt temperature exiting the receiver drops below 370°C. » If cloud cover persists and will not allow further solar collection, the stored energy in the hot salt may be used to continue to produce steam and operate the steam turbine. » Once the hot salt temperature drops and steam quality cannot be maintained, the plant can be placed back into a Standby or Overnight Hold mode.	» As per normal operations while steam is still being produced. » If steam cannot be sustained, the plant can be placed back into a Standby or Overnight Hold mode
Overnight Hold	None (following exhausted	Heliostats in the stow position	» Once hot salt circuit cools to point where sufficient steam can no longer be produced, the receiver panels and	» Feedwater pumps are on to supply water for steam demand. » The steam turbine, once disconnected from the

	thermal storage)		tower are drained to the cold salt tank. » Limited cold salt pumping to regulate heat exchanger temperatures and maintain the steam generation modules at or near 285°C.	transmission network and steam flow stops, is placed on the turning gear. » Steam seals are maintained. » Vacuum is maintained in the condenser.
Long-term Hold	None (expected only during periods of extended maintenance outage >7 days)	Heliostats in the stow position	» Salt pumps are off. » Receiver panels and tower is drained. » The salt side of the steam generation modules is drained. » Salt in the storage tanks is maintained in a liquid state by means of installed electrical heat trace.	» The feedwater side of the steam generation modules is pressurised and drained, with a nitrogen blanket maintained to preclude corrosion inside the system. » The condenser is at atmospheric pressure. » The steam turbine is shutdown, cold, and off the turning gear.
Short-term Hold	None (This is a transition mode from Long-Term Hold to Standby as the facility is prepared for operation	Heliostats in the stow position	» The salt side of the steam generation modules is filled bringing the temperatures up to 285°C. » The receiver panels and tower remain drained.	» The water side of the steam generation modules is filled. » Feedwater pumps are on to supply water for steam seals. » The steam turbine is rotated by the turning gear to in preparation for start-up, » The condenser remains at atmospheric pressure.

c) Plant Cooling

Various cooling options were considered for cooling of the Project. Dry cooling technology was selected as the preferred option. Implementing this cooling technology allows for the use of considerably less water compared to that of a wet CSP Project.

d) Water Demand, Supply, Storage, Use and Treatment

CSP technologies function through the generation of steam to drive a conventional steam turbine and generator. Therefore, suitable and sufficient water resources are required. Water supply pipelines will be constructed and the required volume of water treated and pumped to the facility. Potable water will also be required for on-site staff.

Water Requirements
The project will require approximately 250 000m^3 of water per annum during the operation phase of the Project. Due to the location of the site it is proposed that the project will develop and utilise its own water provision services based on the fact that Municipal services do not reach the Project Site. Water during this phase will be required for the following uses:

» salt solution renewal
» steam generating cycle (makeup water and steam cycle blowdown quench water)
» dry cooling
» heliostat cleaning
» service water for maintenance
» potable use and ablutions
» dust suppression (mostly during construction);
» irrigation during rehabilitation
» fire protection water

Raw Water Supply for operations
The Kai !Garib Local Municipality have confirmed the availability of water from its purification works for the Proposed Project, which has a spare capacity of 4.5Ml per day (refer to Appendix C). The water will be conveyed via an underground pipeline situated within the road reserves of the R27 and the Soafskolk Road or within the servitude of the service road of the Saldanha – Sishen railway line for the operation of the CSP Project.

Please refer to Chapter 4 for a more detailed discussion on the selection of raw water supply alternatives.

Raw Water Storage

Raw water will be pumped from the holding reservoir (20 000m^3). A project storage reservoir with a storage capacity of 5 000m^3 will be located on the identified CSP 1 Project Site itself and will be topped up by the holding reservoir as required.

Water Treatment

The technology used for the CSP Project is highly sensitive and requires that all water used during operations conform to a rigorous water specification. All raw water entering the plant must be treated prior to use in the plant, and a water treatment plant will therefore have to be constructed[6]. The following infrastructure is associated the proposed raw water treatment plant:

- » Raw water storage tank/s
- » Reagent-dispensing systems
- » Pumps with filters
- » Filters, filter washing pump, blowers for washing filters
- » Cartridge filters and high-pressure pumps
- » Measurement systems: flow meters and pressure gauges
- » Reverse osmosis support frame
- » Membrane cleaning system
- » Electro-deionisation module
- » Storage tanks for water of different qualities (stabilised, filtered, osmotically-treated and demineralised waters)

The main water treatment subsystems are detailed below.

Water Treatment Subsystems

i. Multimedia Filter

The Multimedia Filter (MMF) contains multiple types of media with the coarse media layers in the top of the tank to trap large particles, and successively smaller particles trapped in the finer layers of media deeper in the bed. A coagulant will be introduced before the MMF inlet to capture fine particles for ease of filtration in the MMF. The multi-mediafilter is backwashed using reverse or upward flow of water through the filter bed.

ii. Reverse Osmosis

The Reverse Osmosis (RO) system is a filtration process that works by using pressure to force water through a membrane, retaining the contaminants on one side and allowing the pure water to pass to the other side. The RO will include an additional concentration step for RO serving to treat the waste from the main lines and reduce by a maximum the final waste from the system. An anti-scalant and de-chlorinator will be injected upstream of the RO skids to reduce the cleaning cycle of the membranes.

[6] The water treatment plant will operate an average of approximately 60% of each day, in order to minimise water treatment system size and capital cost, and to use off-peak energy at night.

iii. Electrodeionisation

Electrodeionisation (EDI) is a continuous and chemical-free process of removing ionised and ionisable elements and compounds from the water using Direct Current (DC) power. EDI is used to further refine water from the RO circuit. An EDI system has been chosen above a more conventional mixed bed ion exchange system, as this eliminates the need to store and handle hazardous chemicals used for resin regeneration and associated waste neutralisation requirements.

iv. Wastewater Recovery

In order to reduce raw water consumption, an evaporation and recovery unit is proposed which will evaporate and recover water at the end of the steam cycle, as well as from wastewater from the Reverse Osmosis circuit of the raw water treatment system. The recovered water will be reused in steam circuit. The evaporation and recovery unit will have a flow rate of approximately 10m^3/hour. The resultant, post-recovery waste will be discharged to the evaporation pond.

v. Water Balance

As indicated above, the Proposed Project will require approximately 250 000m^3 of water per annum during the operational phase of the project, depending on the requirements of the proposed dry cooling system. A detailed site-specific water balance will be prepared on finalisation of the detailed design of the project.

e) Evaporation Pond

The proposed CSP 1 Project will be operated as a Zero Liquid Effluent Discharge (ZLED) facility; therefore no wastewater will be permitted to be released into the environment or any water bodies. The plant waste discard stream will be piped from the power island wastewater tank at ambient temperature to on-site dual lined surface evaporation pond for de-watering. The purpose of the evaporation pond is to receive the water discard stream from the generation process. The discard water will be retained in the lined evaporation pond to evaporate, leaving solid waste constituents behind. The pond will be designed so that the residual solids will not require removal for the duration of the Project's operating life. If solids removal is necessary for pond maintenance reasons, the removed solids will be transported to an appropriate off-site disposal facility.

Up to three evaporation ponds are planned for the CSP 1 Project to allow plant operations to continue in the event that a pond needs to be taken out of service for maintenance purposes etc. Each pond will have enough surface area so that the evaporation rate exceeds the blow-down rate at maximum design conditions and at annual average climatic conditions. The planned pond depth (capacity), is therefore intended to avoid the need for residual solids removal during the life of the Project.

The wastewater is not classified as hazardous, however, the ponds will be designed in accordance with international and local SANS (1526:2003 – Thermoplastics sheeting for use as a Geomembrane and installation guidelines; 10409:2004 – Design, selection and installation of Geomembranes) requirements and will incorporate suitable HDPE liners with a leachate (leak detection system) in order to ensure no ground contamination.

Typical evaporation pond discard streams could have a total dissolved solids (TDS) of up to 60 000 ppm at a temperature of 40ºC and be roughly 85 000m^3 per annum production and solar resource dependant. Should a leak be detected, the leaking pond in question would immediately be drained into adjacent ponds and repaired. In the case of a catastrophic failure of one of the ponds, the contaminated topsoil layer will be removed and treated in a remedial soil treatment area and disposed of at an appropriate off-site disposal facility.

The remaining residue within the evaporation ponds will be stored in the pond, until the end of the CSP Project's lifespan, where the residue will be removed, and the evaporation pond sites will be remediated and rehabilitated.

The evaporation ponds will be located on the site and within the development footprint and outside of drainage areas. The total depth of the evaporation pond is 1.2 m that includes a 300 mm freeboard and a 105 mm allowance for crystalline salt build up. The crystalline salt build for the evaporation pond was calculated at 233 m^3/annum. Over a 30 year life span of the CSP Project this calculates to approximately 105 mm depth in each compartment of the evaporation pond.

A typical evaporation pond required for a CSP Project is illustrated in Figure 3.6.

Figure 3.6: Photograph of a typical lined evaporation pond utilised for a CSP Project

f) Procurement, Storage and Use of Consumables

In order to maintain operations, the project will require the procurement, storage and handling/use of the following consumables:

» Diesel
» spare parts and equipment
» hydraulic fluids
» process and treatment chemicals
» salt
» staff consumables
» lubricants
» detergents

Consumables will be stored according to end-use and pollution potential in appropriately designed and operated storage facilities. Bulk chemicals may be stored in storage tanks, and most other chemicals may be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills and may utilise concrete containment pits and drain piping. It is noted that make-up salt may be delivered in solid form and stored in such a facility. The salts would be heated and liquefied for use in the plant as and when required. It is possible that the storage facility established during construction could be used for the main plant consumable storage facility.

g) Maintenance and Repair Facilities

Maintenance areas and workshops may be operated in order to keep operational equipment and plant systems in optimal condition. These areas will be designed to ensure proper handling and use of materials and potentially polluting substances in an operationally effective and environmentally safe manner.

Heliostat washing is expected to be accomplished by diesel-fuelled tank trucks specially fitted with high-pressure washers. These trucks are filled with demineralized water and then driven slowly through the heliostat field, spraying high pressure water onto the heliostat mirrors effectively removing any accumulated dust or foreign matter. Biodegradable detergents may be used in this regard.

h) Waste Management

Waste management is the process whereby all wastes produced at the Proposed Project are minimised or reduced, properly collected, treated (if necessary), re-used (if possible) and removed from site for appropriate disposal or recycling. The operation phase of the Proposed Project may generate both liquid and solid waste streams, comprising general/domestic, hazardous and sewage waste. The liquid waste streams may include industrial and process effluent as well as sewage effluent. This is expected to be a hazardous waste stream. The solid waste streams may contain both non-hazardous and hazardous waste materials. In addition to the above, emissions from equipment and machinery ponds are also expected.

Liquid Waste

i. Primary Wastewater Collection System

The primary wastewater collection system will collect process wastewater from all of the plant systems, including the boiler and steam system drains and water treatment process equipment. To the extent practicable, process wastewater may be recycled and reused to reduce the raw water demand and the amount of effluent generated and disposed of. The collective discharge from this waste stream is classified as hazardous waste and will be sent to lined evaporation ponds where the water will be retained on site to evaporate, leaving solid waste constituents behind. The resultant solid waste will be removed from the site for final disposal at an appropriately licensed hazardous waste disposal facility.

ii. Plant Drains and Oil/Water Separator

General plant drains may be used to collect containment area wash down, sample drains and drainage from facility equipment and maintenance area drains. Water from these areas may be collected in a system of floor drains, hub drains, sumps, and piping and routed to a primary wastewater collection system. Drains that potentially could contain oil or grease would first be routed through an oil/water separator. The water from the plant's wastewater collection system will make up a portion of the liquid waste disposed of in the evaporation ponds.

iii. Boiler Blowdown

Depending on the type of steam boiler cooling system to be used, boiler blowdown wastewater may be generated. The boiler blowdown stream would consist of water purged continuously from the boiler during normal operations in order to control the concentration of dissolved solids, silica and pH in the boiler following accepted practices and guidelines for corrosion control. Boiler blowdown flow is purged directly from the boiler steam drum and discharged to a flash tank. Demineralised water is injected into the blowdown flow to limit the temperature of the blowdown (quench) water in order to prevent rapid flashing and over-pressurization when the blowdown water reaches the flash tank which is vented to atmospheric pressure. The flash tank collects and retains a minimum volume of water and drains excess volumes in equilibrium in a relatively continuous flow. This resultant wastewater is drained to remove high concentrations of accumulated salts and particulates. Accordingly, this is a potential hazardous substance and is considered a hazardous waste stream. The wastewater will be incorporated into the primary wastewater collection system for treatment in the evaporation ponds. This waste will not be disposed of on-site.

iv. Operational Sewage/Effluent Waste

Sewage/effluent waste streams may be generated at the administrative building, the operations building and maintenance areas within the power block and at the man camp. Each area may have a kitchen as well as the requisite quantity of toilets and or showers to support the crew size. Effluent from these areas will be treated by the wastewater treatment plant. This activity will adhere to the plant safety program as administered by plant personnel.

With respect to the handling and treatment design and operations of the proposed effluent treatment plant, the following philosophy will be put in place:

» A closed loop system will be introduced and implemented with regards to the handling, treatment and reuse of treated water.
» Effluent treatment of sewage/sanitation water will be done in such a manner that the treated effluent will adhere to the general limit effluent standards.
» It is proposed that treated effluent will be reused where possible.
» Any treated water that cannot be reused will be discharged to the evaporation ponds.
» Sludge will be removed off site for treatment at a municipal sewage treatment facility or disposed of at a licensed hazardous waste disposal facility.

Solid Waste
The Plant will produce solid maintenance and plant wastes typical of power generation operations. All waste to be generated on site will be subject to the principal of "Reduce, Reuse and Recycle" as far as possible before disposal is regarded as an option. Plant wastes include oily rags, broken and rusted metal and machine parts, defective or broken electrical materials, empty containers, broken mirrors, salt that has leaked and hardened, and other solid wastes including the typical domestic refuse generated by staff. Solid wastes will be temporarily kept on site and trucked offsite for recycling or disposal at a suitable recycling facility or licensed landfill site in the vicinity. Salt spills from the system or salt samples extracted pose no significant concerns with respect to hazardous waste. As such, any salt handled outside the closed salt circulation and storage systems will be treated as a controlled substance in terms of the relevant regulations.

Management of Hazardous Waste
Several methods will be employed to properly manage and dispose of hazardous wastes generated by the Plant. Lubricating oil will be rigorously analysed to ensure maximum equipment reliability and operational life. When end-of-life lubricating oil is replaced, the spent oil will be flushed from the system and recycled by a properly licensed waste oil recycling contractor. Spent lubricating oil filters will be changed at the appropriate frequency and disposed of in a licensed hazardous landfill. These waste materials will be temporarily stored on site, prior to collection for disposal, in appropriate containers (depending on whether in liquid of solid state). Plant personnel and maintenance workers will be trained to handle hazardous wastes generated at the site in accordance with all applicable regulations and protocols.

Evaporation ponds
The purpose of the evaporation ponds is to receive the water discard stream from the generation process. The discard water will be retained in the lined evaporation ponds to evaporate, leaving solid waste constituents behind. The ponds will be designed so that the residual solids will not require removal for the duration of the Project's operating life. If solids removal is necessary for pond maintenance reasons, the removed solids will be shipped to an appropriate off-site disposal facility

The wastewater is not classified as hazardous, however, the ponds will be designed in accordance with international and local SANS (1526:2003 – Thermoplastics sheeting for use as a Geomembrane and installation guidelines; 10409:2004 – Design, selection and installation of Geomembranes) requirements and will incorporate suitable HDPE liners with a leachate (leak detection system) in order to ensure that no ground contamination occurs.

i) Emissions

Diesel-powered Equipment

Diesel-powered equipment includes fire pumps and emergency generators. These will only be operated during emergencies and periodically for brief periods, as required by relevant codes and standards, for reliability testing or maintenance within strict limitations on acceptable fuels and maximum allowable run hours.

NOx Emissions

Nitrogen-oxides (NOx) will not be generated during operation of the Project; however, during plant commissioning, the initial melting, heating, and conditioning of the salt will result in limited NOx emissions (to below legislated volumes).

Salt conditioning

For the salt conditioning process, a multi-stage wet scrubber will be used to limit NOx emissions from the decomposition of magnesium nitrate inherent in the salt mixture. This series of operations is limited to a one-time event, resulting in a closed loop system of liquid salt storage and circulation.

j) Stormwater Management

A stormwater management plan will be developed for the Proposed Project for the prevention of clean stormwater runoff from entering the dirty water areas through the construction of clean and dirty water separation channels.

k) Operational Facilities

The operational facilities include (but are not limited to) the main plant, and electrical systems control facility, balance of plant, control room, laboratories, stores, general administration offices, visitors centre, and/or training centre. Offices will have suitable ablutions, catering and sanitation facilities.

The following staff facilities (including but not limited to) will be required:

- Staff parking
- staff drop-off and collection points
- man camp
- change rooms
- catering facilities
- ablutions and sanitation facilities
- appropriate first aid and emergency facilities

l) Fire Protection

A fire protection and prevention plan will be prepared for the operational phase of the project by the operator. The primary aim of this system will be to preserve and protect the receiving environment, human life as well as tangible goods and equipment in the event of a fire. The fire protection system will employ measures to contain and extinguish fires. A fire break along the site perimeter must be maintained.

m) Staffing Requirements

Although much of the plant and operations are automated, operators and maintenance staff as well as managers will be required to ensure that the plant is well maintained and functions optimally. The plant could employ between 30 and 45 people. Anticipated job classifications include plant operators, plant chemist/s, heliostat servicemen, mechanical and electrical technicians, various managers and administrators as well as semi-skilled and/or unskilled labourers.

n) Life of Operations

The Proposed Project will have a lifespan of approximately 20 to 30 years (typical to the technology), at which point the facility can be refitted or decommissioned. Should the plant be refitted, this could extend its operation for up to 60 years.

3.3.3 Decommissioning and Closure Phase

The decommissioning and closure of the Proposed Project will be done once the activity, which is expected to take place after a period of 20 to 60 years subsequent to its commissioning (depending on whether the plant is refitted) and proposed for further operations). A detailed plan for the decommissioning and closure of the facility will be drawn up before operations are ceased and submitted to the relevant competent authority for authorisation and ultimate implementation.

a) Decommissioning Activities

Similar to construction, the removal of the infrastructure associated with the Project would involve the preparation of the area, given the amount of machinery and workers that will remain and work on the decommissioning. The following decommissioning activities are relevant:

» Operational access roads are expected to be in good condition and be appropriate for the transit of decommissioning equipment (heavy cranes, special trucks, etc.).
» A small temporary decommissioning camp may be established with associated staff facilities.

» Laydown areas will be prepared as required. In this regard vegetation may require stripping and topsoil may be stockpiled for use in rehabilitation.
» All waste materials and chemicals will be removed for reuse in other facilities or proper management through authorised waste management service providers.
» The salt storage tanks will be emptied and washed and the salt products that can be sold as farming products may be solidified (since the salt used during the power generation process can be used as an agricultural fertiliser).
» The elimination of all lubricants and chemical products stored in the plant will be carried out. These products may be sold or turned over to an authorised waste management service provider, as they are not the plant's main components.
» Reusable elements are components that can be used again, i.e., are not waste. It is advantageous to find a use for these so-called sub-products, due to the reduced costs involved with the consequent economic and environmental benefits. The possible sub-products from the CSP Project will be multiple in terms of type, quantity and volume. Thus, certain substances are not considered "usable", such as salts, lubricants, etc. Other materials from the plant may be reusable in other such facilities, depending on their condition.
    - The heliostats, including the mirror modules, positioners, etc. will be dismantled and either sold (if still usable) or disposed at appropriate facilities.
    - Storage tanks, pumps, insulation, exchangers and salt conduits will be managed by recycling or reusing.
    - Turbine and generator components will be dismantled and may be sold as second hand equipment (if usable) or for their scrap value.
    - Electrical components will be removed and may be sold as second hand equipment (if usable) or for their copper content.
    - Steel structures will be dismantled and may be sold as second hand equipment (if usable) or for their scrap value.
» Concrete structures and buildings (including foundations) will be demolished and the rubble will be disposed of at appropriate facilities, unless otherwise agreed for an alternative use in line with the decommissioning and closure plan.

b) Rehabilitation

Following decommissioning and removal of all project material from the site, the disturbed areas will be rehabilitated to pre-project land capability. Where possible, rehabilitation will be conducted concurrently with decommissioning. The following rehabilitation activities are relevant:
» The existing profiles of the land affected will be improved and stabilised thereby leaving profiles not incompatible with the topography of the area, which is essentially flat.
» Ripping of compacted soils will be done prior to adding topsoil, which will be done by mechanical means. It is expected that there will be a sufficient amount of

topsoil and/or subsoil moved and stockpiled during the construction phase to facilitate rehabilitation.

» If required, potential areas or land for extracting topsoil or subsoil will be identified. The land capability characteristics of such areas should be similar to the affected soils (same texture, colour, permeability, etc.).
» Vegetation will be re-established. The plant species used will match those naturally occurring in the area. This will be conducted in consultation with a biodiversity specialist.

c) Aftercare and Maintenance

Following rehabilitation, a period of maintenance and aftercare will be required to ensure that rehabilitation is successful. In this regard, the following activities are relevant:

» Fertilisation of soil depending on soil fertility test results
» Control and removal alien/invasive species
» Replacement of unhealthy plants and altering vegetation composition, if needed
» Implementation of erosion controls (if required)
» Support irrigation (if required)
» Auditing of vegetation recover and adaption of strategies where necessary

d) Timeframes

The decommissioning activities are expected to take approximately two (2) years. Rehabilitation will take place concurrently, where possible, and is expected to be complete within a year following decommissioning. Aftercare and maintenance of the rehabilitated environmental may continue for two to three years thereafter.

PROJECT ALTERNATIVES CHAPTER 4

In terms of the Environmental Impact Assessment (EIA) Regulations, reasonable and feasible alternatives are required to be considered within the Environmental Impact Assessment process. All identified, feasible alternatives are required to be assessed in terms of social, biophysical, economic and technical factors.

A key challenge of the EIA process is the consideration of alternatives. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

» incrementally different (modifications) alternatives to the project; and
» fundamentally (totally) different alternatives to the project.

Fundamentally different alternatives are usually assessed at a strategic level, and EIA practitioners recognise the limitations of project-specific EIAs to address fundamentally different alternatives. Electricity generating alternatives have been addressed as part of the National Integrated Resource Plan (IRP) by the Department of Energy. In this regard, the need for renewable power generation has been identified. Kotulo Tsatsi Energy and SolarReserve are therefore proposing the development of a solar thermal generating facility using CSP Central Receiver Tower technology.

Incrementally different alternatives relate specifically to the project under investigation. "Alternatives", in relation to a proposed activity, means different ways of meeting the general purposes and requirements of the activity, which may include alternatives to:

» The property on which, or location where, it is proposed to undertake the activity;
» The type of activity to be undertaken;
» The design or layout of the activity;
» The technology to be used in the activity; and
» The operational aspects of the activity.

These alternatives are discussed below.

4.1. Site and Location Alternatives

The entire study area was subjected to a land capability assessment during the Scoping Phase which took into consideration the sensitivities identified at a desktop in order to optimise the siting of each CSP Project as far as possible. Based on the outcomes of this evaluation, some areas of the larger study area were excluded (as potential no-go areas) and potentially more suitable areas were selected (refer to Section 3.1.5).

The findings of the Scoping Phase provided preliminary indications of the suitability of an area to the west of the Aries – Helios power line for the siting of the CSP 1 Project. Therefore, during the early stages of the EIA Phase investigations, the siting of the CSP 1 Project was situated on the Remainder of the Farm Gemsboks Rivier 301. The subsequent results of the Ecological and Avifauna specialist studies prompted the EAP to recommend to the applicant that an alternative site be identified in another section of the Solar Park concept (i.e. consideration of site alternatives), in response to:

- The position of the CSP 1 Project to an active Martial Eagle nest with a fledging chick and within a 3km buffer around the nest, thereby placing these birds at greater risk from the CSP 1 Project.
- The position of the CSP 1 site within an area of the site considered by the ecological specialist to contribute to the Ecological Support Area / faunal migration corridor delineated in terms of the Namakwa Bioregional Plan and subsequently highlighted as a no-go area.

The original site alternative location to the west of the Aries – Helios power line was considered to potentially result in unacceptable environmental impacts. Therefore, the current siting of the CSP 1 Project on Portion 3 of the Farm Styns Vley 280 has been evaluated as being the option of least environmental impact and preferred site alternative for detailed assessment within this EIA.

Based on the outcome of the EIA Phase specialist studies, the positions/requirements of the infrastructure at CSP 1 have been further refined with the purpose of mitigating environmental impacts (i.e. consideration of micro-siting alternatives). At a broad-scale level, the site is considered to be highly favourable for CSP development due to suitable climatic conditions, topography and grid connection opportunities.

4.2. Activity Alternatives

As it is the intention of the developer to develop renewable energy projects as part of the DoE's REIPPP Programme or other similar energy programme or private agreement, only renewable energy technologies are being considered. Solar energy is considered to be the most suitable renewable energy technology for this site, based on the site location, ambient conditions and energy resource availability (i.e. solar irradiation).

The activity which is selected for implementation (and therefore assessment) is the generation of electricity, using CSP technology. CSP is the only one of the renewable technologies that utilises conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). CSP, through energy storage, can serve baseload demand requirements and due to its conventional power station nature has significant socio-economic benefits.

Alternative activities are limited to sheep grazing which would see a continuation of the status quo or no-project option however, as explained in Chapter 5, the viability thereof is very low due to the prevailing climatic conditions and very low agricultural potential.

4.3. Layout / Design Alternatives

Possible layout/design alternatives for the siting of CSP 1 and associated infrastructure, including the alignment of linear infrastructure such as access roads, power lines or pipelines are considered in this section of the report.

4.3.1. CSP Project footprint / design alternatives

The CSP 1 project and associated infrastructure will have a development footprint of up to 1 000 ha, to be placed within the assessed area of ~ 1586 ha, located within a broader study area of ~20 700 ha. The proposed CSP 1 project and its associated infrastructure can therefore be appropriately located within the broader site.

During the Scoping Phase potentially environmentally sensitive areas were identified for consideration in detail (through site-specific specialist studies) during this EIA Phase. The layout of the proposed facility occupies primarily areas of low ecological sensitivity associated with the mixed shrubland vegetation association and fringes on vegetation associations ascribed to have higher ecological sensitivity (refer to Section 6.8.1). In terms of heritage sensitivity, only one heritage site (abandoned Valsvlei residence) and grave / memorial was identified within the CSP 1 project area.

In this way the environmental sensitivity identification process informed the layout design for project. As far as possible, direct footprint impacts on more sensitive areas will be avoided where possible through detailed design. The layout plan provided by the developer is therefore considered to be the most optimal layout from an environmental perspective and the need to present further layout alternatives for the CSP 1 Project is constrained on this basis.

4.3.2. Grid connection options[7]

Loop in – Loop out of the existing 400kV power line: Realisation of a loop in – loop out configuration into the existing Aries – Helios power line will result in an overall reduced environmental impact. Based on the findings of the avifaunal study, the existing power line is however responsible for a high number of bird mortalities arising from collisions. Should a connection to the existing line be realised it would effectively form part of the project infrastructure. The developer would therefore have a role to play in the mitigation of avifaunal impacts on the line.

Construction of a new 132kV power line: A corridor of 1km in width (500m either side of the existing Aries - Helios 400kV power line) was assessed for the construction of the 132kV power line for the project. The ~50 km power line which is intended to connect the project to the Eskom Aries Substation has been deliberately sited outside the Soafskolk road reserve within the development footprint of the impacted farm portions adjacent to the existing Aries – Helios 400kV power line with the objective of restricting the environmental impacts as far as possible along this common alignment through the consolidation of linear infrastructure.

4.3.3. Raw water supply alternatives

The following raw water supply sources have been investigated during the EIA phase:

» Supply of water from the Kai !Garib Local Municipality (Kenhardt Reservoir);
» Abstraction from boreholes located near to the Project Site and on adjacent farms;
» Abstraction from a new location at a point on the Orange River.

a) Water supply: Municipal supply

As indicated in Section 3.3.2 (d), raw water has been agreed to be supplied by the Kai !Garib Local Municipality from the reservoir situated in Kenhardt (refer to Appendix C)and is the preferred water supply alternative. Based on official correspondence addressed to the developer (refer to Appendix C), spare capacity of 4.5Ml per day is available and an allocation of water has been confirmed for the Proposed Project. This is the preferred water supply alternative. Raw water will be conveyed via a new water supply pipeline to be constructed between the Kenhardt reservoir and the Project Site (further information provided below).

[7] The grid connection options for the project include either a connection to the Eskom grid via a loop in – loop out configuration to the existing Aries – Helios 400kV power line, or the construction of a new 132kV power line to the Eskom Aries Switching Station. **Final grid connection requirements will be determined by Eskom and therefore these options are not assessed as alternatives to each other in this report and are outside of the applicant's control.** All references to these two options in this section are done for comparative purposes only.

b) Water supply: Existing Boreholes

The study included an assessment of the aquifer potential through performing pump tests at six boreholes located within the broader study area. The boreholes were tested in accordance with the procedure recognised by the Department of Water and Sanitation requiring a 48 hour constant rate test. The borehole water quality and yield results are provided in Section 6.4.3.

c) Water supply: Abstraction from the Orange River

Raw water abstraction at a new location at a point along the Gariep (Orange) River and a water supply pipeline of approximately 110km in length was considered. This option presents potential challenges due to the number of farms required to be traversed by the pipeline, variations in topography and number of drainage lines required to be crossed by the pipeline. From this perspective, this is the least preferred water supply alternative.

4.3.4. Water pipeline alignment

In all of the above water supply alternatives considered, a pipeline for the conveyance of raw water from the supply point to the project raw water storage reservoir will be required, however the length and route/alignment of the pipeline will differ in each case.

In the case of the preferred water supply alternative (municipal supply from Kenhardt), water will be conveyed via an underground pipeline described below (refer to Map in Appendix A).

a) Water supply pipeline primarily within SANRAL servitude

From the direction of Kenhardt to the Project Site, the water pipeline could be situated primarily within the road reserves of the R27 (administered by SANRAL) before aligning with the Soafskolk Road to the south east of the site (administered by the Northern Cape Department of Roads and Public Works). This route is approximately 93km in length.

b) Water supply pipeline primarily within Transnet servitude

Alternatively, from the direction of Kenhardt, the water pipeline could be aligned with smaller access roads over a short distance before aligning with the reserve of the service road of the Sishen - Saldanha railway line (administered by Transnet). This route would align with the Soafskolk road to the north west of the site over a short distance. This route is approximately 92km in length.

Both alignments follow a fairly direct route from Kenhardt to the Project Site without having to traverse private property due to the existing servitudes. Wayleave applications to the relevant management authorities are required to be submitted in order to determine the requirements and conditions of these authorities in terms of the construction and operation of the water pipeline.

4.4. Alternative technologies to be used in the Activity

4.4.1. CSP Systems

The Solar Park concept will potentially consist of a mix of solar technology technologies including solar thermal and photovoltaic (PV) options. Two CSP technology types for implementation within the study area in order to maximise the capacity and land available on the site, namely: central receiver tower with molten salt storage and parabolic trough technology will ultimately be considered. Both technologies are based on the operating principle that the power gained from the sun can be maximised if the radiant energy of the sun is gathered and concentrated on a single point. By concentrating the sun's rays, CSP technologies maximise the amount of sunlight that can be converted into electricity, thereby reducing wastage and increasing output[8].

In developed countries, parabolic trough technology has dominated the concentrated solar thermal power industry for the last two decades (http://social.csptoday.com/ technology/towers-versus-troughs). It is reported that, currently, the main barrier to the promotion of central receiver tower and molten salt storage technology is derived from the fact that far less tower plants are currently operational internationally.

Ultimately it was determined during pre-feasibility that the central receiver tower and molten salt storage technology is the most feasible option for the site for the proposed Project and the local conditions; and the designs and calculations for the proposed plant were based on the utilisation of this system. As a first step in the realisation of the Solar Park concept, Kotulo Tsatsi Energy and SolarReserve proposes to develop a central receiver tower and molten salt storage plant based on increasing efficiencies of this technology in relation to CSP Trough technology as discussed below:

4.4.2. Advantages of CSP Tower and Heliostat Technology

Central receiver tower and molten salt storage technology is considered generally suited to the project site for the following reasons:

[8] CSP tower and CSP trough technologies are not considered to be alternative technology choices as they are fundamentally different solar thermal power technologies.

» Whereas an even or levelled land area is required for parabolic troughs, heliostats do not need to be sited on an even surface. Central receiver tower with a heliostat field and molten salt storage technology can even be deployed in slightly uneven terrain.
» As opposed to CSP trough technology, wholesale clearance of land is not a prerequisite for the installation of central receiver tower and heliostat technology. This means that the entire surface area occupied by the heliostat field will not necessarily require vegetation clearance and can be limited to the area directly beneath the individual heliostats. This will have environmental as well as stormwater management benefits.
» Central Receiver Tower plants have the potential to be much more efficient than trough plants, due to far higher concentration ratios.
» While trough plants produce heat at around 400°C, towers can produce up to 550°C. Higher temperatures allow use of more efficient turbines, reducing energy costs and improving storage times.
» Central Receiver Tower plants also have the potential for more efficient storage using molten salt as their working fluid, as well as the storage fluid.
» Central Receiver Tower plants can operate longer when solar resources are not available, as high temperatures allow for storing more energy using the same amount of heat storage media.

4.4.3. Advantages of CSP Trough Technology

A key advantage of parabolic troughs is that it is a very modular technology allowing the capacity of the plant to expand by adding additional loops in parallel. This lends itself to the incremental development of very large-scale parabolic trough plants in less environmentally sensitive areas. This modular nature of parabolic trough plants make them more suited to flatter and more contiguous areas of the larger study area. Suitable areas for the construction of trough plants have been identified in the northern sections of the broader study area and the current Project Site is not considered optimal for the construction of trough plants.

4.4.4. Cooling Alternatives

In thermal power generation there are predominantly two (2) types of cooling systems that are in use. These are wet cooling and dry cooling systems. These systems were evaluated and compared and the most suitable alternative of dry cooling was selected. Implementing this cooling technology allows for the use of considerably less water compared to that of a wet cooled solar thermal power plant. A comparative assessment of these cooling systems is provided below.

a) Wet Cooling

Evaporative wet cooling is widely considered to be the most common method for new power plants due to its economical and high performing cooling technique. This technique however consumes high volumes of water, in excess of 1 million m^3 per annum (or four times the amount of water required for the dry cooling option). Waste heat energy dissipated from the power plant is rejected to the air through evaporation of the cooling water. The cooling water evaporates in a cooling tower. As a result of the continuous evaporation, water treatment chemicals and minerals contained in the water become concentrated over time and require that a portion of the cooling water ("blowdown") be drained to remove high concentrations of accumulated salts and particulates.

b) Dry Cooling

Dry cooling uses considerably less water than wet cooling and is becoming more prevalent in new power plants due to the limitations on water in arid areas, where most solar thermal power plants are established. All of the waste heat from the plant is rejected to the air. Air however, has a much lower capacity to carry heat than water, and is considered less efficient as a cooling medium. Accordingly large fans are required to remove the heat from the pipe array in the cooling system, using a significant portion of the power generated by the plant.

In hot climates particularly, dry cooling is supplemented with hybrid cooling. Dry/hybrid cooling involves a combination of wet and dry cooling. Hybrid designs are aimed at reducing water consumption in comparison with wet cooling and enhance the plant's performance in warm weather when the thermal efficiency of dry cooling is least effective. Dry cooling systems use significantly less water than wet cooling systems and the turbine performance can be maintained on or close to design conditions. Considerably less blowdown will result when compared with a wet cooling system.

4.5. Alternative access during construction and operation

The CSP 1 Project Site is situated directly adjacent to and can therefore be directly accessed via an existing gravel access road (Soafskolk Road) branching off of the R27 between Kenhardt and Brandvlei. No access alternatives exist as the existing road is considered suitable for the project requirements on completion of the necessary intersection upgrades (at the R27) and surfacing requirements.

4.6. The 'Do-Nothing' Alternative

The 'do-nothing' alternative is the option of not constructing the CSP 1 plant. The no-go option would mean that the proposed CSP Project including all associated infrastructure would not be developed. Under this scenario, there would be no direct impacts on the area designated for the construction of the CSP 1 plant due to the associated construction and operation activities. Other CSP Projects would potentially still be developed within the broader study area.

4.6.1. Land use considerations for the Project Site

Agriculture: The current land-use is restricted to low intensity grazing. The natural grazing capacity is approximately 45 ha per stock unit or 7.5 ha per Small Stock Unit (SSU) - sheep. In terms of grazing capacity within the broader study area this equates to approximately 130 sheep per 1 000 ha lost to development. There are therefore no unique benefits to be realised considering the agricultural potential of the site. Under the no-go scenario, the land will continue to be of very low agricultural and economic benefit.

Ecology: The Lower Gariep Broken Veld and Bushmanland Basin Shrubland which occur within the broader study area are regarded as least threatened. There are therefore no unique benefits to be realised in these areas from an ecological perspective. The Bushmanland Vloere are classified as endorheic wetlands, which are created and maintained by seasonal accumulation of runoff water rather than flowing waters, leading to either seasonal waterlogging with little to no surface water, or seasonal slow-flowing or stagnant water, and in the case of these 'intrazonal inland' systems, are associated with high concentrations of salt in the environment. These systems do not occur within the CSP 1 site and will not be impacted. The benefit of the no-go scenario will be that the site which offers no particular ecological benefit will not be impacted.

4.6.2. Benefits to the economy

Sectoral growth: In addition to energy production projects, the Namakwa District Municipality Local Economic Development Plan identifies the development of the manufacturing sector linked to energy opportunities as one of its goals. Tourism potential projects include techno-tourism opportunities (related to space and energy development). The Proposed Project therefore has a role to play in the development of three economic sectors within the District Municipality in alignment with defined LED goals. The no-go alternative will reduce the potential to contribute to the development of these goals.

Economic contribution: Overall, the CSP 1 project is expected to make a notable positive economic impact on the local economies of the Hantam and Kai !Garib Local Municipalities due to the increase in construction activities in the area and the demand created for various services. It is estimated that one CSP Project will lead to generation of R13.6 billion of new business sales in the country during construction and in the process will create 17 700 Full Time Equivalent (FTE) jobs. Importantly, the local unemployment rates during construction are expected to notably decline for the period of 2.5 years while the project is being developed. During the operational phase, the CSP

Project will support R1.8 billion of new business sales on an annual basis and sustain 266 FTE jobs. The project will create much needed employment opportunities in the area and will contribute to the overall objective of national government of diversifying energy sources in the country and improving energy security.

In addition to the above, the positive socio-economic impacts that are associated with the project include skills development in the respective industries, increase in government revenue, improved livings standards of households who will benefit from created employment, as well as long-term injections into the local economies through SED and ED commitments during operations.

Should the do nothing alternative be selected, then the benefits of this project will not be realised, as the generation of electricity from renewable energy resources can offer a range of socio-economic and environmental benefits for South Africa.

4.6.3. General benefits associated with the CSP Project

A CSP Project of this extent has proven socio-economic spin-offs, most specifically during the construction phase but also during operation. These include:

- » **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of power supplementation and specifically CSP as it uses conventional steam generation coupled to storage which enhances despatchability i.e. being capable of supplying energy during the peak demand periods when it is most needed. In addition, renewables offer the opportunity for improving grid strength and supply quality, and result in generation facilities being deployed in a decentralised manner across the country (i.e. away from the dominant power house of the Mpumalanga coal fields).
- » **Resource saving:** Conventional coal-fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres, when compared with wet cooled conventional power stations. This translates into revenue savings of R26.6 million. As an already water-stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly due to the detrimental effects of climate change on water availability.
- » **Exploitation of our significant renewable energy resource:** At present, valuable national resources including biomass by-products, solar radiation and wind power remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.
- » **Pollution reduction:** The releases of by-products through the burning of fossil fuels for electricity generation have a particularly hazardous impact on human health and contribute to ecosystem degradation. The use of solar radiation for power generation

is considered a non-consumptive use of a natural resource, which reduces greenhouse gas emissions.

» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of greenhouse gas (GHG) emissions. South Africa is estimated to be responsible for ~1% of global GHG emissions and is currently ranked 9^{th} worldwide in terms of per capita CO_2 emissions.
» **Support for international agreements:** The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements (under the Kyoto Protocol), and for cementing its status as a leading player within the international community. The continuation of the Kyoto Protocol is endorsed by the Copehagen Accord, to which South Africa is signatory, thereby pledging that greenhouse gas emissions would be reduced from the "business as usual" growth trajectory by ~34% by 2020 and ~42% by 2025.
» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation in South Africa.
» **Acceptability to society:** Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.
» **Support to a new industry sector:** The development of renewable energy offers the opportunity to establish a new industry within the South African economy.

There are no overriding regional or site specific social or environmental reasons to pursue the no-go alternative.

APPROACH TO UNDERTAKING THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE — CHAPTER 5

The EIA process for the Proposed Project is regulated by the EIA Regulations of June 2010 (as amended), which involves the identification of and assessment of direct, indirect, and cumulative environmental impacts (both positive and negative) associated with a Proposed Project. The EIA process forms part of the feasibility studies for a project, and comprises a Scoping Phase and EIA Phase which culminates in the submission of an EIA Report together with an Environmental Management Programme (EMPr) to the competent authority for decision-making.

The EIA process for the proposed CSP 1 plant has been undertaken in accordance with the EIA Regulations in terms of Sections 24 and 24D of NEMA, as read with the EIA Regulations of GN R 543 – GN R 546 of Section 24(5) of the National Environmental Management Act (NEMA Act No. 107 of 1998). In line with the EIA Regulations, an application for authorisation was lodged with the National DEA for the Proposed Project. The Scoping Report, which considered the development of three CSP tower and two CSP parabolic trough plants (a total of five CSP Projects) was accepted by DEA on 27 November 2014. In terms of this acceptance of scoping, an EIA phase study (resulting in a separate EIA report) is required to be undertaken for each of the applications for authorisation for the five CSP Projects.

5.1. Relevant Listed Activities

In terms of sections 24 and 24D of the National Environmental Management Act (Act No 107 of 1998), as read with Government Notices R543 (Regulations 20–25), R544, R545 and R546 (as amended), environmental authorisation is required for various activities associated with the Proposed Project. The activities that are applied for are summarised in Table 5.1.

Table 5.1: Summary of the GN 544, 545 and 546, **listed activities** number and short description of the activities that require authorisation under NEMA

GN 544, 18 June 2010, Activity 9 (i) The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water with an internal diameter of 0.36 metres or more	*The proposed facility will include the construction of a pipeline with an internal diameter of 0.36 metres or more for the bulk transportation of water.*
GN 544, 18 June 2010, Item 10 The construction of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33kv but less than 275kV.	*The proposed facility will be required to evacuate electricity into the national grid and include the construction of a power line of up to 275kV an onsite substation and Eskom switching station.*
GN 544, 18 June 2010, Item 11 (xi) The construction of (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measures from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	*Infrastructure exceeding 50 m² will be required to be constructed within 32m of drainage lines identified on the project site.*
GN 544, 18 June 2010, Item 12 The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.	Ancillary infrastructure includes the construction of raw water storage reservoirs and evaporation ponds.
GN 544, 18 June 2010, Item 13 The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 80, but not exceeding more than 500 cubic metres.	*The auxiliary steam boiler will be used to provide process steam to the facility (i.e. to supplement generation). The fuel (i.e. diesel or liquid petroleum gas (LPG)) for the boiler will be required to be stored at the facility and will have a storage capacity of more than 80 cubic metres, but less than 500 cubic metres.*
GN 544, 18 June 2010, Item 18 (i) The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from a watercourse	*New access roads within the project site will traverse drainage lines which are required to be infilled for the construction of the road.*
GN 544, 18 June 2010, Item 22 (ii) The construction of a road, outside urban	*Access roads of ~8m in width are required to be constructed in order to access the*

areas, (ii) where no road reserve exists where the road is wider than 8 metres.	*project site from the main provincial gravel road.*
GN 544, 18 June 2010, Item 47 (ii) The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 meters	*The development of the facility may require the widening or lengthening of an existing road along certain sections in order to accommodate abnormal loads.*
GN 545, 18 June 2010, Item 1 The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more.	*The proposed Project will have a generating capacity of up to 200 megawatts.*
GN 545, 18 June 2010, Item 5 The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act (Act 59 of 2008) in which case that Act will apply.	*An evaporation pond is required to be constructed which will accept the water discard stream from the energy generation process.*
GN 545, 18 June 2010, Item 8 The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275kV 0r more, outside and urban area or industrial complex.	*The proposed facility will be required to evacuate electricity into the national grid and will require the construction of a 400kV substation and/or a 400kV loop in and loop out power line to facilitate a connection to the existing Aries – Helios 400kV power line.*
GN 545, 18 June 2010, Item 15 Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply.	*The total development footprint for the CSP facility, including associated infrastructure is ~ 1000 ha in extent.*
GN546 Item 2 (a) (iii) (bb) The construction of reservoirs for bulk water supply with a capacity of more than 250	*Ancillary infrastructure includes raw water storage reservoirs situated within an Ecological Support Area as identified in the*

cubic metres (a) in the Northern Cape (iii) outside urban areas in (bb) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	*Environmental Management Framework for the Namakwa District Municipality.*
GN546 Item 4(a) (ii) (cc) The construction of a road wider than 4 metres with a reserve less than 13,5 metres in (a) the Northern Cape (ii) outside urban areas in (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	*A road wider than 4 m will need to be constructed in a sensitive area as identified in the Environmental Management Framework (EMF) for the Namakwa District Municipality.*
GN546 Item 10 (a) (ii) (cc): The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres	*The auxiliary steam boiler will be used to provide process steam to the facility (i.e. to supplement generation). The fuel (i.e. diesel or liquid petroleum gas (LPG)) for the boiler will be required to be stored at the facility in a sensitive area as identified in the Environmental Management Framework (EMF) for the Namakwa District Municipality.*
GN546 Item 12 (b): The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.	*Construction will involve clearance of 300 m² or more of indigenous vegetation where 75% of which constitutes indigenous vegetation within a sensitive area as identified in the Environmental Management Framework for the Namakwa District Municipality.*
GN546 Item 13 (a)(c)(ii)(cc): The clearance of vegetation of an area of 1 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation in the Northern Cape Province in Ecological Support Areas identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.	*Construction will involve clearance of more than 1 ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation in the Northern Cape Province in Ecological Support Areas identified in the Environmental Management Framework for the Namakwa District Municipality.*
GN546 Item 14 (a) (i): The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation (a) In Northern Cape (i) outside urban areas	*An area of 5 ha or more of vegetation will need to be cleared where the vegetation consists of 75% or more of indigenous vegetation which is located outside an urban area in the Northern Cape.*
GN546 Item 16 (iv) (a) (ii) (dd): The construction of (iv) infrastructure	*Infrastructure larger than 10 m^2 which occur within 32 m of a watercourse will be*

covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In the Northern Cape, outside urban areas in (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	*required to be built in a sensitive area as identified in the Environmental Management Framework for the Namakwa District Municipality.*
GN546 Item 19 (a) (ii) (cc): Existing roads may need to be widened or lengthened in an area within sensitive areas as identified in an environmental framework.	*The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre in a sensitive area as identified in the Environmental Management Framework for the Namakwa District Municipality.*

The EIA Regulations were revised in December 2014 in terms of GNR 982 – 985. In terms of Sub-Regulations 53(2) and 53(3) of these Regulations) Transitional Arrangements):

" If a situation arises where an activity or activities, identified under the previous NEMA Notices, no longer requires environmental authorisation in terms of the current activities and competent authorities identified in terms of section 24(2) and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), and where a decision on an application submitted under the previous NEMA regulations is still pending, the competent authority will consider such application to be withdrawn".

and

"Where an application submitted in terms of the previous NEMA regulations, is pending in relation to an activity of which a component of the same activity was not identified under the previous NEMA notices, but is now identified in terms of section 24(2) of the Act, the competent authority must dispense of such application in terms of the previous NEMA regulations and may authorise the activity identified in terms of section 24(2) as if it was applied for, on condition that all impacts of the newly identified activity and requirements of these Regulations have also been considered and adequately assessed."

Therefore, similarly listed and additional activities relevant to the current application have been identified and are listed in Appendix B.

No additional listed activities within the EIA Regulations of December 2014 are relevant to the project.

5.2. Scoping Phase

In accordance with the EIA Regulations, the main purpose of the Scoping Phase is to focus the environmental assessment in order to ensure that only potentially significant issues and reasonable and feasible alternatives are examined in the EIA Phase. The Draft Scoping Report provided stakeholders with an opportunity to verify that the issues they have raised through the process to date have been captured and adequately considered, and provides a further opportunity for additional key issues for consideration to be raised. The Final Scoping Report incorporated all issues and responses raised during the public review of the Draft Scoping Report prior to submission to DEA. The Final Scoping Report was accepted by DEA on 27 November 2014 (refer to Appendix B).

The full extent of the project development site was evaluated within the Scoping phase of the EIA process.

The **potentially sensitive areas** which have been identified through the environmental scoping study across the full extent of the study area are listed below. The scoping sensitivity map was a rough scale estimate of sensitivity on the site identified at a desk-top level. This map represents potentially sensitive areas identified through scoping within which more investigation was required to be undertaken. The map has been further refined in this EIA phase on the basis of the specialist studies conducted, in order to inform appropriate siting and design of the proposed CSP 1 Project. These potentially sensitive areas already identified through the scoping study across the full extent of the broader study area include:

- Boesmanland Vloere (extensive valley floors with temporary precipitation accumulation).
- Ephemeral drainage lines (significant drainage lines with clear riverbed).
- An Ecological Support Area (ESA), delineated in the Northern Cape Bioregional Plan and the Namakwa EMF as a notational migration route across a large portion of the study area.

With an understanding of which areas of the site were excluded from development based on the desktop study, SolarReserve and Kotulo Tsatsi Energy prepared infrastructure layouts for the CSP Project for consideration within this EIA Phase. As indicated in Section 4.1, two site alternatives within the larger study area were considered, with the site initially considered at the start of the EIA process, being discarded on the basis of potentially unacceptable environmental impacts resulting in the development thereof, leading to the selection of the current CSP 1 Project Site.

5.3. Environmental Impact Assessment Phase

The EIA Phase for the Proposed Project aims to achieve the following:

» Provide a comprehensive assessment of the social and biophysical environments affected by the Proposed Project.
» Assess potentially significant impacts (direct, indirect, and cumulative, where required) associated with the proposed facilities.
» Comparatively assess any alternatives put forward as part of the projects.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public participation process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The EIA Report addresses potential direct, indirect, and cumulative[9] impacts (both positive and negative) associated with the Proposed Project including design, construction, operation and decommissioning. In this regard the EIA Report aims to provide the relevant authorities with sufficient information to make an informed decision regarding the proposed CSP 1 project.

5.3.1. Tasks completed during the EIA Phase

The EIA Phase for the proposed CSP 1 Project has been undertaken in accordance with the EIA Regulations published in GN 33306 of 18 June 2010 (as amended), in terms of NEMA. Key tasks undertaken within the EIA phase included:

» Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels).
» Undertaking a public participation process throughout the EIA process in accordance with Regulation 54 of GN R543 of 2010 in order to identify any additional issues and concerns associated with the Proposed Project.
» Preparation of a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 57 of GN R543 of 2010).
» Undertaking of independent specialist studies in accordance with Regulation 32 of GN R543 of 2010.
» Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 31 of GN R543 of 2010.

[9] "Cumulative environmental change or cumulative effects may result from the additive effect of individual actions of the same nature or the interactive effect of multiple actions of a different nature" (Spaling and Smit, 1993).

- » Prepare a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 57 of GN R543 of 2010).
- » Undertaking of independent specialist studies in accordance with Regulation 32 of GN R543 of 2010.
- » Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 31 of GN R543 of 2010.

5.3.2. Authority Consultation

The National DEA is the competent authority administering this application. A record of all authority consultation undertaken is included within this EIA report. Consultation with the regulating authorities (i.e. DEA and Northern Cape DENC) has continued throughout the EIA process. On-going consultation included the following:

- » The Final Scoping Report for the proposed SolarReserve Kotulo Tsatsi 1000MW Concentrated Solar Power Facility together with a Plan of Study for the EIA phase was submitted in September 2014. The Scoping Report was accepted by DEA on 27 November 2014.
- » A meeting was held between the project ecologist and representatives of the Northern Cape Department of Environment and Nature Conservation concerning the Ecological Support Area (possible faunal migration corridor) delineated in the Namakwa Bioregional Plan which occurs over a large part of the larger study area.
- » A site visit with the DEA was undertaken by representatives of the DEA and the EAP on 16 October 2014.
- » A site inspection was attended by representatives of the DEA (Directorate: Strategic Infrastructure Developments, the Sub-directorate: Biodiversity Policy Development Mainstreaming; and Integrated Environmental Authorisations), the Department of Environment and Nature Conservation (Northern Cape Province) and the EAP on 9 September 2015.

The following will also be undertaken as part of the EIA phase:

- » Submission of a final EIA Report to DEA following a public review period for the draft EIA (40 days) and final EIA report.
- » The DENC will be requested to comment on the draft EIA as well as the relationship of the Ecological Support Area relative to the site, informed by the specialist reports and supporting documentation.
- » Notification and Consultation with Organs of State that may have jurisdiction over the project, including:
  - * Provincial and local government departments (including South African Heritage Resources Agency, Department of Water and Sanitation, South African National Roads Agency Limited, Department of Agriculture, Forestry and Fisheries, etc.).

A record of consultation with DEA and the DENC in the EIA process is included within Appendix B.

5.3.3. Public Involvement and Consultation

The aim of the public participation process is primarily to ensure that:

» Information containing all relevant facts in respect of the application is made available to I&APs for review;
» Participation by potential I&APs is facilitated in such a manner that I&APs are provided with a reasonable opportunity to comment on the application;
» Adequate review periods are provided for I&APs to comment on the findings of the draft Scoping and Environmental Impact Assessment Reports.

In order to accommodate the varying needs of stakeholders and I&APs within the study area, as well as capture their inputs regarding the project, various opportunities for stakeholders and I&APs to be involved in the EIA Phase of the process have been / will be provided, as follows:

Scoping phase
The EIA process, commenced in March 2014, and was announced with an invitation to organs of state, potentially affected and neighbouring landowners and the general public to register as I&APs and to actively participate in the EIA process. Table 5.2 below summarises the activities undertaken as part of the public participation process during the Scoping Phase of the EIA process.

