



**PROPOSED SOLAR POWER FACILITY –
PORTION 8 OF OLYVEN KOLK 187
KENHARDT SOUTH AFRICA**

**REPORT ON
GEOTECHNICAL INVESTIGATIONS**

November 2012

Compiled by:

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1 EXECUTIVE SUMMARY

SKCMasakhizwe Engineers (Pty) Ltd (SKCM) was appointed by Greencontinent to perform a geotechnical investigation on Portion 8 of the Farm Olyven Kolk 187, approximately 30km south west of Kenhardt in the Northern Cape of South Africa.

The main objective of the investigation was:

1. To determine the consistency of the soil profile
2. To assess the PH of the soils
3. To evaluate the suitability of in-situ material for use in construction of the works
4. To assess the agricultural potential of the proposed sites
5. To assess the seismic risk of the sites

The site is situated to the west of the Kenhardt Pofadder gravel road and approximately 4km north-east of the existing Eskom Aries substation.

The proposed sites have a low risk of flooding and seismic activity in the area is limited. Ground movement is less than approximately 50cm/s with a 10% probability of exceeding this limit in 50 Years.

The agricultural potential of the sites is low and is suitable for limited grazing only, mainly due to the harsh climate, shallow soils and low annual rainfall.

The soil profile over the study area can be described as a loose to very loose sand in the upper layer and generally underlain by dense and to very dense calcareous pedogenic layers that disintegrate into coarse gravel during excavation. Only one of the five trial pits could be excavated down to 2 000mm by the digger loader. For the rest of the trial pits the depth to refusal varied from 500mm to 1 500mm. I am of the opinion that an excavator will be able to excavate through this layer.

Although the founding method (foundation screws or steel piles) for the solar panels is still to be determined, the dense nature of the soil poses a question mark whether the anchors will be able to penetrate the very dense material. Although we are of the opinion that this founding method will be feasible, we propose that additional tests be conducted by the specialist contractor responsible for the design and installation of the anchors.

The soil PH ranges between 6.4 and 6.9. The soils are therefore slightly corrosive. Conventional galvanising should be sufficient to protect critical elements in contact with the ground from corrosion.

The study area is considered to be suitable from a geotechnical perspective for the proposed development of a solar power facility.

2 INTRODUCTION AND TERMS OF REFERENCE

Greencontinent is investigating the feasibility of establishing a solar power facility near Kenhardt in the Northern Cape. The facility situated adjacent to the close proximity of the existing Eskom Aries Substation. The site location is indicated in Figure 1, while the layout is indicated on Figures 2

The objectives of the geotechnical study were as follows:

1. To determine the consistency of the soil by profiling the vertical succession of soil layers on the proposed sites
2. To determine the PH and conductivity of the soils in order to evaluate the corrosive potential, with specific reference to the use of galvanised ground anchors as a founding system for the photovoltaic panels
3. To evaluate the suitability of in-situ material for use in construction of the works
4. To assess the agricultural potential of the proposed sites
5. To assess the seismic risk of the area

This report describes the results of the various investigations.

3 INFORMATION USED IN THE STUDY

3.1 List of Information

The following maps and supplementary information was consulted:

- 1:50 000 Topographic series map 2920 BD, Grootriet, Third Edition, 2003
- 1:50 000 Topographic series map 2920 DB, Sonderhuis, Third Edition, 2003
- Google Earth Images
- 1:250 000 Geological Series Map, 2920 Kenhardt, and the associated explanation sheet entitled "The Geology of the Kenhardt Area". Geological Survey of South Africa, 1999.
- Site layout prepared by Messers Cape Lowlands Environmental Services
- Agricultural Research Council Database (www.agis.agric.za) regarding soil classification, soil type and land capability
- Soil Classification, a Taxonomic system for South Africa, Soil Classification Working Group, 1991 as published by the Department of Agricultural Development
- Unsealed roads: Design, construction and maintenance. TRH 20, Pretoria

Discussions were also held with Mr. M Van Niekerk, a local farmer regarding conditions on site, as well as with Mr M Langenhoven of Planscape, town and regional planners, and Mr N Hanekom of Eco Impact the environmental consultants.

3.2 Evaluation Procedures

Initial evaluations were made using the topographic map (2920BD Grootriet and 2920DB Sonderhuis), Google Earth Imagery and by studying the geological map (2920 Kenhardt) and associated explanation sheets.

Proposed site layout, as included in the Environmental Assessment report by Eco Impact was also considered. The layout is included in this report as Figure 2.

No open excavations were found on or near the site. Final geotechnical assessments are therefore based on the results of trial pitting and laboratory testing.

4 SITE DESCRIPTION

The proposed sites are situated on the farm Olyven Kolk 187, approximately 30km south west of Kenhardt, as indicated in Figure 1.

The site is situated approximately 1km west northwest of the existing Olyvenhoutsolk homestead and to the west of the Kenhardt / Pofadder gravel road. The existing Eskom Aries Substation is approximately 4km to the south-west (Figure 1). The site is bordered on all sides by uncultivated farm lands used mainly for sheep farming.

The site is situated in an arid region with rainfall of approximately 127mm per annum, mostly from December to May. Annual evaporation is expected to be between 2600mm and 2800mm. Average temperatures varies between approximately 20 °C in July and 36 °C in January.

The site is located on a natural watershed which lies west to east. The northern and southern slopes drain to the well defined water course to the east of the site. The generalised slopes are approximately 2%.

Vegetation cover consists mainly of sparse grass and thorn shrubs.

From the 1:50 000 Topographic Map 2920 BD Grootriet, three main drainage features can be identified bordering the site. Aerial imagery and conditions on site indicate that a major watercourse bordering the site drains from south to north. The flood line of this watercourse does not have an influence on the site. The positions of these drainage features are indicated on Figures 3 and 7.

5 NATURE OF THE INVESTIGATION

5.1 Desk Study

Prior to the site investigations an initial geotechnical evaluation was done using the information contained in the 1:250 000 geological series map 2920 Kenhardt and the associated explanation sheet.

Site investigations were planned using Google Earth imagery and available Topographic maps. The positions of trial pits were determined on site taking into consideration the prevailing site conditions and the site layouts prepared by Messers Eco Impact.

5.2 Site Investigations and Laboratory Testing

Site Investigations were conducted by Mr M Loubser of SKCM Engineers on 13 and 14 November 2012.

Trial pitting was conducted on 13 November 2012 using a Case 580T digger/loader hired from Charl Beard Landbou Produkte.

Laboratory testing was conducted by Messers Matrocast Laboratories (Pty) Ltd at their laboratory in Brackenfell, Cape Town.

5.2.1 Trial Pitting

A total of 5 Trial Pits were excavated. The positions of the trial pits are indicated on Figure 4.

The aim was to excavate the trial pits to a depth of approximately 2.0m since these are the layers in which the structures are expected to be founded. Machine refusal however varied from a depth of 500mm to 1500mm. Only one trail pit could be excavated to 2000mm deep.

Trial pits were profiled according to standard South African practice and described in terms of the moisture content, colour, consistency, structure, soil type and origin (MCCSSO). The profile descriptions are included in Annexure A.

5.2.2 DCP Testing

Due to the density of the material, DCP testing was could not be conducted to determine the consistency and bearing capacity of the shallow soil profile. The energy required to excavate the trial pits is an indication that the soils have ample bearing capacity for the loadings envisaged. The results of the CBR test indicate that the material has a TRH classification of G7.

5.2.3 Laboratory Testing

One representative disturbed sample was for road indicator tests including grading and CBR tests. Conductivity and PH tests were undertaken on all the samples.

The result of the laboratory testing is included in Appendix B.

6 SITE GEOLOGY AND GROUNDWATER CONDITIONS

6.1 General Geology

A portion of the 1:250 000 Geological Series Map 2920 Kenhardt, showing the location of the site, is presented as Figure 6.

Based on the Geological Series Map, the area in the vicinity of the site is masked by red brown Aeolian soils of Quaternary age (Q) of the Kalahari Group, Gordonia Formation. These soils are underlain by soils and weathered rock of the Karoo Supergroup, Dwyka Group (C-Pd), comprising Carboniferous Tillite, Diamictite, subordinate Sandstone, Mudstone and Dolomitic Limestone.

6.2 Site Geology and soil profile

The site is overlain with brown to reddish brown Aeolian soils that forms the topsoil layer (Orhic A diagnostic horizon). Below this layer a hard calcareous pedogenic layer is encountered that disintegrates into coarse gravel when excavated. The diagnostic layers can be identified as a Neocarbonate B horizon underlain by Dorbank or a hardpan carbonate horizon.

Using these diagnostic horizons and information contained on the Agricultural Research Council database (ARC) (www.agis.agric.za), the soils of the site is classified as Augrabies and Trawal soil forms.

Dolorite gravel and cobbles are evident on the surface layer of the site.

