Soventix solar PV project in the Hanover district, Northern Cape (De Aar/Hanover Area)

Soil and wetland assessment

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By
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EXECUTIVE SUMMARY

The soil mapping and grazing assessment was an integrated effort by both Hennie van den Berg and Francois de Wet and the final maps and findings were the results of a collaborative approach. The soils, wetlands and grazing assessment reports and maps should be kept and used together as they are interdependent on each other.

The three focus (alternative) areas are characterised by very shallow soils that varies markedly in clay content. The focus areas are dominated by the Mispah and Swartland soil forms. Sub dominant soil forms are Glenrosa, Hutton, Valsrivier and Oakleaf.

The agricultural potential of these soils is very low and extensive grazing at a low intensity is the only long term viable agricultural option. It is possible that the shading effect of the proposed solar panels will increase soil moisture content and therefore improve the general grazing capacity of the study areas to some extent.

No severe soil erosion has been seen in the three focus areas but care should be taken when constructing infrastructure such as roads to reduce run-off. The floodplains outside the focus areas are showing signs of severe erosion caused by flash floods in years of exceptional rainfall. In general the focus areas have limited to no flood risk and it is only Alternative 2 that has a small portion that overlaps with the flood plain.

For this study a soil unit map, a soil observation point database and a wetland map were produced. Additional to these maps the soil units also formed the basis for the grazing capacity survey maps. Soil property statistics and detailed area analyses were provided for all the maps. Al these datasets are also provided as digital print and GIS maps.

Contents

1 INTRODUCTION

Fieldwork for soil and wetland assessments for the project: Proposed development of a 225MW solar PV plant on several portions of the farm Goedehoop also known as part of the farm De Bad, Hanover District, Northern Cape was done in December 2016. This was followed by mapping of soil and wetland patterns from satellite imagery and digital terrain data. The soil mapping was also used to correlate vegetation patterns and grazing potential and to assist in the spatial delineation of ecological zones. Wetland mapping was done for the three study areas and the general area between the three study areas. The soil, ecological zones and veld condition mapping was a combined and integrated mapping effort by both Hennie van den Berg and Francois de Wet. This report focuses only on the soil and wetland mapping and the detail of the grazing assessment is provided by the grazing assessment report of Francois de Wet.

Soil, ecological zones and veld condition index maps were produced for the three study areas (alternatives) and a wetland map for a much larger surrounding area.

2 STUDY AREA

Figure 1 shows the three study areas (alternatives). A 30 meter buffer has been added to the three study areas and Alternative 1 has been generalised to a continuous area. Table 1 shows the areas of the original study areas and Table 2 the enlarged study area. Wetlands have been assessed for a total area of 11 242 ha that includes the 3 study areas (see Figure 5). The study area is part of the Beaufort Group of the Karoo Supergroup of geology in South Africa and consists mainly of sandstones and shales. Dolerite koppies also form a small but conspicuous part of the landscape. The geology of the three study areas is described in more detail in the geological assessment report of Frederik Stapelberg. The current land-use for all three alternatives is extensive grazing on veld (natural vegetation).

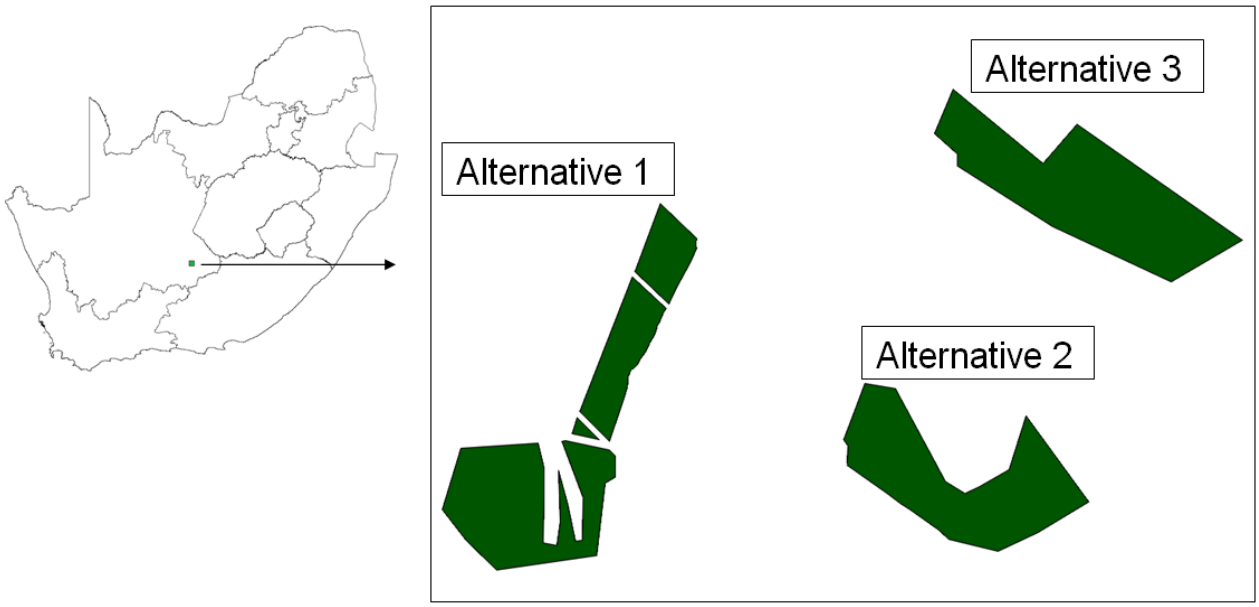


Figure 1. The three focus study areas (alternatives).

Table 1. Areas of the three focus areas.

Study area	Area (ha)
Alternative 3	480.0
Alternative 2	387.5
Alternative 1	513
Total	**1380.5**

Table 2. Areas of the enlarged focus areas.