Table 5.1: Summary of Public Participation Process - Scoping Phase

	Activity	**Date**
Scoping Phase	The EIA process was advertised in the Gemsbok and the Volksblad newspapers.	Volksblad: 8 July 2014 Gemsbok: 11 July 2014
	Placement of site notices, on-site and in public places.	23 July 2014
	Distribution of process notification letters and background information documents to organs of state departments, ward councillors, landowners within the study area, neighbouring landowners and stakeholder groups.	17 June 2014
	Placement of newspaper advertisements in the Gemsbok and Volksblad and notifying I&APs of the availability of the draft Scoping Report and Public	30 July 2014

	Meeting date.	
	40-day public review period for the draft Scoping Report for public comment.	29 July 2014 – 08 September 2014
	Public Meeting & Focus Group Meetings	13 August 2014 – 14 August 2015
	Notification to registered I&APs of submission of final Scoping Report to DEA	15 September 2014

EIA Phase

The draft EIA Report for the proposed SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 will be available for a 40 day review period from 2 November 2015 – 12 December 2015. Table 5.3 below summarises the activities undertaken as part of the public participation process during the Scoping Phase of the EIA process.

	Activity	Date
EIA Phase	Advertisements announcing the availability of the draft EIA Report will be placed in the "Volksblad" newspaper and the "Gemsbok" at the onset of the public review period.	Volksblad: 29 October 2015 Gemsbok: 4 November 2015
	Letters notifying registered I&APs of the availability of the draft EIA Report will be distributed via email and registered post	2 November 2015

Advertisements announcing the availability of the draft EIA Report will be placed in the "Volksblad" newspaper and the "Gemsbok" at the onset of the public review period. Letters notifying registered I&APs of the availability of the draft EIA Report will be distributed via email and registered post on 2 November 2015. I&APs are encouraged to view the draft EIA Report and submit written comment thereon. CD and hard copy versions of the draft EIA Report will circulated to Organs of State via courier at the start of the 40-day review period. Affected and neighbouring landowners as well as I&APs will be invited to view the report at the Kai !Garib Local Municipality in Keimoes, the Kenhardt Public Library and the Hantam Local Municipality in Brandvlei as well as on Savannah Environmental's website.

In terms of the requirement of Chapter 6 of the EIA Regulations of June 2010, the following public participation tasks have been undertaken:

» Distribution of Letters of Notification to I&APs to inform them on the project, the Scoping phase comment period and the initiation of the EIA phase.
» Fixing of notice boards at several conspicuous places on the site.

» Giving written notice to owners and occupiers of land adjacent to the site.
» Providing written notice to the municipal ward councillor and municipality having jurisdiction in the area.
» Placing an advertisement in local newspapers.
» Opening and maintaining a register/ database of interested and affected parties and organs of state.
» Release of a Draft Scoping Report and Draft EIA Report for Public Review for a 40-day period.
» Hosting of a Public Meeting and Focus Group Meetings during the scoping phase and EIA phase by the EAP to discuss and share information on the project.
» Preparation of a Comments and Responses Report which document all the comments received and responses from the project team.
» Apart from the 40 day commenting period on the Draft EIR, in order to give effect to Regulation 56(2), registered Interested and Affected parties will be given access to, and an opportunity to comment on the final report before submitting the final environmental impact assessment report to the DEA.

A record of the documents relevant to the above-mentioned public participation process is contained within Appendix D.

Below is a summary of the key public participation activities conducted up to this point in the process.

» **Placement of Site Notices**
Site notices were fixed on site at conspicuous places including the intersection of the R27 and Soafskolk road and at various points along Soafskolk Road to the Project Site (refer to Appendix D). The site notices were also placed along the power line corridor.

» **Identification of I&APs and creation of an electronic database**
The first step in the public participation process was to identify relevant stakeholders and I&APs. This process was initiated during the Scoping Phase of the EIA process. A database of Interested and Affected Parties (I&APs) was created through utilising existing contacts and databases, recording responses to site notices and newspaper advertisements, as well as through the process of networking. I&APs which were identified are listed in Table 5.3 below.

Table 5.3: Interested & Affected Parties identified during the EIA Process

Organs of State
National Government Departments
Department of Agriculture, Forestry and Fisheries
Department of Communications
Department of Energy
Department of Mineral Resources

Department of Public Works
Department of Rural Development and Land Reform
Department of Water and Sanitation
Department of Science and Technology
Government Bodies and Institutions
Eskom
National Energy Regulator of South Africa (NERSA)
Sentech
South African Civil Aviation Authority (CAA)
South African Heritage Resources Agency (SAHRA)
Square Kilometre Array: Southern Africa
Telkom SA Ltd
Provincial Government Departments
Ngwao-Boswa Ya Kapa Bokone (Northern Cape Provincial Heritage Resources Authority)
Northern Cape Department of Agriculture, Land Reform and Rural Development
Northern Cape Department of Environment and Nature Conservation (DENC)
Northern Cape Department of Roads and Public Works
Local Government Departments
Hantam Local Municipality
Kai !Garib Local Municipality
Namakwa District Municipality
ZF Mgcawu District Municipality
Conservation Authorities
BirdLife South Africa
Endangered Wildlife Trust
Wildlife and Environment Society of South Africa (WESSA)
Landowners
Affected landowners and tenants
Neighbouring landowners and tenants

All relevant stakeholder and I&AP information has been recorded within a database of interested and affected parties (refer to Appendix D9 of the draft EIA Report for a listing of recorded I&APs). While I&APs have been encouraged to register their interest in the project from the start of the process, the identification and registration of I&APs will be on-going for the duration of the EIA process and will act as a record of I&APs involved in the public participation process.

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» **Newspaper Advertisements**

A first round of newspaper adverts was placed to inform the public on the Proposed Project.

A second round of newspaper advertisements were placed to advertise the availability of the draft scoping report and public meeting in the following newspapers:

* Volksblad (8 June 2014) and the Gemsbok (11 June 2014).

A third round of newspaper adverts during the EIA phase was placed to advertise the public meeting:

* Volksblad (27 March 2015) and the Gemsbok (3 April 2015).

A fourth round of newspaper adverts during the EIA phase was placed to advertise the availability of the draft EIA Report for review.

Refer to Appendix D for proof of advertisements which were placed.

» **Consultation with I&APs and stakeholders**

In order to accommodate the varying needs of stakeholders and I&APs within the study area, as well as capture their views, issues and concerns regarding the project, various opportunities have been and will continue to be provided to I&APs to have their concerns and comments captured during the EIA process.

Focus group meetings were held with key government departments, stakeholders and landowners during the 40 day review period. The purpose of these focus group meetings was to introduce the project, facilitate comments on the EIA and note down any issues or concerns raised by stakeholders. The meetings that were held are listed in Table 5.4 below.

Table 5.4: Focus Group Meetings - EIA Phase

Meeting:	**Contact Person:**	**Date and Venue:**
Kai !Garib Local Municipality	Johnny Mackay Meyer Clarke	29 April 2015 Kai !Garib Local Municipality, Kakamas
Landowners Focus Group Meeting	Impacted and Adjacent Landowners	29 April 2015 Farm Gannakom, Kenhardt
Department of Water and Sanitation	Shaun Cloete Danie Potgieter	30 April 2015 DWS, Louisvale Road, Upington
Northern Cape Department of Roads and Public Works	Gerhard Lottering	30 April 2015 DRPW Offices, Provincial Building, Upington

A public meeting was convened on Wednesday 29 April 2015 at 18:00 at the NG Kerk Hall in Kenhardt. The public meeting was cancelled at 18:30 as no one attended the public meeting.

5.3.4. Identification and Recording of Issues and Concerns

All comments received from stakeholders and I&APs on the project to date are included in Appendix D6 of the draft EIA report. The minutes of the focus group meetings are attached in Appendix D7 of the draft EIA Report. All comments received from organs of state, landowners and other stakeholders are included in the Comments and Responses Report which is contained in Appendix D8 of the draft EIA Report.

5.3.5. Assessment of Issues Identified through the Scoping Process

Issues which require investigation within the EIA Phase, as well as the specialists involved in the assessment of these impacts are indicated in Table 5.5 below.

Table 5.5: Specialist studies undertaken as part of the EIA

Specialist Study Undertaken	Specialist	Appendix
Ecology, including flora, and terrestrial fauna	Marianne Strohbach of Savannah Environmental	Appendix E
Avifaunal Impact Assessment	Rob Simmons of Birds Unlimited Environmental Consultants	Appendix G
Surface Water and Groundwater Assessment including aquifer tests	Martiens Prinsloo of Future Flow Groundwater and Project Management Solutions cc	Appendix Ij
Soils and Agricultural potential	Johan van Tol of HydroPedological Solutions	Appendix J
Heritage impact assessment	Jaco van der Walt of Heritage Contracts and Archaeological Consultants	Appendix K
Palaeontological impact assessment	Jon Almond of Natura Viva	Appendix L
Visual impact assessment	Mandy van der Westhuizen from NuLeaf	Appendix M
Noise assessment	Morne De Jager of Enviro-Acoustic Research cc	Appendix N
SKA Risk Assessment	Callie Fouche of ITC Services	Appendix O
Traffic Impact Assessment	Paul van der Westhuizen of Siyazi	Appendix P
Social impact assessment	Candice Hunter of Savannah Environmental and Neville Bews of Neville Bews and Associates	Appendix Q
Economic Impact Assessment	Elena Broughton of Urban-Econ Development Economists	Appendix R

Specialist studies considered direct, indirect, cumulative, and residual environmental impacts associated with the development of the proposed CSP Project. Issues were assessed in terms of the following criteria:

» The **nature**, a description of what causes the effect, what will be affected, and how it will be affected
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high)
» The **duration**, wherein it is indicated whether:
  * The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1
  * The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2
  * Medium-term (5–15 years) – assigned a score of 3
  * Long term (> 15 years) - assigned a score of 4
  * Permanent - assigned a score of 5
» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  * 0 is small and will have no effect on the environment
  * 2 is minor and will not result in an impact on processes
  * 4 is low and will cause a slight impact on processes
  * 6 is moderate and will result in processes continuing but in a modified way
  * 8 is high (processes are altered to the extent that they temporarily cease)
  * 10 is very high and results in complete destruction of patterns and permanent cessation of processes
» The **probability of occurrence**, wh0ich describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
  * Assigned a score of 1–5, where 1 is very improbable (probably will not happen)
  * Assigned a score of 2 is improbable (some possibility, but low likelihood)
  * Assigned a score of 3 is probable (distinct possibility)
  * Assigned a score of 4 is highly probable (most likely)
  * Assigned a score of 5 is definite (impact will occur regardless of any prevention measures)
» The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high
» The **status**, which is described as either positive, negative or neutral
» The degree to which the impact can be reversed
» The degree to which the impact may cause irreplaceable loss of resources
» The degree to which the impact can be mitigated

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M) P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
» **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area)

As the developer has the responsibility to avoid or minimise impacts and plan for their management (in terms of the EIA Regulations), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. A draft EMPr is included as Appendix S.

5.3.6. Assumptions and Limitations

The following assumptions and limitations are applicable to the studies undertaken within this EIA Phase:

» All information provided by the developer and I&APs to the environmental team was correct and valid at the time it was provided.
» It is assumed that the development site identified by the developer represents a technically suitable site for the establishment of the proposed CSP Project.
» It is assumed correct that the proposed connection to the National Grid is correct in terms of viability and need.
» Studies assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated, or offset.
» This report and its investigations are project-specific, and consequently the environmental team did not evaluate any other power generation alternatives.

Refer to the specialist studies in Appendices E – R for specialist study specific limitations.

5.4 Legislation, Policies and Guidelines which have informed the EIA Process

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

» National Environmental Management Act (Act No 107 of 1998)
» EIA Regulations, published under Chapter 5 of the NEMA (GN R543, GN R544 and GN R546 in Government Gazette 33306 of 18 June 2010)
» Guidelines published in terms of the NEMA EIA Regulations, in particular:
  * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010).
  * Public Participation in the EIA Process (DEA, 2010).
» International guidelines – the Equator Principles and IFC Requirements

Several other acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the EIA Report. A review of legislative requirements applicable to the Proposed Project is provided in the **Table 5.6.** .

Table 5.6: Relevant legislative permitting requirements applicable to the CSP 1 project

Legislation	**Applicable Requirements**
National Environmental Management Act (Act No 107 of 1998)	The EIA Regulations have been promulgated in terms of Chapter 5 of the Act. Listed activities which may not commence without an environmental authorisation are identified within these Regulations. In terms of S24(1) of NEMA, the potential impact on the environment associated with these listed activities must be assessed and reported on to the competent authority charged by NEMA with granting of the relevant environmental authorisation. In terms of GN R982, R983, R984 and R985 of December 2014, a Scoping and EIA Process is required to be undertaken for the proposed project.
National Environmental Management Act (Act No 107 of 1998)	In terms of the Duty of Care Provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised. In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.
Environment Conservation Act (Act No 73 of 1989)	National Noise Control Regulations (GN R154 dated 10 January 1992)
National Water Act (Act No 36 of 1998)	Water uses under S21 of the Act must be licensed, unless such water use falls into one of the categories listed in S22 of the Act or falls under the general authorisation (and then registration of the water use is required). Consumptive water uses may include the taking of water from a water resource and storage - Sections 21a and b. Non-consumptive water uses may include impeding or diverting of flow in a water course - Section 21c; and altering of bed, banks or characteristics of a watercourse

	- Section 21i.
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act. Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act. S53 Department of Mineral Resources: Approval from the Department of Mineral Resources (DMR) may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	Measures in respect of dust control (S32) and National Dust Control Regulations of March 2014. Measures to control noise (S34) - no regulations promulgated yet.
National Heritage Resources Act (Act No 25 of 1999)	Stipulates assessment criteria and categories of heritage resources according to their significance (S7). Provides for the protection of all archaeological and palaeontological sites, and meteorites (S35). Provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority (S36). Lists activities which require developers any person who intends to undertake to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development (S38). » Requires the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites as part of tourism attraction (S44).
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened and protected species has been published in terms of S 56(1) - Government Gazette 29657.

	» Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002), 9 December 2011). » This Act also regulates alien and invader species.
Conservation of Agricultural Resources Act (Act No 43 of 1983)	» Prohibition of the spreading of weeds (S5) » Classification of categories of weeds and invader plants (Regulation 15 of GN R1048) and restrictions in terms of where these species may occur. » Requirement and methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R1048).
National Forests Act (Act No. 84 of 1998)	According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.
National Veld and Forest Fire Act (Act 101 of 1998)	In terms of S12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material. In terms of S17, the applicant must have such equipment, protective clothing, and trained personnel for extinguishing fires.

Hazardous Substances Act (Act No 15 of 1973)	This Act regulates the control of substances that may cause injury, or ill health, or death due to their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products. Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc., nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared as Group I or Group II substance • Group IV: any electronic product; and • Group V: any radioactive material. The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.
Development Facilitation Act (Act No 67 of 1995)	Provides for the overall framework and administrative structures for planning throughout the Republic. S (2-4) provide general principles for land development and conflict resolution.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of this Act (GN 921), a Basic

	Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that: » The containers in which any waste is stored, are intact and not corroded or in any other way rendered unlit for the safe storage of waste. » Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land in the Province
National Road Traffic Act (Act No 93 of 1996)	» The technical recommendations for highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. » Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts. » The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.

Northern Cape Nature Conservation Act, Act No. 9 of 2009	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: » Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property; » Aquatic habitats may not be destroyed or damaged; » The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. » The Act provides lists of protected species for the Province.
Astronomy Geographic Advantage Act (Act No. 21 of 2007)	» The Astronomy Geographic Advantage Act (No. 21 of 2007) provides for the preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy; for intergovernmental co-operation and public consultation on matters concerning nationally significant astronomy advantage areas and for matters connected thereto. » Chapter 2 of the act allows for the declaration of astronomy advantage areas while Chapter 3 pertains to the management and control of astronomy advantage areas. Management and control of astronomy advantage areas include, amongst others, the following: * Restrictions on use of radio frequency spectrum in astronomy advantage areas; * Declared activities in core or central astronomy advantage area; * Identified activities in coordinated astronomy advantage area; and * Authorisation to undertake identified activities.

DESCRIPTION OF THE RECEIVING ENVIRONMENT CHAPTER 6

This section of the EIA Report provides a description of the receiving environment that may be affected by the proposed CSP 1 Project situated on Portion 3 of the Farm Styns Vley 280 (Surveyor General Code:C03600000000002800003).

Information is provided in order to assist the reader in understanding the receiving environment within which the proposed facility is situated. However, the broader study area has also been mapped/described in some instances to adequately describe the Project relative to the surrounding area, including the footprint for the larger solar park concept.

Features of the biophysical, social and economic environment that could directly or indirectly be affected by, or could affect, the proposed development have been described. This information has been sourced from existing information available for the study area, as well as collected field data from the EIA process, and aims to provide the context within which this EIA is being conducted.

6.1 Regional Setting: Location of the Study Area Assessed

The larger study area is located approximately 70km south west of Kenhardt and 60km north east of Brandvlei in the Northern Cape Province and falls within the jurisdiction of two Local and District Municipalities. The bulk of the broader study area falls within the Hantam Local Municipality (Ward 3) which is part of Namakwa District Municipality; and the north eastern side of the study area borders the Kai !Garib Local Municipality (Ward 9) which is part of the ZF Mgcawu District Municipality.

The broader study area includes seven farm portions that total approximately 20 700 ha in extent (refer to Figure 6.1). The entire 20 700ha of the study site i.e. Portion 1, 2, and 3 of the Farm Styns Vley 280, Remaining Extent of Farm Melkbosch Vley 278, Portion 2 of Farm Kopjes Vley 281, Portion 1 of Farm Gemsbok Rivier 301 and Remaining Extent of Farm Gemsbok Rivier 301 was subjected to the EIA level assessment in order to:

» Provide a thorough and comprehensive view of the larger study area which was included in the assessment.
» Provide the option of identifying more suitable sites for development of the individual CSP Projects, should any of the areas be found to be technically or environmentally constrained.

The entire study area is located on land that is privately owned (one landowner). The Aries - Helios 400kV power line is located north of the site. The Aries Substation is situated approximately 50km north east of the site.

The closest main access road to the proposed site is the R27 which is a Regional Route that consists of two disjoint segments. The first segment, also known as the West Coast Highway, connects Cape Town with Velddrif along the West Coast. The second runs from Vredendal via Vanrhynsdorp, Calvinia, Brandvlei and Kenhardt to Keimoes on the N14 near Upington. The broader site can be accessed from public gravel roads off the R27 with the most direct access provided by Soafskolk Road. The Sishen/Saldanha freight railway line bypasses the site to the north west.

Proposed CSP 1 project: The Project Site is situated within the Hantam Local Municipality (Ward 3) within the Namakwa District Municipality. A broader site of 1586ha in extent of the larger 20 700ha study area was assessed in order to allow for the movement of individual project components where necessary and in order to respond to the identified technical or environmental constraints. The Project Site is situated adjacent to Soafskolk Road (within 20m) to the east and the Aries-Helios 400kV power line (up to 50km) to the north. The CSP 1 Project Site is characterised by a barren flat to uneven surface bisected by a number of shallow drainage basins. Land use in the general area is dominated by low intensity sheep farming and the affected farms are divided into livestock camps.

6.2 Climatic Conditions

The climate for the study site is expected to be most similar to that of Kenhardt, located approximately 70 km north east of the study area. The area receives on average between 123 mm to 248 mm of rain per year. Moisture availability, which is the ratio of rainfall to evapotranspiration is one of the most important climate parameters for agriculture, and in this area is described as presenting a very severe limitation to agriculture. Rainfall amounts can vary significantly from year to year, and thunderstorms are typical during the early rainy season (Namakwa Bioregional Plan, 2008).

The average midday temperatures for Kenhardt range from 19.3°C in July to 35.5°C in January. The region is the coldest during July when the temperatures on average drop to 2.2°C during the night, but can go below 0°C. The first occurrence of frost may be experienced as early as May and marks the end of the growing season (if not brought on earlier due to a lack of moisture availability).

6.3 Topographical Profile

The larger study area is described as moderately undulating (slopes 3-5%) to flat with few isolated outcrops, draining south-east into ephemeral water washes that drain into the Verneuk Pan System located 18 km to 45 km southeast and east of the study area. The topography of the Project Site area however is flat and homogenous. Elevation across the Project Site ranges from 940m above sea level in the west to 950m above sea level in the east of the Project Site (refer to Figure 6.1). There are no prominent hills within the Project Site with the highest areas of elevation situated to the north east of the Project Site.

6.4 Hydrological Characteristics

6.4.1 Surface water

The study area falls within Water Management Area (WMA) 14 within Quaternary Catchment D57D. The most significant watercourse within the WMA is the Orange (Gariep) River. The Hydrological Characteristics of catchment D57D are summarised as follows:

- Mean Annual Precipitation = 137.68mm;
- Mean Annual Runoff = 1.6mm; and

Hydrological Zone = K.
A non-perennial stream exists approximately 2 800 m west of CSP 1. This stream drains southerly towards the Gemsbokrivier. The Gemsbokrivier discharges into the Sak River approximately 30km downstream of the study area
As it was observed on site, the river bed is dry and consists mainly of small rocks. The river banks are covered with light vegetation and a few trees.

The significance of this stream is rated low as stream flow on the river bed is not readily evident. It is also emphasised that this stream is located at the upper reaches (most upstream point) of Quaternary Catchment D57D. Upper reaches of the catchment are associated with low flows as the effective catchment area is small. Unlike perennial streams, this stream does not have dry weather flow as runoff is only observed during significant storm events and becomes dry for months. From a biological point of view, this stream cannot support flow-dependant aquatic life.

Numerous non-perennial streams define a poorly developed dendritic drainage pattern; these rivers are seasonal and flow only after periods of heavy rainfall. There are a number of dry pans that occur throughout the study area

6.4.2 Groundwater

Two aquifers occur in the area. These two aquifers are associated with the primary / composite material and the underlying competent and fractured rock material.

Primary / composite material aquifer: The primary sand and gravel aquifer in the project area is found in close proximity to watercourses. Sand and gravel, poorly rounded and sorted, clayey gravel and clay attain a maximum thickness of 11m. Saturation is generally confined to narrow, deeper channels that may coincide with zones of weathering in the underlying rock.

Basal deposits in the Hartbees River consist of clayey well rounded gravel about 3m thick, the gravel is overlain by sand, silt and clay about 10m thick. The uppermost deposits consist of gravelly sand. Below the confluence of Driekop Se Rivier, alluvial deposits attain a thickness of up to 37m consisting of fine-grained and clayey material.

Low groundwater yields (0.06 to 0.6 L/s) were struck in the sandy deposits, which have a saturated thickness of 2m to 5m. Groundwater yields exceeding 1 L/s were struck in underlying weathered and fractured metamorphic rocks.

Underlying fractured rock aquifer: Although the lower permeability unweathered rock material will retard vertical infiltration of groundwater, it is expected that around 10% to 30% of the water in the upper aquifer will recharge the lower aquifer. The competent rock is subjected to fracturing associated with tectonic movements during volcanic intrusions and associated faulting.

Drilling results in the project area showed that only four of a possible eleven boreholes were successful, with ranges of between 1.5 to 8 L/s. Weathering and fracturing were reported in 29.8 % of the boreholes.

6.4.3 Depth to groundwater level and flow patterns

There is a slight hydraulic disconnect between the primary and underlying fractured rock aquifers. The depth to groundwater level in the primary aquifer averages 6.98 meters below ground level (mbgl). The underlying fractured rock aquifer shows depth to groundwater level measurements ranging between 14.65 and 32.48 mbgl.

Plotting the groundwater level elevation against topography normally indicates areas where external influences influence the groundwater levels. Plotting the groundwater level elevation against topographical elevation for the primary aquifer yields a 99% correlation, while a similar plot for the fractured rock aquifer yields an 88 % correlation. From this it is concluded that the groundwater levels in the fractured rock aquifer does not mimic topography in the areas where the boreholes are located, possibly due to the effect of current groundwater abstraction.

The groundwater level elevation contours shown in Figure 6.2 are based on the limited information that was available in the study area from the eight measured groundwater levels. Groundwater flows are expected to be directed from the high lying areas toward the topographical lows.

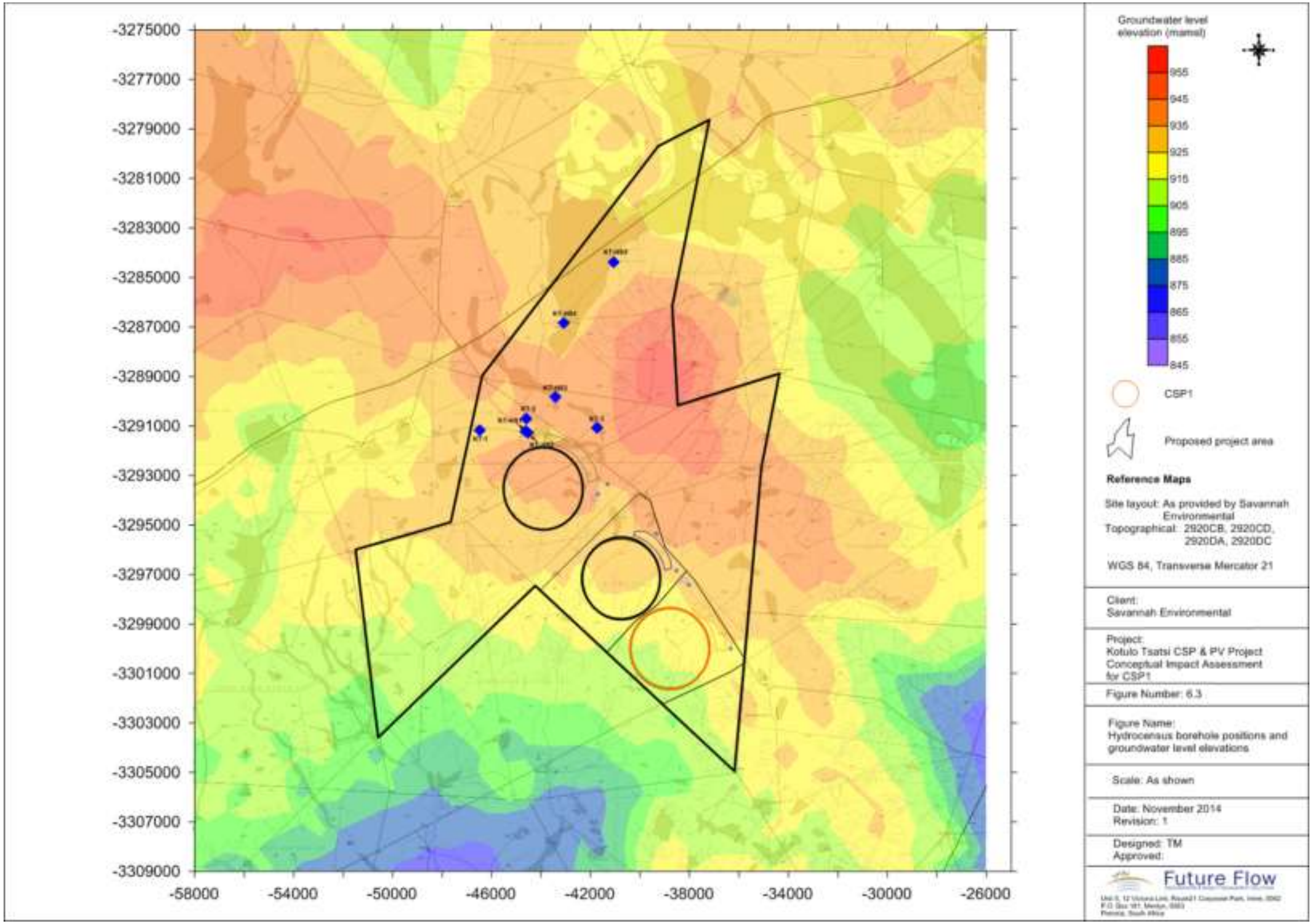

Figure 6.2: Hydrocensus Borehole positions and groundwater elevations relative to the CSP 1 project area (red circle)

6.4.4 Groundwater quality and supply potential

The boreholes in the area are used for water supply by the local landowners. The water is used for domestic, as well as stock watering purposes.

Groundwater quality: A total of thirteen groundwater quality samples were collected. Electrical conductivity, TDS, Chloride, Sulphate and Nitrates and Sodium were found to exceed the SANS 241:2011 guidelines in the majority of boreholes sampled as shown in Table 6.1 below. Consumption of groundwater could therefore induce various negative effects on human health.

Borehole yields: Aquifer supply potential tests were conducted on four boreholes (identified to be the highest yielding boreholes within the study area) located to the north of project in order to determine the extent of groundwater supply. Calculations show that the sustainable yield for the tested boreholes (using a 24 hour pumping day, 365 days a year) is around 130m^3 per day within the study area.

Boreholes tested outside of the project area at Dagab and Francis Visagie Farms yielded results in the region of 263.5m^3 per day and 3.5m^3 per day respectively. However, it should be cautioned that the borehole tested at Dagab is one of a series of boreholes situated around a dam that holds water after rainfall events. The recharge to the aquifer, and also the volume of water kept in storage in the weathered material underlying the dam, is artificially increased by the storage of water on surface. As far as it is known, this borehole has not been used to any great extent recently and it is possible that the yield was artificially increased due to the storage of water on surface (and this would lead to an overestimation of the sustainable yield of the borehole).

Table 6.1: Groundwater chemical analysis results

Parameter	Unit	SANS 241:2011 guideline value	KT-HS1	KT-HS2	KT-HS3	KT-HS4	KT-HS5	KT-HS6	KT1	KT2	KT3	KT4	KT5	Visagie	Dagab
pH		5 – 9.7	7.65	7.80	8.17	8.89	7.51	8.27	7.78	8.02	7.56	8.25	8.24	8.39	8.23
EC	mS/m	<170	1 068	529	407	378	366	449	720	494	541	448	422	246	186
TDS	mg/L	<1 200	7 027	3 238	2 793	2 538	2 499	3 419	4 612	3 029	3 441	3 273	3 299	1 606	1 344
Alkalinity	mg/L	N/L	331	249	172	147	270	350	181	92.1	262	412	306	41.4	200
Chloride	mg/L	<100	2 891	1 301	995	851	860	982	1 821	1 176	1 213	971	955	642	106
Sulphate	mg/L	<240	1 183	756	506	556	543	644	641	757	625	507	638	373	674
Nitrate	mg/L	<11	89.6	0.261	72.6	60.4	31.6	104	136	0.888	85.3	104	125	1.06	1.57
Ammonia	mg/L	<1.5	0.432	1.56	0.484	0.407	0.045	0.311	0.052	0.055	0.041	0.195	0.446	0.917	0.026
Ortho-Phosphate	mg/L	N/L	0.102	0.030	0.030	0.132	0.034	0.028	0.031	0.029	0.029	0.029	0.028	0.045	0.045
Fluoride	mg/L	<1.5	0.759	0.331	0.776	0.574	0.667	1.04	1.29	3.46	0.941	1.00	0.921	0.142	2.36
Calcium	mg/L	N/L	667	518	265	206	303	397	300	113	490	429	390	56.6	104
Magnesium	mg/L	N/L	283	163	174	110	89.2	164	211	16.4	157	127	164	0.404	30.2
Sodium	mg/L	<200	1 396	340	419	452	394	587	922	899	412	522	402	500	296
Potassium	mg/L	N/L	7.09	3.87	5.67	4.11	4.25	5.04	3.64	3.91	4.04	4.90	5.57	2.87	2.36
Aluminium	mg/L	<0.3	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron	mg/L	<0.3	<0.003	0.052	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese	mg/L	<0.1	<0.001	0.395	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Chromium	mg/L	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	<2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.011	0.014	<0.001	<0.001
Nickel	mg/L	<0.07	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	<5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt	mg/L	<0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Cadmium	mg/L	<0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	<0.01	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.016	<0.004	<0.004	<0.004
Total hardness	mg/L	N/L	2 830	1 966	1 380	968	1 125	1 524	1 617	350	1 873	1 596	1 651	143	384

Exceed SANS241:2011 guideline
mS/m = millisiemens per metre
mg/L = milligram per litre
N/L = No guideline value

6.5 Geological and Palaeontological Profile

6.5.1 Geological background

As shown in Figure 6.3 the north-eastern two thirds or so of the broader study area are underlain by glacially-related sediments of the Permo-Carboniferous Dwyka Group (Karoo Supergroup, C-Pd). However, only the northernmost sector of the CSP Project study area itself is underlain by Dwyka rocks. The majority of the CSP Project study area, including the entire development footprint on Styns Vlei 280, is underlain by postglacial basinal mudrocks of the Prince Albert Formation (Karoo Supergroup, Ecca Group, Pp) of Early Permian age. The Karoo Supergroup sediments have been locally intruded and baked by extensive intrusive sheets or sills of the Karoo Dolerite Suite (Jd) which build a north-south trending zone of rocky terrain running along the eastern border of Styns Vlei 280 as well as scattered outcrops further to the northeast and east (e.g. Klipheuwels). Small exposures of much older Precambrian basement rocks of the Namaqua-Natal Province are mapped to the east of the present broader study area on the farm Karee Boom Kolk 248 and similar outcrops may also occur subsurface in the broader study area itself. These comprise two billion year old granitoid intrusions.

6.5.2 Results of the Palaeontological survey

The field study shows that the Karoo Supergroup sediments, Karoo dolerites and any older basement rocks within the broader study area, including the Proposed Project development footprint, are almost entirely mantled with a range of Late Caenozoic superficial deposits, mostly of Late Tertiary to Quaternary age. They include alluvium, pan sediments, calcrete hard pans as well as surface and subsurface gravels and may reach thicknesses of several meters or more. Where exposed in borrow pits along the major roads and the Sishen-Saldanha railway line and in other artificial excavations (e.g. farm dams), the bedrocks are often weathered and calcretised to a depth of several meters, reflecting periods of both drier and wetter climates in the geologically recent past. The projecting small koppies within the area consist largely of dolerite and occasionally of associated baked (thermally metamorphosed) country rocks.

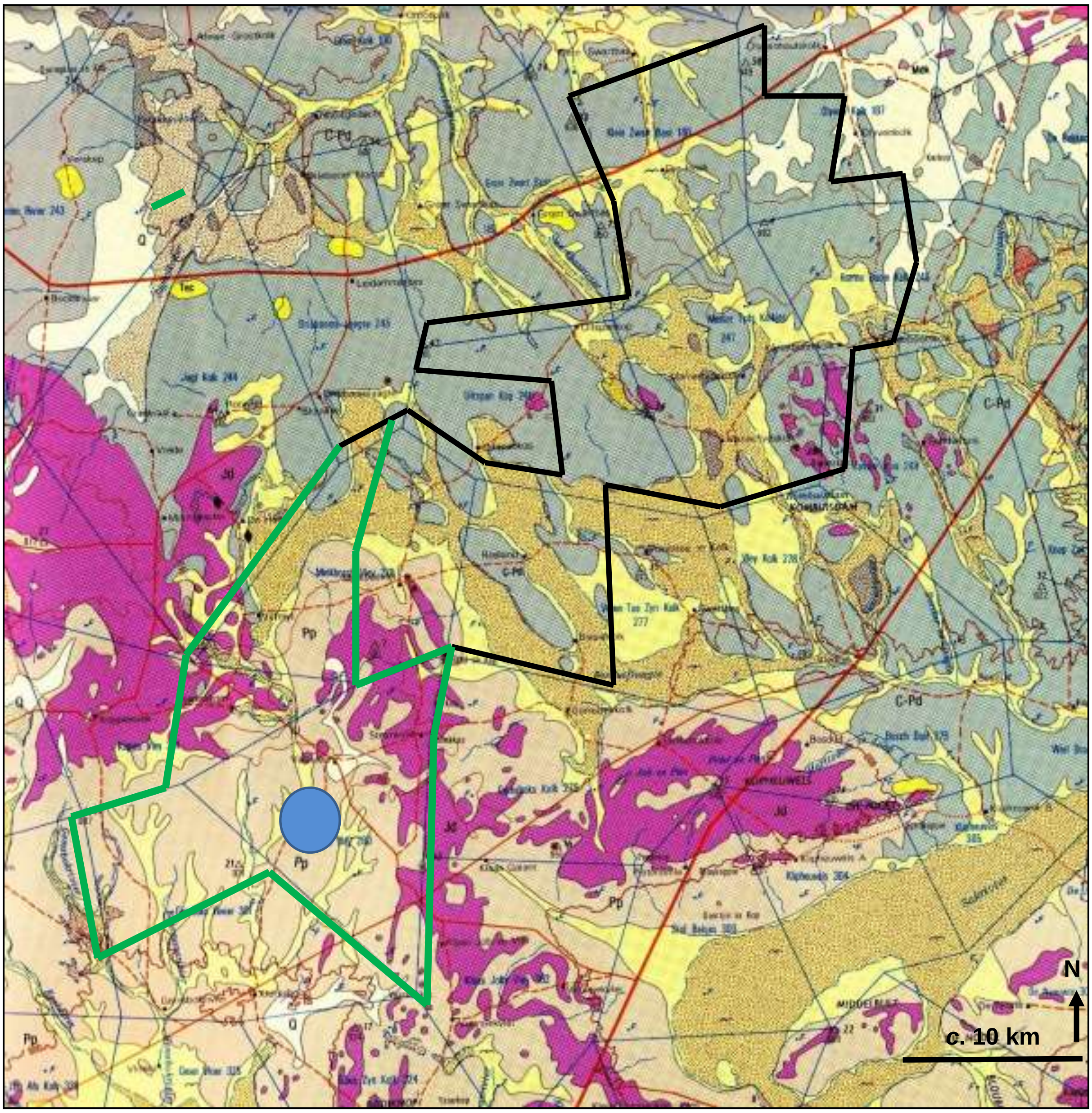

Figure 6.3: Extract from 1: 250 000 geological map 2920 Kenhardt (Council for Geoscience, Pretoria) showing the approximate outline of the broader study area, including land parcels involved in with the power line (black polygon) as well as the larger study area (green polygon) and Project Site (blue circle).

6.5.3 Palaeontological Heritage

Desktop analysis of the fossil records of the various sedimentary rock units underlying the broader study area, combined with field assessment of numerous representative rock exposures within and close to this area, indicate that all of the geological units are of low to very low palaeontological sensitivity. The potentially fossiliferous Karoo Supergroup bedrocks (Dwyka and Ecca Groups) are deeply weathered and extensively calcretised near-surface. Over the majority of their outcrop areas the bedrocks are mantled by various superficial deposits that may reach thicknesses of several meters and that are of low palaeontological sensitivity. These include alluvium, colluvium, a wide range of surface gravels, calcrete hardpans and pan sediments. The only fossil remains recorded during the field assessment are (1) small-scale fossil burrows within Prince Albert Formation mudrocks of Early Permian age, (2) downwasted, ice-transported blocks (erratics) of Precambrian stromatolitic carbonate within surface gravels overlying the Dwyka Group tillites, and (3) rare calcretised termitaria of probable Pleistocene or younger age embedded within weathered Dwyka bedrocks. These fossils are all of widespread occurrence within Bushmanland and special protection or mitigation measures for the very few known fossil sites are therefore not required.

6.6 Soils and Agricultural Potential

6.6.1 Soils and agricultural capability

Existing soil information was obtained from the Land Type database (Land Type Survey Staff, 1972 – 2002). A land type is an area with similar climate, topography and soil distribution patterns which can be demarcated on a scale of 1:250 000. One land type dominates the area covered by the Project, namely Fc137.

F-land types are generally young landscapes where the dominant pedological processes have been weathering, clay illuviation and formation of orthic A horizons. Although the dominant soil forms are normally shallow Glenrosa and Mispah forms, any other soil forms can be accommodated in F-land types provided that they do not qualify the area for inclusion in other land types. The dominant soils in these land types are often shallow, thereby limiting the suitability for crop production.

In land type Fc137, shallow Mispah and Glenrosa soils as well as rock outcrops dominates and covers approximately 70% of the area. Slightly deeper Clovelly and Oakleaf soils cover the remaining 30%. Although the land type database is invaluable to provide background to the study site, it was created on a 1:250 000 scale does not necessary reflect the actual soils on the site.

A predictive mapping approach, instead of traditional grid survey, to capture the variability in soils and soil associations, was undertaken. Based on the site visit undertaken by the soil and agricultural potential specialist, a soil distribution map (Figure 6.4) was generated and the following soil associations distinguished:

- Ag: Augrabies soils (orthic A/neocarbonate B) occurred in the majority of the drainage lines which were covered with large shrubs. These soils are relatively deep (>850 mm) due to alluvial deposits.
- Ms/Ag/R: Large parts of the study area are covered by rock outcrops or shallow Mispah (orthic A/rock) and Coega (orthic A/harpan carbonate). Due to the shallow depths and hence limited storage capacity, erosion might be a problem on steeper slopes.
- Pr: Prieska soils consists of orthic A on neocarbonate horizons on harpan carbonate horizons. These soils are generally shallow (approximately 450 mm).

The soils are sandy with a clay content of less than 12 and 15% in the A and B horizons respectively.

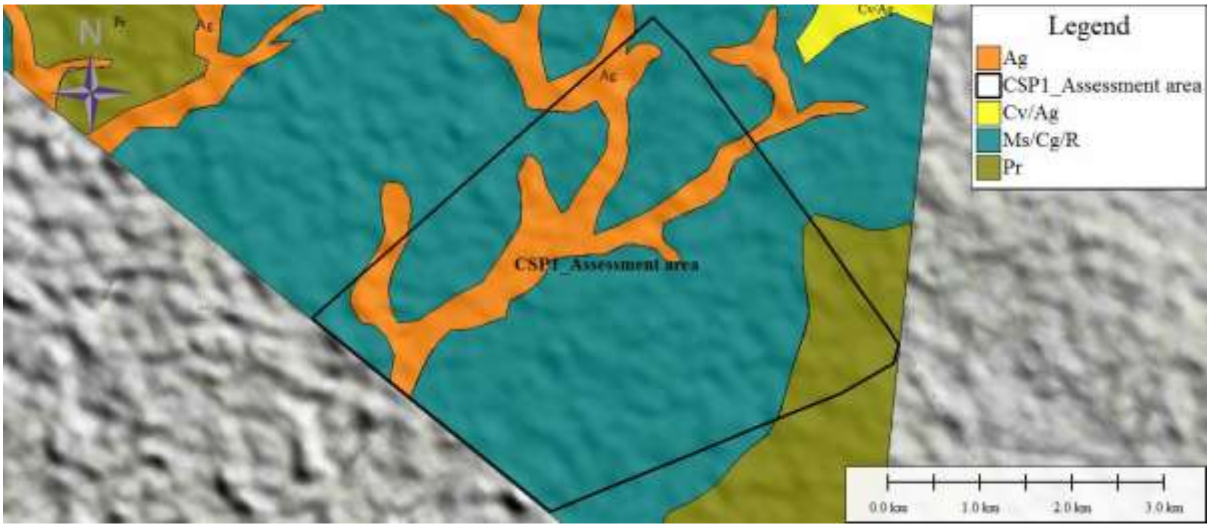

Figure 6.4: The soil association map of the project assessment area for CSP 1

The overall agricultural potential of the site is very low, largely restricted by the arid climate conditions and shallow soils. The Cv/Ag and Ag soil associations are the only areas of the site suitable for crop production should adequate water for irrigation be available.

6.6.2 Land use and carrying capacity

The current land-use is restricted to low intensity grazing. The natural grazing capacity of the larger solar farm is between 41 and 60 ha per stock unit. For the Project, this figure is approximately 45 ha per stock unit (or 7.5 ha per Small Stock Unit (SSU) i.e. about 107 sheep for the total development footprint of project). The low rainfall, high potential evaporation, high maximum and low minimum temperatures, coupled with shallow soils covering most of the site, limits any alternative land-use activities. A number of non-perennial drainage lines are present, but the dominant source of water for agricultural purposes is groundwater.

6.7 Ecological Profile

6.7.1 Vegetation description and associated habitats

Overall, the vegetation is described by Mucina and Rutherford (2006) to consist of the following vegetation types:

- Lower Gariep Broken Veld (Least Threatened)
- Bushmanland Basin Shrubland (Least Threatened)

- Inland Azonal Wetland type Bushmanland Vloere (Least Threatened) with riparian vegetation on the banks of few small ephemeral water washes that drain mostly into lower-lying pan-systems beyond the study area.

Vegetation associations within the larger Solar Park concept study area can be primarily divided into habitats with alluvial deposits and habitats without such deposits, the latter mainly with shallow soils and a high percentage of surface rock.

Associations on Alluvial Soils (habitats derived/influenced strongly by fluvial action) include:

- Association 1: *Cenchrus ciliaris – Lycium bosciifolium* ephemeral drainage lines
- Association 2: *Rosenia spinescens – Salsola rabieana* pans
- Association 3: *Rosenia humilis – Enneapogon desvauxii* valley floors
- Association 4: *Aridaria noctiflora – Salsola namaqualandica* Boesmanland Vloere

Associations on shallow soils with calcrete hardpans, dolerite boulders or shales include:

- Association 5: *Microloma sagittatum – Osteospermum armatum* Broken Plains
- Association 6: *Stipagrostis ciliata – Zygophyllum chrysopteron* Calcrete Plains
- Association 7: Mixed shrublands on undulating rocky plains

Differences between sample sites in terms of species present is the highest in the fluvial systems (Associations 1-4), indicating that the presence of the plant species is highly event-driven (i.e. as variable and unpredictable as the rainfall events), with several species being introduced there due to seeds deposited there from runoff off surrounding, higher lying areas (but the latter only persisting in low numbers).

Of the seven vegetation associations identified within the broader study area, four occur within the Project Site with Mixed Shrublands and Calcrete Plains dominating, followed by valley floors and ephemeral drainage lines. Each association is further described below and mapped in Figure 6.5.

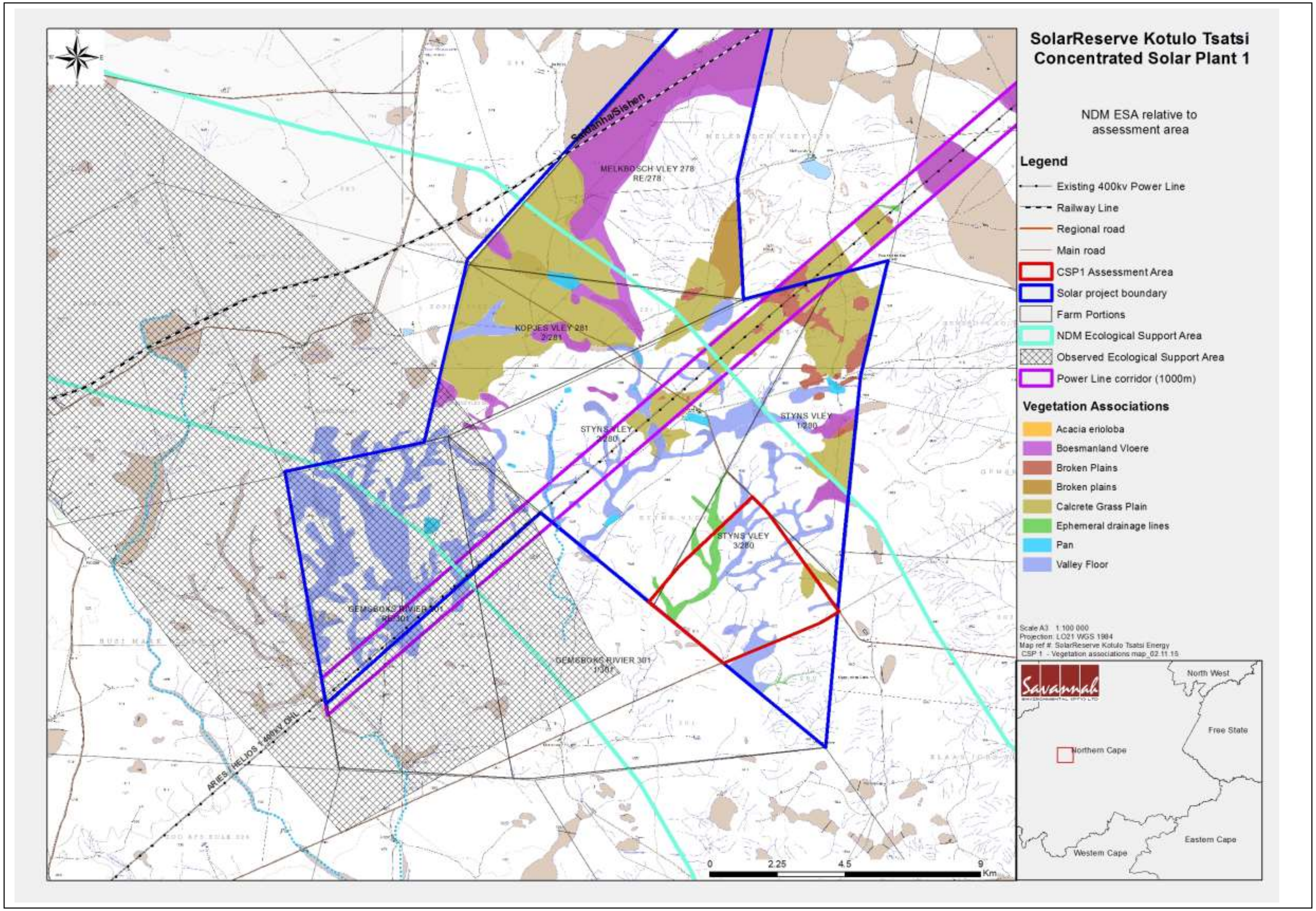

Figure 6.5: Vegetation Associations mapped across the CSP 1 study area

Mixed shrublands

The mixed shrublands have been mapped as a single unit, as their general ecosystem processes, sensitivity and functionality are relatively uniform. However, due to differences in micro-topography and underlying geology and associated soil moisture regimes, the vegetation ranges from a very sparse, low shrub layer to areas with denser, higher shrubs.

It is anticipated that most of the Proposed Project development will be situated on these areas which have an overall low conservation and sensitivity value.

Figure 6.6: General view of the mixed shrublands

Calcrete Plains (Stipagrostis ciliata – Zygophyllum chrysopteron)

These undulating plains are associated most with broken plains, and occasionally border on small pans and other fluvial systems. The vegetation consists mostly of a taller grass layer of variable density (Figure 6.7), interspersed by a low density of low and medium shrubs. High shrubs are generally rare, but do occur in smaller groves where these seem to be preferred places for fauna to rest under during the midday heat.

Localised species diversity was low during the survey, but is expected to be higher after sufficient rains when geophytes and annual species emerge.

Figure 6.7: View of the calcrete grass plains.

Ephemeral Drainage Lines (Cenchrus ciliaris – Lycium bosciifolium)

Drainage lines can be found in narrower incisions within the undulating plains, most of them too small to map individually. Occasionally, smaller washes can also be found within smaller valley floor areas, indicating that these smaller valley floors do not have the same flood-buffering capacities as the larger systems. Generally, the steeper the surrounding undulating low slopes, the larger the drainage lines with a more pronounced and deeper sand-bed in the centre, resulting from many centuries of accumulation of sands.

Figure 6.8: Vegetation along one of the larger drainage lines in the study area

The riparian vegetation consists of a relatively dense low shrub and palatable grass layer – the latter often characterised by patches of the more nutritious grass, *Cenchrus ciliaris*. High shrub cover within the riparian vegetation is extremely variable, ranging from almost none, to dense stands of *Lycium*, *Phaeoptilum* and *Rhigozum* and/or *Parkinsonia* species.

Valley Floors (Rosenia humilis – Enneapogon desvauxii)

The Valley Floors are generally very old, well-established and stable floodplains – typical of the pre-river optimal runoff accumulation and flow systems of southern African drier ecosystems.

The ecosystem processes here can be summarised as follows:

» The Valley Floors are relatively continuous fluvial systems, accumulating runoff from higher undulating areas to lower-lying pans, but always with the possibility of a unidirectional flow of water to lower-lying areas.
» These systems are relatively wide, occasionally with wider lower-lying plains, therefore runoff is seldom concentrated in a narrower channel.
» As there is unidirectional flow of water, and, depending on rainfall volumes, flows may be high, there is accumulation of silts and sandy loams, but not an accumulation of excess minerals (as in pans where the water ends up).
» The deeper alluvial deposits enable a higher retention of water during moist seasons, which enables the establishment of a relatively permanent vegetation layer (shrubs and grasses).
» Fine-grained soils (accumulated from thousands of years of occasional runoff) generally have a low infiltration rate and surface layers dry out very quickly, but the vegetation layer does not only slow down accumulated runoff, but also significantly increases moisture infiltration to such degree that ground water reserves can also be significantly replenished (larger systems).
» While there is a high permanent shrub component, reaching up to 6 m height in places and providing nesting, shelter, browsing, there is also a strong palatable dwarf shrub and herbaceous (grass) layer, which will provide valuable grazing beyond the rainfall season.

The importance of these Valley Floors to the overall ecosystem processes therefore depends largely on the length and width of the channels and their connectivity to lower-lying larger fluvial systems (pans, rivers, dams). Within the CSP 1 Project Site, such connectivity is not as pronounced as in other areas of the larger study area.

Figure 6.9: Dense shrubland and grasses in the larger valley floor systems

Vegetation associations along the water pipeline alignment

The vegetation associations along the two water pipeline alignment alternatives between Kenhardt and the Project Site have not been determined as the servitudes along both options have been variably disturbed in the past and can, at best, be described as semi-natural veld. Some sections of these servitudes have been and remain completely transformed.

6.7.2 Fauna

Although not remarkably rich in species diversity or endemism, the fauna of the region are impressively adapted to its climatic extremes.

a) Amphibians

Nine amphibian species have the potential to occur in the study area. No species were however recorded during the three day site visit. Most amphibians occur in or near wetland habitats or moister sites and therefore will only occur within the study area during periods of higher moisture. It is therefore not expected that the study area supports a high diversity and density of amphibian species due to the arid nature of the area and lack of surface water.

b) Reptiles

Twenty five reptile species have the potential to occur in the study area. Of these, several species were recorded during the site visits: *Psammophis* species (sand snake), Tent Tortoise, Variegated Skink and Southern Rock Agama. Both species were recorded frequently in the rocky outcrops that are scattered throughout the study area. These species are not threatened, but provide a source of food for several small predators observed in the area.

c) Mammals

Thirty three mammal species have the potential to occur in the study area. Of these, several species were either sighted or recent signs of their activity were recorded during the site visit. These included: Aardvark, Aardwolf, Bat Eared Fox, Cape Ground Squirrel, Cape Hare, Porcupine, Springhare, African Wild Cat (tracks only), Rock Dassie, Common Duiker, Steenbok, Suricate and Yellow Mongoose. None of these are threatened and all are common and widespread species in South Africa. No bats or bat roosts were observed on site or in the surroundings.

6.7.3 Alien invasive species

The SANBI database lists several alien invasive species in the wider Kenhardt area. Of these, only *Prosopis glandulosa* could be confirmed within the study area. *Prosopis glandulosa* is considered a Category 3 Listed Invasive species, indicating that it must be managed. However, where it occurs in riparian areas, it must be considered a Category 1b species, indicating that it must be eradicated and controlled.

Additional alien invasive species do occur in the surrounding area along major transport routes, which could be accidentally introduced to the Project Site during construction. Regular monitoring and early eradication should enable a cost-effective control of invasives.

