

ENVIRONMENTAL IMPACT ASSESSMENT

**PROPOSED CONSTRUCTION AND IMPLEMENTATION OF
HOTAZEL SOLAR DEVELOPMENT, NORTHERN CAPE**

APPLICANT:

ABO WIND HOTAZEL PV (PTY) LTD

**AGRICULTURAL IMPACT REPORT
NOVEMBER 2018**

*STUDY CONDUCTED AND
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1. INTRODUCTION

ABO Wind Hotazel PV (Pty) Ltd is applying for authorisation to construct a 100 Megawatt PV facility, to be known as Hotazel Solar, on the Remaining Extent (Portion 0) of Farm York A 279, situated in the District of Hotazel in the Northern Cape Province. The grid connection will be at one of the following: direct to the Hotazel Substation ± 3 km North West or Loop-in-loop-out to one of the existing powerlines crossing the site.

The objectives of this study were to consider possible temporary and permanent impacts on agricultural production that may result from the proposed construction and operation of the PV Power Plant.

2. APPROACH AND METHODOLOGY

The approach was to compile a natural resource database for the study area. This would include all necessary information to determine the agricultural potential and risks for farming on this land unit. The proposed development would then be considered in terms of possible impacts it may impose on agricultural production of the unit and on the surrounding area.

The resource data was obtained from published data (AGIS) and then compared to a field survey done on 5 and 6 June 2018.

3. ASSUMPTIONS AND UNCERTAINTIES

Regional information was mainly obtained through a desktop study. Climatic conditions, land use, land type and terrain are readily available from literature, GIS information and satellite imagery. This information was confirmed as far as possible at the time of the field survey.

The site was visited during the winter season, so that information on summer conditions remains the result of the desktop study.

4. DESCRIPTION OF THE PROPOSED PROJECT

ABO Wind Hotazel PV (Pty) Ltd is applying for authorisation to construct and operate a solar photovoltaic (PV) plant on the remaining extent (Portion 0) of the farm York A 279, situated in the District of Hotazel in the Northern Cape Province. The Solar Plant will be known as Hotazel Solar and will consist of solar photovoltaic (PV) technology with fixed, single or double axis tracking mounting structures, with a net generation capacity of 100 Megawatts.

Associated infrastructure will include, among others, an on-site substation/ switching station, auxiliary buildings, inverter-stations, access road and internal roads, a laydown area, an overhead transmission line and border fencing.

5. THE POTENTIALLY AFFECTED ENVIRONMENT

This section provides a general description of the immediate environment potentially affected by the construction, operation and closure of the proposed PV power plant.

5.1 Locality

The Hotazel PV facility is to be constructed near Hotazel on the remaining portion 0 of farm York A 279. Access to the site is gained directly from the R31 provincial road

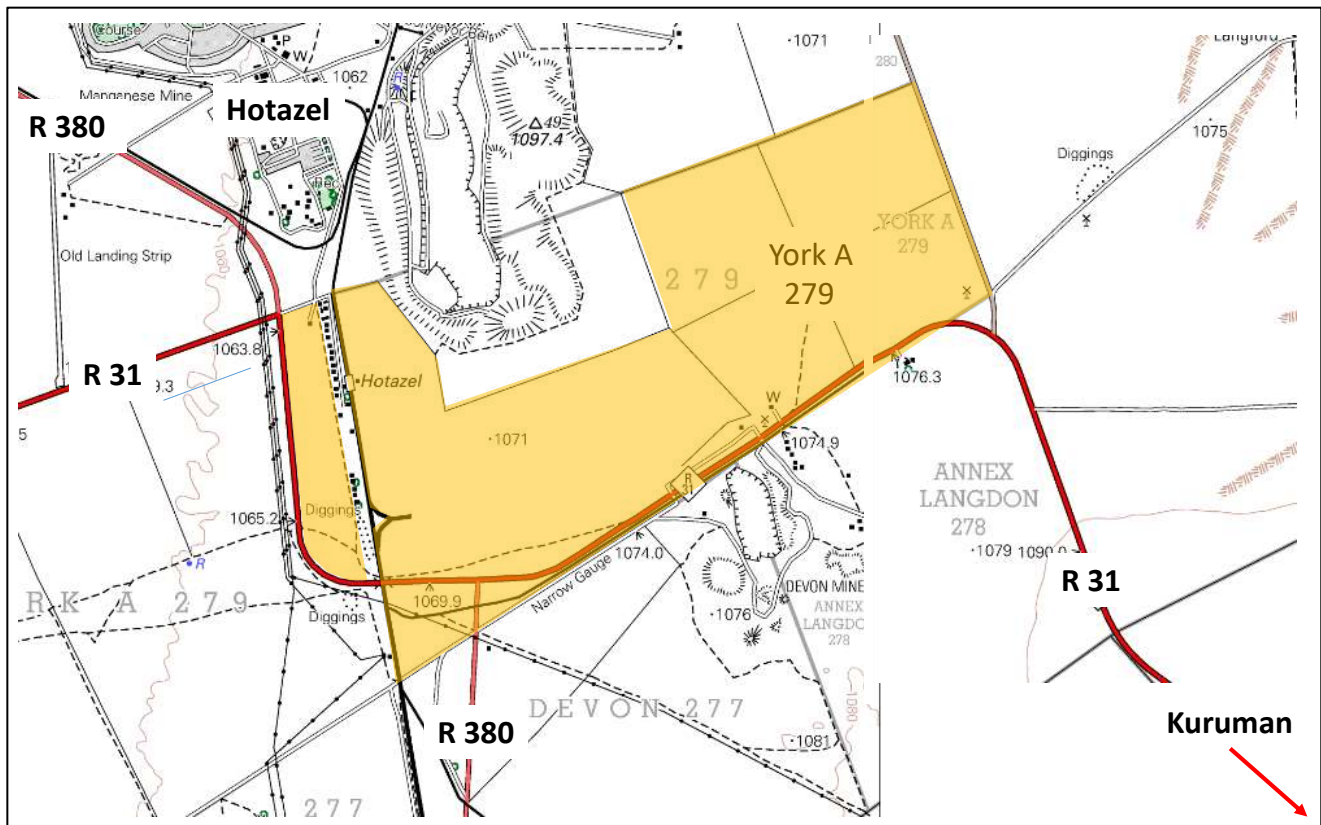


Figure 1: Locality of site

5.2 Physical description

Due to the proximity of the farm to the town and mining areas, the associated infrastructures of these developments converge on the farm. Structures include a provincial road, railway lines, overhead transmission lines, a communication tower and mining areas. These structures restrict the management of the farming activities as it sub divides the farm.

5.3 Climate

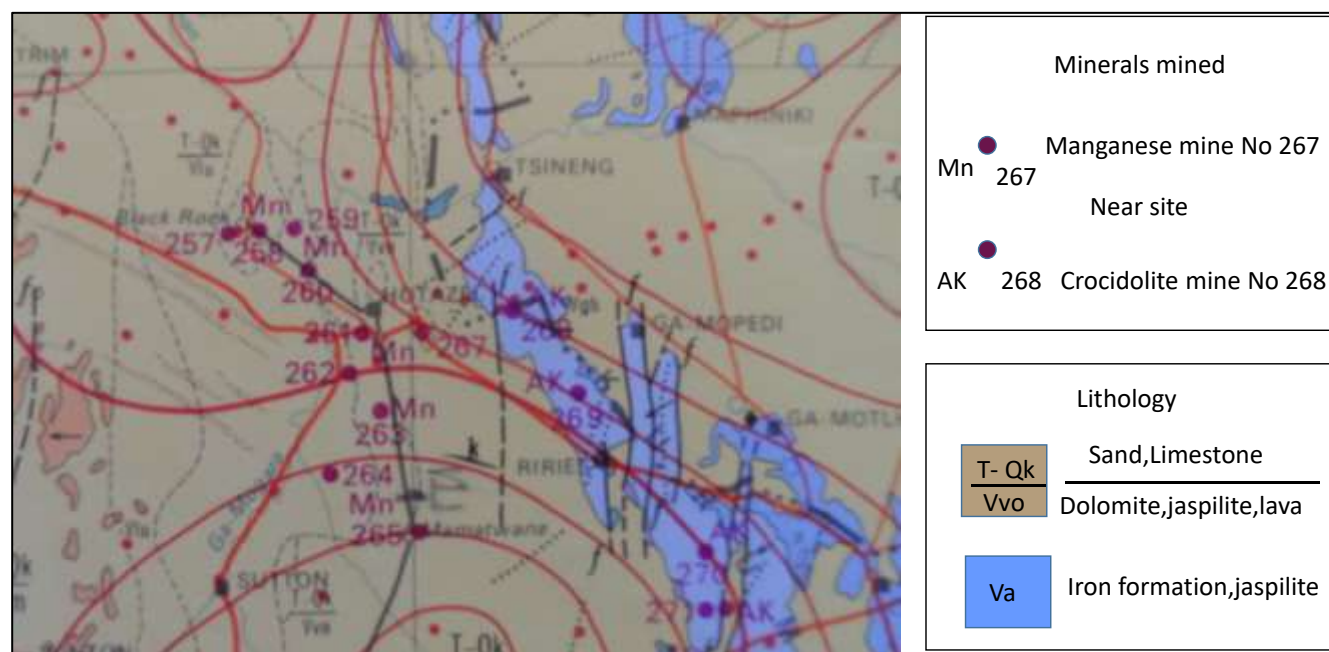
The Kalahari region has consistent temperatures with summer and early autumn rainfall. Winters are very dry. The wettest part appears in the east with a mean annual precipitation (MAP) of 500mm/annum and driest in the west with 120 mm/annum. The MAP for the whole Ecozone is 250 mm/annum. The region is classified as an arid zone with desert climate. The following specific parameters are applicable:

Table 1: Climatic information

Climate						
Rainfall		Evaporation	Temperature			
Month	Monthly mm	Monthly mm	Max °C	Min °C	Mean °C	Heat units
January	63	270	33.7	18.5	26.1	499.1
February	60	284	32.4	17.9	25.1	422.8
March	79	294	29.7	15.8	22.7	393.7
April	33	277	25.7	11	18.8	264
May	21	210	23.2	6.1	14.6	142.6
June	08	193	20.6	2.3	11.4	33
July	00	144	20.4	2	11.2	37.2
August	03	115	23.1	4	13.6	111.6
September	06	91	23.6	8.7	17.4	222
October	16	106	29.7	12.5	21.1	344.1
November	30	154	31.7	15.2	23.4	402
December	43	213	33.0	17.4	25.2	471
Total/Mean	362	2351	27.2	10.95	19.2	

5.4 Geology

The geology belongs to the super group KALAHARI with the occurrence of the Transvaal Rooiberg and Griqualand–West sequences.

**Figure 2: Geological Map 1984 Gravity Edition**

Lithology (parent material) indicated on the Geological map (Figure 2) refers to the primary outcrop as Sand and Limestone (T- Qk) and the sub outcrop (Vvo) as Dolomite, Jaspilite and Lava.

The Sand is also known as loess, which is sediment made up from silt sized particles of sand and clay, normally highly calcareous, deposited by wind.

Limestone is a sedimentary rock consisting largely of calcium carbonate, which is usually derived from shells of minute marine or fresh water animals. Sand clay and minerals such as magnesia or iron oxide are also present.

Dolomite consists of carbonate of calcium and magnesium. Dolomite usually occurs as invisible crystals, but in very large rock masses. The origin of dolomite is partly biochemical as it was formed by the precipitation due to the action of algae. The band of dolomite formed is interspersed with shale and minerals.

As with limestone, dolomite is soluble in water and can be released into the soil profile with the clay of the shale and nutrients of minerals.

The map also indicates some Manganese mines in the vicinity of the proposed PV facility.

5.5 Vegetation

This site is classified by Acocks as tropical bush and savannah bushveld within the Kathu Bushveld Biome. Typical trees include Camel thorn Acacia (*Acacia erioloba*), Umbrella Acacia (*Acacia tortilis*). Black thorn Acacia (*Acacia mellifera*). Indigenous and alien Mesquite *Prosopis* species are invasive in degraded and disturbed areas.

Indicator grasses include the following:

Common name	Botanical name	Gazing value	Ecological value
Small Bushman Grass	Stipagrostis Obtusa	Very high	Decreaser
Lemann's Love Grass	Eragrostis Lehmanniana	Medium	Advancer
Tassel Three-awn	Aristida Congesta	Very low	Advancer
Carrying Capacity	13 ha/ Large Stock Unit (LSU))		
Land Use	Livestock and Game farming		

5.6 Topography

The site has an almost level topography with the straight shape and slope gradient of 0,5 %.