Study area	Area (ha)
Alternative 3	515.0
Alternative 2	420.4
Alternative 1	644.7
Total	**1580.1**

3 METHODS

3.1. Soil and wetland field survey

Roads were delineated on Google Earth imagery of 28 September 2014. Predetermined observation sites were identified on the Google Imagery and a Landsat 8 image of 5 December 2016 to represent the main visible soil, vegetation and geological patterns on the imagery. During the field survey in December 2016 additional observation sites were added to represent additional patterns that were not so clear on the imagery. In total 122 soil observations were made mostly by hand augering until an impenetrable layer, mostly hard rock, was found. All soil observations were done in accordance to the South African Taxonomic System (MacVicar CN (ed.) (1991). Soil classification .A taxonomic system for South Africa. Second Edition. Memoir 15, Department of Agricultural Development, Pretoria). Additionally the coverage of common and dominant plant species was recorded at most of the observation sites.

17 Additional wetland and soil erosion observations were also made inside and outside the study areas.

3.2. Mapping of soil units, ecological units, VCA and wetlands

Soil patterns were mapped mainly from a Google image of 28 September 2014 and the enhancement products of a Landsat 8 image of 5 December 2016 (Figures 2 and 3) and the field observations.

The ecological units were mapped by correlating the results of the grazing potential assessment by Francois de Wet, the additional vegetation cover information of the soil survey and the mapped soil units. This resulted effectively in combining soil units to form larger ecological units. Additionally a Veld Condition Index (VCI) map was created by combining all of the above information and additional mapping from the enhanced Landsat 8 imagery.

Wetlands were mapped from various historical Google imagery and the Landsat 8 image of 5 December 2016 in combination of terrain type derived from an enhanced Digital Elevation Model (DEM) from SRTM data.

Figure 2. PAN sharpend Landsat 8 image (bands 4,3 and 2 displayed as RGB and the PAN band as intensity.

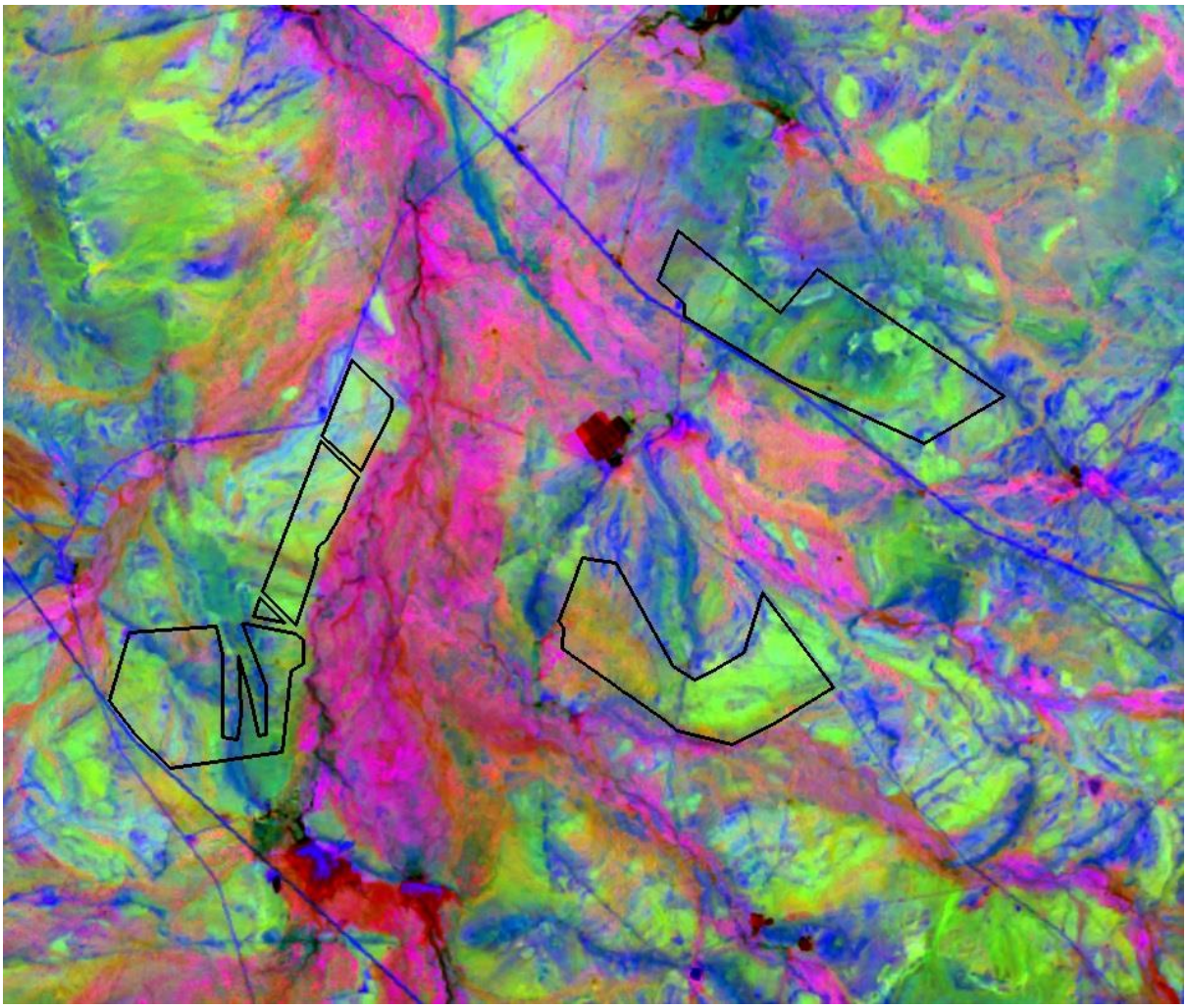
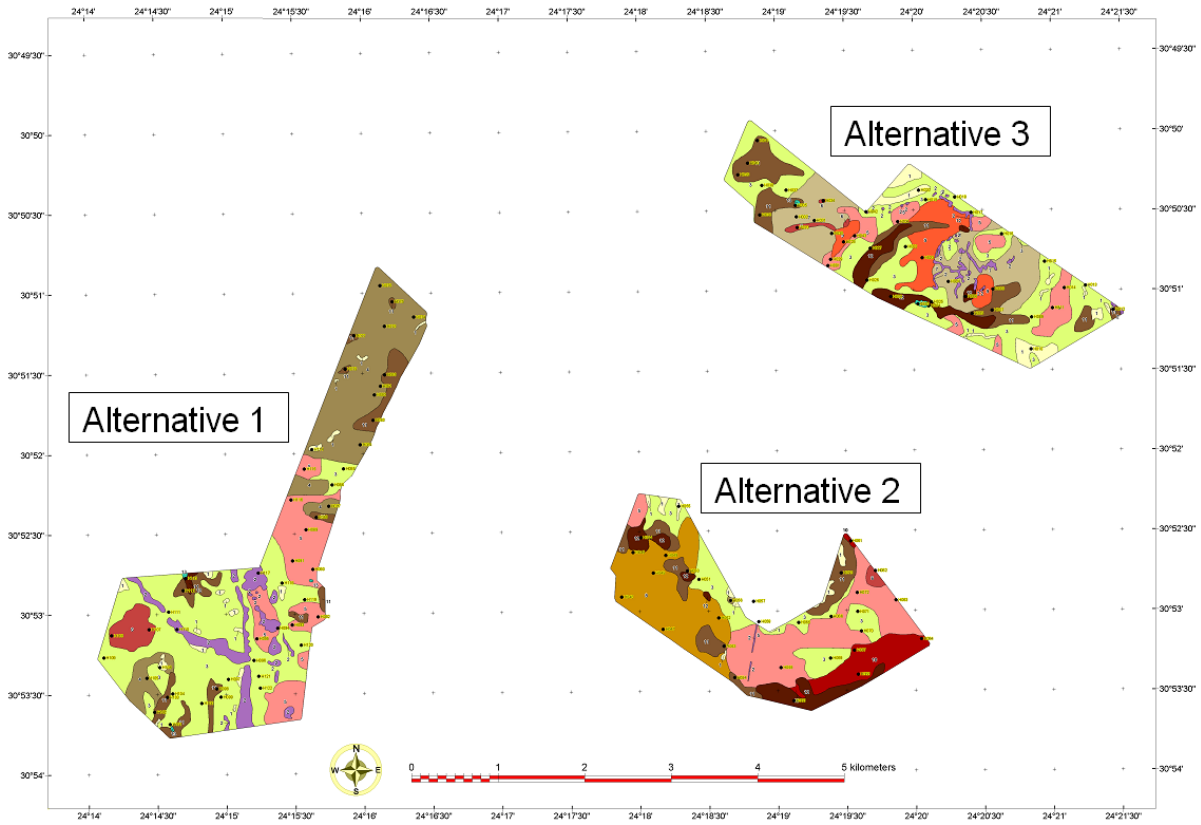