6.7.4 Species of Conservation Concern

The following species of flora and fauna were observed on the study site during this survey are protected:

The Nature Conservation Ordinance (NCO) 8 of 1969 and subsequent amendments

Fauna: Aardvark (*Orycteropus afer)*
Aardwolf (*Proteles cristatus*)
Bat-eared Fox (*Otocyon megalotis*)
Note: all Girdled Lizards, Land Tortoises and Chameleons that may be on the site during construction are protected and must be relocated to safety within the same land portion

Flora:	*Acacia erioloba*	*Psilocaulon coriarium*
	Aridaria noctiflora	*Brownanthus vaginatus*
	Babiana species	*Aloe claviflora*
	Drosanthemum hispidum	*Brownanthus vaginatus*
	Hoodia gordonii	*Prenia tetragona*
	Jamesbrittenia canescens	*Nemesia anisocarpa*
	Larryleachia species	*Moraea species*
	Microloma sagittatum	

National Forest Act (Act No. 84 of 1998)

» Camel Thorn: *Acacia erioloba*

National Environmental Management Act: Biodiversity Act (NEMA: BA) (Act No. 10 of 2004) and amendments

» Ghaap: *Hoodia gordonii*

6.7.5 Regional Ecological Support Zones

The Namakwa Bioregional Plan which was compiled during 2008 outlined several areas that are important to take into consideration during all new developments to ensure that long-term conservation and ecosystem services targets are met. This is especially important as it is anticipated that the Namakwa Region and the wider Succulent Karoo will be the one biome that will potentially be most severely affected by the impacts of climate change.

As part of this Bioregional Plan, the importance of various types of wetlands/pans in the stability of overall ecosystem functioning and eco–services has been emphasised. In addition, the Namakwa Bioregional Plan delineated a notational migration route, as Ecological Support Area (ESA), extending for approximately 200km from the east in the vicinity of the N14 to the west near Kenhardt. The corridor is on average, approximately 10km in width and traverses the broader study area. The corridor has been proposed with the purpose of maintaining a free corridor between some of the major wetland/pan systems present in the region and beyond. This ESA is broadly mapped, and considered to extend across a portion of the larger study area (and was considered in terms of site development footprint placement). On the macro-scale corridors provide for species movement. This entails the ability of fauna and flora to undertake large-scale movements towards areas which continue to provide the conditions required by a species for growth and reproduction. Movements could entail migrations of up to hundreds of kilometers, and corridors of mostly intact natural or near natural vegetation across the landscape are required for this to occur. Refer to Section 7.3.1 for a discussion of the relative importance of the ESA and consideration of the ESA within the site development context.

6.8 Avifauna

6.8.1 Supporting avifaunal habitat within the study area

Bird habitats in the study area can be grouped into three broad categories:

» Open grassy/rocky areas (Bushmanland basin shrubland) that supports grassland dominated by larks, korhaans and also larger dark rocky outcrops that support raptors and wheatears on the kopjes;

» Low shrubland bush which covers much of the lower lying areas, and is especially dense in the dry ephemeral drainage lines

» Pan (Bushmanland Vloere) which are found dotted across the larger study area either as small pans or very large accumulation areas for ephemeral water. When dry, these areas may hold flocks of seed-eating birds and when inundated may hold wetland species (e.g. flamingos) that are attracted from afar with the rains;

» Artificial habitats are provided by (i) the existing power lines and accompanying pylons, and (ii) the water points that are scattered across the landscape for livestock. The pylons are used mainly by large raptorial birds from which to hunt and occasionally nest on (goshawks, kestrels and eagles), while large numbers of birds are attracted to farmer's dams..

During the Avifaunal Study each of the main habitat types was surveyed independently for bird species richness and bird abundance in the dry and wet seasons

6.8.2 Avian species richness and red data species

Although very limited, available research for the area summarised 226 bird species in total and highlighted eleven species of significance: two bustards (Ludwig's and Kori); two eagles (Martial and Verreaux's), two flamingos (Greater and Lesser), two korhaans (Karoo and Northern Black), two larks (Red and Sclater's) and the Secretarybird *Sagittarius serpentarius.*

The avifaunal survey undertaken over 7 days in the dry and wet seasons recorded a low species richness of sixty four avifaunal species recorded within the broader study area, five of which are threatened (red listed species) and forty of which are endemic. Species identified to be of most concern due to their interactions with the broader areas are the large nomadic Ludwig's Bustard *Neotis ludwigii* and Kori Bustard *Ardeotis kori*, the Martial Eagle *Polemaetus bellicosus,* the Sclaters Lark *(Spizocorys sclateri)* and Lanner Falcons *Falco biarmicu.*

An opinion on the occurrence of red data species such as red larks and both species of flamingos on site has been provided by an independent bird specialist (refer to Appendix H) and the opinion states that the only record of flamingos breeding in the area under investigation is from Brandvlei in 1990. This is 100 km south of the CSP 1 project site. There have never been any records of flamingos breeding in the vicinity of the CSP 1 project site due to the lack of natural water present in this area Red Larks were not recorded in the extensive surveys undertaken by the specialist over both wet and dry seasons therefore the opinion states that it is unlikely that Red Larks would move into the area.

6.8.3 Species recorded within the CSP 1 Project Site

From the 1-km transects undertaken, an average 8.75 species/km were recorded in September 2014, while an average of 7.0 species/km were recorded in March 2015. The total number of species recorded in all walking and driving surveys was 64 with slightly more species in the wet than the dry season. Overall however, more birds were recorded in the dry season than in the wet season. This probably arose from birds being attracted away from the dry study site to rain events in the surrounding areas in March 2015. The biggest differences were between habitat variants where the number of birds per kilometre was twice as high in the dry riverlines supporting low scrub (Rhigozum) bushes than they were in the open grassy plains that surrounded them.

6.9 Socio-Economic Characteristics of the Study Area and Surrounds

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6.9.1 Demographic Profile

The HLM covers a geographical area of 36 128km^2 which is approximately 28% of NDM total area. The HLM has a population of 21 578 people at a population growth rate of 0.59 and a population density of 1/km^2. 18% of NDM population resides within the HLM.

Kenhardt is the closest town to the proposed site and is situated within the Kai !Garib Local Municipality and is located approximately 70km north east from the proposed site. Kenhardt is a town that covers an area of 159.35km^2 and consists of a population of 4 843 people, with a density of 30 people per squared kilometre (Census, 2011).

According to Census 2011, HLM has a total population of 21 578, of which 82.2% are coloured. Afrikaans is the most prominent spoken language in both the HLM and KGLM.

6.9.2 Economic Profile

Hantam Local Municipality

The closest town to the site, which is located in the Hantam Local Municipality is Brandvlei. It is situated on the north-western boundary of the municipality and has a population of 2 859 people (Stats SA, 2014). It includes some minor retail shops and a filling station and has little to offer for local residents and visitors. It has limited social infrastructure and primarily services the nearby rural communities and farmers.

The economy is relatively small and in 2013 was valued at R1 307 million in current prices (Quantec, 2014). It contributed 11.0% to the Namakwa District's Gross Domestic Product per Region (GDP-R) or 1.9% to the provincial economy. In the period between 2008 and 2013, the economy of the Hantam municipality grew at a Compounded Annual Growth Rate (CAGR) of 2.4%, showing a better performance than that of Namakwa (0.9%) and the Northern Cape (1.3%) (Quantec, 2014). Overall, the District is considered to be in a distress and the Hantam economy, according to the Hantam SDF (Umsebe Development Planners, 2010), also requires investment injection and government support to turnaround its situation.

The Hantam economy is a service economy with more than three quarters of its GDP-R being generated by the tertiary industries such as trade (10.6%), transportation and communication (8.0%), business services (24.7%), personal services (12.4%), and government services (19.8%) (Quantec, 2014). This means that much of the municipalities' economic base is dependent on local purchasing power, which limits its growth potential. However, over the years, it was these industries growth, aside from the trade sector, which largely contributed to the development of the local economy. The agricultural sector (10.7% of GDP-R) is also a prominent industry in the municipality, which brings much needed income. It predominantly comprises of livestock (sheep) and game farming, but also includes such activities at irrigation (mainly lucerne), cultivation of rooibos tea, and bulb farming.

Aside from agriculture, tourism and mining activities that are considered to be export industries attracting income and allowing the economy to grow beyond what its population can support, are also considered to be integral for development of the local economy. However, these industries' contributions to the local economy are limited and yet to create a notable impact.

In 2011, the Hantam LM had 13 860 people within the working age population, of who 7004 comprised the labour force (Stats SA, 2014). About 3.4% of the working age population was discouraged job seekers, who are capable of working but who are no longer looking for employment (Stats SA, 2014). The labour force comprised of 6 122 employed and 882 unemployed, reflecting a 12.6% unemployment rate which is significantly lower than that of the country's unemployment rate of 29.7% recorded by Stats SA through Census 2011 (Stats SA, 2014). The unemployment rate within the Hantam LM though varied significantly. For example, Brandvlei had the highest unemployment rate of 25.8% in the municipality (Stats SA, 2014).

About 60% of the employed population in the Hantam LM is employed in the formal sector, while one out of five people work in the informal sector (Stats SA, 2014). Private households provide about 16.8% of employment opportunities in the municipality (Stats SA, 2014).

The agricultural sector and personal services sectors in the Hantam LM account for the largest number of jobs created in the area, i.e. 19.7% and 20.6%. Other sectors that make a prominent contribution towards employment in both formal and informal sectors include trade (11.7%), business services (14.7%) and government services (19.1%). Since 2000, the number of jobs in the municipality has declined by 457 positions. Agriculture has lost the largest number of 1 700 jobs during that period following by trade (175 jobs) and construction (86 jobs). Other sectors have increased employment absorption since 2000, however it is clear that it was insufficient to offset the massive losses experienced in the agricultural sector.

Kai !Garib Local Municipality

The closest town within the Kai !Garib Local Municipality to the site where the proposed CSP tower plant is to be located is Kenhardt. It has a population of about 12 001 people (StatsSA, 2014) and was established as an administrative post and is among the three towns in the municipality that hosts municipal offices. The town primarily services the nearby farming communities that comprise of small stock farming, especially dorper sheep.

The Kai !Garib LM economy generated R1 583 million of DP-R in 2013, therefore accounting for 11.6% of the district's economy and 2.3% of the provincial economy. The above shows that the economy of the Kai !Garib LM is slightly bigger than that of the Hantam LM. Over the past five years, the economy of Kai !Garib has been stagnating.

The 2008 financial crises and the global recession that followed it, has significantly impacted on the revenue of the municipality. Half of the value added generated by the municipality is created by the local agricultural sector (49.8%); while the other half is primarily derived from tertiary activities such as trade and accommodation (13.8%) and community services (10.4%) (Quantec, 2014). The performance of all of these sectors during the period between 2008 and 2013 was negative, although the biggest decline has been observed among transport and businesses services sectors.

In 2011, the working age population in the municipality comprised of 46 367 people, of who 30 987 represented the local labour force and 987 were discourage job seekers (Stats SA, 2014). The labour force comprised of 27 928 employed people (formal and informal sector) and 3 159 unemployed, which means that the local unemployment rate was 10.2% - slightly lower than in the Hantam LM. In Kenhardt, the unemployment rate was much greater - 39.8% - with 518 people out of 1 304 people comprising the labour force being unemployed.

About 70.3% of the employed, worked in the formal sector and 17.3% worked in the informal sector. One out of ten employed people in the Kai !Garib LM were working for private households. Almost three quarters (73.1%) of the people working in the formal or informal sector in the municipality was employed in the agricultural sector. Community services (8.4%), trade (6.0%), and construction (4.7%) were the other three industries that made prominent contribution to the local employment. Over the period between 2008 and 2013, the agricultural sector and construction industry were the only two prominent industries that created new jobs, while the tertiary services industries have all shed jobs. As a result, the municipality experienced a negative employment growth.

6.9.3 Settlement and infrastructure

There are no built up areas, towns or mining land uses within the study area. Infrastructure includes the Aries-Helios 400kV overhead power line (directly to the south east of project), and the Sishen/Saldanha railway line (a freight railway line) to the north west of project. Homesteads located on or within close proximity the Proposed Project Site include:

- Valsvlei located within the CSP 1 Project Site (unoccupied)
- Gannakom located to the west of CSP 1 (occupied by manager of the farm)

6.9.4 Social and Noise Receptors

The project site is situated on Portion 3 of the Farm Styns Vley 280. The nearest homestead is Valsvlei which is unoccupied and situated at within the CSP 1 Project Site. The next nearest settlement is a farmhouse at Gannakom which is located approximately 5km from the Project Site and occupied by the manager of the farm.

There are no visible noise sources besides the R27 road and the Sishen - Suldanha railway line. While there are farmers practicing sheep grazing within the broader study area, distances to main roads and other industrial/urban noise sources are considered too great and therefore the existing ambient sound levels are expected to be low. There are therefore no noise-sensitive receptors in close proximity to the Project Site.

6.10 Heritage

6.10.1 Historical and Archaeological Background

The archaeology of the Northern Cape is rich and varied covering long spans of human history. Thousands of square kilometres of Bushmanland are covered by a low density lithic scatter. Cultural Resources Management (CRM) surveys in the immediate vicinity provide some insight as to the occupation of the area and in the wider region provides a good basis for understanding the local archaeology. Collection of surface samples by other archaeologists means that stone artefacts north of the study area have been analysed and indicates the presence of humans in the area for the last two million years. The larger area also probably represented a rich source of rocks for knapping. Previous work therefore suggests that the wider area could contain a widespread distribution of Early and Middle Stone Age material with perhaps a few Later Stone Age sites, depending on topography and proximity to water.

The Project Site is characterised primarily by areas barren of vegetation situated on sedimentary surfaces consisting of mud rock and possibly shale. In the area of CSP 1, no locally available raw material exists which is suitable for knapping.

No Stone Age sites (knapping, quarry or habitation sites) were therefore recorded within the CSP 1 Project Site. Artefact density in the broader study area is so low that they do not represent individual sites but rather background scatter or find spots.

6.11 Square Kilometre Array

The Proposed Project Site is located within an Astronomy Advantage Area declared in terms of Sections 7(1) and (2) of the Astronomy Geographic Advantage Act, 2007 (Act 21 of 2007) of the planned Square Kilometre Array (SKA) radio telescope (refer to Figure 6.10). The core of the SKA will be constructed approximately 80km from Carnarvon in the Karoo. The Project Site is located approximately 135km from the core site and approximately 26km from the nearest outer station to the north, which is also situated approximately 30km west of the Aries Substation. Once it is constructed, the SKA will be the world’s largest and most sensitive radio telescope.

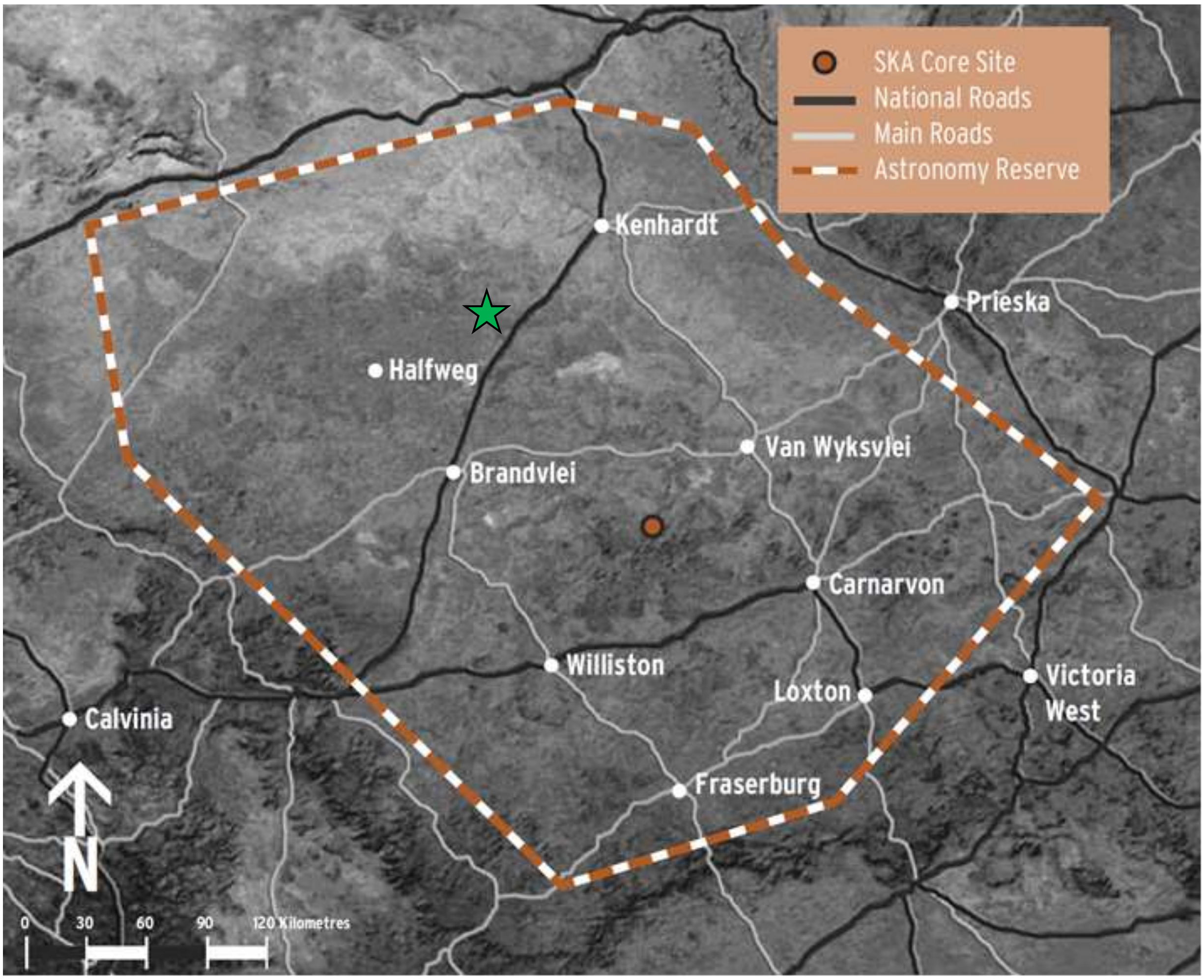


Figure 6.10: SKA Core site and Astronomy Reserve (Source: http://www.ska.ac.za) relative to the proposed CSP 1 Project Site, indicated by the green star

ASSESSMENT OF IMPACTS CHAPTER 7

The CSP 1 plant is proposed to utilise solar tower technology with a generation capacity of up to 200MW, and energy storage of up to 12 hours (using molten salts technology). The project is proposed to be located on Portion 3 of the Farm Styns Vley 280. This chapter serves to assess the significance of the positive and negative environmental impacts (direct, indirect, and cumulative) expected to be associated with the development of the proposed facility.

The proposed development will include the following associated infrastructure:

» Solar Collector Field - consists of all systems and infrastructure related to the control and operation of the heliostats.
» Molten Salt Circuit - includes the thermal storage tanks for storing low and high temperature liquid salt, a central solar-thermal tower receiver, pipelines and molten salt to steam heat exchangers.
» Power Block - consists of the steam turbine and generator, as well as the air-cooled condenser and associated feedwater system.
» Auxiliary facilities - consists of the switch yard, step-up transformers, facility start-up generators (gas or diesel-fired – dependent on detailed design).
» Grid connection infrastructure, including
  - 132 kV on-site project substation
  - Eskom 132kVswitching station
  - Eskom 400kV sub-station
  - 132 kV power line up to 50km in length to connect to Eskom's existing Aries Substation or 400kV loop in – loop out to the existing Aries – Helios 400kV power line
» Access roads (roads up to 8m wide)
» Water supply point located at the Kenhardt Reservoir
» Water supply pipeline within existing road reserves (up to 95km in length).
» Water storage reservoir (20 000 m^3 and 5 $000m^3$).
» Water treatment facility.
» Wastewater treatment facility.
» Plant assembly facility.
» Lined evaporation ponds (approximately 8ha).
» Workshop and office buildings.
» Man camp.

The establishment of the CSP 1 Project is comprised of various phases, including pre-construction (development), construction, operation, and decommissioning. The **construction activities** involved for the proposed CSP Project will include the following:
» Access Control

» Conduct Surveys
» Establishment of Access Roads to the Site
» Undertake Site Preparation
» Transport of Components and Equipment to Site
» Refuelling
» Bulk material laydown
» Construct Power Block and Substation
» Establishment of Ancillary Infrastructure
» Auxiliary Power Supply
» Water Supply
» Man camp and staff facilities
» Management and administration
» Waste Management
» Fire Protection
» Connect Substation to Power Grid
» Undertake Site Remediation

The construction phase is expected to take approximately 30 months.

The **operation activities** will include the following:

» Access and security services
» Generation of electricity using CSP technology
» Start-up and operational power supply and use
» Water supply and use
» Procurement, storage and use of consumables
» Maintenance and repair to operational equipment
» Waste management
» Emissions management
» Storm-water management infrastructure management
» Management and administration facilities (including visitor and training facilities)
» Management of man camp and staff facilities
» Fire protection

The operation phase is expected to extend in excess of 20 – 30 years (possibly 40 years with refitting).

The **decommissioning activities** will include the following:

» Decommissioning of project infrastructure
» Site rehabilitation
» Aftercare and maintenance

The majority of the environmental impacts associated with the facility will occur during the construction phase. Environmental issues associated with **construction and decommissioning** activities of the CSP Project are similar and include, among others:

» Impact on ecology (flora, fauna and avifauna) and potential loss of protected species.
» Potential soil loss and change in land-use for the footprint of the facility.
» Impact on heritage resources.
» Social impacts (positive and negative).
» Visual impacts.

Environmental issues specific to the **operation** of the CSP Project, potentially include, among others:

» Visual impacts (intrusion, negative viewer perceptions and visibility of the facility).
» Social / landuse impacts (positive and negative).
» Impacts on avifauna

These and other environmental issues were identified through a scoping evaluation of the proposed CSP 1 project. Potentially significant impacts have now been assessed during this EIA Phase. This EIA process has involved key input from specialist consultants, the project developer, and from key stakeholders and interested and affected parties. The significance of impacts associated with a facility of this nature is project specific, and therefore impacts may vary significantly between facilities.

This chapter serves to assess the identified potentially significant environmental impacts associated with the development of the Proposed Project, and to make recommendations for the management of these impacts for inclusion in the draft Environmental Management Programme (Refer to Appendix S).

7.1. Approach to the Assessment of Impacts associated with the Proposed Project

Assessment area: In order to assess the potential impacts associated with the proposed CSP Project, it was necessary to understand the extent of the affected area in order to:

» Provide a thorough and comprehensive assessment of impacts for the broader study area.
» Provide the option of identifying more suitable sites for development for the individual CSP Projects, should any of the three CSP Tower sites be found to have major issues.

The assessment included a more focussed/detailed assessment of an area of approximately 1586ha for the construction of the proposed CSP 1 Project (~1000ha) with the purpose of providing flexibility for the movement of individual components within the Project Site (if required) in order to respond to sensitive environmental features/aspects. Within the ~1 000ha Project Site, area infrastructure (i.e. tower and heliostat solar field; power block; and other associated infrastructure) will be established. Linear infrastructure (i.e. external access roads; the water supply pipeline and the power line) will be constructed primarily outside of the Project Site.

No-go areas: Through the specialist assessments undertaken, various 'no-go' zones were identified, to be avoided for the development of a CSP Project. The proposed CSP 1 project is situated outside of the identified no-go areas, including:

» An enlarged system of the Boesmanland Vloere which is considered an important fluvial area in the northern areas of the study area containing several species of protected succulent plants.
» An extensive system of Valley Floor Mixed Shrubveld, which is considered to be part of a larger fluvial system and faunal (terrestrial) migration corridor extending beyond the study area.

Approximately 30 km² (3 000ha) of the 20 700 ha study area (15%) is unavailable for further development based on the value of the above systems from an ecological perspective. The remaining 85% of the surface area is available land of varying environmental sensitivity which has been put forward for consideration for the construction of the project as well as possible future solar energy facilities.

The sections which follow provide a summary of the findings of the assessment undertaken for potential impacts associated with the construction and operation of the proposed CSP 1 plant on the identified site. This assessment has been informed by specialist studies contained in Appendices E – O. Issues were assessed in terms of the criteria detailed in Chapter 5. The nature of the potential impact is discussed; and the significance is calculated with and without the implementation of mitigation measures. Recommendations are made regarding mitigation and management measures for potentially significant impacts and the possibility of residual and cumulative impacts are noted.

7.2. Assessment of alternatives during construction and operation

The following alternatives (refer to Chapter 4 and in accordance with the Final Scoping Report) were identified for the proposed CSP 1 Project:

» Site alternatives
» CSP Project footprint / design alternatives
» Water supply pipeline alignment alternatives
»

Please note that grid connection options for the project include either a connection to the Eskom grid via a loop in – loop out configuration to the existing Aries–Helios 400kV power line, or the construction of a new power line to the Eskom Aries Substation. **Final grid connection requirements will be determined by Eskom and are outside of the applicant's control.** All references to these two options in this section are done for comparative purposes only.

Potential impacts pertaining to the above are assessed in the sections below, and a comparative assessment of the various alternatives (excluding power lines) is provided where relevant.

7.3. Potential Impacts on Ecology (Flora, Fauna and Ecosystems)

The proposed CSP 1 Project including the associated infrastructure will occupy approximately 1 000ha with the larger study area. Potential impacts and the relative significance of the ecological impacts are summarised below (refer to Appendix E - Ecology Report for more details). The sensitivity ratings are based mostly on ecosystem function and processes as well as the rehabilitation potential of these ecosystem services after construction and/or decommissioning, rather than the presence of species of conservation concern.

7.3.1 Results of the Ecological Study

a) General ecological character

Vegetation of the study area consists primarily of low karroid shrublands, interspersed with areas with a sparse to dense high shrub layer. Small-scale plant diversity and ecological state of the vegetation varies considerably across the entire study area, depending on soil surface rockiness, topsoil texture, depth of soil and position in the landscape.

The CSP 1 Project Site is currently used primarily for livestock farming. No significant portion of the vegetation have been transformed or altered to a semi-natural state. Despite past disturbances such as gravel roads, farm tracks, homesteads and farming activities, the natural vegetation is relatively intact.

b) Description of vegetation associations and associated habitats

Vegetation associations within the project development site can be primarily divided into habitats with alluvial deposits and habitats without such deposits, the latter mainly with shallow soils and a high percentage of surface rock. The majority of the CSP 1 footprint is proposed to be located on mixed shrublands located on undulating rocky plains (a Least Threatened vegetation type of low ecological sensitivity), as well as Valley Floors (of medium ecological sensitivity), fringing on the upper reaches of ephemeral drainage lines (of high ecological sensitivity).

c) Ecological Support Area and Biodiversity Support

The Namakwa Bioregional Plan as compiled during 2008 outlined several areas that area important to take into consideration when planning development in order to ensure that long-term conservation and ecosystem services targets are met. This is especially important as it is anticipated that the Namakwa Region and the wider Succulent Karoo will be the one biome that will potentially be most severely affected by the impacts of anticipated climate change. As part of this Bioregional plan, the importance of various types of wetland habitats in the stability of overall ecosystem functioning and services is considered.

In addition, the Bioregional plan delineated a notational migration route, as Ecological Support Area (ESA) proposed to maintain a free corridor between some of the major wetland systems present in the region and beyond. This ESA is broadly mapped, and considered to extend across a portion of the larger study area (and was considered in terms of site development footprint placement). On the macro-scale corridors provide for species movement. This entails the ability of fauna and flora to undertake large-scale movements towards areas which continue to provide the conditions required by a species for growth and reproduction. Movements could entail migrations of up to hundreds of kilometers, and corridors of mostly intact natural or near natural vegetation across the landscape are required for this to occur.

ESA's are aimed at retaining connectivity between all geographic areas in the district and nationally. For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

Definition and purpose of ESAs

According to the Biodiversity Sector Plan, ESAs are defined as "areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas". The specialist ecological report did not identify any highly sensitive fauna or flora within the project development area which lies within Bushmanland Basin Shrubland, which is a very extensive vegetation type with few listed or local endemic species. Therefore, it is clear that the major potential impact of the development on the ESA would be through an impact on ecological processes rather than a direct impact on biodiversity within the development footprint.

The NEMF defines Ecological Supporting Areas (ESA) as one for the six Environmental Management Zones: The principal goal of corridor-planning is to maintain or restore connectivity across the landscape. Achieving this requires stimulating the creation of additional protected areas through voluntary stewardship agreements in the form of conservation areas, biodiversity agreements and contract nature reserves, and assigns an Environmental Sensitivity Index as C.

As defined in the NEMF - Zone C: These areas include environmentally sensitive features. Development in this zone must serve to complement the area and should be limited where relevant. Adequate provision should be made for the protection of environmental features and a fully inclusive participation process should be conducted.

The Ecological Report confirms that the project development footprint (tower and heliostat field) is located well outside the ESA and observed migration corridor. The confirmed/observed faunal migration corridor is situated to the south west and outside of the project footprint (refer the Ecological Report, Appendix E).

The Ecological assessment has been peer reviewed by Simon Todd, who was consulted to review and provide clarification on the Ecological Support Area (ESA) and to evaluate the need for a biodiversity offset agreement for the loss of habitat (Appendix F). The specialist recommends that a biodiversity offset be implemented as part of the authorisation conditions This is justified firstly on account of an area of sensitive wash and valley bottom habitat within CSP 1, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development; and secondly on the total footprint of the development (~1500ha) and the potential cumulative impact on broad-scale ecological processes (i.e. that more than one facility could be developed). The assessed impacts are considered acceptable loss for a single project, and the proposal for a biodiversity offset is to accommodate cumulative loss. The recommended biodiversity offset ratio should be the same as for SolarReserve Kotulo Tsatsi Concentrated Solar Plant (CSP 3) development (DEA Reference number: 14/12/16/3/3/2/694), at 1:2 and the biodiversity offset area should ideally be located contiguously to that for CSP 3.The extension of the biodiversity offset area to approximately 4000ha should both CSP 1 and CSP 3 go ahead, would generate positive outcomes for local biodiversity as large areas are required for most ecological processes in this arid area, many of which are operating at scales far larger than the area required for a single biodiversity offset. .

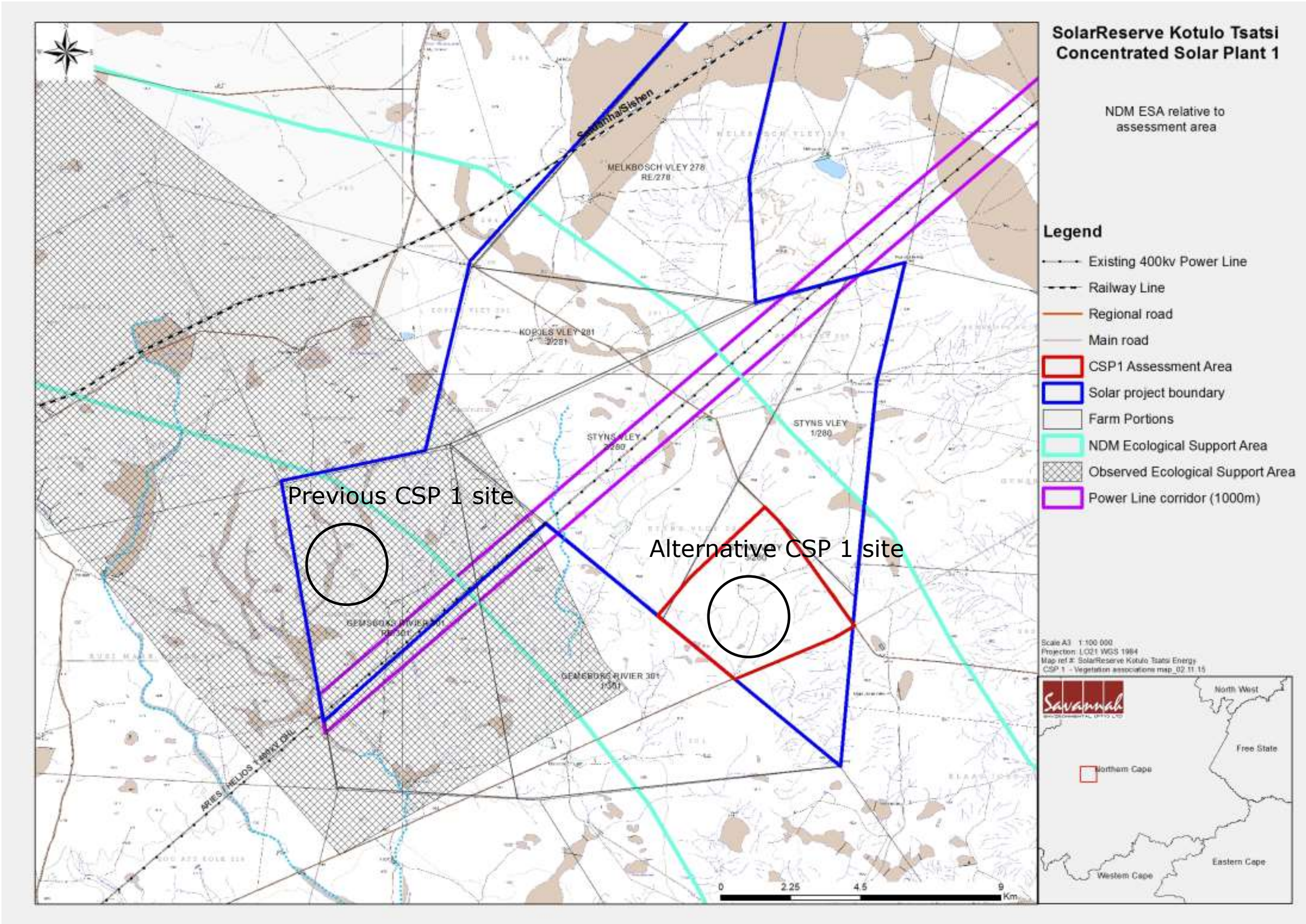


Figure 7.1: CSP 1 assessment area relative to observed ESA

7.3.2 Impact tables summarising the significance of impacts on Ecology

a) Central Receiver Tower Plant and heliostats

Activity: Construction and operation of CSP Central Receiver Tower Plant – including the collector field (heliostats) and power block with molten salt storage technology		
Description: A field of heliostats will be constructed around a central receiver tower and associated power block (including steam turbine and steam cooling mechanism and auxiliary boiler), in which the electricity will be generated. The diameter of the development may be up to 3000 m, and the height of the central receiver tower will be up to 250m. Maintenance tracks in between the heliostat field will need to be relatively level to allow access of big machinery. Individual heliostats are centrally controlled, and will need underground cabling to a central control room.		
Environmental Aspect: Removal of or excessive damage to vegetation, alteration of soil surface and microhabitats, compaction of soils, creation of runoff zone, redistribution and concentration of runoff from panel surfaces, excessive shading of vegetation, displacement of terrestrial vertebrates, reduced buffering capacities of the landscapes during extreme weather events, alteration of microhabitat environmental conditions underneath the heliostats, increased high light levels around receiver, changed night light levels may affect diurnal behaviour of biodiversity in the area affected		
Environmental impact: Loss of vegetation and/or species of conservation concern, loss of and alteration of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from heliostats and higher volumes of storm water and accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible increase of detrimental effects during periods of extreme weather events, e.g. increased erosion or dust due to lower buffering capacity of sparser vegetation		
	Without mitigation	**With mitigation**
Extent (E)	Beyond site and Surroundings (3)	Site and immediate surroundings (2)
Duration (D)	Permanent (5)	Permanent (5)
Magnitude (M)	High (8)	Moderate (6)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	High (80)	High (65)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Low reversibility	Partially reversible

Irreplaceable loss of resources?	Highly Probable	Medium Probability
Can impacts be mitigated?	Reasonably but with limited full restoration potential	

Mitigation:

» For any fluvial system that will be affected by the development, ensure that runoff is re-distributed to either Valley Floor Areas of Boesmanland Vloere using natural soil surfaces – no sealing of such redirected flows with impermeable surfaces (e.g. no concrete canals etc.), unless culverts are necessary for road crossings
» Where ever possible, aim not to place any heliostat support into a restricted wash or drainage line where it could obstruct occasional floods during large rainfall events
» Aim to minimise the destruction of indigenous large shrubs as far as practically possible
» After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
  - Protected succulent plant species should be relocated
  - Animal burrows should be monitored by ECO prior to construction for activity/presence of animal species. If detected, such animals should be removed and relocated by a qualified professional/contractor
» Keep areas affected to a minimum, strictly prohibit any disturbance outside the demarcated footprint area
» Clear as little vegetation as possible, aim to maintain all indigenous vegetation where it will not interfere with the construction or operation of the development
  - Shred all woody material cleared and use the chips for dust and erosion control
» After construction, rehabilitate an acceptable vegetation layer according to rehabilitation recommendations of the relevant EMPr
  - Use only species that were part of the original indigenous species composition as listed in the specialist report, aim to obtain at least the original cover percentages of desirable species
  - Revegetation should occur naturally where topsoils were not severely altered
  - The higher level of shading anticipated from fixed panels may prevent or slow the re-establishment of some desirable species, thus re-establishment should be monitored and species composition adapted if vegetation fails to establish sufficiently.
  - Alternatively, soil surfaces where no revegetation seems possible will have to be covered with gravel or small rock fragments to increase porosity of the soil surface, slow down runoff and prevent wind- and water erosion
» Remove all invasive vegetation, completely uproot potentially resprouting high shrubs, e.g. *Rhigozum trichotomum, Lycium* and *Phaeoptilum* species

» Continuously monitor the establishment of new invasive species and remove as soon as detected, whenever possible before regenerative material can be formed, up to decommissioning » If filling material is to be used, this should be sourced from areas free of invasive species » Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil » Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan » Monitor the area below and around the heliostat panels regularly after larger rainfall events to determine where erosion may be initiated and then mitigate by modifying the soil micro-topography and revegetation efforts accordingly o Due to the fixed nature and larger runoff surfaces of the heliostat panels, the development area should be adequately landscaped and rehabilitated to contain expected accelerated erosion o Runoff may have to be specifically channelled or storm water adequately controlled to prevent localised rill and gully erosion (but see points above) » Employ all measures needed to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
Cumulative impacts of project: » If mitigation measures are not strictly implemented the following could occur: o Considerable loss of biodiversity and large shrubs o Unacceptable disruption of surface hydrology and migration routes, also affecting areas beyond the development footprint (and current study area) o Possible accelerated erosion of areas around the heliostats and continued erosion of the development area o possible spread and establishment of invasive species » Increased habitat fragmentation and displacement of terrestrial vertebrates in the region » Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics, runoff patterns and ecosystem processes
Residual impacts: » Altered topsoil characteristics » Loss of and alteration of microhabitats » Altered vegetation composition, small loss of large trees, lower vegetative cover and possible loss of species diversity » Potential for increased dust and its impact on surrounding environments and biodiversity » Higher risk of invasion by alien plant species

b) Site access and internal maintenance roads

Activity: Upgrading and creation of site access and internal maintenance roads		
Description: Where access roads are created or widened for upgrading, vegetation is cleared, surface is compacted and levelled, road surface is re-enforced with compacted gravel (as a minimum, possibly later covered with tar or concrete), raised where necessary to ensure rapid runoff of water		
Environmental Aspect: ground clearing and removal of vegetation, grading and associated compaction and disturbance of topsoil and subsoils, possible excavation to source sands and gravels for roads, destruction of animal burrows, possible traversing of drainage and other fluvial areas, possible introduction of pollutants and regenerative material of undesirable species		
Environmental impacts: Loss of vegetation, potential increase in runoff and erosion, possible distribution and increased establishment of alien invasive species, possible disturbance and reduction of habitat, potential injury or death to terrestrial fauna, possible change of natural runoff and drainage patterns, possible loss of protected species, possible permanent loss of revegetation potential of soil surface, increase in dust levels, interference with fauna behavioural activities, possible exposure of fauna and flora to contaminants *Note: relatively large access roads already exist to parts of the land portions selected*		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	Medium (50)	Medium (35)
Status (positive, neutral or negative)	Negative	Negative Notes: reduced impact associated with existing roads and tracks
Reversibility	Not reversible	Relatively reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	
Mitigation: » Avoid access roads in larger Valley Floor Areas where possible		

» Use existing jeep tracks where movement across such vegetation is necessary » Keep main access route as planned along existing gravel roads, use larger existing on farm tracks where feasible » After the final layout has been approved, conduct a thorough footprint investigation to determine any protected plant species population location and size, and animal burrows o Map (by GPS) as far as possible *larger* concentrations of large trees and protected species that could be avoided or should be relocated o Protected succulent plant species should be relocated o Animal burrows should be monitored by EO/ECO prior to construction for activity/presence of animal species. If detected, such animals should be removed and relocated by a qualified professional/contractor » During construction: create designated turning areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas » Keep the clearing of natural veld to a minimum » If filling material is to be used, this should be sourced from areas free of invasive species » Topsoil (the upper 25 cm of soil) is an important natural resource; where it must (and can) be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil » Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas » Ensure that runoff from compacted or sealed surfaces is slowed down and dispersed sufficiently to prevent accelerated erosion from being initiated (erosion management plan required) » Prevent leakage of oil or other chemicals or any other form of pollution, as this may infiltrate local groundwater reserves » Monitor the establishment of (alien) invasive species and remove as soon as detected, whenever possible before flowers or other regenerative material can be produced » After decommissioning, if access roads or portions thereof will not be of further use to the landowner, remove all foreign material and rip area to facilitate the establishment of vegetation, followed by a suitable revegetation program
Cumulative impacts: » Possible erosion of areas lower than access roads » Possible contamination of wetlands and/or groundwater reserves due to oil or other spillage » Possible spread and establishment of alien invasive species » Increased transformed areas (together with surrounding developments) that will affect fauna and flora population dynamics and runoff patterns
Residual impacts:

» Localised loss of vegetation, some loss of large indigenous shrubs » Altered topsoil conditions » Potential barren areas remaining after decommissioning » Potential for erosion and invasion by weeds or alien species » Potential for increased dust and its impact on surrounding environments and biodiversity

c) *Fencing of development*

Activity: Fencing area – may also serve as fire-break Note: the incidence of veld fires in this area is regarded as highly unlikely due to low natural fuel loads		
Description: The entire development area will be surrounded by a secure perimeter fence. On either side of the fence line, and area of up to 4 m wide will be cleared and kept clear to facilitate regular inspection and maintenance. Due to access booms and also depending on developer specification, vertebrates, especially smaller nocturnal mammals, would still be able to enter and cross over the development footprint.		
Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, impact on protected species, impact on terrestrial vertebrates by restricting movement		
Environmental impact: Loss of vegetation and specifically protected or red data species, window of opportunity for the establishment of alien invasive species, altered topsoil characteristics prone to capping and sheet erosion, increased runoff and storm water volumes, temporary disturbance of burrowing fauna, possible reduction of habitat and forage availability to terrestrial vertebrates and livestock		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long term (4)
Magnitude (M)	Low (4)	Minor (1)
Probability (P)	Definite (5)	Highly Probable (4)
Significance (S = E+D+M)*P	Medium (50)	Low (24)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be	Reasonably well	

mitigated?		

Mitigation:

- Minimal fencing recommended in larger pan areas, larger Valley Floor Areas, and Boesmanland Vloere and Broken Plains with Outcrops
- Limit cutting of large shrubs (over 3 m) where possible
- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
  - Map (by GPS) as far as possible *larger* concentrations of protected species that could be avoided or should be relocated
  - Protected succulent plant species should be relocated
  - Animal burrows should be monitored by EO/ECO prior to construction for activity/presence of animal species. If detected, such animals should be removed and relocated by a qualified professional/contractor
- During the design phase, the possible impact of burrowing vertebrates and rodents on the development should be determined, and fencing should be designed to either exclude such fauna if it will be detrimental or enable occasional migration of smaller vertebrates onto and across the site (which could be beneficial to small vertebrate populations)
- Minimise area affected, especially during construction
- Monitor the establishment of (alien) invasive species and remove as soon as detected, whenever possible before flowers or other regenerative material can be produced
- If the area will be used as fire-break as well, maintain a suitably low vegetation layer by regular mowing or appropriate plant species selection, but do not leave soil bare. Alternatively, ensure that the soil has a covering of gravel or small rock that prevents erosion.

Cumulative impacts:

- Possible erosion of cleared areas and associated accelerated erosion from surrounding areas
- Possible new accumulation area for wind-blown seeds of alien invasive herbaceous species, causing more invasions if mitigation measures are not implemented
- Possible loss of ecosystem functioning due to increase in invasive species
- Increased habitat fragmentation and displacement of terrestrial vertebrates in the region
- Possible disruption of natural migration corridors

Residual impacts:

- Altered vegetation composition
- Compacted topsoils
- Possibility for erosion and invasion by alien invasives

d) Substation

Activity: Construction of substation for the evacuation of power generated to the Eskom Grid		
Description: An area of 400m x 400 m is entirely cleared and levelled, open surfaces usually compacted and covered by gravel, kept entirely clear of vegetation. Substation is surrounded by a secure perimeter fence, which should also prevent access to all mammal, even burrowing species. Connection from the solar energy facility will most likely be by underground cabling, connection to the project Substation or Eskom Grid will be by overhead power line		
Environmental Aspect: Removal of vegetation, compaction and alteration of topsoils, creation of runoff zone, redistribution and concentration of runoff from new sealed surfaces, displacement of terrestrial vertebrates		
Environmental impact: Loss of vegetation and/or species of conservation concern, loss of microhabitats, reduced vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from sealed surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Moderate (6)	Low (3)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	Medium (60)	Medium (40)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	
Mitigation: » During the design phase avoid planning of substation in Valley Floor Areas and ephemeral drainage lines » Aim to minimise the destruction of indigenous large shrubs o Shred all woody material cleared and use the chips for dust and erosion control		

» After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
  o Protected plant species should be relocated
  o Animal burrows should be monitored by ECO prior to construction for activity/presence of animal species. If detected, such animals should be removed and relocated by a qualified professional/contractor
» Limit disturbance to footprint areas as far as practically possible
» During construction: stay within demarcated footprint areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
» Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
» Topsoil (the upper 25 cm of soil) is an important natural resource; where it should and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil
» Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a topsoil management plan
» Rehabilitate and revegetate all areas outside footprint area that have been disturbed
» After decommissioning remove all foreign material prior to starting the rehabilitation
» The rehabilitation plan for all temporarily affected areas and for the development area after decommissioning should aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover
» Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed

Cumulative impacts:
» If mitigation measures are not strictly implemented the following could occur:
  o Erosion of areas around sealed surfaces and continued erosion of the development area
  o Contamination of ground water resources
  o Spread and establishment of invasive species
  o Disruption of surface hydrological processes and associated faunal movements on and beyond the study area
» Increased habitat fragmentation and displacement of terrestrial vertebrates in the region
» Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics

Residual impacts: » Altered topsoil characteristics » Loss of microhabitats

» Reduced vegetation cover and loss of species diversity » Potential for increased dust and its impact on surrounding environments and biodiversity

e) Grid Connection to existing power line (option 1)

Activity: Construction of a power line (subject to Eskom technical capabilities) to connect with a direct loop-in/loop-out configuration to the existing Eskom Aries line from the new project Substation		
Description: Small scale clearing of vegetation on construction tracks along transmission corridor, excavation of support structure holes, blasting only necessary in structure locations with bedrock or large boulders, some backfilling with concrete or concrete bases may be necessary		
Environmental Aspect: Removal of vegetation – especially higher trees and shrubs, compaction of soils, temporary or permanent damage to animal burrows		
Environmental impact: Loss of vegetation, potential loss of individuals of keystone species and associated microhabitats, increase in runoff and erosion, disturbance of burrowing animals		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Minor (2)	Small (0)
Probability (P)	Definite (5)	Highly Probable (4)
Significance (S = E+D+M)*P	**Medium (40)**	**Low (20)**
Status (positive, neutral or negative)	Negative	Slightly negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	
Mitigation: » Avoid pan areas, Valley Floor Areas, and Boesmanland Vloere or drainage lines and washes as far as possible » Aim to minimise the destruction of indigenous large trees o Shred all woody material cleared and use the chips as mulch for dust and		

erosion control

- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
- During construction: create designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
    - For construction and maintenance access create jeep tracks only as far as is feasible, aim to coincide these with existing farm tracks where possible
- Limit clearing of indigenous vegetation at pylon positions and during stringing only where possible
- Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
- Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed

Cumulative impacts:

- Possible erosion of surrounding areas if no mitigation is implemented, no major cumulative impact on flora or fauna expected (excluding avifauna)

Residual impacts:

- Localised alteration of soil surface characteristics
- Localised loss of flora, possible loss of large trees, and displacement of fauna

f) Grid Connection via construction of new power line (option 2)

Activity: Construction of a power line, Option 2, from SolarReserve Kotulo Tsatsi Substation to Aries Substation adjacent to existing Eskom line (subject to Eskom technical capabilities)

Description: Small scale clearing of vegetation on construction tracks along transmission corridor, excavation of support structure holes, blasting only necessary in structure locations with bedrock or large boulders, some backfilling with concrete or concrete bases may be necessary

Environmental Aspect: Removal of vegetation – especially higher trees and shrubs, compaction of soils, temporary or permanent damage to animal burrows

Environmental impact: Loss of vegetation, potential loss of individuals of keystone species and associated microhabitats, increase in runoff and erosion, disturbance of burrowing animals

	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)

Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Definite (5)	Highly Probable (4)
Significance (S = E+D+M)*P	**Medium (50)**	**Low (28)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- Use existing servitude tracks for construction and maintenance access where possible
- Aim to minimise the destruction of indigenous large shrubs
    - Shred all woody material cleared and use the chips as mulch for dust and erosion control
- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
- During construction: maintain existing designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
- Limit clearing of indigenous vegetation to pylon positions only
- Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
- Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed

Cumulative impacts:

- Possible erosion of surrounding areas if no mitigation is implemented, no major cumulative impact on flora or fauna expected (excluding avifauna)

Residual impacts:

- Localised alteration of soil surface characteristics
- Localised loss of flora, possible loss of large trees, and displacement of fauna

g) Water supply pipeline

Due to the existing, variably disturbed servitudes followed by both route options and similar habitats crossed, the impact of the pipeline routes will be very similar, and from an ecological perspective, both routes are equally feasible.