Features captured on Topographical map 2722BB Hotazel include Arterial road R31, Main road R320, Railway station and railway lines, power lines, a wind pump, a communication tower, mine dumps and excavations, prominent rock outcrops, erosion and sand, a narrow gauge track, a hiking trail, cadastral and internal fences, and contours at 20 m intervals.

The cross section in Figure 3 provides information regarding the shape of the slope of the development footprint. It shows a straight shape for the foot slope (4).

This information is valuable when interpreting the land type data as this will indicate what soil forms can be expected in each terrain unit.

The terrain slope can be calculated using the difference in vertical height (20 m) divided by difference in horizontal distance (4000 m) X 100. The slope is 0.5%.

It is expected to find deeper soils on concave soils with water locked soils at foot slopes and valley bottoms.



Figure 3: Topographical map.

5.8 Soil

Soil and terrain information was obtained from the Land Type database. The desktop review provided a baseline agricultural and land use profile, focusing on the specific geographical area potentially impacted by the proposed project.

Land type refers to an area with similar climate, topography and soil distribution patterns, which can be demarcated on a scale of 1:250 000.

The land type map, 2722 Kuruman, is reflected in Figure 4 and the inventory for the map appears in Figure 5.

The map shows that the pedosystem **Ah 9** was allocated to the location. **Ah** represents the land type in respect of the terrain form, soil pattern and climate. This refers to red or yellow high base status soils >300 mm deep. The **9** is the first available number allocated to a land type identified on the map. Thus **Ah 9** was given to the 9th land type which qualified for inclusion in the broad soil pattern (or map unit) Ah.

The pedosystem is predominately located on a Footslope (95%) with a slope gradient of less than 1 %.

The dominant soil type predicted is an apedal, fine sandy textured soil with effective soil depth in excess of 1200 mm.

Very low mechanical limitations are predicted.

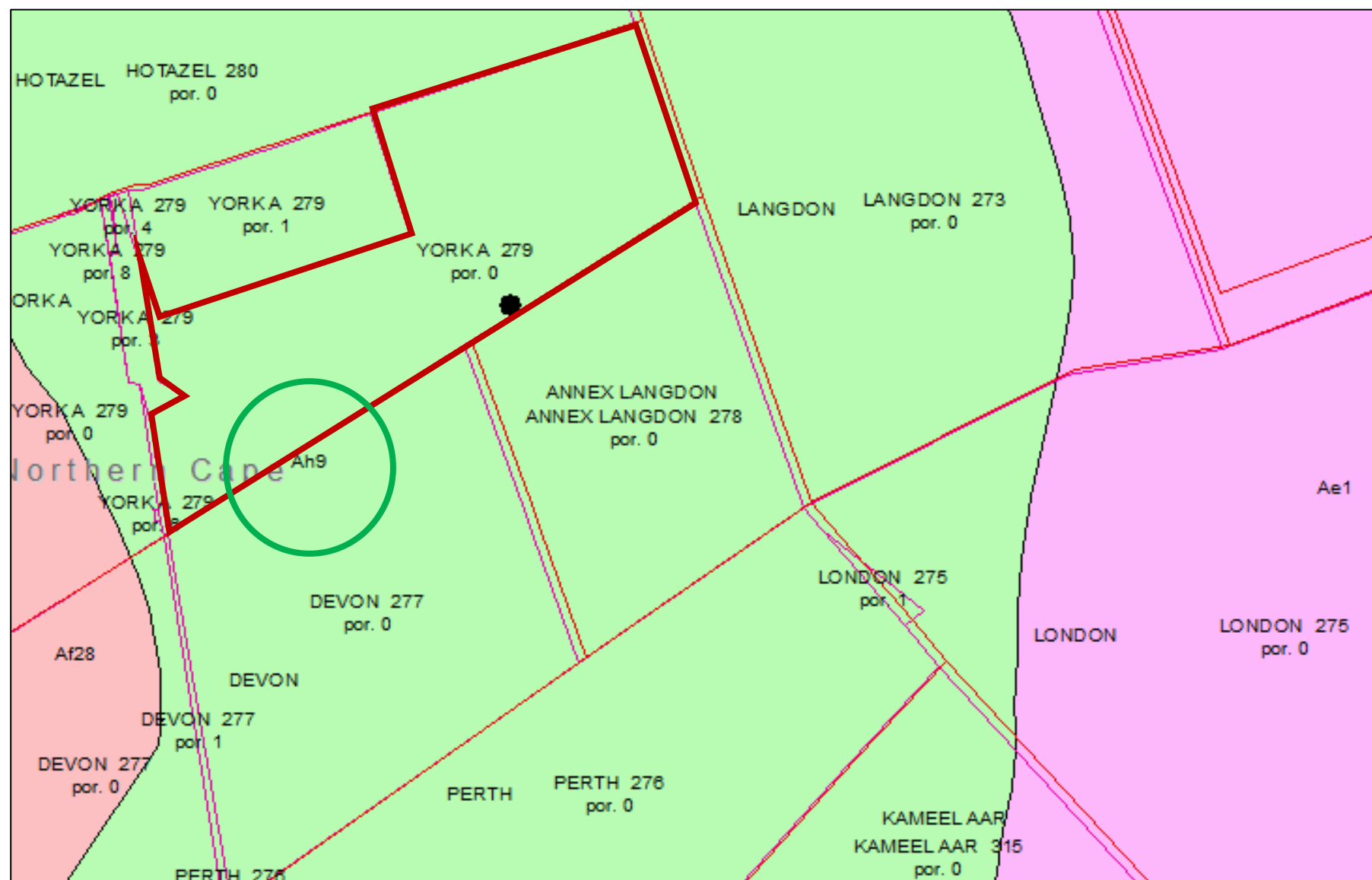


Figure 4: Land type map 2722 Kuruman

LAND TYPE / LANDTIP: Ah9

CLIMATE ZONE / KLIMAATZONE: 3S

Area / Oppervlakte: 89190 ha

Estimated area unavailable for agriculture

Beraamde oppervlakte onbeskikbaar vir landbou: 1080 ha

Terrain unit / Terreineenheid	:	4	5
% of land type / % van landtipe	:	91	5
Area / Oppervlakte (ha)	:	84730	4460
Slope / Helling (%)	:	0 - 1	1 - 3
Slope length / Hellinglengte (m)	:	100 - 10000	200 - 1200
Slope shape / Hellingvorm	:	Z	Z
MB0, MB1 (ha)	:	83883	1784
MB2 - MB4 (ha)	:	847	2676

Occurrence (maps) and areas / Voorkoms (kaarte) en oppervlakte:

2722 Kuruman (89190 ha)

Inventory by / Inventaris deur:

J F Eloff en A T P Bennis

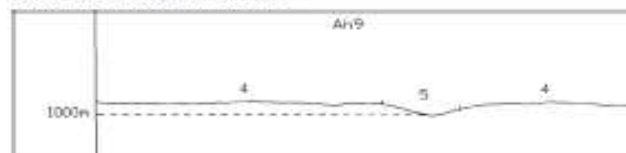
Modal Profiles / Modale profile:

None / Geen

Soil series or land classes / Grondseries of landklasse	Depth / Diepte					Total / Totaal	Clay content % / Klei-inhoud %	Texture / Tekstuur	Depth-limiting material / Diepte-beperkende materiaal
	(mm) MB:	ha	%	ha	%	ha	%	A E B21 Hor Class / Klas	
Sunbury Cv30	>1200 0 :	35587	42			35587	39.9	2-4 3-6 B fiSa	
Mangano Hu33	>1200 0 :	15251	18			15251	17.1	3-6 6-10 B fiSa	
Annandale Cv33	>1200 0 :	15251	18			15251	17.1	3-6 6-10 B fiSa	
Roodespoort Hu30, Gaudam Hu31	>1200 0 :	10168	12			10168	11.4	2-4 3-6 B fi/meSa	
Sandspruit Cv31	>1200 0 :	6778	8			6778	7.6	2-4 3-6 B meSa	
Mispah Ms10, Kalkbank Ms22	100-250 3 :	847	1	2230	50	3077	3.5	6-10 A fiSa	R,ka
Maputa Fw10, Motopi Fw20,	:								
Fernwood Fw11, Langebaan Fw21	>1200 0 :	847	1	1338	30	2185	2.5	3-6 4-8 B fiSa	
Sherrocks Hu36	>1200 0 :			446	10	446	0.5	7-10 15-18 B fiSaLm	
Pans/Panne	4 :			446	10	446	0.5		

Terrain type / Terreintipe: A1

Terrain form sketch / Terreinvormskets



For an explanation of this table consult LAND TYPE INVENTORY (table of contents)

Ter verduideliking van hierdie tabel kyk LANDTIP - INVENTARIS (inhoudsopgawe)

Geology: Aeolian sand of Recent age with a few outcrops of Tertiary Kalahari beds (surface limestone, silcrete and sandstone) in the riverbeds.

Geologie: Eoliese sand van Reiente ouderdom met enkele dagsome van Tertiêre Kalaharilae (oppervlakkalksteen, silkreet en sandsteen) in die rivierlope.

Figure 5: Land type inventory Ah 9

On 5 and 6 June 2018, the site was visited to conduct a soil survey.

An augering survey was carried out, assigning a unique number to each augering point and capturing the physical and morphological information on an observation coding sheet. The observation points and its coordinates are shown in Figure 6.

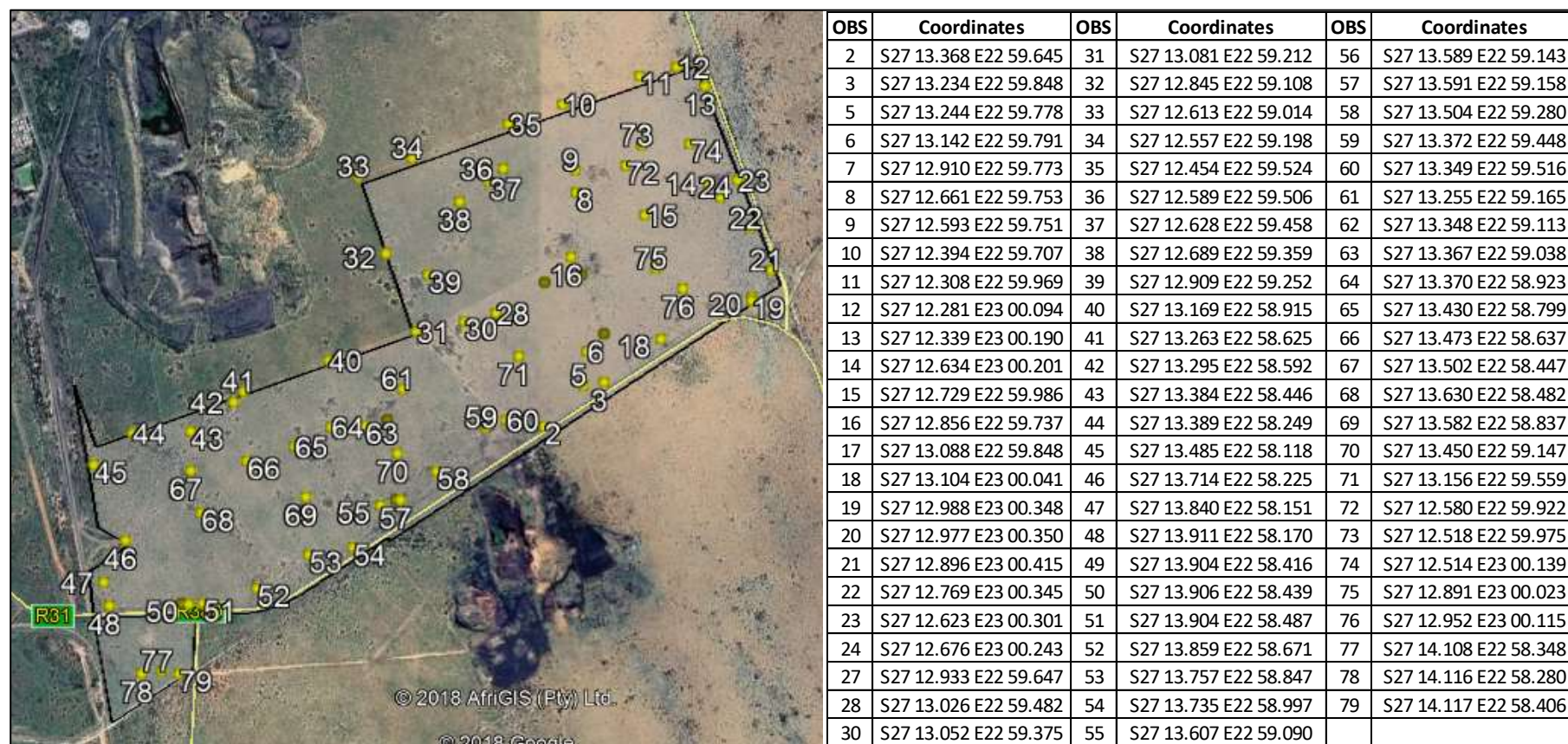


Figure 6: Soil survey Hotazel

The soil sampling was done with a hand auger and textural analysis by finger method. Soil was augered to a depth of 1.2m. No restrictions were encountered to even 1.5 m. Some points showed colouring differences from 800mm (see Figure 7) but not noted as a specified horizon.