6.3 Water Table

No seepage water or water table was observed during trial pitting.

7 GEOTECHNICAL EVALUATION

7.1 Engineering and material characteristics and constraints

7.1.1 Site Topography

The gentle slopes of the site will aid storm water drainage and prevent ponding of surface water.

Overland flow will be such that the risk of erosion will remain low.

7.1.2 Soil Profile

The general soil profile comprises a layer of medium to coarse sand underlain by a calcareous pedogenic layer that is dense to very dense in the undisturbed form. This material disintegrates into coarse gravel during excavation.

The material covering the proposed is a silty sand and gravel with a low swell potential.

The results of the grading analysis included in Annexure B are summarised in Table 2 below:

Table 2: Grading Analysis results

Trial Pit No	Soil Type	Depth (m)	Particle Size Distribution ¹			UCS Classif.	Atterburg Limits		
			4.75mm	0,425mm	0,075mm		LL	PI	LS
TP A	sand	0.4-1.2	47	12	4	GW	-	SP	0.5
TP B	silty sand	0.2-1.9	55	28	12	SW-SC	-	SP	0.5
TP C1	sand	0.3-1.5	63	14	3	SW	-	NP	0

1 - % of soil fraction passing the indicated sieve size

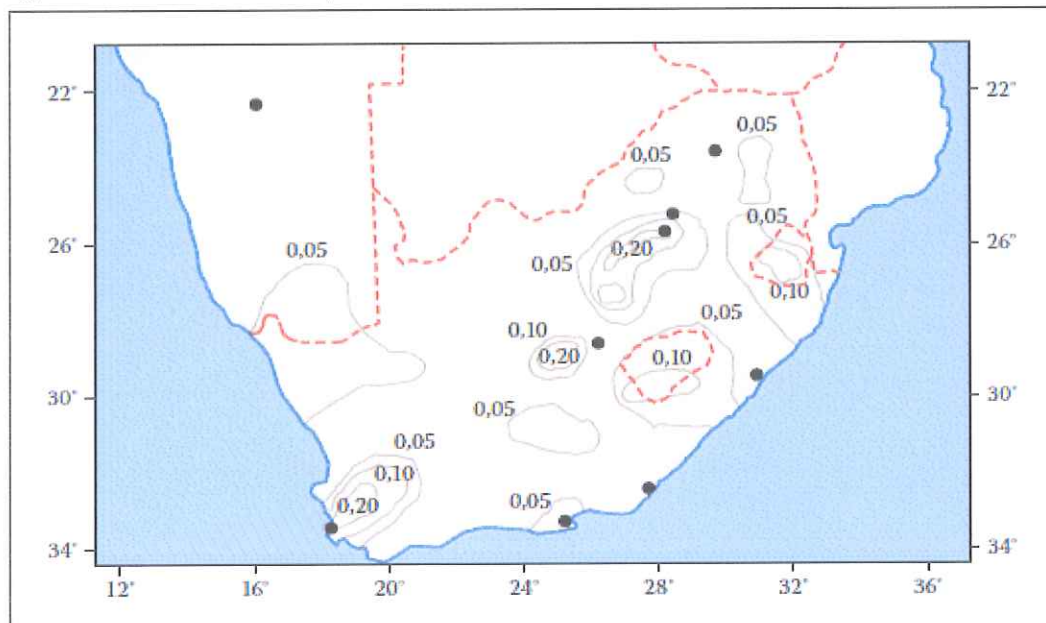
LL – Liquid Limit (%)
 LS – Linear Shrinkage (%)
 SP – Slightly Plastic

UCS – Unified Classification System
 PI – Plasticity Index
 NP – Non Plastic

7.1.3 Seismic Activity

According to the seismic hazard map contained in SABS 0160-1993, (reproduced as Figure 7 below), the proposed sites are located in an area where the peak ground acceleration will not exceed 0.05g (gravity acceleration) or approximately 50cm/s², with a 10% probability of exceeding this limit in 50 years.

Figure 6: Seismic hazard map from SABS 0160-1993



According to a map produced by the United Nations Office for the Coordination of Humanitarian affairs depicting earthquake intensity zones in Africa (reproduced in Appendix C), the proposed sites are located in an area where earthquake magnitude may vary from instrumental to fairly strong. (Earthquake intensity degree I–V according to the Modified Mercalli scale of 1956.)

No incidences of widely perceived seismic activity have been recorded in the area. No special foundation measures are therefore required due to possible seismic activity.

7.1.4 Conductivity and PH

The conductivity and PH gives an indication of the corrosion potential of the soils. These laboratory test results were outstanding at the writing of this report and will be included in an updated report to follow. The PH of previous soil tests conducted in the area varied between 6.4 and 6.9. The soils are therefore expected to be very slightly corrosive. Conventional galvanising of critical elements in contact with the soil will provide adequate long term corrosion protection to all metal elements.

7.1.5 CBR test results

Material from Trial pit A was tested as a representative sample of the insitu material. Test results are attached in Annexure B

The material has a CBR of 36 at 95% of MOD AASHTO. The material has a TRH classification of G7 and a COLTO classification G6. This material will be suitable as a sub base layer in the roads. The material is not suitable for use as a wearing course on the gravel access roads. It is therefore recommended that a investigation be commissioned to identify borrow pits in the vicinity of the site where suitable material for use as a wearing coarse may be found if required.

7.1.6 Load Bearing capacity of the soils

Although the founding method (foundation screws or steel piles) for the solar panels is still to be determined, the dense nature of the soil poses a question mark whether the anchors will be able to penetrate the very dense material. The vertical and horizontal load bearing capacity of the soil will be sufficient to transmit vertical compression and horizontal loads applied to the screws. Pull out resistance of the screws should be sufficient if the screws are placed deep enough into the calcareous pedogenic material below the sand layers, since minimal wind loads is expected on the screws due to the elevation of the Photovoltaic panels.

Although we are of the opinion that this founding method will be feasible, we propose that additional tests be conducted by the specialist contractor responsible for the design and installation of the anchors.

8 FLOOD RISK

A flood risk assessment was conducted under a separate study. The flood lines are indicated in Figure 7.

As can be seen from this drawing, the proposed photovoltaic panels are located above the 1:100 year flood line. The risk of flooding and associated damage to the structures is in our opinion, low.

AGRICULTURAL POTENTIAL

The following information was obtained from the ARC (www.agis.agric.za) database regarding the agricultural potential of the sites.

Table 1: Agricultural Potential

Land Type No	Ag2
Land Capability Class	VII
Land use option	Light Grazing

A land Capability Class VII is defined as follows:

(source: http://www.agis.agric.za/agisweb/?Mlval=land_capability&rb=Land_capability_soil_capability)

Land in Class VII has very severe limitations that makes it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife.

Restrictions are caused by one or more continuing limitations that cannot be corrected, such as:


1. Very steep slopes
2. Erosion
3. Shallow soil
4. Stones
5. Wet soil
6. Salts or sodality
7. Unfavourable climate

The physical conditions of this land class are such that it is impractical to apply pasture or range improvements as seeding, liming and fertilizing. Depending on the soil characteristics and climate, land in Class VII may be well or poorly suited to woodland. In unusual instances some occurrences may be used for special crops under unusual management practices.

Based on the above information, the very low annual rainfall and the high average temperatures it is clear that the agricultural potential of the soils in the study area is low. The soils are only suited to sustain limited grazing, such as sheep farming.

9 CONCLUSIONS AND RECOMMENDATIONS

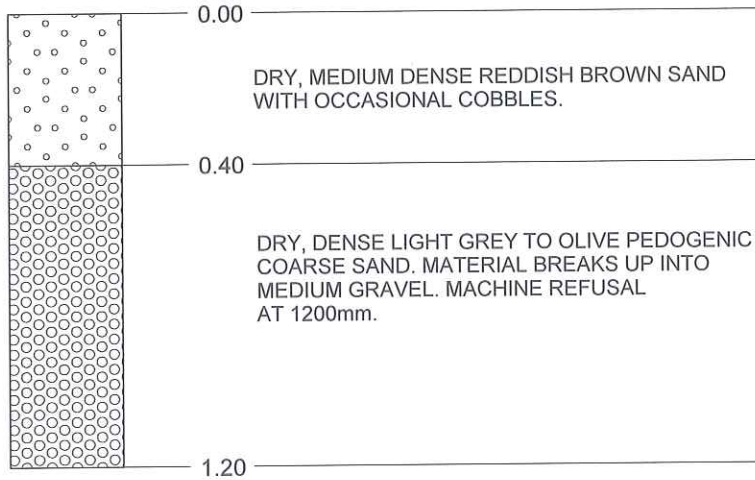
1. The general soil profile on the sites can be described as a layer of loose sand underlain by layers of hard, calcareous pedogenic material. The pedogenic material disintegrates into coarse gravel during excavation.
2. The soil PH is expected to range between 6.4 and 6.9. The soils are therefore very slightly corrosive. Conventional galvanising will be sufficient for long term corrosion protection of critical elements in contact with the soil.
3. The use of ground screws as foundation system for the photovoltaic cells are feasible based on the initial assessments performed during the study. The specialist contractor responsible for the design and installation of the screws will however need to confirm the soil suitability with appropriate on site tests prior to installation of the screws.
4. The risk of flooding of the sites are very low
5. The risk of seismic movement that could cause damage to structures is low.
6. The agricultural potential of the sites are low, mainly due to the harsh climate, shallow soils and low annual rainfall.
7. No significant geotechnical constraints were identified in the study that could negatively affect the proposed development. The site is therefore suited for the development of a solar power facility.