Activity: Construction of a pipeline, either along the R27 servitude and existing gravel road servitude, or along existing gravel road and the railway line road servitudes between Kenhardt and the proposed development site, with a length of approximately 92 – 93 km.		
Description: Small scale clearing of vegetation, excavation of trenches – including trenches through ephemeral drainage lines and in locations with bedrock within previously incised servitude		
Environmental Aspect: Removal of vegetation – especially higher trees and shrubs, compaction of soils, temporary disturbance of ephemeral drainage channels and their flow dynamics		
Environmental impact: Loss of vegetation, potential loss of individuals of keystone species and associated microhabitats, possible disturbance of burrowing animals, possible disturbance of flow regimes of ephemeral drainage lines.		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Moderate-term (3)	Short-term (2)
Magnitude (M)	Minor (2)	Small (0)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	Medium (35)	Low (15)
Status (positive, neutral or negative)	Negative	Slightly negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	
Mitigation: » Ensure proper re-instatement of dry riverbeds and other fluvial system surfaces to prevent the alteration of hydrological systems » Aim to minimise the destruction of indigenous large trees, regardless of species or protection status		

» After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species » During construction: create designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas o Make sure that topsoil and excavated soil is stored in separate berms, o and topsoil is used over excavated soil for backfilling and rehabilitation of the pipeline servitude » Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan » Monitor the establishment of invasive species on stored topsoil and remove as soon as detected, whenever possible before regenerative material can be formed
Cumulative impacts: » No major cumulative impact on flora or fauna expected (excluding avifauna) if mitigation measures are put in place as most of the servitudes affected have already been disturbed previously to varying degrees
Residual impacts: » Localised alteration of soil surface characteristics » Localised (temporary) loss of indigenous flora

h) Ancillary facilities

Activity: Construction of permanent offices, guardhouses, and other permanent buildings		
Description: Clearing and levelling of area, construction of permanent buildings with running water and electricity		
Environmental Aspect: Removal of vegetation, compaction and alteration of topsoils, creation of runoff zone, redistribution and concentration of runoff from new sealed surfaces, displacement of terrestrial vertebrates		
Environmental impact: Loss of vegetation and/or species of conservation concern, loss of microhabitats, reduced vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from sealed surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)

Magnitude (M)	Moderate (6)	Low (3)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	Medium (60)	Medium (40)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

» During the design phase, consider that no building of ancillary infrastructure is permissible in Valley Floor Areas or drainage lines and washes.
» Aim to minimise the destruction of indigenous large shrubs
  o Shred all woody material cleared and use the chips for dust and erosion control
» After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
» Limit disturbance to footprint area as far as practically possible
» During construction: stay within demarcated footprint areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
» Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
» Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil
» Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan
» Rehabilitate and revegetate all areas outside footprint area that have been disturbed by construction
» After decommissioning remove all foreign material prior to starting the rehabilitation
» The rehabilitation plan for all temporarily affected areas and for the development area after decommissioning should aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover
» Monitor the establishment of invasive species and remove as soon as detected,

whenever possible before regenerative material can be formed
Cumulative impacts: » If mitigation measures are not strictly implemented the following could occur: o Erosion of areas around sealed surfaces and continued erosion of the development area o Contamination of ground water resources o Spread and establishment of invasive species » Increased habitat fragmentation and displacement of terrestrial vertebrates in the region » Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics
Residual impacts: » Altered topsoil characteristics » Loss of microhabitats » Reduced vegetation cover and loss of species diversity » Potential for increased dust and its impact on surrounding environments and biodiversity

i) Temporary laydown areas and construction camps

Activity: Temporary laydown areas construction camps and sites where materials and machinery will be kept during construction, site offices will be located, assembly plants will be housed		
Description: These may be at one or several locations, area will be cleared and levelled where necessary, site offices may be temporary structures, includes batching plants		
Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, displacement of terrestrial vertebrates, possible contamination of topsoil and groundwater by chemicals or oils		
Environmental impact: Loss of vegetation and/or species of conservation concern, alteration and loss of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from sealed or compacted surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible contaminated topsoil, possible contaminated ground water or wetlands, possible increased dust levels, possible unwanted sealed surfaces (e.g. concrete spillages around batching plants)		
	Without mitigation	**With mitigation**
Extent (E)	Beyond site and surroundings (3)	Local (1)
Duration (D)	Short term (3)	Short-term (2)

Magnitude (M)	High (7)	Low (3)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	High (65)	Medium (30)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- No building of temporary infrastructure allowed in Valley Floor Areas or drainage lines and washes
  - Aim to minimise the destruction of indigenous large shrubs
  - Shred all woody material cleared and use the chips for dust and erosion control
- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
- Place infrastructure as far as possible on sites that have been disturbed by past farming activities already
- Stay within demarcated temporary construction areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
- Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas
- Facilities may not be used as staff accommodation
- No vehicles may be washed on the property, except in suitably designed and protected areas
- Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil
- Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan
- After construction remove all foreign material prior to starting the rehabilitation
- The rehabilitation plan for all temporarily affected areas should aim to re-introduce all

non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover » Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed
Cumulative impacts: » If mitigation measures are not strictly implemented the following could occur: o Considerable loss of biodiversity and large shrubs o Loss of wetland and other fluvial habitats o Erosion of the laydown area o Contamination of ground water o Spread and establishment of invasive species o Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns
Residual impacts: » Altered topsoil characteristics » Loss of and alteration of microhabitats » Altered vegetation composition » Higher risk of invasion by alien plant species » Potential for increased dust and its impact on surrounding environments and biodiversity

j) Man camps for construction and operational staff accommodation

Activity: Provision of accommodation close to site for construction and operational staff
Description: Due to the remoteness of the construction area, between 800 and 3000 construction staff will have to be accommodated closer to site, accommodation for maybe 50 or more permanent staff may be required closer to site for the operation of the facility. For the project development, accommodation facilities will have access to water and electricity, as well as catering (possibly some shops) and adequate waste facilities.
Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, displacement of terrestrial vertebrates, possible contamination of topsoil and groundwater hydrocarbons, possible pollution of the area and surrounds with litter
Environmental impact: Loss of vegetation and/or species of conservation concern, alteration and loss of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from sealed or compacted surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible contaminated topsoil, possible contaminated ground water or wetlands, possible increased dust levels, possible

increased pollution levels, possible increase in illegal activities such as wildlife snaring and plant poaching		
	Without mitigation	**With mitigation**
Extent (E)	Beyond site and surroundings (3)	Local (1)
Duration (D)	Long-term (4)	Short-term (2)
Magnitude (M)	Moderate (6)	Low (3)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	High (75)	Medium (30)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- No building of accommodation facilities allowed in Valley Floor Areas or drainage lines; position close to existing provincial gravel roads for easy access
  - Aim to minimise the destruction of indigenous large shrubs
  - Shred all woody material cleared and use the chips for dust and erosion control
- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
- Place infrastructure as far as possible on sites that have been disturbed by past farming activities already
- Fence area to restrict movement of staff onto areas beyond the development footprint, regularly inspect fences along main gravel roads and easily accessible fences (also old existing fences) for the presence of snares
- Stay within demarcated temporary construction areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas
- Employ all measures need to prevent spillage of construction material and other pollutants, including hydrocarbons, ensure the site is equipped with an emergency spill response management plan
- No open fires may be lit for cooking or any other purposes (e.g. heating), unless in

designated (braai) areas » No vehicles may be washed except in a designated area; servicing and repairs on the property should be limited to emergency situations only. » Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil » Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan » After construction remove all foreign material prior to starting the rehabilitation » The rehabilitation plan for all temporarily affected areas should aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover » Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed
Cumulative impacts: » If mitigation measures are not strictly implemented the following could occur: o Considerable loss of biodiversity and keystone shrubs o Increased poaching of plants and animals o Erosion of the development area o Contamination of ground water o Spread and establishment of invasive species o Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns
Residual impacts: » Altered topsoil characteristics » Loss of and alteration of microhabitats » Altered vegetation composition » Higher risk of invasion by alien plant species » Potential for increased dust and its impact on surrounding environments and biodiversity

k) Soil stockpiles

Activity: Subsoil and topsoil stockpiles may be required during or after construction
Description: The landscape is slightly undulating, hence some footprint areas will have to be levelled by either removing topsoil and subsoil or stockpiling these somewhere (especially where footprint areas need to be complete level) or moving/importing materials to fill up smaller depressions. *Gravel and sand will also be required for construction of roads, or buildings and foundations/platforms, and may have to be sourced from a quarry site/sand pit if it cannot be sourced from construction-related excavations.*

Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, displacement of terrestrial vertebrates		
Environmental impact: Loss of vegetation and/or species of conservation concern, loss of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, possibly higher accelerated erosion, possible loss of topsoil resources, reduction of habitat and resource availability for terrestrial fauna, possible source of dust		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Short-term (2)
Magnitude (M)	Moderate (6)	Low (4)
Probability (P)	Highly Probable (4)	Probable (3)
Significance (S = E+D+M)*P	Medium (48)	Low (21)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- Avoid storage of stockpiles in Valley Floor Areas or drainage lines
- Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil, manage stored topsoil according to a dedicated topsoil management plan
- Temporarily stored topsoil should be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan
- Monitor erosion of areas and control where necessary
- After construction remove all foreign material prior to starting the rehabilitation
- Fill up borrow pits that may be created first with overburden or subsoils, covered with topsoils, following a detailed rehabilitation plan
- The rehabilitation plan for all temporarily affected areas should aim to re-introduce all desirable indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover
- Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed

Cumulative impacts: » If mitigation measures are not strictly followed the following could occur: o Continued erosion of the altered surfaces with associated degradation of the site and surrounding areas o Spread and establishment of invasive species » Increased habitat fragmentation and displacement of terrestrial vertebrates in the region » Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns
Residual impacts: » Altered topsoil characteristics » Loss of and alteration of microhabitats » Altered vegetation composition, lower vegetative cover and loss of species diversity » Potential for increased dust and its impact on surrounding environments and biodiversity » Higher risk of invasion by alien plant species

l) Lined Evaporation pond

Activity: Construction and operation of an evaporation pond		
Environmental Aspect: creation of open source of permanent water in an arid environment, possible gradual mineral enrichment of this water, clearing of vegetation and transformation of surface		
Environmental impact: loss of vegetation, alteration of soil surface and associated runoff patterns (up to 8 ha), permanent attraction of fauna to this water source (birds and terrestrial fauna), possible loss of fauna due to drowning or other injury incurred when trying to reach water source		
	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Moderate (6)	Minor (2)
Probability (P)	Definite (5)	Probable (3)
Significance (S = E+D+M)*P	Medium (60)	Low (21)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Low reversibility	Reversible
Irreplaceable loss of	Medium Probability	Small possibility

resources?		
Can impacts be mitigated?	Reasonably but with limited full restoration potential	

Mitigation:

- No evaporation ponds allowed in or within 100 m of pan areas, Valley Floor Areas or drainage lines and washes
- Limit the destruction of large shrubs
- After the final layout has been approved, conduct a thorough walkthrough survey of the footprint area to determine any protected plant species population location and its size, and animal burrows, and compile a suitable photo record that can be used by ECO/construction staff to identify the relevant species
- Keep areas affected to a minimum, strictly prohibit any disturbance outside the demarcated footprint area
- Ensure all open water areas are fenced off in order to keep mammals (also burrowers) and larger reptiles (tortoises) out
  - If smaller mammals or larger reptiles to manage to get in or many larger birds come in, line the sides with a rougher material that will enable such fauna to climb out and not slip back into the water
- Clear as little vegetation as possible, aim to maintain all indigenous vegetation where it will not interfere with the construction or operation of the development
  - Shred all woody material cleared and use the chips for dust and erosion control
- After construction, rehabilitate an acceptable vegetation layer according to rehabilitation recommendations of the relevant EMPr
  - Use only species that were part of the original indigenous species composition as listed in the specialist report, aim to obtain at least the original cover percentages of desirable species
  - Revegetation should occur naturally where topsoils were not severely altered

Cumulative impacts:

- If mitigation measures are not strictly implemented the following could occur:
  - Considerable loss of fauna, especially nocturnal species of conservation concern
  - Possible accelerated erosion of areas around the evaporation ponds and continued erosion of the development area
- Increased habitat fragmentation and displacement of terrestrial vertebrates in the region
- Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns

Residual impacts:

- Altered topsoil characteristics
- Loss of and alteration of microhabitats
- Altered vegetation composition, small loss of large shrubs, lower vegetative cover
- Potential for increased dust and its impact on surrounding environments and biodiversity
- Higher risk of invasion by alien plant species

7.3.3 Assessment of grid connection

There is a difference in the anticipated impacts between the construction of a new power line compared to the loop in – loop out configuration (as reflected in the tables above) due to construction activities within the power line corridor and establishment of new pylons. The significance for both options in terms of the ecological impact however remains low. This is due to the existing Eskom servitude and the suitability of the ecosystems identified along the power line route to accommodate additional power lines.

7.3.4 Comparative Assessment of Alternatives

Site alternative: The occurrence of an extensive valley floor system in the south west of the study area which demonstrates extensive connectivity with other systems across multiple properties (ESA) has been mapped as a no-go area due to the following ecosystem functions:

- Accumulation and filtering of runoff before it seeps into below-ground water reserves
- Seasonal provision of grazing, the latter enabling migration of terrestrial fauna across vast expanses of harsh environments (important corridor function)
- Seasonal seed sources to replenish seed banks and be available to fauna
- Significant slowing of large volumes of runoff that may occur during occasional thunderstorms, apparent significant re-charge of ground-water reserves through these systems (many boreholes located along larger Valley Floor Areas)
- Seasonal support of a higher plant species diversity

Due to the original CSP 1 site partially conflicting with this important fluvial system and the potential impact on the observed ESA, the current CSP 1 Project Site on Portion 3 of the Farm Styns Vley 280 is preferred.

Water supply: Raw water is required to be supplied to the Proposed Project through abstraction or municipal supply. Abstraction of water from a natural resource (Gariep River or an underground aquifer) could result in potential ecological impacts at the abstraction point (more likely if no existing abstraction point exists), while conveyance thereof could result in differing impacts depending on the route or alignment of the raw water pipeline. In terms of the water supply option from the Kenhardt reservoir, due to the existing, variably disturbed servitudes followed by both route options and similar habitats to be traversed, the impact of the pipeline routes will be very similar, and from an ecological perspective, both routes are considered equally feasible.

7.3.5 Implications for Project Implementation

With the diligent implementation of mitigating measures by the developer, contractors, and operational staff, the severity of ecological impacts of the proposed CSP 1 plant can be significantly reduced or avoided. The Project can be developed and ecological impacts managed by adhering to the following key actions:

- » It is anticipated that most of the Proposed Project development will be situated on primarily on mixed shrublands of low ecological sensitivity and Valley Floors of medium ecological sensitivity. The loss of these areas to CSP development is regarded to be acceptable loss in terms of ecological functioning, as well as conservation thresholds. Areas of high ecological sensitivity associated with ephemeral drainage lines to the east of the CSP 1 plant can be avoided by keeping the plant west towards the power line as far as possible.
- » The slightly undulating plains covered with a surface of extensive shale fragments are very harsh, and most suitable for the development components. Runoff should be redirected to larger Boesmanland Vloere or Valley Floor areas (where runoff can be naturally slowed down by vegetation and absorbed into the ecosystem).
- » The proposed CSP 1 plant will create a localised reduction of vegetation, including individual slow-growing indigenous succulents (which should be minimal due to relocation efforts) shrubs and geophytes. At this stage, however, it is not anticipated that the development will significantly affect the current conservation status of any species.
- » The impact on terrestrial fauna is expected to be small for the development if mitigation measures are put in place. Animals that are present can be relocated out of harm’s way (within the selected land portions), and will most likely resettle after construction, depending on safety specifications necessitated by the development.
- » Potentially significant negative impacts on the ecological environment could be soil- and associated degradation on and beyond the development area, possible introduction of alien invasive plants, significant alteration of surface runoff patterns and undesirable associated effects on groundwater recharge, severance of migration corridors and low or absent vegetation cover after construction. With the diligent implementation of mitigating measures by the Project Company, contractors, and operational staff, the severity of these impacts can be significantly reduced.

7.3.6 Biodiversity Offset Plan

Due to loss or disturbance of an area of sensitive wash and valley bottom habitat within CSP 1 and to accommodate cumulative loss from the proposed broader development a proposal for a biodiversity offset has been prepared (Appendix F). The primary purpose of a biodiversity offset area should be to enhance the ecological value of the area to fauna and flora and provide a refuge area where species can avoid the pressures associated with the surrounding farmland. The value of the area as a biodiversity offset lies in providing habitats and features that are not widely available in the landscape and this would be created primarily by removing livestock from the area. The indigenous herbivores of the area are likely to increase and provide sufficient levels of disturbance and grazing pressure to maintain any ecological processes which rely on these disturbances. As most of the indigenous fauna of the area is independent of water, it would not be necessary to provide water or other infrastructure for fauna.

Management of the biodiversity offset area should be closely aligned and integrated with the open space-management plan for the development site itself. This would enhance the value of the biodiversity offset area as well as the open space in the broader area and between the development footprints at the site.

Therefore the following are identified as the primary aims and management approaches for the biodiversity offset area:

» Exclude grazing by livestock whilst allowing access by native fauna;
» Maintenance of the indigenous vegetation of the area to enhance its value as a conservation area and improve its' status as faunal habitat and to provide corridors for fauna movement.
» Encouraging the recovery of the natural vegetation within disturbed or degraded areas.

7.4. Potential Impacts on Avifauna

To adequately identify avifaunal impacts bird monitoring was undertaken by a qualified Bird Specialist in both the wet and the dry season (Appendix F of the Amended EIAr) The specialist ensured that the monitoring programme included a wet season survey as well as a dry season survey, which is considered relevant for the Northern Cape. Seasonal monitoring was undertaken for this project, following a reasonable methodology, and that due consideration of the sensitivity of the site, and ultimately the suitability of the site for the proposed project was in line with (and exceeded) the BirdLife South Africa monitoring guidelines in place. A letter from the avifauna specialist (refer to Appendix H) confirms that Birds Unlimited, as the bird specialist have high confidence in the findings from the wet and dry season surveys undertaken for the project,

7.4.1 Results of the Avifaunal Assessment

The avifaunal survey undertaken recorded a low species richness of sixty four avifaunal species recorded within the broader study area, five of which are threatened (red listed species) and forty of which are endemic. Species identified to be of most concern due to their interactions with the broader areas are the large nomadic Ludwig's Bustard *Neotis ludwigii* and Kori Bustard *Ardeotis kori*, the Martial Eagle *Polemaetus bellicosus* the Sclaters Lark (*Spizocorys sclateri*) and Lanner Falcons *Falco biarmicu*.

Alternative site: The CSP 1 Project Site was moved to an alternative location within the study area on account of the discovery of an active Martial Eagle nest on top of a tower on the 400kV power line adjacent to the original position of identified for the siting of CSP 1. The outer edge of the heliostat field of CSP1 project is currently situated outside of the recommended 3 km buffer of the Martial Eagle nest, while the central receiver tower is be located over 4.5km from the nest. From the driving surveys undertaken, no flights of a Martial Eagles through the proposed CSP 1 Project Site were observed.

7.4.2 Impact tables summarising the significance of impacts on avifauna (with and without mitigation)

The potential impacts to avifauna from the construction and operation of the Proposed Project facility include:

» Disturbance during construction and operation,
» Habitat alteration,
» Interaction of avifauna with the facility and potential impact of solar flux, and
» Direct collision with the power line network.

Habitat alteration: Little is known about the impacts of solar thermal plants on birds, largely because commercial-scale solar technologies are only now under construction in South Africa. The primary impact on bird species and communities is mainly due to the large footprint required for commercial-scale energy production. This would refer to the habitat loss and disturbance created during the construction phase of the facility.

The alteration of bird habitat or the introduction of artificial environments attracting birds to the facility has been identified as a potential impact. The presence of open evaporation ponds (albeit brine water) could potentially attract arid zone birds for sampling or bathing. The fieldwork results indicate that small water sources attract 25 birds per hour (of 17 species). The evaporation ponds are considered to be a potential water resource and may attract water birds leading to instances of cumulative solar flux impacts or drowning. Insects may be attracted to the intense light at the CSP Project, which in turn may attract species such as bustards which eat mainly insects and other insectivorous species within close proximity to central receivers.

Solar flux: Due to the limited number of CSP Projects in operation internationally, baseline data concerning the impact of solar flux on birds is limited. The Ivanpah Solar Electric Generating System[10] in the U.S.A has come under scrutiny for bird mortalities due to the phenomenon known as solar (light) flux, which is the concentration of light onto the bird passing through the solar field, and while the technology for the Proposed Project development will be different, may be the best example to demonstrate potential avifaunal interactions with the facility.

There is no super-heated air in the heliostat field. Light energy, and even infrared light energy, is not heat. Only when the light energy is absorbed by an object that it hits, is it converted to thermal energy. The glass in the heliostat mirrors is transparent, and as such they absorb very little light, mostly on the low or UV end of the solar spectrum. Air absorbs, for all practical purposes nothing, but small particles in the air can scatter or absorb depending on their colour or reflectivity. Therefore the air in the heliostat field does not get hot from solar flux: it cannot absorb the flux and convert it to thermal energy.

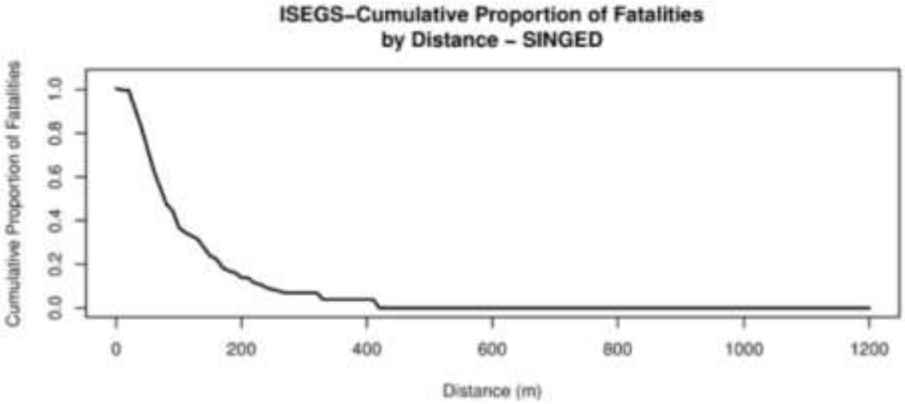
Perspective from the developers of the Ivanpah facility (BrightSource) based on the monitoring results of the facilities operations, suggest that the majority of bird mortalities have occurred due to solar flux singeing within a distance of 100m from the central receiver. While bird mortalities are reported, birds also appear to be able to survive flux burns[11].

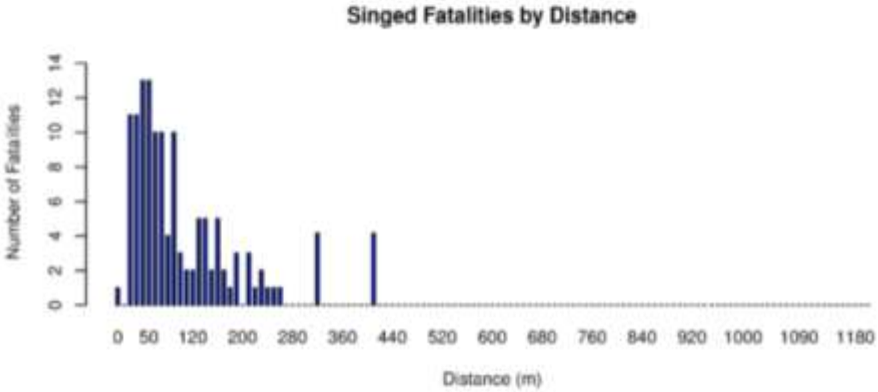
The area between 100m and 200m from the tower is the main area of concern due to the potential for birds to be singed from super-heated air, as illustrated in the Figure below which shows that more than 99% of the bird mortalities that have evidence of flux singing were found within 100m to 200m of a tower. The extent of the impacts associated with this impact would therefore be local in extent.

[10] SolarReserve technology is proposed for the project

[11] http://www.brightsourceenergy.com/setting-the-record-straight-solar-flux-and-impact-to-avian-species

Understanding where the majority of bird deaths occur helps to more accurately estimate the number of birds potentially impacted by flux and focus avian deterrent efforts for maximum effect.





(Reference:http://www.brightsourceenergy.com/stuff/contentmgr/files/0/adada6e4cb1ff6a39fd268084026eb95/files/isegs_setting.jpg)

Nature: Impact of avifaunal interaction around the CSP Project for the Red-listed bird groups identified as at risk during operations. (**ME**= Martial Eagle, **LB** = Ludwig's Bustard, **KB** = Kori Bustard):		
	Without mitigation	**With mitigation**
Extent	1	1
Duration	4	4
Magnitude	7 (ME), 7 (LB, KB)	5 (ME), 5 (LB,KB)
Probability	5 (ME), 5 (LB, KB)	4 (ME), 4 (LB, KB)
Significance	60 (ME), 50 (LB, KB) (high)	40 (ME), 40 (LB, KB)
Status (+ve or –ve)	Negative	
Reversibility	Low (no known mitigation)	
Irreplaceable loss of species?	Possibly if other Martial Eagles are attracted into the space provided by the loss of a territorial birds. Otherwise they do	

	relatively well in a Karoo setting. Bustard interactions with CSPs are unknown
Can impacts be mitigated?	Possibly but most mitigation measures are untested around the CSP towers
Mitigation: **Solar flux:** Buffer Zone – Application of a 3km buffer around the Martial Eagle nest to reduce the risk to these individuals. Diversion - The region within 100 m of the tower is the main area of concern. The mitigation solution entails deterring birds in this zone. To effectively reduce risk, a deterrent, or combination of deterrents, would need to exclude birds from the area around the tower. Investigate a combination of bird radar and acoustics as measures to divert or deter birds from the vicinity of the CSP site. Relocation - Translocation of the Martial Eagle nest, 2 km west and away from the CSP Project Site. The impact of solar flux impacting on birds within the vicinity of the central receiver is not well understood due to the lack of baseline data. Therefore, further research and monitoring is recommended. This mitigation measure is not preferred. **Evaporation ponds:** Evaporation ponds should ideally be positioned well away (1 km) from the central receivers to avoid birds seeking water being attracted to them.	
Cumulative impacts: Another CSP facility is proposed within the larger study area	
Residual impacts: None identified	

The CSP tower position is in excess of 4.5km from the Martial Eagle nest. Martial Eagle territories can be in excess of 100km^2 and the potential for these birds to fly over the CSP sites and near to the tower during operation, potentially placing these birds at risk, is considered to be a possibility. A further possibility however, is that the small number of endangered avifauna identified in the project area will be naturally deterred from using the CSP Project during operations, limiting the probability of the impact, while other less desirable species may be attracted to the facility. Further monitoring during operation is recommended in order to adequately understand the potential avifaunal impact.

Collision impacts: Direct collision with the power line network (existing 400kV power line and/or proposed 132kV power line) by collision prone species such as Bustards is currently occurring and could potentially be exacerbated.

Nature: Direct impact mortality around the existing and new power line for the Red-listed bird groups identified as at risk during operations. (**ME**= Martial Eagle, **LB** = Ludwig's Bustard, **KB** = Kori Bustard):		
	Without mitigation	**With mitigation**
Extent	3	3
Duration	4	4
Magnitude	4 (ME), 8 (LB, KB)	3 (ME), 6 (LB, KB)
Probability	4 (ME), 5 (LB, KB)	3 (ME), 4 (LB, KB)
Significance (E+D+M)P	44 (ME), 75 (LB, KB) – high to very high	30 (ME), 33 (LB, KB) – medium to medium-high
Status (+ve or –ve)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of species?	Yes, both bustard species are being killed in unsustainable numbers affecting the SA population	
Can impacts be mitigated?	Yes, by marking all existing and all future lines	
Mitigation: » Mark power lines with bird diverters (diurnal and nocturnal). The priority areas (those with the highest Bustard mortality rate identified near to the Project Site) should be marked first.		
Cumulative impacts: Red-listed Bustards and Martial Eagles will always be attracted to the food sources and habitats provided in the Karoo. Thus all power lines that cross these remote areas should be fitted with bird diverters (diurnal and nocturnal) to reduce the high incidence of collisions. Given that there are 14 500 km of transmission lines alone in South Africa (2013 estimate) the cumulative impact of 0.39–1.0 bustards killed per kilometre per year is significant. Shaw (2013) estimated 47 000 Ludwig's Bustards alone are killed in South Africa. As the number of power lines increase so the number of deaths of bustards and other birds will increase.		
Residual impacts: After mitigation, direct mortality through collision or area avoidance by the affected species may still occur and further research and mitigation for the sections of power line responsible for Bustard mortalities will be required.		

7.4.3 Assessment of grid connection

Comparatively there is no significant difference in operational impacts between the construction of a new power line adjacent to the existing Eskom line compared to the loop in – loop out configuration on this power line, provided that bird diverters to reduce the high incidence of collisions of Bustards are installed on the power lines, regardless of which grid connection option is implemented.

7.4.4 Comparative Assessment of Alternatives

Site alternative: The original CSP 1 site is situated within the 3km buffer around the Martial Eagle nest prescribed to mitigate the potential effect of solar flux from CSP tower facilities, thereby placing these individuals directly at risk. The current CSP 1 Project Site CSP tower is situated ~4.5km from the nest, significantly reducing the risk. The current CSP 1 Project Site is therefore preferred due to an appropriate separation distance from the nest being observed.

Water use: Raw water is required to be supplied to the Proposed Project through abstraction or municipal supply. The conveyance of such water to the Project Site via pipeline within existing road reserves and the proposed cooling technology is not anticipated to have a negative impact on avifauna.

7.4.5 Implications for Project Implementation

» A low number of bird species were recorded at the Project Site and five endangered species were recorded as making use or interacting with the Project Site during the dry and wet season.
» The prescribed 3 km buffer around the Martial Eagle nest located on the existing Aries – Helios power line must be maintained.
» The potential interaction of avifauna with the facility leading to solar flux mortalities is not well understood. Construction and operational monitoring should be conducted to determine whether and how endangered species will interact with the facility and whether additional mitigation measures need to be considered.
» Evaporation ponds present a potential artificial water source to avifauna and should be spaced as far as possible from the central receiver to mitigate the potential cumulative impact of solar flux.
» Other mitigation measures which could be considered as part of monitoring efforts include preventing roosting and perching at the CSP central receiver.
» Systems to assist in the detection, monitoring and deterrence of bird movement within the CSP site should be implemented to discourage avifauna from utilising the site on the back of pre-construction and operational monitoring data. Such deterrence measures may include bird control devices may be used, if considered to be feasible and if significant fatalities are recorded on site, in order to deter birds from the CSP Project Site/ solar field.
» Eskom should be alerted to the high Bustard mortality rates due to power line collisions in the vicinity of the Project Site.
» All existing and proposed power lines within the Project Site should be marked with bird diverters upon consultation with an avifaunal specialist to deter further mortality of Bustards.

7.5. Assessment of Impacts on Water Resources

Water requirements: The proposed CSP 1 Project Site will have a construction phase water demand of 150 000m^3 per annum and an operational phase water demand of 250 000m^3 per annum. The use of dry-cooled technology is proposed due to water supply constraints however wet cooled technology has been included in the assessment due to the comparative cost advantages and plant efficiencies as well as the potential to secure a large supply of water from the Kai !Garib Local Municipality.

Water supply: Water supply alternatives investigated for the purposes of providing raw water to the project include:

» Supply from the Kai !Garib Local Municipality conveyed via a 95km – 96km pipeline within the servitudes of existing farm, main and service roads;
» Abstraction from boreholes located near to the Project Site. Chemical analyses at thirteen boreholes were undertaken with pump test undertaken at six of the boreholes;
» Abstraction from a point on the Orange (Gariep) River conveyed via a pipeline of approximately 110km in length.

The potential for provision of groundwater resources to meet the requirements of the project were investigated in the water impact assessment report (refer to Appendix I).

7.5.1 Results of the Surface and Groundwater Resources Assessment

Surface Water: The watershed in the project area is poorly defined due to the flat terrain and poorly organised river system. A non-perennial drainage line originates outside of the western boundary of CSP 1 within the upper reaches (most upstream point) of the catchment area. Upper reaches of the catchment are associated with low flows as the effective catchment area is small. Drainage occurs in a southerly direction towards the Gemsbokrivier. The Gemsbokrivier discharges into the Sak River approximately 30km downstream of the study area.

Groundwater: Two aquifers occur in the project area, associated with the primary / composite material which is found in close proximity to drainage lines and underlying fractured rock material. Based on the slight hydraulic disconnect between the primary and underlying fractured rock aquifers, the depth to groundwater level in the primary aquifer average 76.9 mbgl below ground level. The underlying fractured rock aquifer shows depth to groundwater level measurements ranging between 14.65 and 32.48m below ground level. Groundwater yields in the project area are low based on the results of the pump tests undertaken.

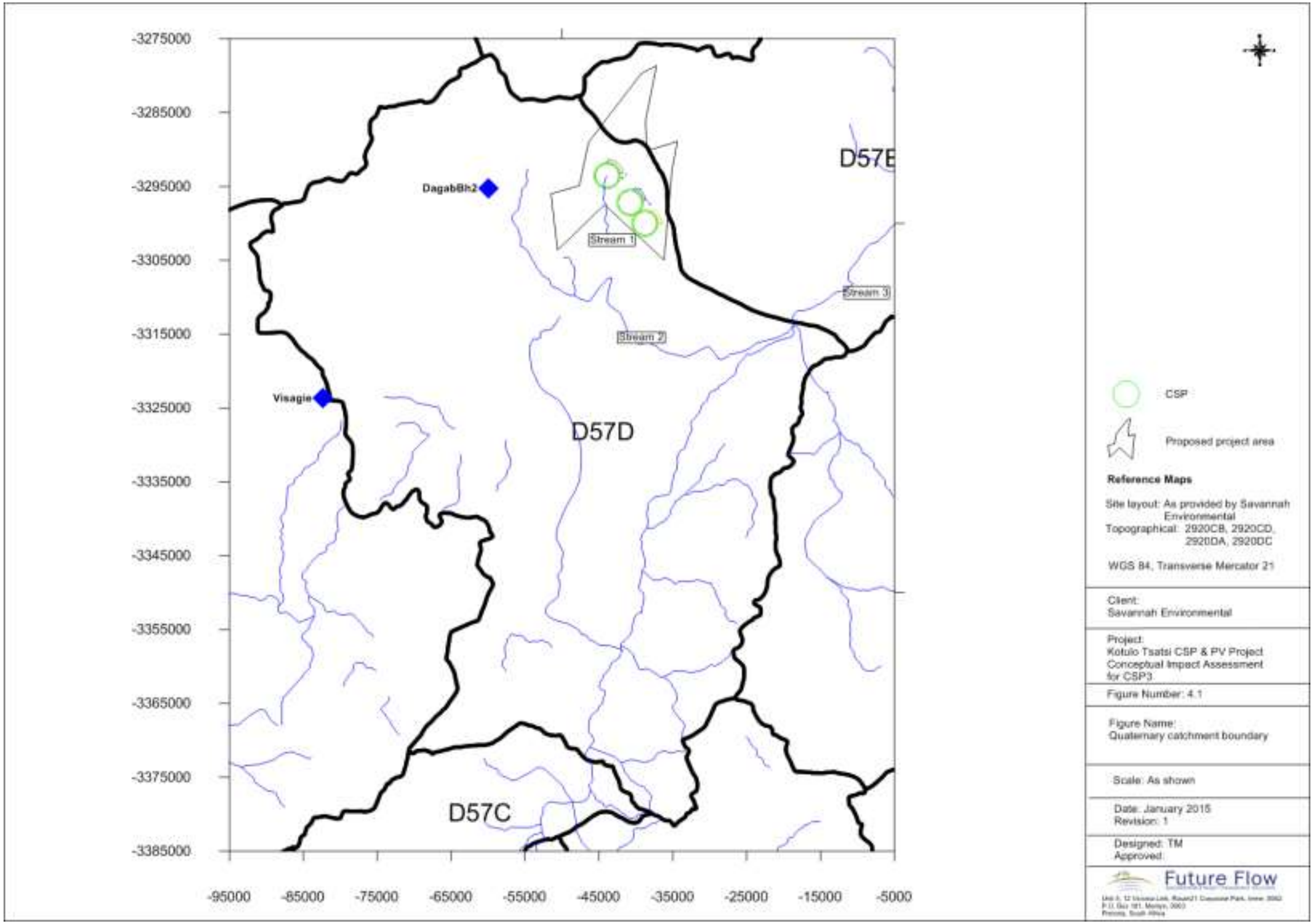


Figure 7.2: Map illustrating the drainage lines mapped within the broader study area.

7.5.2 Impact tables summarising the significance of impacts on surface and groundwater resources (with and without mitigation)

a) Construction Phase

Surface and groundwater levels, flow patterns and volumes during construction

During the construction phase the natural vegetation in the Project Site will be removed for the construction of access roads, power block, heliostats and other associated infrastructure. There will be a higher potential for sediment transport during storm events as soil particles are loosened due to an increased percentage of bare surfaces. Reduced vegetation cover will decrease infiltration and increase surface runoff which would result in a higher potential for hydrological yield. An increase in denuded surfaces may lead to increased run-off, which may result in reduced recharge entering the underlying aquifers.

Nature: Impacts on surface water due to loss / disturbance of drainage lines		
	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	Site specific (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (4)	Low (4)
Probability	Definite (3)	Improbable (2)
Significance	24 (Low)	16 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » Limit construction activities directly within drainage channels as far as possible » Avoid the removal of riparian vegetation where it occurs as far as possible » Avoid infill of drainage lines so as not to alter natural hydrological regime where possible		
Cumulative Impact: » Downstream catchment impact is low due to the impacted stream having low stream flows and being unable to support flow dependent aquatic life.		
Residual impacts: N/a		

» Altered runoff patterns and stormwater flows

Nature: Impacts on surface water yield due to clearance of vegetation		
	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	Site specific (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (4)	Improbable (2)
Significance	Moderate to Low (40)	Low (16)
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Minimise vegetation clearance » Re-vegetate bare surfaces to prevent the formation of gullies and transportation of sediments » Compaction of road surface to increase stability		
Cumulative Impacts: Altered runoff patterns and stormwater flows		
Residual impacts: » N/a		

The foundation design and requirements for the proposed developments are assumed to occur relatively close to the surface, above the groundwater level at the Project Site. The average depth to groundwater level in the project area as recorded by the hydrocensus boreholes ranges between 6.65 and 32.48 mbgl. Deep excavations are not expected during the construction of the proposed development, therefore no dewatering of the aquifers will be required.

Nature: Impacts on groundwater level due to reduced recharge from denuded surfaces		
	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (3)
Probability	Definite (4)	Probability (4)

Significance	Moderate (52)	Moderate to Low (40)
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » Minimise impervious surfaces or use porous paving / concrete surfaces as far as possible		
Cumulative impacts: Reduction of groundwater recharge		
Residual Impacts: N/a		

The surface and groundwater may be contaminated by possible hydrocarbon spills from vehicles and heavy machinery used to construct and transport the proposed infrastructure to site.

The construction vehicles and heavy machinery moving around the Project Site will result in the generation of dust which impacts negatively on surface water quality.

Nature: Impacts on surface and groundwater quality due to hydrocarbon spills		
	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (10)	High (10)
Probability	Definite (5)	Improbable (2)
Significance	85 (High)	32 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: » Undertake good housekeeping and provide safe storage of potentially hazardous material within properly constructed and lined or paved areas » Appropriately size and maintain oil traps to contain all discard oil from working areas etc.		

Cumulative impacts: Potential impacts on groundwater quality
Residual impacts: N/a

Nature: Impacts on surface water quality due to waste handling		
	Without mitigation	**With mitigation**
Extent	Affects beyond site boundary (3)	Affects immediate surrounding areas (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low to Moderate (4)
Probability	Probable (4)	Improbable (2)
Significance	44 (Moderate)	16 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Yes
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	**Yes**	
Mitigation: » General waste must be collected and disposed of at a registered waste disposal site. » Maintenance of construction vehicles must be conducted on a demarcated area with a concrete slab and oil collection system.		
Cumulative impacts: Groundwater infiltration affecting quality. Pollution of larger downstream surface water systems.		
Residual impacts: N/a		

b) Operational Phase

Power generation has predominantly two types of cooling systems that are in use, wet cooling and dry cooling. The cheapest and most widely used method is using water as a cooling mechanism. The wet cooling system results in water demand difficulties in arid areas. Cooling with air instead of water decreases the efficiency of the system, as air has a lower capacity to carry heat as compared to water. Large fans will be required to remove heat from the pipe array in the cooling system, using a significant portion of the power generated by the plant. The use of dry instead of wet cooling increases investment costs and lowers efficacy.

The proposed method of cooling for the Proposed Project plant will be the dry cooling method, due to the dry cooling systems having a significantly smaller water-use footprint than the traditional wet cooling systems. Water will also be used for cleaning solar collection and reflection surfaces such as heliostats. Up to 250,000m^3 per annum of raw water will be required for operations. The amount of water required may be more significant in the project area due to the dust storms as more frequent cleaning will be required.

Surface and groundwater levels, flow patterns and volumes during operation

Groundwater could potentially be extracted for use during the life of operations of the project. Long term pumping of groundwater to supply the plant operations will result in dewatering of the underlying aquifers if the abstraction rate is not managed properly. This could also lead to a loss of surface water and groundwater connectivity. A long term decline in the groundwater level could result in reduced baseflow to surface water.

Currently none of the individual boreholes sampled have a sustainable yield which can meet the water requirements of the Proposed Project but deeper drilling could result in sustainable yields being realised. This impact may not occur if all operational phase raw water requirements are serviced by the municipality.

Nature: Impacts on groundwater level due to pumping of boreholes		
	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	N/A
Duration	Long term (5)	N/A
Magnitude	Moderate to Low (4)	N/A
Probability	Definite (5)	N/A
Significance	Moderate (55)	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Irreversible	N/A
Irreplaceable loss of resources?	Yes	N/A
Can impacts be mitigated?	No	N/A
Mitigation: » The groundwater levels should be managed so that the main aquifer is not dewatered on a regular or long term basis as it could lead to a decrease in the sustainable yield of the aquifer over time.		
Cumulative impacts: N/A		
Residual impacts: N/A		

Contamination of the surrounding watercourses and aquifers

Residential (man camp) and industrial establishments will require the development of adequate sanitation in and around the Project Site during the operational phase. The failure of sewage treatment works will impact negatively on the chemical and microbiological characteristics of the receiving surface water resources. The proposed development will result in higher sewage volume generations.

Contamination of the underlying aquifers can occur from raw sewage overflow, leaking sewer lines and septic tanks or loss of integrity to the evaporation pond. The threat from sewage arises from contamination by bacteria, nitrates, metals and trace quantities of toxic metals.

Nature: Impacts on surface water and groundwater quality due to sewage effluent		
	Without mitigation	**With mitigation**
Extent	Affects beyond site boundary (3)	Affects immediate surrounding areas (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate to Low (4)
Probability	Probable (3)	Improbable (2)
Significance	Moderate to Low (42)	Low (22)
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Ensure integrity of all infrastructure and wastewater systems		
Cumulative impact: Impacts on groundwater and surface water		
Residual impact: N/a		

Liquid salts used for heat transfer in power plants are called molten salts. Conventional mixtures of sodium / potassium nitrates are proven as energy storage media in tower plants. Molten salts as an HTF pollute less, are non-flammable and have lower vapour pressures. Leaking molten salts will solidify and can be cleaned by scooping with a shovel, therefore are not a potential threat to the underlying aquifers.

Nature: Impacts on groundwater quality due to contaminant migration from leakages

	Without mitigation	**With mitigation**
Extent	Affects immediate surrounding areas (2)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Slight (2)	Slight (2)
Probability	Probable (2)	Improbable (2)
Significance	Low (18)	Low (16)
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Appropriate lining of the liner system for evaporation ponds » Appropriate maintenance and monitoring of HTF pipes and receivers		
Cumulative impacts: None		
Residual impacts: None		

7.5.2 Assessment of grid connection

Comparatively there is no significant difference in impacts between the construction of a new power line adjacent to the existing Eskom line compared to the loop in – loop out configuration on this line from a hydrological perspective provided that power line tower structures are sited outside of drainage lines occurring within the power line corridor.

7.5.3 Comparative Assessment of Alternatives

Site alternative: The previous CSP 1 site is positioned near to an extensive valley floor system which is expected to contribute to the slowing of large volumes of runoff that may occur during occasional thunderstorms and accumulation and filtering of runoff before it seeps into groundwater reserves. This system is ascribed to be a no-go area due to the ecological importance and contribution to the ESA. The current CSP 1 Project Site is not affected by notable hydrological/ecological systems and is therefore preferred from a hydrological perspective.

Water conveyance: Raw water is required to be supplied to the Proposed Project by way of municipal supply, although boreholes on the farm have been tested to investigate the potential water yield and quality from underlying aquifers. Abstraction of groundwater at boreholes located close to the Project Site will have a moderate impact on groundwater resources, however it is questionable whether these boreholes can provide sustainable water supply during operations. The impact will not occur should all raw water requirements for the project be serviced by the municipality. The impact on surface water resources for the conveyance of water between the source and the Project Site via a water pipeline will be more significant for the municipal supply alternative, however the significance thereof is decreased due to the proposed alignment within existing road servitudes. The construction of a new water pipeline from the abstraction point on the Gariep River to the Project Site will have the highest impact due to impacts resulting from construction activities at the abstraction point and the construction of the pipeline in excess of 140km. From this perspective it is the least preferred alternative.

Water use: Water abstraction from boreholes could potentially service the need of a dry cooled plant, however the use of wet cooled technology would far exceed the potential sustainable yield of the available groundwater resource. Wet cooled technology would significantly increase the water use requirement of the plant and despite potential allocations being made by the municipality, is not considered preferred within the context of the receiving environment. There is the potential for impacts on existing water users depending on whether water will be abstracted from boreholes or supplied by the municipality. Due to the low yield of borehole water in the area, any unsustainable abstraction for industrial use could potentially impact on underground aquifers which in turn could have an impact on existing neighbouring users (for sheep watering and domestic supply).

7.5.4 Implications for Project Implementation

- » The CSP 1 Project Site does not significantly affect identified drainage line, however it should be considered in the stormwater management plan that runoff should be redirected to Valley Floor areas (where runoff can be naturally slowed down by vegetation and absorbed into the ecosystem).
- » The project development area covers a surface area of approximately 1 000ha. Based on flood calculations, the Proposed Project development area yields approximately 42.45 m^3/s and 62.95 m^3/s for the 1:50 and 1:100 years storm event respectively (in a 24 hour storm event). Based on the drainage density calculations undertaken, there is no flood risk for the Project Site.
- » Raw water is required to be supplied to the Proposed Project primarily by way of municipal supply although boreholes on the farm have been tested to investigate potential yield as an alternative/supplementary supply source. The raw water requirements for the operational phase of the CSP Project are in the region of 28m^3 per hour while cumulative yields from all boreholes tested near to the Project Site were in the region of 9m^3 p/h. Therefore, although yields from the identified boreholes are not anticipated to meet the operational phase project requirements, the application for a Water Use License should include water uses for the potential supply of water during the construction phase.

7.6. Impacts on Soils, Land-Use and Agricultural Potential

7.6.1 Results of the Soils Survey

The soils and agricultural potential study (Appendix J) revealed the following:

» The Project Site is currently used for grazing purposes (sheep).
» The Project Site is underlain by three soil associations dominated by rock outcrops or shallow Mispah and Coega soils (more than 50% of project surface area), followed by sandy Prieska soils and Augrabies soils which occur in the majority of the drainage lines. Most of the soil forms and associations are relatively resistant to erosion.
» The Project Site is situated on soils with very low agricultural potential largely restricted by the arid climate conditions and shallow soils.
» There are no areas of agricultural sensitivity that should be avoided by the development.
» There has never been any cultivation or irrigation on the site.

7.6.2 Impacts on Soils

The components of the project that can impact on soils, agricultural resources and productivity are:
» Construction activities that disturb the soil profile and vegetation, for example for levelling, excavations, blasting (if required), drilling and so forth.
» Construction of access roads.
» Spills or contamination from dangerous goods or hazardous fuels utilised on the site during construction or operation.

7.6.3 Impact tables summarising the significance of impacts on soils and land use (with and without mitigation)

Nature: Loss of agricultural land due to the direct occupation of CSP Project		
	Without mitigation	**With mitigation**
Extent	Site (1)	N/A
Duration	Permanent (5)	N/A
Magnitude	Low (2)	N/A
Probability	Probable (4)	N/A
Significance	Medium (32)	N/A
Status	Negative	N/A
Reversibility	1 – Site	N/A

Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	
Mitigation: None; limit footprint where possible and ensure that adequate erosion measures are in place		
Cumulative impacts: The development of multiple solar projects in the area can have cumulative impact on soil; however this can be managed to acceptable levels.		
Residual impacts: None		

Nature: The loss of topsoil due to construction of energy facilities and associated infrastructure		
	Without mitigation	**With mitigation**
Extent	Low (1)	N/A
Duration	Short (2)	N/A
Magnitude	Small (2)	N/A
Probability	Definite (4)	N/A
Significance	Low (20)	N/A
Status	Negative	N/A
Reversibility	High	N/A
Irreplaceable loss of resources?	No	N/A
Mitigation » Strip and stockpile topsoil from all areas where soil will be disturbed. » After cessation of disturbance, re-spread topsoil over the surface. » Dispose of any sub-surface spoils from excavations where they will not impact on agricultural land, or where they can be effectively covered with topsoil. » Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil. » Topsoil and spoil material/subsoil storage areas must be delineated in the final layout plan. » Combined final stockpiles may not exceed 4 m in height, preferably should not be higher than 1 m, and must be managed according to a strict landscaping, rehabilitation and soil erosion management plan until decommissioning.		

» Temporarily stored topsoil must be re-applied within 6 months, topsoil stored for longer need to be managed according to a topsoil management plan.
Cumulative impacts: The overall loss of agricultural land in the region due to other developments. The significance is low due to the extremely limited agricultural potential of the area.
Residual impacts: No mitigation possible so same as impacts without mitigation

Nature: Constructing of access roads to facility leading to the loss of agricultural land and potential erosion		
Comment:		
	Without mitigation	**With mitigation**
Extent	Low (1)	N/A
Duration	Long term (4)	N/A
Magnitude	Low (2)	N/A
Probability	Probable (4)	N/A
Significance	Low (28)	N/A
Status	Negative	N/A
Reversibility	Low	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	Yes	
Mitigation: » Use existing roads as far as possible, adequate erosion measures are vital (especially at watercourse crossings)		
Cumulative impacts: The cumulative impact of construction is expected to be small due to the low agricultural potential of the land. There is low risk of erosion due to the very gentle slopes.		
Residual impacts: Low		

Nature: Increased soil erosion due to convergence of flow lines under heliostats and access roads		
	Without mitigation	**With mitigation**

Extent	Low (1) - Site	N/A
Duration	Permanent (5)	N/A
Magnitude	Low (2)	N/A
Probability	Probable (4)	N/A
Significance	Medium (32)	N/A
Status	Negative	N/A
Reversibility	Low	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	Yes	
Mitigation: » Ensure that adequate erosion measures are in place and limit direct footprint.		
Cumulative impacts: The cumulative impact on soil and agricultural resources is expected to be low due low rainfall and relatively gentle slopes of the area.		
Residual impacts: Low		

Nature: Increased vehicle activity and associated dust generation		
	Without mitigation	**With mitigation**
Extent	Low (2)	N/A
Duration	Short term (2)	N/A
Magnitude	Low (2)	N/A
Probability	Probable (2)	N/A
Significance	Low (12)	N/A
Status	Negative	N/A
Reversibility	Low	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	Yes	
Mitigation: » None; limit vehicle movement and ensure that road surfaces are moist during maximum vehicle movement periods		

Cumulative impacts: If managed correctly the cumulative impact of vehicles on dust creation can be limited.
Residual impacts: Low

The impact of a new power line within the power line corridor on existing soil and agricultural resources is assessed in the table below. Although some of the soils and soil associations along the proposed line are inherently good for intensive production (e.g. Hutton and Clovelly soils of Ah11), the arid climate limits the agricultural potential severely. The cumulative impact on soil and agricultural resources is expected to be low due to the low agricultural potential of the area.

Nature: Impact of the erection of a new overhead power line on soils		
	Without mitigation	**With mitigation**
Extent	Low (1)	N/A
Duration	Permanent (5)	N/A
Magnitude	Low (2)	N/A
Probability	Probable (4)	N/A
Significance	Medium (32)	N/A
Status	Negative	N/A
Reversibility	Low	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	Yes	
Mitigation: » None; ensure that adequate erosion measures are in place and limit direct footprint		
Cumulative impacts: Low		
Residual impacts: Low		

7.6.4 Assessment of grid connection

There is a greater potential for impacts arising from construction of a new power line compared to the loop in – loop out configuration to the existing power line. This is due to soils being inherently good for production (albeit with the introduction of a water supply) identified within the power line corridor.

7.6.5 Comparative Assessment of Alternatives

Site alternative: Both the previous and current CSP 1 Project Sites are dominated by shallow soils of poor agricultural value. Both sites are therefore suited to the proposed CSP development as neither site is more sensitive from an agricultural perspective.

Water supply: Raw water is required to be supplied to the Proposed Project through abstraction or municipal supply. Abstraction of water from a natural resource (an underground aquifer) could result in potential agricultural impacts due should unsustainable abstraction occur. As the proposed water pipeline route will be situated within existing road reserves the potential agricultural impact of constructing the pipeline will be low.

7.6.6 Implications for Project Implementation

» The development of the CSP Project will have low to medium negative impacts on soils, agricultural resources and productivity. The major limitations to agriculture are the aridity and lack of access to water, as well as the shallow soils. The land is only suitable for low intensity grazing.
» The Project Site is underlain by four soil associations dominated by rock outcrops or shallow Mispah and Coega soils, followed by sandy Prieska soils and Augrabies soils which occur in the majority of the drainage lines. Most of the soil forms and associations are relatively resistant to erosion.

7.7. Assessment of Potential Impacts on Heritage Sites

7.7.1 Results of the Heritage Survey

CSP 1 Project Site: The Project Site is characterised primarily by areas barren of vegetation situated on sedimentary surfaces consisting of mud rock and possibly shale. In the area of the project facility no locally available raw material exist which are suitable for knapping and no Stone Age sites were therefore recorded within the CSP 1 Project Site. Stone Age Material was restricted to isolated widely dispersed low density scatters outside of the CSP 1 footprint.

No heritage sites are located within the proposed development footprint of CSP 1 (Figure 7.3).

Power line corridor: A much reduced density of sites was noted during the survey of the southern section of the power line corridor compared to the northern section of the power line corridor in the area of Klein Swartbast. In the southern section MSA and LSA sites were recorded around the proposed Eskom Substation. In terms of the built environment, a single rectangular stone walled kraal was recorded within the corridor which should be avoided.

The location of the heritage site and find spots relative to the Project Site and within the power line corridor is indicated in Figure 7.4.

Water pipeline alignment: As the proposed water pipeline options are located within road reserves that are already disturbed, it is assumed that sparse heritage surface indicators remain. However two cemeteries are located close to R27 alignment. The first is located on the farm Stof Bakjes 303 dating to 1876 consisting of approximately 5 or 6 graves. The second is located on the Farm 390, Vleikolk consisting of a single grave. These sites should be avoided by the pipeline alignment.

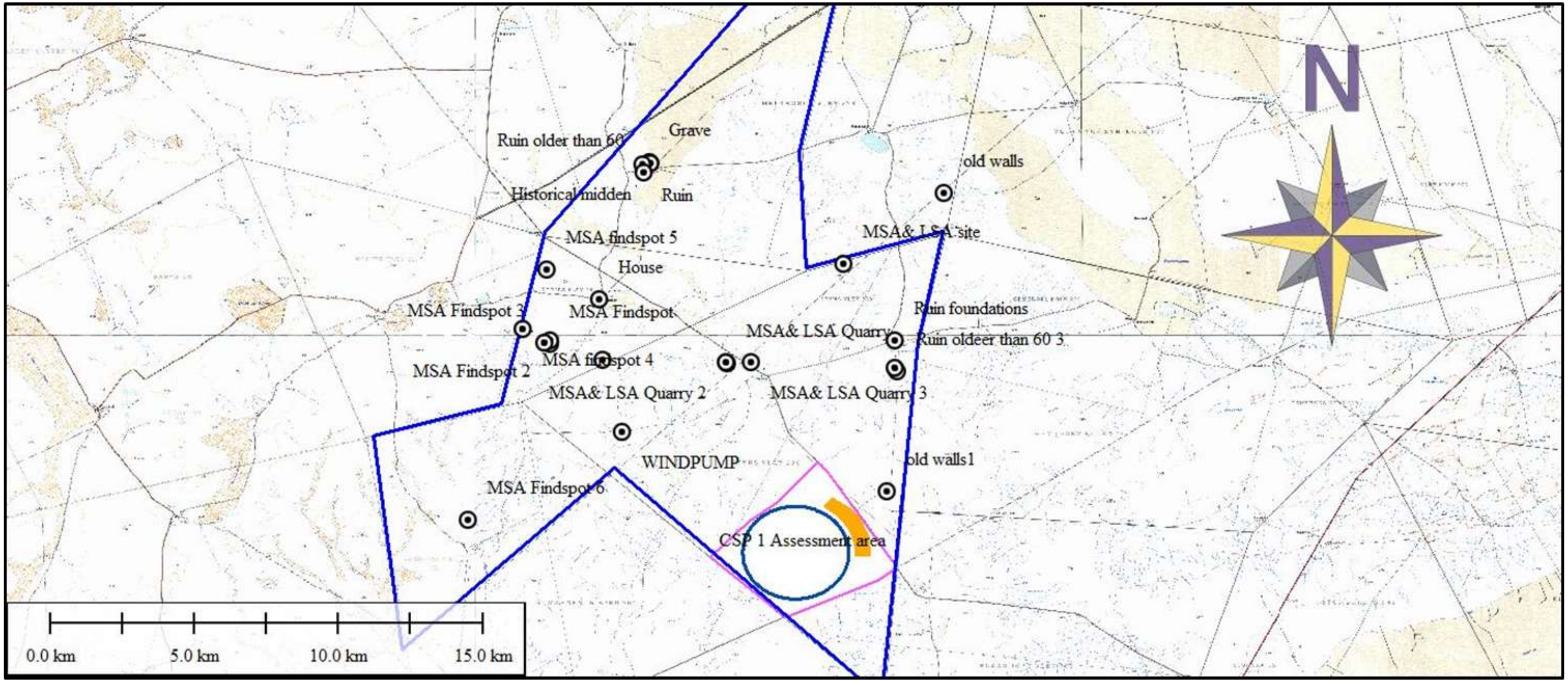


Figure 7.3: : Known heritage sites in relation to the proposed development footprint

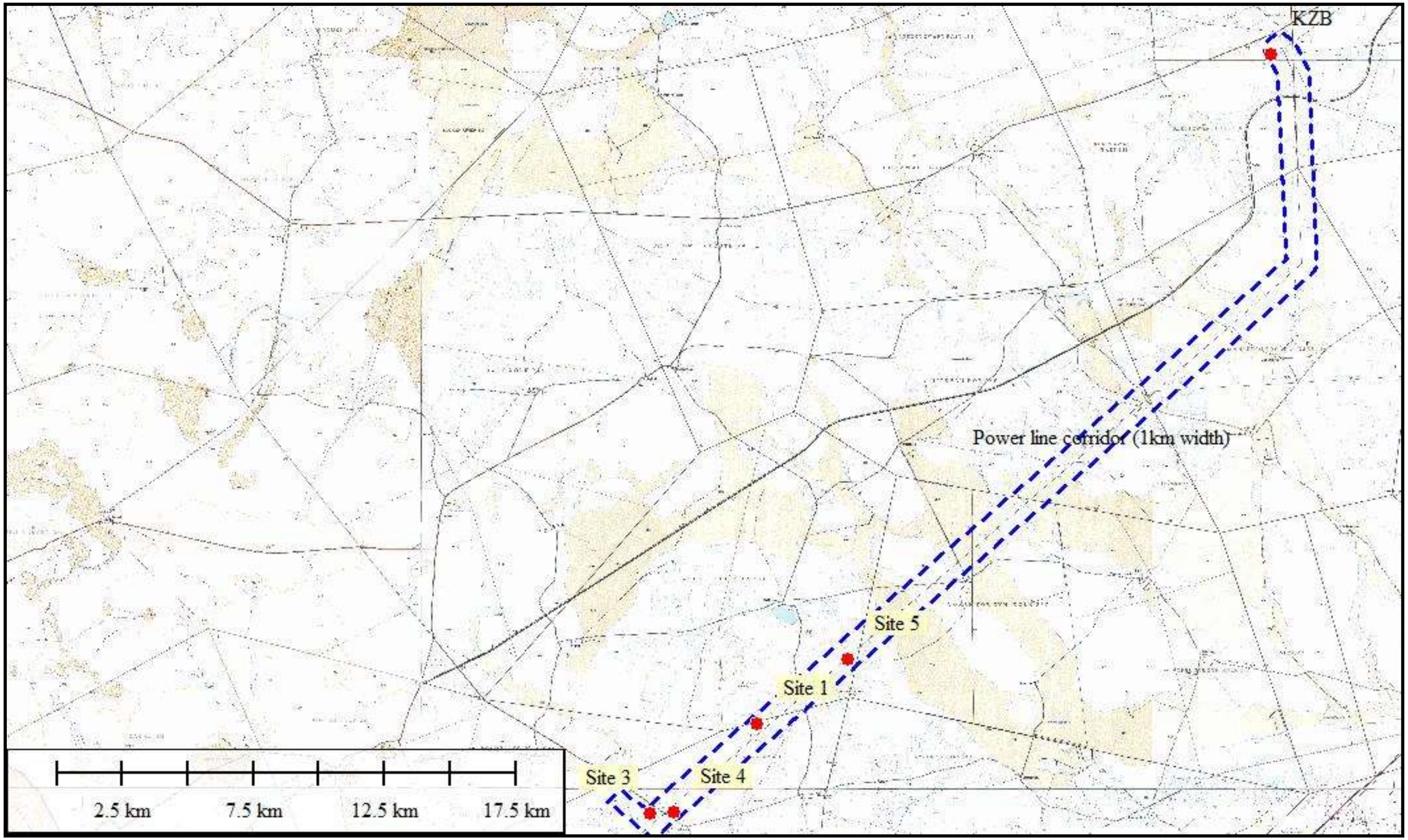


Figure 7.4: Stone Age find spots in relation to the proposed power line corridor (indicated by red dots)

7.7.2 Impact tables summarising the significance of impacts on heritage resources (with and without mitigation)

a) Project Site

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological and paleontological material or objects.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (3)	Low (3)
Probability	Probable (2)	Probable (2)
Significance	Low (20)	Low (20)
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes unless sites can be preserved.
Can impacts be mitigated?	No Further action required, sites are recorded in heritage report.	No Further action required, sites are recorded in heritage report.
Mitigation: A walk down of the final lay out of the CSP facility is recommended. A conservation management plan should be drawn up for the entire SolarReserve Kotulo Tsatsi development. It is recommended that construction crews should be informed of the identified sites and that these areas should be avoided to prevent accidental damage to the recorded archaeological and heritage sites as well as grave sites.		
Cumulative impacts: Archaeological sites are non-renewable and impact on any archaeological context or material will be permanent and destructive.		
Residual Impacts: Depletion of archaeological record of the area.		

b) Power line corridor

During the survey six heritage areas/sites were recorded including MSA and LSA material, as well as a rectangular dry stone-walled kraal.

