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FIRST DRAFT

ENVIRONMENTAL IMPACT REPORT

EIA Ref No. – 12/12/20/2258

ESTABLISHMENT OF PHOTOVOLTAIC (SOLAR POWER) FARMS IN THE NORTHERN CAPE

JULY 2011

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SUMMARY OF IMPACT REPORT & RECOMMENDATIONS

This Environmental Impact Report has been compiled to provide an indication of the ecological, social and economic impacts that may arise through the establishment of photo-voltaic (solar power) farms on the properties described.

The applicant, Scatec Solar SA (Pty) Ltd, represented by Mr. J Borrill wishes to establish between 5 and 9 solar farms on a number of properties in order to produce between 10MW and 100 MW of power which is to be fed into the localized power grid.

The Northern Cape region is conducive to the establishment of solar farms on account of its generally high insolation, level topography and proximity to major power lines serving the Western Cape and Eastern Cape. The land in question is free of built structures and has been highly transformed as a result of grazing of livestock.

Solar power is considered a "clean energy" source and is a form of energy generation being promoted at local and international levels to meet energy demand and reduce reliance upon carbon based fuels. The utilization of "non-Carbon" based energy sources is a key objective of the South African government, as signatory to COP XIV and other protocols on the reduction of CO_2 emissions.

The results of the environmental impact assessment contained in the EIR, has eliminated five of the nine sites identified during the scoping phase, based primarily on technical evaluation of the capacity of the localized grid and the ability or feasibility to connect to proximal substations. The four sites that have been retained for further consideration were reviewed in terms of their bio physical suitability, as well as social and economic aspect. It is evident from specific review of the sites, that

- Limited geophysical constraints are apparent on the sites in question, with sandstone, shale and mudstone forming the predominant underlying geology. Soils vary from *clayey sands* to *sands.* No significant geotechnical or geophysical constraints have been identified.

- All sites show limited ecological significance at a local and regional level of consideration on account of the extensive use of the land in question for livestock husbandry. A rapid appraisal of habitat on the sites indicated that habitat across all sites showed conformity and that grazing, rather than natural factors were the master factors affecting site habitat.

- One site was identified with a cultural heritage resource, a stone redoubt emanating from the Second Boer War together with a portion of low gauge railway line. The resource has been excluded from the development footprint on site H, Taaibos.

- Agricultural impacts were considered to be low on account of the fact that the activity would not preclude livestock from the site and indeed grazing was considered to be important in the management of the site.

- Social and socio-economic benefits were considered to be of a high level and of regional (or wider) significance. Such benefits, aside from the generation of power, include job creation, diversification of the local economy and social investment programmes to be undertaken by the applicant.

Given the above and in terms of bio physical components on the sites, the layout and design of the photo voltaic power generation facilities at each site were finalized according to the following*, inter alia*

1) avoidance of geophysical, topographic and hence ecological points of constraint ;
2) improved operational management ;
3) avoidance of cultural heritage and other social and socio-economic negative externalities.

The most significant negative externality arising from the impact assessment process is the issue of stormwater management and the possibility of panels exacerbating erosion of surfaces within the PV generation facility. This matter can be attended to through design and management of the site with identified beneficiation to the farming operation itself as a result of these management provisions. Other issues that have been identified in the EIR that would require management and mitigation in the short to long term include:

- Buffering of the cultural heritage resource on site H (Taaiboschfontein)
- Maintenance of visual buffers (Site I)
- Possible change in land values in the long term
- At a cumulative level, local economic development opportunities will improve with possible increases in lifestyle requirements with concomitant economic drivers coming to the fore.

Under evaluation across the environmental spectrum, the proposed activity is seen to have significant regional beneficiation with limited negative, localized impacts arising, all of which can be mitigated.

The "no-go" option or preservation of the status quo is seen to have generally negative consequences across the environmental spectrum.

ENVIRONMENTAL STATEMENT

In terms of the regulations promulgated under NEMA - GNR 546 of August 2010, regulation 32 of Chapter 3, Part 3 a full environmental impact assessment has been undertaken which has identified that the proposed Photo voltaic (PV) power generation facilities proposed on portions of the farms:

Site D : Vanderlindeskraal No 79
Site G : Erfpag seinde die plaas New Kalkbult No. 181
Site H : Restant van die plaasTaaiboschfontein nr. 41
Site I : Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Remainder of the Farm Van der Linderskraal No 79

Show broad based social and economic benefit across the environmental spectrum with limited negative impact. Any negative externalities are able to be managed and mitigated and through such mitigation, additional benefits may arise primarily in the agricultural sector.

It is recommended that the mandated authority support the four identified sites for the proposed activity, with endorsement of :

- **The layout and design options provided in Annexure A of this report**
- **The management and mitigation measures recommended in the EIR and within the environmental management programme, annexed to this report**

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ABBREVIATIONS USED IN THIS DOCUMENT

CANOCO	Canonical Correspondence Analysis
CARA	Conservation of Agricultural Resources Act
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
ESR	Environmental Scoping Report
HIA	Heritage Impact Assessment
IAP	Interested and Affected Party
MTS	Main Transmission System
NEMA	National Environmental Management Act
PV	Photo-voltaic
REFIT	Renewable Energy Feed in Tariff

1 BACKGROUND AND INTRODUCTION

An Environmental Scoping Report was compiled in December 2010 following a process that commenced in August 2010 in terms of R544 and R 545 of the National Environmental Management Act (107 of 1998). The process saw the evaluation of nine (9) sites within the Northern Cape Province that were identified as potential or "candidate" sites for the establishment of photo-voltaic centres of facilities for the generation of power. The photo voltaic centres (PV Centres) would through the capture of ultra violet radiation by selenium based PV cells, provide electrical power back into the electrical grid through connection to a suitably sized sub-station.

The provision of power is of national concern within South Africa, with the Northern Cape experiencing considerable short falls in the provision of Level 1 power to the region. At a national level, power provision is of national and strategic concern while the use of environmentally sustainable forms of power generation, including solar power is a noted policy.

The applicant Scatec SA (Pty) Ltd, a subsidiary of Scatec Solar AS (Norway) and Scatec Solar Engineering GmbH (Germany) through the scoping process, has been informed that four (4) issues require specific consideration within the Environmental Impact Report, namely:

1. The identification of technical constraints that may apply to each site. In particular the ability of each site to connect with the existing grid and the willingness of the electricity service provider to facilitate and allow for connection.

2. Review of geophysical and bio physical constraints that may affect the establishment of a photovoltaic centre on sites suitable for connection.

3. Review other impacts, primarily socio-cultural and socio-economic, that may arise on sites found to be suitable in terms of 1 and 2 above, including;
    a. Visual constraints
    b. Agricultural constraints - ability to maintain land for agricultural purposes
    c. Access and related management issues
    d. Stormwater management

4. Provide mitigation and environmental management actions for integration into suitable site management procedures

The selected and evaluated sites for establishment of PV centres are :

- Die Plaas Elandsheuwel No 146 (Hanover)
- Plek Petrus Valley gemerk La. H & lot 317 (known as Vermeulens Application)
- Rem of Vermeulens Application No 90. Hanover
- Vanderlindeskraal No 79
- Rem of the Farm Sweetfontein No 92 (Britstown) ;Portion 3 (Annex De Hoop) of the farm 94 (Britstown) and Portion 2 (De Hoop) of the farm No 94 (Britstown)
- Koensdraai no.36(Hopetown Erfpagte Boekdeel 5 nr. 12)
- Erfpag seinde die plaas New Kalkbult No. 181
- Restant van die plaasTaaiboschfontein nr. 41
- Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79

Fig 1 overleaf indicates the sites in a regional perspective

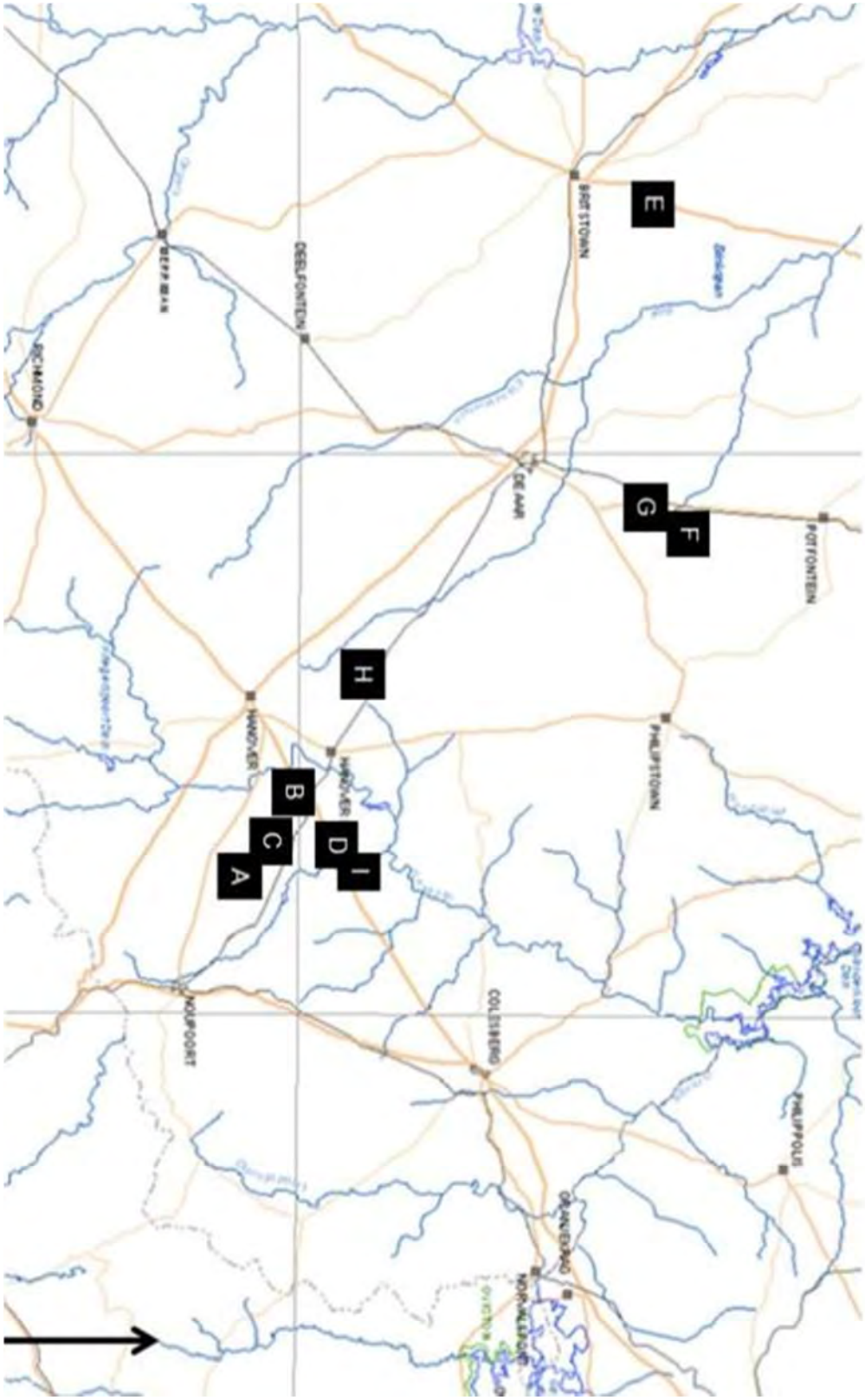

Fig 1. Regional plan of study area with sites identified

1.1 Project and technical specific issues

The proposed activity entails the setting aside of areas of land, between 30 and 80 ha in extent (depending upon availability of connection capacity to the network). The identified areas will have panels of photo voltaic cells mounted on wood or aluminium frames established across level areas of the identified site. Some minor earthworks may have to be undertaken to accommodate such frames, however due to the flexible nature of aluminium and the general low weight of the panels, this will be minimal and the bulk of such earthworks can be undertaken by manual labour. Such excavations will be surface related and will be required to ensure orientation of the panels is congruous throughout the PV farm, while the founding conditions of the panels is secure and stable. (See Fig 2). Small steel "plinths" will be established to "anchor" the panels