M. P. J. Loubser Pr Eng
For SKCM

Annexure A – Trial Pit Profile Descriptions

<u>PROFILE NO :</u>	75 MW TP A	<u>DATE</u>	21/11/2012	<u>PROFILED BY:</u>	ML
<u>LATITUDE :</u>	29°26.42'	<u>LONGITUDE :</u>	20°49.26'	<u>ELEVATION (m)</u>	904
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.20		UNKNOWN		UNKNOWN	



SCALE 1:20

NOTES:

1. DISTURBED SAMPLE TAKEN @ 0.40m & 1.2m DEPTH
2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TEXTURE	
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

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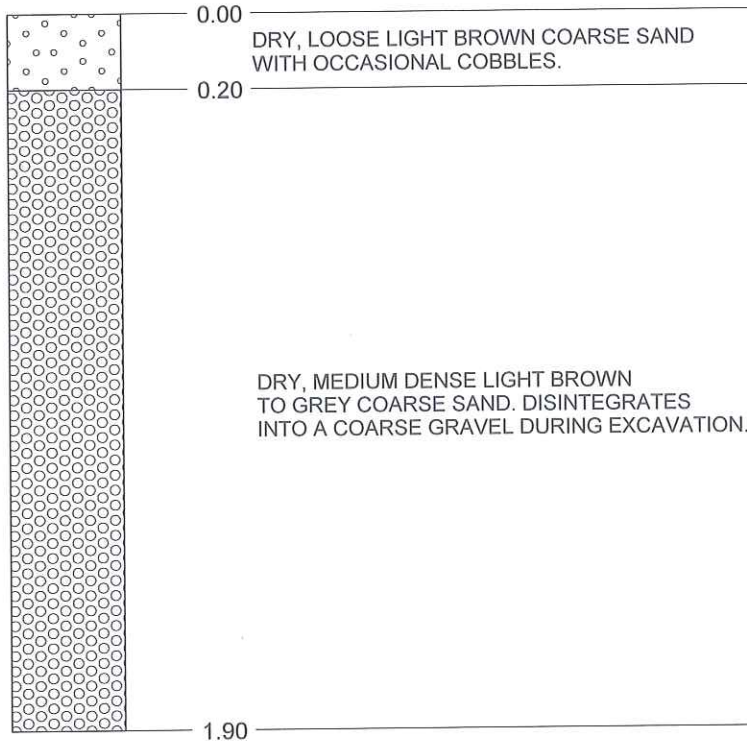
TITLE PROPOSED SOLAR POWER FACILITY PORTION 8

CLIENT GREENCONTINENT PARTNERS

	BY	DATE	CH
DESIGNED	ML	21/11/2012	
DRAWN	GA	21/11/2012	
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SCALE:		1:20	
DRAWING NO.:			REVISION:
W1484-75 MW-TPA			0

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PROFILE NO. :	75 MW TP B	DATE	21/11/2012	PROFILED BY:	ML
LATITUDE :	29°26.46'	LONGITUDE :	20°49.48'	ELEVATION (m)	904
DEPTH OF PROFILE PIT (m)		DEPTH OF WATER TABLE		DEPTH TO WEATHERED ROCK	
1.90		UNKNOWN		UNKNOWN	





SCALE 1:20

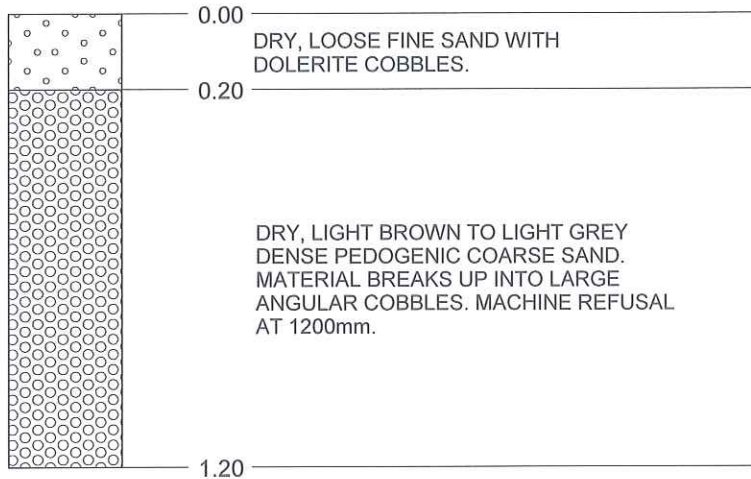
NOTES:

1. DISTURBED SAMPLE TAKEN @ 0.20m & 1.9m DEPTH
2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TEXTURE	
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

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PROFILE NO. :	75 MW TP B1	DATE	21/11/2012	PROFILED BY:	ML
LATITUDE :	29°26.46'	LONGITUDE :	20°50.57'	ELEVATION (m)	904
DEPTH OF PROFILE PIT (m)		DEPTH OF WATER TABLE		DEPTH TO WEATHERED ROCK	
1.20		UNKNOWN		UNKNOWN	



SCALE 1:20

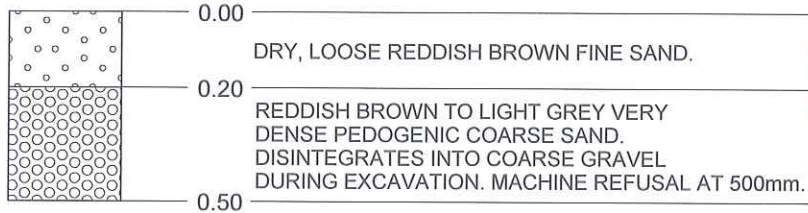


NOTES:

1. DISTURBED SAMPLE TAKEN @ 0.20m & 1.2m DEPTH
2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TEXTURE	
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

PROFILE NO :	75 MW TP C	DATE	21/11/2012	PROFILED BY:	ML
LATITUDE :	29°26.49'	LONGITUDE :	20°50.14'	ELEVATION (m)	904
DEPTH OF PROFILE PIT (m)		DEPTH OF WATER TABLE		DEPTH TO WEATHERED ROCK	
0.50		UNKNOWN		UNKNOWN	



SCALE 1:20

NOTES:

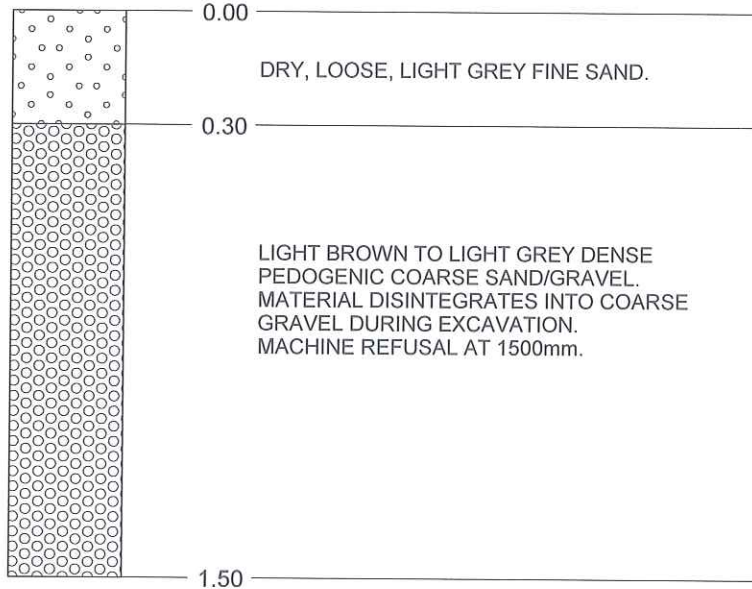
1. DISTURBED SAMPLE TAKEN @ 0.20m & 0.50m DEPTH
2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TEXTURE	
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

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<u>PROFILE NO :</u>	75 MW TP C1	<u>DATE</u>	21/11/2012	<u>PROFILED BY:</u>	ML
<u>LATITUDE :</u>	29°27.48'	<u>LONGITUDE :</u>	20°50.10'	<u>ELEVATION (m)</u>	906
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.50		UNKNOWN		UNKNOWN	



SCALE 1:20

NOTES:

1. DISTURBED SAMPLES TAKEN @ 0.3m & 1.5m DEPTH
2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TEXTURE	
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS



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TITLE PROPOSED SOLAR POWER FACILITY PORTION 8



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			0

Annexure B – Laboratory Test Results

0219816724



MATROCAST

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Reg.No.: 2000/030983/07 - VAT. Reg.No.: 4130197405

a SANAS Accredited Testing Laboratory, No. T0245

4 HARBOT CLOSE, BRACKENDUST, 7560
P.O BOX 1106, BRACKENFELL

Tel. : 021 9815558
Fax : 021 9816724
Email : info@matrocast.co.za



TEST RESULTS

SKC ENGINEERS P.O. BOX 229 PAARL 7620 Attention: MR M.LOUBSER

Project : SOLAR FARM, KENHARDT

Your Ref :
Our Ref : 46168
Date Reported : 29.11.2012

SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TM1:A1-A5,A7,A8)

SAMPLE NO.	K 0161			
MOLE NO.	A + C1			
ROAD NO.	-			
DEPTH	-			
CHAINAGE	-			
LAYER TYPE	-			
STABILISED WITH	Neat			
SUPPLIER	-			
CURING METHOD	N/a			
DESCRIPTION	Dusky Mudstone & D/Ol Weath.Granite			

SIEVE ANALYSIS (% PASSING)

75 mm	100			
63 mm	94			
53 mm	94			
37.5 mm	90			
26.5 mm	87			
19.0 mm	83			
13.2 mm	80			
4.75 mm	55			
2.0 mm	32			
0.425 mm	13			
0.075 mm	4			

SOIL MORTAR

COARSE SAND <2.000mm >0.425mm	59			
FINE SAND <0.425mm >0.075mm	28			
MATERIAL <0.075mm	13			

CONSTANTS

GRADING MODULUS	2.51			
PRA CLASSIFICATION	A-1-a(0)			
UNIFIED SOIL CLAS.	SW			
COLTO CLASSIFICATION	G6			
TRH CLASSIFICATION	G7			
LIQUID LIMIT (%)	-			
PLASTICITY INDEX (0.425mm)	NP			
LINEAR SHRINKAGE (%)	0.0			

MOD AASHTO

MAXIMUM DRY DENSITY (kg/m³)	2066			
OPTIMUM MOISTURE CONTENT (%)	6.3			
MOULDING MOISTURE (%)	6.2			

TYPE OF TEST	CBR			
--------------	-----	--	--	--

CBR-UCS @ 100% MOD AASHTO	71			
CBR-UCS @ 98% MOD AASHTO	53			
CBR-UCS @ 97% MOD AASHTO	46			
CBR-UCS @ 95% MOD AASHTO	36			
CBR-UCS @ 93% MOD AASHTO	32			
CBR-UCS @ 90% MOD AASHTO	27			

CBR-UCS @ % MOD AASHTO derived from calculation.

% SWELL AT [MOD][NRB][PROC]	0.00	0.00	0.00							
-----------------------------	------	------	------	--	--	--	--	--	--	--

Remarks :

Technical Signatory : Raymond van Niekerk

FORM: A1

3.3R (06.10.2010)

0219816724



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Tel. : 021 9816558
Fax : 021 9816724
Email : info@matrocast.co.za



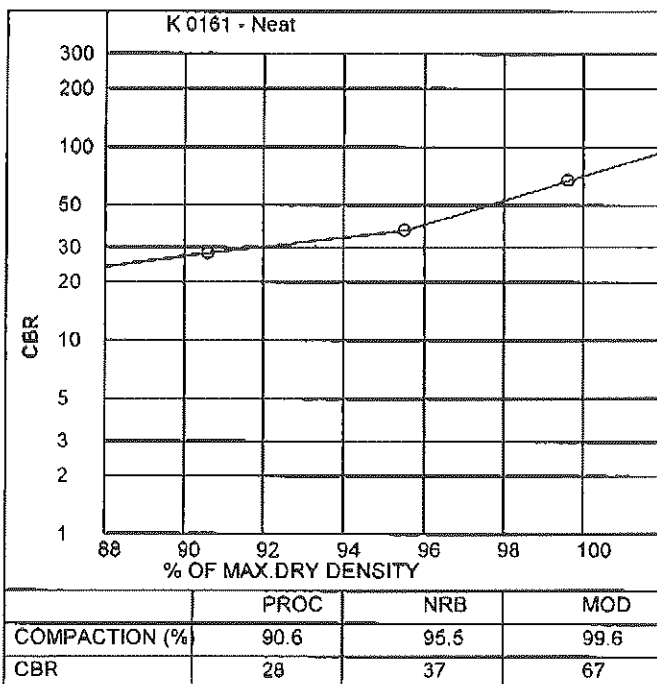
TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

Project : SOLAR FARM , KENHARDT

Your Ref :
Our Ref : 46168
Date Reported : 29.11.2012

CBR-UCS GRAPH/S (OPTIONAL INFORMATION)



(R_v)

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TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

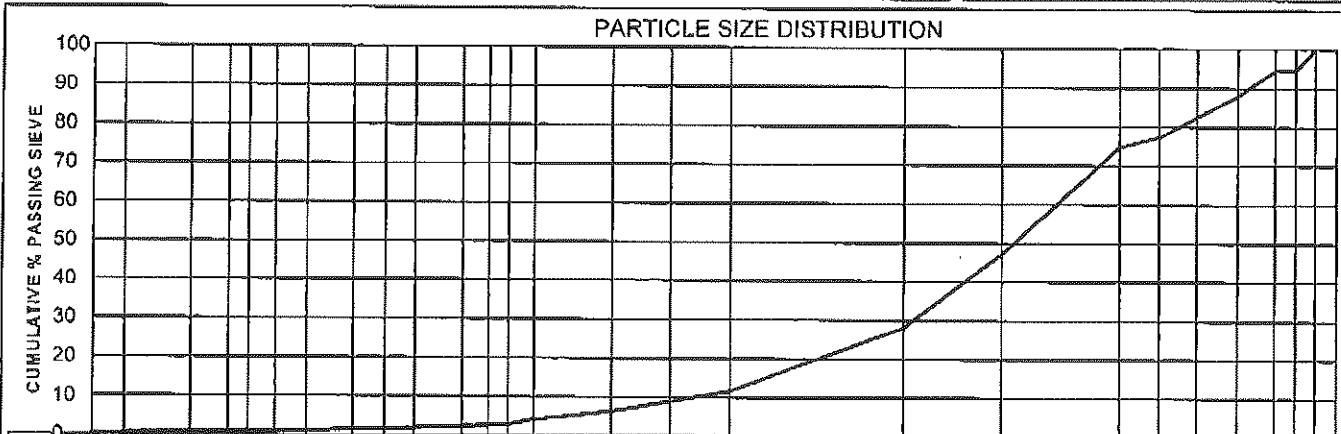
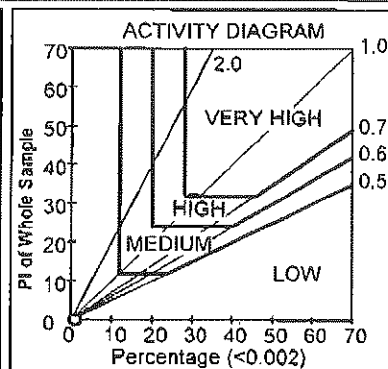
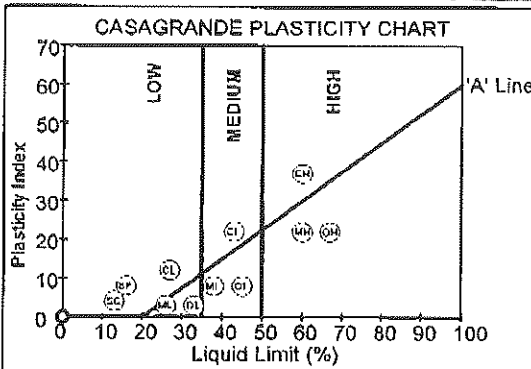
Project : SOLAR FARM , KENHARDT

Your Ref :
Our Ref : 46168
Date Reported : 28.11.2012

FOUNDATION INDICATOR (ASTM: D422)

Sample No. : K 0155
Hole No. : A
Depth : -
Liquid Limit (%) : -
Plasticity Index : SP
Linear Shrinkage (%) : 0.5
PI of Whole Sample : 0
P.R.A. Classification : A-1-a(0)
Unified Soil Classification : GW
Activity : 0.00
Heave Classification : LOW
Grading Modulus : 2.56
Percentage (<0.002) : 1.0
Moisture Content (%) : 1.8

Material Description : DUSKY GREEN					
	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.1	1.6	25.6	71.8	SAND
Astm	1.1	3.1	43.1	52.7	SAND
British Standard	0.6	2.2	25.4	71.8	SAND



Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0250	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	0	1	1	1	1	1	1	1	2	2	2	3	3	4	6	9	12	26	47	75	78	83	88	95	95	100
JENN CLAY															SAND				GRAVEL							
ASTM CLAY															FINE SAND		MEDIUM SAND		COARSE SAND	GRAVEL						
BS CLAY	FINE SILT		MEDIUM SILT		COARSE SILT		FINE SAND		MEDIUM SAND		COARSE SAND		FINE GRAVEL		MEDIUM GRAVEL		COARSE GRAVEL									

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Raymond van Niekerk
Technical Signatory : Raymond van Niekerk

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Tel. : 021 9815556
Fax : 021 9816724
Email : info@matrocast.co.za



TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

Project : SOLAR FARM , KENHARDT

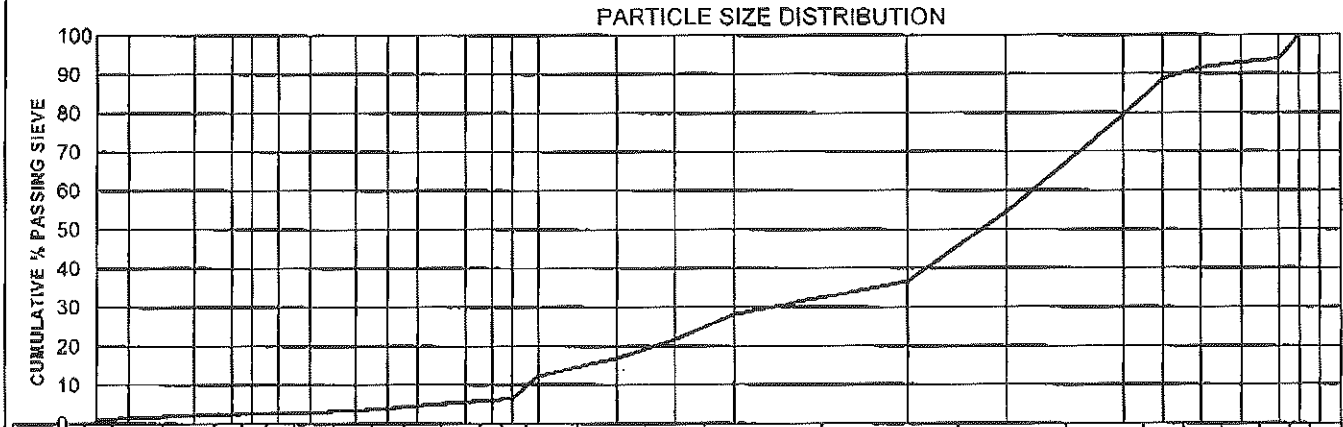
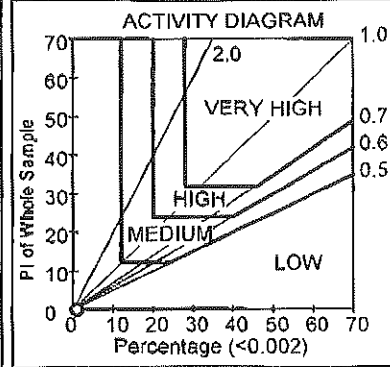
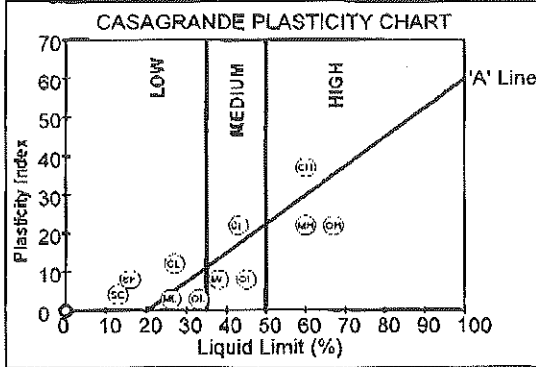
Your Ref :
Our Ref : 46168
Date Reported : 28.11.2012

FOUNDATION INDICATOR (ASTM: D422)

Sample No.	: K 0156
Hole No.	: B
Depth	: -
Liquid Limit (%)	: -
Plasticity Index	: SP
Linear Shrinkage (%)	: 0.5
PI of Whole Sample	: 0
P.R.A. Classification	: A-1-a(0)
Unified Soil Classification	: SW-SC
Activity	: 0.00
Heave Classification	: LOW
Grading Modulus	: 2.23
Percentage (<0.002)	: 1.0
Moisture Content (%)	: 3.3

Material Description : DARK BROWN

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	2.5	3.7	30.5	63.3	SAND
Astm	2.5	9.9	42.3	45.4	SILTY SAND
British Standard	1.4	5.2	30.1	63.3	SAND



Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0250	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	1	1	2	2	3	3	3	3	4	5	6	6	7	12	17	22	28	37	55	79	89	92	93	100	100	100
JENN	CLAY		SILT					SAND										GRAVEL								
ASTM	CLAY		SILT					FINE SAND		MEDIUM SAND			COARSE SAND		GRAVEL											
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL																

Remarks : SAMPLED AND DELIVERED BY CUSTOMER

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3.3R (06.10.2010)

Technical Signatory : Raymond van Niekerk

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P.O BOX 1106, BRACKENFELL

Tel. : 021 9815558
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Email : info@matrocast.co.za



TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

Project : SOLAR FARM, KENHARDT

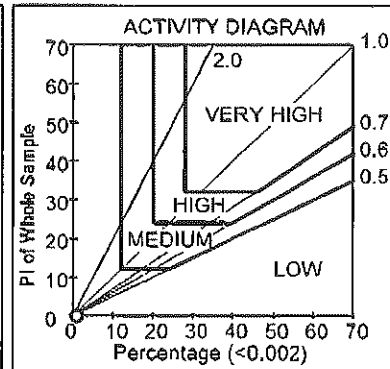
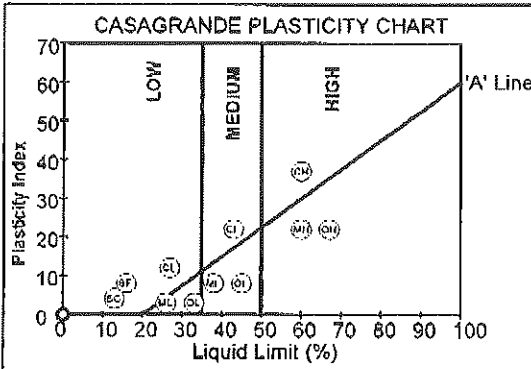
Your Ref :
Our Ref : 46168
Date Reported : 28.11.2012

FOUNDATION INDICATOR (ASTM: D422)

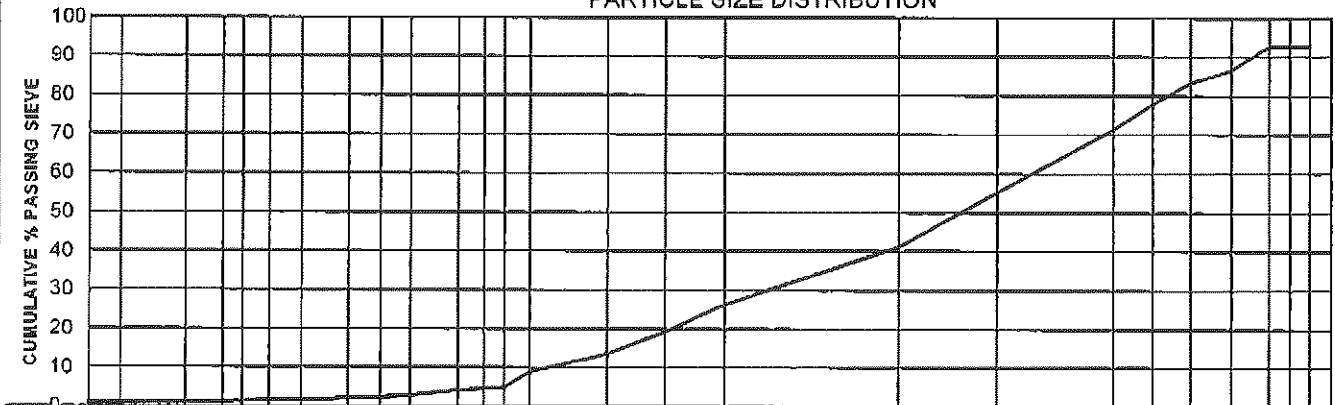
Sample No. : K 0158
Hole No. : D
Depth : -
Liquid Limit (%) : -
Plasticity Index : NP
Linear Shrinkage (%) : 0.0
PI of Whole Sample : 0
P.R.A. Classification : A-1-a(0)
Unified Soil Classification : SW-SC
Activity : 0.00
Heave Classification : LOW
Grading Modulus : 2.24
Percentage (<0.002) : 1.0
Moisture Content (%) : 2.3