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological and paleontological material or objects.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (3)	Low (2)
Probability	Probable (3)	Not Probable (2)
Significance	Medium (30)	Low (16)
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes unless sites can be preserved.
Can impacts be mitigated?	Yes	Yes, Micro adjustments of pylon positions can ensure in situ preservation of sites.
Mitigation: Micro siting of pylon positions to ensure in situ preservation of sites		
Cumulative impacts: Archaeological sites are non-renewable and impact on any archaeological context or material will be permanent and destructive.		
Residual Impacts: Depletion of archaeological record of the area.		

c) Raw water pipeline alignment

The water pipeline option following the R27 has at least two cemeteries in close proximity to the proposed servitude.

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological and paleontological material or objects.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (3)	Low (3)
Probability	Probable (3)	Probable (2)
Significance	Medium (30)	Low (20)
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes – and grave sites have high social	Yes unless sites can be preserved.

	significance.	
Can impacts be mitigated?	Yes	Yes
Mitigation*: :* Realignment of route R27 pipeline to ensure that the cemeteries are not impacted. The cemeteries will have to be fenced off with 15 m buffer zone to protect them from damage during construction. The pipelines will have to subjected to a heritage walk down prior to construction.		
Cumulative impacts: Archaeological sites are non-renewable and impact on any archaeological context or material will be permanent and destructive. Grave sites have high social significance.		
Residual Impacts: Depletion of archaeological record of the area.		

7.7.3 Assessment of grid connection

There is a greater potential for impacts on heritage sites arising from construction a new power line compared to the loop in – loop out configuration to the existing power line. This is due to the number of find spots (six) identified within the power line corridor. However it is expected that the micrositing of pylons can be undertaken to adequately avoid the identified heritage sites.

7.7.4 Comparative Assessment of Alternatives

Site alternative: Both site alternatives are equally devoid of significant heritage material and therefore both are preferred from a heritage sensitivity perspective.

Water pipeline alignment: The option following the R27 has at least two cemeteries in close proximity to the proposed water pipeline. Provided that the cemeteries can be avoided during the detailed design phase, both routes are acceptable from a heritage point of view.

7.7.5 Implications for Project Implementation

CSP 1 Project Site: A heritage site walkover is recommended before commencement with construction.

Power line: The construction of pylons associated with a new power line should avoid the six find spots identified within the power line corridor. Granite outcrops in the south should rather be avoided as they contain LSA material as well as quarry sites.

Water pipeline: Re-alignment of the section of pipeline in the vicinity of the cemeteries is required to be undertaken and a 15m buffer zone around the sites implemented should the R27 alignment be technically preferred. Chance finds of heritage artefacts within the water pipeline alignment within the existing road reserves should be reported to the ECO during the construction phase to determine whether the inputs of an archaeologist are required to assess the significance of the find.

7.8. Assessment of Potential Impacts on Palaeontology

7.8.1 Results of the Palaeontological Survey

The study area is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary age. The construction phase of the proposed development will entail substantial excavations into the superficial sediment cover and locally into the underlying bedrock as well. Such excavations may potentially unearth or expose fossil material, or may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils at or beneath the surface of the ground that are then no longer available for scientific research or other public good.

7.8.2 Impact tables summarising the significance of impacts on fossil heritage resources during the construction phase

a) Project Site

No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the project study area and larger study area. The majority of fossil sites recorded in the study region lie outside of the project development footprint on the margins of the broader study area and outside the anticipated development footprints. The fossil remains identified in this study are mostly of widespread occurrence within the formations concerned (i.e. not unique to the study area). Irreplaceable loss of fossil heritage is therefore not anticipated.

Nature: Disturbance, damage, destruction or sealing-in of fossil remains preserved at or beneath the ground surface within the development area, most notably by bedrock excavations during the construction phase of the solar energy facilities.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (1)	Low (1)
Probability	Probable (3)	Probable (3)
Significance	Low (21)	Low (21)
Status	Negative	Negative (loss of fossils) &

		positive (improved fossil database following mitigation)
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No since the limited fossil resources concerned are also represented outside the development area (*i.e.* not unique)	No since the limited fossil resources concerned are also represented outside the development area (*i.e.* not unique)
Can impacts be mitigated?	Yes	Yes
Mitigation: Monitoring of all substantial bedrock excavations for fossil remains by ECO, with reporting of substantial new palaeontological finds to SAHRA for possible specialist mitigation.		
Cumulative impacts: Unknown (Insufficient data on local solar energy and other developments available) but probably low.		
Residual impacts: Negative impacts due to loss of local fossil heritage will be partially offset by *positive* impacts resulting from mitigation (*i.e.* improved palaeontological database).		

b) Power line corridor

The power line project area is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary age. The construction phase of the proposed power line will entail shallow excavations into the superficial sediment cover and locally into the underlying bedrock as well.

No areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the study area. The majority of fossil sites recorded in the study region lie on the margins of the broader development area and outside the anticipated development footprint. The fossil remains identified in this study are mostly of widespread occurrence within the formations concerned (*i.e.* not unique to the study area). Irreplaceable loss of fossil heritage is therefore not anticipated.

Nature of impact: Disturbance, damage, destruction or sealing-in of fossil remains preserved at or beneath the ground surface within the development area, most notably by bedrock excavations during the construction phase of the transmission line.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (1)	Low (1)
Probability	Probable (3)	Probable (3)

Significance	Low (21)	Low (21)
Status	Negative	Negative (loss of fossils) & positive (improved fossil database following mitigation)
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No since the limited fossil resources concerned are also represented outside the development area (*i.e.* not unique)	No since the limited fossil resources concerned are also represented outside the development area (*i.e.* not unique)
Can impacts be mitigated?	Yes	Yes.
Mitigation: Monitoring of all substantial bedrock excavations for fossil remains by ECO, with reporting of substantial new palaeontological finds to SAHRA for possible specialist mitigation.		
Cumulative impacts: Unknown (Insufficient data on local solar energy and other developments available) but probably low.		
Residual impacts: Negative impacts due to loss of local fossil heritage will be partially offset by *positive* impacts resulting from mitigation (*i.e.* improved palaeontological database).		

7.8.3 Assessment of grid connection

There is no significant difference on fossil heritage resources for the construction a new power line compared to the loop in – loop out configuration to the existing power line. This is due to the low occurrence of fossil heritage and the associated low impact significance.

7.8.4 Comparative Assessment of Alternatives

Site alternative: No fossil finds or palaeontological significant areas were identified during the survey and both site alternatives are suitable from this perspective.

Water pipeline alignment: As the proposed water pipeline route will be situated within existing road reserves, it is not anticipated that impacts to fossil heritage resources will be registered for either pipeline alignment. Both alignments are therefore acceptable from a palaeontological perspective with the application of general mitigation measures.

7.8.5 Implications for Project Implementation

Given the low impact significance of the Proposed Project and associated infrastructure as far as palaeontological heritage is concerned, no further specialist palaeontological heritage studies or mitigation are considered necessary for this project, pending the discovery or exposure of substantial new fossil remains during development. Monitoring of all substantial bedrock excavations for fossil remains must be undertaken by the ECO, and any substantial new palaeontological finds reported to SAHRA for specialist mitigation.

7.9. Assessment of Potential Visual Impacts

A visual impact study was undertaken by a visual specialist to assess the potential visual impact related to the development of the project Plant. Refer to Appendix M.

7.9.1 Visual Character of the landscape

Topography and land cover: The topography of the study area is flat and homogenous, consisting of lowlands with hills. Elevation ranges from 870 m above sea level (a.s.l.) in the south and north to 970 m a.s.l. in the central study area. There are no prominent hills within the study area, but the proposed site is located on a local high lying area. Land use within the study area is limited to grazing (sheep), and land cover consists mostly of shrubland. Limited woodland and thicket and shrubland areas are present in the north and south of the study area respectively. Patches of bare rock and soil are also present in the centre of the study area.

Existing Settlement and Infrastructure: There are no built up areas, towns or mining land uses within the study area. Infrastructure includes the Aries-Helios 400kV overhead power line and the Sishen - Suldanha railway line. Settlements, where they occur, are rural homesteads and farmsteads. These include Gannakom and Valsvlei (unoccupied) in the vicinity of the CSP 1 project development site.

Visual Significance: Sensitive visual receptors include residents of homesteads and farmsteads and secondary roads. Users of the R27 will also be exposed to visual impact.

7.9.2 Visual Assessment

The Proposed Project will comprise one power plant with a generation capacity of up to 200MW. Primary infrastructure includes:

- One central receiver (with a height of up to 250m)
- A collector field of heliostats (with a height of ~12m – 15m).

The methodology for the visual impact assessment involves both quantitative and qualitative criteria to determine potential visual impacts arising from the central receiver and the heliostat collector field. These are rated to determine both the expected level and significance of the visual impacts.

Visibility: Visibility tends to be determined by distance between the proposed CSP Project and the viewer. The proposed infrastructure will be visible within an area that is generally characterised by low growing shrubland and isolated wide-open areas. The infrastructure would be visible within an area that incorporates various sensitive visual receptors that would consider visual exposure to this type of infrastructure to be intrusive. The low occurrence of sensitive visual receptors within this environment, and specifically in close proximity to the proposed facility is of relevance however, and has affected the significance rating of the anticipated visual impacts.

Viewer Incidence, Perception and Sensitivity: Viewer incidence is calculated to be the highest along the main road (i.e. the R27) as well as secondary roads within the study area. Commuters and possible tourists using these roads may be negatively impacted upon by visual exposure to the proposed infrastructure. Homesteads and farmsteads, by virtue of their visually exposed nature, are also considered to be sensitive visual receptors.

Visual Absorption Capacity: Overall, the Visual Absorption Capacity (VAC) of the receiving environment is deemed to be low by virtue of the low growing vegetation and sparsely populated/limited development overall.

Visual Impact Index: The visual impact index indicates a core zone of very high visual impact within 4 km of the proposed facility. These are areas where both the power tower and the heliostats will be visible. Small patches of high visual impact occur on the outskirts of this zone, especially in the south west. These are areas where only the power tower will be visible. Sensitive visual receptors within this zone comprise mainly of users of the secondary road east of the site and residents of homesteads. The following homesteads (receptors) are likely to experience a high to very high impact:

» Valsvlei; an unoccupied farmstead located within the CSP 1 Project Site
» Gannakom to the north west of the site
» Klaas Job se Vlei to the south east

Visual impact is high between 4 km and 8 km from CSP 1, especially in the especially in the north west, south west, south and south east. These are areas where only the central receiver tower will be visible.

Areas of moderate visual impact lie mainly in the north, north east, east and west. These are areas where only the power tower will be visible. Sensitive visual receptors within this zone comprise mainly of users of the secondary roads to the north west and south east of the site and residents of homesteads. The following homesteads are likely to be affected:

» Stynsvlei to the north east
» Klaas Job se Vlei to the south east
» Klerkshoopto the south

» Gannakom to the north west of the site.

Between 8 km and 16 km of the proposed facility, the extent of potential visual impact remains high, with moderate visual impacts expected mostly in the south, south west and far north west where both the power tower and the heliostats will be visible.

Areas of low visual impact lie mainly in the east, north east, north and portions of the north west. These are areas where only the power tower will be visible and include users of the secondary roads as well as residents of the following homesteads:

» Moutons Vlei, De Hoop, Melkbosvlei, Vyfmyl, to the north
» Rosland, Biesiekolk and Gemsbok Kolk to the north east
» Pietersville to the east
» Vuursiek Vlei and Gous se Kolk to the south east
» Vloera and Gemsbokrivier to the south west
» Rooidam to the west
» Koppiesvlei to the north west of the site

Remaining impacts beyond 16 km of the proposed facility are expected to be very low to negligible on the whole, with low impacts along roads and at homesteads and farmsteads.

Cumulative Visual Impact: This is the accumulation of visual impacts in the area, particularly in relation to the two other CSP Tower facilities (total of three) proposed to be situated within the larger study area. A high cumulative visual impact is anticipated within 16km of the proposed facilities, with the highest frequency of exposure expected in the south west of the study area. Very few areas within the 16km offset will be screened from all potential visual impact.

Sensitive visual receptors include residents of homesteads and farmsteads and secondary roads. Users of the R27 will also be exposed to visual impact, but they lie beyond the 16km offset, thus reducing the expected magnitude of the impact. Refer to Chapter 8 for further information regarding the potential for cumulative impact.

7.9.3 Impact tables summarising the significance of visual impacts (with and without mitigation)

a. Potential visual impact on sensitive visual receptors in close proximity to the proposed infrastructure.

The visual impact on sensitive visual receptors (i.e. users of secondary roads and residents of homesteads) in close proximity to the proposed infrastructure (i.e. within 4km) is expected to be of moderate significance.

In addition to the very low occurrence of receptors within the receiving environment, a mitigating factor within this scenario is that one homestead is located on the facility site itself and therefore are most likely going to be relocated, while the other is abandoned. These mitigating factors reduce the probability of this impact occurring.

No mitigation is possible within this environment and for a facility of this scale, but measures have been included as best practice guidelines. The table below illustrates this impact assessment.

Nature of Impact: Visual impact on the users of roads and residents of homesteads, in close proximity to the proposed facility.		
	No mitigation	**Mitigation considered**
Extent	Local (2)	N/a
Duration	Long term (4)	N/a
Magnitude	Very High (10)	N/a
Probability	Probable (3)	N/a
Significance	Moderate (48)	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated?	No	
Mitigation / Management: Planning: » Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint. » Wherever possible, use materials, coatings, or paints that have little or no reflectivity. Construction: » Rehabilitate all construction areas, when no longer required. » Ensure that vegetation only cleared where required making way for infrastructure. Operations: » Maintain the general appearance of the facility as a whole. » Monitor rehabilitated areas, and implement remedial action as and when required. Decommissioning: » Remove infrastructure not required for the post-decommissioning use of the site. » Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. » Monitor rehabilitated areas post-decommissioning and implement remedial actions.		
Cumulative impacts: The construction of CSP 1 together the remainder of the other facilities in the proposed Solar Park concept, although in line with current development and land use trends in the region, will contribute to the increased cumulative visual impact of solar energy facilities		

Residual impacts:
The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.

b. Potential visual impact on sensitive visual receptors within the region

The visual impact sensitive visual receptors (i.e. users of roads and residents of homesteads) within the region (i.e. beyond the 4km offset) is expected to be of moderate significance. The low occurrence of visual receptors reduces the probability of this impact occurring. No mitigation is possible within this environment and for a facility of this scale, but measures have been included as best practice guidelines. The table below illustrates this impact assessment.

Nature of Impact: Visual impact on users of the R27 and secondary roads as well as residents of homesteads		
	No mitigation	**Mitigation considered**
Extent	Regional (3)	N/a
Duration	Long term (4)	N/a
Magnitude	Very High (10)	N/a
Probability	Highly Probable (4)	N/a
Significance	High (68)	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated?	No	
Mitigation / Management: Planning: » Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint. » Wherever possible, use materials, coatings, or paints that have little or no reflectivity. Construction: » Rehabilitate all construction areas where no longer required. » Ensure that vegetation is not cleared unnecessarily to make way for infrastructure. Operations: » Maintain the general appearance of the facility as a whole. » Monitor rehabilitated areas, and implement remedial action as and when required. Decommissioning: » Remove infrastructure not required for the post-decommissioning use of the site. » Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. » Monitor rehabilitated areas post-decommissioning and implement remedial actions.		

Cumulative impacts: The construction of the CSP Tower Facility 2 together the remainder of the other facilities in the proposed SolarReserve Kotulo Tsatsi Solar Park concept, although in line with current development and land use trends in the region, will certainly contribute to the increased cumulative visual impact of solar energy facilities (refer to Section 7.2 Potential Cumulative Visual Exposure for more details).
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.

c. Potential visual impact of associated infrastructure on sensitive visual receptors in close proximity thereto

Infrastructure will be located within the facility footprint, but may still be visible to visual receptors in close proximity to the proposed facility. Since the height of the associated infrastructure is unlikely to exceed the expected 12m height of the proposed heliostats, the visual exposure of these components will fall within the viewsheds generated for the heliostats.

Access roads will be required both to construct and to maintain the facility (operational phase). These access roads have the potential of manifesting as landscape scarring, and thus represent a potential visual impact within the viewshed areas. This is especially relevant for steep slopes where erosion could occur over time. Such erosion and landscape scarring could represent a visual impact. As access roads and servitudes have no elevation or height, the visual impact of this associated infrastructure will be absorbed by the visual impact of the primary infrastructure.

The potential visual impact of the associated infrastructure on sensitive visual receptors in close proximity (i.e. within 4km of the proposed facility) is expected to be of moderate significance, and may be mitigated to low.

In addition to the very low occurrence of receptors within the receiving environment, a mitigating factor within this scenario is that both of the homesteads affected are located on the facility site itself and therefore are most likely going to be relocated. These mitigating factors reduce the probability of this impact.

Nature of Impact: Visual impact of the associated infrastructure located on the site on sensitive receptors in close proximity to the proposed facility.		
	No mitigation	**Mitigation considered**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Probable (3)	Improbable (2)

Significance	Moderate (42)	Low (28)
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation / Management: Planning: » Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint. » Use existing roads wherever possible. Where new roads are required these should be planned carefully, taking due cognisance of the local topography. All efforts should be employed to try and align roads along the landscape contours wherever possible. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Construction: » Rehabilitate all construction areas, when no longer required. » Keep vegetation clearing to a minimum Access roads, which are not required post-construction, should be rehabilitated according to the EMPr. Operation: » Maintain the general appearance of the infrastructure. » Maintain roads to avoid erosion and suppress dust. » Monitor rehabilitated areas, and implement remedial action as and when required. Decommissioning: » Remove infrastructure not required for the post-decommissioning use of the site. » Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. » Monitor rehabilitated areas post-decommissioning and implement remedial actions.		
Cumulative impacts: The construction of CSP 1 together the remainder of the other facilities in the proposed Solar Park concept, although in line with current development and land use trends in the region, will certainly contribute to the increased cumulative visual impact of solar energy facilities		
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.		

d. Potential visual impact of the proposed power line on sensitive visual receptors

Nature of Impact: Visual impact of the new power line on visual receptors in close proximity to the proposed infrastructure.		
	No mitigation	**Mitigation considered**

Extent	Regional (3)	N/a
Duration	Long term (4)	N/a
Magnitude	Moderate (6)	N/a
Probability	Improbable (2)	N/a
Significance	Low (26)	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated?	No	

Mitigation:

Planning:

» Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint.

» Keep vegetation clearing to a minimum.

» Use existing roads wherever possible. Where new roads are required these should be planned carefully, taking due cognisance of the local topography. All efforts should be employed to try and align roads along the landscape contours wherever possible. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.

Construction:

» Rehabilitate all construction areas, when no longer required.

» Keep vegetation clearing to a minimum Access roads, which are not required post-construction, should be rehabilitated according to the EMPr.

Operation:

» Maintain the general appearance of the infrastructure.

» Maintain roads to avoid erosion and suppress dust.

» Monitor rehabilitated areas, and implement remedial action as and when required.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.

» Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts:

The loop in - loop out scenario will not increase the cumulative impact of the facility. The cumulative impact of a new power line adjacent to the existing power line will be partially mitigated by its location adjacent to the existing line.

Residual impacts:

The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.

e. Potential visual impact of construction on sensitive visual receptors

During the construction period, there will be an increase in heavy vehicles utilising the roads to the construction sites that may cause, at the very least, a visual nuisance to other road users and landowners in the area in close proximity.

Within the region, dust as a result of construction activities may be visible, especially in this receiving environment, and as such will result in visual impact during construction. This impact is likely to be of **moderate** significance, but may be mitigated to **low**.

Nature of Impact: Visual impact of construction activities, vehicles and dust on sensitive visual receptors in close proximity to the proposed facility.		
	No mitigation	**Mitigation considered**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	Moderate (33)	Low (22)
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation / Management: Construction: » Keep vegetation removal to a minimum where possible. » If possible keep the construction period to a minimum. » Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible. » Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads. » Ensure that rubble, litter, and disused construction materials are appropriately stored and then disposed regularly at licensed waste facilities. » Employ dust suppression techniques as and when required (i.e. whenever dust becomes apparent). » Restrict construction activities to daylight hours whenever possible in order to reduce lighting impacts. » Rehabilitate all disturbed areas as per the rehabilitation plan and schedule.		
Cumulative impacts: N/a – there are few to no sensitive visual receptors that will be affected in the area.		
Residual impacts: N/a		

f. Potential visual impact of lighting at night on sensitive visual receptors

The receiving environment has a relatively small number of populated places, and it can be expected that the light trespass and glare from the security and after-hours operational lighting (flood lights) for the facility will have some significance. In addition, the remote sense of place and rural ambiance of the local area increases its sensitivity to such lighting intrusions.

Another potential lighting impact is known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The substation lighting may contribute to the effect of sky glow in an otherwise dark environment.

Visual impacts are likely to be of moderate significance, and may be mitigated to low. The low occurrence of visual receptors reduces the probability of this impact occurring.

Nature of Impact: Visual impact of direct lighting and sky glow on sensitive visual receptors in close proximity to the proposed facility.		
	No mitigation	**Mitigation considered**
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	Moderate (45)	Low (26)
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation: Planning & operation: » Shield the sources of light, such as security lights, parking areas, service areas etc., by physical barriers (walls, vegetation, or the structure itself) as far as possible. Note that this mitigation measure excludes the CAA requirements of aircraft warning lights mounted at the top of the tower as well as the glow emitted from the tower as it is required to be painted white. » Limit mounting heights of lighting fixtures, or alternatively use foot-lights or bollard level lights. » Make use of minimum lumen or wattage in fixtures where possible. » Make use of down-lighters, or shielded fixtures where possible. » Make use of Low Pressure Sodium lighting or other types of low impact lighting where possible. » It is recommended that motion detectors on security lighting be considered. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.
Cumulative impacts: The light generated at night locally is minimal. The impact of the proposed CSP 1 will contribute to a regional increase in lighting impact.
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.

g. Potential visual impact on the visual character and sense of place of the region (secondary impact)

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

This area has a largely natural and undeveloped character as such the landscape is characterised by wide-open expanses of undeveloped landscape. A specific sense of place related to the visual quality characterises the region, but is not particular to this study area.

The anticipated visual impact on the visual character and sense of place of the study area is expected to be of low significance. The low occurrence of visual receptors reduces the probability of this impact occurring. No mitigation is possible within this environment and for a facility of this scale, but measures have been included as best practice guidelines.

Nature of Impact: Visual impact of the proposed facility on the visual quality of the landscape and sense of place of the region.		
	No mitigation	**Mitigation considered**
Extent	Regional (3)	N/a
Duration	Long term (4)	N/a
Magnitude	High (8)	N/a
Probability	Highly probable (4)	N/a
Significance	High (60)	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated?	No	
Mitigation / Management: Planning: » Retain / re-establish and maintain natural vegetation in all areas outside of the development footprint. » Wherever possible, use materials, coatings, or paints that have little or no reflectivity. Construction: » Rehabilitate all construction areas. » Keep vegetation removal to a minimum where possible. Operations: » Maintain the general appearance of the facility as a whole. » Monitor rehabilitated areas, and implement remedial action as and when required. Decommissioning: » Remove infrastructure not required for the post-decommissioning use of the site. » Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. » Monitor rehabilitated areas post-decommissioning and implement remedial actions.		
Cumulative impacts: There are no similar facilities adding to the cumulative visual impact in the area - construction of the CSP Project, together with its associated infrastructure, together with other similar future facilities will increase the cumulative visual impact of Solar Energy infrastructure within the region.		
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.		

7.9.4 Assessment of grid connection

The construction of a new power line will require the installation of new pylons (up to 30m in height) adjacent to the existing Aries – Helios power line. Comparatively the visual impact will be greater than if a loop in – loop out configuration into the existing power line were achievable. Therefore, from a visual perspective the loop in – loop out scenario is preferred to some extent, however it is noted that the grid connection configuration will be determined by Eskom.

7.9.5 Comparative Assessment of Alternatives

Site alternatives: The original CSP 1 Project Site is ~5km from the Soafskolk Road (nearest sensitive visual receptor) while the current CSP 1 Project Site is situated adjacent to Soafskolk Road. The CSP Project will therefore be more visible at the Proposed Project Site than the original site. From a visual perspective, the original site is marginally preferred.

Note on technology alternatives: No alternative CSP technologies (i.e. trough) are considered in this EIA for comparative purposes as CSP trough technology is also proposed to be developed in other areas within the study area. The use of other technologies therefore, is not considered necessary or relevant to mitigate the potential visual impacts of the project, the overall visual impact is considered to be acceptable.

7.9.6 Implications for Project Implementation

» The overall visual impact on sensitive visual receptors will be moderate to low.
» Natural vegetation in all areas outside of the development footprint should be retained / re-established and maintained.
» Ancillary infrastructure should be planned in such a way and in such a location that clearing of vegetation is minimised. Existing infrastructure should be consolidated as much as possible and make use of already disturbed areas rather than pristine sites wherever possible.
» Use existing roads wherever possible. Where new roads are required to be constructed, these should be planned carefully, taking due cognisance of the local topography. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.

7.10. Noise Impacts

A noise study was undertaken by an acoustic specialist to determine the potential noise impact related to the development of the CSP Project. Refer to Appendix N for further information. No visible noise sources besides the R27 road and the ore export Sishen – Saldanha railway line were identified. No other mining, industrial or urban activities exist and therefore relatively low ambient sound levels are anticipated. There are no noise sensitive receptors identified within the study area which could be affected by the proposed CSP 1 Project.

7.10.1 Construction Phase Noise Impacts

Potential noise sources during the construction phase include:

» Construction equipment: The equipment likely to be required to complete the above tasks will typically include: excavators/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, TLB, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.
» Construction Vehicles: This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the facility.
» Construction workers.

Construction activities are highly dependent on the final operational layout. A number of different noise-generating activities might occur in the area. The cumulative impact will therefore be considered simultaneously with the various construction activities.

There will be a number of smaller equipment, but the addition of the general noise source (at each point) covers most of these noise sources. It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. This is likely the worst case scenario that can occur during the construction of the facility.

Even though construction activities are projected to take place only during day time, it might be required at times that these activities take place during the night (particularly for a large project). Construction activities that might occur during night time include:

» Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
» Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore, it is hard to judge beforehand if a construction team would be required to work late at night.

The scenario was modelled using the proposed layout for the project facility. The impact assessment for the various construction activities that may impact on the surrounding environment is presented in the table below.

Nature: Numerous simultaneous construction activities that could cause noise and impact on receptors.

Acceptable Rating Level	Rural district (excluding construction traffic): 45 dBA outside during day Use of $L_{Req,D}$ of 45 dBA for rural areas Ambient sound level = 20 dBA
Extent ($\Delta L_{Aeq,D}$>7dBA)	Local – Assuming a uniformly 20 dBA ambient sound level over the study area, ambient sound levels could extend further than 1,000 meters from activities (3)
Duration	Short – Noisy activities in the vicinity of the receptors would last the duration of the construction period (2)
Magnitude	Noise Rating Levels (at receptors) < Rating Level – Low (2)
Probability	While it is possible that the closest receptors may hear construction activities at some time during the construction period (ideal sound propagation conditions), it is definite that it will not impact on them. Improbable (1)
Significance	Low (7)
Status	Negative.
Reversibility	High
Irreplaceable loss of resources?	n/a
Comments	Modelling considered a worse-case scenario with significant activities taking place for 16 hours each day
Can impacts be mitigated?	Mitigation not required.
Mitigation:	Not required.
Cumulative impacts: This impact is cumulative with existing ambient sound as well as other noisy activities conducted in the same area.	
Residual Impacts: This impact will only disappear once construction activities cease.	

7.10.2 Operational Phase Noise Impacts

The main noise source associated with the operation of the project facility relates to the fans used to assist with the condensing of the steam/water used in the power generation circuit. The following noise sources will be evaluated during the operational phase:

» Noises from the conventional electrical power generating plant (steam generation, steam storage, steam turbine and cooling system).
» Plant-generated traffic (maintenance crew, cleaning crew(s), etc.)
» Ancillary equipment such as pumps and pressure release valves.
» Possible general noise from the maintenance/workshop.

» With the steam turbine and generators situated within a building (that will significantly reduce the noise generation from these sources) noises from the fans will be the dominating noise in the area. The impact assessment therefore would focus on the noise generated by the fans and no other equipment.

The noise study therefore considers the worse-case scenario and illustrates the noise rating contours from 35 dBA (rural night-time acceptable rating level) upwards. Cumulative noise rating levels due to the operation of three proposed CSP tower facilities within the proposed study area are indicated in Section 8. It does not consider potential cumulative impacts due to existing ambient sound levels and assumes a very quiet background sound level.

Nature: Noise due to fans related to the CSP Projects and others solar plants operating simultaneously	
Acceptable Rating Level	Rural district (excluding construction traffic): 45 and 35 dBA outside during day and night respectively. Use of $L_{Req,D}$ of 45 dBA and $L_{Req,N}$ of 35 dBA for rural areas Ambient sound level = 20 dBA
Extent ($\Delta L_{Aeq,n}$>7dBA)	Local – Impact could extend further than 1,000 meters from activity. (3).
Duration	Long – Facility will operate for a number of years (4).
Magnitude	Noise Rating Levels (at receptors) < Rating Level – Low (2)
Probability	While it is possible that the closest receptors may hear construction activities at some time during the construction period (ideal sound propagation conditions), it is definite that it will not impact on them. Unlikely (1)
Significance	Low (16)
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	Yes, not required
Mitigation: Possible but not required	
Cumulative impacts: This impact is cumulative with existing ambient background noises.	
Residual Impacts: This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.	

7.10.3 Assessment of grid connection

There is no significant difference between the construction a new power line compared to the loop in – loop out configuration to the existing power line from a noise perspective. This is due to the absence of sensitive noise receptors along the corridor which could potentially be exposed to corona noise (albeit highly unlikely to occur in this arid environment) from overhead conductors.

7.10.4 Comparative Assessment of Alternatives

Site alternatives: Due to the absence of noise sensitive developments in the broader study area, there is no preference between the original and current CSP1 Project Site and both are considered equally feasible.

Cooling alternatives: Wet cooling will be inherently quieter due to the absence of fans required for in the dry cooling process. Due to the absence of noise sensitive developments, there is no preference between the two cooling technologies.

7.10.5 Implications for Project Implementation

» The noise study utilised the noise emission characteristics of equipment expected to be used at the CSP Project. With the input data as used, this assessment indicated that the potential noise impact would be insignificant during both the construction and operational phases.
» No routine noise measurements are recommended before the construction starts or during the operational phase. However, if a valid and reasonable noise complaint is registered (relating to the operation of the facility) additional noise monitoring should be conducted by an acoustic consultant. Noise monitoring must be continued as long when noise complaints are registered.
» It is recommended that the developer consider the implementation of a grievance mechanism or method of communication for submitting noise complaints.

7.11. Assessment of Potential Impacts on the Square Kilometre Array (SKA)

The SKA, once constructed and operational, will be highly sensitive to outside radio frequency emissions, especially within the 200MHz to 20GHzA frequency band. The SKA provided a risk assessment during the scoping phase in which concerns regarding the risk to the SKA facility were noted. A radiofrequency risk assessment has been undertaken by a specialist company (ITC) to determine the potential risk and the mitigating factors to be considered in the design of the project facility in order to satisfy the requirements of the SKA Project Office. The findings of the study are attached in Appendix O.

Practical mitigation measures which include implementation of shielding and filtering solutions are required to ensure installed CSP Project equipment emissions remain approximately 15dB below the EN 55022 (information technology equipment) limit.

7.12. Assessment of Potential Economic Impacts

7.12.1 Results of the Economic Impact Assessment

Overall, the Proposed Project is expected to make a notable positive economic impact on the local economies of the Hantam and Kai !Garib due to the increase in construction activities in the area and the demand created for various services. This is outlined in the Economic Impact Assessment contained in Appendix R.

It is estimated that one CSP Project will lead to generation of R13.6 billion of new business sales in the country during construction and in the process will create 17 711 Full Time Equivalent (FTE) jobs. Importantly, the local unemployment rates during construction are expected to notably decline for the period of 2.5 years while the project is being developed. During the operational phase, the CSP Project will support R1.8 billion of new business sales on an annual basis and sustain 266 FTE jobs. The Project will create much needed employment opportunities in the area and will contribute to the overall objective of national government of diversifying energy sources in the country and improving energy security. The positive socio-economic impacts that are associated with the project include skills development in the respective industries, increase in government revenue, improved livings standards of households who will benefit from created employment, as well as long-term injections into the local economies through SED and ED commitments during operations.

7.12.2Impact tables summarising the significance of economic impacts associated with the project

a) Temporary stimulation of the economy due to investment in the project

Some of the positive spin off effects that are to ensue from the project expenditure will be localised in the communities located near the site. The local services sector and specifically the trade, transportation, catering and accommodation, renting services, personal services and business services are expected to benefit the most. These impacts are envisaged to be created as a result of activities in the area and particularly:

- » Due to the expenditure on the establishment of the man camp on site that would require temporary/portable housing, ablution and sewage treatment, and catering facilities
- » Due to the expected expenditure of construction workers in the nearby towns of Brandvlei and Kenhardt, who moved from outside the area on personal items, while they are living and working in the area.

The impacts on production and value added experienced during constructing will be temporary and will expire once the construction phase is complete. However, due to the magnitude and spatial extent of the impact, the significance will be high.

Nature: Temporary increase in production and GDP-R of the national and local economies during construction		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefit is terminated with the end of construction	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Efforts should be made where practical and feasible to encourage the Engineering, Procurement and Construction (EPC) contractor to increase the local procurement practices and employ people from local communalities as far as feasible to maximise the benefits to the local economies. » The Developer or its EPC contractor should engage with local authorities and business organisations to investigate the possibility of procurement of construction materials, goods, and products from local suppliers where feasible		
Cumulative impacts: » Numerous solar energy facilities are being built and proposed to be built in the Northern Cape, including the two municipalities under consideration. This could provide sufficient economies of scale and thus open opportunities for the establishment of new industries in the country and new businesses in the local area, specifically in the sectors that are not well represented in the local economy.		
Residual Impacts: » None foreseen at this stage		

b) Temporary increase in employment due to investment in the project

Approximately 1 202 direct Full Time Equivalent jobs will be created during construction of the project plant, which considering its duration equates to about 481 people working on the project for the entire duration of the construction period. Of these, 50 positions will be occupied by engineers and consultants, 75 positions will be taken up by supervisors and foremen, and the rest will be construction workers. This means that on average, 356 people will be working on site throughout the entire construction period.

At least a third of these jobs will become available for the local communities and specifically people residing in Brandvlei and Kenhardt, which means that local employment situation in the nearby communities will be improved, albeit temporarily. Combined, these towns had 746 people who were unemployed in 2011 and it is clear that if the majority of the construction crew were employed from the local communities, the local unemployment rate could be significantly improved albeit for a limited time of 2.5 years. Furthermore, considering that Kenhardt had a much worse unemployment situation than Brandvlei, the potential benefits to the former could be of a greater significance than to the latter.

The increase in household income that would result from the creation of temporary employment opportunities will generate another round of economic effects that are induced by consumption of goods and services by these households. Considering the expenditure pattern of households, industries that will experience the greatest increase in the FTE jobs during that time will be manufacturing, agriculture, trade and accommodation. While the majority of the benefits will spread throughout the country, businesses located within the local communities will also benefit from creation of new jobs or retention of existing employment positions. Most of these will be in the tertiary sector and specifically trade, catering and accommodation, transport services, rental services (i.e. ablution and sewage, portable housing), and personal services.

Nature: Temporary increase in employment in local and national economies		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefit is terminated with the end of construction	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation:		

» Support domestic manufacturers as far as feasible without jeopardising the quality of input materials and goods and bankability of the project in general » Recruit labour from the nearby communities of Brandvlei and Kenhardt as far as feasible to increase the benefits to the local households » Employ labour intensive methods in construction where feasible » Sub-contract to local construction companies where possible » Use local suppliers where feasible and available and consider arrangements with local Small and Medium Enterprises to provide transport, catering, and other services to the construction crew
Cumulative impacts: » The development of other solar energy projects throughout the municipality and the Northern Cape will result in the creation of employment opportunities in this sector with workers capable and knowledgeable of the new industry; it will also extend the duration of construction-related jobs developed in the industry.
Residual Impacts: » Experience gained during construction activities.

c) Contribution to skills development due to investment in the project

The establishment of the CSP Project will offer numerous opportunities for skills transfer and development. This is relevant for both on-site activities and manufacturing activities. Three CSP Projects are already being established in the country, which means that the transfer of skills from foreign experts to the local engineers and construction workers already takes place. The Proposed Project will create an additional opportunity to expand skills development activities and create a domestic work force with significant expertise in CSP Project construction.

Nature: Contribution to skills development in the country and in the local economy		
	Without mitigation	**With enhancement**
Extent	National (4)	National (4)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	High (8)
Probability	Probable (3)	Highly probable (4)
Significance	42 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Skills can be lost if not practiced	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Encouraging the contractor to transfer knowledge from foreign experts to the domestic experts » Employ local labour as far as feasible to increase the skills levels and subsequently employability of the local labour		

Cumulative impacts: » Improved labour productivity and employability of construction workers for similar projects » Possible development of local skills and expertise in related R&D and manufacturing industries
Residual Impacts: » South Africa's human capital development

d) Temporary increase in households earnings due to investment in the project

Investment in the proposed CSP Project and subsequent creation of up to 53 thousand FTE jobs during the construction period throughout the national economy will have a positive effect on income and standard of living of households benefiting directly and through multiplier effects of the project. As indicated in Table 4, R191.6 million (2013 prices) will be paid out in salaries and wages to employees directly involved in the establishment of one CSP Project and R574.8 million will be paid if three CSP Tower plants are developed on site.

Nature: Temporary improvement of the standard of living of the positively affected households		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefit is terminated with the end of construction	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Recruit local labour as far as feasible to increase the benefits to the local households » Employ labour-intensive methods in construction where feasible » Sub-contract to local construction companies where possible » Use local suppliers where feasible and consider arrangements with local Small and Medium Enterprises to provide transport, catering, and other services to the construction crew		
Cumulative impacts: » Improved standard of living of the affected households		

» Improved health and living conditions of the affected households » Reduction in local poverty » Reduced dependency on social grants
Residual Impacts: » Possible increase of households' savings accounts

e) Temporary increase in government revenue due to investment in the project

Approximately R204.8 million in 2013 prices will be paid to government from direct activities in the form of personal income taxes and company's tax during construction of the CSP Tower plant. Government earnings will be distributed by national government to cover public spending, which includes among others the provision and maintenance of transport infrastructure, health and education services, and other public goods.

Nature: Temporary increase in government revenue		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	40 (Medium)	40 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefit is terminated with the end of construction	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » None suggested		
Cumulative impacts: » Lower government debt and servicing costs		
Residual Impacts: » None envisaged		

Operational phase:

f) Sustainable increase in production and GDP-R due to operations

One CSP Tower plant is expected to generate an average annual turnover of up to R1 582.5 million considering its generation capacity could reach 200 MW. Of these, about R189.4 million will be spent on operations. The resulting operating expenditure will have a positive impact on the local, provincial and national economies. The effects on production in the country ensuing from the operation of one CSP Project amounts to a total of about R1 819.3 million (2013 prices) per annum. This means that for every R1 million of turnover generated by the facility, it will create an additional R0.15 million of new business sales elsewhere in the country.

Nature: Sustainable increase in production and GDP-R nationally and locally		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Highly probable (4)
Significance	64 (High)	64 (High)
Status (positive or negative)	Positive	Positive
Reversibility	Benefits are sustained only over project's lifespan	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » The operator should be encouraged to procure materials, goods and products required for the operation of the facility from local suppliers to increase the positive impact in the local economy as far as possible within the design parameters of the Project		
Cumulative impacts: » Improved energy supply in the country and in the province » Reduced transmission losses » Reduced carbon emissions in generation of electricity		
Residual Impacts: » None foreseen at this stage		

g) Creation of sustainable employment positions due to operations

During the operational period, one proposed CSP Tower plant will create and support 45 jobs over a 30-year period. Highly specialised local experts that are expected to be trained at other CSP Projects operating in the country by that time will occupy five of the employment opportunities. In the situation, where local labour force will not have sufficient skills by the time the project is operational, foreign experts will be employed for a few years to transfer necessary skills. The majority of the opportunities will be skilled and highly skilled job opportunities that might be difficult to fill by the local work force considering the relatively unsophisticated nature of the local economy and its small economic base. Nonetheless, the 12 unskilled and semiskilled jobs for one CSP Tower plant and 36 jobs for three CSP Tower plants will be possible to fill by people coming from the local communities of Brandvlei and Kenhardt.

Nature: Creation of sustainable employment positions nationally and locally

	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefits are sustained only over project's lifespan	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Where possible, the local labour should be considered for employment to increase the positive impact on the local economy and towns of Brandvlei and Kenhardt » Local Small and Medium Enterprises should be approached to investigate the opportunities for supplying inputs required for the maintenance and operation of the facility, as far as feasible		
Cumulative impacts: » Improved living standards of the directly and indirectly affected households		
Residual Impacts: » Experience in operating and maintaining a CSP Tower plant		

h) Skills development of permanently employed workers at the plant

Establishing and operating the plant will result in improved skills amongst the staff as the facility will include a training centre. A certain percentage of the plant's operating expenditure will also be allocated towards training and skills development. On-the-job training is a key element of the staff development; many of the required skills during the operational phase will be taught to staff through day-to-day operations. It is also expected that the training programme implemented at the CSP Project will reduce the necessity to acquire foreign expertise in the future. Thus, potentially all employment positions created by the facility will be allocated to South Africa's residents.

Nature: Skills development of permanently employed workers		
	Without mitigation	**With mitigation**
Extent	Local economies (3)	Local economies (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Definite (5)
Significance	52 (Medium)	65 (High)
Status (positive or negative)	Positive	Positive

Reversibility	Skills can be lost if not practiced	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Ensure that where expertise in south Africa is not available, foreign experts are employed on a temporary basis only to allow for a transfer of skills, if relevant and feasible » Consider establishing vocational training programs for the local labour force to promote the development of skills required by the solar energy industry		
Cumulative impacts: » Development of new skills and expertise in the country to support the CSP industry development		
Residual Impacts: » Human capital development of the beneficiaries		

i) Improved standards of living of households benefitting from operations

Given the positive impact on employment realised by all affected households there will be an increase in income levels, which subsequently will improve the standard of living for these households. The operation of one CSP Tower plant will directly increase and secure the earnings of approximately 47 households to an estimated value of R26.9 million per annum in 2013 prices. Through indirect and induced impacts, the CSP Project will further provide income security to an additional 219 households to the value of R50.2 million in 2013 prices. This income will allow the households to improve their standards of living.

Nature: Improved standard of living of benefiting households		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefits are sustained only over project's lifespan	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Where possible, the local labour should be considered for employment to increase the positive impact on the local economy. » Local Small and Medium Enterprises should be approached to investigate the		

opportunities for supplying inputs required for the maintenance and operation of the facility, as far as feasible.
Cumulative impacts: » Improved productivity of workers » Improved health and living conditions of the affected households
Residual Impacts: » None foreseen at this stage.

j) Sustainable increase in government revenue due to operations

The Proposed Project is due to have a positive impact on government revenue. On local level, the project would contribute to local government revenue through payment for utilities used in the operation of the facility. It will also increase its revenue through collection of greater property taxes compared to the current level. On national level, the revenue derived by the project during its operations, as well as payment of salaries and wages to the employees will contribute to the national fiscus. Although it is impossible to trace exactly how such revenue is allocated, it all adds to the government revenue stream that is then spent on providing public goods and services.

Nature: Sustainable increase in national and local government revenue		
	Without mitigation	**With mitigation**
Extent	National (4)	National (4)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	56 (Medium)	56 (Medium)
Status (positive or negative)	Positive	Positive
Reversibility	Benefits are sustained only over project's lifespan	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » None suggested		
Cumulative impacts: » Possible improvement in local service delivery due to greater revenue derived by the local government		
Residual Impacts: » None foreseen at this stage		

k) Local community economic and social development benefits derived from the project's operations

Any renewable energy project approved by government will need to allocate a certain percentage of its revenue towards social and enterprise development activities in the local communities. Furthermore, the Community Trust that will be set up will also receive certain allocations in the form of dividends that could be used to improve the livelihoods of the beneficiaries. As a result, the proposed CSP Project will fund local welfare and community development initiatives that will be directed at uplifting local people, improving their standards of living and assisting them in securing sustainable employment opportunities either through provision of training or support and development of local enterprises.

It is envisaged that the Socio-Economic Development (SED) and Enterprise Development (ED) allocations generated by the CSP Project alone will range between R16.6 million and R33.2 million[12], which will be available for investment into the local community on an annual basis. Proper investigation and planning would allow directing these funds to address the most pertinent challenges faced by the communities, which could substantially improve their livelihoods and standard of living.

Nature: Local community and social development benefits derived from the project's operations		
	Without mitigation	**With mitigation**
Extent	Local economies (3)	Local economies (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	65 (High)	65 (High)
Status (positive or negative)	Positive	Positive
Reversibility	Benefits could stretch beyond project's lifespan	
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » In the event the Project is bid as part of the RE IPP Procurement Programme, it is recommended that a social development and economic development programmes be devised by the Developer prior the start of operations » When devising enterprise development initiatives, the focus should be on creating sustainable and self-sufficient enterprises.		
Cumulative impacts: » Declining levels of poverty in the local communities of Brandvlei and Kenhardt » Improved standards of living of the members of the Community Trust and households that benefited from Enterprise Development Programme		

[12] This figures are calculated based on the projects annual average business sales of the CSP Project depending on its capacity (i.e. between 100 MW and 200 MW) and the assumption that 1.5% and 0.6% of the revenue are to be allocated towards SED and ED commitments

» Possible improvements in access to services and status of local infrastructure
Residual Impacts: » None foreseen at this stage

7.10.6 Assessment of grid connection

The construction of a new power line will result in a greater number of employment opportunities during the construction phase than the loop in – loop out scenario requiring direct connection to the existing power line. This option is preferred on this basis however the grid connection will be subject to determinations by Eskom.

7.12.3 Comparative Assessment of Alternatives

Site alternatives: Comparatively the preferred CSP 1 Project Site would be more economically feasible to develop due to a shorter access road required to access the site. From a grid perspective, both sites are situated in close proximity to the existing 400kV power line so long power lines to the central corridor are not required.

Water pipeline alignment: Comparatively the two water pipeline alignments are very similar in length and therefore similar construction phase costs (including cost of labour) is anticipated. Both are preferable from an economic perspective.

7.12.4 Implications for Project Implementation

Overall, the project is expected to make a notable positive economic impact on the local economies of the Hantam and Kai !Garib due to the increase in construction activities in the area and the demand created for various services. It is estimated that the Proposed Project plant will lead to generation of R13.6 billion of new business sales in the country during construction and in the process will create 17 700 FTE jobs. Importantly, the local unemployment rates during construction are expected to notably decline for the period of 2.5 years while the project is being developed. During the operational phase, the Proposed Project plant will support R1.8 billion of new business sales on an annual basis and sustain 264 FTE jobs. The projects will create much needed employment opportunities in the area and will contribute to the overall objective of national government of diversifying energy sources in the country and improving energy security.

7.13. Assessment of Potential Social Impacts

7.13.1 Results of the Social Impact Assessment

The SIA primarily focused on the collection of primary data to identify and assess social issues and potential social impacts. Secondary data was collected and presented in a literature review and primary data was collected through consultations with key stakeholder and the public participation process. The environmental assessment framework for assessment of impacts and the relevant criteria were applied to evaluate the significance of the potential impacts.

7.13.2Impact tables summarising the significance of social impacts associated with the project Construction Phase

a) Direct employment and skills development

The construction of the proposed project will require a workforce and therefore direct employment will be generated. The proposed development will create employment opportunities for the local community. CSP technology is generally more labour intensive than PV technology; therefore CSP facilities generally employ more people during construction and operation phases. The nearest towns to the proposed site are Kenhardt and Brandvlei. The population of the two closest towns are relatively small; however there is a large economically active population in search for employment opportunities in the impacted local municipalities and district municipalities. This is therefore a positive social impact. Based on the economic impact assessment it is estimated that during the construction phase (for the period of 30-36 months) approximately ~1 202 employment opportunities will be generated for the CSP Central Receiver Tower plant. In terms of skills requirements, it is common that highly skilled or skilled labour such as engineers, technical staff and project managers will constitute about 26% of the work force; skilled staff would typically be required to operate machinery and this will constitute about 44.5% of employees; while unskilled staff such as construction and security workers will constitute about 29.5% of the work force. Additional employment opportunities will also be generated for the construction of the associated infrastructure (power line). Employment opportunities for the proposed development will peak during construction phase and significantly decline during the operation phase. The estimated salary and wage bill will equate to R191.6 million for the proposed CSP 1 project

The HLM and the KGLM is characterised by low levels of unemployment and poverty. The unemployment rates at 10% in the KGLM and 11.8% in the HLM which is significantly low in comparison to the provincial unemployment level at 27.4%. There will be significant job opportunities available for low skilled (construction, security and maintenance workers) and semi-skilled workers, which can be sourced from the local area. Construction workers could be sourced from the nearest local towns, this being Kenhardt and Brandvlei. However due to the small population sizes of these towns (Kenhardt has a population of 4 843 and Brandvlei has a population of 2 859); the number of employees required and the limited skills available at local level, the required labour may need to be sourced from outside the immediate local area within the Kai !Garib (KGLM) and Hantam (HLM) Local municipalities. Therefore it could be expected that some of the workers from outside the local area would form part of the construction team. Local labour should be sourced from within the towns of Kenhardt and Brandvlei first and if need be extend search to KGLM and the HLM. If employees for the construction phase are sourced from other municipalities or provinces this could result in cultural change and social conflicts. Adverse impacts could occur if a large in-migrant workforce, culturally different from the local communities within HLM and KGLM, are employed and brought in during the construction phase. While the local labour pool may be qualified for less-skilled jobs, often local hiring will not meet the demands in professional, technical and supervisory areas. A number of specialist contractors would most likely be brought in from other areas.

It should be encouraged that majority of the labour be sourced from within the local pool and if the relevant skills are not available then these should be sought out from surrounding local municipalities or provincial basis. The proponent will need to demonstrate a commitment to local employment targets in order to maximise the opportunities and benefits for members of the local community. It is likely that an Engineering, Procurement and Construction (EPC) contractor will be appointed by the developer who will hire the necessary employees. The applicant has indicated that training will also be provided to employees with the proposed development through a training centre. Specific skills training for local communities have the opportunity to develop local employee potential. This is crucial to long-term development of skills and education in the area. This will accelerate the positive benefits and impacts of the development on the regional economies.

Another positive impact is the indirect employment opportunities that will be created. These opportunities will be experienced in the industries that will provide services to the construction team where more women can be involved and employed in the process through catering and laundry services that will be needed in the man camp etc. Other indirect employment opportunities that will be created during construction phase will relate to increased demand for transportation, equipment rental, sanitation and waste removal etc. (also refer to economic impact assessment for additional information).