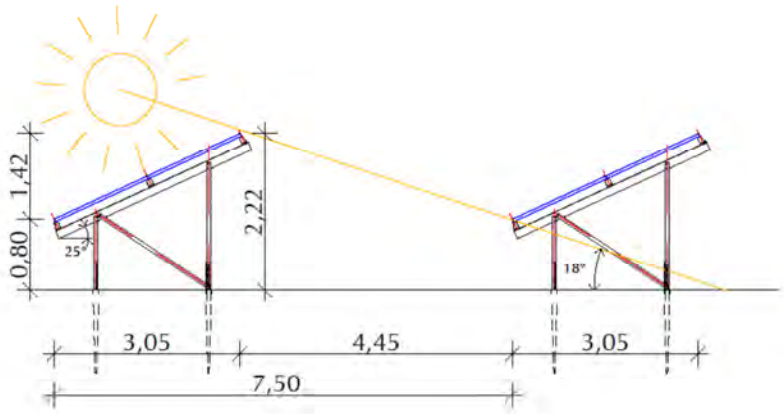

Fig 2. Schematic diagram of panels as established within PV farm (source Scatec SA)

The panels will approximate 2.2m in height above natural ground level, with a width of approximately 3.0m. The panels are constructed of Selenium based material encapsulated in a laminated plastic of high durability. Each panel is "edged" in plastic and feeds a small circuit board that cumulatively delivers a direct current to an invertor. This current is then stepped up within a step up transformer for delivery to the grid. The panels are non reflective (they are required to absorb solar radiation, not reflect it) and are of a dark grey colour. Fig. 3 indicates a solar power facility in Europe, similar in nature to that envisaged for this project.

Fig 3. Solar PV facility in Europe (Source Scatec Solar SA)

2 PROJECT TEAM

This impact report and the compilation of documentation was undertaken with input from the following professionals (Table 1)

Table 1 Project Team

Environmentalists	S C Bundy - Sustainable Development Projects cc BSc MSc Dip Proj Man (Pr. Sci. Nat.) MIAIA A M Whitehead. – Sustainable Development Projects cc. BSc Hons. (Pr Sci Nat) R Maharaj (BA Env Man)- Sustainable Development Projects cc
Engineer	Scatec – Axel Pustet (Eng)
Geotechnical	Groundworks Geotechnical Solutions cc – Francis Smith BSc Hons (Pr. Sci. Nat)
Geohydrological	Groundwork Geotechnical Solutions – Francis Smith BSc Hons (Pr. Sci. Nat.)
Ecological	Sustainable Development Projects cc– Mr. A. M. Whitehead BSc. Hons. S C Bundy BSc MSc
Project Manager	Scatec SA : Mr J Borrill (BA LlB P G Dip Env Law

Annexure L provides a full company profile for consideration

3 LEGAL FRAMEWORK GOVERNING ASSESSMENT

The proposed activity requires authorization in terms of the National Environmental Management Act (1998) for the following regulated activities:

Activity 1a of R 544 :- *The construction of facilities or infrastructure for the generation of electricity where;*

- the electricity output is more than 10 MW but less than 20 MW or
- the output is 10MW or less but the total extent of the facility covers an area in excess of 1 hectare.

Activity 10 of R 544 :- *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 33 but less than 275 kV; or*
(ii) inside urban areas or industrial complexes with a capacity of 275 kV or more

Activity 1 of R 545 :- *The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 MW or more*

Activity 8 of R 545 :- *The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more outside and urban area or industrial complex*

It should be further noted that while application to the Provincial environmental authority was originally undertaken in terms of the prevailing legislation, further interaction with that authority identified that the National Department of Environmental Affairs (DEA) had issued a directive in or around February 2011 stating that all power generation applications must be provided to the DEA for evaluation and that local or provincial authorities were to be involved in the process as interested and affected parties.

Furthermore, the activity is governed by the principles and provisions of NEMA, specifically Sections 2 and 24.Other items of relevant legislation that have been considered include:

- The National Cultural Heritage Act (1998)
- The National Forest Act (1998)
- The National Water Act (1998)
- Conservation of Agricultural Resources Act (1983)
- National Environmental Management: Biodiversity Act (2004)

The nature of the structures, as will be described below, are such that these structures can or may be considered **temporary** in nature. As such, the major focus of the environmental authorization process will consider the siting of the facilities and the possible geotechnical and ecological concerns, as may be relevant under the NEM Biodiversity Act, agricultural issues that may be associated with CARA, visual impacts and possible cultural heritage issues that may arise.

4 METHODOLOGY

This environmental impact report documents the rationale utilised in evaluating the sites identified as possible photo voltaic generation centres during the environmental scoping process and undertakes, through a process of elimination, to identify the most appropriate sites for the establishment of PV Centres.

Fig. 4, below identifies the "cascade" of evaluations, commencing with a technical evaluation of each site in terms of its suitability and ability to connect with the existing Eskom Network. As such, Transmission Connection Capacity within regional Main Transmission Substations (MTS) through existing and appropriately situated sub stations will be the key factor determining the suitability of a particular site as a PV Centre. As such, this level of evaluation will eliminate a number of sites based on the technical suitability of the site. Those sites deemed to be technically capable of connecting to the grid will then be evaluated in terms of their bio physical constraints (i.e. founding conditions, aspect, drainage, erosion potential and ecological suitability). Those sites deemed suitable in terms of the bio physical constraints within the prevailing landscape, will be further evaluated in terms of socio-cultural and socio-economic criteria. These criteria are ; ability of PV centre to integrate with existing agricultural activities, visual impacts; cultural heritage impacts and other possible socio-economic issues.

Final evaluation of any untoward constraints on each site is undertaken prior to identification of suitable sites. Such constraints may include access issues and general management issues that may arise, such as the availability of water for general maintenance of PV panels.

Thus, by a process of elimination, sites suitable for the establishment of PV centres will be identified for establishment by 2012. The sites selected will, utilizing the information presented above, be designed in order to :

- Maximize solar incidence on panels (namely aspect and design).
- Optimize land use on selected sites in terms of land use efficiency and economic efficiency.
- Minimise bio physical impacts including stormwater management and erosion control.

The above will be attended to through an environmental management plan which will include inter alia :

- Design and layout of PV centre and positioning of panels
- Implementation of technical methods to address erosion and similar concerns

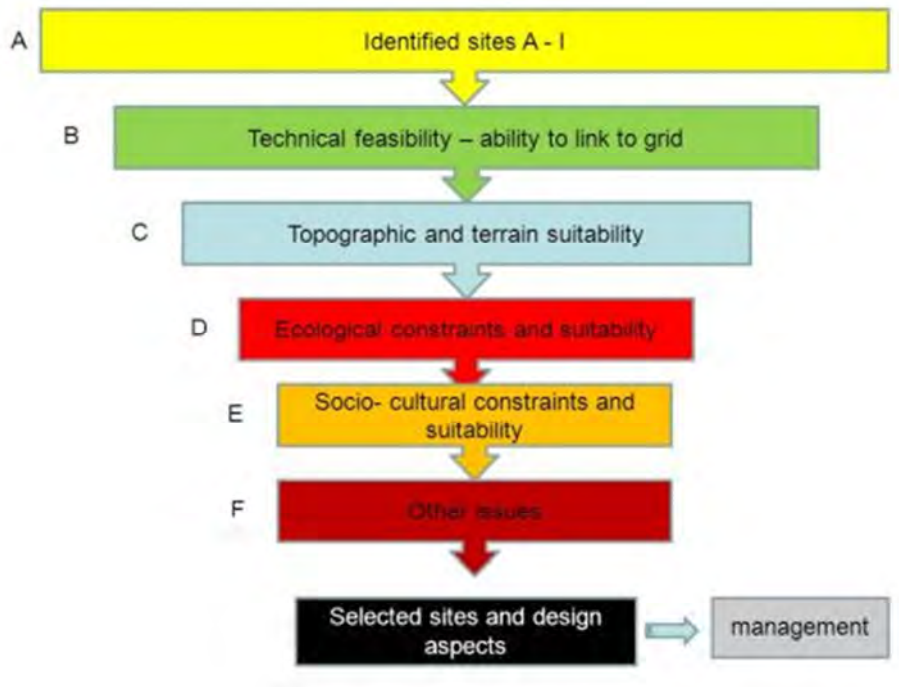

Fig 4. Cascade diagram indicating methodology employed in identifying suitable sites for the establishment of PV centres in the Northern Cape.

4.1 Public Input and Commentary

Interested and affected parties (IAPs) were identified during the scoping process through:

4.1.1 Provision of a background information document which was compiled together with a response form and forwarded to identified I&AP's.

4.1.2 All neighbouring property owners adjacent to and within 100m of the development footprint, all relevant government departments and other mandatory I&APs were identified and informed via registered post of the application through the background information document.

4.1.3 A notice 60cm x 42cm was placed outside sites A to I, indicating that the application is to be submitted, identifying assessment processes, identifying the general nature of the development proposed, a contact address for the EAP and how and when further representation should be made.

4.1.4 An advertisement was placed in the local newspaper (The Echo) on 12th September 2010.

4.1.5 A public meeting was held on 22 October 2010 at Hanover. A total of 4 interested and affected parties attended the meeting.

4.1.6 Questionnaires were distributed at the meeting and all attendees were requested to provide a response within 14 days of date of the meeting (5th November 2010).

5 THE STATUS OF RENEWABLE ENERGY AND CAPACITY WITHIN THE MTS OF THE NORTHERN CAPE AND SITE SUITABILITY

At an international level and within the Republic of South Africa, the provision of energy has become a significant limiting factor to economic growth and competitiveness. In addition to these limitations, there is both mandatory and voluntary directives for the establishment of sustainable energy projects including wind and solar (the so – called "green energies") within the country. As the need for alternative and renewable energy sources has gained momentum, governments and parastatal power service providers (Eskom) have developed a "feed in tariff" (REFIT – Renewable Energy Feed in Tariff), payable to those parties who generate power by acceptable means and provide such power back to the grid. As a result, the capacity of the grid is strengthened and the service provider is able to fulfill its mandate to its consumers.