Material Description : DARK BROWN SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.3	3.4	36.6	58.8	SAND
Astm	1.3	7.6	46.5	44.7	SAND
British Standard	1.0	4.0	36.2	58.8	SAND



PARTICLE SIZE DISTRIBUTION



Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0250	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	25.000	37.500	53.000	63.000	75.000		
% Pass. Sieve	1	1	1	1	1	2	2	2	2	3	4	5	5	9	14	19	26	41	55	71	78	83	87	93	93	93		
JENN CLAY			SILT											SAND										GRAVEL				
ASTM CLAY			SILT											FINE SAND			MEDIUM SAND			COARSE SAND		GRAVEL						
BS CLAY	FINE SILT		MEDIUM SILT			COARSE SILT						FINE SAND			MEDIUM SAND			COARSE SAND		FINE GRAVEL		MEDIUM GRAVEL			COARSE GRAVEL			

Remarks : SAMPLED AND DELIVERED BY CUSTOMER

Raymond van Niekerk

FORM: A6

3.3R (06.10.2010)

Technical Signatory : Raymond van Niekerk

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Fax : 021 9816724
Email : info@matrocast.co.za



TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

Project : SOLAR FARM, KENHARDT

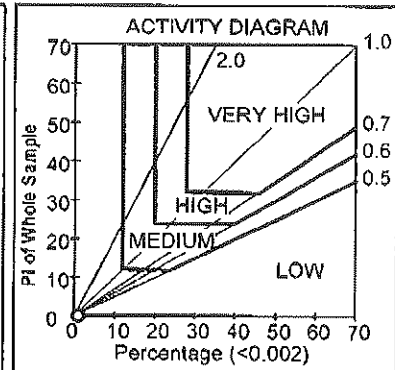
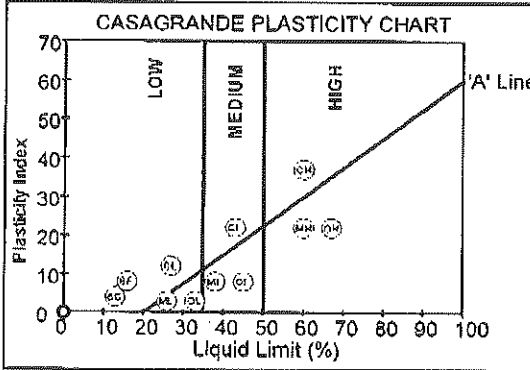
Your Ref :
Our Ref : 46168
Date Reported : 28.11.2012

FOUNDATION INDICATOR (ASTM: D422)

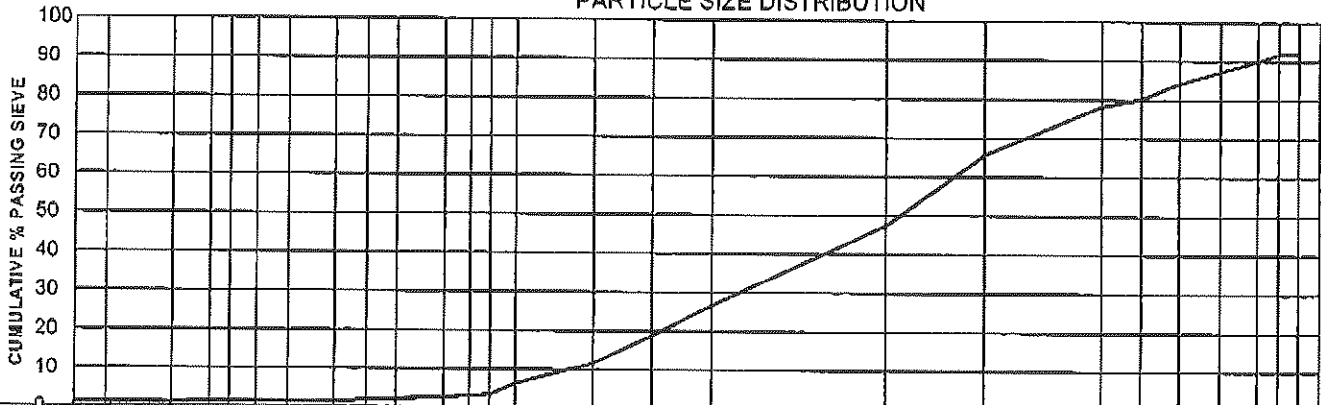
Sample No.	: K 0159
Hole No.	: G
Depth	: -
Liquid Limit (%)	: -
Plasticity Index	: NP
Linear Shrinkage (%)	: 0.0
PI of Whole Sample	: 0
P.R.A. Classification	: A-1-a(0)
Unified Soil Classification	: SW-SC
Activity	: 0.00
Heave Classification	: LOW
Grading Modulus	: 2.20
Percentage (<0.002)	: 1.0
Moisture Content (%)	: 2.3

Material Description : DARK OLIVE & BROWN SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.3	1.9	44.2	52.6	SAND
Astm	1.3	5.1	59.3	34.3	SAND
British Standard	1.1	2.5	43.8	52.6	SAND



PARTICLE SIZE DISTRIBUTION



Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass	1	1	1	1	1	2	2	2	2	2	3	3	4	6	12	19	27	47	66	78	80	84	87	90	92	92

JENN CLAY	SILT										SAND										GRAVEL																			
ASTM CLAY	SILT										FINE SAND					MEDIUM SAND					COARSE SAND					GRAVEL														
BS CLAY	FINE SILT			MEDIUM SILT			COARSE SILT				FINE SAND					MEDIUM SAND					COARSE SAND					FINE GRAVEL					MEDIUM GRAVEL					COARSE GRAVEL				

Remarks : SAMPLED AND DELIVERED BY CUSTOMER

Raymond van Niekerk

FORM: A6

3.3R (06.10.2010)

Technical Signatory Raymond van Niekerk

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Fax : 021 9816724
Email : info@matrocast.co.za



TEST RESULTS

SKC ENGINEERS
P.O. BOX 229
PAARL
7620
Attention: MR M.LOUBSER

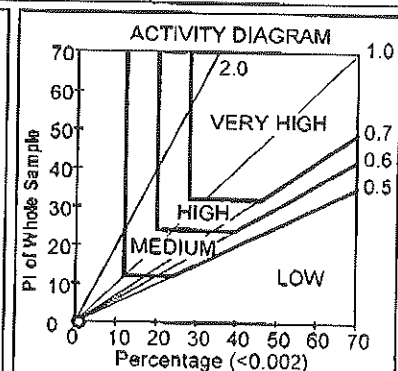
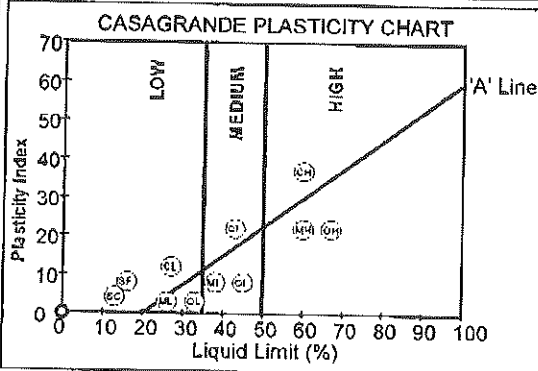
Project : SOLAR FARM, KENHARDT
Your Ref :
Our Ref : 46168
Date Reported : 28.11.2012

FOUNDATION INDICATOR (ASTM: D422)

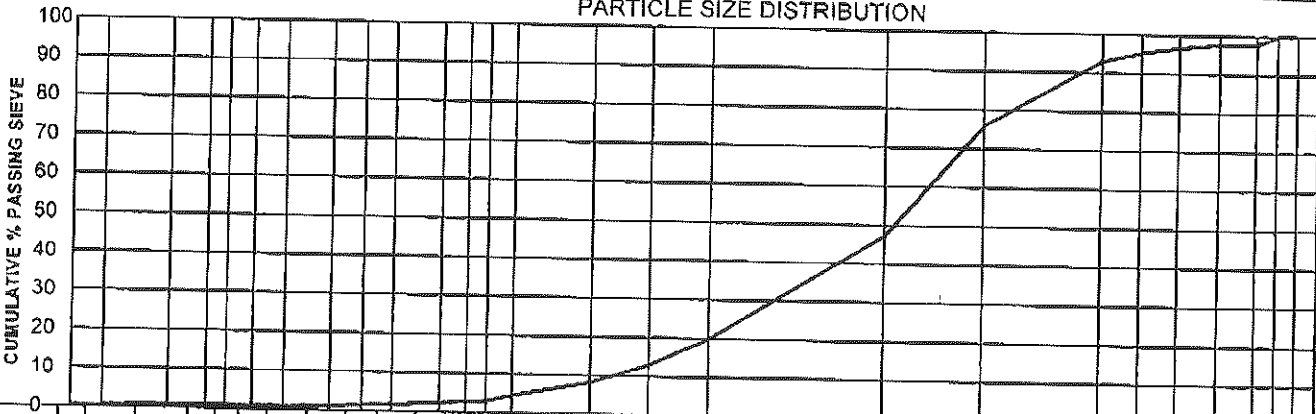
Sample No. : K 0160
Hole No. : H
Depth : -
Liquid Limit (%) : -
Plasticity Index : NP
Linear Shrinkage (%) : 0.0
PI of Whole Sample : 0
P.R.A. Classification : A-1-a(0)
Unified Soil Classification : SW-SC
Activity : 0.00
Heave Classification : LOW
Grading Modulus : 2.28
Percentage (<0.002) : 1.0
Moisture Content (%) : 1.0