Nature: The creation of employment opportunities and skills development opportunities during the construction phase for the country and local economy		
	Without enhancement	**With enhancement**
Extent	Local- Regional (3)	Local- Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Moderate (6)
Probability	Highly probable(4)	Definite (5)
Significance	**Medium (36)**	**Medium (55)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of	N/A	

resources	
Can impacts be enhanced	Yes
Enhancement measures: In order to enhance the local employment and business opportunities associated with the construction phase the following measures should be implemented: » Efforts should be made to employ local contractors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria, where possible » It is recommended that local employment policy is adopted to maximise the opportunities made available to the local labour force (Sourced from nearest towns or within the HLM and KGLM). » The recruitment selection process should seek to promote gender equality and the employment of women wherever possible » Efforts need to be employed to enhance indirect local employment/entrepreneurship opportunities by supporting local entrepreneurs as far as possible » It is recommended to set realistic local recruitment targets for the construction phase » Where feasible, training and skills development programmes should be initiated prior to the commencement of the construction phase » Also refer to Economic Impact Assessment	
Cumulative impacts » Opportunity to upgrade and improve skills levels in the area » Opportunity for local entrepreneurs to develop their businesses	
Residual impacts » Improved pool of skills and experience in the local area » Economic growth for small-scale entrepreneurs » Temporarily employment during construction phase will result in jobs losses and struggles for construction workers to find new employment opportunities	

The impact is therefore assessed to be positive; local and regional in extent; temporary in duration; moderate intensity and definite with enhancement measures followed. The impact is assessed to be of high significance to the decision making process.

b) Economic multiplier effects

There are likely to be opportunities for local businesses to provide services and materials for the construction phase of the development. The local service sector will also benefit from the proposed development. The site is located approximately 70km south west from the small town of Kenhardt. On-site accommodation would be required for labourers due to the remote location of the proposed site; a man camp will be set up where all the necessities will be provided to employees. Off-site accommodation in the nearest towns (Kenhardt or Brandvlei) would also be required for contract workers and certain employees. The economic multiplier effects from the use of local goods and services opportunities will include, but is not limited to, construction materials and equipment and workforce essentials such as services, catering, trade clothing, safety equipment, accommodation, transportation and other goods. There would be expenditure on the man camp on site as it would require temporary/portable housing, ablution and sewage treatment, and catering facilities. In addition, it is expected that labourers who move into the area will need to purchase various consumables and personal items while living and working in the area. It is estimated that 44% of the capital expenditure – R4 413.1 billion - will be spent locally on all other goods and services required for the development of the CSP Central Receiver Tower plant.

The capital expenditure associated with the construction of the project and proposed power line is estimated to be in the region of R10 billion at current prices. About 44% of the capital expenditure will be spent locally on goods and services required for the development of the CSP 1 project. In terms of business opportunities for local companies, expenditure during the construction phase will create business opportunities for the regional and local economy. The increase in demand for new materials and services in the nearby area may stimulate local business and local economic development (however locally sourced materials and services will be limited due to availability). There is likely to be a direct increase in industry and indirect increase in secondary businesses. The implementation of the enhancement measures below can enhance the opportunities for locally based companies.

The proponent or contractors should source services needed from the local area as much as possible. These necessities should be sourced from nearby towns and local service providers. Other CSP developments in the province (i.e. Khi Solar One) have demonstrated the benefits created for the local service sector in the area (i.e. Upington specifically). Experience from other large construction projects indicates that the potential opportunities for local economies, decrease in unemployment and increase in incomes will in turn stimulate further expenditure and sales within the local economies. The impacts on production and value added experienced during constructing will be temporary and will expire once the construction phase is complete.

Direct impacts would include the creation of employment opportunities and the associated income generated by the solar project that would have a positive impact on the local region. The direct estimated salary and wage bill will equate to R191.6 million for the CSP Central Receiver Tower plant. The injection of income into the area in the form of wages will represent an opportunity for the local economy and businesses in the area. Through the stimulation of employment and income is the creation of new demand within the local and regional economies. With increased income comes additional income for expenditure on goods and services supplied. Indirect impacts would occur as a result of the new economic development, and would include new jobs at businesses that support the expanded workforce or provide project materials, and associated income. The economic impact assessment concluded that an additional 16 509 Full Time

Equivalent positions will be created in the national economy during the construction of one CSP Central Receiver Tower plant through the production and consumption induced effects (i.e. along upstream activities of the construction value chain). The intention is to maximise local labour employment opportunities, this is likely to have a positive impact on local communities and have downstream impacts on household income, education and other social aspects (also refer to economic impact assessment for additional information).

Nature: Significance of the impact from the economic multiplier effects from the use of local goods and services		
	Without enhancement	**With enhancement**
Extent	Local- regional (3)	Local- Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Moderate (6)
Probability	Highly probable (4)	Definite (5)
Significance	**Medium (36)**	**Medium (55)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources	N/A	
Can impacts be enhanced	Yes	
Enhancement » It is recommended that a local procurement policy is adopted to maximise the benefit to the local economy. » Create and consult a database of local companies, specifically Historically Disadvantaged (HD) which qualify as potential service providers (e.g. construction companies, security companies, catering companies, waste collection companies, transportation companies etc.) prior to the tender process and invite them to bid for project-related work where applicable » Local procurement is encourage along with engagement with local authorities and business organisations to investigate the possibility of procurement of construction materials, goods and products from local suppliers where feasible » Refer to the Economic Impact Assessment		
Cumulative impacts Opportunity for local capital expenditure, potential for the local service sector		
Residual impacts Improved local service sector, growth in local business		

The impact is therefore assessed to be positive; local and regional in extent; temporary in duration; moderate intensity; and definite if enhancement measures are implemented. The impact is assessed to be of medium significance to the decision-making process.

c) Population change

During the construction period a population change would be associated with the influx of the construction crew coming to the area. Population change refers to the size, structure, density as well as demographic profile of the local community. There will be temporary in-migration of labourers coming into the area. There will be approximately 1 202 employment opportunities, however not all of these employment opportunities will be fulfilled for the entire duration of the constructions phase. A man camp will be developed to accommodate majority of the workers on site; the construction crew will reside in the study area (approximately 70km south of Kenhardt). Bringing in construction workers will significantly change the population dynamics in the immediate local area. The area will be populated for approximately 30-36 months for one CSP Central Receiver Tower plant as well as for the additional construction periods for the other solar facilities to form the Solar Park concept which could be up to 10 years of construction (it is expected that the same construction crew will be utilised for the additional solar facilities as part of the Solar Park concept).

Construction workers would need to be brought into the immediate local area. Currently the local area has a rural nature and is sparsely population with extremely low population density. The nearest towns to the proposed site are Kenhardt and Brandvlei located approximately 70km away. The influx of construction workers will result in a population increase over the medium-term in the immediate local area, placing pressure on local resources and pressure social networks. The man-camp will put pressure on existing services and infrastructure in the local area. Solid waste will be disposed of off-site at the Kenhardt solid waste site. Liquid waste / waste water will treated by a package plant on site. Electricity for the construction site and man camp would need to be sourced either from Eskom or an off grid solution. Construction water will be sourced from municipal supply (by truck or via pipeline). The construction of a raw water pipeline between Kenhardt and the project site will occur during the construction phase. The Kai !Garib Local Municipality have indicated that there is sufficient water available to supply the project during construction and operation. A raw water pipeline of approximately 95km will be constructed from the Kenhardt Reservoir to the project site (Also refer to the surface and ground water study for further details). Additional consequences of an outside workforce are that they often remain in the area after completion of the project, thereby posing a negative long-term impact on services and infrastructure. A rapid population increase in the current rural area would have a negative impact in terms of service delivery, pressure on resources, cellular coverage and social dynamics.

Another negative impact from population increase will be additional pressure on the cellular network in the area. According to key stakeholders the cellular network coverage is very limited in the area. The increase in the population of the area could place additional pressure on cellular network coverage. Due to the poor cellular coverage in the area, the influx of workers from the development and the increase in phone use, it is most likely that the proponent would require cellular communication provisions in order to accommodate the project. However the cellular service provider would be responsible to increase the cellular coverage in the area (due to consumer demand); if the cellular service provider feels that this would be financially viable then they may increase the coverage (although this would also need to be in line within the limits prescribed by the Square Kilometre Array (SKA) project).

Nature: Population changes adding pressure on resources, cellular network coverage, service delivery, infrastructure maintenance and social dynamics during the construction phase as a result of an influx of construction workers into the study area		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate(6)	Moderate(6)
Probability	Highly probable (4)	Probable (2)
Significance	**Medium (36)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » Compile and implement a Grievance mechanism » A Community Liaison Officer should be appointed. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the local community to express any complaints or grievances with the construction process.		
Cumulative impacts » Additional pressure on natural resources, services, infrastructure and social dynamics in the area due to rapid population change		
Residual impacts Possibility of outside workers remaining in the area after construction is completed and subsequent pressures on local infrastructure, resources and services		

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity; probable and have a low significance with mitigation measures. The impact is assessed to be of low significance to the decision - making process.

d) Influx of jobseekers

The proposed development will create a range of employment possibilities and thus it will attract jobseekers. An influx of people looking for economic opportunities could result in pressure on economic and social infrastructure on the local population (rise in social conflicts and change in social dynamics). Influx of jobseekers into the area, could lead to a temporary increase in the level of crime, cause social disruption and put pressure on basic services. Influx of jobseekers could potentially create conflict between locals and outsides mainly due to difference in racial, cultural and ethnic composition. The high unemployment rates and expectations of job creation is already a potential source of competition among locals and could be exacerbated through outsiders coming into the area resulting in conflict. A further negative impact that could result due to an inflow of jobseekers is that local unemployment levels could rise due to an oversupply of an available workforce, particularly with respect to semi and unskilled workers.

The small towns closest to the proposed site (Kenhardt and Brandvlei) are seen as sensitive social receptors and jobseekers coming into the area could put pressure on social infrastructure; create social problems, tensions and conflicts. The impact associated with in-migration of jobseeker includes pressure on local services and infrastructure. This includes municipal services such as sanitation, electricity, water, waste management, health facilities, transportation and availability of housing. Informal settlements may develop near towns to accommodate jobseekers. It is very difficult to control the influx of people into an area, especially in a country where there's high levels of unemployment. An influx of jobseekers to an area often results in an increase in prostitution activities and temporary sexual relations with locals; this could result in the spreading of HIV/Aids and STD's and unwanted pregnancies (currently the area has a very low HIV prevalence rate amongst antenatal women). The proposed CSP development disrupting the societies largely depends on the level of local employment achievable and clearly stipulating a local employment regime to limit outsiders coming into the area. Employment opportunities can be sourced from the surrounding local towns first, Kenhardt and Brandvlei and if availability of labour is limited then extend search to KGLM and HLM. The KGLM and HLM population could fulfil the majority of the lower and semi-skilled employment opportunities that emerge.

Nature: Added pressure on economic and social infrastructure and increase in social conflicts during construction as a result of in-migration of jobseekers		
	Without mitigation	**With mitigation**
Extent	Local-regional (3)	Local- regional (3)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate(6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**

Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » A 'locals first' policy should be advertised for construction employment opportunities, especially for semi and low-skilled job categories. Enhance employment opportunities for the immediate local area, Kenhardt and Brandvlei, if this is not possible, then the broader focus areas should be considered for sourcing workers such as KGLM and HLM » It is recommended that local employment policy is adopted to maximize the opportunities made available to the local labour force. » Tender document should stipulate the use of local labour as far as possible » Prior to construction commencing representatives from the local community e.g. ward councillor, surrounding landowners should be informed of details of the construction schedule and exact size of the workforce. » Recruitment of temporary workers at the gates of the development should not be allowed. A recruitment office with a Community Liaison officer should be established to deal with jobseekers. » Set up labour desk in a secure and suitable area to discourage the gathering of people at the gates of the construction site » Have clear rules and regulations for access to the proposed site » Security company to be appointed and appropriate security procedures to be implemented » Local community organisations and policing forums / neighbourhood watches must be informed of construction times and the duration of the construction phase. Also establish procedures for the control and removal of loiters at the construction site » A Community Liaison Officer should be appointed. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the local community to express any complaints or grievances with the construction process		
Cumulative impacts » Additional pressure on infrastructure and municipal services in area due to additional people in the area » Possible increase in criminal activities and economic losses in area for property owners		
Residual impacts Possibility of outside workers remaining in the area after construction is completed and subsequent pressures on local infrastructure and services		

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity; and improbable with mitigation measures. The impact is assessed to be of low significance to the decision - making process.

e) Impacts on daily living and movement patterns

An increase in traffic due to heavy vehicles could create short-term disruptions and safety hazards for current road users. Transportation of project components and equipment to the proposed site will be transported using vehicular / trucking transport. The existing formal access road (Soafskolk road) is off the R27 located approximately 70Km south west of Kenhardt. The secondary formal access road is approximately 22km long and will be the primary access road to the proposed site. The primary roads that will be used for transportation of project components and equipment will be the R27 and the secondary formal road (gravel access road) that is off the R27. Local farmers use the gravel road to access their farms. Increased traffic due to heavy vehicles could cause disruptions to local community and increase safety hazards. The use of local roads and transport systems may cause road deterioration and congestion. This impact will be magnified since farm roads are not designed to carry heavy traffic and are prone to erosion.

An increase of traffic from the rise in construction vehicles is a safety concern for other road users and local communities in the area. The movement of construction related activities crossing over the R27 does have the potential to increase the risk for road users (however refer to the traffic impact assessment). Also with wear and tear on roads that is not maintained / repaired; the safety risk also increases. The R27 and the formal access road would mainly be affected and the use of unroadworthy vehicles, drivers disobeying traffic rules and the obstruction of motorist's views will contribute to this potentially negative impact. Noise, vibrations, dust and visual pollution from heavy vehicle traffic during the construction phase would cause temporary disruptions in daily living, movement patterns and quality of life for local residents.

According to the proponent, the formal access road to the proposed site will be upgraded due to heavy construction vehicles and trucks carrying abnormal loads will require access to the site. As a result of the upgrade of the access road off the R27 the upgrade may negatively impact the fences/electric fences along the access road. Infrastructure such as roads and fencing/ electric fencing should be maintained in the present condition or repaired, if disturbed due to project activities. The contractor should be responsible for managing this impact on private property. In terms of provincial and regional roads involved, the expectation is that the proponent should consult with the relevant roads agency to ensure that they do not contribute to the deterioration of roads without taking some responsibility for repairing the impact that their construction vehicles may have on the road during construction phase.

The formal gravel road coming off the R27 bisects the farm Klaas Jobs Vley 1/302 (see figure 9, landowners map). There is no water situated on the one portion of the farm. The livestock currently cross the road to access water that is currently only available on the one side of the farm. The upgrading of the road and increased traffic along the gravel road during the construction phase will negatively impact the movement pattern of livestock. If access to water supply is cut off by the project this access will need to be restored though other means. The developer/proponent would need to establish appropriate measures together with the landowner from the farm Klaas Jobs Vley 1/302 to ensure that livestock moving between the farm and the watering point will be able to safely access water in the event of access to water being restricted during construction (due to traffic impacts and road surfacing). This could be in the form of traffic attenuation, or infrastructure solutions with the objective that no harm comes to livestock and that adequate water is provided throughout construction.

Nature: Temporary increase in traffic disruptions and movement patterns during the construction phase		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	High Intensity (8)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » Working hours to be appropriately arranged during the construction phase, and/or as any deviation that is approved by the relevant authorities. » All vehicles must be road worthy and drivers must be qualified, obey traffic rules, follow speed limits and made aware of the potential road safety issues. » Heavy vehicles should be inspected regularly to ensure their road safety worthiness. » Provision of adequate and strategically placed traffic warning signs and control measures along the R27 and access road to warn road users of the construction activities taking place for the duration of the construction phase. Warning signs must be visible at all times. » Implement penalties for reckless driving for the drivers of heavy vehicles as a way to enforce compliance to traffic rules. » Avoid heavy vehicle activity during 'peak' hours (when children are taken to		

school, people driving to work) » The developer and engineering, procurement and construction (EPC) contractor's must ensure that the fencing/ electric fencing along the access road must either be maintained in the present condition or repaired if disturbed due to project activities » The developer and engineering, procurement and construction (EPC) contractor's responsibility to ensure roads utilised are either maintained in the present condition or upgraded if disturbed due to project activities. » The developer and engineering, procurement and construction (EPC) contractor's must ensure that any damage / wear and tear to the roads caused by construction related traffic/ project activities is repaired » Provide adequate signage along the R27 and access road to warn motorists of the construction activities taking place and displaying road safety messages and speed limits » The developer/proponent would need to establish appropriate measures together with the landowner from the farm Klaas Jobs Vley 1/302 to ensure that livestock moving between the farm and the watering point will be able to safely access water in the event of access to water being restricted during construction (due to traffic impacts and road surfacing). This could be in the form of traffic attenuation, or infrastructure solutions with the objective that no harm comes to livestock and that adequate water is provided throughout construction. » Implement traffic safety measures put forward in the Traffic study. » A Community Liaison Officer should be appointed as a grievance mechanism. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the local community to express any complaints or grievances with the construction process
Cumulative impacts Possible increased traffic and traffic disruptions impacting local communities
Residual impacts Non anticipated

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity and improbable with mitigation measures. The impact is assessed to be of low significance to the decision making process.

f) Impacts associated with the man camp

According to information provided by the proponent, on-site accommodation for the construction crew during the construction phase will be provided, which will provide all basic necessities for workers, such as sanitation, water, accommodation and catering. . It is estimated that in total, approximately 1 202 employment opportunities will be created during the construction phase. Occupation will be staggered over the construction phase and the maximum number of people housed at any given time will vary. The man camp will be located at a single location however the selection of the location will be finalised in conjunction with the appointed construction contractor to ensure that the locations are appropriate from an environmental and practical perspective. It is anticipated that the man camp will not be decommissioned following the completion of construction of the first CSP Central Receiver Tower plant, in order to provide accommodation for staff for the subsequent Solar Park concept. The man camp could therefore be operational for up to 10 years or longer depending on project phasing. A man camp is proposed for the duration of the Solar Park concept project construction period due to the distance of the site from Kenhardt and Brandvlei (approximately 70km away) and the limited accommodation opportunities provided there for the workforce. The man camp will be constructed to accommodate staff required for the construction of a single CSP Central Receiver Tower plant and will cover an area of approximately 50ha. The man-camp will put pressure on existing services and infrastructure in the local area. Solid waste will be disposed of off-site at the Kenhardt solid waste site. Liquid waste / waste water will treated by a package plant on site. Electricity for the construction site and man camp would need to be sourced either from Eskom or an off grid solution. The construction of a raw water pipeline between Kenhardt and the project site will occur during the construction phase. The Kai !Garib Local Municipality have indicated that there is sufficient water available to supply the project during construction and operation.. A raw water pipeline of approximately 95km will be constructed from the Kenhardt Reservoir to the project site (Also refer to the surface and ground water study for further details).

If the man camp is not managed efficiently this may lead to localised pollution, lack of sanitation, lack of adequate water, litter and lack of solid waste management. This could lead to unhygienic living conditions and could create health issues for the workforce and the surrounding communities. Other impacts associated with man camp include degradation of the natural environment, risk of fires, increase risk of crime in the area, security and safety concerns and increased noise levels. Workers living in the man camp will be separated from their families and/or place of residence for a significant period of time. This could lead to misbehaviour of construction workers; alcohol abuse, prostitution, temporary sexual relationships with locals that could lead to unwanted pregnancies and the spreading of HIV and other sexually transmitted diseases.

Nature: Temporary negative impacts associated with man camp during the construction phase		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	High Intensity (8)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**

Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	

Mitigation

» Safety at and around the construction site and man camp should be ensured by fencing off the construction area to avoid unauthorised access and employing security personnel
» Working hours should be kept between 6am and 6pm during the construction phase, and/or as any deviation that is approved by the relevant authorities.
» The perimeter of the construction site and man camp should be appropriately secured to prevent any unauthorised access to the site; the fencing of the site should be maintained throughout the construction periods
» Access in and out of the construction camp should be strictly controlled by a security company
» Each person entering the project site and man camp should be required to present an access cards
» Family members and friends should not to be permitted access into the man camp
» Security company to be appointed and appropriate security procedures to be implemented
» The contractor must ensure that open fires on the site for heating, smoking or cooking are not allowed except in designated areas
» Contractor must provide adequate firefighting equipment on site and provide firefighting training to selected construction staff.
» A comprehensive employee induction programme would cover land access protocols, fire management and access controls. This must be addressed in the construction EMPr as the best practice.
» The contractor should have personal trained in first aid on site to deal with smaller incidents that require medical attention
» Rubble and other solid waste should be disposed of appropriately on a regular basis
» Appropriate sanitation and waste facilities to be provided to eliminate possible pollution problems. These facilities should be cleaned and maintained on a regular basis.
» A comprehensive employee induction programme should address issues such as HIV/ AIDS and sexually transmitted diseases as well as alcohol and substance abuse. The induction should also address a code of conduct for employees that would align with community values.
» Appoint a Health and Safety Officer. Contact details of this person should be made available to the construction workers and local community and

procedures to lodge complaints set out. » A Community Liaison Officer should be appointed as a grievance mechanism for the construction workers as well for the local community. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the construction workers/ local community to express any complaints or grievances.
Cumulative impacts Possible increase in crime levels (with influx of people) with subsequent possible economic losses and increased traffic
Residual impacts None anticipated

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity and improbable with mitigation measures. The impact is assessed to be of low significance to the decision making process.

g) Impacts on the sense of place

Intrusion impacts such as aesthetic pollution (building material, construction vehicles), noise and light pollution and impacts on the present rural nature of the site and activities (grazing of livestock, sparsely populated farmstead) will impact the 'sense of place' for the local community. The construction related activities will negatively change the local 'areas sense' of place.

Nature: Intrusion impacts from construction activities will have an impact on the areas 'sense of place'		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » Limit noise generating activities to normal daylight working hours and avoid weekends and public holidays » The movement of heavy vehicles associated with the construction phase should be timed to avoid weekends, public holidays and holiday periods where		

feasible » Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers » All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits » Communication, complaints and grievance channels must be implemented and contact details of the Community Liaison Officer is to be provided to the local community in the study area
Cumulative impacts » Other construction activities in area will heighten the intrusion impacts, such as noise, dust and aesthetic pollution and further negatively impact the areas 'sense of place'
Residual impacts None anticipated

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity; and probable. The impact is assessed to be of low significance to the decision - making process.

h) Nuisance Impacts (noise & dust)

Impacts associated with construction related activities include noise, dust and disruption or damage to adjacent properties is a potential issue. Experience from other Solar Energy Facilities (CSP and PV) projects and construction of power lines indicate that site clearing does increase the risk of dust and noise being generated, which can in turn impact on adjacent properties. The potential impacts can be addressed by implementing effective mitigation measures. The movement of heavy construction vehicles and construction activities have the potential to create noise along the R27 and along the formal gravel access road off the R27. The primary sources of noise during construction would be from the construction equipment and other sources of noise include vehicle/truck traffic, blasting and ground vibration. Noises levels can be audible over a large distance however are generally short in duration (refer to noise impact assessment). Generation of dust would come from construction activities as well as trucks/ vehicles driving on the gravel access road off the R27. This impact will negatively impact social sensitive receptors. The impact of noise and dust on farmsteads can only be reduced through mitigation measures and not avoided. With the in-migration of people and construction workers into the area, this will also increase noise impacts. The noise, dust and increased use of the local roads are expected to be negative, mainly impacting the nearby social but are short term impacts receptors (see farming community discussed in section 4).

Nature: Nuisance impacts in terms of temporary increase in noise and dust, or

the wear and tear on access roads to the site		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » The movement of heavy vehicles associated with the construction phase should be timed to avoid weekends, public holidays and holiday periods where feasible » The contractor must ensure that damage / wear and tear caused by construction related traffic to the access roads is repaired before the completion of the construction phase. » Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers » Ensure all vehicles are road worthy, drivers are qualified and are made aware of the potential noise and dust issues A Community Liaison Officer should be appointed. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the local community to express any complaints or grievances with the construction process » Also refer to the noise impact assessment for mitigation measures		
Cumulative impacts » If damage to roads is not repaired then this will affect other road users and result in higher maintenance costs for vehicles of road users » Other construction activities in area will heighten the nuisance impacts, such as noise, dust and wear and tear on roads.		
Residual impacts Only damage to roads that are not fixed could affect road users		

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity; and probable. The impact is assessed to be of low significance to the decision - making process.

i) Safety and security impacts

An increase in crime is often associated with construction activities. The perceived loss of security during the construction phase of the proposed project due to the influx of workers and/ or outsiders to the area (as in-migration of newcomers, construction workers or jobseekers are usually associated with an increase in crime), may have indirect effects such as increased safety and security issues for neighbouring properties and damage to property, increase risk of veld fire, stock theft, poaching, crime and so forth. A man camp is proposed for the duration of the Solar Park concept project construction period due to the distance between Kenhardt and Brandvlei and the limited accommodation opportunities provided there for the workforce expected to be required. The man camp will be constructed to accommodate the maximum amount of staff required for the construction of a single CSP Central Receiver Tower plant. It is anticipated that the man camp will not be decommissioned following the completion of construction of the first CSP Central Receiver Tower plant, in order to provide accommodation for staff of subsequent solar energy park concept. The man camp could therefore be operational for up to 10 years or longer depending on project phasing. The influx of labour over this period could potentially result in a security risk and conflict with residents who have farmed in this area for generations. It will be mandatory on the project developer to foster and maintain good relationships with neighbouring land owners and institute adequate grievance control mechanisms.

Apart from construction crew that poses a potential increased risk there may also be an influx of people looking for economic opportunities. Safety and security impacts are a reality in South Africa which needs to be addressed through appropriate security measures. Majority of the impacted and adjacent farm owners utilise their farms for sheep farming, there are also minor game farming activities on nearby farms. Landowners were invited to a focus group meeting to share their concerns and many of them indicated that stock theft is a problem in the area and therefore a concern that the proposed development and the in-migration of people to the area (that will be residing in the immediate area in the man camp for 30-36 months or possibly up to 10 years or longer) as well as outsider coming into the area (contractors, construction crews and jobseekers) may increase risk posed to workers, properties, stock theft and poaching. Adjacent farm owners are thus concerned that criminal activity would increase during the construction phase which poses a potential risk to surrounding farming operations. The movement of people along the access road also increases these potential risks for farms located on the formal access road. The primary access road off the R27 bisects Farm Klaas Jobs Vley 1/302. In an email sent by the land owner from Farm Klaas Jobs Vley 1/302 dated 23 April, he points out that: *"…increase of people using the road through my farm will definitely impact on the risk posed to workers, livestock and property in general. There is a shed where vehicles and fuel is stored about 100m away from this road and at night there is no lighting or protection for property and staff. We need to understand what will be done to protect us against secondary elements that are not under the direct control of the operator…* [and suggests that] *…the protection of the project site should be extended to include at least the homestead and shed on my farm* *e.g. regular patrols of the route."* Is it viable for the appointed EPC contractor to consult with the farm owner and these farm workers and to implement specific security measures. It is therefore recommended that the appointed EPC contractor takes these points into consideration and it is important that a security company is appointed and appropriate security procedures and measures implemented. The appointed EPC contractor should take these issues into consideration within the stakeholder engagement and management plan.

<table>
<tr><td colspan="3">Nature: Temporary increase in safety and security concerns associated with the influx of people during the construction phase</td></tr>
<tr><td></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Extent</td><td>Local (2)</td><td>Local (2)</td></tr>
<tr><td>Duration</td><td>Short term (2)</td><td>Short term (2)</td></tr>
<tr><td>Magnitude</td><td>High Intensity (8)</td><td>Moderate (6)</td></tr>
<tr><td>Probability</td><td>Probable (3)</td><td>Improbable (2)</td></tr>
<tr><td>Significance</td><td>Medium (36)</td><td>Low (20)</td></tr>
<tr><td>Status (positive or negative)</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Reversibility</td><td colspan="2">Yes</td></tr>
<tr><td>Irreplaceable loss of resources</td><td colspan="2">No</td></tr>
<tr><td>Can impacts be mitigated</td><td colspan="2">Yes</td></tr>
<tr><td colspan="3">Mitigation
» Working hours should be kept between daylight hours during the construction phase, and/or as any deviation that is approved by the relevant authorities.
» The perimeter of the construction site and man camp should be appropriately secured to prevent any unauthorised access to the site; the fencing of the site should be maintained throughout the construction periods
» Access in and out of the construction camp should be strictly controlled by a security company
» Family members and friends should not to be permitted access into the man camp
» The appointed EPC contractor must appoint a security company and appropriate security procedures and measures are implemented
» The contractor must ensure that open fires on the site for heating, smoking or cooking are not allowed except in designated areas
» Contractor must provide adequate firefighting equipment on site and provide firefighting training to selected construction staff.
» A comprehensive employee induction programme would cover land access protocols, fire management and road safety. This must be addressed in the construction EMPr as the best practice.
» The contractor should have personal trained in first aid on site to deal with</td></tr>
</table>

smaller incidents that require medical attention » A Community Liaison Officer should be appointed as a grievance mechanism. A method of communication should be implemented whereby procedures to lodge complaints are set out in order for the local community to express any complaints or grievances with the construction process
Cumulative impacts Possible increase in crime levels (with influx of people) with subsequent possible economic losses
Residual impacts None anticipated

The impact is assessed to be negative; local in extent; temporary in duration; moderate intensity and improbable with mitigation measures. The impact is assessed to be of low significance to the decision making process.

7.13.3 Impact tables summarising the significance of social impacts associated with the project Operational Phase

a) Direct employment and skills development

The operation phase of the project will require a workforce and therefore direct employment will be generated. Although the exact number of construction workers is not confirmed at this stage, it is estimated that approximately ~45 jobs will be generated for the lifetime of the project (approximately 20 years). Given that CSP Central Receiver Tower plants are relatively new in South Africa, a number of highly skilled personnel may need to be recruited from outside the local labour force. Highly skilled employees are required for the proposed project and local experts will be trained at other CSP Central Receiver Tower plants operating in the country by that time. If the local labour force does not have sufficient skills by the time the project is operational, foreign experts will be employed for a few years to transfer the necessary skills. Less skilled employees will also be required for the operation of the CSP Central Receiver Tower plant, such as safety and security personal, cleaning crew and engineering assistants. It is estimated at approximately ~45 people including five highly specialised positions that would be filled by local experts and two-thirds of the positions reflecting unskilled and semi-skilled workers such as labourers, cleaners, security guards, etc.. Routine activities would include operation of the solar facility to produce power, and regular monitoring and maintenance activities to ensure safe and consistent operation of the CSP Central Receiver Tower plant and power line. The power line route will also contribute to a relatively small number of employment opportunities during the lifetime of the power line. Maintenance will be carried out throughout the lifetime of the CSP Central Receiver Tower plant and power line. Typical activities during maintenance include washing solar panels routinely (in the evening) and vegetation control and maintenance (for the CSP Central Receiver Tower plant and power line). Employment opportunities will be generated during the operation phase from the local community, although there will be a relatively small number of jobs created, these jobs will have a positive impact on the local economy (in terms of revenue generated and the unemployment situation).

It should be encouraged that majority of the employees be sourced from within the local and regional municipal pool and if the relevant skills are not available then these should be sought out on a national basis. The proponent will need to demonstrate a commitment to local employment targets in order to maximise the opportunities and benefits for members of the local community. The focus for employment should be on local people, including women; this will have a maximum positive long-term impact (and if there is sufficient transfer of skills the positive impact can be extended). As the employment opportunities generated during the operation phase are more permanent and sustainable in the long run, as opposed to those generated during the construction phase (which are only temporary), sourcing of local labour during this phase will have long term beneficial impact. The applicant has indicated that training will also be provided to employees through a training centre. Establishing and operating the plant will result in improved skills amongst the staff as the facility will include a training centre. A certain percentage of the plant's operating expenditure will also be allocated towards training and skills development. On-the-job training is a key element of the staff development; many of the required skills during the operational phase will be taught to staff through day-to-day operations. It is also expected that the training programme implemented at the CSP Central Receiver Tower plant will reduce the necessity to acquire foreign expertise in the future. Thus, potentially all employment positions created by the facility will be allocated to South Africa's residents. Specific skills training for local employees have the opportunity to develop local employee potential. This is crucial to long-term development of skills and education in the area. This will accelerate the positive benefits and impacts of the development on the economy.

Nature: The creation of employment opportunities and skills development opportunities during the operation phase for the country and local economy		
	Without enhancement	With enhancement
Extent	Local- regional (3)	Local- Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Highly probable (4)
Significance	**Low (27)**	**Medium (36)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of	N/A	

resources	
Can impacts be enhanced	Yes
Enhancement In order to enhance the local employment and business opportunities associated with the operation phase the following measures should be implemented: » It is recommended that local employment policy is adopted to maximise the opportunities made available to the local community. » The recruitment selection process should seek to promote gender equality and the employment of women wherever possible » Vocational training programs for employees should be established to promote the development of skills	
Cumulative impacts » Opportunity to upgrade and improve skills levels in the area » Opportunity to reduce unemployment rates	
Residual impacts Improved pool of skills and experience in the local area	

The impact is assessed to be positive; local to regional in extent; long-term; minor intensity and probable. The impact is assessed to be of medium significance to the decision - making process.

b) Development of clean, renewable energy infrastructure

Energy production has been and still is one of the main pivots of the social and economic development of South Africa. South Africa currently relies on coal-generated energy to meet its energy needs. Almost 72% of South Africa's primary energy is from coal, over half used to generate electricity and a quarter used for synfuels production. South Africa's carbon emissions are higher than those of most developed countries partly because of the energy-intensive sectors which rely heavily on low quality coal. Use of low quality coals is the main contributor to GHG emission. The energy-intensive sectors of the economy emit carbon emissions that are higher than those of most developed economies. The use of solar radiation for power generation is considered a non-consumptive use of a natural resource which produces zero greenhouse gas emissions. The generation of renewable energy will contribute to South Africa's electricity market. The advancement of renewable energy is a priority for South Africa. The government considers the use of renewable energy as a contribution to sustainable development (White Paper on Renewable Energy). As most of the sources are indigenous and naturally available, its use will strengthen energy security as it will not be subjected to disruption by international crisis. Furthermore, recent policy highlights the desirability of clean; green energy and solar generated energy will play a significant role in reaching these quotas (Energy Research Centre UCT, 2004). Given South Africa's reliance on

Eskom as a power utility, the benefits associated with an Independent Power Producer based on renewable energy are regarded as an important contribution.

Increasing the contribution of the renewable energy sector to the local economy may contribute to the diversification of the local economy and provide greater economic stability. The growth in the solar energy sector could introduce skills and development into the area. The development of a CSP Central Receiver Tower plant could therefore add to the stability of the economy, and even though this project is small scale in comparison to the overall potential of the sector, it could contribute to the local economy. The overall contribution to South Africa's total energy requirements of the proposed CSP Central Receiver Tower plant is small; however, the 200MW facility will help contribute to offset the total carbon emissions associated with energy generation in South Africa.

Nature: Development of clean, renewable energy infrastructure		
	Without enhancement	**With enhancement**
Extent	Local- Regional- National (4)	Local- Regional- National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (40)**	**Medium (40)**
Status (positive or negative)	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources	Yes (impact of climate change)	
Can impacts be enhanced	No	
Enhancement None anticipated		
Cumulative impacts Reduce carbon emissions through the use of renewable energy and contribute to reducing global warming		
Residual impacts Reduce carbon emissions through the use of renewable energy and contribute to reducing global warming		

The impact is assessed to be positive; local to national in extent; long term; minor intensity; and highly probable. The impact is assessed to be of medium positive significance to the decision - making process.

c) Visual impact and sense of place impacts

The sense of place is developed over time as the community embraces the surrounding environment, becomes familiar with its physical properties, and creates its own history. The sense of place is created through the interaction of various characteristics of the environment, including atmosphere, visual resources, aesthetics, climate, lifestyle, culture and heritage. Importantly though it is a subjective matter and is dependent on the demographics of the population that resides in the area and their perceptions regarding trade-offs. The change in land use that is relevant to the project is the change from agricultural land to an area that must be kept clear. An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light. The social impacts associated with the impact on sense of place relate to the change in the landscape character and visual impact of the proposed CSP Central Receiver Tower plant and power line. The alteration of the sense of place in view of the local residents and road users will start during the construction phase; visual impacts will remain during the entire operation period. Sense of place impacts from the CSP Central Receiver Tower plant and power line is difficult to mitigate. This could also affect tourism in the area (eco-tourism, hunting) that relies on the natural beauty and pristine nature of the area. The visual impact of the proposed development was assessed in detail as part of the Visual Impact Assessment (VIA). It was indicated in the VIA that the construction and operation of the CSP Central Receiver Tower plant will have an expansive visual impact on the scenic resources of the study area. It is envisaged that farmers residing adjacent to the proposed site and power line and commuters travelling on the R27 will be predominantly impacted visually and impacted in terms of the areas sense of place from the proposed development. There is some infrastructural character within the area. Prominent features surrounding the proposed site and power line route include:

» A railway line
» R27 regional road
» Electricity transmission lines and telephone lines
» Aries substation

These are infrastructural elements that currently have an impact on the sense of place and visual resources in the area. The VIA has indicated that there are not many options as to the mitigation of the visual impact of the proposed infrastructure, as no amount of vegetation screening or landscaping would be able to hide the structure of the CSP dimensions (especially within the receiving environment). Therefore the receiving environment will be visually transformed for the lifespan of the project.

Nature: Visual impacts and sense of place impacts associated with the operation phase of the CSP Central Receiver Tower plant and power line		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)

Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (44)**	**Medium (44)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation » Implement mitigation measures and recommendations proposed by the visual specialist as part of the VIA.		
Cumulative impacts Potential impact on the current sense of place in the area due to other developments		
Residual impacts None anticipated if the visual impact will be removed after decommissioning, provided the CSP and power line infrastructure is removed and the site is rehabilitated to its original (current) status.		

The impact is assessed to be negative; local in extent; long term; moderate intensity; and highly probable. The impact is assessed to be of medium significance to the decision - making process, however review of the VIA should be acknowledged and recommendations implemented.

d) Impacts associated with the loss of agricultural land

Direct occupation of land by proposed CSP Central Receiver Tower plant infrastructure has the effect of taking the impacted land out of agricultural production, through the occupation of the site by the footprint of the facility. The proposed site is located within the agricultural zone. The construction and assembly of the CSP Central Receiver Tower plant and Power Line will disturb the current cattle grazing activities. The activities associated with the operation phase will result in a loss of farmland available for grazing and potential agricultural production for the operation period of 20-25 years.

Change in land use means that some affected communities will no longer have access to natural resources on which they depend for their livelihoods. The results could be loss of income and drop or change in standard of living. With regards to the power line, some properties already have power lines and railway line traversing their properties and another power line will intensify the impact. Properties that will be traversed by an additional power line may lose productive land to the servitude and servitude road.

Nature: Impacts associated with loss of farmland available for potential

agricultural purposes due to occupation of land by the CSP Central Receiver Tower plant and power line		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate(6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (44)**	**Medium (44)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	At footprint for the duration of the operation phase of the CSP Central Receiver Tower plant and Power Line	
Can impacts be mitigated	No	
Mitigation None anticipated		
Cumulative impacts » The overall loss of agricultural land in the region due to other developments		
Residual impacts Overall loss of farmland, income and change in livelihood		

The impact is assessed to be negative; local in extent; long-term; low intensity; and probable. The impact is assessed to be of medium significance to the decision - making process.

7.13.4 Impact tables summarising the significance of social impacts associated with the project Decommissioning Phase

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning however for a limited period of time.

Given the relatively small number of people employed during the operation phase (~45), the social impacts at a community level associated with decommissioning are likely to be limited. In addition, potential impacts associated with the decommissioning phase can be effectively managed with the implementation of a retrenchment and downscaling programme.

Nature: Social impacts associated with retrenchment including loss of jobs and source of income		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Short term (1)	Short Term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**Low (28)**
Status	Negative	Negative
Reversibility	No	
Irreplaceable loss of resources?	No	
Can impact be mitigated?	Yes	
Mitigation » Implementation of a retrenchment and downscaling programme » All structures and infrastructure associated with the proposed facility should be dismantled, removed and transported off-site on decommissioning; & the landscape rehabilitated/ re-vegetated.		
Cumulative impacts Loss of jobs and associated loss of income etc. can impact on the local economy and other businesses. However, decommissioning can also create short term, temporary employment opportunities associated with dismantling etc.		
Residual impacts Loss of jobs and associated loss of income, can impact on local economy and other businesses.		

The impact is assessed to be negative; local in extent; short term; low intensity; and highly probable. The impact is assessed to be of low significance to the decision - making process.

7.13.5Comparative Assessment of Alternatives

The selection of the proposed project and power line route was based on a detailed pre-feasibility study, which considered climatic conditions in the area, extent of the site, topographic conditions, availability of land, road access and proximity to a grid connection. No alternative sites or power line routes were identified for assessment in the EIA process. Therefore, no site alternatives for the proposed project were assessed during the EIA process. The final location of the proposed project on the proposed site will be informed by technical considerations and in-puts from the relevant specialist studies (including the SIA) being undertaken as part of the EIA process.

7.13.6 Implications for Project Implementation

» Local labour (i.e. from the nearest settlements and towns - specifically people who are not employed elsewhere) should be sourced, where possible, to enhance the positive impact of employment creation in the area. Local businesses should be involved with the construction activities where possible. It is imperative that local labour be sourced to ensure that benefits accrue to the local communities. Preference should thus be given to the use of local labour during the construction and operational phases of the project as far as possible. Recruitment offices in nearby towns should be established to prevent job seekers from going to the site in search of work.
» Consideration needs to be made with respect to the inclusion of local entrepreneurs in nearby communities should also be allowed an opportunity to be included in a list of possible local suppliers and service providers, enhancing the multiplier effect. This aspect would serve to mitigate other subsequent negative impacts such as those associated with the inflow of outsiders to the area, the increased pressure on the infrastructure and services in the area, as well as the safety and security concerns.
» Involve the community in the process as far as possible (encourage co-operative decision making and partnerships with local entrepreneurs).
» Impacts associated with the construction period should be carefully mitigated to minimise the dust and noise pollution and damage to existing roads.
» Safety and security risks should be taken into account during the planning/construction phase of the Proposed Project. Access control, security and management should be implemented to limit the risk of crime increasing in the area.

7.14. Impacts Related to the Storage and Handling of Dangerous Goods

During the operational phase, the CSP Project will require the storage of materials which may be considered to be dangerous goods.

"Dangerous goods" is defined under the Listing Notices that deal with the storage, or storage and handling, of dangerous goods. "Dangerous goods" are defined in the Listing Notices as:

"Goods containing any of the substances as contemplated in South African National Standard No. 10234, supplement 2008 1.00: designated "List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)" published by Standards South Africa, and where the presence of such goods, regardless of quantity, in a blend or mixture, causes such blend or mixture to have one or more of the characteristics listed in the Hazard Statements in section 4.2.3, namely physical hazards, health hazards or environmental hazards"

The above definition makes specific reference to SANS 10234. South Africa has implemented the Globally Harmonized System of Classification and Labelling of Chemicals by issuing this national standard.

The operation of the CSP Project requires fuel for start-up, diesel and other chemicals. The facilities or infrastructure for the storage, or storage and handling of a dangerous good in containers will have a combined capacity of up to / not exceeding 500 cubic metres. These chemicals will be stored on-site in appropriate storage vessels in bunded areas/ on impervious surfaces. The storage and handling of these dangerous goods has the potential to result in soil and/or water contamination should any spillages/leakages occur. While not all materials to be stored on site are considered to be hazardous (or have a hazard rating), materials such as fuel and oils are flammable and also have the potential to cause fires, explosions, damage to infrastructure, as well as injuries of staff.

Molten salts are specific to the operation of power tower plant with storage. The molten salt to be utilised in the CSP Project is made up of a blend of Sodium Nitrate (approximately 60%) and Potassium Nitrate (approximately 40%). Neither is listed under Annex A of SANS 10234 supplement 2008 1.00: designated "List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)" published by Standards South Africa. Molten salt therefore does not qualify as a dangerous good in terms of the definition under NEMA EIA Regulations. It is, however, superheated when being used for thermal energy storage.

Nature: Storage and handling of dangerous goods in containers with a combined capacity of up to / not exceeding 500 cubic metres		
	Without mitigation	**With mitigation**
Extent	Local (5)	Local (5)
Duration	Short (1)	Short (1)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (2)
Significance	**Low (36)**	**Low (24)**

Status (positive or negative)	Negative	Negative
Reversibility	Irreversibility	Irreversibility
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Undertake regular integrity inspections on all dangerous goods containment vessels » Ensure procedures for the handling of dangerous goods are in place » Ensure that adequate secondary containment is provided in the event of spillages » Regular inspections of the permanent bunded areas for storage of dangerous goods must be undertaken. » Any spillages of dangerous substances must be contained, and remedial and clean-up actions initiated immediately. » Maintenance vehicles must have access to spill kits. » An emergency spill response plan must be developed for implementation during the construction and the operational phase. » Store flammable substances in enclosed containers away from heat, sparks, open flames, or oxidizing materials. » Develop and implement a procedure for handling and clean-up of the chemical spill » Develop a monitoring and leak detection procedure for monitoring of the chemical spillages.		
Cumulative impacts: The development of the CSP Project and its proximity to other CSP Projects will increase the cumulative environmental risk of contamination due to the storage and handling of chemicals and flammable substances.		
Residual Impacts: None		

Nature: Operation of the CSP Project including possible release of toxic substances and associated contamination of soil and groundwater		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Small (0)
Probability	Definite (5)	Probable (3)
Significance	**Medium (60)**	**Low (15)**
Status (positive, neutral or negative)	Negative	Negative

Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be m itigated?	Reasonably	
Mitigation: » Routinely checks for chemical spillages. » Prior to construction and up to decommissioning, clear method statements must be drafted and available on site at all times on how spillages will be contained and remediated.		
Cumulative impacts: » Possible pollution of surrounding areas and downstream rivers and wetlands if no mitigation is implemented		
Residual impacts: » None expected if mitigation measures are implemented		

7.15. Assessment of the Do Nothing Alternative

The 'Do-Nothing' alternative is the option of not constructing the Proposed Project. Should this alternative be selected, there would be no environmental impacts on the site due to the construction and operation activities of a solar energy facility.

a) Land use and agriculture

The current land-use is restricted to low intensity grazing of sheep. The natural grazing capacity of the larger solar farm is between 41 and 60 ha per stock unit (or 7.5 ha per Small Stock Unit (SSU)). Should the current land use activities continue, sheep farming would continue to occur indefinitely. The potential to utilise the site sustainably (due to the very low agricultural potential and stock yield) will therefore not be realised. It is the intention of the landowner (as project co-developer) to continue with sheep farming on the portion of the farm not occupied by a CSP Project.

b) Ecological processes

It has been established that sections of the broader study area serve as migration corridors (Ecological Support Area) allowing for the movement of fauna. The project development footprint is sited within a section of the larger study area which is not considered to have an impact on this ESA or system, which is shown through the field survey to be more defined in the southern section of the larger study area. The no-go alternative will therefore not play a role in the overall viability of faunal movement and ecological processes occurring within the corridor. However, should the project not be realised, there will be no opportunity for the formal protection of this area. As the area is excluded from any development footprint, but is close enough to a secured site, this area could be offered some formal protection by the project developers should the project continue.

c) Socio-economic impact

Social: The impacts of pursuing the No - go Option are both positive and negative as follows:

» The benefits would be that there is no disruption from, nuisance impacts (noise and dust during construction), visual impacts and safety and security impacts. The impact is therefore neutral.
» There would also be an opportunity loss in terms of job creation, skills development and associated economic business opportunities for the local economy.

Foregoing the proposed CSP development would not necessarily compromise the development of renewable energy facilities in South Africa. However, the socio-economic benefits for local communities would be forfeited.

Capital investment: Establishment of a 200 MW CSP Project will cost approximately R6 714.1 million (2013 prices), of which 65.7% or R4 413.1 million (2013 prices) will be spent in the country. The localised expenditure on the project will stimulate the local and national economies, albeit for a temporary period of 30 months or two and a half years. Through production and consumption induced effects it will further stimulate new business sales in the economy to the amount of R9 183.4 million (2013 prices). Thus, the total contribution of the project towards production or new business sales in the South African' economy during the construction phase is estimated to be R13 596.5 million in 2013 prices.

New Business: New business sales that will be stimulated as a result of the establishment of one CSP Project will generate R4 725.5 million (2013 prices) of Gross Domestic Product per Region (GDP-R) in the country, thus increasing the size of the national economy albeit for a temporary period. Some of the positive spin off effects that are to ensue from the project expenditure will be localised in the communities located near the site, such as Kenhardt and Brandvlei. The local services sector and specifically the trade, transportation, catering and accommodation, renting services, personal services and business services are expected to benefit the most because of project activities during the construction phase.

Employment: About 1 202 direct Full Time Equivalent jobs will be created during construction, which considering its duration equates to about 481 people working on the project for the entire duration of the construction period. Considering that 50 positions will be occupied by engineers and consultants and 75 positions will be taken up by supervisors and foremen, 356 people will comprise the construction crew and will be working on site throughout the entire construction period. At least a third of these jobs will become available for the local communities and specifically for the nearby town of Kenhardt and Brandvlei. Combined, these towns had 746 people who were unemployed in 2011 and it is clear that if the majority of the construction crew were employed from the local communities, the local unemployment rate could be significantly improved albeit for a limited time of 2.5 years. Furthermore, considering that Kenhardt had a much worse unemployment situation than Brandvlei, the potential benefits to the former could be of a greater significance than to the latter.

Skills development: The establishment of the CSP Project will offer numerous opportunities for skills transfer and development. This is relevant for both on-site activities and manufacturing activities. Three CSP Projects are already being established in the country, which means that the transfer of skills from foreign experts to the local engineers and construction workers already takes place. The Proposed Project will create an additional opportunity to expand skills development activities and create a domestic work force with significant expertise in CSP Project construction.

Multiplier effects: Investment in the proposed CSP Project and subsequent creation of more than 17 thousand FTE jobs during the construction period throughout the national economy will have a positive effect on income and standard of living of households benefiting directly and through multipliers effects of the project. With the construction of one CSP Project, about R191.6 million (2013 prices) will be paid out in salaries and wages to employees directly involved in the establishment of the CSP Project. A portion of this income will be accrued in the local communities, thus benefiting the households located in the nearby towns, including Kenhardt and Brandvlei.

Taxes: Approximately R204.8 million in 2013 prices will be paid to government from direct activities in the form of personal income taxes and company's tax during construction. Government earnings will be distributed by national government to cover public spending, which includes amongst other the provision and maintenance of transport infrastructure, health and education services, and other public goods.

Municipal goals: The LED goals of the District Municipality (in terms of energy development, manufacturing growth through energy development and techno-tourism) will not be met to the extent possible should the project not be constructed.

The landowner as co-developer would have lost an opportunity of using the land in a sustainable manner. Furthermore, the municipality would lose the opportunity to improve and uplift their Local Economic Development (LED) goals through the additional community trust to be put in place.

The no-go alternative will therefore result in the above economic benefits **not being realised** and a subsequent loss of income and opportunities to local people. From this perspective the no-go alternative is not preferred.

d) Regional scale impact

At a broader scale, the benefits of additional capacity to the electricity grid and those associated with the introduction of renewable energy would not be realised. The Northern Cape has the best solar resource in the South Africa. Although the facility is only proposed to contribute 200MW to the grid capacity, this would assist in meeting the growing electricity demand throughout the country and the agglomeration of multiple CSP Projects within the broader study area has the potential to contribute up to 1 000MW cumulatively. The generation of electricity from renewable energy resources offers a range of potential socio-economic and environmental benefits for South Africa. These benefits include:

» **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of power supplementation. In addition, given that renewables can often be deployed in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality, while reducing expensive transmission and distribution losses.

» **Resource saving:** Conventional coal fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres, when compared with wet cooled conventional power stations; this translates into revenue savings of R26.6 million. As an already water-stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly due to the detrimental effects of climate change on water availability.

» **Exploitation of our significant renewable energy resource:** At present, valuable national resources including biomass by-products, solar radiation and wind power remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.

» **Pollution reduction:** The releases of by-products through the burning of fossil fuels for electricity generation have a particularly hazardous impact on human health and contribute to ecosystem degradation.

» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of greenhouse gas (GHG) emissions. South Africa is estimated to be responsible for ~1 % of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.

» **Support for international agreements:** The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol, and for cementing its status as a leading player within the international community.

» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation in South Africa. The South African government is mandated to create formal employment opportunities in the economy.

» **Acceptability to society:** Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.

» **Support to a new industry sector:** The development of renewable energy offers the opportunity to establish a new industry within the South African economy.

7.16. Conclusion

The 'do nothing' alternative will do little to influence the macro-level renewable energy targets set by government due to competition in the sector, and the number of renewable energy projects being bid to the DoE. However, as the site experiences some of the best irradiation in the country and optimal grid connection opportunities are available, not developing the project would see such an opportunity being lost. Overall, the loss of the land to the project is considered to be acceptable. In addition the National grid will be deprived of an opportunity to benefit from the additional generated power being evacuated directly into the Province's grid. The "Do Nothing" alternative is therefore not preferred as South Africa needs to diversify electricity generation sources, to which this project will contribute.

ASSESSMENT OF POTENTIAL CUMULATIVE IMPACTS CHAPTER 8

Cumulative impacts in relation to an activity are defined in the Environmental Impact Assessment Regulations (GN R543) as meaning "the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area".

There has been a steady increase in renewable energy developments recently in South Africa as legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs) and renewable energy into the electricity generation mix. The Department of Energy has, under the REIPPP Programme released requests for proposals to contribute towards Government's renewable energy target of 3725 MW and to stimulate the industry in South Africa.

Various grid strengthening and expansion projects are being proposed by Eskom in the near vicinity of the Proposed Project area. These include the proposed Aries-Helios 765kV Transmission Power Line Project (DEA Ref. 14/12/16/3/3/2/441) and the authorised 400/50kV Eskom Substation between the Aries and Helios Substation (DEA Ref. 12/12/20/1167) on the Farm Moutonsvlei 1615.

Due to the growth in interest in renewable energy developments in South Africa, it is important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts are considered and minimised where required and possible. This chapter considers whether the Proposed Project's potential impacts become more significant when considered in combination with the other CSP Projects proposed to occur within the area, as well as other known or proposed solar energy facility projects within the region.

8.1 Assessment of Potential Cumulative Impacts

A cumulative impact, in relation to an activity, refers to the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse undertaking in the area[13].

Significant cumulative impacts that could occur due to the development of the solar energy facilities and its associated infrastructure in proximity to each other include impacts such as:

» Visual impacts

[13] Definition as provided by DEA in the EIA Regulations.

» Socio-economic impacts
» Loss of vegetation and impacts on ecology
» Impacts to soil
» Impacts on heritage resources
» Impacts related to abstraction of water from surface water resources.