Figure 7: Hand held auger with soil sample

The following field forms represent observations recorded during the field visit:

Dominant soil profile (represented by observation form 16)

OBS	16	COMMENT														
LAT	27.214260	SLOPE GRAD	1			MOISTURE	L									
LONG	22.995610	SLOPE SHAPE	R			EROSION	L									
	FORM	Cv	TSD	120	WET	0	HOR	TYPE	DEPTH	COL	CLAY	S-GR	CONS	STRUC	STONE	
	FAM	3100	ESD	120	C	I	1	A	30	7.5YR5/6	6	Vf	5	sg	0	
	ROUGH	1	ASD		GEO	L2	2	B	120	7.5YR5/8	6	Vf	5	a	0	
	TERR_POS	6	LTN		PHOTO		3									
	L_COVER/USE:															
	VIS.VELD.COND	A		B		C		D		E		TOTAL				

Exceptions in soil profile description:**Observation points 20, 23 and 60 (represented by observation form 60)**

OBS	60	COMMENT	bleached A													
LAT	27.220410	SLOPE GRAD	1			MOISTURE	L									
LONG	22.987020	SLOPE SHAPE	R			EROSION	L									
	FORM	Fw	TSD	120	WET	0	HOR	TYPE	DEPTH	COL	CLAY	S-GR	CONS	STRUC	STONE	
	FAM	1210	ESD	120	C	I	1	A	30	10YR5/4	6	Vf	5	sg	0	
	ROUGH	1	ASD		GEO	L2	2	B	120	10YR5/6	6	Vf	5	sg	0	
	TERR_POS	6	LTN	E	PHOTO		3									
	L_COVER/USE:															
	VIS.VELD.COND	A		B		C		D		E		TOTAL				

Observation point 19

OBS	19	COMMENT	ou pad lyk soos Cg													
LAT	27.216460	SLOPE GRAD	1			MOISTURE	L									
LONG	23.005800	SLOPE SHAPE	R			EROSION	L									
	FORM	Wb	TSD	20	WET	0	HOR	TYPE	DEPTH	COL	CLAY	S-GR	CONS	STRUC	STONE	
	FAM	1000	ESD	20	C	I	1	A	20	10YR4/4	6	F	5	sg	20	
	ROUGH	1	ASD		GEO	L2	2									
	TERR_POS	6	LTN	ma	PHOTO		3									
	L_COVER/USE:															
	VIS.VELD.COND	A		B		C		D		E		TOTAL				

The dominant soil form on site is Clovelly with an effective depth of 1200+ mm. The sub-dominant is Fernwood and is closely related to Clovelly, with the same texture, colour and soil depth.

The Witbank soil is on an old road.

Observation point 48 is in a borrowing pit and the area is sensitive to erosion. The connection line to the Grid is suggested to follow through this point.

After comparison of the various soil forms and its locations, a soil map was drafted. See Figure 8.

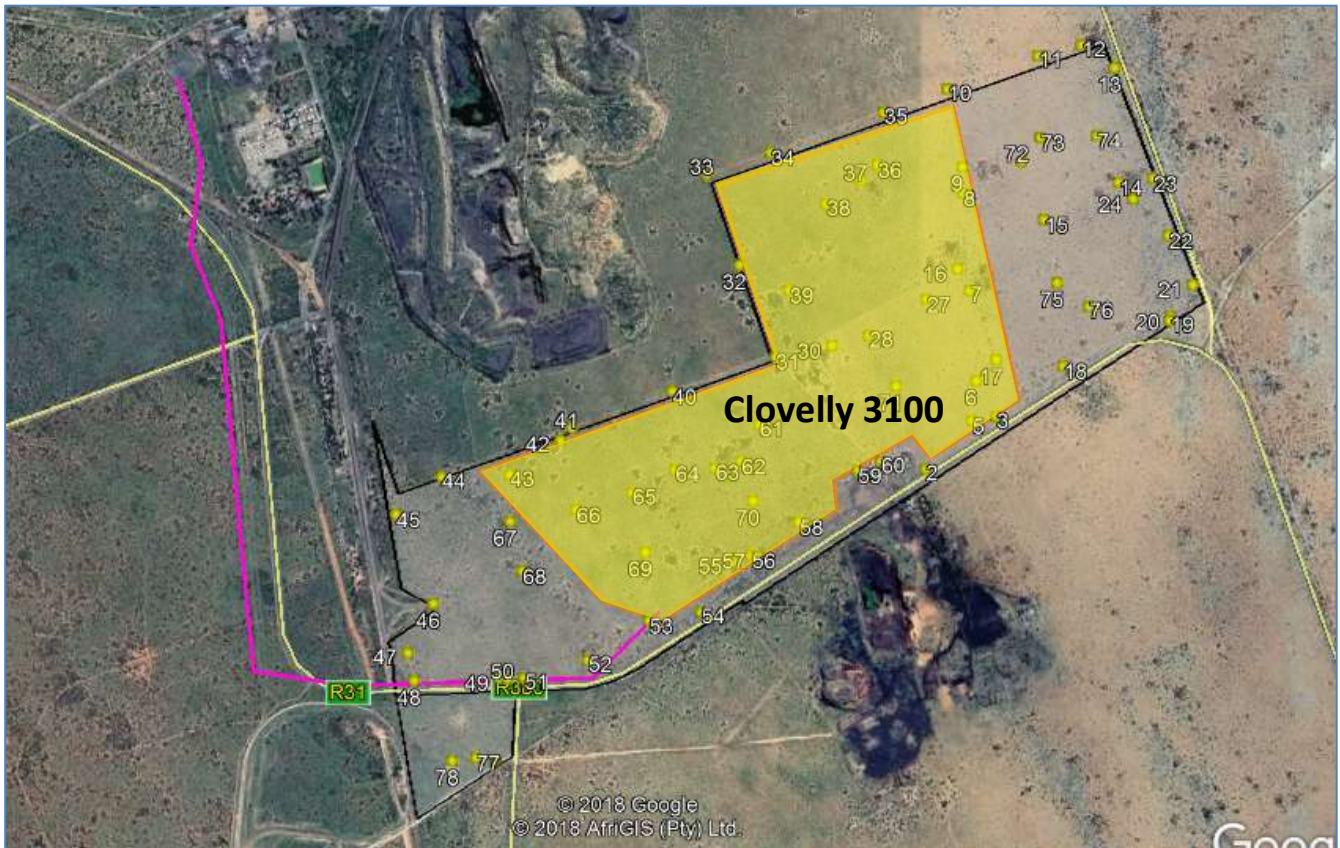


Figure 8: Soil map

5.9 Vegetation

A veld condition assessment by visual acknowledgement was done simultaneous with the soil survey. The photos in Figure 9 show the veld condition. The vegetation type is Savanna (Kathu biome). The composition of the grazing varies from open grass with low to heavy encroachment of Black Thorn acacia (*Acacia mellifera*), as can be seen in Figure 9. Encroachment takes place when veld is over-grazed or where construction took place.



Acacia haematoxylon



Acacia hebeclada



Acacia erioloba



Over grazing bush encroachment



OBS 33 Mining north of site



Savanna veld *A haematoylon* and *A erioloba*

Figure 9: Vegetation

The grasses identified on site are shown in Figure 10.

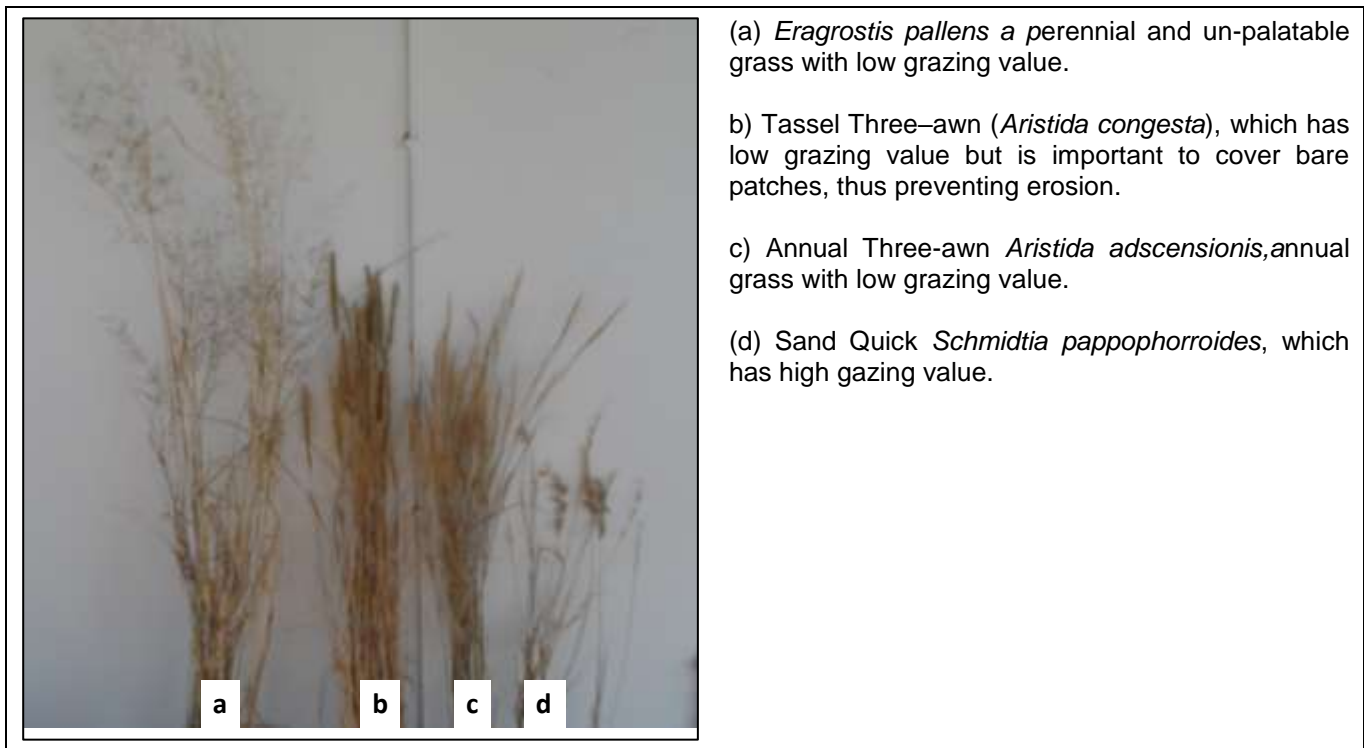


Figure 10: Grasses identified on site

6. AGRICULTURAL POTENTIAL OF THE SITE

The agricultural potential of the land is vested in the interaction of the soil physical properties and climatic conditions.

Table 2 gives a summary of the soil physical properties.

Table 2: Soil physical properties

Clovelly Setlagole			
Soil Properties	A Horizon Topsoil	B Horizon Sub-soil	C-Horizon Sub-strata
Texture	Very fine sand	Very fine sand	Not specified
Consistency	Loose to very loose	Loose to very loose	
Structure	Single grain	Apedal	
Colour	Strong Brown	Strong Brown	
Horizon Depth	300mm	>1200mm	>1500 mm
Depth limitation	None < 1500 mm		
Effective Depth	1200 mm		
Carbon content	Low <3%		
Consistency	Loose		
Terrain position	Foot Slope		
Geology	Dolomite formations/Aeolian sand		
Slope shape	Strait		
Slope gradient	1%		
Moisture availability	Low		
Erosion potential	Low. Susceptible to wind erosion if vegetation is altered.		
Leaching status	Eutrophic		
Transition	Non Luvic		

Although the soil has a depth in excess of 1500 mm, the effective wetting depth is limited by the texture of the soil and rainfall. This is mainly because of the excessive drainage and poor water holding capacity of the soil (sand can only retain 12% of rainfall). Low carbon and clay content lead to low nutrient availability to plants. Consistency is the degree of cohesion and adhesion within the soil mass or its resistance to deformation. With a loose consistency, the soil is very vulnerable if not covered with vegetation.