Figure 3. PCA enhanced Landsat 8 image (bands 1,2 and 3 displayed as RGB.

4 RESULTS

4.1. Soil map

The soil maps for the study areas can be seen in Figure 4. Table 3 show the area analysis of the soil units for all three focus areas (alternatives) combined. The results of the area analysis for each area are shown in Appendix A.



Colour	No	Class	Dominant soils
	1	Sandstone outcrops	Outcrop/Ms complex
	2	Dolerite outcrops	Outcrop
	3	Very shallow yellow brown loamy soils	Ms
	4	Very shallow yellow brown clayey soils	Ms
	5	Very shallow red loamy soils	Ms, Gs
	6	Very shallow red clayey soils	Ms, Hu, (Gs)
	7	Shallow to medium deep yellow brown loamy soils	Gs, (Ms, Cv)
	8	Shallow to medium deep yellow brown clayey soils	Oa, Ad, Ag, (Gm)
	9	Shallow to medium deep red loamy soils	Hu (Gs)
	10	Shallow to medium deep red clayey soils	Hu, Oa
	11	Structured shallow soils	Sw
	12	Structured medium deep soils	Va
	13	Permanent wetland	

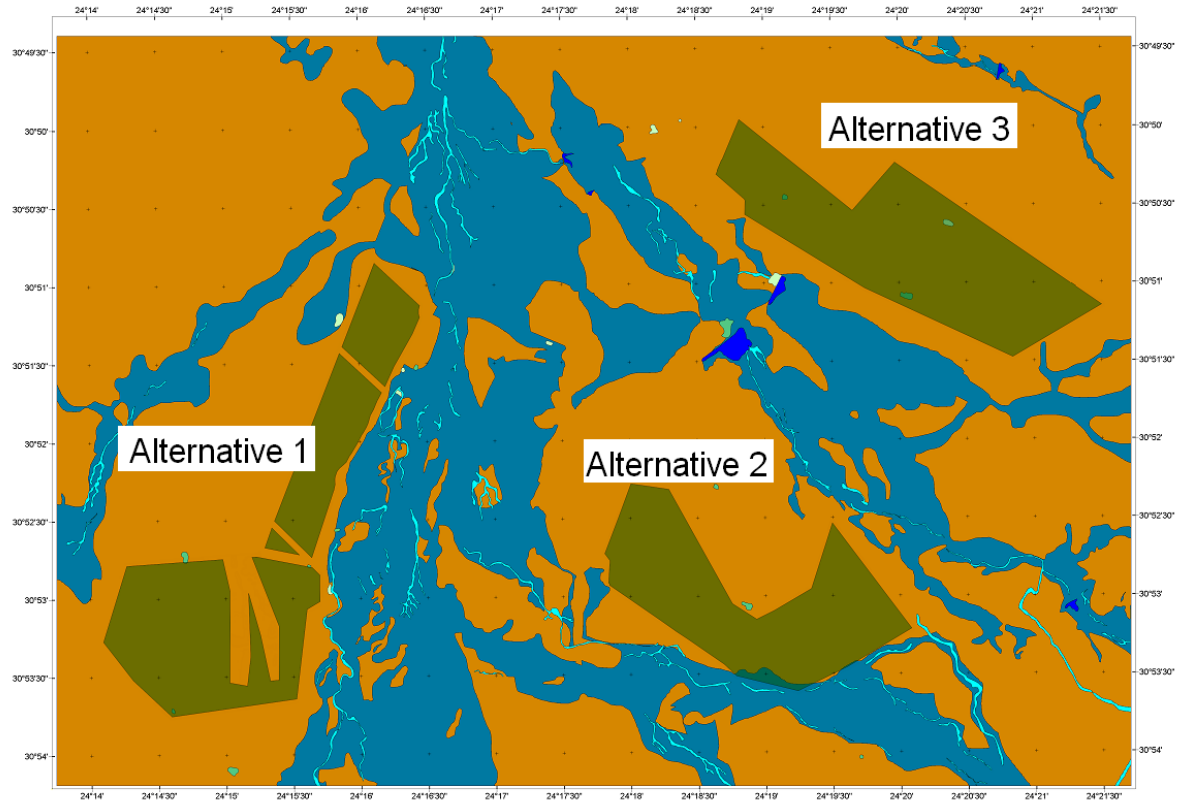
Figure 4. The soil maps for the three focus study areas. The 122 observation sites are also displayed over the maps. An A0 version of this map is also available. See Appendix B.

Table 3. Area analysis of the combined soil maps.

No	Class	Dominant soils	%	Area (ha)
1	Sandstone outcrops	Outcrop/Ms complex	2.7	43.0
2	Dolerite outcrops	Outcrop	3.6	57.4
3	Very shallow yellow brown loamy soils	Ms	31.4	496.6
4	Very shallow yellow brown clayey soils	Ms	10.4	164.1
5	Very shallow red loamy soils	Ms, Gs	16.4	258.4
6	Very shallow red clayey soils	Ms, Hu, (Gs)	1.7	27.3
7	Shallow to medium deep yellow brown loamy soils	Gs, (Ms, Cv)	6.8	107.4
8	Shallow to medium deep yellow brown clayey soils	Oa, Ad, Ag, (Gm)	6.7	105.6
9	Shallow to medium deep red loamy soils	Hu (Gs)	3.1	49.5
10	Shallow to medium deep red clayey soils	Hu, Oa	2.6	41.0
11	Structured shallow soils	Sw	10.1	160.1
12	Structured medium deep soils	Va	4.3	68.1
13	Permanent wetland		0.1	1.8
	Total		**100.0**	**1580.1**

4.2. Wetland map

The wetland map is shown in Figure 5. The area analysis for the large area covered by this map is shown in Table 4.



Colour	No	Class
	1	Water
	2	Permanent wetland
	3	Seasonal wetland
	4	Floodplain
	5	Streambeds
	6	Non-wetland

Figure 5. Wetland map for the wider area around the three focus study areas (alternatives). An A0 version of this map is also available. See Appendix B.

Table 4. Area analysis of the wetland map.

No	Class	%	Area (ha)
1	Water	0.1	14.7
2	Permanent wetland	0.1	7.8
3	Seasonal wetland	0.1	5.7
4	Floodplain	28.2	3166.6
5	Streambeds	1.1	120.1
6	Non-wetland	70.5	7927.0
	Total	**100.0**	**11241.8**

Figure 6 shows a dolerite koppie and Figure 7 a mosaic of shallow soils and sandstone outcrops. Figure 8 shows an example of extensive erosion in the flood plains between the focus areas.

Figure 6. An example of one of the conspicuous dolerite koppies inside the focus areas.

Figure 7. A mosaic of shallow soils and sandstone outcrops.

Figure 8. Extensive erosion in the flood plains between the focus areas.

4.3. Statistical analysis of important soil properties

Tables 5 and 6 give statistics for focus study Alternative 3. Tables 7 and 8 give statistics for Alternative 2. Tables 9 and 10 give statistics for Alternative 1. The median Effective Rooting Depth (ERD) is given for all three focus areas in Table 11.

Table 5. Alternative 3 soil depth and clay content statistical analysis.

Horizon	Median depth (cm)	Median clay (%)	Depth range (cm)	Clay range (%)
H1	10	25	5 to 30	10 to 35
H2	30	33.5	15 to 60	10 to 40
H3	120	35	50 to 120	28 to 38

Table 6. Alternative 3 soil form statistical analysis.

Dominant Soil form	Count	%
Mispah	11	27.5
Swartland	9	22.5
Glenrosa	12	30
Hutton	2	5
Valsrivier	4	10
Coega	1	2.5
Etosha	1	2.5
Total		**100**

Table 7. Alternative 2 soil depth and clay content statistical analysis.

Horizon	Median depth (cm)	Median clay (%)	Depth range (cm)	Clay range (%)
H1	15	28	5 to 20	18 to 34
H2	45	35	20 to 60	28 to 40
H3	82.5	37	45 to 110	30 to 38

Table 8. Alternative 2 soil form statistical analysis.

Dominant Soil form	Count	%
Mispah	11	39.3
Swartland	4	14.3
Hutton	1	3.6
Valsrivier	2	7.1
Oakleaf	4	14.3
Addo	2	7.1
Augabies	1	3.6
Gamoep	2	7.1
Sepane	1	3.6
Total		**100.0**

Table 9. Alternative 1 soil depth and clay content statistical analysis.