Given the financial incentives on offer as indicated above, renewable energy provision has received considerable attention from the private sector, seeking to provide power to the national grid, chiefly by means of wind (Fig 5) and solar power (other methods are also being proposed). These two forms of energy production each offer their own technical merits but are however. dependent upon a number of factors , Table 2 identifies the environmental, technical and economic aspects associated with these differing forms of renewable energy generation:

Table 2 Comparative review of wind and solar power generation facilities

	Environmental requirements	**Technical requirements**	**Budget implications**
Wind Power	• Consistent winds • Moderate to high wind speed • 15-18ms-1 wind speed required for sustainable energy generation	• Large turbine structures up to 80m in height • Prominent or unencumbered site with significant improvements to road and rail infrastructure to enable access • Importation of materials • Structures are effectively permanent features	• High
Solar Power	• Consistent radiance • 1.5ha of land to generate approximately 1MW	• A number of panels covering area to generate required power • Low level access requirements • Structures are essentially temporary in nature	• Moderate to high

Fig.5 Wind turbine near Port Elizabeth

Both wind turbine generated power and solar (photovoltaic generated) power are appropriate means of renewable energy generation, given the correct environment and *inter alia*, demand issues and ability to supply to the grid (or ability of grid to accept power from such source). It is also apparent that wind power as a renewable energy, offers a sound option for such power generation when winds are favourable, however, should seasonal or unforeseen lulls in winds arise, such structures can prove to be highly inefficient. Solar power has similar constraints and benefits. It is obvious that at night generation of power cannot proceed, however, solar radiation is more consistent and reliable than wind and as such, power generation during diurnal periods is almost guaranteed.

Scatec Solar, have selected photo voltaic solar power as the power generation method of choice. The Northern Cape offers significant benefits in terms of solar power including high irradiance levels, due to low levels of cloud cover. Comparative data indicates that the Middelberg region receives 0.5kWh/m^2/day more than the coastal town of Port Elizabeth, probably as a result of low cloud cover in Port Elizabeth being a common occurrence. The region also enjoys a high irradiance during the winter months as a result of its latitudinal position

By far the most significant factor affecting the generation of renewable energy resources is the ability to feed the power generated by the facility into the power grid. Eskom in December 2010, undertook

to identify areas within the Northern, Western and Eastern Cape which were suitable (available) for renewable energy generation projects (or any generation project) to connect to the power grid under their jurisdiction. To this end, the study of available capacity within the Eskom Main Transmission System (MTS) sub stations identified that:

1. Single contingency (N-1) generation capacity for the Northern Cape (Zone north) was 129MW for Level 1 condition connections
2. Single contingency (N-1) generation capacity for the Northern Cape was 1000MW for Level 2 condition connections.

Levels 1 and 2 refer to the ability of the generation facility (such as a wind power or solar power centre), to connect to a MTS substation. Level 1 indicates that connections are available at 132kV and 66kV LV busbars, while Level 2 refers to the ability to connect to HV busbars within sub stations at 220kV, 275kV and 400kV. Eskom identifies that Level 1 connections require no transmission re-inforcement,(GCCA 2012) and thus can be rapidly implemented.

Eskom Distribution are responsible for the provision of power to end user customers. Most delivery arises through powerlines with a 132kV capacity. The photovoltaic power facilities proposed will generate power at this level of distribution capacity, requiring 132kV and 66kV supply. It is thus important that all sites identified are able to :

- Connect to a sub-station in close proximity to the point of power generation. Eskom has identified that power generation facilities having direct connection capability to a substation are preferable on account of:
    - Infrastructure already exists.
    - Connection can commence immediately once necessary processes are complete.
    - Substantial cost saving in terms of infrastructure.
    - Speed of connection. “Speed of connection

- Where no substation is available, a significant financial, administrative and environmental “risk” arises for both the REFIT applicant and Eskom.
- It is Eskom’s intention to ensure supply to the local load within a given distribution supply area, with any excess possibly being placed into the Transmission network via the MTS substation.
- That the substation serves a MTS with capacity and ability to connect the REFIT facility.

The evaluation of site suitability thus entails:

1. Identification of site(s) in close proximity to substation and general ability to connect to substation.

2. Identification of suitable sub station with few or no limitations to connection and is identified as having least "upgrade" requirements.

3. Identification of whether the site was a property contiguous with the sub station

The following table indicates the nine sites under review and their nearest substation, as well as the proximity of the substation.

Table 3. Sites indicating proximal sub station for connection and distance to sub station

Site	Property Description	MTS	Nearest Substation	Distance to Substation
A	Die Plaas Elandsheuwel No 146	Hydra	Linde	23km
B	Plek Petrus Valley gemerk La. H & lot 317 (known as Vermeulens Application)	Hydra	Linde	17km
C	Rem of Vermeulens Application No 90. Hanover	Hydra	Linde	17km
D	Vanderlindeskraal No 79	Hydra	Linde	<1km
E	Rem of the Farm Sweetfontein No 92 (Britstown) ;Portion 3 (Annex De Hoop) of the farm 94 (Britstown) and Portion 2 (De Hoop) of the farm No 94 (Britstown)	Hydra	Britstown	12km
F	Koensdraai no.36(Hopetown Erfpagte Boekdeel 5 nr. 12)	Hydra	Kalkbult	1km
G	Erfpag seinde die plaas New Kalkbult No. 181	Hydra	Kalkbult	<1km
H	Restant van die plaasTaaiboschfontein nr. 41	Hydra	Taaibos	<1km
I	Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79	Hydra	Linde	<1km

Specific interaction with Eskom indicated that sites, D, G, H and I in close proximity to the sub stations Lindeskraal, Taaibos and Kalkbult, offered opportunity to connect for the provision of power. Annexure D indicates that these substations do offer such opportunity and the applicant has been informed of the cost of such connection, (please note that these amounts / costs have been omitted due to confidentiality aspects). The quotation provided by Eskom Ltd also identifies that the proponent has made specific application to Eskom for the generation of power and REFIT

From Table 3 and the information provided above, it is evident that there is a large degree of variation between data and that the large number of sites made sound determination of the most appropriate sites by linear methods, difficult. To overcome this a cluster technique of all technical information was undertaken which took into consideration the following:

- Nearest substation
- Capacity of nearest sub station
- Level 1 and Level 2 connection requirements
- Requirement to traverse (other) private land to reach sub station
- Feasibility to establish PV facility adjacent to sub station or establish as contiguous PV facility with sub station

To overcome the inherent problems associated with a linear evaluation a multi-variate analysis using groups or "clustering techniques" was undertaken through an ordination process. Fig 6 indicates the results of the ordination.

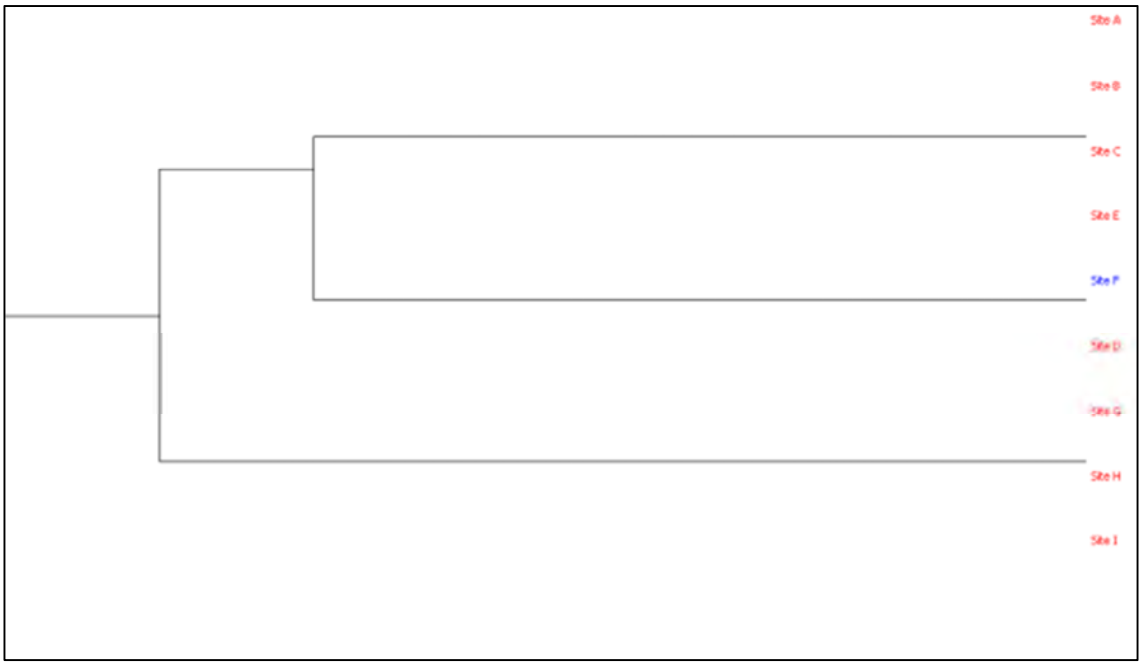

Fig 6 Ordination dendrogram of all information pertaining to technical suitability of sites.

From Fig. 6 it is evident that Sites D, G,H and I are significantly similar and meet all criteria in terms of the technical requirements outlined above. Site F meets some criteria and is thus grouped separately from both the most select sites, while sites A,B,C and E, meet only some of the criteria.

The following sites are thus considered to be the most appropriate sites for the establishment of photovoltaic power generation centres based on present technical limitations. Should such limitations change, then review and consideration of the balance of the sites should be undertaken. The sites that are given further review are:

Site D : Vanderlindeskraal No 79
Site G : Erfpag seinde die plaas New Kalkbult No. 181
Site H : Restant van die plaasTaaiboschfontein nr. 41
Site I : Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79

Fig. 7 identifies the position of these sites in a regional context.

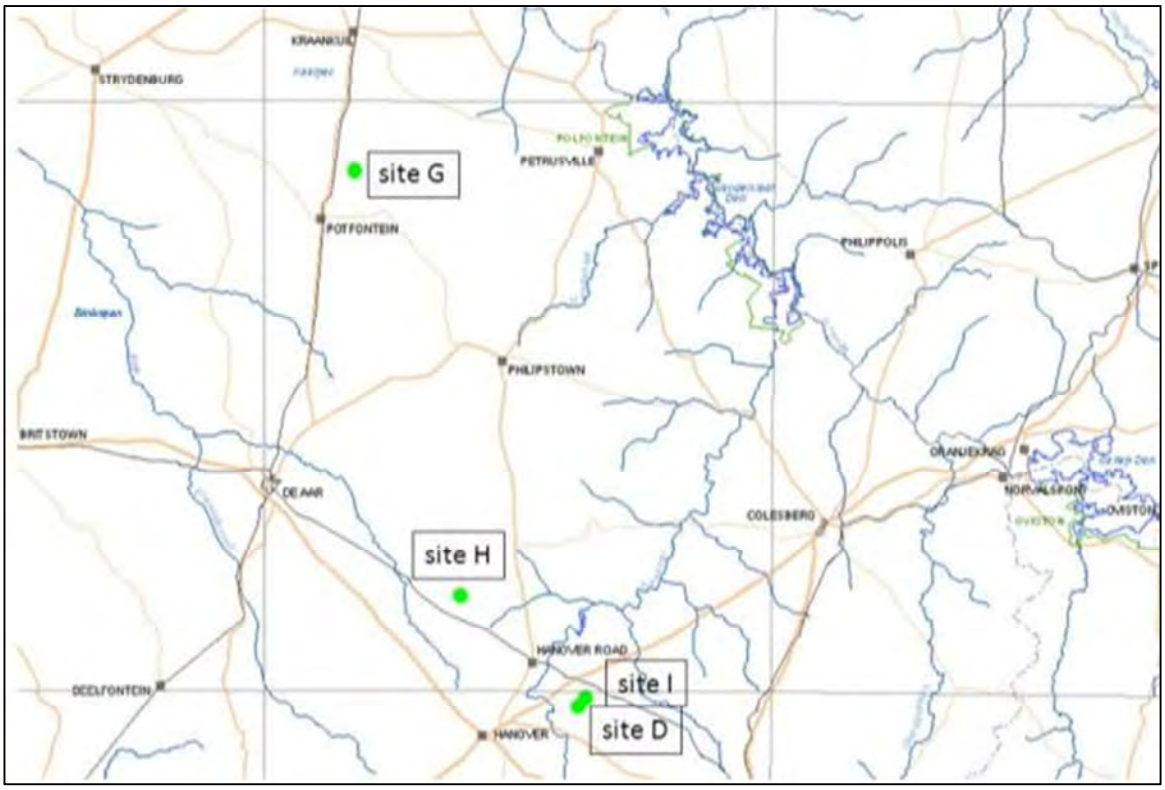

Fig 7. Regional map indicating sites D, G,H and I

Having identified the above sites and with reference to Fig 6, further evaluation of bio physical constraints, which would either constrain or identify the design and establishment criteria to be employed is undertaken

6 TOPOGRAPHIC AND TERRAIN SUITABILITY

Sites D, G, H and I are considered to have limited constraints imposed by topographic and terrain conditions present within the areas under consideration. As would be expected, most sites are generally of low gradient. It is an obvious constraint to the operations of PV power generation centres to be positioned in mountainous areas where extended periods of shadow, either at dawn or dusk impede irradiance incidence on PV panels, a problem that may be exacerbated during the winter months. In addition, terrain or topography that proves too undulating or has geological or geomorphological constraints, will prove difficult to establish an extensive PV generation centre upon, either through the *cost of establishment* or through general management and maintenance issues. An overview of the sites under consideration is provided (Table 4).