Material Description : DARK OLIVE & BROWN SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	0.8	2.0	44.4	52.8	SAND
Astm	0.8	3.9	71.4	24.0	SAND
British Standard	0.6	2.5	44.1	52.8	SAND



PARTICLE SIZE DISTRIBUTION



Sieve Size (mm)	0.0075	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0250	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000		
% Pass. Sieve	0	1	1	1	1	1	1	1	1	2	2	3	3	5	8	13	20	47	76	93	95	97	98	98	98	100	100	
JENN CLAY																												
ASTM CLAY																												
BS CLAY																												

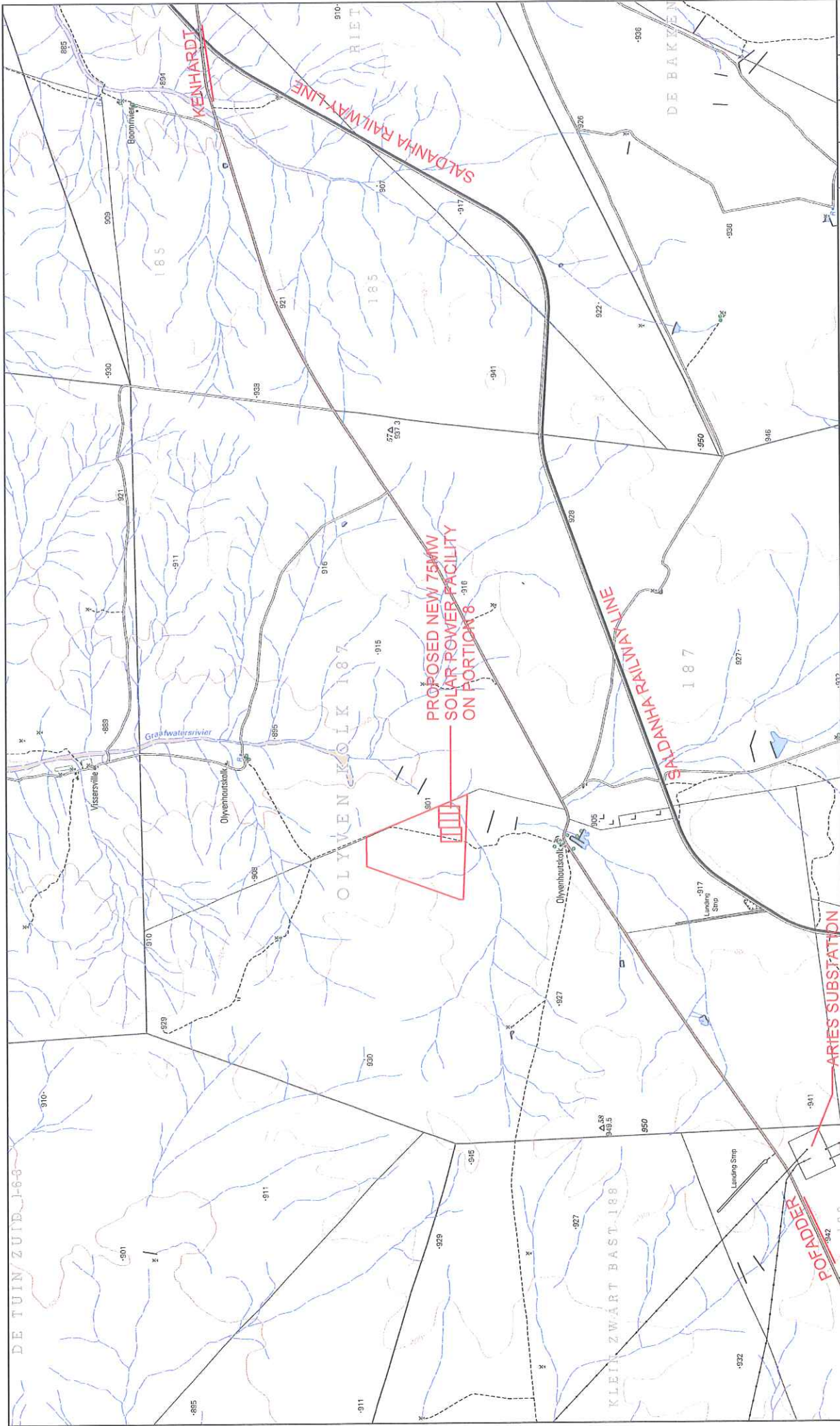
Remarks : SAMPLED AND DELIVERED BY CUSTOMER

Raymond van Niekerk

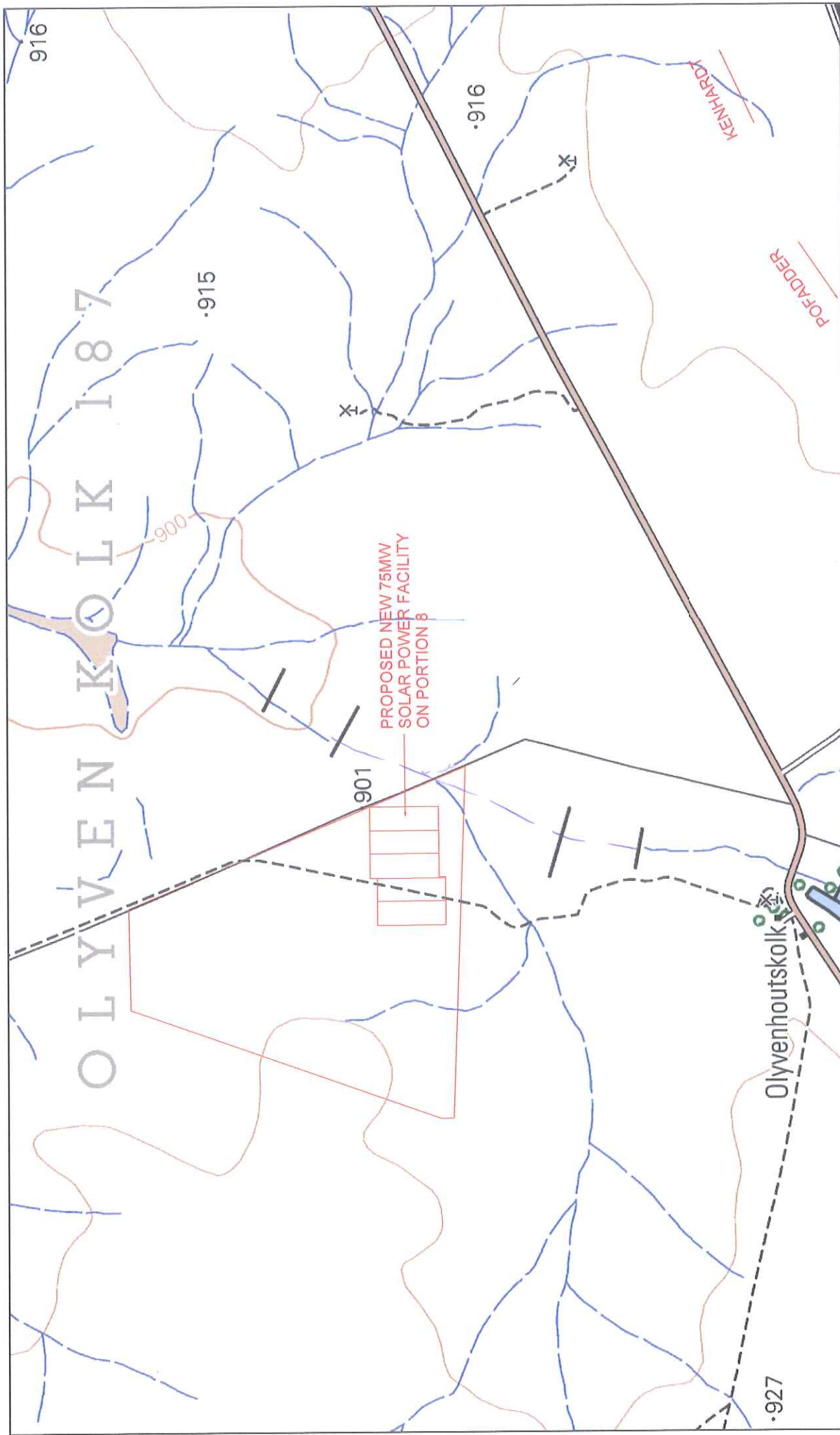
FORM: A6 3.3R (06.10.2010)