Horizon	Median depth (cm)	Median clay (%)	Depth range (cm)	Clay range (%)
H1	10	25	3 to 25	18 to 35
H2	30	34	20 to 60	23 to 38
H3	80	30	65 to 95	32 to 45

Table 10. Alternative 1 soil form statistical analysis.

Dominant Soil form	Count	%
Mispah	22	46.8
Swartland	10	21.3
Glenrosa	1	2.1
Hutton	6	12.8
Valsrivier	1	2.1
Oakleaf	3	6.4
Clovelly	4	8.5
Total		**100.0**

Table 10. Focus area Effective Root Depth (ERD).

Study area	ERD (cm)
A	20
B	20
C	15

4.4. Detailed area analyses for the Soil, Ecological zone and VCI maps

The area analyses per focus area for the soil units, ecological zone and veld condition index maps are given in Appendix A.

5 DISCUSSION

The study areas are dominated by the Mispah and Swartland soil forms. Sub dominant soil forms are Glenrosa, Hutton, Valsrivier and Oakleaf. Ten soil forms have been identified from 122 soil observation sites. The majority of the soils are very shallow (around 15-30cm) with only a small minority of soils deeper than 120cm. Clay content ranges from sandy to very clayey. Calcareous soils are covering relative small areas with only Alternative 2 that has a significant area of 105.6 ha (class 8 on the soil map) that is dominated by these soils. The median effective rooting depth of only 20cm for focus areas A and B and even less at 15cm for Alternative 1 implies that even with irrigation the soils are unsuitable for most types of agriculture. Extensive grazing with relative low animal numbers is the most suitable agricultural application.

No severe donga erosion has been observed in the study areas. Minor to moderate plate erosion is present in all three main study areas. The three study areas are

separated by floodplains that contain seasonal to temporary wetland systems. Severe donga and sheet erosion have been observed on these flood plains.

There are no significant wetlands present in the three main study areas. The most conspicuous wetlands are small artificial permanent wetlands around watering points. There is no major flood danger inside the study areas except for a small southern portion of Alternative 2 that overlaps with the edge of the floodplain. However, the adjacent flood plains are characterised by severe flooding during some rainy seasons.

It is not envisaged that the proposed development will result in major soil erosion or any other degradation of the soils of the focus areas provided that there is proper runoff management from roads and other bare areas. The shallow soils may present a challenge for some construction items like poles that need to be planted. The clayey soils and most noticeably the Valsrivier soils may restrict vehicle movement during the wet season. It is possible that the shading effect of the proposed solar panels will increase soil moisture content and therefore improve the general grazing capacity of the study areas.

6 ACKNOWLEDGEMENTS

The contribution of the following persons assisting with fieldwork for the soil survey is acknowledged:

The farm owner of De Bad: Willem Retief

Soil technicians: Lourens Janse van Rensburg and Drihan van der Westhuizen

APPENDIX A

Area analyses per focus study area

Table A1. Soil map area analysis for Alternative 3.

No	Class	Dominant soils	%	Area (ha)
1	Sandstone outcrops	Outcrop/Ms complex	4.6	23.7
2	Dolerite outcrops	Outcrop	2.1	10.6
3	Very shallow yellow brown loamy soils	Ms	33.0	170.2
4	Very shallow yellow brown clayey soils	Ms	0.0	0.0
5	Very shallow red loamy soils	Ms, Gs	9.7	49.8
6	Very shallow red clayey soils	Ms, Hu, (Gs)	0.8	3.9
7	Shallow to medium deep yellow brown loamy soils	Gs, (Ms, Cv)	20.9	107.4
8	Shallow to medium deep yellow brown clayey soils	Oa, Ad, Ag, (Gm)	0.0	0.0
9	Shallow to medium deep red loamy soils	Hu (Gs)	9.6	49.5
10	Shallow to medium deep red clayey soils	Hu, Oa	0.0	0.0
11	Structured shallow soils	Sw	13.1	67.5
12	Structured medium deep soils	Va	6.1	31.2
13	Permanent wetland		0.2	1.2
	Total		**100.0**	**515.0**

Table A2. Soil map area analysis for Alternative 2.

No	Class	Dominant soils	%	Area (ha)
1	Sandstone outcrops	Outcrop/Ms complex	1.9	7.8
2	Dolerite outcrops	Outcrop	0.2	0.7
3	Very shallow yellow brown loamy soils	Ms	17.1	72.0
4	Very shallow yellow brown clayey soils	Ms	0.1	0.6
5	Very shallow red loamy soils	Ms, Gs	26.6	112.0
6	Very shallow red clayey soils	Ms, Hu, (Gs)	0.8	3.3
7	Shallow to medium deep yellow brown loamy soils	Gs, (Ms, Cv)	0.0	0.0
8	Shallow to medium deep yellow brown clayey soils	Oa, Ad, Ag, (Gm)	25.1	105.6
9	Shallow to medium deep red loamy soils	Hu (Gs)	0.0	0.0
10	Shallow to medium deep red clayey soils	Hu, Oa	9.7	41.0
11	Structured shallow soils	Sw	10.1	42.6
12	Structured medium deep soils	Va	8.3	35.0
13	Permanent wetland		0.0	0.0
	Total		**100.0**	**420.4**

Table A3. Soil units map area analysis for focus Alternative 1.