Figure 11 shows the interaction of rain and temperature expected for the specific site.

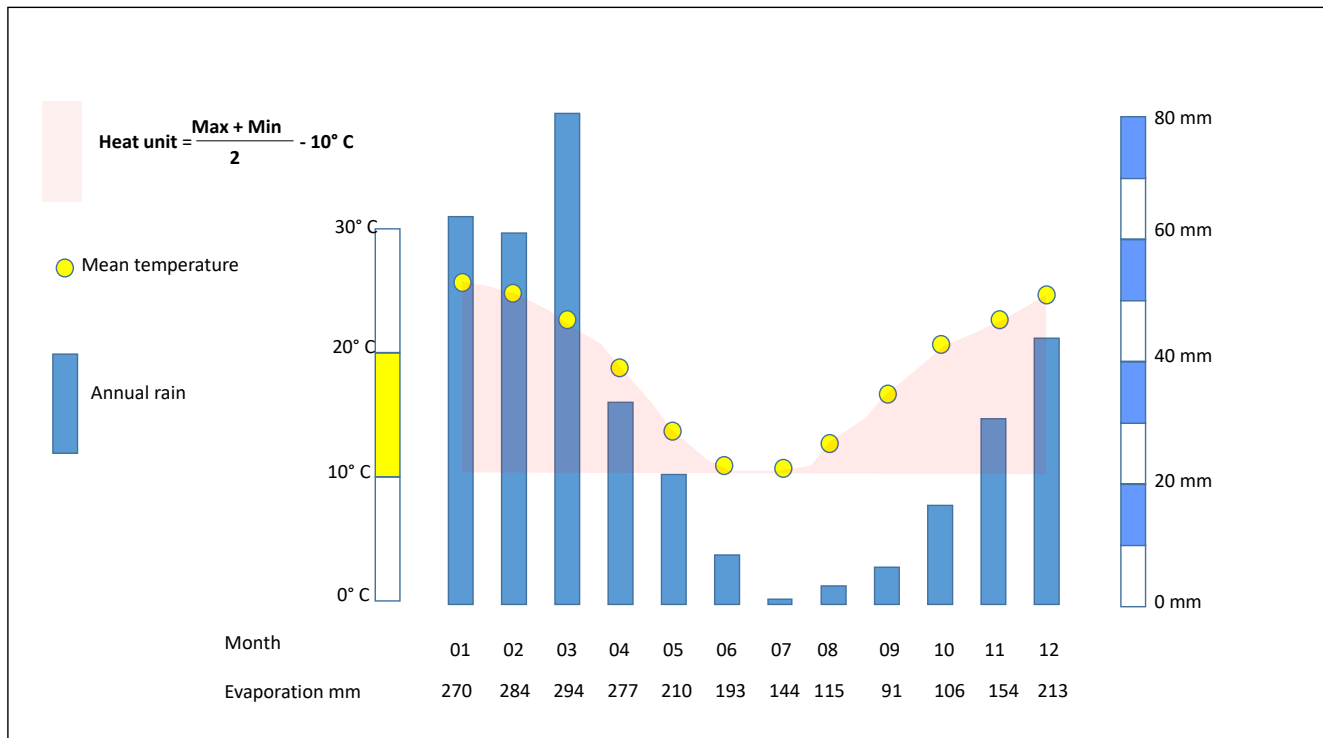


Figure 11: Climatic interaction of rain, temperature and evaporation.

A crop requires specific elements to yield successfully at the end of its growing season, of which heat and moisture are the most important. The time when these elements are required, are of significant importance.

As an example, maize is usually planted when 650-850 heat units can be expected for a minimum period of 61 days, thus, during the summer months. The peak of the rain season on site is in March, the end of the growing season. This is also when the highest evaporation is recorded. In Figure 11, the yellow dots show the mean temperature and the red zone the expected heat units. The required planting date and necessary follow up rain combination is not found.

Sustainable cash crop production is not recommended under these conditions.

7. LAND CAPABILITY AND SUITABILITY FOR AGRICULTURE

The land is classified to have a capability for grazing woodland or wildlife (class VII)

Land in Class VII has severe limitations that make it generally unsuited for cultivation and limit its use largely to pasture, range and woodland.

Land in Class VII also has continuing limitations that cannot be corrected, such as:

- Severe erosion hazard;
- Stoniness;
- Shallow rooting zone;
- Low water holding capacity; and
- Severe climate.

Physical conditions allow range or pasture improvements, if needed, such as seeding, liming and fertilizing. In some instances, the soil can be safely used to grow common crops, but it will require unusually intensive management activities

The farm is used as a grazing unit for cattle and is bordered by mining activities to the north and south, roads on the south and east side and a railroad on the west side. The unit is divided in five grazing camps with handling facilities near the homestead (observation point 60) and a diversion kraal (observation point 16).

With a usable area of 509 ha and suggested carrying capacity of 13 ha/LSU, a herd of 39 LSU can safely be allowed to graze the area. The currently does not utilise the farm for grazing, due to repeated incidents of stock theft.

8. ASSESSMENT OF ACCESS ROAD AND GRID CONNECTION

The proposed alternative access roads, grid connections and overhead line are shown in Figure 12. The photos in Figure 13 illustrate the area along these lines.

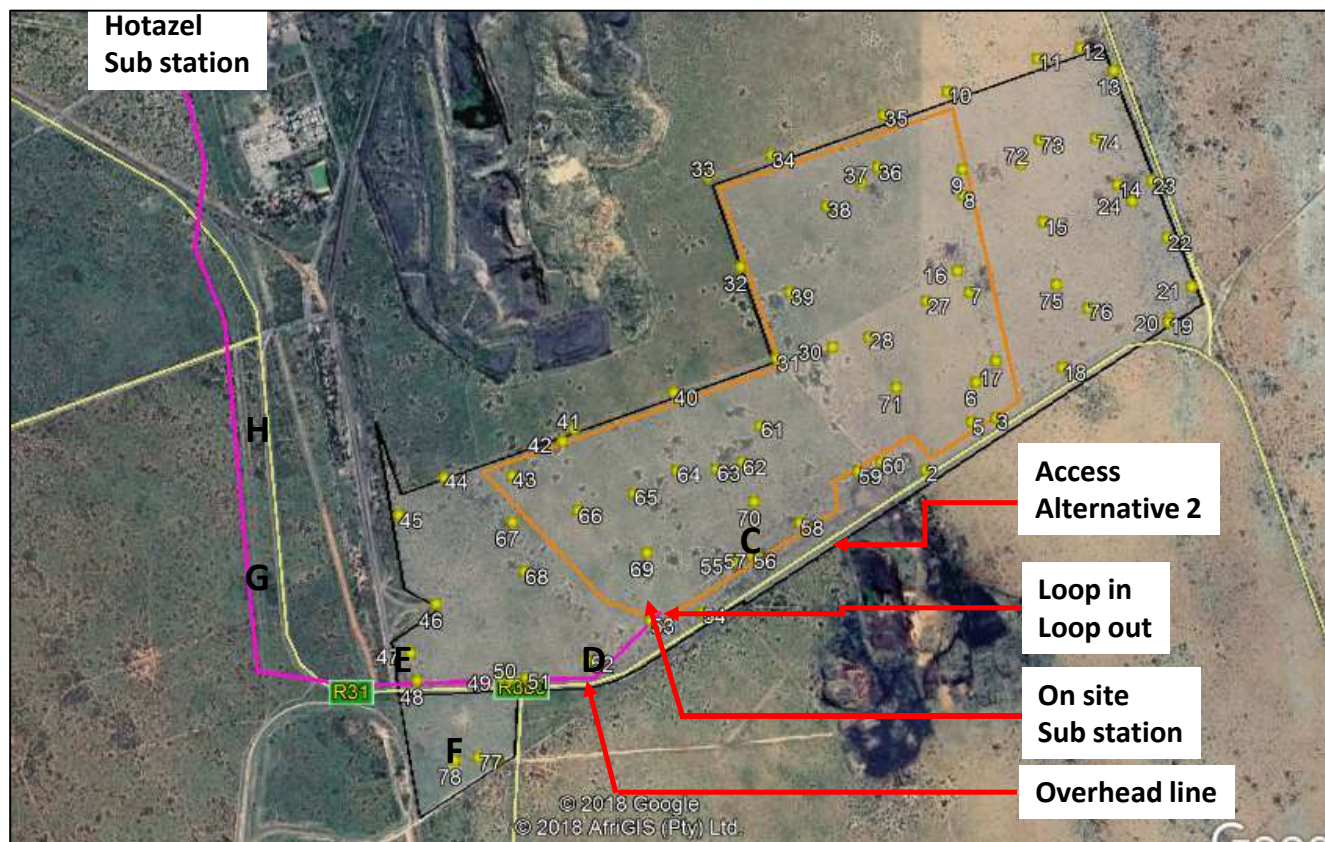
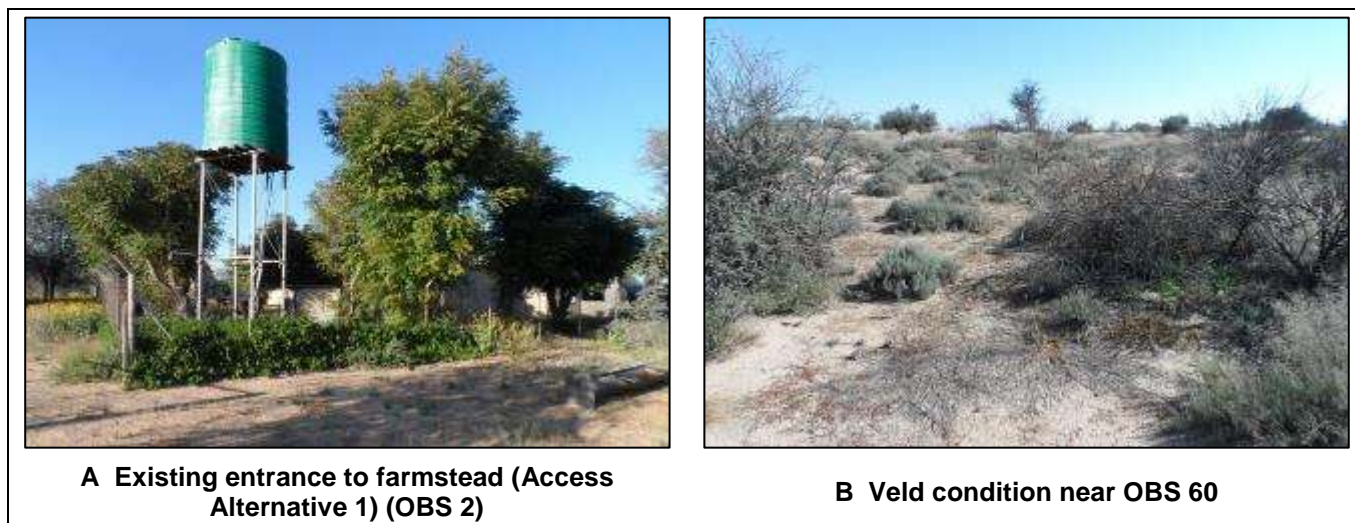