Technical Signatory : Raymond van Niekerk

Figures



DESCRIPTION: PROPOSED NEW SOLAR POWER FACILITY - PORTION 8 ON OLYVENKOLK 187, KENHARDT SOUTH AFRICA	13/09/11 DATE	1 REPORT REFERENCE	GA BY	NOTE: COPYRIGHT IS VESTED IN THIS DOCUMENT AND NO USE OR REPRODUCTION OR DUPLICATION THEREOF MAY OCCUR WITHOUT THE WRITTEN CONSENT OF THE AUTHOR	 SKCM SAKMASHAKE ENGINEERS (PTY) LTD CONSULTING ENGINEERS TO BUILD THE NATION 13 PASTOREK AVENUE, PARKLANDS, JOHANNESBURG TEL: (011) 871 1229 FAX: (011) 871 7140 email: skcm@skcm.co.za	SITE LOCATION 	DESIGNED	BY	DATE	CH
	DRAWN	GA	13/09/11				WV			
TRACED		SCALE: 1:50000		DRAWING NO.: FIGURE 1		REVISION: 1				



DESCRIPTION: PROPOSED NEW SOLAR POWER FACILITY - PORTION 8 ON OLYVEN KOLK 187, KENHARDT SOUTH AFRICA	20/11/12 DATE	1 REFERENCE	GA BY	NOTE: COPYRIGHT IS VESTED IN THIS DOCUMENT AND NO USE OR REPRODUCTION OR DUPLICATION THEREOF MAY OCCUR WITHOUT THE WRITTEN CONSENT OF THE AUTHOR	 SKCEN SKCMasakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION 15 PACIFIC AVENUE PARKLANDS JHB TEL: (011) 971 1422 FAX: (011) 972 7142 www.skcmasakhizwe.co.za	TITLE: PROPOSED 75MW SOLAR POWER FACILITY SITE LAYOUT PORTION 8	DESIGNED	BY	DATE	CH
	DRAWN	GA	21/11/12				ML			
	TRACED									
	SCALE: 1:15000 DRAWING NO.: FIGURE 2 REVISION: 1									



PROPOSED NEW 75MW
SOLAR POWER FACILITY
ON PORTION 8

LEGEND
— Main Drainage Feature
— Stream

DESCRIPTION:
**PROPOSED NEW SOLAR
 POWER FACILITY - PORTION 8
 ON OLYVEN KOLK 187,
 KENHARDT SOUTH AFRICA**

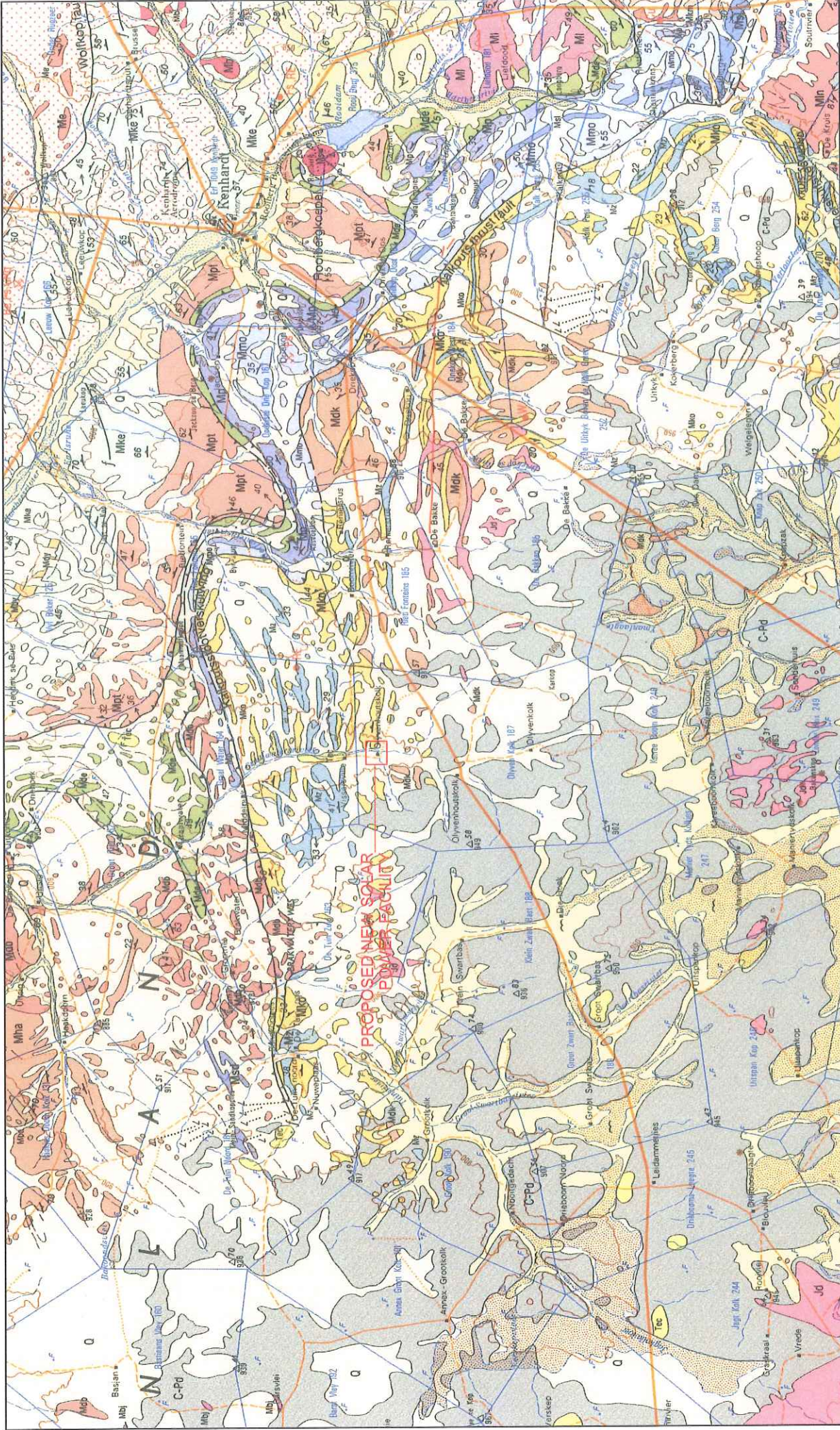
21/11/21	1	REPORT	GA
DATE	REFERENCE		BY


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 SKC Masakhzwe Engineers (Pty) Ltd
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 PAKELI 225
 PAKELI
 TEL: (031) 971 1420
 FAX: (031) 971 7740
 55 CHURCH STREET
 PAKELI 225
 TEL: (022) 482 2017
 FAX: (022) 482 2017
 email: info@skcen.co.za

TITLE
 SITE DRAINAGE FEATURES

DESIGNED	BY	DATE	CH
DRAWN	GA	21/11/21	ML
TRACED	SCALE:	1:50000	
DRAWING NO. FIGURE 3			REVISION 1



DESCRIPTION: PROPOSED NEW SOLAR POWER FACILITY - PORTION 8 ON OLVENKOLK 187, KENHARDT SOUTH AFRICA	2011/102-11 REPORT	GA	NOTE: COPYRIGHT IS VESTED IN THIS DOCUMENT AND NO USE OR REPRODUCTION OR DUPLICATION THEREOF MAY OCCUR WITHOUT THE WRITTEN CONSENT OF THE AUTHOR	SKKCN SKCMasakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION 13 PASTINE AVENUE PO BOX 229 A.S. JACOBS 7200 TEL: (031) 871 1420 FAX: (031) 872 7740 email: info@skkcn.com.za	GENERAL GEOLOGY 	DESIGNED BY: DATE: CH:
	2011/102-11 REPORT	GA				DRAWN BY: DATE: ML: TRACED BY: DATE: ML: SCALE: 1:20000 DRAWING NO.: FIGURE 5 REVISION: 1

LEGEND
 — DRAINAGE LINE
 — 1:100 FLOOD LINE



DESIGNER: PROPOSED NEW SOLAR POWER FACILITY - PORTION 8 ON OLYVEN KOLK 187, KENHARDT SOUTH AFRICA	DATE	21/11/12	REPORT	GA	BY
	REFERENCE				
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TITLE	FLOOD LINES LAYOUT				
DESIGNED	BY	DATE	CH		
DRAWN	GA	21/11/12	ML		
TRACED					
DRAWING NO.:	W1484-FIGURE 7				
SCALE:	1:50000				
CLIENT	GREENCOMBENT				
	1				