No	Class	Dominant soils	%	Area (ha)
1	Sandstone outcrops	Outcrop/Ms complex	1.8	11.5
2	Dolerite outcrops	Outcrop	7.1	46.1
3	Very shallow yellow brown loamy soils	Ms	39.5	254.4
4	Very shallow yellow brown clayey soils	Ms	25.4	163.5
5	Very shallow red loamy soils	Ms, Gs	15.0	96.6
6	Very shallow red clayey soils	Ms, Hu, (Gs)	3.1	20.0
7	Shallow to medium deep yellow brown loamy soils	Gs, (Ms, Cv)	0.0	0.0
8	Shallow to medium deep yellow brown clayey soils	Oa, Ad, Ag, (Gm)	0.0	0.0
9	Shallow to medium deep red loamy soils	Hu (Gs)	0.0	0.0
10	Shallow to medium deep red clayey soils	Hu, Oa	0.0	0.0
11	Structured shallow soils	Sw	7.8	50.0
12	Structured medium deep soils	Va	0.3	1.9
13	Permanent wetland		0.1	0.6
	Total		**100.0**	**644.7**

Table A4. Ecological zones map area analysis for Alternative 3.

No	Ecological zone	%	Area (ha)
1	GRAZING UNIT I = Classes 7 to 10 and class 12: Medium deep soils at lower parts of the catena, including soils with lime present (i.e., Hutton, Oakleaf, Gamoep, Addo, Augrabies soils. It also includes Valsrivier soils).	36.5	188.0
2	GRAZING UNIT II = Class 11: Shallow to slightly deeper structured soils (unit dominated by Swartland soils)	13.1	67.5
3	GRAZING UNIT III = Classes 3 to 6: Shallow soils (i.e., Mispah and Glenrosa soils)	43.5	224.1
4	GRAZING UNIT IV = Classes 1 and 2: Koppies of sandstone and dolerite (i.e., outcrops and Mispah soils)	6.6	34.2
5	Permanent wetland	0.2	1.2
	Total	**100.0**	**515.0**

Table A5. Ecological zones map area analysis for Alternative 2.

No	Ecological zone	%	Area (ha)
1	GRAZING UNIT I = Classes 7 to 10 and class 12: Medium deep soils at lower parts of the catena, including soils with lime present (i.e., Hutton, Oakleaf, Gamoep, Addo, Augrabies soils. It also includes Valsrivier soils).	43.2	181.6
2	GRAZING UNIT II = Class 11: Shallow to slightly deeper structured soils (unit dominated by Swartland soils)	10.1	42.5
3	GRAZING UNIT III = Classes 3 to 6: Shallow soils (i.e., Mispah and Glenrosa soils)	44.7	187.8
4	GRAZING UNIT IV = Classes 1 and 2: Koppies of sandstone and dolerite (i.e., outcrops and Mispah soils)	2.0	8.5
5	Permanent wetland	0.0	0.0
	Total	**100.0**	**420.4**

Table A6. Ecological zones map area analysis for focus Alternative 1.

No	Ecological zone	%	Area (ha)
1	GRAZING UNIT I = Classes 7 to 10 and class 12: Medium deep soils at lower parts of the catena, including soils with lime present (i.e., Hutton, Oakleaf, Gamoep, Addo, Augrabies soils. It also includes Valsrivier soils).	0.3	1.9
2	GRAZING UNIT II = Class 11: Shallow to slightly deeper structured soils (unit dominated by Swartland soils)	7.8	50.0
3	GRAZING UNIT III = Classes 3 to 6: Shallow soils (i.e., Mispah and Glenrosa soils)	82.9	534.5
4	GRAZING UNIT IV = Classes 1 and 2: Koppies of sandstone and dolerite (i.e., outcrops and Mispah soils)	9.0	57.7
5	Permanent wetland	0.1	0.6
	Total	**100.0**	**644.7**

Table A7. VCA map area analysis for Alternative 3.

No	Veld Condition Index Zone	%	Area
1	GOOD	82.0	422.5
2	INTERMEDIATE	18.0	92.5
3	POOR	0.0	0.0
	Total	**100.0**	**515.0**

Table A8. VCA map area analysis for Alternative 2.

No	Veld Condition Index Zone	%	Area
1	GOOD	10.8	45.5
2	INTERMEDIATE	59.4	249.7
3	POOR	29.8	125.2
	Total	**100.0**	**420.4**

Table A9. VCA map area analysis for Alternative 1.

No	Veld Condition Index Zone	%	Area
1	GOOD	0.0	0.0
2	INTERMEDIATE	87.9	566.9
3	POOR	12.1	77.7
	Total	**100.0**	**644.7**

APPENDIX B

Digital data and print maps

The following A0 soft copy print maps were produced and are part of this report:

- A0 map - Soil units at De Bad 28 Feb 2017
- A0 map - Wetlands at De Bad 28 Feb 2017
- A0 map - Ecological Zones at De Bad 28 Feb 2017
- A0 map - VCI Zones at De Bad 28 Feb 2017

The following shape and TIFF files were produced and are part of this report:

- Soil units at De Bad Lo 25 N
- Soil observations - point data
- Wetlands at de Bad Lo 25 N
- Ecological zones at de Bad Lo 25 N
- VCI at De Bad Lo 25 N
- Potential flooding at Alternative 2 Lo 25 N
- Soil observations point database geographic shape file and Excel spreadsheet
- Classified slope map (TIFF format, geographic, derived from 1 arc sec SRTM)

APPENDIX C

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IRIS International
Integrated Resource Information Systems

IRIS International

Integrated Resource Information Systems CC

IRIS International specialises in the application of the latest technology to characterize the spatial distribution of natural resources. Remote sensing and GIS technologies are applied in mapping and spatial modelling applications. Custom-made solutions are provided for packaging, distribution and retrieval of spatial data. National and international networking creates synergy for a multidisciplinary approach. Currently IRIS International employs a number of part time specialists on project demand.