Table 4 Overview of Sites under Consideration

	Property Description	**Image**	**Available land**
D	Vanderlindeskraal No 79		n/a
G	Erfpag seinde die plaas New Kalkbult No. 181		257ha

	Property Description	Image	Available land
H	Restant van die plaas Taaiboschfontein nr. 41		481ha
I	Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79		590ha

6.1 Site D, (The Farm Van der Lindeskraal) and **Site I** (Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79)

The Farm van der Lindeskraal is situated at 30˚ 00' 59"S / 24˚ 39'09 " E. The farm lies upon a shale – sandstone conglomerate with some doleritic dykes apparent to the north of the site. This geology is overlayen by a sandy clay alluvium and residual soils derived from weathering of dolerite. (See Annexure "G")

The site is generally well suited from a topographical perspective for the establishment of a PV facility, with no adverse slopes being encountered. Using the geotechnical terrain classification system, low to intermediate erosion likelihood is expected, while excavation to at least 1.5m below natural ground level is not expected to affect permanent or perched ground water tables. While no evidence of extensive flooding was noted, sheet flow from extensive rainfall may be an issue for consideration. In addition, there is a low probability of seismic activity within the region (See Annexure "G").

The geotechnical appraisal of site undertaken by Groundwork Geotechnical Solutions (Annexure G) indicates that founding conditions are suitable for the establishment of the panels and associated footings / plinths with excavation meeting little resistance to a depth of approximately 1.5m

The geotechnical appraisal identified a "recommended" development zone which is attached in Annexure "B" for all site. Recommendations on retention of slopes, where required have been proposed, while control of stormwater run off is seen as a necessary precaution against erosion of surface soils.

6.2 **Site G** Erfpag seinde die plaas New Kalkbult No. 181

Site G is situated at 30˚ 09' 94"S / 24˚ 07'73" E between Potfontein and De Aar. The farm lies upon a relatively level, although somewhat prismatic, plain with a westerly aspect. Surface water flow is thus generally east to west, away from the Kalkbult sub station. The predominant underlying geology is shale, with siltstones and sandstone formation. A high degree of kaolinisation has resulted in a chalk like rock (See Annexure "G"), which is evident at points of excavation (hence 'Kalk bult'). The 'prismatic' effect noted across the site is due to a doleritic dome found centrally within the site.

Dominant soils identified on site are decomposed doleritic residuum as well as ferricrete gravels. The doleritic Hutton soils are somewhat expansive and "heaving" soils may be anticipated under high precipitation events. Soils are generally considered to be thin to moderately thick (Annexure G), with depths of up to 2.5m to be expected.

Due to the level nature of site, the landform is considered to have a low incidence of slip and low erosion probability. Founding conditions are expected to be "intermediate" in terms of the geotechnical terrain classification system while a low probability of flooding is expected.

A preferred "development footprint" has been proposed, which indicates that much of the Kalkbult site is open to establishment, with some constraints being identified in and around the dolerite intrusion mentioned above.

6.3 **Site H** Restant van die plaas Taaiboschfontein nr. 41

The Farm Taaiboschfontein, situated to the north of Hanover (30˚ 52' 34"S / 24˚ 23'42 E) and covering an area of 480ha exhibits an undulating terrain driven by resistant sandstone and dolerites. Soils are primarily sandy- sandy clays with occasional boulder wash being noted. The site has an

eastern and western aspect, divided by a sandstone promontory, with some weakly drained areas of colluvial soils being located to the west.

Although steeper grades are encountered at Taaiboshfontein than on other sites investigated, it is evident that the site cannot be precluded as being feasible for the establishment of solar panel structures. Indeed, a light grade may assist with orientation of the panels within the facility.

As indicated, the western, lower portions of site indicate poor drainage, possibly exacerbated by the establishment of the former and existing railways (which act as a berm) and as such the areas indicated in Annexure G, have been precluded from development. In addition to inundation, these areas are susceptible to erosion, which may be exacerbated by the positioning of structures such as the panels in the weakly drained areas.

Groundwork Geotechnical Solutions in their appraisal of the site (Annexure G) further indicated a low seismic probability with favourable founding conditions to approximately 1m in depth. The possibility of extreme event (1 : 10 year flood or greater) giving rise to localized flooding in the lower westerly points of site cannot be ignored. As such, the proposed development footprint excludes these areas.

The GGS investigation indicates that the site is a feasible option for development, with erosion control and stormwater management being points of management that should be intercalated into site under the proposed development scenario. A summary of impacts on each site is provided below in Table 5.

Table 5. Summary of significance of terrain and geotechnical impacts / issues associated with sites before and after the application of mitigation measures

	Impact	**Before**	**Mitigation**		
Terrain and Geotech Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after Mitigation**
Site D	X			Erosion control and design	LOW
Site G	X			Erosion control and design	LOW
Site H		X		Erosion control and design	LOW
Site I	X			Erosion control and design	LOW

In general, sites D, G, H and I are considered to be feasible options for the implementation of solar panel facilities with specific siting of the structures being adhered to and on-site management protocols being implemented, with specific regard to stormwater management. As such, none of the

sites evaluated can be eliminated on the grounds of being unsuitable from a terrain and geophysical perspective.

7 ECOLOGICAL CONSTRAINTS AND SUITABILITY

All sites fall within the Nama - Karoo Biome and the vegetation type, Northern Upper Karoo and Eastern Upper Karoo. This is the largest vegetation biome in South Africa with a conservation status of "least threatened" (Mucina and Rutherford 2007) – see Fig. 8.

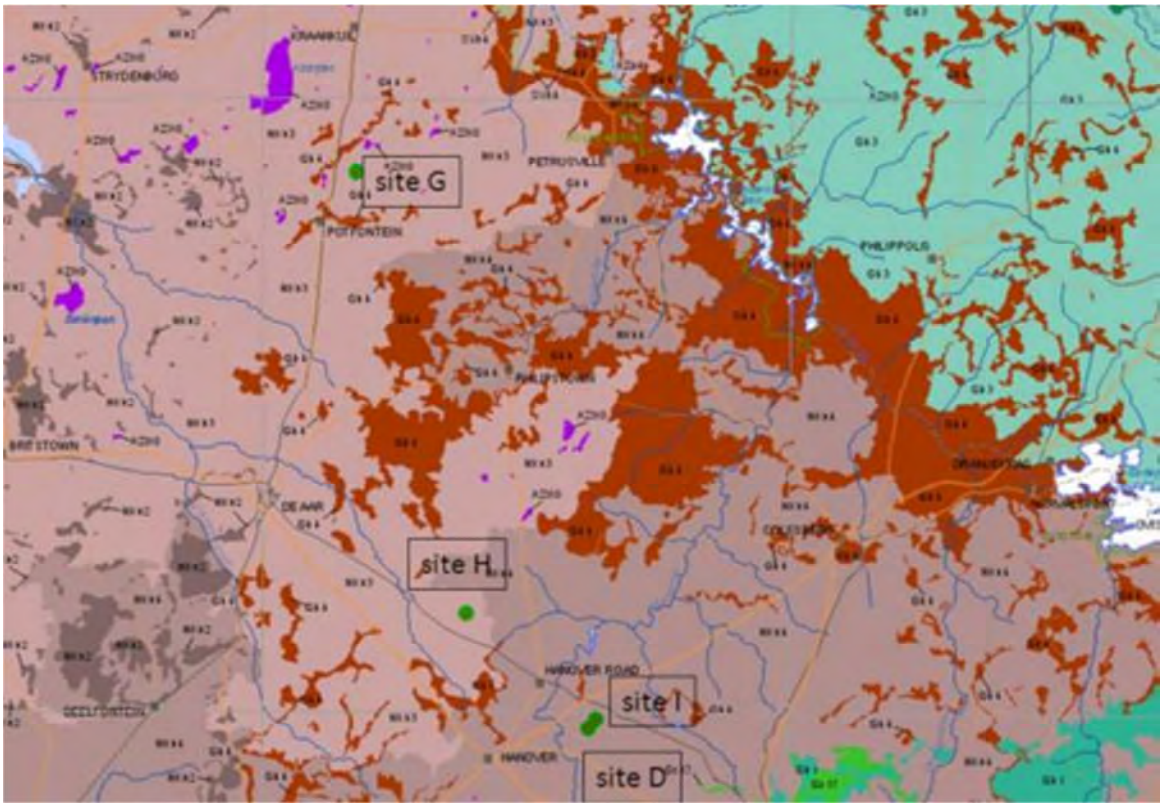

Fig 8. Vegetation types prevalent within study area (identified) (source SANBI). Sites G and H fall within Northern Upper Karoo vegetation unit and sites D and I fall within the Eastern Upper Karoo vegetation unit.

Specific review of each site is provided below

7.1 Site D : Vanderlindeskraal No 79

Site D and Site I lie adjacent to each other and as such share the same bio physical master factors evidenced by similar vegetation and faunal composition. The site was reviewed in both winter

(August) and summer (February) following good rains in the summer of 2010 / 2011. The prevailing grass form noted on site are *Aristida congesta* with *Themeda triandra, Stipagrostis ciliata* and *Eragrostis bergiana* with *Lyceum spp* and the flowering herbs *Gazania krebsiana* and *Felicia muricata* being common. The non-graminae species are primarily associated with the doleritic dykes and sandstone outcrops. Grazing and strong, persistent winds have led to low level site specific erosion, which is attended to by the farm owners during normal farming operations through scarification. Wind factors may be a low level management issue immediately following establishment of PV panels on site when there is a need to ensure sound re-establishment of disturbed vegetation.(See Annexure F)

There is limited water availability on site, such resource being concentrated on neighbouring site I and limited to boreholes and watering holes established by the farmer for provision to livestock. These water resources indicated the presence of *Afrana angolensis*, the common river frog with Tarraebia sp (pond snail) also being identified. These water points serve as focal points for local fauna at an invertebrate level upwards, thus serving to increase faunal activity at anthropogenic or "artificial" points within the landscape.