Figure 12: Grid connections Alternative 2



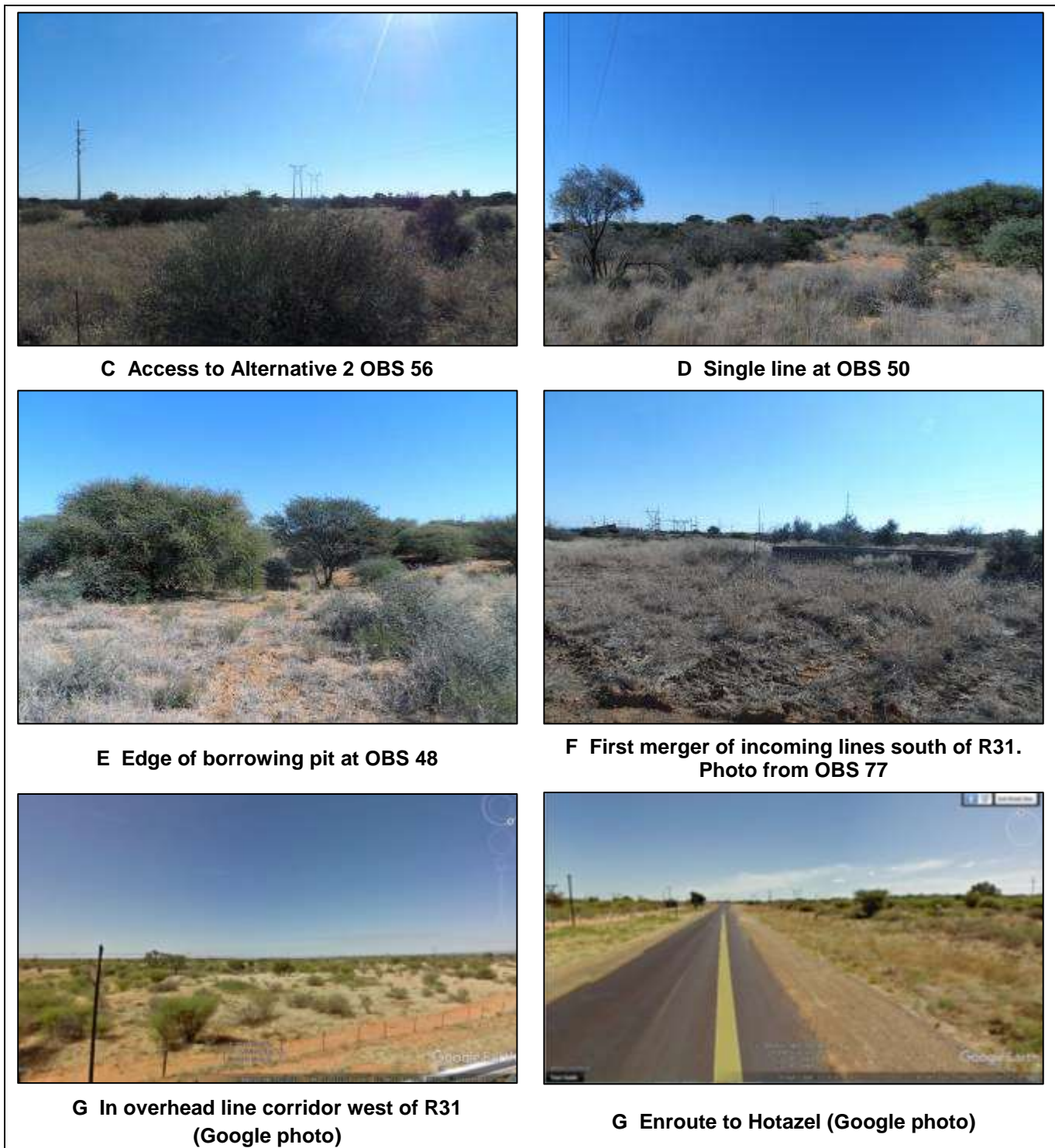


Figure 13: Access road and grid connection photos

7.1 Access to site

Access to the site in Alternative 1 is directly from the R31 provincial road as shown in **Error! Reference source not found..** The R31 connects Kuruman and Hotazel and is in a good condition. Access to the 132kV Eskom line, currently under construction, is also at this point.

Access to the site in Alternative 2 is also directly from the R31 provincial road, as shown in Figure 12 (photo C).

The dominant soil is a Clovelly 3100 with a soil depth of >1200 mm. The soil is valued as low potential, due to the low clay content (<10%), loose consistency of top and sub-soil and arid climate. Black thorn Acacia is prominent.

Precautionary measures must be taken to mitigate the risk of ground disturbances with the construction of the access road. Attention should be given to drainage, water flow, erosion, and the existence of *Acacia eriloba*. In terms of agricultural impacts, both alternatives are suitable from an agricultural perspective, and neither is seen as more beneficial than the other.

7.2 Grid Connection

Alternative 1

Alternative 1 is demonstrated in **Error! Reference source not found.** and Figure 13. The connection to the grid will be from one of the onsite substation alternatives to the Hotazel Substation (S27.20591 E 22.96261). There is a possibility to connect with a loop-in-loop-out at point (S 27.225087 E 22.990116).

The overhead line stretches from the onsite substation, up to point **E** on the proposed site. From **E** towards Hotazel it follows the existing alignment of Eskom power lines.

The dominant soil is Clovelly 3100 with a soil depth of >1200 mm. The soil is of low potential because of the low clay content (<10%), loose consistency of top and sub soil and arid climate.

At **OBS 59** and **48**, the land is disturbed, possibly used as a borrowing pit. Precautionary measures must be taken to mitigate the risk of erosion during construction of the overhead line.

Alternative 2

Figure 12 and Figure 13 shows this alternative. The connection to the grid will be from one of the onsite substation positions to the Eskom Substation at Hotazel (S27.20591 E22.96261). A possibility exists to connect with a loop-in-loop-out at point (S 27.229960 E 22.981897).

The overhead line is for the stretch from the onsite substation, up to point **E** on the proposed site. From **E** towards Hotazel it follows the existing alignment of Eskom power lines.

The dominant soil is a Clovelly 3100 with a soil depth of >1200 mm. The soil is valued as low potential because of the low clay content (<10%), loose consistency of top and sub soil and arid climate.

At **OBS 59** and **48**, the land is disturbed, possibly used as a borrowing pit. Precautionary measures must be taken to mitigate the risk of erosion during construction of the overhead line.

The overhead line will have a **low impact** on agricultural production, as grazing can continue and the lines are in a compact, narrow gauge.

9. ASSESSMENT OF PROPOSED DEVELOPMENT

The development proposed is to construct a commercial photovoltaic (PV) solar energy facility (SEF) on ± 275 ha agricultural land. See Figure 14 for the proposed layout of the facility. The approximate area that each component of the SEF will occupy is summarised in Table 3.

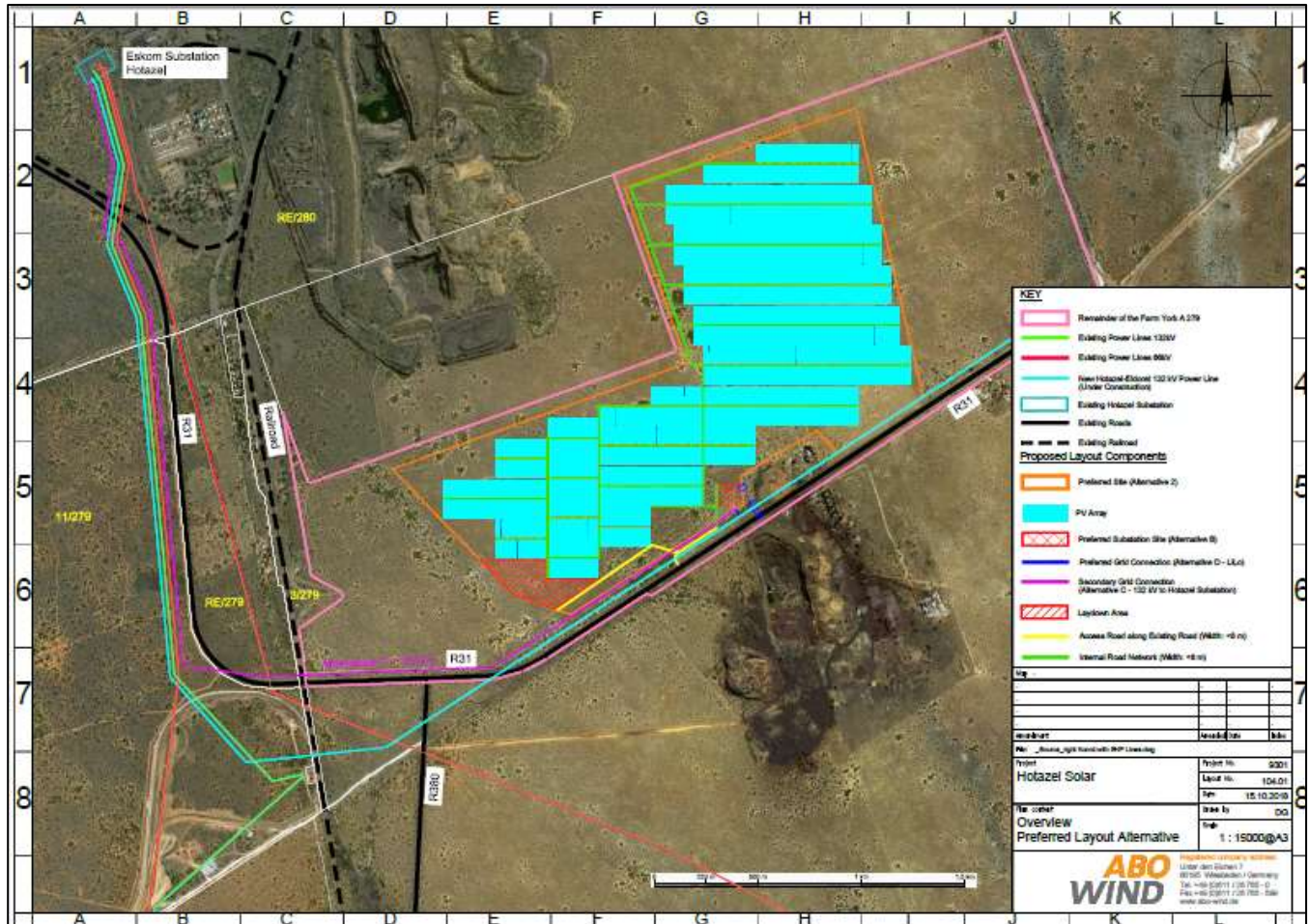


Figure 14: Proposed outlay of facility

Table 3: Components of the development

SEF Component	Estimated Area	% of Development Area (275 ha)	% of Farm Area (636.7946 ha)
PV Structures/modules	± 250 ha	90.91%	39.26%
Internal roads	± 18 ha	6.55%	2.83%
Auxiliary buildings	± 1 ha	0.36%	0.16%
Substation	± 1 ha	0.36%	0.16%
Other	± 5 ha	1.82%	0.78%

From the detail above, the potential impacts that the facility may have on agricultural development of the farm are discussed next.

9.1 Loss of agricultural land

The land is classified to have a capability for grazing, woodland or wildlife (class VII).

The total size of the farm is 636 ha. With a carrying capacity of 13 ha /LSU, only 48 large stock units are allowed for sustained grazing on the farm.

The current manageable area is downsized to 509 ha, due to separation by the road and railway line. This allows only 39 LSU to graze, which is not an economical unit on its own.

The proposed PV facility will have a footprint of 275 ha, which means a loss of 21 large stock units. However, this isn't significant as the capacity on the current manageable area is already not an economical unit on its own.

Mitigation proposed

Option 1

After construction of the facility, the project owner should investigate the possibility of utilising livestock for the management of biomass underneath the panels, with due consideration to possible damage caused by livestock.

The PV panels' ground clearance limit the height of livestock. Sheep would be better suited for the grazing under the panels, or calves between 3 and 7 months. With a conversion ratio of 4½ sheep to 1 LSU, 100 sheep are the equivalent of the 21 LSU presumably lost.

There are 52 sheep under the shelter in Figure 15. This gives an indication of the space needed for half the herd recommended above.



Figure 15: Ground clearance under PV panels in comparison with shelter provided to sheep.

During the operational phase, the re-vegetated trench lines and regrowth under the panels must be managed.

To manage the grass, the primary "tool" is an efficiently controlled camping system. If the livestock is left free ranging in their grazing habit, the veld condition will deteriorate. The reason for this is that they are allowed to graze selectively and stay too long in the same area with the result that they start grazing on the regrowth.

The footprint of the PV facility forms the skeleton of a camping system, as indicated in Figure 16. With the use of electrified fencing, the partitioning of any number and size of camps required, can be carried out by one labourer herding the stock. Watering would be portable troughs.