IRIS International has extensive experience in the mapping and modelling of natural resources. Remotely sensed data and other spatial data layers are integrated in a GIS environment and supported by relevant fieldwork. Experience gained over the past 26 years includes:

- Soil and vegetation modelling and mapping
- Natural resource auditing
- Land-cover mapping

- Vegetation biomass estimations
- Terrain-mobility analysis for military applications
- DEM correction, terrain morphological mapping and hydrological modelling
- Mineral exploration
- The creation of electronic data atlases
- Spatial sampling designs and accuracy assessment of spatial data
- Project management for large projects
- Remote Sensing and GIS training - nationally and internationally
- Map composition and spatial data creation / integration
- Presentation of research work at various national and international conferences, seminars, workshops and exhibitions
- Scientific publications
- International networking

Projects from 2002-2017:

- Project management and technical assistance to the National Land-Cover 2000 project – NLC 2000. The duties included technical consortium member evaluation and selection, acting project leader, edge-matching of classifications, quality control, training and accuracy assessment. CSIR and ISCW NLC 2000 project consortium, South Africa.
- The mapping of natural resources (soils and vegetation) and land-cover for 5 provinces (30 million ha) in Angola at a 1:50 000 - 1:100 000 scale.
- The creation of electronic data atlases for several regions in Angola.
- The compilation of Rural Rapid Appraisal (RRA) maps for a number of municipals in southern Angola.
- Technical assistance for natural resource auditing in development nodes 1 and 4 in South Africa.
- Digital and hard copy vegetation map creation for the greater St. Lucia Wetland Park (South Africa) - EcoTrust.
- Geo-rectification of MSS satellite imagery for the National Department of Agriculture – South Africa.
- Geo-rectification of Landsat ETM and ASTER data for vegetation mapping for a number of farms close to Ghanzi in Botswana - space-map compositions.
- Space-maps for updating the vegetation types of the Kgalagadi Transfrontier Park (South Africa and Botswana).
- Digital vegetation map, area analysis and map compositions for the KGNP
- Digital vegetation map, area analysis and map compositions for several private game reserves (including Phinda, Ithala and Timbavati) - EcoTrust.
- Digital vegetation map, area analysis and map compositions for the Roggeveld region in the Northern and Western Cape - Department of Botany University of Pretoria
- High-resolution land-cover, land-use and transformation mapping for EIA studies (South Africa).
- Terrain mobility assessment for Africa on various scales – SANDF peacekeeping operations.

- *Ad hoc* space map compilation, and digital map creation for vegetation surveys – various areas in South Africa.
- Ortho-rectification of QuickBird imagery for a number of towns in Angola.
- Ortho-rectification of 140 SPOT 4 and 2 images for South Africa.
- Ortho-rectification of Landsat TM images covering the whole of Namibia.
- Hydrological modelling for Porto Amboim (Angola).
- DEM correction and hydrological modelling for the Cape floristic region and California (USA).
- Soil modelling for the Katse and Mohale catchments in Lesotho.
- Characterization of the agricultural potential of Tchiange and Uaba areas in Angola.
- Desktop study on natural resources – sugar production in the Cunene province in Angola.
- Aerial photo mosaic's for a number of farms in South Africa and Botswana (including contour generation and the creation of digital atlases).
- Transformation mapping of forests, woodlands and sensitive ecosystems in Angola (national project).
- Conservation potential studies and desktop mapping for the Tundavala area (Angola).
- The mapping and characterization of natural resources in Namibe province in Angola – ongoing assistance for a PhD study.
- MODIS biomass monitoring for Northwest Province – SA.
- MODIS biomass monitoring for Kuanza Sul and Malange provinces.
- Habitat modelling for the Molopo area.
- Sampling frame for a national alien vegetation survey in Swaziland.
- Vegetation and habitat modelling for Bezuidenhoutshoek private game range.
- Vegetation and habitat modelling for Crock River Gorge conservancy.
- Vegetation and habitat modelling for Sabie Sand game reserve.
- Biomass mapping for power line routing (Delta Epsilon project – Enviro Pulse, PBA and ESKOM 2009).
- Soil modelling and mapping for 3 tertiary catchments in South Africa (3.5 million ha).
- Soil modelling and mapping for KZN and parts of adjacent provinces (15 million ha on 1:100 000 scale) – National Dept of Agriculture .
- Land-Cover mapping for the Free State Province SA (2010-2011).
- Detailed soil mapping for an area of more than 3 000 ha in the Kuanza Sul province of Angola for an irrigation scheme feasibility study (2009-2011).
- Extensive digital elevation data correction for an area of more than 3 000 ha in the Kuanza Sul province of Angola for an irrigation scheme feasibility study (2009-2011).
- National dry-land cotton and maize production potential modelling for Angola (2010-2011).
- Hydrological correction of SRTM digital elevation data for South Africa, Swaziland and Lesotho and full catchment areas stretching into Zimbabwe, Botswana and Namibia – Water Research Commission project (2009-2011).
- Geological feature mapping for study areas in Liberia and the Congo (2011) - Southern Mapping Company.