The sandstone exposures and doleritic dykes are ecological variants in the landscape and this is evidenced by variable vegetation and increased botanical diversity (these points show increased woody vegetation presence) while scorpions (Hadogene family) and evidence of rabbit (Lepus spp) and aardvark (*Orycteropus afer*) in and around these promontories is also noted. With regard to the former, the possibility of the riverine rabbit (*Bunolagus monticularis*) was considered, however it is evident that neither habitat nor previous recorded points of distribution (Fraserburg, Victoria West) were conducive to its occurrence in any of the sites considered. Common mammals to the site are Black back jackal (*Canis mesomelas*) and Springbok (*Antidorcas marsupialis*), the latter focusing at the abovementioned water points.

From an ecological perspective, site D (and site I) offer little variation in habitat to the surrounding landscape. The establishment of a PV facility with increased shading may affect the movement of larger mammals in traversing the area, while the possible increase and concentration of vegetation cover in and around the PV facility may act to concentrate smaller game in and around the facility.

7.2 Site G : Erfpag seinde die plaas New Kalkbult No. 181

Site G is dominated by a *Lycium hirsutum* with *Hertia pallens* association and *Stipagrostis ciliata* being common following the good summer rainfalls. (See Annexure F). The site has been heavily

grazed with some evidence of overgrazing with exacerbated aeolian erosion leading to points of bare ground. Woody species encountered on site are primarily planted (*Olea europaea*) and lie within abandoned or operational camps. The site has little topographical variance or geological variance leading to regular and low vegetative diversity on site. Water provision from a borehole is available to site.

Fig 9 View of Kalkbult substation and adjacent land identified for PV centre

As per sites D and I, water points act to concentrate wildlife within the area. Evidence of springhare (*Pedetes capensis*) and aardvark (*Orycteropus afer)* was noted on site and it is understood from anecdotal information that *C mesomelas* and aardvark (*O afer*) are common. Termitaria are a common feature of site and may prove to be problematic in the management of the PV facility in terms of undermining of structures. To this end, aluminium stands rather than wooden stands (even treated timber may prove problematic) should be utilised. It should be understood that termite activity is an important pedo-formation activity within the region. Termite and aardvark interaction on site should be noted and may prove problematic in maintaining ground level integrity on site.

7.3 Site H : Restant van die plaasTaaiboschfontein nr. 41

This site offers some topographic variance as a result of a low level, north facing sandstone promontory (see Fig 9, below). The dominant grass community on site is an Aristida – Eragrostis

complex (*Aristida congesta* and *E bergiana / E bicolor*). Other common grasses include *Stipagrostis spp* and *Themeda triandra*. The area shows significant grass cover in the summer period with a few forbs evident, primarily Pentzia sp and occasionally, Ruschia spp . The upper sandstone promontory supports occasional taller shrubs, primarily Lyceum spp. (See Annexure F).

No open water resource is present on site and as such the ecological focal point on site would be associated with the sandstone promontory, a dominant physical feature of this area. The present and previous railway line does serve to attenuate flow from the land in general and may under heavy rainfall episodes become inundated with water. (See Fig 10 below) This area does not however constitute "wetland" due to the limited time under which water is maintained on site, although the site may constitute refugia for fossorial (burrowing) species such as Karoo toad (*Amietophryne gariepensis*). The lower lying area is, as a result of the concentration of flow, showing signs of erosion. As such and because of the two, abovementioned factors, it is recommended that this area be excluded from the development site and that all panel structures be positioned on higher ground above the existing power line.

Larger mammals common to site are ubiquitous within the region and include black back jackal, aardvark and aardwolf. The geological promontory may prove to act as habitat to a number of smaller vertebrate species including Agamids

Fig 10. Sandstone promontory at Taaibosch

Fig. 11 Area in foreground at Taaibosch subject to possible inundation to be excluded from development area, with all panels being positioned above the powerline straddling image in foreground

7.4 Site I : Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79

Site I shows ecological parameters akin to Site D above (See Fig 11 below). As in site D, the area indicates and grassland complex of *Aristida – Eragrostis* with *Themeda triandra* and *Stipagrostis ciliata* also being common (See Annexure F). A large dolerite dyke forms the most significant geological promontory with a low lying area to the south east forming a point of concentration of water (Fig 12). Two artificial water resources were identified within the study area, namely an excavated water impoundment at a low point within the site and a wind driven borehole. The latter site showed the presence of *Afrana angolensis* and may also support other anurans, while the presence of the common pond snail (Tarrebia sp) within the troughs at the borehole indicated regular water availability. Large mammals noted on site included Springbok, which were common in and around the abovementioned water facilities.

The sandstone promontory was noted to support some larger woody species, primarily *Euclea divinorum*, while the site was noted to act as a localized habitat for the scorpion Hadogenes sp.

Fig 12 Substation with adjacent excavated watering hole at van der Lindeskraal.

Fig 13 Borehole noted to act as focal point for larger and smaller game on site.

From a comparative basis, the four sites were considered in terms of their habitat form and the prevailing master factors associated with each site including:

- Elevation
- “slope” or “grade of land”
- Edaphics or “nature of soils”

Each site was considered in terms of its prevailing botanical species diversity through a “presence – absence” review of species at site. Reconnaissance of the sites indicated that a total of 22 species were identified on all sites, of which 4 (18%) were considered exotic. Atriplex sp (Australian Salt Bush) appeared to be a co-dominant on some sites during winter months. The data collated, including geophysical and biological information was reviewed using an ordination analysis (CANOCO) which was undertaken to assess the influence of geophysical or natural factors on the prevailing botanical composition on site. Where such measured factors have no significant influence, it can be assumed that other factors, such as ongoing disturbance, affect and influence the ecology on the evaluated sites. Fig. 14 below indicates the bi plot associated with such evaluation.

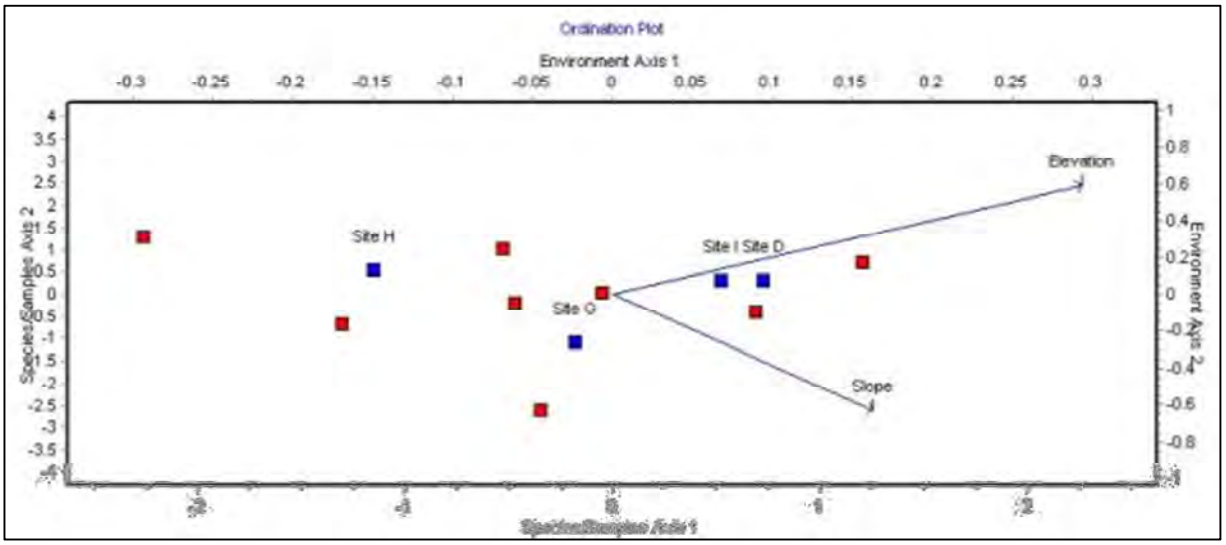

Fig 14. Ordination bi plot indicating site habitat and influence of prevailing natural factors on vegetation and ecology of site.

From Fig 14. and the scattered nature of the results, it is evident that there is little correlation between the sites and the measured environmental parameters (slope and elevation). This result is indicative of the fact that the sites constitute highly altered lands, in the case of sites D, G,H and I, being areas subject to grazing and ongoing animal husbandry.

Given the above information, Table 6 identifies the impacts on ecological processes that is likely to arise from the establishment of the proposed PV centres on the four sites under consideration.

Table 6 Summary of significance of ecological impacts / issues associated with sites before and after the application of mitigation measures

	Impact Before Mitigation				
Ecological Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D	X			Erosion control and design	LOW
Site G	X			Erosion control and design	LOW
Site H	X			Erosion control and design	LOW
Site I	X			Erosion control and design	LOW

From Table 6, it is evident that the sites in question show limited ecological significance or significance akin to the prevailing landscape and as such, with mitigatory and sound management application, the impacts arising at an ecological level may be considered to be "low".

8 SOCIO – CULTURAL CONSTRAINTS AND SUITABILITY

8.1 Cultural Heritage issues

Site H, Restant van die plaas Taaiboschfontein nr 41 is the only site that has been identified with cultural heritage resources present in or adjacent to the site in question. The site has evidence of Boer War military redoubts associated with portion of relic railway which lies adjacent to the present railway line (see Fig 15).

A heritage resource specialist evaluated the sites in question (Annexure G) in order to :

- Evaluate the site and adjacent area in order to identify the spatial parameters of the resource
- Identify the significance of the resource
- Recommend measures at site in order obviate any impacts that may arise from the establishment of a PV centre in or around site.

Fig 15. Military redoubt of Boer War origin on site

The Heritage Impact Assessment (Annexure G) identified the area of the site with five stone redoubts as being a **significant local historical resource**. The structures are military installations utilised by British garrisons to protect the north bound railway line to Kimberley and have historic linkage to war graves in the Hanover cemetery dating back to the 1899 – 1902 Boer War. There is also acknowledgement of a British train being derailed on the neighbouring farm associated with these redoubts during this time. Annexure G provides a full account of the site

The HIA practitioner has deemed the structures to be worthy of conservation, although of little national significance. The preservation of both redoubts and railway line has been suggested, although the railway line is not deemed to be of sufficient significance to ensure that it is retained. The HIA practitioner has identified that the impact on the redoubts of a solar panel farm is considered "low" and has recommended a minimum "setback buffer" of 15m from the redoubts and 5m from the "old" railway line. Given the development footprints identified in Annexure "A", such buffers have been accommodated.

Table 7 identifies the significance of impacts of this feature from a cultural heritage perspective (as well as heritage impacts at other sites) given the proposed land use change.

Table 7 Summary of significance of heritage impacts / issues associated with sites before and after the application of mitigation measures

	Impact	Before	Mitigation		
Cultural Heritage Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D	X				LOW
Site G	X				LOW
Site H		X		Establish buffer	LOW
Site I	X				LOW

From Table 7 above, it is evident that the sites in question show limited heritage impact significance, with the exception of Taaibosch, which after mitigatory measures being introduced indicates that such impacts may be considered to be "low".

8.2 Local Economic Development

Photo voltaic facilities are considered to have a number of economic linkages. Such linkages are both direct and indirect. The impact of these effects can be summarized as follows

Indirect linkages. Such linkages relate to secondary externalities arising from the establishment of the PV facility. As such, the manufacture of panels, frames and other technical components, as well as the planning and design of the facilities, may be considered as an indirect linkage. While much of the technical components are manufactured abroad, the applicant has specifically sourced South African producers of PV Panels in order to ensure economic beneficiation remains within the country. With the exception of some technical expertise, professional services are also contained within the country.