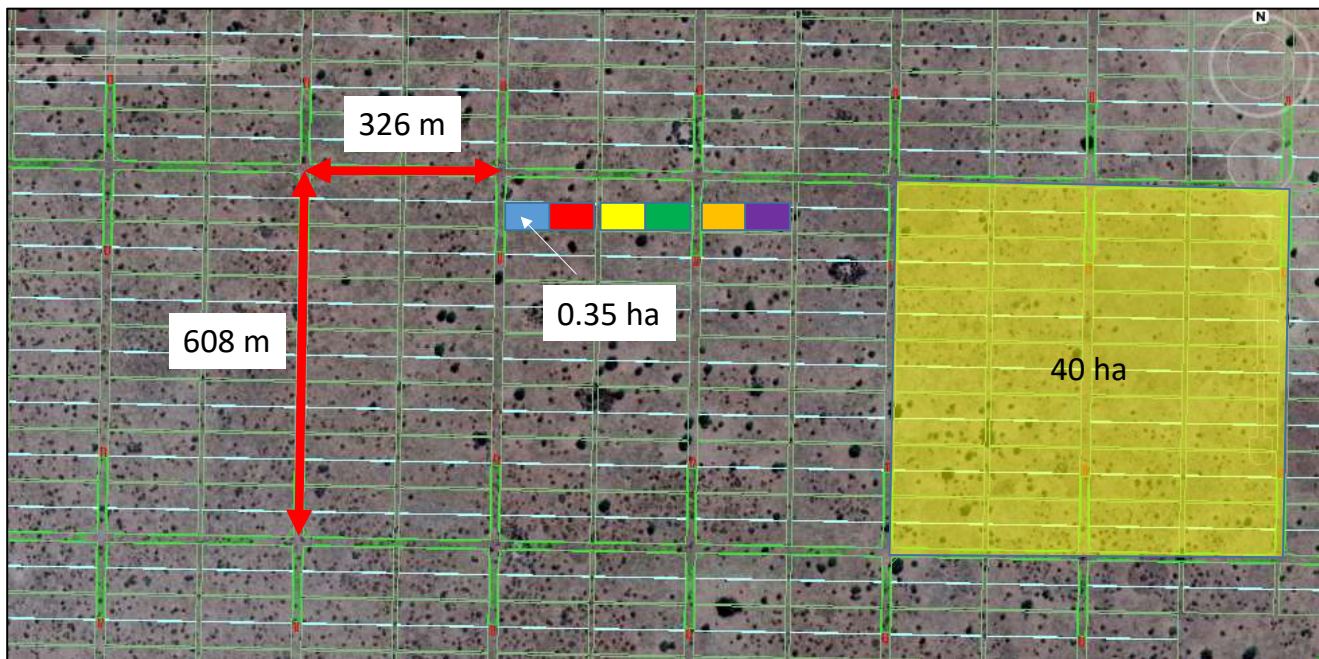


Figure 16 PV footprint as skeleton for camp outlay

The camps will be confined to the borders of the service roads, which ensure no interference with the service traffic.

The two camp sizes (0.35 ha and 40 ha) refer to different management systems. The 0.35 ha camps are used for ultra high density grazing. These camps are used for 1½ hour for six grazing sessions a day. The 40 ha is high density grazing camps where livestock stay 7 days before rotated.

A detailed rotation system with suitable camp size can be formulated to ensure the best results in animal gain and veld composition.

Option 2

There will be a time lapse after construction before grazing will be available, in which fodder will have to be provided for feeding.

The loss of area can also be calculated as loss of grazing for 20 LSU. It is assumed that an animal eats the equivalent of 3% of its body mass per day. The mass of an LSU is estimated as 450 kg; therefore, one LSU requires 13.5 kg roughage/day. The loss due to the footprint size is then 20 x 13.5 kg, which is 270 kg /day.

It is possible to produce 500 kg of fresh fodder in seven days from 50 kg cereal grain seed in a container measuring 8m x 4m x 2m. Once in production, 500 kg fodder can be harvested daily. The requirement for such production is to control the temperature between 20°C and 28°C and artificial (fluorescent) lighting. The seed is sprayed with a hydroponic nutrient three times a day.

The fodder is fed directly to the animals: tray, roots and all.

Instead of sheep, bull calves 3 months old can be finished off (200 kg) on grass in the PV facility after which they can be moved to the remaining area. With additional fodder available, the remaining area of 234 ha (509 ha– 275 ha) can be used to prepare them for the feedlot (300 kg).

The number of animals can actually be the same (39) as calculated at the end of the season.

On the 234 ha remaining land and with a carrying capacity of 13ha/LSU, 18 LSU is allowed.

Because of their weight they are regarded as half a livestock unit and 39 stock units can therefore be harvested at the end of the season.

9.2 Impairment of land capability due to construction

During the construction phase, interference with the agricultural activities takes place.

9.2.1 Removal of infrastructure

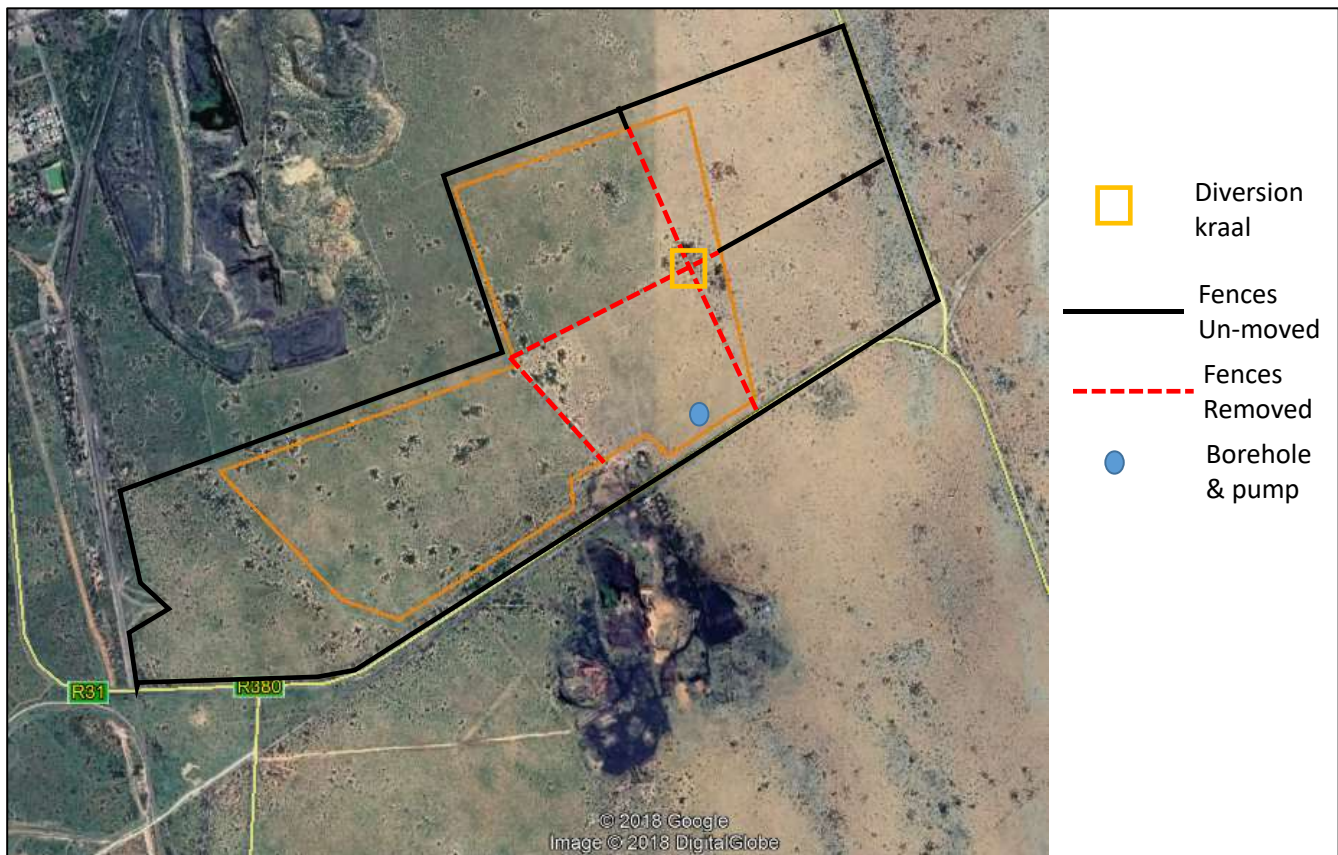


Figure 17: Effect on infrastructure

The farm was used extensive grazing with cattle, but due to repeated stock theft, this practice no longer takes place. Refer to Figure 17, showing five camps used to manage the cattle on 509 ha. With the construction of a solar facility, only 234 ha remain without any effective infrastructure. The borehole with pump will still be operational. The safety fence shall form a corridor to allow movement from west to east between the two remaining grazing camps.

9.2.2 Removal of vegetation

The development of the proposed facility will take place in three phases, namely construction, operation and decommissioning. During each of these phases, vegetation will be exposed to specific impacts caused by the stripping of vegetation and mechanical disturbance of the soil profile.

Construction phase

During this phase, vegetation is stripped, topsoil is removed and stockpiled, access roads are constructed, structures are erected and vegetation resettled. Where soil conditions allow, topsoil should be left in situ as far as possible.

The stripping should be executed on a selective way. Only the bushes and trees should be removed, leaving the grass intact. Only where trenches for cabling are needed, top soil should be removed and piled up for reuse with rehabilitation.

The resettlement of vegetation forms the basis on which the last two phases shall perform. Therefore, this is the starting point of the rehabilitation process.

When veld is re-established after construction, the seed of climax grasses adapted for the site should be used. Grass species recommended are:

- Tassel Three-awn (*Aristida congesta*), which has low grazing value but is important to cover bare patches, thus preventing erosion;
- Small Bushman Grass (*Stipagrostis obtusa*), which has high grazing value and good binder of sand;
- Tall Bushman Grass (*Stipagrostis ciliata*) a palatable grass with high grazing value and good binder of sand;
- Lehmann's Love Grass (*Eragrostis lehmanniana*), which is moderately palatable and good for stabilizing eroded soil;
- Guinea Grass (*Panicum maximum*), a very palatable good cultivated pasture; and
- Wool Grass (*Anthephora pubescens*).

Operational phase

This is the longest phase (25-30 years). During this phase, the re-vegetated surface must be conserved and used for maintaining the livelihood of the owner and workers. Adaption to new methods of operating must be incorporated in the management plan.

Decommissioning phase

When the facility reaches the end of its economic lifespan, decommissioning will take place. The area must then be restored to its natural stage.

9.3 Altering of drainage patterns with construction of roads support buildings and PV panels

The facility will be constructed on a footslope with a regular shape, slope gradient of <1% and no defined waterway.

The solar panels will be supported by posts without reaching the soil surface. There will be very low obstruction of run-off. The run-off water will flow in a lateral way without concentration into furrows or depressions. When re-vegetation starts, these strips will slow down the flow speed on surface and enhance the infiltration rate.

The facility will have a very low effect on the drainage pattern of the site.

During construction of all the components, possible spillages of concrete and fuel may impact the soil.

10. POTENTIAL IMPACTS ON THE AGRICULTURAL ENVIRONMENT

10.1 Methodology to assess impacts

Potential impacts of the proposed project on agriculture were identified and evaluated. Impacts identified through the study were rated in terms of the following criteria:

- The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The duration, wherein it will be 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; or
 - 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, which 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 shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the status, which will be 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 calculated by combining the criteria in the following formula:

$$S = (E+D+M)P$$

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).

10.2 Possible impacts during construction

Soil pollution with contaminants during the construction phase may take place, including spillages of hydrocarbon (fuel oil) and cement. This is possible during the construction of all facets of the facility: laydown area, concrete foundations of the auxiliary buildings, inverter stations subterranean cabling, main access and internal service roads.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Medium Term (2)	Very short (1)
Magnitude	Low (4)	Minor(2)
Probability	Probable (3)	Probable(3)
Significance	Low(21)	Low (12)
Status (Positive or negative)	Negative	Negative
Reversibility	Partly reversible	Fully reversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes

Mitigation: Refuelling normally takes place in the laydown area. Proactive measures must be taken which include constructing a designated area where refuelling can take place. This area must have an impervious floor with low wall that will keep the spillage inside. This area should be cleaned with absorbent material on a regular basis. The use of cut-off drains must be incorporated to divert upslope clean storm water around the site into a natural drainage system. On the down slope, polluted water must be collected via a cut-off drain into a leachate collection and recovery system. When spillage accidentally takes place, it should be removed and replaced with unpolluted soil. The clean soil can be sourced from excavations nearby. The polluted soil must be piled at a temporary storage facility with a firm waterproof base and is protected from inflow of storm water. It must have an effective drainage system to a waterproof spillage collection area. Contaminated soil must be disposed of at a hazardous waste storage facility.

The following is handy to have available



Ultra-Drain Guard



Oil Dri Bucket Spill Kit

Cumulative impacts: No, site-bound

Residual Risks: Yes, it is impossible to clear the affected area completely.