The cumulative effect or impacts are considered, assessed and presented as follows:

» Potential cumulative impacts as a result of the Proposed Project added to all other renewable energy facilities proposed to be constructed or being constructed within the region (within a 50 km radius from the site). These impacts will be registered throughout the broader region requiring mitigation through planning at a regional level.
» Potential cumulative impacts as a result of proposed CSP Project, added to other proposed CSP facilities which could be located within different areas within the larger 55 000 ha study area (at this stage, only one CSP facility has been authorised within the larger study area, but it is envisaged that up to 3 tower plant facilities could be accommodated within the larger study area).

8.2 Cumulative Impacts of Renewable Energy Facilities in the Region

The site of the proposed CSP 1 facility is located within 50km from authorised solar PV renewable energy facilities, all located in close proximity to the Aries Substation. These are described in the table below[14]. One authorised CSP facility is located, within the broader study area within the SolarReserve Kotulo Tsatsi solar park concept, and is discussed further in Section 8.3.

Project Name	Distance from the proposed site	Project Status
Proposed construction of the SolarReserve Kotulo Tsatsi Concentrated Solar Plant, Northern Cape Province, Exheredo Pty Ltd. DEA reference number 14/12/16/3/3/2/694	Adjacent and north of the site	Environmental Authorisation issued
Proposed construction of a photovoltaic (PV) power plant, Kenhardt, AES Solar Energy Ltd. Process: Scoping & EIA (DEA reference number: 12/12/20/2170)	37 km north east of the site, east of Aries Substation	Environmental Authorisation issued
Solar Cape photovoltaic energy facility generation facility, Kenhardt District, Solar Land CC. Process: Scoping & EIA. (DEA reference number:	39 km north east of the site, east of Aries Substation	Environmental Authorisation issued

[14] These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR.

12/12/20/2113)		
Proposed Green Continent Partners 75MW Solar Energy Electricity Generation Facility (Kenhardt District), Wine Estate Capital Management South Africa (Pty) Ltd. Process: Scoping & EIA. (DEA reference number: 14/12/16/3/3/2/344	45 km north east of the site, east of Aries Substation	Environmental Authorisation issued
Green Continent Partners photovoltaic energy electricity generation facility, Kenhardt district, Green Continent Partners (Pty) Ltd. Process: Scoping & EIA.(DEA reference number: 12/12/20/220)	47km north east of the site, east of Aries Substation	Environmental Authorisation issued
Aries Photovoltaic PV Solar Energy Facility One, Northern Cape, BioTherm Energy (Pty) Ltd (DEA 12/12/20/2098/2)	36 km north east of the site, east of Aries Substation	Round 1 preferred bidder. Project is constructed and operational.

A map showing the location of the solar projects in the study area close to Aries Substation is shown in Figure 8.1.

The following projects are preferred bidders for CSP Projects in the Northern Cape. These projects are all located approximately 150 km from the proposed project site, and do not contribute to the cumulative impact of this facility.

Project Name	**Capacity**	**Preferred Bidder Window**
Xina Solar One -parabolic trough plant near Pofadder	100MW	Three
Project Ilanga - parabolic trough plant near located east of Upington	100MW	Three
Bokpoort CSP - parabolic trough plant near Groblershoop	50MW	Two
Khi Solar One – tower plant near Upington.	50MW	One
KaXu Solar One - parabolic trough plant near Pofadder	100MW	One

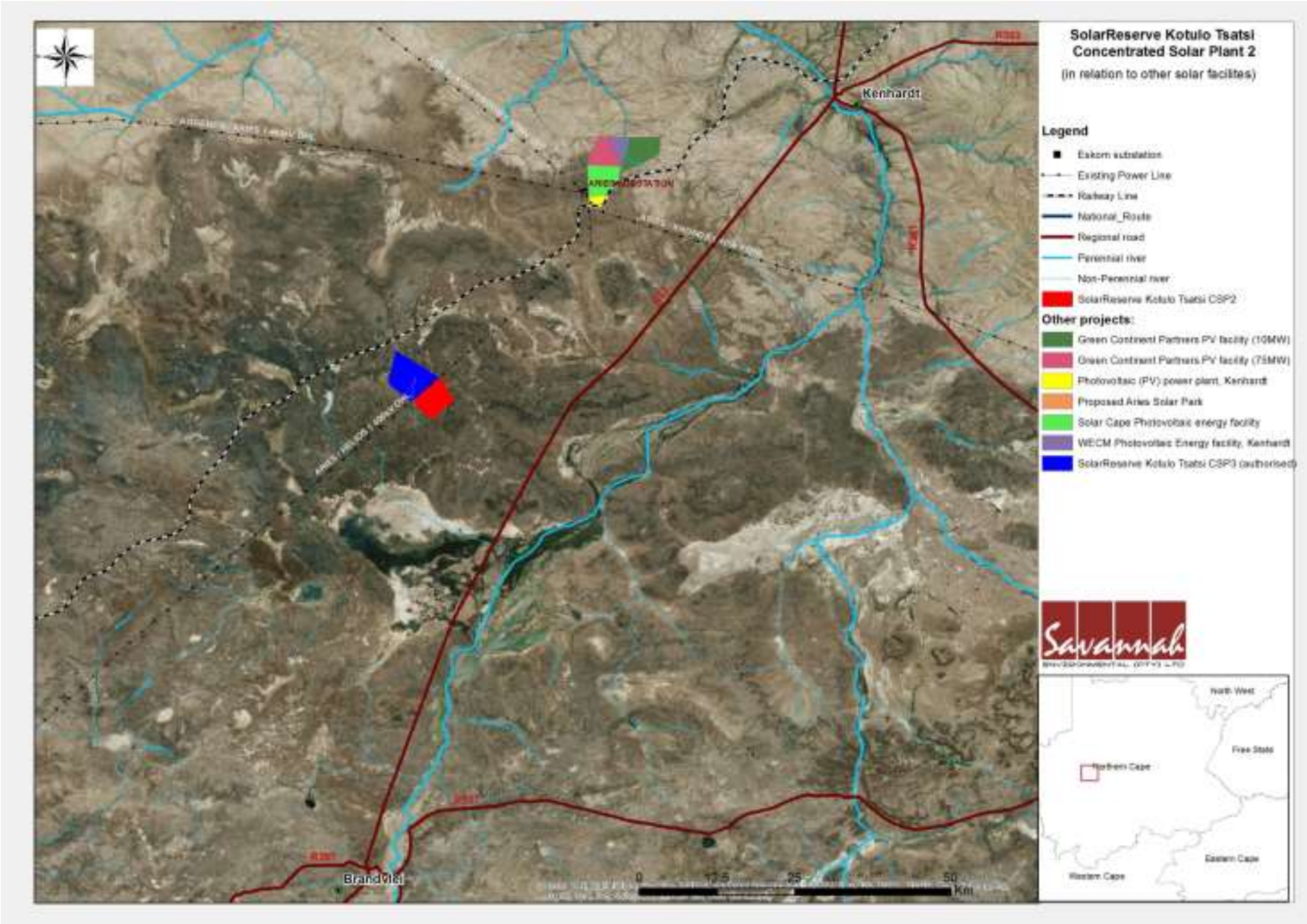


Figure 8.1: Map showing other projects in the region in relation to the CSP 1 plant. These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR

8.2.1. Cumulative Impacts on Ecological Processes

The cumulative loss of broad ecological processes resulting from the current and as well as the other developments in the region I accommodated by the proposal for a biodiversity offset (Appendix F) This will result in the negative impacts on ecosystems on each site being managed to acceptable levels, and therefore in keeping with the principles of sustainable development. With the implementation of good environmental management practise during the life cycle of each project, cumulative impacts on ecology as a result of the establishment of similar facilities will be to an acceptable level.

8.2.2. Cumulative Impacts on Soil and Agricultural Resources

Although the cumulative footprint of the proposed development might occupy a large area (approximately 5 000 ha for all CSP facilities and associated infrastructure) the cumulative impact of the project on agricultural resources is expected to be low due to the very low potential of the land across the solar park concept study area. With an average grazing capacity of 7.5 ha SSU^{-1} it would imply that approximately 670 sheep will be taken out of production – a small number considering that the same number of stock could be reared on approximately 15% of the area in other parts of South Africa.

8.2.3. Cumulative Heritage Impacts

Archaeological sites are non-renewable and impact on any archaeological context or material will be permanent and destructive. Very sparse heritage traces were found on the site and from an archaeological perspective the observed heritage resources may be regarded as being of generally low significance. It still remains important for each renewable energy facility to observe mitigation measures and to incorporate any sensitive heritage features into the layout plans where possible.

8.2.4. Cumulative Effects on Water Resources

Other than the Gariep River, the Northern Cape is largely devoid of significant surface water resources. Water abstraction from the Gariep River is controlled by the DWS, who will determine if sufficient reserves exist for the Lower Gariep River Catchment taking into consideration cumulative impacts. All applicants proposing to do so will have to apply to DWS for a water use licence for abstraction of water from the Gariep River.

The cumulative effect on alternative water resources, being municipal supply and water abstraction on site, are more localised and less regional-scale impacts and are considered in Section 8.3.2.

Water resources or drainage features within the regional area are scarce and cumulative impacts on drainage lines as a result of the establishment of similar facilities will be to an acceptable level.

8.2.5. Cumulative Visual Impacts

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Sensitive visual receptors include residents of homesteads and farmsteads and secondary roads. Users of the R27 will also be exposed to visual impact, however they lie within the 8-16km offset, thus reducing the expected magnitude of the impact.

, Other solar energy facilities have been proposed within the Kenhardt/Aries region. These facilities consist mainly of solar energy facilities. The closest of these facilities is the Aries Solar Energy Facility located south west of Kenhardt.

Considering the above, it can be stated that the potential cumulative visual impact of approved and pending Solar Energy Facilities within the region is low.

8.2.6. Cumulative Social Impacts

a) Cumulative impact from employment, skills and business opportunities

The proposed CSP Central Receiver Tower plant and the establishment of other Solar Energy Facilities has the potential to result in significant positive cumulative impacts; specifically with the creation of a number of socio-economic opportunities for the Province, which in turn, will result in a positive social benefit. The positive cumulative impacts include creation of employment, skills development and training opportunities, and downstream business opportunities. Benefits to the local, regional and national economy through employment and procurement of services could be substantial should many renewable energy facilities proceed. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the renewable energy facilities to be manufactured in South Africa. Furthermore at municipal level, the cumulative impact could be positive and could incentivize operation and maintenance companies to centralize and expand their activities towards education and training and more closely to the projects. The type of employment will most likely change significantly due to the skilled nature of the jobs associated with solar energy projects. Cumulative impacts on local entrepreneurs will be positive and assist in developing their businesses further. The cumulative impacts of are likely to have significant positive impact on the local economy.

Nature: An increase in employment opportunities, skills development and

business opportunities with the establishment of more than one solar energy facility		
	Without enhancement	With enhancement
Extent	Local- regional (3)	Local- Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)
Significance	**Medium (33)**	**Medium (52)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources	N/A	
Can impacts be enhanced	Yes	
Enhancement The establishment of a number of solar energy facilities in the area does have the potential to have a positive cumulative impact on the area in the form of employment opportunities, skills development and business opportunities. The positive benefits will be enhanced if local employment policies are adopted and local services providers are utilised by the developers to maximise the project opportunities available to the local community.		
Cumulative impacts » Opportunity to upgrade and improve skills levels in the area » Cumulative impacts on local entrepreneurs in developing their businesses		
Residual impacts » Improved pool of skills and experience in the local area » Economic growth for small-scale entrepreneurs		

The impact is assessed to be positive; local to regional in extent; long-term; low intensity and probable. The overall impact is likely to have a medium positive significance to the local area.

b) Cumulative impact with large scale in-migration of people

The development of large-scale solar projects in the local area will likely draw a large number of labour, businesses and jobseekers to the area. If the local labour force cannot be sourced locally or the local labour pool is inadequate for the solar energy projects, outside labour will likely move to the area to fill the gap. The area may experience an influx of new residents who may move to the area looking for job opportunities; which will have effects on the existing population during the construction period that could entail problems of housing, sanitation, water usage and solid waste disposal. Employment at a solar energy facility peaks during construction and significantly declines during operation; since solar energy facilities need relatively few workers while in operation solar facilities will not create long-term boomtowns. Though there may be an influx of workers during construction, these workers are largely temporary. Rapid population growth is a common experience in rural towns near new large development projects. Towns with larger populations (greater than 1000 individuals) and with developed services will likely experience greater rates of population growth than areas without developed services. In relation to the area the two towns that are sensitive receptors will be Kenhardt and Brandvlei. Kenhardt covers an area of 159.35km^2 it has a population of 4 483 and approximately 1 167 households. Brandvlei covers an area of 29.25km^2 it has a population of 2 589 and approximately 752 households. With the influx of new individuals, secondary industries in the town may also begin to grow, more individuals will move to the area to fill these secondary positions. The impact of this on services and resources is likely to impact the current communities and increase the pressure on local municipalities to meet the basic needs of these potential new communities. The poor communities are likely to be the most vulnerable to loss of service provision and suffer the negative impact of large-scale in-migration. There is potential for the influx of migrants to significantly change the local receiving environment and is likely to have a permanent impact in the region. Due to the number of solar energy facilities proposed in the nearby area and the proposed SolarReserve Kotulo Tstasti Solar Park concept; the impacts from in-migration of people is likely to have significant negative impacts on the local area. It is very difficult to control an influx of people into an area, especially in a country where unemployment rates are high.

Construction & Operational Phase		
Nature: Negative impacts and change to the local economy with an in-migration of labourers, businesses and jobseekers to the area.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	High intensity (8)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (56)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation In order to alleviate the potential cumulative impact, it is the responsibility of each solar project developer (and its contractors) to provide services (such as housing,		

water and sewage) for the labour related to their projects. This could be done through a number of means, such as; » Develop a recruitment policy/ process (to be implemented by contractors), which will source labour locally; » Working together with government agencies to ensure service provision is in line with the development needs of the local area; » Forming joint ventures with community organisations, through Trusts, which can provide local communities with benefits, such as employment opportunities and services.
Cumulative impacts » Additional pressures on infrastructure and municipal services in area due to additional people in the area » Possible increase in criminal activities and economic losses in area with influx of people
Residual impacts Possibility of outside workers remaining in the area after construction is completed and subsequent pressures on local infrastructure, services and poverty problems

The impact is assessed to be negative; local to regional in extent; long-term; moderate intensity and probable. The overall impact is likely to have a medium negative significance to the local area.

c) Cumulative impacts on the sense of place and landscape

The visual impact of solar energy facilities (PV and CSP) is likely to change the immediate landscape of the area. The cumulative impact of other solar energy projects in the area could alter the nature of the visual landscape. The potential impact of solar facilities on the landscape is an issue that does need to be taken into consideration, specifically given the growing number of solar energy facility applications in the Northern Cape Province. There are a number of proposed solar energy facilities in the nearby area, as well the SolarReserve Kotulo Tsatsi Solar Park concept facilities which will have a significant impact on the areas sense of place. With regards to the area, a number of Solar Energy Facilities could be proposed in the future. The Environmental Authorities in the province should therefore be aware of the potential cumulative impacts when evaluating applications.

Operational Phase		
Nature: Visual impacts and change in the sense of place impacts associated with the establishment of more than one solar energy facility in the area		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)

Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	No	
Can impacts be mitigated	No	
Mitigation » None anticipated		
Cumulative impacts Impact on other activities whose existence is linked to natural sense of place and character of the area		
Residual impacts None anticipated if the visual impact will be removed after decommissioning, provided the CSP and power line infrastructure is removed and the sites are rehabilitated to its original status.		

The impact is assessed to be negative; local to regional in extent; long-term; moderate intensity and probable. The overall impact is likely to have a medium negative significance to the local area.

8.3 Cumulative impacts of additional CSP Tower projects in the immediate area

The assessment of cumulative impacts of multiple CSP tower projects within the immediate study area) was undertaken taking into consideration the construction and operation of up to three CSP Tower facilities. One authorised CSP facility is located on the property adjacent to that of the CSP 1 project.

Project Name	Distance from the proposed site	Project Status
SolarReserve Kotulo Tsatsi Concentrated Solar Plant, Northern Cape Province, Exheredo (Pty) Ltd. DEA reference number 14/12/16/3/3/2/694	6km north of the site	Environmental Authorisation issued
SolarReserve Kotulo Tsatsi Concentrated Solar Plant 2, Northern Cape Province, Exheredo (Pty) Ltd. DEA reference number 14/12/16/3/3/2/694/2	Directly adjacent (< 1m) north of the site	Draft EIAr out for Public Review

8.3.1 Cumulative Impacts on Ecological Processes and Biodiversity

Cumulative negative impacts on ecology relate to transformation of land, disturbance of ecosystems and habitat loss as well as impacts on fauna and flora resulting from three

CSP Projects and their respective grid connections in one local area. The position of the three CSP tower project relative to the larger Solar Park concept study area is reflected in Figure 8.2.

a) Impacts on Bioregional plans and ecological systems

The Namakwa Bioregional Plan as compiled during 2008 outlined several areas that area important to take into consideration when planning development in order to ensure that long-term conservation and ecosystem services targets are met. This is especially important as it is anticipated that the Namakwa Region and the wider Succulent Karoo will be the one biome that will potentially be most severely affected by the impacts of anticipated climate change. As part of this Bioregional plan, the importance of various types of wetland habitats in the stability of overall ecosystem functioning and services is considered.

Ecological corridor: Given the plans for other CSP developments within the larger area, the potential for significant cumulative impacts to develop is high. These impacts would be largely on ecosystem processes such as dispersal and habitat fragmentation rather than on any species of conservation concern within the development footprint. Minor disruptions to the wildlife corridor already exist in the form of railway tracks and gravel roads and the power line. The three CSP project development sites have avoided the most sensitive ecological areas, thereby presenting as little a barrier as possible to the migration corridor. Other associated infrastructure should be planned to not impede animal migration routes. It will therefore be imperative to put in place some protection that this migration corridor will be maintained (i.e. no land use other than current livestock agriculture permissible) between landscapes to the west and Grootvloerpan- and Verneukpan-areas to the east of the proposed development and possible future developments. This protection will be enforced through the need for a biodiversity offset area and an open space management plan for the authorised SolarReserve Kotulo Tsatsi concentrated solar project, located adjacent to the CSP 1 site and for the proposed CSP1 project. The Biodiversity offset area will be in extent of 4000ha and would generate positive outcomes for local biodiversity as large areas are required for most ecological processes in this arid area. With these commitments and measures to maintain the migration corridor, the potential cumulative impacts are considered to be acceptable.

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b) Impacts resulting from edge effects

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of a development be kept as close together as possible. New power lines for example, should follow routes of existing servitudes if such exist, renewable energy facilities should be constructed as close as possible to existing infrastructure or substations, and if several developments are planned within close proximity, these developments should be situated as close together as possible and in a way that interferes as little as possible with natural ecosystem processes, not scattered throughout the landscape.

In line with the above principles, the CSP tower facilities have been sited within the study area for the reduction of edge effects. Similarly the proposed 132kV power lines are situated within a common corridor adjacent to an existing power line with only short power lines required in order to enter the corridor. The cumulative impacts related to edge effects are considered to be low.

c) Impacts on avifauna

Potential impacts to avifauna are anticipated during the operational phase of the project and depending on avifaunal interaction with the solar field include injuries or mortalities resulting from solar flux burns in the vicinity of the CSP central receiver. The construction of evaporation ponds in close proximity to the receiver tower could potentially increase the cumulative impact on avifauna should they be visited by avifauna. The impact of cumulative CSP development within a larger study area could potentially result in an increase in the probability of these impacts occurring, with specific reference to protected species identified in the broader area.

Solar flux: The proposed CSP tower projects are located on sites which are considered to be acceptable from an avifaunal standpoint and demonstrate an overall low avifaunal species richness. The project sites fall outside of the 3km buffer prescribed by the avifaunal specialist around the nest of the Martial Eagle, thereby reducing, but not altogether eliminating the potential risk of this species being affected by solar flux. All the CSP central receiver positions are situated outside of the Martial Eagle nest buffer. Martial Eagle territories can be in excess of $100km^2$ and the potential for these birds to fly over the CSP sites and near to the tower (where most reported cases of solar flux burns are reported) during operation remains a possibility. The potential for these impacts to occur is not adequately understood and further monitoring will be required to be undertaken at the pre-construction and operational phase to address cumulative effects.

Power lines: The mortality of endangered species (particularly Bustards) has been identified as an existing impact due to collisions with the existing Aries – Helios 400kV power line traversing the study area. Each CSP tower facility will potentially require its own power line from the facility on-site substation in order to access the common power line corridor adjacent to the existing power line. An increase in bird collisions with power lines could potentially occur due to the increased number of power lines, albeit that these would run in parallel. The cumulative impact is anticipated to be of greatly reduced significance with the implementation of the mitigation measures, specifically through marking of the existing and future power lines with bird diverters

8.3.2 Cumulative Impacts on Surface and Groundwater Resources

a) Water supply

In terms of water supply and based on the results of the groundwater study, it is not considered feasible that sustainable groundwater supply for the operation phases of all three CSP Projects could be achieved. There is the potential for cumulative impacts on existing water users depending on whether water will be abstracted from boreholes or supplied by the municipality. Due to the low yield of borehole water in the area, any unsustainable abstraction for industrial use could potentially impact on underground aquifer yields, which in turn could have an impact on existing neighbouring users (for sheep watering and domestic supply).

An allocation of up to 750 000m^3 of raw water per annum from the Kai !Garib Local Municipality would need to be secured for all three CSP tower plants. According to the municipality, such an allocation is available. Provision of this water to the project/s could potentially result in an extension of the water pipeline from the Project Site to Brandvlei, which is currently largely dependent on borehole water supply.

b) Impact on drainage

The larger area drains in a southerly direction towards the Gemsbokrivier which in turn discharges into the Sak River. Apart from intermittent pans which represent poor drainage conditions, the area is characterised by washes, representing preferential flow paths of water within the landscape, rather than definable drainage areas. Various drainage lines will be impacted by the siting of the proposed CSP facilities and surface water dynamics may be altered to some extent. According to the specialist studies undertaken, two drainage lines stand out from the dendritic drainage pattern and will be affected by all three proposed CSP tower projects. First order streams (poorly defined ephemeral drainage areas and intermittent drainage lines) will be partially affected by the CSP 1 heliostat field. These converge into a second order stream to the east of CSP

1, where CSP 1 is proposed to be situated. Construction of all three CSP Projects will result in approximately 5km of ephemeral drainage lines being impacted by construction activities. Based on the overall low hydrological sensitivity of the three project areas, the cumulative impact is anticipated to be low due to the impacted streams being poorly defined, having low flows and being unable to support flow dependent aquatic life. The cumulative impact is anticipated to remain low due to the absence of watercourses identified.

c) Contamination

Surface and groundwater may be contaminated by possible hydrocarbon spills from vehicles and heavy machinery used to construct and transport the proposed infrastructure to site. The watershed in the area is poorly defined due to the flat terrain and poorly organised river systems suggesting that pollution of downstream systems, should a significant spill event occur, is of low probability. With the implementation of suitable mitigation measures, the extent of this impact is considered to be low.

8.3.3 Cumulative Impacts on Soil and Agricultural Capability

a) Soil erosion

The cumulative impact soil erosion is expected to be low due low rainfall and relatively gentle slopes of the area. During the construction phase vehicle traffic is expected to increase.

b) Agricultural potential and capability

Although the cumulative footprint of the proposed development might occupy a large area (approximately 3 000 ha for 3 tower facilities and associated infrastructure) the cumulative impact of the project on agricultural resources is expected to be low due to the very low potential of the land. With an average grazing capacity of 7.5 ha / small stock unit, it would imply that approximately 670 sheep will be taken out of production. This is considered to be a small number considering that the same number of stock could be reared on approximately 15% of the area in other parts of South Africa.

Based on the above, the potential loss of agricultural land will be very low. Should all three CSP tower projects be developed, a cumulative loss of approximately 3 000 ha of land would occur (or 11.6% of the broader 20 700ha study area). Livestock could continue to graze the undeveloped areas, however, should this not be a viable option, the affected livestock can be transferred further south to another 35 000ha currently owned and farmed by the landowner. The cumulative agricultural impacts are therefore considered to be of low significance.

8.3.4 Cumulative Heritage and Palaeontological Impacts

Limited heritage material was identified in the Solar Park concept study area. Finds were limited to low density scatters of low significance The Project Sites are not considered to contribute to the heritage landscape of the region. Loss of the all three CSP tower Project Sites will therefore not contribute to cumulative archaeological or heritage impacts. Cumulative impacts may however extend to the power line corridor and the proposed R27 water pipeline alignment due to a greater number of heritage finds identified, however it is expected that construction in the identified areas can be avoided mitigating the potential loss of heritage resources.

No cumulative palaeontological impacts are anticipated due to the very low palaeontological sensitivity ascribed to the study area.

8.3.5 Cumulative Visual Impacts

The anticipated cumulative visual impact of the three CSP tower facilities, and specifically the anticipated frequency of visual exposure is illustrated in Figure 8.3. Areas shaded in dark red are likely to be exposed to the power towers and heliostats of all three facilities, while areas shaded in yellow are likely to be exposed to only the power towers of the three CSP facilities. Areas shaded in light yellow are likely to be exposed to only one tower, while areas shaded in green are likely to be visually screened.

A high cumulative visual impact is anticipated within 16km of the proposed facilities, with the highest frequency of exposure expected in the south west of the study area. Very few areas within the 16km offset will be screened from all potential visual impact. Figure 8.4 – 8.7 provides a pre-construction and post-construction photosimulation of the CSP Projects from a viewpoint (Valsvlei) within the greater area, thereby demonstrating the potential cumulative impact. The absence of visual sensitive receptors in the study area means that three CSP towers will not significantly add to the cumulative impact.

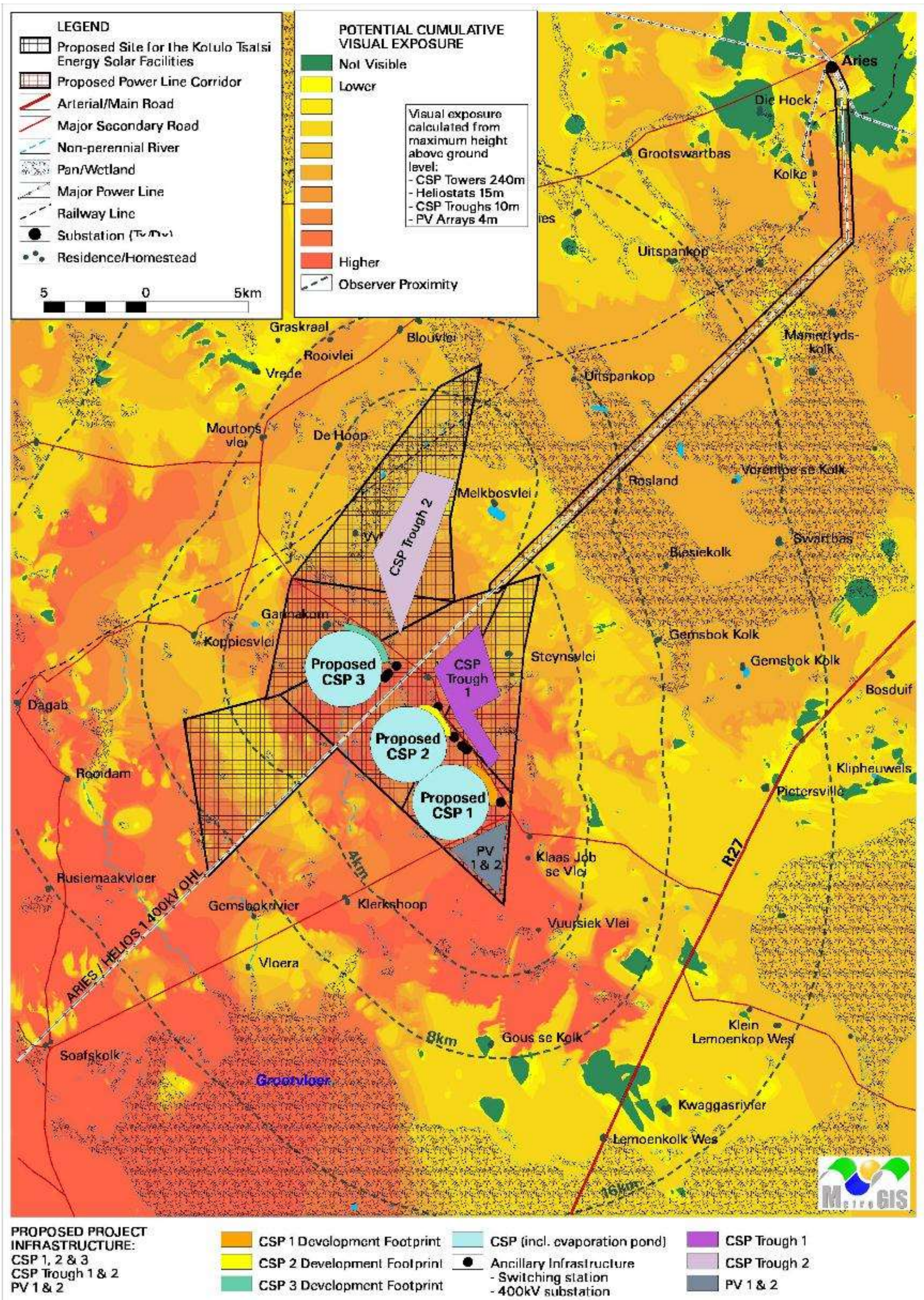

Figure 8.3: Potential cumulative visual exposure of all solar energy facilities within the broader study area

Figure 8.4: Pre-construction panoramic view from Valsvlei

Figure 8.5: Post construction panoramic view from Valsvlei for CSP 1 (left) and CSP 1 (right)

Figure 8.6: Pre-construction panoramic view from a ~5km distance from the tower

8.3.6 Cumulative Noise Impacts

The projected cumulative noise rating levels due to the operation of three CSP Tower plants facilities is illustrated in Figure 8.8. The projected cumulative noise rating does not consider potential cumulative impacts due to existing ambient sound levels which already assumes a very quiet background sound level.

The operational phase model of the Proposed Project illustrates contours of predicted sound levels. These contours impacted quite far from the source, and in the correct environmental conditions such as rural districts noise can propagate to a distance of 3km from the source of the noise. Even though noise can impact to such a distance the closest Noise Sensitive Development is more than 3km from the Proposed Projects. Therefore, the noise impact on these dwellings that is very low or none at all.

8.3.7 Cumulative Impact of radio-frequency emissions on the SKA

A large number of non-correlated noise sources (heliostat controls) could increase the noise floor at a receiving site distant from the noise sources. This will however be included in the measurement data of a single CSP Project. The addition of further CSP Project will result in a theoretical increase of 15dB can be added to the expected emission field strength. Cumulative impacts can be mitigated through shielding and filtering solutions to ensure installed plant equipment emissions remain approximately 15dB below the EN 55022 (information technology equipment) limit.

8.3.8 Cumulative Socio-Economic Impacts

a) Economic Impacts

The cumulative economic impacts should the three CSP tower developments be realised will be significant. Effectively the range of the multiplier effect will vary depending on whether the projects are constructed separately or simultaneously.

Contribution to GDP: The potential contribution towards the national production and GDP-R would triple. Development of all three CSP Tower plants will increase the national output by R40.7 million in 2013 prices and the national GDP by R14.2million in 2013 prices.

Job creation: Three CSP Projects are already being established in the country, which means that the transfer of skills from foreign experts to the local engineers and construction workers already takes place. The Proposed Project will create an additional opportunity to expand skills development activities and create a domestic work force with significant expertise in CSP Project construction.

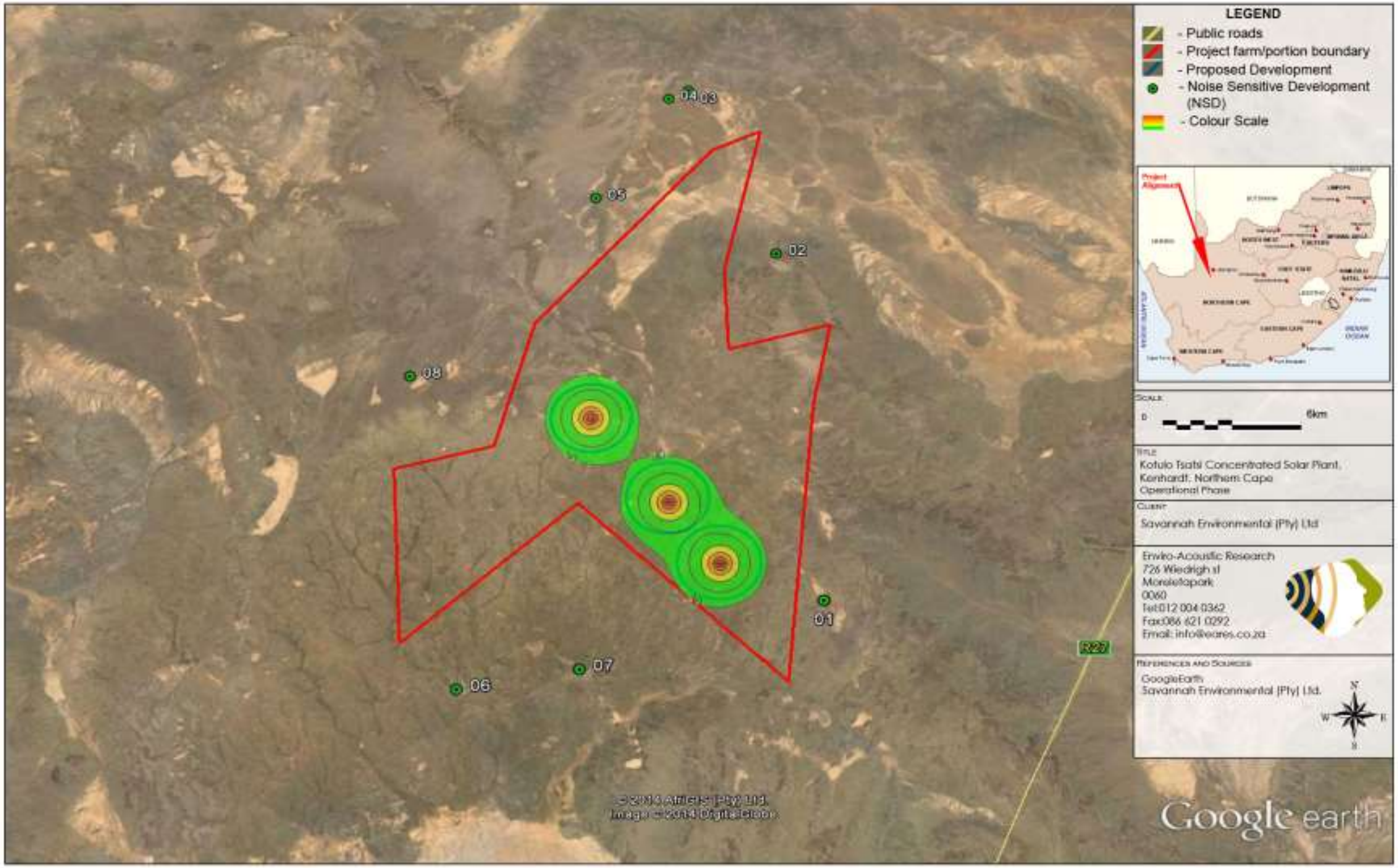

Figure 8.8: Projected conceptual operational Noise Rating Levels; Contours of constant sound levels (Enviro-Acoustic Research) for the three CSP tower facilities

Such opportunities will multiply if three CSP Tower plants are developed on the proposed site. With the establishment of three CSP tower plants, the direct number of jobs created during construction will increase three times, resulting in a much greater number of jobs that will be made available for the local communities. Considering the small size of the two nearby towns, it is likely that communities located further away from the site will also benefit from the job creation created on site. The total increase, albeit temporary, in employment that will ensue due to the construction of one 200 MW CSP Project will be in excess of 17 700 Full-Time-Equivalent jobs; if three CSP Tower plants are built, this number will grow to in excess of 53 100 FTE jobs.

b) Social impacts

The site for the proposed development is located within less than 50km from other renewable energy facilities. There are three CSP facilities proposed for the SolarReserve Kotulo Tsatsi Solar Park concept. Preferred bidders for CSP projects in the Northern Cape located approximately 150km from the proposed 1 000MW CSP Energy Facility Project includes; Xina Solar One, parabolic trough plant near Pofadder (Bidder name: Khi Solar); Karoshoek Consortium concentrated solar power located east of Upington; Bokpoort CSP near the town of Groblershoop; Khi Solar One near Upington; KaXu Solar One parabolic trough plant near Pofadder. The proposed Solarreserve Kotulo Tsatsi CSP Project is the only CSP project near Kenhardt.

Employment, skills, and business opportunities

The proposed CSP plant and the establishment of other solar energy facilities has the potential to result in significant positive cumulative impacts; specifically with the creation of a number of socio-economic opportunities for the Province, which in turn, will result in a positive social benefit. The positive cumulative impacts include creation of employment, skills development and training opportunities, and downstream business opportunities. Benefits to the local, regional and national economy through employment and procurement of services could be substantial should many renewable energy facilities proceed. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the renewable energy facilities to be manufactured in South Africa. Furthermore at municipal level, the cumulative impact could be positive and could incentivize operation and maintenance companies to centralize and expand their activities towards education and training and more closely to the projects. The type of employment will most likely change significantly due to the skilled nature of the jobs associated with solar energy projects. Cumulative impacts on local entrepreneurs will be positive and assist in developing their businesses further. The cumulative impacts of are likely to have significant positive impact on the local economy.

Large-scale in-migration of people

Rapid population growth is a common experience in rural towns near new large development projects. Towns with larger populations (greater than 1000 individuals) and with developed services will likely experience greater rates of population growth than areas without developed services. In relation to the area the two towns that are sensitive receptors will be Kenhardt and Brandvlei. Kenhardt covers an area of 159.35km^2 it has a population of 4 483 and approximately 1 167 households. Brandvlei covers an area of 29.25km^2 it has a population of 2 589 and approximately 752 households. With the influx of new individuals, secondary industries in the town may also begin to grow, more individuals will move to the area to fill these secondary positions. The impact of this on services and resources is likely to impact the current communities and increase the pressure on local municipalities to meet the basic needs of these potential new communities. The poor communities are likely to be the most vulnerable to loss of service provision and suffer the negative impact of large-scale in-migration. There is potential for the influx of migrants to significantly change the local receiving environment and is likely to have a permanent impact in the region. Due to the number of solar energy facilities proposed in the nearby area and the proposed SolarReserve Kotulo Tsasti Solar Park concept; the impacts from in-migration of people is likely to have significant negative impacts on the local area. It is very difficult to control an influx of people into an area, especially in a country where unemployment rates are high.

Sense of place and landscape

The visual impact of solar energy facilities (PV and CSP) is likely to change the immediate landscape of the area. The cumulative impact of other solar energy projects in the area could alter the nature of the visual landscape. The potential impact of solar facilities on the landscape is an issue that does need to be taken into consideration, specifically given the growing number of solar energy facility applications in the Northern Cape Province. There are a number of proposed solar energy facilities in the nearby area, as well the SolarReserve Kotulo Tsatsi Solar Park concept facilities which will have a significant impact on the areas sense of place. With regards to the area, a number of Solar Energy Facilities could be proposed in the future. The Environmental Authorities in the province should therefore be aware of the potential cumulative impacts when evaluating applications

8.4 Conclusion regarding Cumulative Impacts

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data/information on each of the receptors and the site specific developments. This however, is beyond the scope of this study.

The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant.

The potential cumulative impacts resulting from the construction and operation of multiple (three) CSP Tower projects[15] are likely to be largely contained to within the boundaries of the study area, and with the application of the necessary mitigation measures, contained within each of the respective plant areas. This is deduced based on the following:

» The development footprints of the three proposed CSP tower projects are outside of the larger systems identified to be of significance in terms of the migration corridor identified in terms of the ESA. Overlap with areas of high sensitivity does occur at a Project Site level, however the loss of the smaller identified ecologically sensitive areas (as opposed to the larger representative ecologically sensitive areas) is considered to be acceptable.
» Limited heritage resources are found on the greater farm but primarily outside of the CSP tower sites. As a result the cumulative heritage impact is expected to be low.
» Palaeontological sensitivity is low and cumulative impacts are expected to be low.
» Visual impacts of developing three CSP tower plants (having the most visually prominent structures at 250m) will be of medium significance due to the low number of visual receptors in the area, with the majority of cumulative visual impacts being experienced from the R27.
» The development of up to three CSP Projects in one area means that each plant will require water which is expected to be supplied by the local municipality, or from groundwater resources. Any abstraction proposed to occur from existing boreholes to supplement water supply for construction or operational purposes will need to be licensed. Use of groundwater will impact on the scarce groundwater resources of the area.
» The development of multiple CSP Projects may impact on the R27 intersection during construction and operations. However, this impact can be managed through the upgrade of the intersection.
» Shared infrastructure between the three CSP Projects could include the existing shared access road and possibly man camps (depending on timing of the construction for each project). This is favourable.

[15] The siting and layout of an additional two proposed CSP Trough plants were not available at the time of preparation of this report but have been approximated based on site sensitivity for the assessment of cumulative impacts.

» Social – benefit to people in the area and increased opportunities for employment and spin-offs may occur.

Based on the above, the cumulative impacts associated with the construction and operation of the proposed CSP Project are considered to be acceptable provided that environmental impacts are mitigated to suitable standards by strict control and implementation of EMPrs for each project.

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 9

Kotulo Tsatsi Energy, in a joint development venture with SolarReserve, proposes the development, construction and operation of a commercial solar thermal electricity generating facility (using a Central Receiver Tower and molten salt storage technology) and associated infrastructure, with a generating capacity of up to 200 megawatts (MW), located approximately 70km west of Kenhardt in the Northern Cape Province. The project known is known as the **SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 (CSP 1)** and is one of three CSP Tower projects proposed to be developed within the study area as part of a larger Solar Park concept consisting of a mix of solar technologies, including concentrated solar thermal and photovoltaic technologies.

This EIA Report applies to the proposed CSP 1 project, situated on Portion 3 of the Farm Styns Vley 280. The project has been allocated the DEA Reference Number: 14/12/16/3/3/2/694/1.

The facility will have a total development footprint of ~ 1 000ha and will include the following associated infrastructure:

- » Solar collector field – consists of all systems and infrastructure related to the control and operation of the heliostats.
- » Molten salt circuit – includes the thermal storage tanks for storing low and high temperature liquid salt, a central solar-thermal tower receiver, pipelines and molten salt to steam heat exchangers.
- » Power block – consists of the steam turbine and generator, as well as the air-cooled condenser and associated feedwater system.
- » Auxiliary facilities - consists of the switch yard, step-up transformers, facility start-up generators (gas or diesel-fired – dependent on detailed design).
- » Grid connection infrastructure, including:
    - o 132 kV on-site project substation
    - o Eskom 132kVswitching station
    - o Eskom 400kV sub-station
    - o 132 kV power line up to 50km in length to connect to Eskom's existing Aries Substation or 400kV loop in – loop out to the existing Aries – Helios 400kV power line
- » Access roads (roads up to 8m wide)
- » Water supply point located at the existing Kenhardt Water Reservoir and water supply pipeline situated within the servitude of existing roads (approximately 95km in length).
- » Water storage reservoir (20 000m^3 and 5 000m^3).
- » Water treatment facility.
- » Wastewater treatment facility.

» Plant assembly facility.
» Evaporation ponds (approximately 8ha in extent).
» Workshop and office buildings.
» Man camp.

Need and desirability: An advantage of CSP Projects is their potential for storing solar thermal energy to use during non-solar periods and to dispatch electricity when it is needed most. Through a due diligence process undertaken by the applicant, CSP Tower technology was specifically chosen (as opposed to CSP parabolic trough technology) as the most feasible technology choice for the specific site. The primary reasons for this includes the suitability of the technology to be constructed on moderate topography without the absolute need to undertake wholesale clearance of the land, the potential for CSP Tower plants to be operated more efficiently due to higher concentration ratios and higher temperatures, as well as more efficient energy storage periods.

Project Site selection:
The Project is proposed to be situated on Portion 3 of the Farm Styns Vley 280 which was identified through the Scoping process as being suitable from an environmental perspective for a project of this nature. The larger project area was identified by the Developer as suited to the development of the Proposed Project due to the availability of the solar resource, proximity to a viable grid connection, support from the local municipality and willing landowner. Based on the outcomes of the Scoping evaluation, some areas of the larger study area were excluded (as potential no-go areas) and potentially more suitable areas were selected for further investigation through the EIA. Therefore, a funnel-down approach to site identification was followed in order to allow environmental sensitivity to inform the siting and preliminary layout design of the proposed project. This was further informed during the EIA by way of the specialist field investigations. This allowed for the larger study area to be divided into representative segments within which the smaller Project Sites could be defined within which additional and stand-alone CSP projects are proposed to be developed by SolarReserve and Kotulo Tsatsi Energy, with the intention that the potential environmental and social impacts be contained or consolidated to a smaller area of the larger study area. CSP 1 is proposed to be on one such segment, The proposed CSP 1 project is located south east of the first proposed CSP Project, known as the SolarReserve Kotulo Tsatsi Concentrated Solar Plant, for which an Environmental Authorisation was granted in September 2015.

The development site which showed a low impact to the environment was considered within the more detailed EIA Phase which was further informed by way of the specialist field investigations. For the CSP 1 project, based on the land capability of the greater farm portion an area of approximately 1586ha in extent was identified for specialist assessment, which allowed for the identification of specific environmental sensitive areas/receptors to be avoided and/or mitigated by the ~1 000ha project development footprint. Therefore, the approach adopted during site selection allowed for the avoidance of site sensitivities (following the mitigation hierarchy) by the ~1000ha project development footprint.

Assessment Area:
The potential impact and appropriate siting of the infrastructure within the larger site and infrastructure proposed to be constructed outside of the site boundaries has been informed by several field verified EIA phase specialist studies as listed in Table 5.2 of this report. Where relevant, EIA phase specialist studies have been undertaken to assess impacts specifically relating to the development of the proposed CSP 1 project. All infrastructure relating to CSP 1 was assessed within the relevant specialist studies, including:

» The proposed CSP project site (within a 1586 ha assessment area located within the broader study area)
» The power line corridor (within a 1 km corridor)
» The water pipeline servitude (to be aligned within existing road reserves and for which two alignments were considered)

9.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices E - O provide a detailed assessment of the environmental impacts on the social and biophysical environment that may result from the proposed CSP 1 project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the CSP 1 Project Site and associated infrastructure. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA and presents an informed opinion of the environmental impacts associated with the Proposed Project.

Local site-specific impacts as a result of physical disturbance/modification to the site (up to 1 000 hectares) with the establishment of the CSP Project that may occur during the construction phase is indicated below.

9.1.1 Impacts on ecology

The proposed project site is comprised predominantly of the mixed shrubland vegetation association ascribed to have a low ecological sensitivity. Localised areas of sensitivity were identified and are associated with valley bottom habitat and ephemeral drainage lines. A biodiversity offset has been proposed to accommodate for the cumulative ecological impacts on broad scale ecological processes (refer to Appendix F). The proposed development on the site will create a highly localised reduction of indigenous shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. .

At the request of the DEA (Item xvii of the Acceptance of Scoping Letter attached in Appendix B), the scope of the ecological specialist study was expanded to include the Ecological Support Area (ESA) identified during the EIA to occur as a faunal migration corridor to the south-west of the CSP 1 Project Site (as discussed in Section 6.7 of this report). The Northern Cape conservation authorities were approached to assist in the drafting of the ecological study terms of reference (refer to minutes in Appendix D7). The sensitive vegetation associations considered to play a role in the movement of small animal species occurring within the migration corridor area have been flagged as no-go areas and are avoided by the location of the CSP 1 project The confirmed/observed faunal migration corridor is situated to the west and well outside of the project footprint and is aligned primarily with drainage lines depicted as no-go features. This corridor supersedes that which is denoted as an Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan however to accommodate cumulative loss a proposal for a biodiversity offset has been prepared (Appendix F)

9.1.2 Impacts on regionally significant ecological focus areas

The project development footprint does not fall within any "protected areas" or Critical Biodiversity Areas (CBAs). However, the existence of an Ecological Support Area (ESA), which was identified in the Namakwa Bioregional Plan as a faunal corridor across the larger study area, was interrogated and further defined as part of the EIA. The observed position of the ESA was mapped as part of the ecological study. The Project development site does not contain the vegetation associations characteristic of the faunal corridor and accordingly is not ascribed as participating in the functionality of the faunal corridor. Through the current siting of the planned facility and by excluding sensitive vegetation and habitats from the development, the overall impact significant has been significantly reduced to acceptable levels and faunal migration routes maintained. Residual impacts to be managed through a biodiversity offset.
An opinion on whether or not the CSP1 development warrants a biodiversity offset has been provided by an independent ecologist (refer to Appendix F), and the opinion states that the assessed ecological impacts are considered acceptable loss for a single project. However, as cumulative impacts are a concern in the area as the development of several solar plants in close proximity to one another would result in large tracts of transformed land which would potentially disrupt landscape connectivity in the area, a biodiversity offset proposal has been prepared (refer to Appendix F). The biodiversity offset is justified firstly on account of an area of sensitive wash and valley bottom habitat within CSP 1, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development; and secondly on the total footprint of the development (~1000ha) and the potential cumulative impact on broad-scale ecological processes (i.e. that more than one facility could be developed)..
The biodiversity offset implementation plan provides a summary of the legislative background for such an activity and provides guidelines and recommendations as to how

this might occur and identifies actions that should occur in order to drive this process forward so that the Applicant can meet their commitments in this regard. The biodiversity offset implementation plan will be submitted to the DENC (and DEA) for their consideration and input.

9.1.3 Impacts on avifauna

The avifaunal monitoring programme that included a wet season survey as well as a dry season survey, which is considered relevant for the Northern Cape (refer to Appendix H) recorded a low species richness of sixty four avifaunal species recorded within the broader study area, five of which are threatened (red listed species) and forty of which are endemic. Species identified to be of most concern due to their interactions with the broader areas are the large nomadic Ludwig's Bustard *Neotis ludwigii* and Kori Bustard *Ardeotis kori*, the Martial Eagle *Polemaetus bellicosus* the Sclaters Lark (*Spizocorys sclateri*) and Lanner Falcons *Falco biarmicu*. The impact on avifauna during the construction phase is considered to be low as no protected bird nests were identified on the site for development, or will be directly impacted. Impacts on avifauna during the operation of the facility, includes the effect of solar flux near to the tower and collision with power lines (for collision prone species such as bustards). CSP 1 is situated outside of the recommended 3km buffer zone around a noted martial eagle roost located on the Aries – Helios 400kV power line, with the power tower being situated approximately 4.5km away from the martial eagle nest. The potential for martial eagle interaction with the proposed tower facility during operations remains due to the territorial range of this species. It is therefore uncertain as to how this species and any other species will interact with the facility and systems to assist in the detection, monitoring and deterrence of bird movement within the CSP 1 site may be required to be implemented during operations should monitoring efforts determine the risk to be too high in order to minimise the potential for impact to an acceptable level.

9.1.4 Impacts on soil and agricultural resources

The Project Site is currently used for grazing purposes (sheep farming) and is situated on soils with very low agricultural potential largely restricted by the arid climate conditions and shallow soils. Loss of agricultural land due to development of the project has been assessed to be of low significance due to these conditions whereby severe limitations to sustainable farming practices are presented.

9.1.5 Surface and groundwater resources

The watershed in the project area is poorly defined due to the flat terrain and poorly organised river system. A non-perennial drainage line originates outside of the western boundary of CSP 1 and therefore direct impacts on surface water resources identified on the Project Site can be avoided. Impacts on surface water yields due to clearance of vegetation is considered to be of **low** significance (provided that vegetation clearance is minimised).

Groundwater resources in the study area were investigated from a water supply (quantity), quality and sensitivity perspective. From a land development perspective, impacts on the groundwater level as a result of reduced recharge from denuded surfaces are considered to be low. From a supply perspective, based on the evaluation of selected existing boreholes near to the Project Site, sustainable groundwater yields for operational purposes are not anticipated, however should be sufficient for construction phase purposes. Should the pumping of groundwater be undertaken at boreholes, the potential impacts are considered to be of **moderate** significance.

9.1.6 Visual impacts

Given the scale of the proposed facility, both in terms of footprint and height, along with the open nature of the landscape, there is little opportunity for screening of the CSP 1 project. In terms of visual impacts, the following is relevant:

» The CSP Project has a high visual impact due to the height (up to 250m) of the central receiver tower and the extent of the heliostats. Sensitive visual receptors include residents of homesteads and farmsteads (including Gannakom on the site as well as the abandoned Valsvlei) and secondary roads (Soafskolk Road and the R27). Potential visual impacts would be of **moderate** significance due to the very low occurrence of receptors within the near vicinity and the region.
» Potential visual impacts for associated infrastructure include the connecting power lines, which are rated as low significance before mitigation, due to the potential for alignment with the existing power line.

9.1.7 Noise impacts

Noise impacts are anticipated during construction phase as well as the operation phase due to the running of the turbine and cooling fans. Noise impacts have been demonstrated to be of **low** significance, to none at all due to the absence of sensitive noise receptors in and around the study area.

9.1.8 Heritage and palaeontological impacts

The impacts to heritage resources by the proposed development are not considered to be highly significant and the impact on archaeological sites is acceptable if the recommendations made by the Heritage Specialist are adhered to. Subject to approval from SAHRA, HCAC is of the opinion that from an archaeological point of view there is no reason why the development should not proceed if the recommendations are implemented.

9.1.9 Socio-Economic impacts

The area under investigation is sparsely populated. There are some vulnerable communities in the project area that may be affected by the proposed CSP and power line development. Construction phases are traditionally associated with social impacts. Many of the social impacts are unavoidable and will take place; therefore the management of social impacts are more important. Negative and positive social impacts have been identified. The assessment of the key issues indicated that there are no negative impacts that can be classified as fatal flaws. Positive impacts can be enhanced by implementing appropriate enhancement measures and through careful planning. Based on the social impact assessment, the following general conclusions and findings can be made:

» The potential negative social impacts associated with the construction phase are typical of construction related projects and not just focussed on the construction of CSP Central Receiver Tower plant (these relate to influx of non-local workforce and jobseekers, intrusion and disturbance impacts (noise and dust, wear and tear on roads) and safety and security risks) and could be reduced with the implementation of the mitigation measures proposed. Although this will impact the local farming community, the impacts can be mitigated.
» The development will introduce a significant number of employment opportunities during the construction phase (temporary employment) and a limited number of permanent employment opportunities during operation phase.
» Capacity building and skills training among employees are critical and would be highly beneficial to those involved, especially if they receive portable skills to enable them to also find work elsewhere and in other sectors.
» The proposed project could assist the local economy in creating entrepreneurial growth and opportunities, especially if local business is involved in the provision of general material, goods and services during the construction and operational phases.
» The proposed development also represents an investment in infrastructure for the generation of clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.
» The largest negative social impacts associated with the proposed development will result in change in land use and an influx of people into the local area.
» When considering the proposed CSP 1, it is also important to consider the cumulative social impacts that may arise with other proposed Solar Energy facilities in the area.