In addition to this tier, with the establishment of the PV facilities, it can be identified that economic benefits will be accruing in terms of maintenance, delivery and related services that would arise during the operations of the facilities.

Direct Linkages. Direct economic linkages are those economic benefits that are internalized within the site of the PV facility or within the localized society / community. To this end the establishment and operation of a PV facility is deemed to generate a number of jobs.

Greenpeace and the European Union, in 2008 provided the following statistics associated with the operations and management of PV centres in Europe

- 10 jobs are created per MW during production
- 33 jobs are created per MW during the process of installation
- 3-4 jobs per MW for wholesaling of the system and indirect supply
- 1-2 jobs per MW created in research
- "Greenpeace and European Photovoltaic Industry Association -Solar Generation V – 2008"

Given the above, it can be expected that *on average* and assuming a 30MW installation for each site, 990 jobs can be created in and around each of the four sites under consideration. This excludes the jobs identified in other sectors above and relates only to the installation process In total, the establishment of the four sites would see just less than 4000 jobs being created in the Northern Cape region.

Social Upliftment

Aside from the abovementioned direct and indirect positive externalities and internalities arising from the PV Centre establishment, the applicant has committed itself to supporting national policy initiatives towards black economic empowerment and social upliftment. In this respect the applicant, Scatec Solar South Africa, a joint venture company that is 55% owned by Scatec Solar AS and 45% by its South African partner Simacel Pty Ltd, is an accredited 20.25% BEE Company.

In addition, Scatec Solar SA has set up three Broad Based Black Economic (BBBEE) trusts in the Northern Cape. These are the Hanover Community Trust, The De Aar Community Trust and The Phillipstown Community Trust. The purpose of these trusts will be to assist in development initiative within these communities by building much needed infrastructure, including schools and clinics. Furthermore a mandate has been signed with South Africa's biggest bank, Standard Bank, by means of a financial arrangement to support such trusts and ensure their sustainable operation. Standard Bank will also be providing BEE finance and advice to the trustees of the three community trusts. Should a license to generate be granted, the applicant has undertaken to build an "off grid" PV system for the local villages so as to provide power. Similar initiatives have successfully been undertaken in approximately 33 villages in India. The off grid solution provides additional employment and stimulates industry. Refer to Annexure "H".

In addition to the project link support arising from Scatec Solar SA, the company has also made direct financial aid provision to:

- Mamenlani (http://www.mamelani.org.za/) works with various communities to assist youth development, health, family support and development.
- De Aar Rotary Club – Scatec Solar SA has assisted primary schools with school bags and school books. (http://deaarrotary.co.za/rotary/)
- KZN Department of Education – sponsored a dinner for disadvantaged puils.
- I Am Water Trust (http://www.iamwater.co.za/you-are-water/) A trust established in 2010 to assist in ocean and beach clean ups; community free diving courses and other ocean educational initiatives.

Table 8 below indicates a review of the positive impacts associated with this project

Table 8. Economic beneficiation as **a positive externality**

	Impact	**Before**	**Mitigation**		
Economic Beneficiation	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D			X	n/a	HIGH
Site G			X	n/a	HIGH
Site H			X	n/a	HIGH
Site I			X	n/a	HIGH

As can be gleaned from Table 8, direct and indirect impacts of a social nature associated with the proposed PV project is considered "high - positive".

8.3 Visual aspects

"Landscape" and other issues related to "aesthetics" are seen as issues which are highly subjective in nature. It is evident that the landscape associated with the development site is not "unique" being "common" in occurrence within the region. Using the criteria of the United Kingdom's Institute of Environmental Management and Assessment "landscape sensitivity" and "visual receptors" should form the basis for the evaluation of visual impacts. Temporal and spatial arrangement should also be considered from a mitigation perspective. Further to the above, the presence of existing "visually intrusive" structures should be taken into consideration.

From a visual amenity perspective the Karoo can be considered to have such amenity by virtue of its "arid terrain" and sense of "open space" with related geological features under an agricultural land-use regime. As such, alteration of these, the prevailing visual parameters will be subject to variance as a result of the proposed developments.

The **sensitivity of a landscape** is defined as the amount to which a landscape or view can accommodate an impact without adverse effect on its character. **Visual receptors** to the sites would primarily be persons traversing the major roadways, as all sites are positioned on private land. The only site considered to have a moderate sensitivity (as identified in the scoping process) was Site I, due primarily to the proximity of the national freeway to the northern edge of the site.

The visual receptor site (road) is located approximately 1.6km north of the proposed development footprint, at approximately 5m below the average height of the development footprint. As such the development site is located at approximately 0.18 ˚ elevation from observer. Prominence is thus less than 1˚ elevation (see Fig 16). In addition, at 1.6km from receptor, the proposed structures would be at approximately 20% of the most extended range of view to the naked human eye (which is generally the horizon at approximately 8 – 10 km). The structures at 2.2m in height would extend the elevation from the receptor site to 0.25˚ an angle of increase which is indiscernible to the human eye.
By way of comparison, when considering the national road as viewed from the development site, this structure and the traffic on it, which approximates between 1.5m and 4m in height and is thus generally indiscernible, as indicated in Fig 16.

Fig 16. Conceptual arrangement of receptor (observer) and development footprint at Site I.

A review of the visual impacts associated with all sites and primarily with the introduction of mitigatory measures on site I , is provided below.

Table 9 Visual Impacts associated with sites

	Impact	Before	Mitigation		
Visual Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D	X				LOW
Site G	X				LOW
Site H	X				LOW
Site I	X			Maintain set back from National Road	LOW

Table 9 indicates that all sites have limited or low visual significance even without mitigation and that due to the temporary nature of these facilities, the impacts themselves must be considered to be "temporary". The possible cumulative impact or so-called "landscape amnesia" (Thetard 2002) may play a role over time, thus reducing visual incidence. Such effects should be reviewed in the event of any further phases being added to, in particular, site I.

Fig 17. View from site northwards towards freeway – which indicates that structures will remain below horizon and would not generally be identified from major roadway.

9 OTHER ISSUES AFFECTING SELECTED SITES

9.1 Agriculture

An agricultural assessment/comment was undertaken in order to evaluate the possible repercussions of establishing a PV centre on land presently utilised for livestock production. The object of such evaluation is to ensure that the PV centre does not neutralize the agricultural potential of the land in question. The impact report (Annexure I) indicates that little significant impact would arise from the intercalation of solar PV facilities to site. Comment on the exclusion of larger livestock and goats should however, be considered by all farmers in the area.

Table 10. Summary of significance of impacts on agricultural activities, associated with sites before and after the application of mitigation measures

	Impact	**Before**	**Mitigation**		
Agro technical Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D	X			Erosion control	LOW
Site G	X			Erosion control	LOW
Site H	X			Erosion control	LOW
Site I	X			Erosion control	LOW

9.2 Access

Much of the "suitability" of photo voltaic facilities for power generation is based on the "temporary nature" of the structures and the ease with which the panels and supporting structures can be relocated. This allows for the rapid and easy deployment of PV panels and structures to almost any point regardless of terrain. However, the scale of the PV farms envisaged has necessitated some consideration of "access' to the facilities whereby the necessity to bring in larger vehicles (trucks) in order to off load or establish mini substations or similar sized structures can be easily undertaken.

In reviewing sites D, G, H and I, all sites lie within 50m of an established road and/ or railway siding. (Annexure B) In the case of Van der Lindeskraal (Sites D and I) a siding allows for trains to stop and material to be delivered to and from site. All other sites (including Sites D and I) have existing earth and / or hard-topped roads leading to site, approximately 5m width, suitable for the movement of a low bed truck or similar vehicle. As such and not withstanding general maintenance to existing roads, there will be no requirement to establish new roads and as such impacts relating to access for each site should remain "low". Table 11 indicates impacts associated with access to the specific sites.

Table 11 Summary of significance of impacts associated access improvements and maintenance with sites before and after the application of mitigation measures

	Impact	**Before**	**Mitigation**		
Access Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D	X			Maintenance of existing access	LOW
Site G	X			Maintenance of existing access	LOW
Site H	X			Maintenance of existing access	LOW
Site I	X			Maintenance of existing access	LOW

9.3 Erosion

Erosion within the Karoo area may be considered to be of the following origins:

- Aeolian – wind driven
- Anthropogenic – caused by human disturbance, including overgrazing
- Surface flow (water) related – flood related, concentration of flowing water
- Rainfall impingement (splash erosion) - rainfall on unvegetated or unstable surfaces

Soils within the sites are either Lithic or Cumulic in nature (Fey 2010) and as such are generally percolative with a high calcareous presence, particularly in the E horizon where this is present. Most erosion in the region and with particular regard to the sites in question, are the result of anthropogenic impacts over time. Grazing, and in particular "over-grazing" has led to significant vegetative cover loss, making the area in general, susceptible to both Aeolian, sheetflow and splash erosion (Annexure G). Presently, these forms of erosion are countered by the establishment of livestock camps, allowing areas to remain free of grazing, with vegetative cover being restored through both vegetative growth and seeding.

The establishment of photovoltaic panels within the said sites is unlikely to exacerbate this situation directly and is most likely to lead to direct improvement in grass production below the panels through shading and improved water availability, as the panel will require cleaning on a regular basis.

However, the panels may act to exacerbate erosion through:

Wind sheer. The flat panels, positioned parallel to natural ground levels may serve to interrupt surface laminar flow winds and create wind sheer under high wind periods. This may be a low level and possibly latent effect, but should require monitoring from a management perspective.

Splash induced erosion and surface flow. The panels will serve to concentrate flow and to direct this flow on particular points within site, where, assisted by gravity, concentrated volumes of water will erode surface soils (splash erosion) and may under high precipitation circumstances, lead to concentrated sheet flow and gulley formation.

The latter is a significant concern and has been highlighted in the geotechnical and ecological evaluations of the site. Table 12 identifies the significance of impacts arising on each site as a result of splash erosion at each site, which can be considered to be of a "moderate" level at all sites. However, the risk is easily countered through mitigation by the implementation of a number of management principles which would require on-going implementation to not only prevent erosion, but to ensure the sound maintenance and operation of the PV facility.

Table 12 Summary of significance of impacts associated erosion effects at study sites before and after the application of mitigation measures

	Impact	**Before**	**Mitigation**		
Access Impacts	**Low**	**Moderate**	**High**	**Mitigation**	**Impact after mitigation**
Site D		X		Drip capture/harvesting and attenuation methods	LOW
Site G		X		Drip capture/harvesting and attenuation methods	LOW
Site H		X		Drip capture/harvesting and attenuation methods	LOW
Site I		X		Drip capture/harvesting and attenuation methods	LOW

While considered to be of "low" significance, the present incipient effect of erosion on the sites in question is one that is ubiquitous within the Karoo and has been highlighted as the most significant bio physical impact arising out of the proposed activity. As such, **sound implementation of erosion control and stormwater management methods is the most important aspect of environmental management on any of the sites evaluated. (See Annexure M)**

9.4 Indirect and Cumulative Impacts

Indirect impacts are by definition, those impacts that arise as a result of a "creeping normalcy" (Diamond 2006) where the negative effect arising from the proposed activity is not manifest as a consequence of the activity, but is either delayed on a temporal basis or is manifest spatially outside of the perceived zone of influence of the activity. As the proposed activity is a temporary one, indirect (and cumulative) impacts arising from the activity should be easily reversed if necessary. However, a number of possible effects of an indirect nature may manifest themselves over time, these being primarily socio-economic and agro economic in nature and may include:

- **Land use variation or change**. With an alternative land use arising that has more sustainable long term income opportunities, land that is available for solar power facilities may prove to be a more significant income generator than livestock ranching, the dominant land use within the region. While both activities are compatible, economic drivers in other sectors may change (i.e. input costs for livestock management), which coupled with the alternative PV land use, may see an increased abandonment of livestock on these lands. Such impacts will be tempered by the availability and capacity of the grid. This impact, while possibly of a small but low significance, may at a cumulative and regional level create problems in terms of the maintenance of agricultural land uses in the region and the sheep and goat industry in general. The approach to such concerns would require a shift in Governmental policy towards farmers, which would see a decision to either allow for a *laissez faire* process in terms of competitive land utilisation or intervene to support and maintain livestock farming in the region.