The establishment of the PV Solar facility will be done at the expense of agricultural land. The area to be lost for agricultural development would be 275ha in size. This includes the area under PV panels, internal service roads and temporary laydown area.

	Without mitigation	With mitigation
Extent	Local – Regional (3)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	Medium (39)	Low (20)
Status (Positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

The general objective is to position the PV facilities on the lowest potential soil and not in places that may have impact on agricultural activities, drainage lines and places with a sensitive nature, such as protected tree species. Existing road alignments are followed and roads upgraded for use during the lifespan of the facility. With the appropriate planning, the same lifestyle can be maintained during the existence of the facility.

Cumulative impacts:

Impact is low due to agricultural potential of the locally available agricultural. With increasingly adding of facilities, the impact will become more of significance if not mitigated. .

Residual Risks:

No, after decommissioning this impact will be reversed when rehabilitation has been completed.

The construction of a PV Solar facility will cause impairment of the land capability with the potential risk of erosion		
	Without mitigation	With mitigation
Extent	Local (2)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Low (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium(30)	Low (24)
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: Clear trees and bushes selectively, leaving grass un-disturbed. Use mechanised machinery when installing posts to eliminate need for foundations. Construct on alternate strips to combat possible erosion.		
Cumulative impacts: No cumulative impacts are expected to occur, as all impacts will be site bounded.		
Residual Risks: No. Affected areas will be rehabilitated, as the impact will only be applicable during construction phase.		

The establishment of the PV Solar facility may alter drainage patterns with construction and cause erosion		
	Without mitigation	With mitigation
Extent	Local (2)	Local (1)
Duration	Long term (2)	Long term (2)
Magnitude	Low (2)	Low (2)
Probability	Probable (2)	Probable (2)
Significance	Low(12)	Low (10)
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: Establish structures on the contour. Use grass strips to regulate flow speed		
Cumulative impacts: No, all impacts will be site bounded.		
Residual Risks: No. Affected areas will be rehabilitated when operation has ceased.		

10.3 Possible impacts during operational phase

Soil pollution with contaminants during the operational phase may take place, including spillages of
--

hydrocarbon (fuel oil) and cement. This is possible during the maintenance of the facility.		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (4)
Magnitude	Low (2)	Minor(2)
Probability	Probable (2)	Probable(2)
Significance	Low (14)	Low (14)
Status (Positive or negative)	Negative	Negative
Reversibility	Partly reversible	Fully reversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: Refuelling normally takes place in the workshop of the control building. A designated area for refuelling must be constructed with an impervious floor and low wall that will keep the spillage inside. Any spillage must be cleaned with absorbent material as soon as possible and disposed into clearly marked containers. Where spillage takes place, contaminated soil must be excavated and replaced with unpolluted soil. The contaminated soil should be collected by a licenced landfill contractor.		
Cumulative impacts: No, site-bound.		
Residual Risks: Yes, It is impossible to clear the affected area completely.		

The establishment of the PV Solar facility will be done at the expense of agricultural land. Area to be lost for agricultural development would be 275 ha in size. This includes the area under PV panels, internal service roads and temporary laydown area.

	Without mitigation	With mitigation
Extent	Local – Regional (3)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	improbable (2)
Significance	Medium (39)	Low (20)
Status (Positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: The general objective is to position the PV facilities on the lowest potential soil and not in places that may have impact on agricultural activities, drainage lines and places with a sensitive nature. Existing road alignments are followed and roads upgraded for use during the live span of facility. With the appropriate planning, the same lifestyle can be achieved during the lease period of the facility from the land so occupied by the facility.		
Cumulative impacts: Impact is low due to the low agricultural potential of the surrounding land. With additional facilities, the impact will become more of significance if not mitigated. .		
Residual Risks: No, after decommissioning this impact will be reversed when rehabilitation has been completed.		

10.4 Possible impacts during decommissioning phase

All components of the facility should be disassembled and roads demolished. Rehabilitation should focus on:

- Demolish and removal of structures
- Demolish related roads
- Establish cultivation environment
- Stabilisation of erosion
- Reinstall camp fences and stock watering

Soil pollution with contaminants during the decommissioning phase may take place, including spillages of hydrocarbon (fuel oil) and cement. This is possible during the decommissioning of all facets of the facility: laydown area, demolished concrete foundations of the auxiliary buildings, inverter stations subterranean cabling, main access and internal service roads.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Medium Term (2)	Very short (1)
Magnitude	Low (4)	Minor(2)
Probability	Probable (3)	Probable(3)
Significance	Low(21)	Low (12)
Status (Positive or negative)	Negative	Negative
Reversibility	Partly reversible	Fully reversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes

Mitigation: Refuelling normally takes place in the workshop of the control building. A designated area for refuelling must be constructed with an impervious floor and low wall that will keep the spillage inside. Any spillage must be cleaned with absorbent material as soon as possible and disposed into clearly marked containers. Where spillage takes place, contaminated soil must be excavated and replaced with unpolluted soil. The contaminated soil should be collected by a licenced landfill contractor.

Cumulative impacts: No, site-bound.

Residual Risks: Yes, It is impossible to clear the affected area completely.

11. CUMULATIVE IMPACT ASSESSMENT

To assess the cumulative impacts, an overview map showing the land capability, drainage and grazing capacity is used to identify possible impacts that may accumulate as similar developments are developed in a 30 km radius from this facility – see Figure 18.

There are Six PV power facility locations within a 30km radius, including Hotazel Solar (See map in Figure 18).

Reference	Name	Status
1	East Solar Park	Approved 2015
2	Tshepo Solar	Approved 2016
	Kagiso Solar	Approved 2016
	Perth Solar	Approved 2016
3	Adams Solar	Approved 2011
4	Portion farm Shirley	Under Review
5	Roma	Lapsed (therefore not considered in the cumulative transformations)
H	Hotazel	Application

When investigating the cumulative impact of similar developments, the most common concerns are

- Loss of agricultural land
- Altering drainage patterns
- Changing agricultural character to industrial

11.1 Loss of agricultural land

The total area in which these facilities are planned to be erected is classified as land only suitable for grazing, woodland or wildlife (Class VII). The suggested grazing capacity is 11-13 ha/Large Stock Unit.

With every facility added, the loss in land use will increase with 220 ha or 20 LSU on average.

The land loss will only be temporary (for the time it is leased for the facility). Thereafter it will be returned to the owner, in a rehabilitated condition in compliance with the EMP. During the lease period, livestock could still be produced and new markets established.

11.2 Altering drainage patterns

The facilities are located in a low rainfall area with level topography and on soil with a very fast infiltration rate, from which a low runoff is expected. Units 1, 3, 4 and 5 on the map in Figure 18 are positioned on the lowest point in the relief sequence and close to the river, therefore not affecting any drainage patterns. Hotazel and unit 2 also would have no influence on the drainage patterns of the mines, due to the topography and their locality.

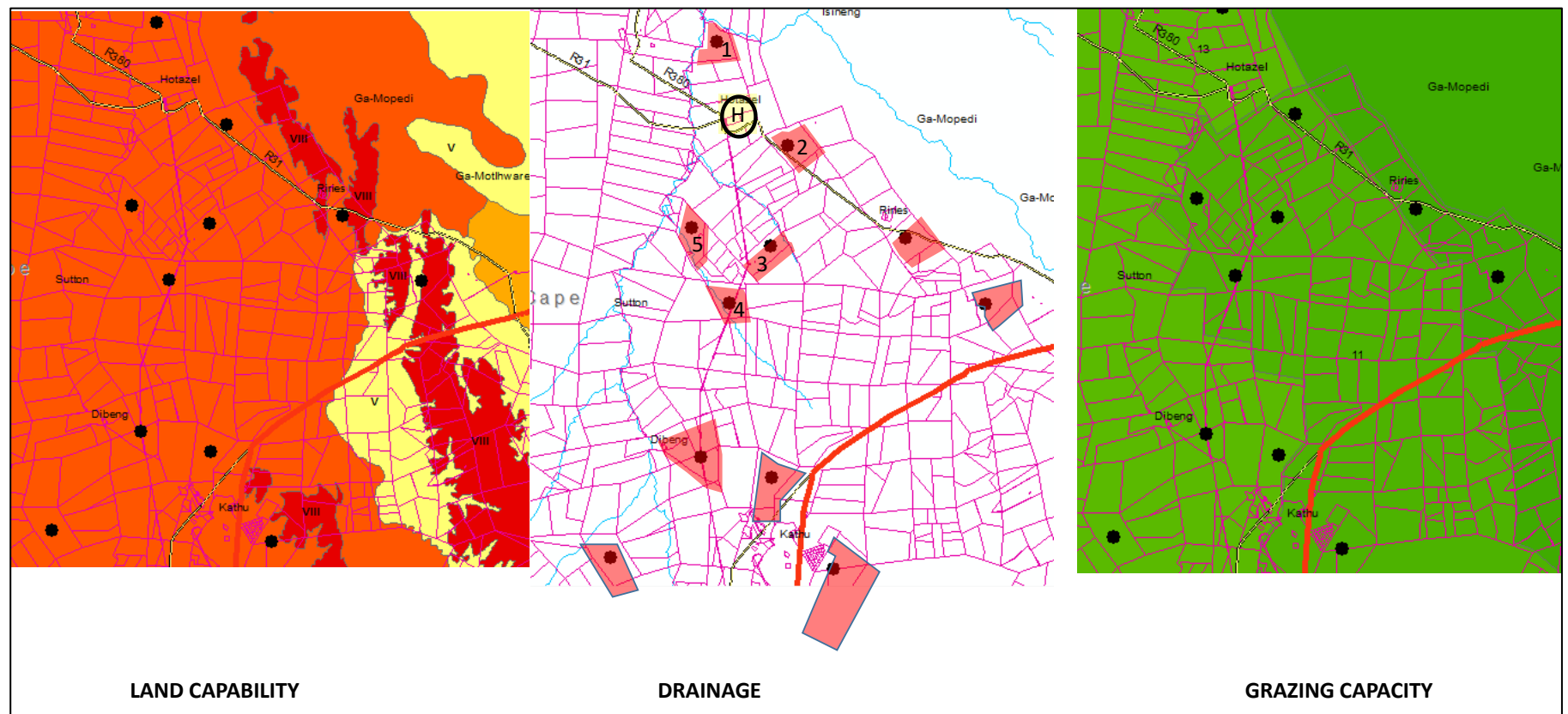


Figure 18: Proposed similar developments in the region

11.3 Changing agricultural character to industrial

The region already has an industrial character because of the mining activities and high power gridlines. The proposed solar facility will tap directly into these lines. The increasing intensified farming methods influence the perspective on “agricultural character”. With their low height above soil level, the solar panels could be mistakenly perceived as a horticultural venture under shade net. If sheep were allowed to graze among the panels, the character would be close to agricultural. This should only be considered if the project owners are comfortable that the grazing will not cause damage to project infrastructure. Alternatively, livestock can be grazed within the fenced off area, that does not contain infrastructure. The image below depicts large tracts of unutilised land within the fenced off area.



Figure 19: Completed facility

The quantity of available soil for agricultural production decreases as a result of the footprints of these facilities. The quality of soil decreases in the way the construction of these structures alters the workability of the soil. This includes the physical deformation in the soil profile.

	Overall impact of proposed project considered in isolation	Cumulative impact of the projects in the area
Extent	Local – Regional (1)	Regional(2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Low(4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	Low (27)	Medium (36)
Status (Positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation:

Ensure that most infrastructure features are erected on transformed or non-arable land. Implement stormwater management as an integral part of planning and as a guideline for the positioning of structures. Use existing roads and conservation structures to the maximum in the planning and operation phases. Rehabilitate disturbed areas as soon as possible after construction. Incorporate livestock in the fire management plan or as a production unit on its own.

Clearing of vegetation increases flow speed and a lower infiltration tempo increases silt transport.

	Overall impact of proposed project considered in isolation	Cumulative impact of the projects in the area
Extent	Local (1)	Regional(2)
Duration	Long Term (4)	Long Term (4)
Magnitude	low (4)	Low (4)
Probability	Improbable (2)	Probable (3)
Significance	Low (18)	Medium (30)
Status (Positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: Erosion and sediment control with proper water run-off control planning.		

Chemicals, hazardous substances and waste used or generated during lifespan of the facility accumulates and soil may become contaminated

	Overall impact of proposed project considered in isolation	Cumulative impact of the projects in the area
Extent	Local (1)	Regional(2)
Duration	Long Term (4)	Long Term (4)
Magnitude	low (4)	Low (4)
Probability	Improbable (2)	Probable (3)
Significance	Low (18)	Medium (30)
Status (Positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: Appropriate handling and storage of chemicals and hazardous substances and waste should be done.		