- Image geo-rectification for Rakodzi, Sable and Springvale farms in Zimbabwe (2011).
- View sheds from the SRTM Digital Elevation Model for southern Africa - SKA telescope project (2011)
- Semi detail soil mapping (2 000ha) for the Nkomazi area (2011).
- Land-cover mapping for the Upper Orange River catchment (31 SPOT 5 images – 2011).
- Iron deposit probability mapping for the Melmoth area – Southern Mapping Company (2011).
- Field maps and burn management map compositions for Alicecot, Inyati and Ulusaba - Sabie Sand Game reserve (2011).
- Biodiversity, habitat land-use mapping for Jagtlust – Mpumalanga (2011) – joint project with EnviroPule.
- Fire scar mapping for 3 seasons Pilanesburg National Park and surrounding areas (2011).
- Evelyn vegetation map composition – (2012) Department of Botany University of Pretoria
- Map compositions to show the area affected by the 2011 veld fire for 3 study areas (Amalia, Ventersdorp and Bodibe) NW University (2012)
- Habitat, bush density and biomass maps for the Mier and Khuis areas (Kalahari Namib project) – NW University (2012).
- Map compositions for the Amalia, Ventersdoerp and Bodibe areas affected by the 2011 veld fire) – NW University (2012).
- Geological feature mapping for study areas in the DRC – Southern Mapping Company (2012).
- Flood analysis for a catchment in the Central African Republic – Southern Mapping Company (2012).
- Soil and vegetation mapping for the SASOL Sasolburg and Secunda conservation and farming areas – joint project with EnviroPulse (2012).
- Geological feature mapping and target mineral probability mapping and modelling for a study area in Madagascar – Southern Mapping Company (2012).
- Kloof Driefontein Complex - East vegetation map composition – (2012) Ecotrust
- Geological feature mapping for a study area in Sudan – Southern Mapping Company (2012).
- SKA -telescope core area flood risk mapping – Southern Mapping Company (2012)
- Vegetation map compilations Roodepoort – EnviroPulse (2012)
- Black Eagle Valley map composition - Heli Trace Trust (2012)
- Congo - Sintikoula vegetation map composition - FLORA FAUNA & MAN, Ecological Services Ltd (2012)
- Mineral exploration in Madagascar using multi-spectral and hyper-spectral satellite imagery - Southern Mapping Company (2013)
- Soil and terrain survey for the Wonderwater mine rehabilitation - SASOL (2013)
- Wetland mapping for Kruger, Marekele and Mapungubwe National Parks - IP (2013)

- Land-use change mapping for the period 1985-2010 Congo Mayoko Exxaro study area (2013)
- Hinda land-use change mapping for the period 1990 - 2014 Congo - FLORA FAUNA & MAN, Ecological Services Ltd. Dr. Jerome Gaugris (2014)
- Soil mapping in the Kilombero valley in Tanzania (52 000 ha semi-detail) – Southern Mapping Company and CDM Smith International (2013 - 2015)
- Soil mapping in Angola for Fazenda Cristalina - Farmsecure/IrriCheck (2013-2014)
- Soil mapping for the Chrisiesmeer conservancy 185 000 ha - EnviroPulse (2013-2014)
- Vegetation condition mapping for the Mier area in the Northern Cape (NWU - 2015)
- BBK flood modelling. Flood modelling for the Pilanesberg and Bakgatla Ba Kgafela Traditional Administration areas - SATPLAN (2014/2015)
- Dish Mountain Project. Land use change mapping in Ethiopia - FLORA FAUNA & MAN, Ecological Services Ltd. Dr. Jerome Gaugris (2015)
- Dish Mountain Project. Field maps (Ecotrust, 2015)
- Weedy forbs mapping Sasolburg and Secunda rangeland and wildlife areas. SASOL and EnviroPulse (2015)
- One Tree-Hill soil and vegetation mapping assistance to EnviroPulse (2015)
- Consultancy to upgrade the AMESD Drought Monitoring System (DMS) (Software/application) for the Monitoring for Environment and Security in Africa (MESA) - RS/GIS consultant in collaboration with Dr Markus Metz of Geospatial Data Services - MESA SADC THEMA Grant Contract No. FED/2014/328-638 (2015).
- Secunda (SASOL plant and surrounding properties) detailed and simplified land cover maps.(SASOL, 2016)
- Weedy forbs mapping - 3 x focus areas Secunda (Enviropulse, 2016)
- Kathu Bushveld Kathu Bushveld study: research offset for first development phase of Adams Solar Energy Facility - Mapping of habitat and vegetation types and woody density mapping for 1.4 million ha. (2014-2016 - ENEL and Ecotrust)
- Pre-feasibility study: Habitat and ecological capacity assessments for the Catofe and Somue properties (Sociedade Agro-pecuaria, Sagrada Esperança, 2016)
- Potential alluvial gold deposit mapping - Utah, USA (Oremax and SWIFT Geospatial Solutions, 2017)
- Weedy forbs and veld condition trend mapping - 3 x focus areas Secunda (Enviropulse, 2017)
- Dunn Roman - Tea Estate, land-cover, frost risk and tea water stress mapping (2017 - Bongani Consulting)
- Borehole identification by satellite imagery and terrain analysis - Rietfontein (Shaun Harrop-Allin, 2017)
- Vegetation growth analyses for various locations in North West Province, RSA (Geolab, 2017).
- Soil mapping for the proposed development of a 225MW solar PV plant on several portions of the farm Goedehoop also known as part of the farm De Bad, Hanover District, Northern Cape (Ecoleges and Soventix 2017)

Hendrik Marthinus (Hennie) van den Berg (Remote Sensing and GIS specialist, vegetation ecology and soil science)

Hennie has 26 years experience in natural resource applications using GIS and remote sensing technologies. He obtained M.Sc. in vegetation ecology from the University of Pretoria in 1993. He has extensive experience in stereoscopic interpretation of black and white aerial photographs and obtained in 1989 a postgraduate diploma (NWU) in terrain evaluation for military applications. From 1990 to 1995 he worked in the natural resource section of the Transvaal Region of the Department of Agriculture. Here he was given the opportunity to do digital image processing on SPOT and Landsat satellite data for natural resource characterization. He was employed in 1995 at the Geo-informatics division at the Institute for Soil, Climate and Water. He was project leader for the National Land-Cover and land-cover change-mapping projects at the Institute. He was also project leader and co-worker on various other projects integrating remotely sensed data with other spatial data for monitoring and mapping of natural resources. He specialized in spatial modelling, spatial sampling designs and accuracy assessment of spatial data. In the beginning of 2002 he formed IRIS International including strategic alliances with various specialists inside and outside South Africa.

Project management

Extensive experience in project management has been acquired over the past 25 years. Hennie has been project leader for various local, regional and international projects. Multidisciplinary teams have been managed and extensive liaison has been done with clients to develop and structure projects.