- **Land and Property Prices**. Coupled with the above, the value of land adjacent to sub stations, or able to offer suitable PV establishment facilities may (should) increase. With the abovementioned job creation potential the demand for residential land may increase significantly. As such, it can be surmised that a "gradient of land prices" may arise according to proximity and distance from sub stations. While not a necessarily negative impact, the agro economic effects of this "gradient" will have to be considered in time.

- **Residential Property Requirements**. As a job creation tool, the benefits of establishing solar PV facilities has been identified. Some of the job opportunities arising require specialist skills which require highly skilled and relatively high to highly paid individuals to be positioned in and around these facilities. As a result it can be expected that residential properties in particular in towns such as Hanover, where property prices are presently "low"

in comparison to the country, may rise as lifestyle demands of higher earning individuals arise in the area. With such increases, comes a general increase in the price of consumer goods. The socio-economic impact associated with such cost of living increases is spread across the local society as a whole and it must be identified that in the long term, wages will have to increase accordingly.

10 DESIGN ISSUES & ALTERNATIVES

Reference is made to Annexure B (annexures B1 to B4) where the preferred and recommended layouts are indicated. The following comments pertain to the sites in question and the final proposed layouts are indicated.

10.1 Site D

Site D and Site I (below) are "linked" and are considered in terms of a single layout. No significant constraints have been noted at a bio physical level. Annexure B 1.1 (Fig 18 below) identifies the proposed layout, with Annexure B1.2. being the original considered proposal.

Fig. 18. Recommended Final layout at Site D

10.2 Site G

Site G offers few limitations and constraints in terms of layout. As such Annexure B2.1 (Fig. 19 below) offers no alternative layout and design and it is evident that much of the area can be utilised for the establishment of PV facilities.

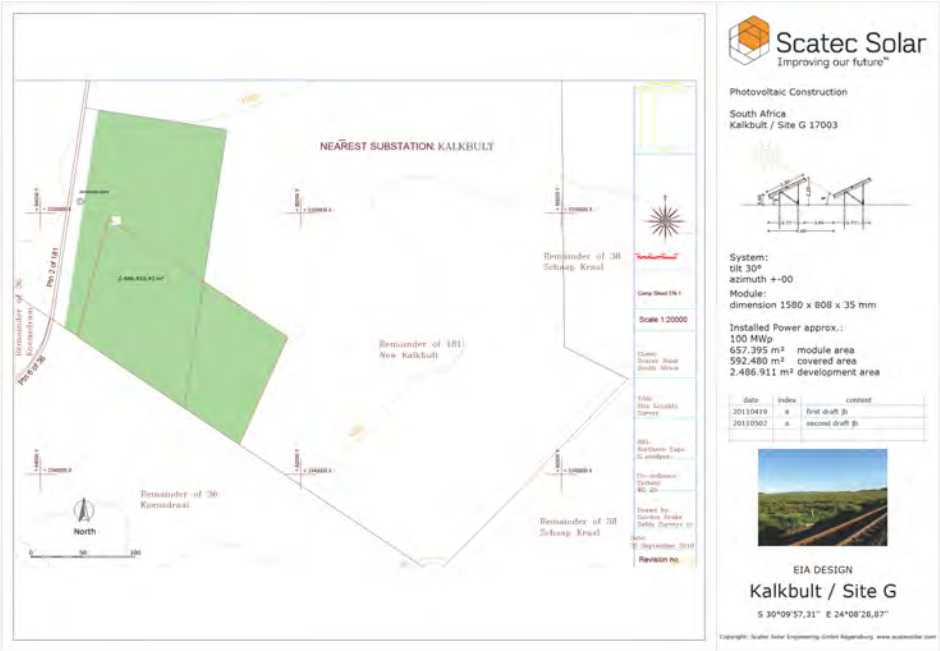

Fig. 19. Recommended Final layout at Site G

10.3 Site H

Site H offered some limitations in design in terms of "avoidance" of low lying areas as well as the buffering of the heritage site identified in close proximity to the railway line. Annexure B3.1 (Fig 20 below) indicates that clear avoidance of the heritage sites has been undertaken and concentration of panels in the north west of the site has been preferred, which avoids lower lying ground and possible erosion threats..

Annexure B3.2 offers the alternative layout originally proposed prior to evaluation of impacts

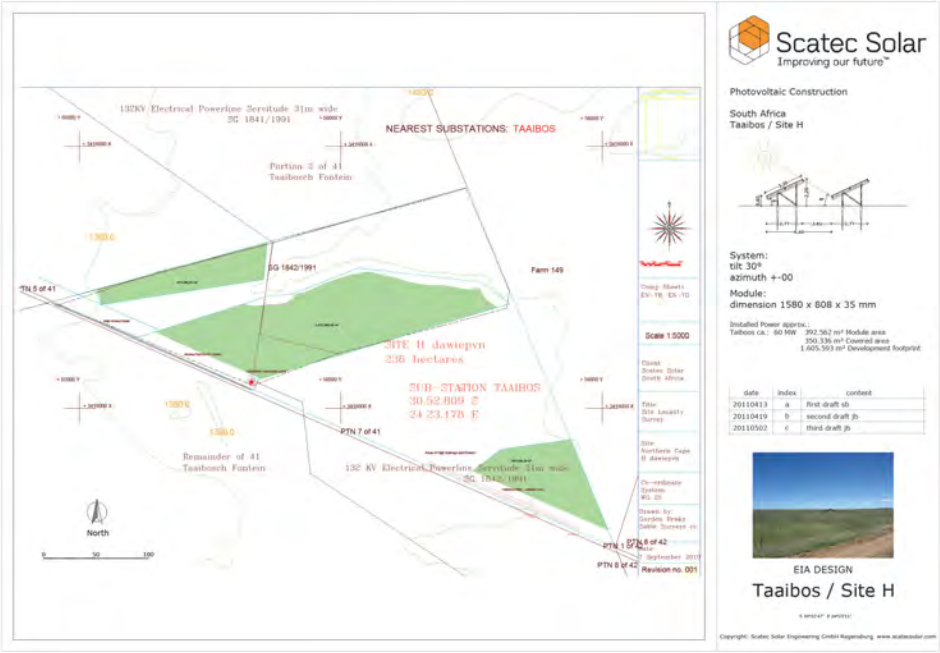

Fig. 20. Recommended Final layout at Site H

10.4 Site I

Site I should be considered in conjunction with Site D. The layout in site I has been constructed to avoid the sandstone promontory identified in the bio physical evaluation.

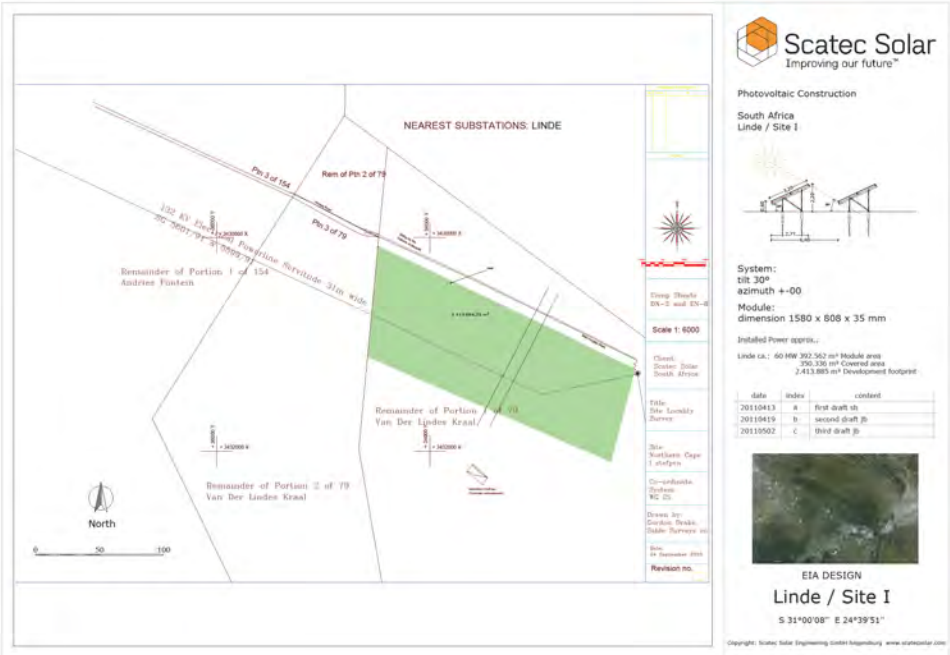

Fig. 21. Recommended Final layout at Site I

11 PUBLIC ENGAGEMENT AND PARTICIPATION

11.1 "Process and Authority Issues"

A public participation process as contemplated in terms of Chapter 6 of the Environmental Impact Assessment Regulations of the National Environmental Management Act (1998) was engaged in by the applicant, during the scoping phase (August 2010 to December 2010).

The scoping report was submitted in January 2011 to the Northern Cape Department of Environment and Nature Conservation . The applicant was subsequently informed telephonically in March 2011 that following a meeting held in February 2011 between Provincial departments and the National Department of Environmental Affairs, that the application was no longer subject to evaluation by the Provincial Departments, but was to be referred to the National Department of Environmental Affairs. Due to the fact that a new application form had to be compiled and due to the delays described above, the relevant legislation, particularly the "trigger activities" under which the application was lodged was also changed. The revised submission to the Department of Environmental Affairs in Pretoria was undertaken in March 2011, with the resubmission of application forms and scoping documentation. Condoning of the fact that the scoping and EIA was undertaken in terms of an application to the Provincial department was sought as to "re institute" the application and compile the scoping in terms of the new regulations which would severely prejudice the applicant.

The EIR document has been circulated to all parties, with the Northern Cape Department of Environment, Conservation and Economic Development being considered as a Lead Interested and Affected Party. All land owners have been provided with copies of the draft EIR as have Eskom (Ltd), a Lead Interested and Affected Party. The responses received from the IAPs to the EIR are intercalated under Annexure F.

12 EVALUATION OF IMPACTS

Figure 22 below visually summarises the impacts associated with the proposed development at a bio-physical level. The most significant issue arising from the proposed activity is the possible impact of erosion of land arising from the establishment of the panel structures. The effect of placing an impermeable structure of approximately $3m^2$ and approximately 2m above ground is generally inconsequential on a singular basis in respect to increased hardpan and the concentration of water (rainfall). However, the effect of covering several hectares with such structures, is significant and unless brought under management, may give rise to severe erosion.

Fig 22 also identifies the effect of "shadow" which together with alteration of general precipitation fall onto natural ground is expected to result in some general ecological change in terms of vegetation cover and species composition. The latter changes should not necessarily be considered 'negative' as agricultural benefits may be derived from the presence of the panels. A latent and minor bio physical variation may also arise, namely 'wind sheer', which, together with drip effects, may exacerbate erosion problems in the immediate site.