The following recommendations are made on the basis of the Social Impact Assessment and a thorough review of the concerns and suggestions raised by stakeholders and interested and affected parties during the stakeholder engagement process. The proposed mitigation measures should be implemented to limit the negative impacts and enhance the positive impacts. Based on the social assessment, the following recommendations are made:

» The appointment of a community liaison officer to assist with the management of social impacts and to deal with community issues, if feasible.
» In terms of employment related impacts, it is important to consider that job opportunities for the unskilled and semi-skilled in the study area could create competition among the local unemployed. Introducing an outside workforce will therefore most likely worsen local endeavours to obtain jobs and provoke discontent as well as put pressure on the local services available. It is imperative that local labour be sourced, wherever possible, to ensure that benefits accrue to the local communities. Efforts should be made to involve local businesses during the construction activities where possible. Local procurement of labour and services/products would greatly benefit the community during the construction and operational phases of the project.
» Local procurement of services and equipment where possible in order to enhance the multiplier effect. This aspect would serve to mitigate other subsequent negative impacts such as those associated with the inflow of outsiders to the area, the increased pressure on the infrastructure and services in the area, as well as the safety and security concerns.
» Involve the community in the process as far as possible (encourage co-operative decision making and partnerships with local entrepreneurs).
» Employ mitigation measures to minimise the dust and noise pollution and damage to existing roads.
» Safety and security risks should be taken into account during the planning/construction phase of the proposed project. Access control, security and management should be implemented to limit the risk of crime increasing in the area.

9.1.10 Conclusion

No environmental fatal flaws were identified with the establishment of the proposed CSP 1 Project. However a number of mitigation measures to be implemented have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Programme (EMPr) included within Appendix S.

From the conclusions of the detailed EIA studies undertaken, sensitive areas within the development footprint area were identified and flagged for consideration in the preparation of the facility layout. An environmental sensitivity map is provided in Figure 9.1 and discussed further in Section 9.4.

9.2. Assessment of Potential Cumulative Impacts

The assessment of cumulative impacts considered cumulative impacts potentially occurring due to the cumulative effects of the project added to all other renewable energy facilities proposed to be constructed or being constructed within the region, as well as those potentially occurring due to the cumulative effects of the project added to the other proposed CSP facilities within the study area.

Cumulative impacts for the project added to other potential CSP Tower facilities are summarised in the table below:

Cumulative Impact	Description of impact
Bioregional plans and ecological systems	Based on a refinement of this corridor in the context of the site through specialist ecological evaluation, the siting of the three CSP sites has been planned as to avoid the most sensitive ecological areas within the area and thereby present as little a barrier as possible to the migration corridor. However possible further expansions of solar developments on the selected and adjacent properties may severely impede animal migration routes. Provided that measures to maintain the migration corridor are put in place, the potential cumulative impacts are considered to be acceptable.
Edge effects	The CSP tower facilities have been sited within study area for the reduction of edge effects. Similarly the proposed power lines are situated within a common corridor adjacent to an existing power line with only short power lines required in order to enter the corridor. The cumulative impacts related to edge effects are considered to be low.
Avifauna	Cumulative avifaunal impacts are reduced by the low number of avifaunal species observed to occur in the broader study area. However, potential impacts to avifauna are anticipated primarily during the operational phase of the projects and include the effects of solar flux in the vicinity of the CSP central receiver and collisions with power lines. The potential cumulative impacts is increased should artificial water sources such as evaporation ponds be introduced, attracting avifauna, thereby bringing them nearer to the central receiver.
Surface and Groundwater Resources	Based on the overall low hydrological sensitivity direct impacts on drainage lines are considered to be of low significance for multiple projects. It is expected that smaller fluvial systems will be affected within the CSP Project Sites, but development should be possible without significantly affecting the Grootvloerpan catchment.
Soil and Agricultural Capability	The cumulative agricultural impacts are considered to be of low significance due to the overall low sustainable agricultural yield of the farm due to unaccommodating soil and climatic conditions.
Heritage and Palaeontology	The cumulative heritage and palaeontological impacts are considered to be of low significance as infrastructure can be moved to accommodate more sensitive heritage sites identified.
Visual	The existence of three towers will have a cumulative visual impact on the area.

	The cumulative visual impacts are considered to be of moderate significance due to the low number of sensitive visual receptors occurring in the region.
Social	Although it is considered unlikely that all three CSP tower projects will be constructed simultaneously, the construction of all three projects simultaneously could potentially lead to an exacerbation or compounding of potential negative social impacts identified due to the intensity of such impacts, including: » Degradation of access roads » Traffic congestion » Nuisance impact on adjacent landowners » Impact on farming practices » Security issues It is anticipated that should all three CSP tower projects be constructed, that the construction periods will be phased in separate 2.5 year intervals (duration of construction). The abovementioned impacts could potentially occur, however the intensity of the impacts will be reduced. The sharing of facilities constructed with the first CSP tower project would likely occur with subsequent projects, including but not exclusive to the water reservoir, access road (Soafskolk Road), the man camp and evaporation ponds.

9.3 Comparison of Alternatives

The following alternatives were comparatively described and assessed where relevant in this report:

» Site alternatives - a broad 55 000ha study area was initially considered at the start of the EIA process Parts of the broader study area were discarded on the basis of potentially unacceptable environmental impacts, thereby leading to the selection of the current CSP 1 Project Site.
» Water supply alternatives being one or a combination of water supply from the Kai !Garib Municipality, groundwater abstraction on or near to the Project Site or abstraction from a point on the Gariep River. Overall municipal supply is considered to be the most sustainable and viable option. Raw water is proposed to be conveyed via pipeline from the Kenhardt Reservoir to the Project Site within existing road servitudes.

Grid integration options being the construction of the necessary substations, a loop in – loop out configuration to the existing Aries to Helios 400kV power line; or the construction of a new power line adjacent to the existing line to the Eskom Aries Substation within 50km from the site are not considered to be alternatives to each other as final grid connection requirements will be determined by Eskom. Either option has been considered to be environmentally suitable with the requirement that mitigation measures (bird diverters) are installed on the existing line or any future power lines to mitigate the high mortality rate of collision prone Bustards occurring within the area.

In terms of the specialist studies undertaken, the following conclusions were made regarding the preferred alternatives:

Aspect	**Site alternative**	**Water supply alternative**	**Cooling alternative**
Ecology	Observed faunal corridor situated in close proximity to original CSP 1 site. Alternative site identified and preferred.	Abstraction closer to site preferred to minimise ecological impacts of longer pipelines (mitigated if situated in road servitudes).	No preference in cooling technology
Avifauna	Original CSP 1 site situated in 3km buffer of Martial Eagle nest. Alternative site identified and preferred.	No preference in the routing of water supply infrastructure.	No preference in cooling technology.
Water resources	Proposed and preferred CSP site less sensitive in terms of proximity to surface water resources	Sustainable groundwater yield on site unlikely for operational phase. Conveyance from municipal source preferred to minimise impact on groundwater resources.	High preference for dry cooling due to lower water requirements.
Soils and agricultural potential	No preference	No preference in the routing of water supply infrastructure.	No preference in cooling technology.
Visual	No significant difference in overall visual impact. No preference.	No preference in the routing of water supply infrastructure.	Slight preference for dry cooling due to absence of cooling towers.
Noise	No preference	No preference	No noise sensitive developments nearby – no preference between cooling technologies.
Heritage & palaeontology	No preference	No preference	No preference
Social	No preference	Preferred	No preference

Other than the use of the wet cooling alternative, there are no impacts of unacceptably high significance associated with the alternatives assessed for the Project. In addition, there are slight differences between the impacts associated with each. All alternatives are considered to be environmentally acceptable for implementation at the proposed facility, apart from the use of wet cooling technology. Also, a considerable allocation of raw water from the municipality is potentially available for use in the plant. Realisation of municipal supply will ultimately reduce the impact of abstraction on groundwater reserves on the site or at a point on the Gariep River.

9.4 Environmental Sensitivity Mapping

The environmental sensitivities identified as occurring on the project development site and the project layout plan have been overlaid onto a composite environmental sensitivity map in Figure 9.1. The following is relevant in terms of the detail as provided on the map:

Infrastructure siting

» The project development footprint is located adjacent to an existing linear disturbance in the area, Soafskolk Farm road and within 3km of another linear disturbance - the Aries–Helios 400kV power line thereby making use of already disturbed areas rather than pristine sites which is found to be acceptable from an environmental perspective.
» The outer edge of the heliostat field is positioned outside the 3km avifauna buffer zone around the Marial Eagle nest. The power tower is situated approximately 4.5km from the martial eagle nest therefore the position of the heliostats and tower are found to be acceptable from an environmental perspective.
» The heliostat field infringes an area of sensitive wash and valley bottom habitat, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development. To offset the cumulative impact on broad scale ecological processes the ecological specialist recommends that a biodiversity offset be implemented as part of the authorisation conditions (Appendix F).
» The proposed grid connection is located adjacent to an existing linear disturbance in the area, Soafskolk Farm road and adjacent to another linear disturbance - the Aries–Helios 400kV power line. Therefore the location of the powerline is consolidated as much as possible with other linear infrastructure and makes use of already disturbed areas rather than pristine sites, which is found to be acceptable from an environmental perspective.
» An access road of ~1km in length branching off Soafskolk Road will be required to access the heliostat field after providing access to the administration block and project substation.
» The temporary laydown area (100ha), temporary assembly plant (100ha) and spoil area are situated north east of the heliostat field thereby located outside areas of environmental sensitivity which is found to be acceptable from an environmental perspective.
» The evaporation pond is required to be situated at the lowest point of the site in order to be gravity fed i.e. southern section of the site. The evaporation pond is situated well away (>100m) from any ephemeral drainage line, and in an area of low groundwater contamination risk. The location of the evaporation pond is

outside areas of environmental sensitivity which is found to be acceptable from an environmental perspective.

Environmental sensitivity

- The assessed ecological impacts are considered acceptable loss for a single project. However, as cumulative impacts are a concern in the area as the development of several solar plants in close proximity to one another would result in large tracts of transformed land which would potentially disrupt landscape connectivity in the area, a biodiversity offset proposal has been prepared (refer to Appendix F). The biodiversity offset is justified firstly on account of an area of sensitive wash and valley bottom habitat within CSP 1, with an extent of ~7.1% of the project development footprint, which would be lost or at least significantly impacted by the development; and secondly on the total footprint of the development (~1000ha) and the potential cumulative impact on broad-scale ecological processes (i.e. that more than one facility could be developed)..
- The confirmed/observed faunal migration corridor is situated to the west and well outside of the project footprint and is aligned primarily with drainage lines depicted as no-go features. This corridor supersedes that which is denoted as an Ecological Support Area (ESA) delineated in terms of the Namakwa Bioregional Plan however to accommodate cumulative loss a proposal for a biodiversity offset has been prepared (Appendix F).
- The recommended 3km avifauna buffer zone around the martial eagle nest identified at the top of a power line tower structure has been mapped. This buffer zone does not overlap with the project development area and the martial eagle nest is situated approximately 4.5km from the power block (tower). Typically birds are at greater risk of succumbing to the effects of solar flux (singed feathers) within 100m from the tower. The evaporation pond (which could potentially be viewed by birds as an artificial waterbody thereby attracting them in the vicinity of power lines and the central receiver) has been sited appropriately in accordance with specialist recommendations to mitigate the potential for placing birds at risk from collision with power lines and at risk from the effects of solar flux in proximity to the central receiver.
- No heritage find spots are located within the CSP 1 development footprint. Two find spots within the power line corridor and two other find spots within the R27 water pipeline alignment option will not be directly affected by the facility layout.
- No noise sensitive developments are mapped within 3km of the project site.

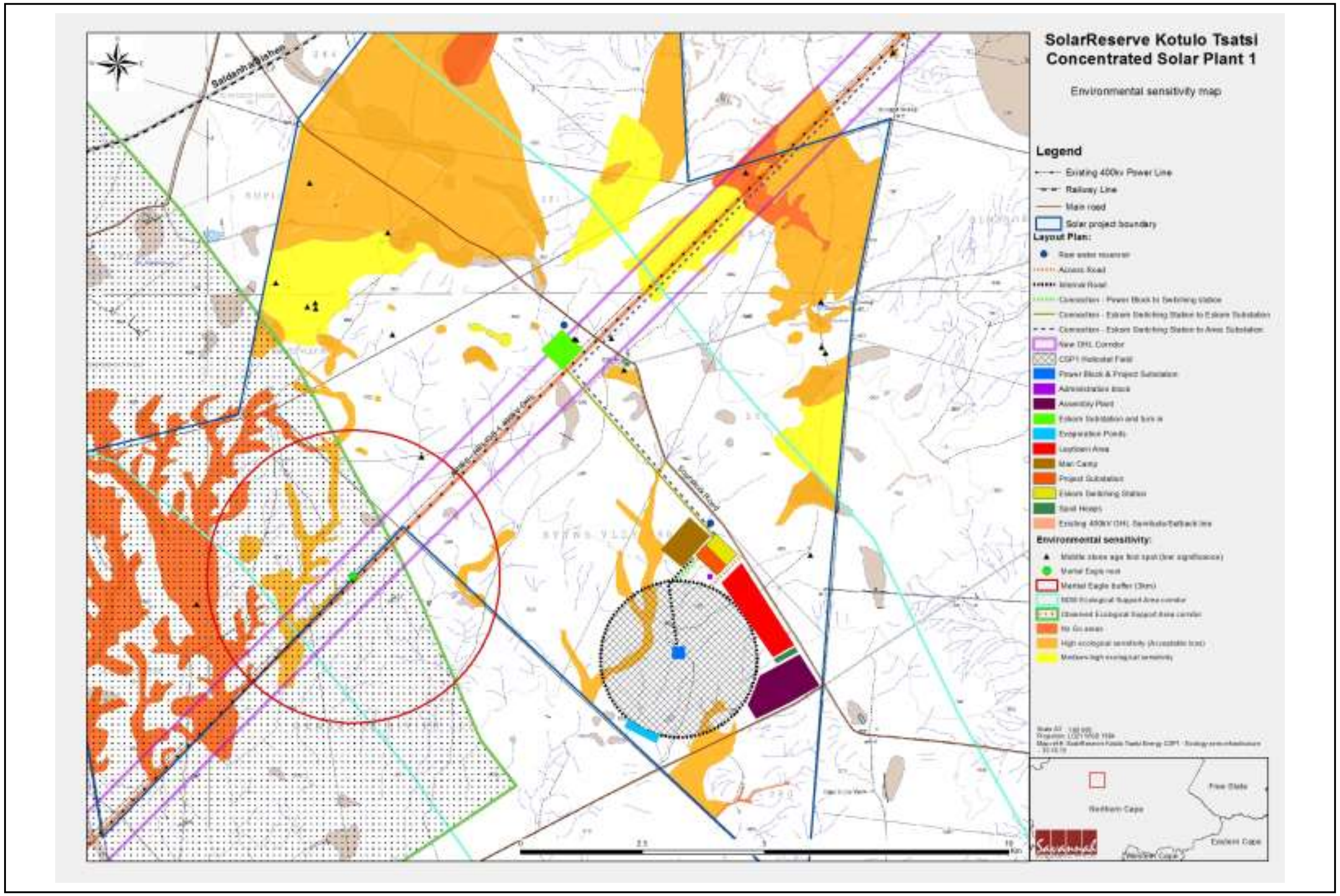

Figure 9.1: Combined Layout and Composite Environmental Sensitivity Map for CSP 1

9.5 Environmental Costs of the Project versus Benefits of the Project

Environmental (natural environment, economic and social) costs can be expected to arise from the project proceeding. This could include:

» Direct loss of biodiversity, flora, fauna and soils due to the clearing of land for the construction and utilisation of land for the CSP Project (which is limited to the development footprint of up to ~1000 ha and only to be undertaken if necessary). The cost of loss of biodiversity has been minimised on the broader site through the careful location of the development to avoid key areas supporting biodiversity of particularly high conservation importance.
» Visual impacts associated with the facility and power line. The cost of loss of visual quality to the area is reduced due to the very low number of visual receptors in the area.

These costs are expected to occur at a local and site level and are considered acceptable with the implementation of the mitigation measures as outlined in the EMPr.

Benefits of the project include the following:

» The Project is poised to bring about important economic benefit at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will transpire during the preconstruction/ construction and operational phases and multiplied significantly should other CSP Projects be constructed within the study area.
» There is also a critical deficiency in energy to supply South Africa's baseload power needs, which can be addressed through CSP development due to energy storage.
» The project serves to diversify the economy and electricity generation mix of South Africa by addition of solar energy to the mix.
» South Africa's per capita greenhouse gas emissions being amongst the highest in the world due to reliance on fossil fuels, the Proposed Project will contribute to South Africa achieving goals for implementation of non-renewable energy and 'green' energy. Greenhouse gas emission load is estimated to reduce by 0.86% for a 500MW coal-fired power station compared to a similar MW solar project, on a like for like basis.

The benefits of the project are expected to occur at a national, regional and local level. These benefits partially offset the localised environmental costs of the project.

9.4. Overall Conclusion (Impact Statement)

The viability of establishing the CSP 1 project with a maximum generating capacity of up to 200MW on a site between Kenhardt and Brandvlei has been established by Kotulo Tsatsi Energy and SolarReserve.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated from the Project conclude that:

» There are no environmental fatal flaws that should prevent the proposed CSP 1 project and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation and management measures are implemented, and given due consideration during the process of finalising the facility layout. The **ecological impacts** of the Project will be of a medium acceptable significance The proposed project site is comprised predominantly of the mixed shrubland vegetation association ascribed to have a low ecological sensitivity. Localised areas of sensitivity were identified and are associated with valley bottom habitat and ephemeral drainage lines. A biodiversity offset has been proposed to accommodate for the cumulative ecological impacts on broad scale ecological processes (refer to Appendix F). The proposed development on the site will create a highly localised reduction of indigenous shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected.
» The threat to **fauna** communities would be from the loss of habitat, disturbance, and/or any interaction of fauna with the facility, and is not anticipated to have a significant negative impact on fauna in the area. The Project Site is situated well outside of the observed Ecological Support Area defined as a terrestrial fauna migration corridor traversing a section of the larger Solar Park concept study area and was moved out from this area during site selection.
» The threat to **avifauna** would arise primarily from disturbance during construction and potential interaction of avifauna with the project facility during operations, the latter impact being mitigated to a large extent by siting of the CSP 1 Project Site outside of the 3km buffer of the Martial Eagle nest. The construction of a new power line or loop in – loop out of the existing power line is not anticipated to increase the risk of bird mortalities due to alignment / tie into the existing line and the inclusion of bird diverters as a mitigation measure.
» The impacts to **heritage resources** by the proposed CSP 1 facility, water pipeline routes and powerline are not considered to be highly significant and the impact on archaeological sites is acceptable. Construction phase activities relating to the disturbance, alteration, removal or destruction of heritage sites are anticipated to be of **low** significance for both CSP 1 and the proposed linear components with mitigation. Similarly, the fossil record from the geological deposits is very poor with

respect to finds of fossiliferous material and the Project Site and linear component is considered to be of **low** palaeontological sensitivity and significance.

» The cumulative significance of all the potential impacts on the **agricultural potential** is low due to the limited agricultural potential of the Project Site.
» The anticipated **visual** impact is not considered to be a fatal flaw from a visual perspective, considering the low incidence of visual receptors in the region. The absence of visual sensitive receptors in the study area means that three CSP towers will not significantly add to the cumulative impact.
» The proposed project and associated infrastructure is unlikely to result in permanent damaging **social** impacts. From a social perspective it is concluded that the project could be developed subject to the implementation of the recommended mitigation measures and management actions contained in the report.
» The development will only yield significant positive **economic** impacts. These impacts are significantly multiplied should the development of multiple CSP Projects be realised.

9.5. Overall Recommendation

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated from the proposed project conclude that the significance levels of the majority of identified negative impacts can be reduced by implementing the recommended mitigation measures. The confidence in the environmental assessment undertaken is acceptable. Taking into consideration the above and based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated infrastructure, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the impacts associated with the development of the proposed SolarReserve Kotulo Tsatsi Concentrated Solar Plant 1 can be managed and mitigated to an acceptable level. The information provided as part of the EIA process, and specifically within this EIA report, is sufficient to enable the DEA to make an informed and defendable decision. The layout plan as presented in this report has been informed by the findings of the specialist studies. The facility in its current position results is considered acceptable loss for a single project and is considered to be the preferred layout and environmentally acceptable. However, as cumulative ecological impacts are a concern in the area as the development of several solar plants in close proximity to one another would result in large tracts of transformed land which would potentially disrupt landscape connectivity in the area, a biodiversity offset proposal has been prepared.

The following conditions would be required to be included within an authorisation issued for the project:

Facility layout and design

- » Any component of the facility which could potentially affect areas to be of no-go environmental sensitivity should be avoided in the design and layout of the CSP Project.
- » The observed Ecological Support Area (terrestrial fauna migration corridor) defined in terms of the ecological specialist study traversing a section of the larger study area in the ecological study, should be kept free of development. It is recommended that faunal monitoring be undertaken should multiple projects within the larger study area be approved.

A biodiversity offset is recommended for CSP1 and should be stipulated as a condition of the Authorisation, should it be granted. A draft biodiversity offset management plan to be developed, in consultation with the Provincial Conservation Authority (DENC).

Pre-construction

- » A Search-and Rescue program will be required to be implemented to relocate protected species found on the Project Site. Permits are to be obtained for removal of protected trees and provincially protected flora that are affected by development.
- » An ecological walk through survey for the CSP Project and associated infrastructure must be undertaken prior to construction.
- » A stormwater management plan should be compiled for the developmental footprint prior to construction.
- » An avifaunal monitoring programme is required to be developed stipulating monitoring protocols and allowing for quantification of species mortality. Mitigating measures should be developed based on the programme.
- » A walk-through survey should be undertaken by an avifauna specialist for the route of the power line (for loop in – loop out scenario and new power line scenario) to identify sections of line (existing or new) requiring collision mitigation.
- » A Water Use Licenses for identified water uses (storage, abstraction and impacting of water courses) is required to be obtained from DWS.
- » A heritage walkthrough of the final layout of the CSP 1 facility is conducted prior to construction. Although the water pipeline and powerline corridor options are acceptable from a heritage point of view it is clear that Stone Age manifestations, graves and possibly engravings can be expected in the proposed corridors and it is therefore recommended that when the final option is determined that the alignment and pylon positions are subjected to a heritage walk through
- » Approved biodiversity offset management plan to be implemented, in consultation with the Provincial Conservation Authority (DENC).

Construction

- » During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.

» Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
» All mitigation measures detailed within this report and the specialist reports are to be implemented.
» The draft Environmental Management Programme (EMPr) as contained within Appendix S of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed solar energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the Proposed Project is considered key in achieving the appropriate environmental management standards as detailed for this project.
» If during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find
» Approved biodiversity offset management plan to be implemented, in consultation with the Provincial Conservation Authority (DENC).

Operations

» Avifaunal deterrence measures should be implemented at the CSP Project. An avifaunal monitoring programme for operations should be developed to establish the efficacy of deterrence measures and whether any further mitigation measures are required.
» Biodiversity offset management plan to be implemented, in consultation with the Provincial Conservation Authority (DENC).
» Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species for the operation phase.
» The operational phase EMPr must be implemented and used to ensure compliance with environmental specifications and management measures.

REFERENCES CHAPTER 10

Ecology:

Apps, P. (ed). 2000. Smither's Mammals of Southern Africa. A field guide. Random House Struik, Cape Town, RSA

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications, Pretoria, RSA.

Namakwa Bioregional Plan. 2008. Department of Environment and Nature Conservation, Northern Cape.

Germishuizen, G. and Meyer, N.L. (eds). 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14. South African National Biodiversity Institute, Pretoria.

Henderson, L. 2001. Alien weeds and invasive plants: A complete guide to declared weeds and invaders in South Africa. Agricultural Research Council, Paarl Printer, Cape Town.

Hill, D. and R. Arnold. 2012. Building the evidence base for ecological impact assessment and mitigation. Journal of Applied Ecology 49(1): 6-9.

Hoffman, T. & Ashwell, A. 2001. Nature divided: Land degradation in South Africa. University of Cape Town Press, Cape Town.

Kremen, C. 2005. Managing ecosystem services: what do we need to know about their ecology? Ecology Letters 8: 468-479.

Mucina, L, & Rutherford, M.C. (Eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. Red list of South African plants 2009. Strelitzia 25:1-668.

UNCCD: United Nations Convention to Combat Desertification, 1995.

Wynberg, R. 2002. A decade of biodiversity conservation and use in South Africa: tracking progress from the Rio Earth Summit to the Johannesburg World Summit on Sustainable Development. South African Journal of Science 98: 233 – 243.

Avifauna:

Allan DG 2005. Ludwig's Bustard Neotis ludwigi. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp 293-294. John Voelcker Bird book Fund, Cape Town.

Allan DG, Osborne TO. 2005. Kori Bustard Ardeotis kori. In: Roberts' birds of southern Africa. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp 295-296. John Voelcker Bird book Fund, Cape Town.

Dean WRJ, Payne RB. 2005. Village Indigobird Vidua chalybeata. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp 1076-1077. John Voelcker Bird book Fund, Cape Town.

Dean WRJ, Ryan PG. 2005. Red Lark Calendulauda burra. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp 871-872. John Voelcker Bird book Fund, Cape Town.

Dean W.R.J. 2004. Nomadic Desert Birds. Adaptations of Desert Organisms series. Springer Verlag, Berlin, Heidelberg, New York

Harvey HT and Associates 2015. Ivanpah solar electric generating system. Avian & bat monitoring plan, 2013-2014 annual report (revised)(29 october 2013 – 20 october 2014). Unpublished report to California Energy Commission.

Jenkins AR. 2005. Lesser Kestrel Falco naumanni. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp. John Voelcker Bird book Fund, Cape Town.

Lloyd P. 2005. Sclater's Lark Spizocorys sclateri. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp 894-895. John Voelcker Bird book Fund, Cape Town.

Lloyd P. 1999. Rainfall as a breeding stimulus and clutch size determinant in South African arid-zone birds. Ibis 141, 637–643.

Mucina L and Rutherford MC. (eds) 2006. The vegetation zones of South Africa, Lesotho and Swazialnd. Strelitzia 19, South African National Biodiversity Programme, Pretoria.

Shaw J. 2013. Power line collisions in the Karoo: conserving the Ludwig's Bustard. PhD thesis University of Cape Town.

Simmons RE. 2005. Martial Eagle Polemaetus bellicosus. In: Roberts' birds of southern Africa. VII. Hockey PAR, Dean WRJ, Ryan PG (eds). Pp. John Voelcker Bird book Fund, Cape Town.

Simmons R.E., Barnard P. and Jamieson I.G. 1999. What precipitates influxes of wetland birds to ephemeral pans in arid landscapes? Observations from Namibia. Ostrich 70, 145–148.

Smallie J, Shaw J. 2013. Aries-Helios 765 kV overhead power line: avifaunal impact assessment. Unpubl report to Mokgope Consulting.

Soil:

JENNY, H. (1941). Factors of Soil Formation: A System of Quantitative Pedology. McGraw-Hill, New York, N.Y.

LAND TYPE SURVEY STAFF (1972-2002). 1:250 000 scale Land Type Survey of South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

MUCINA, L. & RUTHERFORD, M. C. (eds), 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia, 19. South African Biodiversity Institute, Pretoria.

SCHULZE, R.E. (2007). South African Atlas of Climatology and Agrohydrology. Water Research Commission, Pretoria. WRC Report 1489/1/06.

SOIL CLASSIFICATION WORKING GROUP (1991). Soil classification: a taxonomic system for South Africa. Memoirs on the Agricultural Natural Resources of South Africa No. 15. SIRI, D.A.T.S., Pretoria.

Visual:

Chief Directorate National Geo-Spatial Information, varying dates. 1:50 000 Topo-cadastral Maps and Data.

CSIR/ARC, 2000. National Land-cover Database 2000 (NLC 2000)

Department of Environmental Affairs and Tourism (DEAT), 2001. Environmental Potential Atlas (ENPAT) for the Northern Cape Province

National Botanical Institute (NBI), 2004. Vegetation Map of South Africa, Lesotho and Swaziland (Unpublished Beta Version 3.0)

Noise:

Autumn, Lyn Radle, 2007: The effect of noise on Wildlife: A literature review

Bhattachan, A., D'Odorico, P., Dintwe, K., Okin, G. and Collins, S. (2014). "Resilience and recovery potential of duneland vegetation in the southern Kalahari". Ecosphere, 5(1), p.2.

Committee of Transport Officials. "TRH 26, South African Road Classification and Access Management Manual". Version 1.0.2012

Darwish, M., Hassan, A. and Mohtar, R. (2013). "Toward Implementing HH the Amir Declaration of 2\% Electricity Generation by Solar Energy in 2020". Scientific Research Publishing.

Enviro-Acoustic Research, (2013). Environmental Noise Impact Assessment Establishment of the Khi Concentrated Solar Plant on farm McTaggarts Camp 453 near the town of Upington, Northern Cape. Pretoria: Enviro-Acoustic Research.

ISO 9613-2: 1996. 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'

Milieu, 2010: 'Inventory of Potential Measures for a Better Control of Environmental Noise', DG Environment of the European Commission

Musina L. & Rutherford."The vegetation of South Africa, Lesotho and Swaziland". Strelitzia 19, South African National Biodiversity Institute, Pretoria. 2006.

Noise quest, Aviation Noise Information & Resources, 2010: http://www.noisequest.psu.edu/pmwiki.php?n=Main.HomePage

Norton, M.P. and Karczub, D.G.: "Fundamentals of Noise and Vibration Analysis for Engineers", Second Edition, 2003

Rutherford, M., Mucina, L. and Powrie, L. (2003). "Nama-karoo veld types revisited: a numerical analysis of original Acocks' field data". South African journal of botany, 69(1), pp.52-61.

SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.

SANS 10210:2004. 'Calculating and predicting road traffic noise'.

SANS 10328:2008. 'Methods for environmental noise impact assessments'.

SANS 10357:2004 The calculation of sound propagation by the Concawe method'.

Savannah Environmental (2014) Final Scoping Report: Kotulo Tsatsi Energy 1000MW Concentrated Solar Power Facility, Northern Cape Province.

USEPA, 1971: Effects of Noise on Wildlife and other animals

Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "Environmental Potential Atlas for South Africa", Pretoria, 1998.

World Health Organization, 2009: Night Noise Guidelines for Europe

World Health Organization, 1999: Protection of the Human Environment; Guidelines for Community Noise

SKA risk assessment:

ISKAF2010 Square Kilometre Array: a concept design for Phase 1 (Proceedings of Science June 10–14 2010)

ITU-R P.525 Calculation of free-space attenuation

EN 55022 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.

Social:

Census 2011. Community Profiles Database. Statistics South Africa.

CSIE, DME and Eskom. 2001. South African Renewable Energy Resource Database. Available from: www.csir.co.za/environmentek/sarerd/contact.html

Hantam Local Municipality Integrated Development Plan (IDP) (2013-2014)

Interorganizational Committee on Principles and Guidelines for Social Impact Assessment. US Principles and Guidelines – Principals and guidelines for social impact assessment in the USA. Impact Assessment and Project Appraisal, 21(3): 231-250.

Kai !Garib Local Municipality Integrated Development Plan (IDP) (2013-2014)

Namakwa District Municipality Integrated Development Plan (2013-2014/2012-2016)

Namakwa District Municipality Local Economic Development Strategy (LED) (2009)

National Climate Change Response Green Paper (DEA, 2010)

National Energy Act (2008)

National Environmental Management Act 107 of 1998 (NEMA)

National Development Plan (2030)

National Integrated Resource Plan South Africa (2010-2030)

Northern Cape Government. 2011. Northern Cape Provincial Growth and Development Strategy. Draft 4.

Northern Cape Provincial Development and Resource Management Plan / Provincial Spatial Development Framework (PSDF) (2012)

Northern Cape Provincial Growth and Development Strategy (NCPGDS) (2011)

Northern Cape Provincial Local Economic Development Strategy (LED) (2009)
Namakwa District Municipality Environmental Management Framework (EMF) and Strategic Environmental Management Plan (SEMP) (2011)
Siyanda (ZF Mgcawu) District Municipality Integrated Development plan (IDP) (2013-2014)
State of the Environment Report (SOER). 2005. Northern Cape Province. Department of Tourism, Environment and Conservation. CSIR Environmentek.
Siyanda (ZF Mgcawu) District Municipality Growth and Development Strategy (2007)
Strategic Infrastructure Projects (SIPs)
The Constitution Act 108 of 1996
Vanclay, F. 2003. Conceptual and methodological advances in Social Impact Assessment. In Vanclay, F. & Becker, H.A. 2003. The International Handbook for Social Impact Assessment. Cheltenham: Edward Elgar Publishing Limited.
White Paper on Energy Policy of the Republic of South Africa (1998)
White Paper on Renewable Energy of the Republic of South Africa (2003)

Economic:

CNdV Africa. (2012). Namakwa District Spatial Development Framework .
Dennis Moss Partnership. (2012). Northern Cape Provincial Spatial Development Framework: First Consultative Draft, March 2012.
Department of Economic Development. (2010). New Growth Path: Framework .
Namakwa DM. (2014). Integrated Development Plan 2013-2014.
National Planning Comission . (2011). National Development Plan: Vision for 2030.
Northern Cape Government . (2008). Provincial Growth and Development Strategy.
Quantec. (2014). Standardised Regional Database.
Stats SA. (2014). Census 2011.
Umsebe Development Planners. (2010). Hantam Rural Spatial Development Framework.

Heritage:

Archaeological Database Wits University 2009
Beaumont, P.B., Smith, A.B. & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In: Smith, A.B. (ed.) Einiqualand: studies of the Orange River frontier: 236-264. Cape Town: University of Cape Town Press.
De Jong, R & Associates. 2011. Heritage Impact Assessment Report: Proposed solar power station on the remainder of Portion 1 (known as Die Hoek) and a portion of Portion 2 of the farm Klein Zwart Bast 188, Kenhardt Registration Division, Siyanda District Municipality, Northern Cape Province. Unpublished report for eScience Associates (Pty) Ltd
Du Preez, S. J. 1977. Peace attempts during the Anglo Boer War until March 1901. Magister Artium thesis in History. Pretoria: University of Pretoria.

Halkett, D & Orton, J. 2011. Heritage Impact assessment proposed Olyven Kolk Solar Plant. Unpublished report.

Hocking, A. 1983. Kaias and cocopans: the story of mining in South Africa's Northern Cape. Johannesburg: Hollards Publishers.

Kaplan, J. 2011. Archaeological Impact Assessment The Proposed Solar Cape 100 Mw Photovoltaic Energy Generation Facility Near Kenhardt Northern Cape Province. Unpublished report.

Lombard, M. 2011. Background to the Stone Age of the Kakamas/Keimoes area for CRM purposes. Unpublished report.

Marais, J. J. 1977. De Aar, Stad in wording 1902-1977. De Aar: Feeskomitee.

Morris, D. 1988. Engraved in place and time: a review of variability in the rock art of the Northern Cape and Karoo. South African Archaeological Bulletin 43: 109-121.

Morris, D. 2006. Archaeological Specialist Input to the EIA Phase for the proposed Aries-Garona ESKOM Transmission Power Line, Northern Cape and Comment on the Garona Substation Extension. Unpublished Report September 2006 for Tswelopele Environmental.

Mucina, L. & Rutherford, M.C. 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute. Pretoria.

National Heritage Resources Act NHRA of 1999 (Act 25 of 1999)

Pelser, A.J. 2011. A Report on an Archaeological Impact Assessment (AIA) for the proposed Solar Energy Plant on Klein Zwart Bast 188, Kenhardt District, Northern Cape. Unpublished Report Archaetnos AE1104. January 2011. For Robert de Jong & Associates

Pelser, A. 2012. Final Report On The Archaeological Phase 2 Mitigation Of An Open-Air Stone Age Site To Be Impacted On By The Aries Solar Energy Plant On Portion 1 Of The Farm Klein Zwart Bast 188 Kenhardt District, Northern Cape

Ross, R. 2002. A concise history of South Africa. Cambridge: Cambridge University Press.

SAHRA Report Mapping Project Version 1.0, 2009

Van der Walt, J. 2012. Archaeological Impact Assessment Report Proposed reuse of abandoned hard rock quarry (road construction Borrow Pit) On the Farm Zonder Huis 249 portion 4 in the Kenhardt District 42km South of Kenhardt on the R27. Unpublished Report

Van Ryneveld, K. 2007. Phase 1 Archaeological Impact Assessment - Portion of the FarmBoksputs 118, Groblershoop District, Northern Cape, South Africa

Wagenaar, E. J. C. 1984. A Forgotten frontier zone: settlements and reactions in the Stormberg area between 1820-60. Pretoria: Government Printer, 1984.

Webley, L & Halkett, D. 2012. Heritage Impact Assessment: Proposed Kenhardt Photo-Voltaic Solar Power Plant On Remainder Of The Farm Klein Zwart Bast 188, Northern Cape Province. Unpublished report.

ARCHIVAL SOURCES (National Archive, Pretoria)

National Archives of South Africa. 1901. SAB, Maps: 3/1044. Map of the Cape Colony. Areas that were occupied during the Anglo-Boer War.

Paleontology:

Agenbacht, A.L.D. 2007. The geology of the Pofadder area. Explanation of 1: 250 000 geology sheet 2918. 89 pp. Council for Geoscience, Pretoria.

Almond, J.E. 2008a. Fossil record of the Loeriesfontein sheet area (1: 250 000 geological sheet 3018). Unpublished report for the Council for Geoscience, Pretoria, 32 pp.

Almond, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area (1: 250 000 geological sheet 3218). Unpublished report for the Council for Geoscience, Pretoria, 49 pp. (To be published by the Council in 2009).

Almond, J.E. 2009. Contributions to the palaeontology and stratigraphy of the Alexander Bay sheet area (1: 250 000 geological sheet 2816), 117 pp. Unpublished technical report prepared for the Council for Geoscience by Natura Viva cc, Cape Town.

Almond, J.E. 2011. Proposed Solar Cape Photovoltaic Electricity Generation Facility near Kenhardt, Northern Cape Province. Palaeontological impact assessment: desktop study, 18 pp. Natura Viva cc, Cape Town.

Almond, J.E. & Pether, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

Anderson, A.M. 1974. Arthropod trackways and other trace fossils from the Early Permian lower Karoo Beds of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg, 172 pp.

Anderson, A.M. 1975. Turbidites and arthropod trackways in the Dwyka glacial deposits (Early Permian) of southern Africa. Transactions of the Geological Society of South Africa 78: 265-273.

Anderson, A.M. 1976. Fish trails from the Early Permian of South Africa. Palaeontology 19: 397-409, pl. 54.

Anderson, A.M. 1981. The Umfolozia arthropod trackways in the Permian Dwyka and Ecca Groups of South Africa. Journal of Paleontology 55: 84-108, pls. 1-4.

Anderson, A.M. & Mclachlan, I.R. 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. Palaeontologia africana 19: 31-42.

Anderson, J.M. 1977. The biostratigraphy of the Permian and the Triassic. Part 3: A review of Gondwana Permian palynology with particular reference to the northern Karoo Basin, South Africa. Memoirs of the Botanical Survey of South Africa 45, 14-36.

Anderson, J.M. & Anderson, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp, 226 pls. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

Bamford, M.K. 2000. Fossil woods of Karoo age deposits in South Africa and Namibia as an aid to biostratigraphical correlation. Journal of African Earth Sciences 31, 119-132.

Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan South Africa. Gondwana Research 7, 153-164.

Bamford, M.K. & De Wit, M.C.J. 1993. Taxonomic description of fossil wood from Cainozoic Sak River terraces, near Brandvlei, Bushmanland, South Africa. Palaeontologia africana 30: 71-80.

Bangert, B., Stollhofen, H., Lorentz, V. & Armstrong, R. 1999. The geochronology and significance of ash-fall tuffs in the glacigenic Carboniferous – Permian Dwyka Group of Namibia and South Africa. Journal of African Earth Sciences 29: 33-49.

Bangert, B., Stolhofen, H., Geiger, M. & Lorenz, V. 2000. Fossil record and high resolution tephrostratigraphy of Carboniferous glaciomarine mudstones, Dwyka Group, southern Namibia. Communications of the Geological Survey of Namibia 12, 235-245.

Bangert, B. & Bamford, M. 2001. Carboniferous pycnoxylic woods from the Dwyka Group of southern Namibia. Palaeontologia africana 37, 13-23.

Bender, P.A. & Brink, J.S. 1992. A preliminary report on new large mammal fossil finds from the Cornelia-Uitzoek site. South African Journal of Science 88: 512-515.

Bousman, C.B. *et al*. 1988. Palaeoenvironmental implications of Late Pleistocene and Holocene valley fills in Blydefontein Basin, Noupoort, C.P., South Africa. Palaeoecology of Africa 19: 43-67.

Brink, J.S. 1987. The archaeozoology of Florisbad, Orange Free State. Memoirs van die Nasionale Museum 24, 151 pp.

Brink, J.S. *et al*. 1995. A new find of Megalotragus priscus (Alcephalini, Bovidae) from the Central Karoo, South Africa. Palaeontologia africana 32: 17-22.

Brink, J.S. & Rossouw, L. 2000. New trial excavations at the Cornelia-Uitzoek type locality. Navorsinge van die Nasionale Museum Bloemfontein 16, 141-156.

Buatois, L. & Mangano, M.G. 1995. The paleoenvironmental and paleoecological significance of the lacustrine Mermia ichnofacies: an archetypal subaqueous nonmarine trace fossil assemblage. Ichnos 4: 151-161.

Buatois, L. & Mangano, M.G. 2004. Animal-substrate interactions in freshwater environments: applications of ichnology in facies and sequence stratigraphic analysis of fluvio-lacustrine successions. In: McIlroy, D. (Ed.) The application of ichnology to palaeoenvironmental and stratigraphic analysis. Geological Society, London, Special Publications 228, pp 311-333.

Butzer, K.W., Helgren, D.M., Fock, G. & Stuckenrath, R. 1973. Alluvial terraces of the Lower Vaal River, South Africa: a re-appraisal and re-investigation. Journal of geololgy 81, 341-362.

Churchill, S.E. et al. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. South African Journal of Science 96: 161-163.

Cole, D.I. 2005. Prince Albert Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 33-36.

Cooke, H.B.S. 1949. Fossil mammals of the Vaal River deposits. Memoirs of the geological Survey of South Africa 35, 1-117.

Cooper, M.R. & Oosthuizen, R. 1974. Archaeocyathid-bearing erratics from Dwyka Subgroup (Permo-Carboniferous) of South Africa, and their importance to continental drift. Nature 247, 396-398.

De Wit, M.C.J. 1990. Palaeoenvironmental interpretation of Tertiary sediments at Bosluispan, Namaqualand. Palaeoecology of Africa and the surrounding islands 21: 101-118.

De Wit, M.C.J. 1993. Cainozoic evolution of drainage systems in the north-western Cape. Unpublished PhD thesis, University of Cape Town, Cape Town, 371 pp.

De Wit, M.C.J. 1999. Post-Gondwana drainage and the development of diamond placers in western South Africa. Economic Geology 94: 721-740.

De Wit, M.C.J. & Bamford, M.K. 1993. Fossil wood from the Brandvlei area, Bushmanland as an indication of palaeoenvironmental changes during the Cainozoic. Palaeontologia africana 30: 81-89.

De Wit, M.C.J., Marshall, T.R. & Partridge, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.55-72. Oxford University Press, Oxford.

Dickens, J.M. 1961. Eurydesma and Peruvispira from the Dwyka Beds of South Africa. Palaeontology 4: 138-148, pl. 18.

Dickens, J.M. 1984. Late Palaeozoic glaciation. BMR Journal of Australian Geology and Geophysics 9: 163-169.

Dingle, R.V., Siesser, W.G. & Newton, A.R. 1983. Mesozoic and Tertiary geology of southern Africa. viii + 375 pp. Balkema, Rotterdam.

Du Toit, A. 1954. The geology of South Africa. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.

Eriksson, P.G., Altermann, W. & Hartzer, F.J. 2006. The Transvaal Supergroup and its precursors. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 237-260. Geological Society of South Africa, Marshalltown.

Evans, F.J.E. 2005. Taxonomy, palaeoecology and palaeobiogeography of some Palaeozoic fish of southern Gondwana. Unpublished PhD thesis, University of Stellenbosch, 628 pp.

Grill, H. 1997. The Permo-Carboniferous glacial to marine Karoo record in southern Namibia: sedimentary facies and sequence stratigraphy. Beringeria 19: 3-98, 1 pl.

Haddon, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp. 173-181. Oxford University Press, Oxford.

Helgren, D.M. 1977. Geological context of the Vaal River faunas. South African Journal of Science 73, 303-307.

Herbert, C.T. & Compton, J.S. 2007. Depositional environments of the lower Permian Dwyka diamictite and Prince Albert shale inferred from the geochemistry of early diagenetic concretions, southwest Karoo Basin, South Africa. Sedimentary Geology 194: 263-277.

Johnson, M.R., Van Vuuren, C.J., Visser, J.N.J., Cole, D.I., De V. Wickens, H., Christie, A.D.M., Roberts, D.L. & Brandl, G. 2006. Sedimentary rocks of the Karoo

Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

Kiberd, P. 2006. Bundu Farm: a report on archaeological and palaoenvironmental assemblages from a pan site in Bushmanland, Northern Cape, South Africa. South African Archaeological Bulletin 61, 189-201.

Klein, R. 1980. Environmental and ecological implications of large mammals from Upper Pleistocene and Hoocene sites in southern Africa. Annals of the South African Museum 81, 223-283.

Klein, R.G. 1984a. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

Klein, R.G. 1984b. Palaeoenvironmental implications of Quaternary large mammals in the Fynbos region. In: Deacon, H.J., Hendey, Q.B., Lambrechts, J.J.N. (Eds.) Fynbos palaeoecology: a preliminary synthesis. South African National Scientific Programmes Report No. 10, pp. 116-133.

Klein, R. 2000. The Earlier Stone Age in southern Africa. The South African Archaeological Bulletin 40, 107-122.

Macey, P.H., Siegfried, H.P., Minnaar, H., Almond, J. And Botha, P.M.W. 2011. The geology of the Loeriesfontein Area. Explanation to 1: 250 000 Geology Sheet 3018 Loeriesfontein, 139 pp. Council for Geoscience, Pretoria.

Macrae , C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.

Mclachlan, I.R. & Anderson, A. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15: 37-64.

Meadows, M.E. & Watkeys, M.K. 1999. Palaeoenvironments. In: Dean, W.R.J. & Milton, S.J. (Eds.) The karoo. Ecological patterns and processes, pp. 27-41. Cambridge University Press, Cambridge.

Miller, R.M. 2008. Karoo Supergroup, pp. 16-1 to 16-115 in Miller, R.G. The geology of Namibia. Volume 3. Upper Palaeozoic to Cenozoic. Geological Survey, Namibia.

Oelofsen, B.W. 1986. A fossil shark neurocranium from the Permo-Carboniferous (lowermost Ecca Formation) of South Africa. In: Uyeno, T, Arai, R., Taniuchi, T & Matsuura, K. (Eds.) Indo-Pacific fish biology. Proceedings of the Second International Conference on Indo-Pacific Fishes. Ichthyological Society of Japan, Tokyo, pp 107-124.

Orton, J. 2012. Heritage impact assessment for a proposed solar energy facility on the farm Hoekplaas near Copperton, Northern Cape, 32 pp. Archaeology Contracts Office, University of Cape Town, Cape Town.

Partridge, T.C. & Scott, L. 2000. Lakes and Pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145-161. Oxford University Press, Oxford.

Partridge, T.C., Botha, G.A. & Haddon, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

Pickford, M. & Senut, B. 2002. The fossil record of Namibia. 39 pp. The Geological Survey of Namibia.

Plumstead, E.P. 1969. Three thousand million years of plant life in Africa. Alex Du Toit Memorial Lectures No. 11. Transactions of the Geological Society of South Africa, Annexure to Volume 72, 72pp. 25 pls.

Prinsloo, M.C. 1989. Die geologie van die gebied Britstown. Explanation to 1: 250000 geology Sheet 3022 Britstown, 40 pp. Council for Geoscience, Pretoria.

Rossouw, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. Navorsinge van die Nasionale Museum Bloemfontein 22, 145-162.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

Savage, N.M. 1970. A preliminary note on arthropod trace fossils from the Dwyka Series in Natal. IUGS Second Gondwana Symposium, South Africa, 1970, Proceedings and Papers, pp 627-635, pls. 1-5.

Savage, N.M. 1971. A varvite ichnocoenosis from the Dwyka Series of Natal. Lethaia 4: 217-233.

Schneider, G. & Marais, C. 2004. Passage through time. The fossils of Namibia. 158 pp. Gamsberg MacMillan, Windhoek.

Scott, L. 2000. Pollen. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.339-35. Oxford University Press, Oxford.

Seilacher, A. 2007. Trace fossil analysis, xiii + 226pp. Springer Verlag, Berlin.

Senut, B., Pickford, M., Ward, J., De Wit, M., Spaggiari, R. & Morales, J. 1996. Biochronology of the Cainozoic sediments at Bosluis Pan, Northern Cape Province, South Africa. South African Journal of Science 92: 249-251.

Siebrits, L.B. 1989. Die geologie van die gebied Sakrivier. Explanation of 1: 250 000 geology sheet 3020, 19 pp. Council for Geoscience, Pretoria.

Skead, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

Slabbert, M.J., Moen, H.F.G. & Boelema, R. 1999. Die geologie van die gebied Kenhardt. Explanation to 1: 250 000 geology Sheet 2920 Kenhardt, 123 pp. Council for Geoscience, Pretoria.

Stapleton, R.P. 1977. Carboniferous unconformity in southern Africa. Nature 268, 222-223.

Stephenson, M.H. 2008. A review of the palynostratigraphy of Gondwanan Late Carboniferous to Early Permian glacigene successions. In: Fielding, C.R., Frank, T.D. & Isbell, J.L. (eds). Resolving the Late Paleozoic Ice Age in time and space. Geological Society of America Special Paper 441, 317-330.

Stollhofen, H., Stanistreet, I.G., Bangert, B. & Grill, H. 2000. Tuffs, tectonism and glacially-related sea-level changes, Carboniferous-Permian, southern Namibia. Palaeogeography, Palaeoclimatology, Palaeoecology 161: 127-150.

Stone, P. & Thomson, M.R.A. 2005. Archaeocyathan limestone blocks of likely Antarctic origin in Gondwanan tillite from the Falkland Islands. Geological Society, London, Special Publications 246, 347-357.

Thomas, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620 and 2720). Unpublished MSc thesis, University of the Orange Free State, Bloemfontein, 138 pp.

Thomas, R.J., Thomas, M.A. & Malherbe, S.J. 1988. The geology of the Nossob and Twee Rivieren areas. Explanation for 1: 250 000 geology sheets 2520-2620. 17pp. Council for Geoscience, Pretoria.

Thomas, D.S.G. & Shaw, P.A. 1991. The Kalahari environment, 284 pp. Cambridge University Press.

Veevers, J.J., Cole, D.I. & Cowan, E.J. 1994. Southern Africa: Karoo Basin and Cape Fold Belt. Geological Society of America, Memoir 184: 223-279.

Visser, J.N.J. 1982. Upper Carboniferous glacial sedimentation in the Karoo Basin near Prieska, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology 38, 63-92.

Visser, J.N.J. 1985. The Dwyka Formation along the north-western margin of the Karoo Basin in the Cape Province, South Africa. Transactions of the Geological Society of South Africa 88, 37-48.

Visser, J.N.J. 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by a predominantly subpolar marine ice sheet. Palaeogeography, Palaeoclimatology, Palaeoecology 70, 377-391.

Visser, J.N.J. 1992. Deposition of the Early to Late Permian Whitehill Formation during a sea-level highstand in a juvenile foreland basin. South African Journal of Geology 95: 181-193.

Visser, J.N.J. 1997. Deglaciation sequences in the Permo-Carboniferous Karoo and Kalahari Basins of southern Africa: a tool in the analysis of cyclic glaciomarine basin fills. Sedimentology 44: 507-521.

Visser, J.N.J. 2003. Lithostratigraphy of the Elandsvlei Formation (Dwyka Group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 39, 11 pp. Council for Geoscience, Pretoria.

Visser, J.N.J., Loock, J.C., Van Der Merwe, J., Joubert, C.W., Potgieter, C.D., Mclaren, C.H., Potgieter, G.J.A., Van Der Westhuizen, W.A., Nel, L. & Lemer, W.M. 1977-78. The Dwyka Formation and Ecca Group, Karoo Sequence, in the northern Karoo Basin, Kimberley-Britstown area. Annals of the Geological Survey of South Africa 12, 143-176.

Visser, J.N.J., Von Brunn, V. & Johnson, M.R. 1990. Dwyka Group. Catalogue of South African Lithostratigraphic Units 2, 15-17. Council for Geoscience, Pretoria.

Visser, J.N.J., Van Niekerk, B.N. & Van Der Merwe, S.W. 1997. Sediment transport of the Late Palaeozoic glacial Dwyka Group in the southwestern Karoo Basin. South African Journal of Geology 100: 223-236.

Von Brunn, V. & Visser, J.N.J. 1999. Lithostratigraphy of the Mbizane Formation (Dwyka group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 32, 10 pp. Council for Geoscience, Pretoria.

Wells, L.H. 1964. The Vaal River 'Younger Gravels" faunal assemblage: a revised list. South African Journal of Science 60, 92-94.

Zawada, P.K. 1992. The geology of the Koffiefontein area. Explanation of 1: 250 000 geology sheet 2924 Koffiefontein, 30 pp. Council for Geoscience, Pretoria.

Hydrology:

Surface Water

Boelema, R. (1994). The Metallogeny of the Upington and Kenhardt Area, Northern Cape. Grahamstown: Rhodes University.

Jackson, C. (1992). A microstructural kinematic study of selected shear zones in the Hartbees River Thrust Belt, Northeastern Namaqua Tectonic Province. Grahamstown: Rhodes University.

Vegter, J. R. (2006). Hydrogeology of groundwater Region 26: Bushmanland. Pretoria: Water Research Commission.

Groundwater:

Smithers, J.C. and Schulze, R.E. (2002). Design Rainfall Estimation in South Africa. Water Research Commission. Report no. K5/1060. Pretoria.

Midgley, D.C. (1972). Design flood determination in South Africa. Hydrological Research Unit Report No 1/72. University of the Witwatersrand. Department of Civil Engineering.

Midgley, D.C. & Pitman W.V. (1978). A depth-duration-frequency diagram for point rainfall in Southern Africa. Hydrological Research Unit Report No 2/78. University of the Witwatersrand. Department of Civil Engineering.