12. ENVIRONMENTAL MANAGEMENT PROGRAMME

The following should be included in the Environmental Management Programme:

Objective: Prevent and clean up soil pollution		
Project components	<ul style="list-style-type: none"> • PV energy facility • Substation; • Access roads; • Power line; • All other infrastructure (site camp, batching plant etc.). 	
Potential impact	Pollution of soil by fuel, cement and other toxic materials	
Activity/risk source	Soil will become contaminated	
Mitigation: Target/Objective	All solid waste must be collected at a central location at each construction site and stored temporary until it can be removed to an appropriate landfill site in the vicinity. The target should be to minimise spillages and soil contamination.	
Mitigation: Action/control	Responsibility Construction manager Maintenance team	Timeframe Lifespan of facility
Performance Indicator	No spillages	
Monitoring	Regular inspections of terrain and various infrastructure units.	

Objective: Conservation of soil		
Project components	<ul style="list-style-type: none"> • PV energy facility • Substation; • Access roads; • Power line; • All other infrastructure (site camp, batching plant etc.). 	
Potential impact	Erosion of revegetated land	
Activity/risk source	Soil becomes unusable and unproductive	
Mitigation: Target/Objective	Apply conservation measures.	
Mitigation: Action/control	Responsibility Construction Manager Maintenance team Environmental manager	Timeframe Lifespan of facility
Performance Indicator	No water run-off problems / erosion	
Monitoring	Regular inspections of terrain	

13. CONCLUSION

The proposed PV facility is planned on a site with a high coincidence of natural and manmade features that determine the feasibility of such a structure.

Geology and climate dictates the soil characteristics to be found in this location, which is a sandy textured soil with low cohesive structure. The soil will have a high base status due to low leaching that took place.

The soil and climate combination restricts cash crop production, due to low water retention, excessive drainage, low nutrient adsorption with high fertilizer requirements and high susceptibility to wind erosion.

The arid conditions restrict choice of crops to be planted.

Due to the limiting conditions set out above, including the continual stock theft, the site is classified as Class VII capability, in terms of which it is unsuited for cultivation and restricts utilisation to grazing, woodland or wildlife.

The concentration of mines in the area increases the need for infrastructure to support the mining activities. These include urbanisation, railways, roads and electricity provision. These all impact on agricultural land.

The challenge is to reach a compromise that will ensure the safety and prosperity of all these roleplayers.


The first step was to position the facility on the area with the lowest impact on the agricultural entity. This has been done with the footprint of the facility snuck between the two mining excavations and with the existing gridline on the boundary.

Further, the construction has to be within the framework of soil and environmental conservation principles. The ecological study predicts the lowest impact on the existing population of protected tree species and mitigating measures for soil conservation

Finally, switching from extensive to intensive farming and finding new target markets. The potential for intensive farming can counter for loss of agricultural land and livelihood of farmer and workers

From an environmental and land use perspective, no fatal flaws are associated with the project, if the mitigation measures recommended are applied.

As far as agriculture is concerned, the photovoltaic (PV) solar energy facility will have a low impact on its environment and could therefore be authorised.



C R LUBBE
AGRICULTURAL SPECIALIST

21 November 2018

LIMITATIONS

This Document has been provided subject to the following limitations:

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Soil Classification Working Group, 1991. *Soil Classification: A Taxonomic System for South Africa*. Department of Agricultural Development, Pretoria.

Thomas V, Moll E and Grant R, 2008. *Sappi Tree Spotting: Cape –From Coast to Kalahari*. Jacana, Johannesburg

Van der Walt, HvH and Van Rooyen, TH, 1995. *A Glossary of Soil Science*. Soil Science Society of SA, Pretoria

Van Oudtshoorn F, 1994. *Gids tot Grasse van Suid-Afrika*. Briza, Arcadia

Appendix A: Curriculum Vitae of Specialist

KEY QUALIFICATIONS:

National Higher Diploma in Agriculture (Irrigation), Technikon Pretoria, 1982
Certificate in Stereoscopic Interpretation, Geology and Resource Classification and Utilisation, Department of Agriculture, 1979
National Diploma in Agriculture, Technikon Pretoria, 1976

OTHER EDUCATION:

Certificate in Turf Grass Management, Technikon Pretoria, 1987
Certificate in Landscape Management, Technikon Pretoria, 1988
Cultivated pastures (Mod 320), University of Pretoria, 1995
FSC Auditors Course (Woodmark, UK), Sappi Ltd, 2003
NOSA Health and Safety Certificate, 1996
Certificate of Competence: Civil Designer - Design Centre and Survey and Design (Knowledge Base, August 2005)

EMPLOYMENT RECORD:

July 2006 to date	CR LUBBE Self employed Involved in various projects (see project related experience).	
June 2004- June 2006	Gauteng Department of Agriculture Conservation and Environment (Component: Technology Development and Support) Acting Assistant Director: Resource Planning and Utilization	Johannesburg, SA
Jan 1997 – May 2004	CR LUBBE Self employed Involved in various projects (See Project related experience below)	Pretoria, SA
1980 to 1996	Technikon Pretoria Lecturer Teaching Agricultural Engineering and Land Use Planning subjects. Teaching included practical courses, examination and moderation	Pretoria, SA
1974 - 1979	Department of Agriculture (Transvaal Region) Senior Extension Technician Farm Planning, Surveying, Design of soil conservation systems, Agricultural Extension.	Carolina and Ermelo, SA

SUMMARY OF EXPERIENCE

Has 42 years of experience in planning and managing natural resources to ensure optimal utilisation, without exploiting such resources to the detriment of future generations.

Fourteen years experience as a soil consultant, doing mainly soil surveys, terrain classification and agricultural potential studies. Reports include a variety of maps and GIS aspects thus play a large role in these surveys and studies.

Seventeen years of lecturing agricultural engineering subjects: Soil Conservation Techniques I, II and III, which dealt with the surveying, design and drawing of soil conservation structures; Farm Planning, which dealt with optimal resource utilization and Agricultural Mechanization, which dealt with the implements and machinery used to mechanize farming.

Ten years experience in the survey, design and supervising the construction of soil conservation structures in the agricultural field, mainly for farm planning.

PROJECT RELATED EXPERIENCE

PROJECTS UNDERTAKEN IN INDIVIDUAL CAPACITY

Cape EA	Apr 2015
Agricultural Impact Assessment : EIA for the Construction and Operation of two Photovoltaic Power Stations at Kathu in the Northern Cape.	

Savannah Environmental	Mar 2015
Agricultural Impact Assessment : EIA for the Construction and Operation of a Wind Farm near Moorreesburg, Western Cape.	

Department of Agriculture, Forestry and Fisheries	Mar 2015
Eastern Cape Land Capability Verification Survey	

Department of Agriculture, Forestry and Fisheries	Dec 2014
Western Cape Land Capability Verification Survey	

Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Upington (RE Cap 5) in the Northern Cape.	Aug 2014
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Postmasburg (RE Cap 5) in the Northern Cape.	Aug 2014
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Upington (Joram) in the Northern Cape.	Aug 2014
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Copperton (RE Cap 5) in the Northern Cape.	Aug 2014
Cape EA Agricultural Impact Assessment : EIA for the Establishment of a Cemetery at Zoar, near Ladismith in the Western Cape. .	Aug 2014
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Copperton (RE Cap 5) in the Northern Cape.	Aug 2014
Macroplan Agricultural Impact Assessment: Application for rezoning of Agricultural land at Upington (Sweet Sensation), Northern Cape	Jun 2014
Macroplan Agricultural Potential Study: Application for change of land use at Upington (McTaggarts), Northern Cape	Mar 2014
Agricultural Development Corporation Design of Feedlot infrastructure and stock watering systems for Kenana Sugar in Sudan.	Jan to March 2014
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station in the Richtersveld, Western Cape.	Nov 2013
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station at Upington in the Northern Cape.	Jul 2013
Cape EA Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station near Danielskuil in the Northern Cape.	Oct 2012
Senter360 Agricultural Potential Study for a Food Security Development Units in the Democratic Republic of the Congo.	Oct 2012
Africa Livestock Project Development Consortium Agricultural Impact Assessment for the Construction and Operation of a Beef Cattle Handlings Facility for a Sugar Company in Northern Sudan	Aug 2012
Van Zyl Environmental Consultants Agricultural Impact Assessment : EIA for the Construction and Operation of a Photovoltaic Power Station in the Northern Cape.	Mar 2012
Bushveld Eco Services Design and cost estimate of a stock watering system in the Lephalale district.	Nov 2011
WSM Leshika Soil suitability survey for two new upcoming farmers at Vhuawela & Tshoga in the Limpopo Province.	Sep 2011
National Department of Agriculture Soil survey investigating soil potential for change of land use at the Levendal Development in the Paarl district, Western Cape.	Aug 2011
Van Zyl Environmental Consultants Agricultural Impact Assessment : EIA for the Construction and Operation of four Photovoltaic Power Stations in the Northern Cape.	Mar 2011
WSM Leshika Potential assessments and land use plans for four new upcoming farmers in the Limpopo Province.	Nov 2010
FP Botha Potential assessments and land use plans for various new Limpopo agricultural development hubs	Apr 2010

Golder Associates Africa (Pty) Ltd**May 2009 – Apr 2010**

Potential assessments and Landuse plans for the resettlement of land tenants at Mafube Coal Mine in the Belfast district of the Mpumalanga Province

Sappi**Vryheid, RSA**

Undertook reconnaissance soil surveys on various plantations and farms in the Vryheid and Piet Retief districts to establish forestation potential and evaluation for species choice (covering a total area of 5173 ha).

Environmentek, CSIR**Nelspruit, RSA**

Undertook soil and terrain classification surveys on the Jessievale (8313 ha) and New Agatha (1 700 ha) plantations.

Safcol (Komatieland)**Limpopo Province**

Undertook environmental, soil and terrain classification surveys on the Thatevondo (4 500 ha), Mafela (920 ha) and Mmamotola (1 263 ha) plantations.

Measured Farming**Gabon, Swaziland & RSA**

Undertook soil and terrain classification surveys on Ranch Lope and Ranch Suba in Gabon, Kubuta Farm in Swaziland and on the farms Madikwe in the Limpopo Province and Stoffelsrus in the Free State, South Africa.

Loxton Venn and Associates**Potgietersrus, RSA**

Assess comparative soils and area for relocating Village Ga-Sekhaolelo on Overysel 815LR to Rooibokfontein 812LR and Village Ga-Puka on Swartfontein 818 LR to Armoed on Potgietersrus Platinum Mine.

Department of Water Affairs and Forestry**Gauteng**

GPS survey and alien identification for mapping of Jukskei and Swartspuit areas, as part of the Working for Water Program.

Sustainable Forestry Management Ltd**Limpopo and Mpumalanga**

Participated in a due diligence audit on various SAFCOL plantations in the Limpopo and Mpumalanga Provinces as part of the preparation of a British company's tender to purchase these plantations.

Mustek Engineering Ghana

Survey to provide a detailed inventory of the forest resources in 17 specified Forest Reserves in Ghana to develop a practical and operationally sound methodology for monitoring the natural forest resources in Ghana, based on satellite imagery for the Ghana Forestry Commission.

Afrigis Environmental Solutions, Pretoria

Various Soil Surveys and Landuse Plannings – Domestic and Neighbouring Countries

Rural Integrated Engineering, Pretoria

Various Soil Surveys and Landuse Plannings

Africa Land-Use Training, Modimole

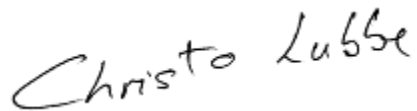
Lectures at Basic Farm Planning Course (Limpopo and Gauteng)

Declaration of Independence

CR Lubbe was appointed by Abo Wind Hotazel PV (Pty) Ltd via Cape Environmental Assessment Practitioners (Pty) Ltd, the EAP, to conduct an independent agricultural scoping study for the proposed Hotazel PV Power Plant in the Northern Cape.

He is not a subsidiary or in any way affiliated to Abo Wind Hotazel PV (Pty) Ltd.

CR Lubbe also does not have any interest in secondary developments that may arise from the authorisation of the proposed project.

A handwritten signature in black ink that reads "Christo Lubbe". The signature is written in a cursive, slightly slanted style.

CR Lubbe

21 November 2018