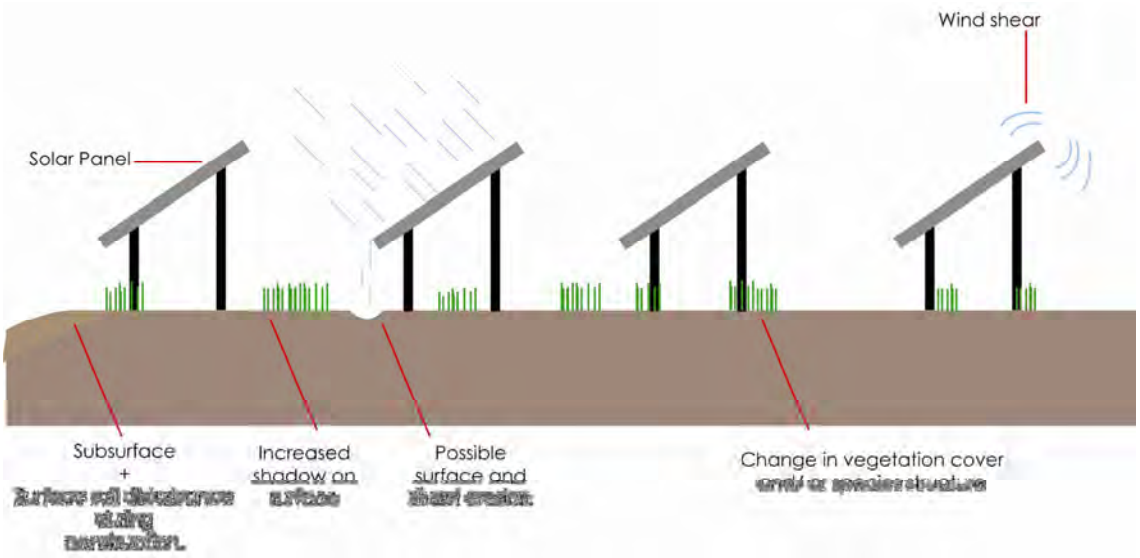

Fig 22 Concept diagram identifying possible impacts arising from PV facility during operation and during construction

The impacts identified above are summarized in Table 13 below in order to gauge the significance and probability of occurrence.

Table 13 Nature and significance of impacts associated with development.

Issue	Description/ Nature	Timeframe to manifestation of Impact [1]	Reversibility	Impact Significance / Intensity	Probability of Occurrence	Significance of Impact
				Low = 1 Moderate = 2 Extensive = 3	Certain =1 Probable = 0.5 Unlikely = 0.1	Severity x Probability Max score = 3
Terrain and geotech.	Physical alteration of natural surfaces and environment as well as suitability for establishment and seismic stability. Consideration of terrain and topography	Short	Reversible	1	0.3	**0.3**
Ecological	Alteration of vegetative cover and communities. Disruption of ethology of species.	Short to moderate	Reversible	1	0.6	**0.6**
Visual	Alteration of the prevailing ambience at landscape level.	Short	Reversible	1	1	**1**
Cultural Heritage	Destruction or alteration of cultural and historical resources	Short	Reversible	1	0.1	**0.1**
Agricult	Alteration of land use leading to change in agro-economic status of land and associated operations	Short	Reversible	1	0.3	**0.3**
Socio econ	The resultant impacts on local economy and change in social structures, personal and community economic status	Short to long term	Reversible	3	0.8	**2.4**
Erosion Potential	Prevailing and significant loss of soil sediment and / or mineral composition as a result of disturbance.	Short to moderate	Reversible	1	0.8	**0.8**
Access	The establishment of maintenance of new and or existing roads to allow for construction of facilities.	Short	Reversible	1	0.1	**0.1**

: [1] Less than 12 months = short : 12 – 60mnths = medium : >60mnths = long

From Table 13 above, it is noted that most identified impacts are of a generally "low" rating, (impacts are considered to be of a value equal to or less than 30% of the maximum score), with the exception of the socio-economic impacts, which achieve a rating of 80% of total achievable score.

The four issues which are considered to be of some significance and are highlighted in the table, are, namely "ecological change", "visual amenity", "socio-economic aspects" and "erosion". All impacts identified are to be considered "reversible" on account of the fact that the PV centre may be removed over time and that management input may address most impacts directly. Comment on the identified impacts highlighted in Table 13 above is provided below.

As has been identified above, the affected **ecology** of each site is considered to be of limited significance and such habitat cannot be deemed to be "rare" or providing a "high ecological or environmental service".

Visual impacts are considered to be of some significance as they are definite and landscape alteration is to be expected. However, as discussed above, the visual receptors are considered to be distal to the structures envisaged, while the receiving environment is not generally considered unique, thus indicating that while visual alteration is an expectation, the impacts are generally isolated and localized.

Socio-economic impacts are highlighted as being highly significant on account of the expected increase in job opportunities and the expected local economic development linkages that will be created as a result of the proposed development. Such impacts can be considered as "positive impacts" with positive externalities.

The effect of the PV facilities as conduits for **erosion** and an increase in erosion potential on the sites in question cannot be ignored. While erosion is an impact that is of high probability, the counter-balance of such effect is through management and a number of management options are provided in the environmental management plan proposed for the sites in question, where one or more of the erosion control measures proposed may be implemented.

With due regard to the significance of impacts, a holistic approach to each site may be undertaken, whereby the impacts identified may be applied to each site and their significance ("low", "moderate" or "high") may be provided with a value in which an overall "impact" of the proposed activity on site may be determined. Table 14 provides a qualitative evaluation of each site and impact, while Table 15 allocates a value to each site and impact in order to determine an overall, indicative level of

impact. A comparative "no go" evaluation is also undertaken whereby the impact of retaining the *status quo* or present land use / site status is undertaken.

Table 14 : Descriptive matrix for key sectorial evaluations of impacts at sites, after mitigation. Comparative "no-go" option applied

Issues						
	Terrain and geotechnical	**Ecological**	**Visual**	**Cultural Heritage**	**Agricultural**	**Socio -Economic**
Site D	**Low** . Limited erosion risk, suitable founding conditions. Construction related alteration of surfaces	**Low.** Nama – karoo grasslands with low diversity of shrubs and herb species.	**Low**. Receptor sites are distant	**Low.** Limited likelihood of resources	**High.** Possible improved veld. Diversification of land use.	**High.** Increased job creation opportunities. Sustainable energy production
Site G	**Low** . Limited erosion risk, suitable founding conditions. Construction related alteration of surfaces	**Low**. Primarily low diversity grass – succulent mix, with significant grazing	**Low.** Receptor sites are distant	**Low**. Limited likelihood of resources	**High.** Possible improved veld. Diversification of land use.	**High**. Increased job creation opportunities. Sustainable energy production
Site H	**Low** . Limited erosion risk. Avoidance of low lying areas. Suitable founding conditions. Construction related alteration of surfaces	**Low.** Taller grassland with low forb diversity	**Low**. Receptor sites are distant	**Low**. Cultural heritage resource, suitably buffered	**High.** Possible improved veld. Diversification of land use.	**High.** Increased job creation opportunities. Sustainable energy production
Site I	**Low** . Limited erosion risk, suitable founding conditions. Construction related alteration of surfaces	**Low.** Nama – karoo grasslands with low diversity of shrubs and herb species	**Low**. Receptor is distant but within 1.6km.	**Low** : Limited likelihood of resources	**High.** Possible improved veld. Diversification of land use.	**High**. Increased job creation opportunities. Sustainable energy production
No Go Option	**Low**. No change to status quo	**Low**. No change to status quo	**Low**. No change to status quo	**Low**. No change to status quo	**Low.** No change to status quo	**Low**. No change to status quo

Using the above qualitative description, values are applied according to the following :

High + ve impact	=	+3
Moderate +ve impact	=	+2
Low +ve impact	=	+1
No change in impacts	=	0
Low –ve impacts	=	- 1
Moderate – ve impacts	=	-2
High – ve impacts	=	-3

A decision matrix can be utilized to provide an indication of the preferred design options for the PV farms to be employed, based upon the components identified in table 14 vs the prevailing land use or "no go option". The "no go" option will be given an overall value of '0', with the greatest positive value being adjudged the favoured activity across the environmental spectrum.

The outcome of the impacts of proposal vs "no go" option can be further tempered by mitigation measures.

Table 15 Collated review of Impacts Associated with Sites

Issues							
	Terrain and geotechnical	**Ecological**	**Visual**	**Cultural Heritage**	**Agricultural**	**Socio - Economic**	**Value**
Site D	-1	1	0	0	+1	+3	4
Site G	-1	1	0	0	+1	+3	4
Site H	-1	1	0	0	+1	+3	4
Site I	-1	1	0	0	+1	+3	4
No Go Option	0	0	0	**0**	**0**	**-3**	**-3**

From Table 15 above, it is evident that all sites show significant and generally equal benefits across the environmental spectrum. The option of not implementing the proposed activity indicates that at a local and regional level, a significant socio-economic benefit would be lost. It can thus be concluded that the development of PV power generation facilities on all sites identified (Sites D,G,H and I) should be supported on the grounds of the minimal localized bio physical impacts associated with the facilities' construction and operation, while socio-economic and economic beneficiation at local and regional scales are high.

13. CONCLUSION & MANAGEMENT RECOMMENDATIONS

The Environmental Impact Report has identified a number of positive and negative impacts that would arise with the development of PV power generation facilities on the four sites in question. The initial investigations of 9 sites proved that five of the sites were not feasible on technical grounds and should be discarded.

The balance of the sites, namely sites D, G, H and I, do offer significant opportunity to develop PV facilities. Using the evaluated footprints determined by application of bio physical evaluation, the following power provision is expected at each of the sites in question:

Table 16 Sites and expected power generation capabilities as a function of area

Site	Property Description	Total Development Area (Ha)	Total Power Production Potential (MW)	Initial Power Production (MW)
D	Vanderlindeskraal No 79	56	86	30
G	Erfpag seinde die plaas New Kalkbult No. 181	249	383	100
H	Restant van die plaasTaaiboschfontein nr. 41	161	248	60
I	Remainder of portion 1 of the Farm Van der Linderskraal No 79 ; Portion 3 (of 1) of the Farm Van der Linderskraal No 79 ; Remainder of the Farm Van der Linderskraal No 79	241	370	60

The implementation of the proposed PV centres with the generation capacity indicated above and the expected local economic development potential is considered to be a significant positive beneficiation from the project with minimal impacts arising, and through thoughtful and considered management, should be mitigated with ease.

References

Adams J, 1976 "Wildflowers of the Northern Cape" Dept of Nature and Environmental Conservation of the Cape of Good Hope

Cowling R M 1986, The Karoo Biome : A Preliminary synthesis . Part 2 – vegetation and history. South African National Scientific Programmes Report 142 CSIR Pretoria

Diamond J, E Ostrom, R Walker 1994 "Rules, Games and Common Pool Resources" Univ Michigan Press.

Mucina L and Rutherford M.C. (eds) (2006) – The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Low B.A. and Rebelo A.G. (1998) – Vegetation of South Africa, Lesotho and Swaziland. A companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Solar Generation V" 2008 Greenpeace and European Photovoltaic Industry Association

United Kingdom Institute of Environmental Assessment (1996) "Guidelines for Visual Impact Review"